# ANNUAL REPORT

# 2018-2019

**Bangladesh Agricultural Research Council**

**New Airport Road, Farmgate, Dhaka-1215**

**www.barc.gov.bd**

## National Agricultural Research System (NARS)

| Institute | Ministry | Areas of Research |
|---|---|---|
| Bangladesh Agricultural Research Council (BARC), Dhaka www.barc.gov.bd | Agriculture | Strengthen the national agricultural research capability, through research planning, coordination, integration and resource allocation |
| Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur www.bari.gov.bd | Agriculture | Basic, applied and adaptive research on cereals (other than rice), pulses, oilseeds, vegetables, horticultural crops etc. |
| Bangladesh Rice Research Institute (BRRI), Joydepur, Gazipur www.brri.gov.bd | Agriculture | Basic, applied and adaptive research on rice |
| Bangladesh Jute Research Institute (BJRI), Shere-e-Bangla Nagar, Dhaka www.bjri.gov.bd | Agriculture | Basic, applied and adaptive research on jute production and utilization |
| Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh www.bina.gov.bd | Agriculture | Application on nuclear technology in agriculture |
| Bangladesh Sugarcrop Research Institute (BSRI), Ishurdi, Pabna www.bsri.gov.bd | Agriculture | Applied and adaptive research on sugarcrops |
| Soil Resource Development Institute (SRDI), Farmgate, Dhaka www.srdi.gov.bd | Agriculture | Soil survey, soil classification and soil characterization |
| Cotton Development Board (CDB), Khamarbari, Farmgate, Dhaka www.cdb.gov.bd | Agriculture | Cotton production and research |
| Bangladesh Fisheries Research Institute (BFRI), Mymensingh www.fri.gov.bd | Fisheries and Livestock | Marine and freshwater fisheries research |
| Bangladesh Livestock Research Institute (BLRI), Savar, Dhaka www.blri.gov.bd | Fisheries and Livestock | Basic and applied research on cattle, buffalo, sheep, goats, poultry, duck etc. |
| Bangladesh Forest Research Institute (BFRI), Sholashahar, Chittagong www.bfri.gov.bd | Environment Forests and Climate change | Forestry and agroforestry research |
| Bangladesh Tea Research Institute (BTRI), Srimangal, Moulvibazar www.btri.gov.bd | Commerce | Applied and adaptive research on tea |
| Bangladesh Sericulture Research and Training Institute (BSRTI), Baliapukur, Rajshahi www.bsrti.gov.bd | Textile and Jute | Research and training on sericulture |
| Bangladesh Wheat and Maize Research Institute (BWMRI) www.bwmri.gov.bd | Agriculture | Basic, applied and adaptive research on wheat and Maize |

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# Foreword

It's my pleasure to write few words on BARC Annual Report 2018-2019. The report reflects the annual activities accomplished during the period 2018-2019. The Bangladesh Agricultural Research Council (BARC) executes its annual activities which are carried out by its divisions (six), units (four), and a center.

A glimpse of the report reveals each of the BARC's divisions, units and the center had several scheduled works within the stipulated time. