Research Achievement 2020-2021
(Technology Developed)

Sl. No.	Technology Developed	How Country/Farmer /User will be benefited
	Plant Breeding Division	
	Research Achievement 2020-2021 (Technology Developed)	
	Program Area: Varietal Development program (VDP)	
1	**BRRI dhan97:** BRRI dhan97 is a salinity tolerant rice variety for Boro season. The breeding line of BRRI dhan97 is IR83484-3-B-7-1-1-1. It was developed through hybridization between IRRI113 and BRRI dhan40 followed by pedigree selection method. The line was introduced from IRRI and several trials were conducted in saline prone coastal region of Southern part of Bangladesh for the evaluation of yield and adaptability and finally, it was released as salinity tolerant rice variety by the National Seed Board in 2020 for the Boro season. The main feature of this variety is that it is more salinity tolerant than conventional variety. The milled rice is medium bold in size and shape, translucent and cooked rice is non-sticky. The flag leaf is erect, wide and long, dark green in color. It has non-shattering behavior in the panicle. The anthocyanin color in the base of leaf sheath is present. Plant height of the variety is 100 cm. The average thousand grain weight is 25.5 gm. The average growth duration is 152 days. Amylose content is 22.0% and protein content is 8.6%. It can tolerate 14 dS/m salinity at the seedling stage. Moreover, BRRI dhan97 can produce grain yield with 8-10 dS/m salinity at all the salt sensitive stages of vegetative to reproductive stages. It is more salinity tolerant than BRRI dhan67. Average yield potential of this variety is 4.89 t/ha even though it can produce 3.93 to 5.95 t/ha depending on the salinity level. It can yield a maximum of 7.0 t/ha in favorable environment with proper management.	Rice cultivation areas will be expanded under the southern coastal prone areas where salt-stress is a key problem for rice production during dry seasons in Bangladesh. .

		
2	**BRRI dhan98:** An advanced breeding line BR9011-67-4-1 was approved and released by the National Seed Board (NSB) as a new variety, BRRI dhan98 for cultivating in partially irrigated rice ecosystem known as T. Aus. It produced 0.79 t/ha higher yield than the check variety BR26 (4.30 t/ha) with similar growth duration having high amylose (27.9%) with long slender (LS) grain. 	The growth duration of BRRI dhan98 is 112 days which is complementary with BRRI dhan48. The average yield of this variety is 5.09 ton per hectare. If proper management is ensured, it can produce 5.90 ton per hectare yield.
3	**BRRI dhan99:** An advanced breeding line HHZ5-DT20-DT2-DT1 (GSR IR1-5-D20-D2-D1) was approved and released by the National Seed Board (NSB) as a new variety, BRRI dhan99 for salinity tolerance in Boro season. It produced 1.2 t/ha higher yield than the salinity tolerant check BRRI dhan67 with 5 days longer growth duration. The level of salinity tolerance of the variety is relatively higher than the standard check BRRI dhan67. It has high amylose (27.1%) with long slender (LS) grain.	The growth duration of BRRI dhan99 is 154 days with average yield 5.4 ton per hectare in saline-prone areas. If proper management is ensured, it can produce 6.56 ton per hectare yield.

		
4	**BRRI dhan100:** Zinc enriched rice line BR8631-12-3-5-P2 was approved and released as BRRI dhan100 for Boro season by the National Seed Board (NSB). It can produce 0.28 t/ha and 1.20 t/ha higher yield (mean) than BRRI dhan74 and BRRI dhan84, respectively1441. The grain size and shape of the variety is similar to that of BRRI dhan49, Nizersail and Zira rice and eventually it is expected to be very popular in the areas where local variety of Zira is cultivated. BRRI dhan100 was named as the Bangabandhu dhan100 by the government with the consent from the Father of the Nation Bangabandhu Sheikh Mujibur Rahman Memorial Trust on 28 June 2021 in the Mujib year 2020-21. The average yield of BRRI dhan100 (Bangabandhu dhan100) was 7.7 t/ha and zinc content of the milled rice was 25.7 mg/kg which was higher than that of BRRI dhan74 (24.2 mg/kg). 	The growth duration of BRRI dhan100 is 148 days with average yield 7.7 t/ha. Grain size and shape is similar to BRRI dhan49, Nizersail and Zira rice, so it is expected to be very popular in Zira growing area.
5	**BRRI dhan101:** BRRI dhan101 is a bacterial blight resistance rice variety for Boro season. The flag leaf is erect, wide and long, dark green in color. It has non-shattering behavior in the panicle. The grain size and	Its growth duration is 142 days which is four days earlier than the popular variety BRRI dhan58. The average yield of this variety is 7.72 ton per

	shape of the variety are long and slender and golden in color. Thousand-grain weight of this variety is around 23.1 grams. Its grain contains 25.0% amylose and 9.8% protein. The proposed variety shows highly resistant to BB (BB score-1) in artificial inoculation with virulent BB pathogen. The results of SNP QTL fingerprinting the BB-resistant proposed variety obtained BB-resistant dominant genes Xa21, Xa7 and Xa4.  	hectare. If proper management is ensured, it can produce 8.99 ton per hectare yield.
	Biotechnology Division	
	Research Achievement 2020-2021 **(Technology Developed)**	
Sl. No.	**Technology Developed**	**How country/farmer/user will be benefited**
1	Three advance breeding lines for low GI were evaluated as SYT during Boro 2020-21.	These lines will be used to develop high yield low GI rice variety that ultimately benefits the farmers
2	Seventeen antioxidant enriched black rice were evaluated as OT. Among them 10 entries were selected for further evaluations.	These lines will be used to develop high yield antioxidant enriched black rice variety that ultimately benefits the farmers
3	Bacterial Blight (BB) gene pyramided two lines having three BB resistant genes (Xa4, xa13 and Xa21) were evaluated as ALART at 10 locations in Boro 2020-21.	Bacterial Blight (BB) gene pyramided these lines will be used as parent to developed high yielding bacterial blight resistant variety that ultimately benefits the farmers.
4	A construct was made with salt tolerant gene, vacuolar H^+-ATPase (PVA1) from Porteresia coarctata. For Agrobacterium-mediated genetic transformation regeneration protocol of BRRI dhan86, BRRI dhan87, BRRI dhan89 was optimized.	Salt tolerant transgenic rice variety will be develop that ultimately benefits the farmers

5	A functional marker of BADH2 gene was validated which can differentiate fragrant and non-fragrant rice varieties. By using this functional marker F_6 and F_3 aromatic progenies of BRRI dhan28/Kalizira and BRRI dhan87/Kalizira, respectively was selected. Besisde this, 22 green plants were regenerated from BRRI dhan90/Kataribhog, BRRI dhan90/Kalijira, BRRI dhan90/BRRI dhan34, and BRRI dhan90/Tulshimala cross. Moreover 17 doubled haploid line derived from these two crosses BRRI dhan38/Basful and BRRI dhan50/Basful was evaluated and 11 plants were selected among them.	Aromatic rice variety will be developed ultimately benefits the farmers.
	Hybrid Rice Division	
	Research Achievement 2020-2021 (Technology Developed)	
Sl. No	**Technology Developed**	**How country/farmer/user will be benefited**
01.	A total of 14223 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 released 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.	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.	Eight promising restorer lines (BRRI32R, BRRI36R, BRRI37R BRRI38R, BRRI45R, BRRI46R, BRRI50R & BRRI53R) were selected 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 combinations
	Rice Farming Systems Division	
	Research Achievement 2020-2021 (Technology Developed)	

Sl. No	Technology Developed	How country/farmer/user will be benefited
01	An improved cropping pattern for highland of Madhupur Tract soil: Mustard-Mungbean-T. Aus-Black gram • The cropping pattern (CP) technology is suitable for the high land of Madhupur Tract where partial irrigation facilities exist • In the existing CP only one crop is cultivated in the in drought prone areas of highland however, in the improved cropping pattern four crops are cultivated round the year • About 310 days are required for the cultivation of four crops • It is a water saving technology • Short duration variety of crops are used • Inclusion of pulse and oil crops improve diversity and soil health • The cropping pattern can contribute in the nutritional requirement of the family and to income **Suitability of the technology:** The technology is suitable for the highland of Madhupur Tract soil where irrigation facilities prevail. The cropping pattern can be practiced in clay loam to sandy loam soil. The technology can also be followed in the other high land areas of the country where irrigation facilities exist.	•Rice equivalent yield of the improved cropping pattern is 14.5 t/ha •The gross margin is 385% higher than the existing Fallow-Fallow-T. Aman or vegetable-Fallow-Fallow cropping pattern The marginal benefit cost ratio of the improved cropping pattern is 1.51
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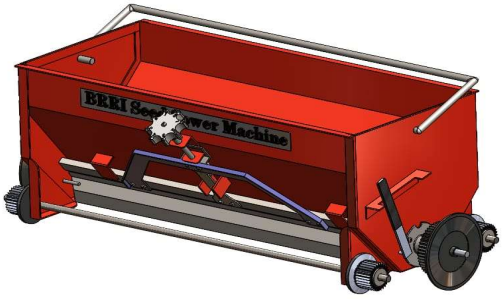
	Agronomy Division	
	Research Achievement 2020-2021 **(Technology Developed)**	
Sl. No.	**Technology Developed**	**How country/farmer/user will be benefited**
01	**Name of the technology: Suitable variety and appropriate crop establishment time For Haor region.** Details: BRRI dhan67, BRRI dhan84 and BRRI dhan88 may cultivate as alternates of BRRIdhan28 as short duration variety, which must be transplanted after 10 to 30 December with 30-day-old seedlings for obtaining higher yield (>7 t/ha) and avoiding sterility due to cold at Haor region .	Farmers of the Haor region can be benefitted from cultivating proposed short-duration and long-duration varieties by obtaining higher yields a Escaping natural hazards like "Flash Floods" and "Sterility due to cold".

	Long-duration variety especially BRRI dhan89 may adopt for higher yield (>8 t/ha) which must be transplanted before 20 December with 30-day-old seedlings may be the alternate option of BRRI dhan29 at Haor region. Cold susceptible varieties like BRRI dhan74 and BRRI dhan28 should not recommend for early seeding and transplanting for the Haor area and these varieties should be avoided for cultivation.	
	Soil Science Division	
	Research Achievement 2020-2021 (Technology Developed)	
Sl. No.	**Technology Developed**	**How country/ Farmer/ User will be benefited**
1	Updating the critical limit of P, K, S and Zn for soils and rice	The critical limit (CL) of different plant nutrients essential to formulate an optimum fertilizer dose of nutrients for achieving satisfactory crop yield. CLs of P, K, S and Zn for rice have been formulated to delineate the nutrient status of calcareous, non-calcareous, piedmont and terrace soils.
	Irrigation and Water Management Division	
	Research Achievement 2020-2021 (Technology Developed)	
Sl. No.	**Technology Developed**	**How Country/Farmer/ User will be benefited**
1	**Increasing cropping intensity by growing early maturing T. Aman rice verities in Coastal area of Bangladesh** In coastal region, land productivity will be increase by cultivating high yielding short duration T. Aman verities. Rabi crops and Boro rice can be cultivated timely by cutting the early matured T. Aman rice so that the cropping intensity will be increased in coastal area. This technology is suitable for tidal prone coastal area (Barishal and Khulna Region). **Technological benefit:**	• Cropping intensity will be increased • Farmers will be benefited economically. • Livelihood opportunities of the local farmers will be increased

	(a) Land productivity will be increased by growing high yielding T. Aman verities (b) Rabi crop or Boro rice can be cultivated timely by cutting early matured T. Aman rice (c) The technology is eco-friendly and increases farmer's income.	
	Plant Physiology Division	
	Research Achievements 2020-21 **(Technology Developed)**	
1	**Project Areas:Salinity tolerance**	
	A total of 39 significant QTLs were identified for plant height (2), panicle number (3), filled grain number (10), filled grain weight (14), spikelet fertility (7) and plant survivability (3). In all mapping, one cluster of QTL in chromosome 6 was found consistent for filled grain number and filled grain weight within the marker interval id6007312- K_id6011324.	New QTL could be used as trait development for salinity tolerant breeding program.
	Nine advanced breeding lines (IR103783-B-B-6-2, IR15T1319, SVIN468, SVIN164, SVIN160, IR58443, BR11911-4R-386, BR11920-4R-521 and BR11921-4R-100) were found highly tolerant to 12 dS/m salinity at seedling stage having the SES score 3 and survivability percentage more than 87.	Help the breeder to developed salinity tolerant variety.
2	**Submergence tolerance**	
	Seven advanced breeding lines (BR10190-3-7-3-2-10-1-14, BR10190-3-1-19-5-1-1-13, IR118194-B-3-3-HR3, IR118194-B-6-4-HR1, IR118194-B-6-4-HR2, IR118194-B-17-3 and IR118194-B-10-1) were found moderately tolerant (SES score 5) to submergence. Their survivability rate ranged from 75 -86%.	Help the breeder to developed submergence tolerant variety.
3	**Drought tolerance**	
	The advanced breeding lines IR118194-B-17-3 was found tolerant to drought stress at reproductive phase showing yield reduction and sterility below 50%.	Help the breeder to developed drought tolerant variety.
	Four BRRI Gene bank, Acc. no. 2276, 1800, 1905 and 1907 were consistently found drought tolerant in two consecutive evaluations under field and controlled drought condition could be useful as donor parent in drought breeding program. The sterility percentage of these genotypes was less than 50.	Breeder can use this material as donor parent for drought tolerant breeding program.
4	**Heat tolerance**	

	One moderately heat tolerant (SES score: 5) homozygous line (BR12266-44-11-32-5-1-1-HR10-B) of BRRI dhan28 background was selected for preliminary yield trial having yield advantage 0.5 t/ha -1 and finer grain (1000-grain weight: 19.62 g) compared to parent BRRI dhan28.	Heat tolerant variety development.
	Four BRRI Genebank Acc. no. 1782, 1783, 1797 and 2085 were found tolerant to heat at reproductive phase with more than 60% spikelet fertility while N22 a high temperaturetolerant genotype had 53% fertility.	Could be used as donor parent for Heat tolerant variety development.
5	**Cold tolerance**	
	A total 250 rice genotypes were screened for seedling stage cold tolerance of which 32 germplasm and BRRI dhan84 were selected as moderately tolerant.	Breeder can use this material as donor parent for cold tolerant breeding program.
	Polythene covering during cold wave and polythene covering for all time with opening at both end could be used as suitable technology for raising seedling at Boro season under cold period.	Seedling raising under cold stress condition.
6	**Photosensitivity**	
	14 advancedbreeding lines were strongly photosensitive, while 6 and 37 lines were found moderately and weakly photosensitive, respectively.	Help the breeder to developed strong photosensitive variety.
	Entomology Division	
	Research Achievement 2020-2021 (Technology Developed)	
Sl. No.	**Technology developed**	**How Country/Farmer/User Will be benefited**
01	**Biopesticide (Neemazole 1.2%) for management of brown planthopper (BPH) in rice field**. The biopesticide namely Neemazal 1.2 EC was found effective to control BPH in rice field. The active ingredient of Neemazole is azadirachtin 1.2% which is widely distributed and used as biopesticide in different countries. This biopesticide showed the similar impact compared to chemical insecticide such as chlorpyrifos against BPH in rice field.	Reduced chemical insecticide use in BPH management. It will reduce environment pollution. Reduce import of chemical pesticide and save foreign currency.
	Plant Pathology Division	
	Research Achievement 2020-2021 (Technology Developed)	

	Programme area: Pest management	
Sl. No.	**Technology developed**	**How country/farmers/users will be benefited**
1.	Development of pre breeding blast resistant materials	Farmers can increase rice yield through minimizing loss by using newly developed resistant variety.
2.	Development of pre breeding resistant materials for multiple disease resistant	Pre breeding multiple disease resistant materials will help the breeders to develop durable disease resistant variety and rice growers will be directly benefited.
3	Confirmation of resistant genes of Bacterial blight through gene based SSR markers and pathogenicity test	Out of 74 resistant germplasms 2 materials showed highly disease resistant performance that materials were the combination of major 4 Bacterial blight resistant genes
4	Development of pre breeding materials for tungro disease resistance	Tungro resistant advanced materials were developed which will help to develop tungro resistant rice variety particularly in Aus season in Cumilla and Habigonj region.
5	Evaluation of new chemicals for sheath blight disease of rice	Out of 19 chemicals 6 fungicides-controlled sheath blight successfully, these were Mukti 32.5 SC, Newtec 300SC, Opec 32.5 SC, Clean 75 W, famous 60WG, and Farmbin 32.5 EC.
6	Evaluation of new chemicals for Blast disease of rice	Out of 22 chemicals 7 fungicides controlled blast disease more than 80%, that's were mostly try cyclazole group.
	Farm Machinery and Postharvest Technology Division	
	Research Achievement 2020-2021 (Technology Developed)	
	Programme Area: Farm Mechanization and Postharvest Technology	
Sl. No.	**Technology developed**	**How country/farmers/user will be benefited**
1	Design and development of a manual seed sower machine for raising mat type seedling	Mechanical transplanting of rice is the process of transplanting rice seedlings that have been grown in a mat nursery or plastic tray. Equal-density seedlings are essential for transplanting with the help of a rice

		transplanter. Sowing seeds by hand is a time-consuming task as it is not possible to maintain the same density of seedlings. In view of this, the BRRI FMPHT Division developed a hand-operated seed-sowing machine. The machine can be used to sow seeds in a rigid plastic/flexible tray or in a polythene sheet on a thin layer of soil (20-25 mm) in equal density. Seed sowing density can be adjusted as required. The efficiency of seed sowing of the machine is about 400 times that of hand broadcasting. The device is very easy to operate and more efficient. It can be fabricated and repaired easily in local workshops.
	Agricultural Economics Division	
	Research Achievement 2020-2021 **(Technology Developed)**	
Sl. No.	**Technology developed**	**How country/farmers/user will be benefited**
1	**Farm level Adoption and Evaluation of Modern Rice Cultivation in Bangladesh**. Adoption of modern varieties was 92.26, 86.39, and 99.52% in Aus, T. Aman, and Boro seasons, of which coverage of BRRI varieties was about 73.90, 52.81, and 61.44%, respectively. It is worthwhile to mention that there is a common debate on the depletion of water resources that are affected mainly by Boro cultivation using underground water. To address this issue, the government launched incentives and other subsidy programs for Aus cultivation that motivated the farmers to grow more Aus which mainly shifted from the Boro area. With the broader disbursement of incentives, BRRI dhan48 ranked the top position (46.08%) in the Aus season in terms of area coverage, followed by BRRI dhan28 (7.51%). The coverage of Indian varieties in the T. Aman season was about 21.43%. BRRI dhan28 and BRRI dhan29 were the most dominant varieties in the Boro season, covering 41.05% of areas. BRRI dhan82 produced the highest yield (4.48 ton/ha) in Aus season	• Breeders may use the information of the study for developing climate resilient region specific popular modern varieties. • Researchers, extension personnel' and policy makers may also use this information to formulate appropriate policy for enhancing food grain production.

	whereas, in T. Aman and Boro seasons, it was BRRI dhan87 (5.15 ton/ha) and BRRI dhan89 (6.69 ton/ha), respectively. The average yield of hybrids was 7.46 ton/ha, whereas BRRI developed hybrids yielded 7.18 ton/ha in Boro season.	
2	**Estimation of Costs and Return of MV Rice Cultivation at Farm Level.** This year, although farmers used comparatively higher quantities of DAP from the BRRI recommended doses, they used minimal amounts in the past year. Fertilizer cost of Boro (Tk. 13,055/ha) and T. Aman rice (Tk 8,797 /ha) was higher than that of Aus (Tk 6,450/ha) rice cultivation. The per hectare yield of Boro paddy (6,625 kg) was higher, followed by T. Aman rice (4,610 kg) and T. Aus rice (4,234 kg). Per hectare, the gross margin of rice cultivation in the T. Aman season (Tk. 71,988) was higher, followed by Boro (Tk. 67,798) and T. Aus season (Tk. 38,657.2). Similarly, per hectare net returns for T. Aman (Tk. 39,345) was higher, followed by Boro (Tk. 32,053) and Aus paddy (Tk. 7,600.2). Overall, rice cultivation was profitable at the current year due to the higher yield and market price. The gross profit ratio is 27.4 for T. Aman, for T. Aus is 22.8, for Boro is 25.00. A high-profit ratio is an indication that the farmers are selling their produce at a high-profit level.	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	**Constraints to Adoption of BRRI Released Modern Rice Varieties at Burichang Upazila in Cumilla Districts: A Policy Option.** The overall adoption of BRRI varieties in Burichang Upzila under Cumillla district is satisfactory. Highest area was covered in Aus season (95.46) followed by T.Aman (94.85%) and Boro season (72.63%).More than 27% area was under hybrid rice in Boro season. In Aus season, BRRI dhan48 covered 53.33% of total areas followed by BRRI dhan28 (22.95%) and BRRI dhan55(13.15%). In T. Aman season most popular BRRI variety was BR22 covering 48.29% areas followed by BRRI dhan 49 (19.62%) and BRRI dhan46 (12.93). BRRI dhan58 was found the most popular variety during Boro season covering 33.71% area followed by BRRI dhan29 (10.24%) and BRRI dhan28 (9.66%). Newly released BRRI variety was not adopted in the study locations may be due to less demonstration, nonavailability of seeds and lower yield compare to existence varieties.	• Breeders may use the information of the study for developing climate resilient region specific popular modern varieties. • Researchers, extension personnel' and policy makers may also use this information to formulate appropriate policy for enhancing food grain production.

4	**Drivers Influencing Adoption Decision of Aromatic Rice in Some Selected Areas of Bangladesh: An Econometric Approach.** This study investigates the pattern of input utilization and profitability of aromatic rice cultivars. It identifies the factors that influence the adoption of aromatic rice cultivars within the specified research region. The majority of aromatic paddy produced in Bangladesh is grown in Dinajpur and Sherpur. In Aman season Dinajpur and Sherpur district total 41.87 and 22.25 percent area cultivated aromatic rice cultivars and produced total 259842.15 and 33869.60 ton of clean rice respectively. Profitability analysis reveals that aromatic rice averagely produced 3.12 t/ha and earned a greater net return of 56,947 Tk/ha. However, the cultivation of aromatic rice cultivars is more beneficial for farmers than the cultivation of non-aromatic rice cultivars. For the identification of the determinants of adoption, probit econometric model was applied and the empirical marginal effects results revealed that ln farm size, price difference, market demand, eating quality, extension service, and credit are all positive and significant means increasing uses of these factors would boost in the adoption of more aromatic cultivars in the research region. Whereas occupation only farming and yield difference negatively impact aromatic cultivars adoption.	Researchers, extension personnel' and policy makers may use this information to formulate appropriate policy for enhancing food grain production and farm income.
5	**Understanding Climate Variability and Market Insights of Rice in Haor Ecosystems.** Boro rice faces severe damage just before harvesting almost every year by flood, especially flash floods. Understanding the climate and its variability is very important to attain sustainable food security of the haor basin as well as for the whole country. Haor is the most significant rice production hub in the country. Impacts of climate variability of rice cultivation in the haor ecosystem and market insight will contribute to the policy implication for the haor areas. Evidence suggests that Baniachong is more vulnerable than Ajmiriganj as the flood depth, as well as recession duration, is more in that case. Farmer-Bepari-Aratdar-Miller appeared as the most frequently used marketing channel in both the study areas. However, for both the study areas rice farming was a profitable enterprise considering both cash cost and full cost basis, due to the good price of paddy and straw last year. To prevent frequent floods,	• Breeders may use the information of the study for developing climate resilient region specific popular modern varieties. • Researchers, extension personnel and policy makers may use this information to formulate appropriate policy for increasing food grain production in the Haor region of Bangladesh

	especially flash floods, the government should take an adaptive policy like creating channels across the haors, building dams in the upstream border areas, and also bringing the haor farmers under crop insurance to maintain the smooth and uninterrupted rice production.	
6	**Assessment of Popular Local Rice Varieties Cultivated in Different Seasons of Bangladesh** Although the yield of local rice varieties is lower than that of the modern varieties, the local varieties achieved satisfactory benefit cost ratio as the market price is much higher than contemporary cultivars. The main reason for cultivating local rice varieties in the respective areas is the stress production environment. The special characteristics of local rice varieties, such as good taste to eat, higher market price, demand for special dishes (Polao, Biryani, Cake, etc.), aroma and high elongation ratio are also influential drivers of achieving popularity in the study areas. About 80% and 57% of produced local rice varieties in the Aman and Boro seasons, respectively used for the farm family consumption. Remaining are the marketable surplus and usually goes to the local markets. It was found that lower yields, flooding-related difficulties in preparing seed beds, labor shortages during transplanting and harvesting times, and pest and disease issues was the major constraints of the local varieties in Bangladesh.	• The government, policy makers, researcher and extension workers may use this information to formulate appropriate policy to disseminate BRRI released rice varieties which will help to increase farmer's income and reduce rural poverty.
7	**An Economic Investigation of Rice Seed Production Status in A Selected Area of Bangladesh** Though contract growing in rice seed production is profitable than normal seed production, root-level farmers don't get quality seeds to produce rice always. If the quality seed is provided to all the farmers to produce rice, then the total production of rice would be increased significantly. To do that, expansion of contract growing zones is necessary, more initiatives should be taken by the relevant organization and/or institute to engage more farmers in contract growing to ensure that peasants get good quality standard seed for rice production.	• Researchers, extensionists' and policy makers may use this information to formulate appropriate policy to increase seed production in these areas.
8	**Present Scenario of Rice Milling and Branding Practices and Its Impact on Pricing in Bangladesh** Around 78-83% of the paddy in the studied regions was processed in automatic rice mill which implies that automatic rice mills are capturing the business of	• Researchers, extensionists' and policy makers may use this information to formulate appropriate policies and regulations to rice markets of the country.

	semiauto and husking-type rice mills. Around 83% medium type grain was treated with high DoM of 20%, which is an alarming indicator of the way through which medium grain turns into overpriced Miniket, Nazir, and Pajam. The mill-gate price of different grain types of rice increased 9-15 percent with the increase of DoM from standard to high. Results found that irrespective of grain types, brand names are being formalized based on DoM. According to most of the stakeholders, DoM or over-polishing was the most impactful factor considered in rice branding.	
9.	**Economic Assessment and Utilization Pattern of Rice Byproducts: A Case of Rice Bran in Bangladesh** Rice bran is the main raw material of rice bran oil-producing mills. In Mymensingh, Sherpur, and Netrakona district, about 75 rice mills yearly processed 1835950 ton raw rice where millers were found rice bran 164397.50 ton. On average conversion ratio of rice bran was 8.50%. About 50% of Rice bran produced at automatic rice mills, were used to produce rice bran oil, about 40% were used to produce poultry and fish feed in the feed mill industry. The remaining 10% rice bran was used by local farmers for poultry and fish feed. In case of semi-automatic rice mill, 70% of their bran is used for the feed mill industry, 20% were used by the local farmers for poultry and fish feed purpose whereas only 10% of their bran go to the rice bran oil mill. The bran party shared the highest cost (62.09%) and obtained the highest percentage of total net profit (63.08%) among the actors. The bran retailer captured 36.92% of the total net marketing margin by incurring 37.91% of the total marketing cost. Entrepreneurs should be encouraged to consider rice bran as a major source of bioactive components for the development of superfoods.	• Researchers, extensionists' and policy makers may use this information to formulate appropriate policies and regulations to the byproducts market of rice in the country.
10.	**Spatial Market Integration and Price Transmission of Rice in Bangladesh: Co-integration and Vector Error Correction Model Approach** Using monthly wholesale price data for the period 2012-2020 from four regional markets in Bangladesh, this study has investigated the nature and extent of market integration in the most recent era. The overall results of the market integration analysis indicate that, although Dhaka, Rangpur, Sylhet, and Barisal markets are co-integrated i.e. they have a stable long-run relationship,	• Researchers and policy makers may use this information to further research and formulate appropriate policies and regulations to the rice market of the country.

	these markets are only weakly integrated in the short-run. Granger causality results indicated that there was unidirectional causality originating from Dhaka to Rangpur, Sylhet, and Barisal, and from Rangpur to Sylhet and Barisal while no causal relationship between Sylhet and Barisal. The short-run results indicate that these four rice markets are not well integrated at short-run while long-run coefficients confirm that Dhaka, Rangpur, Sylhet, and Barisal market do move together as a system in long-run. The price adjustment is highest in moderately deficit market Sylhet followed by moderate surplus market Barisal while the lowest adjustment process was found for highly deficit market Dhaka followed by surplus market Rangpur during the study period.	
11	**Resilience of Rice Value Chain: Recent Transformation and Vulnerabilities** The study found no major disruption in rice input and output supply chains in recent years including COVID-19 induced lockdown periods. The overall findings showed that, at the upstream of the value chain in general, farmers mostly market their products with the help of Bepari. The expansion of telecommunication network and development of roads and transportation in the fur flung villages and higher use of mobile phone, has cut the length of marketing chain, though the price was being marked up absorbing the profit by the intermediary actor himself. In the midstream of rice value chains, consumers' demand-driven operation and changes were recorded. Furthermore, auto-rice millers reported an inclusive use of whitening and polishing rice to acquire the expected grain qualities which had higher market demand. Aratdar and commission agents directly sent paddy to auto-mills; with prior contact or just informing over phone; at a price mostly set by the millers.	• Researchers and policy makers may use this information to further research and formulate appropriate policies and regulations to the rice market of the country.
12	**Market Concentration of Popular Rice Brands in Bangladesh** This study is the preliminary finding of 'Tracking Rice Varietal Authentication in Bangladesh: A Pathway from Farm to Market' where the varietal sources of existing rice brands will be figured out. The findings reveal that both Upazila and city markets are very highly concentrated and the competition among the traders with rice brands is very low. The rice brands in Bangladesh	• Researchers and policy makers may use this information to further research and formulate appropriate policies and regulations to the rice market of the country.

	are BR28, Minikit, Zira, Nazir, and BR29. The rice processors are highly concentrated to produce the top 4 - 5 brands that captured more than 97% share of the markets. By the end of this study, the varietal sources of different rice brands and the causes of producing brandings would be identified.	
13	**Comparative Advantage of Export Potential Aromatic Rice (BRRI dhan50) Variety in Selected Areas of Bangladesh** Bangladesh has comparative advantage for producing and exporting export potential aromatic rice like BRRI dhan50 at import and export substitution. A plausible reason for these results is high prices of aromatic rice in the international market, higher per unit yield of aromatic rice, head rice recovery ratio and marketing spread of price between the wholesale to retail levels is a bit low. In accelerating comparative advantage in aromatic rice production in the long-run in Bangladesh, the following policy implication can be drawn: We know, marketing spread of price between the wholesale to retail levels has strongly influenced to DRC values. One of the reasons behind the wider price spread is the existence of market power of dominated millers and traders. So, the government can actively participate in the market to reduce the market power of the dominated millers and traders to refrain them from exercising price controlling power to earn excess profit that will minimize the price spread in the supply chain and increase the comparative advantage of the aromatic rice production at import and export substitution.	• Researchers and policy makers may use this information to further research and formulate appropriate policies and regulations to the rice market of the country.
14.	**Understanding Rice Consumption Patterns in Bangladesh: Evidence From Household Survey** The rice consumption patterns have been significantly changing in the last two decades. To dig out these changes, we used four-round national representative household survey data from 2000 to 2016 to understand the rice consumption pattern in Bangladesh. According to the findings, national per capita rice intake in the surveyed years of 2000, 2005, 2010, and 2016 was 458.5, 439.6, 416.0, and 367.2 gm/day, respectively. Rice intake was higher in rural areas than urban areas, and the intake gap ranged from 17.0 to 22.2 per cent. Per capita rice consumption in national, rural and urban areas was decreased by 1.40, 1.20 and 0.90 per cent each year, respectively. The consumption share of coarse	• Researchers and policy makers may use this information to further research and formulate appropriate policies and regulations to the rice market of the country. • Breeders may use the information of the study for developing region specific suitable popular modern varieties.

	grain rice has declined from 42.4% in 2000 to 21.6% in 2016; medium and fine grain rice has increased sharply. In the divisions of Barishal, Khulna, Rangpur, and Sylhet, consumption of coarse grain rice was greater. Mymensingh, Rajshahi, and Chattogram divisions had higher consumption of medium grain rice, whereas Dhaka division had higher consumption of fine grain rice. Rice consumption is comparatively higher in working-age populations, followed by the old-aged and younger generations.	
15.	**Transforming Rice Breeding Through Capacity Enhancement of BRRI: Market Analysis** The preference on rice varietal traits varies by season, geographical regions, gender, occupational status and market segments because of different agro-climatic, sociocultural and behavioral factors. Therefore, breeders must consider the preferences of the rice value chain actors and agro-climatic conditions of the regions in the process of variety development. In this regard, short to medium growth duration, higher yield potential, biotic and abiotic stress resistant, good market demand of the variety should be under due considerations. The preference of stakeholders frequently changes after 3 to 5 years so we have to continue verified the product profile.	• Breeders may use the information of the study for developing climate resilient region specific popular modern varieties. • Researchers, extension personnel' and policy makers may also use this information to formulate appropriate policy for enhancing food grain production.
	Agricultural Statistics Division	
	Research Achievement 2020-2021 **(Technology Developed)**	
Sl No	**Technology Developed**	**How Country/ Farmer/User will be benefited**
1	Genetic Trend of BRRI Varieties	People will come to know the efficiency of thee varieties.
2	Digitalized Salary Management System for BRRI HQ	Save Time, Money and Visit
3	Digitalized CL Application Management System for Agricultural Statistics Division	Save Time, Money and Visit
4	Suitability (Edaphic) Mapping of BRRI dhan90 to BRRI dhan92	People will able to know which variety is suitable where.
5	Identifying the Severe Flood Affected Areas of Bangladesh in 2020 Based on Satellite Remote Sensing	People will able to know district wise flood affected area.

6	Strengthening Cyber Security System for BRRI	Using cyber security system nobody can trace the server (back end server) of any location in the world. When client point and server point are connected through VPN, only that time server (back end or admin panel or c panel) will be visible for only the client computer. so all server as well as all data will be safe and secured.
7	BRRI Rice Doctor	Farmer will get instant feedback through specific question answering as a diagnostic tool. It is also focusing significant improvement of rice productivity through this tool.
8	Bangladesh Rice Knowledge Bank (BRKB) website	The extension service providers are the immediate beneficiaries of the BRKB. However, ultimately farmers will be benefited from it.
	Farm Management Division	
	Research Achievement 2020-2021 **(Technology Developed)**	
	Program Area: Socio-Economics and Policy	
	1.Project : Rice production management	
	Expt. 1. Effect of transplanting date and spacing on the yield and yield components of short duration rice varieties in T. Aman and Boro seasons. Findings: In T. Aman season, transplanting date 15 July to 31 July and spacing (15 cm × 15 cm) produced the highest grain yield of short duration (growth duration 113 to 115 days) rice varieties. On the other hand, during Boro season, 31 December produced the highest grain yield which was statistacally similar with 15 December and the lowest in 1 February. Among the spacing the 20 cm × 15 cm produced the highest grain yield followed by 25 cm × 15 cm spacing and the lowest in 20 cm × 20 cm spacing.	This finding may be useful for the rice growers and researchers.
	Expt. 2. Integrated nutrient management for yield maximization of rice. Findings: Grain yield, tiller number, panicle number, plant height and grain number were significantly affected by the different nutrient management in both T. Aman and Boro season. STB dose with poultry litter (1 t ha^{-1}) and STB dose with VC (1 t ha^{-1}) dose were	This finding may be useful for the rice growers and researchers/ production farm.

	performed better in all the parameter except 1000-grain weight (TGW). On the other hand, control plot (no nutrient supply) showed the lowest result.	
	Expt. 3. Efficacy of mechanical seedling transplanter and deep placement of mixed fertilizer on rice yield Findings: Growth parameters such as plant height, seedling number, leaf number, panicle length, etc and yield contributing parameters such as tiller number, panicle number, filled grain, unfilled grain and 1000 grain-wt, etc were not significantly affected by mechanical transplanting with fertilizer deep placement and hand transplanting with hand broadcasting of fertilizer. Mechanical transplanting with 80% fertilizer deep placement gave the highest yield and reduces 20% of fertilizers cost and transplanting costs.	This finding may be useful for the rice growers and researchers.
	2. Project: Labor Management System	
	Expt. 1. Monitoring labor wage rate at different locations of Bangladesh Findings: The average wage rate day^{-1} varies from Tk 505-553. The wage rate day^{-1} during the peak periods of the year Tk 540 to 570 in May, Tk 520 to 575 in July-August and Tk. 530 to 575 in December -January were existed.	This finding may be useful for the rice growers and researchers.
	3. Project: Rice Seed Production	
	Expt. 1. Performance of Boro varieties in seed production plots during 2020-21 Findings: Among 11 BRRI released rice varieties, BRRI dhan89 produced the hghest yield (9.61 t ha^{-1}) followed by BRRI dhan92 (9.46 t ha^{-1}), BRRI dhan29 (8.72 t ha^{-1}), BRRI dhan88 (8.70 t ha^{-1}).	This finding may be useful for the rice growers and researchers.
	4. Project: Management and utilization of resources	
	Expt. 1. Management and utilization of land, labour and other resources. Findings: Including regional stations, BRRI has 717 labours of which 497 regular and 220 irregular. In BRRI HQ, total numbers is 458 of which 289 regular and 155 irregular labours. Total labour utilization in different divisions was 1,93,143 man days of which 50.87 %, 45.71 % and 3.42 % were utilized for research, support service and holidays, respectively in BRRI, HQ (Table 12). It was observed that total labour wages was 10,12,88,210/- of which Tk. 5,15,26,887/-, Tk. 4,62,94,224/- and Tk. 34,67,099/- were paid to the	This finding may be useful for the rice growers and researchers.

	labourers for research work, support service works, leaves and holidays, respectively	
	Adaptive Research Division	
	Research Achievement 2020-2021 (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 dhan97, BRRI dhan98, BRRI dhan99, Bangabandhu dhan100 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	
	Research Achievement 2020-2021 (Technology Developed)	
Sl. No.	**Technology Developed**	**How Country/Farmer/User will be benefited**
	Program Area : Technology Transfer	
	1. Capacity Building and Technology Transfer Through Training	Knowledge and skill of the trained personnel on the subject matters were increased.
	Total training conducted : 37 No. of participants : 667 Duration: 2 days to 2 months Participants: Extension personnel of DAE, ACI and IRRI officers, Scientists, SA, SSA and LA of BRRI	1. Knowledge and skill of the participants on rice production technologies were enriched. 2. Rice yield and production of the country will be increased. 3.Writing capacity of scientists will be enriched.
	Regional Station, Cumilla	
	Research Achievement 2020-2021 (Technology Developed)	

Sl. No.	Technology developed	How Country/Farmer/User will be benefited
1	**Rice tungro disease management technology:** Several experiments were conducted from 2019 to 2021 to develop a complete management package for preventing rice tungro disease devastation in Cumilla region. Preventive measure is the only way to control tungro disease devastation. Recommended rice tungro disease management technology is given below: **Chemical Control** 1. Seedbed along with surroundings should be free from GLH by light trapping/hand sweeping/insecticide spray. 2. Spray registered systemic insecticide viz. MIPC 2.6g /Cartap 2.4g /Carbaryl 3.4g /Carbosulfan 2ml per litre water are the most effective) in the seedbed for 2 times for controlling GLH. The season-wise spray times are as follows: a) During Aus season, 10 days after seeding (DAS) and about 3-5 days before transplanting b) During T. Aman season, 10-15 DAS and about 5 days before transplanting c) During Boro season, 15-20 DAS and about 5 days before transplanting **Or, Mechanical Control** Five days' interval hand sweeping along with light trap at night in the seedbed reduces the GLH population as well as the tungro disease infection in the main field.	By following this technology, farmers can prevent rice tungro disease of rice. Farmer can protect at least 17280/- (1080/- x 16 mounds) per bigha by spraying insecticide in the seedbed 2 times cost 104/- (44 for insecticide+60 for labor) or by mechanical 1000/- for 5 times (hand sweep and light trap cost with labor). By this way, farmers can protect their rice yield from tungro disease which may take role in the development of the farmer's socio-economic condition and ultimately contribute to food security of the country.
	Regional Station: Habiganj	
	Research Achievement 2020-2021 **(Technology Developed)**	
Sl No.	**Technology developed**	**How Country/ Farmer/User will be benefited**
1	Truthfully labeled and Breeders Seed production	Around 20 tons TLS seeds of different varieties were produced during the reporting year, which will be distributed to the famers. About 27 tons breeder seeds were also produced and sent to the Genetic Resource and Seed Division. This breeder seed will be given to BADC, NGOs and SMEs for production foundation seeds.

2	Double transplanting of Boro rice is a good technology for escaping flash flood in haor areas.	Double transplanted rice matured earlier (7-10 days) than normal transplanted rice. It saved Boro rice from early flash-flood in the haor areas without sacrificing yield.
	Regional Station, Sagardi, Barisal	
	Research Achievement 2020-21 **(Technology Developed)**	
Sl No.	**Technology developed**	**How Country/ Farmer/User will be benefited**
01	Novel Rectangular hand net developed for insecticides free rice seedbed	A novel Rectangular hand net (RHN) was developed for insecticides free rice Seedbeds. RHN performance found significantly better than traditional round hand net. Rectangular hand net is suitable to sweep at early aged rice seedlings. Newly developed Rectangular hand net application method is used as rapid walking around the seedbed (model seedbed one-meter width and length depends on land condition). After sweep full seedbed harmful insect pest had been destroyed and beneficial insect released back in the same field. Using this technology farmers can be saved about 800-1000tk per bigha of rice seedbed. Long lasting environmental and economical effects to farmers and consumers.
	Regional Station, Satkhira	
	Research Achievement 2020-2021 **(Technology Developed)**	
Sl No.	**Technology developed**	**How Country/ Farmer/User will be benefited**
1	Four-crop model Mustard (Relay)-Boro-Jute (Transplanted)-T.Aman	Farmers' net return/unit area /year will be increased.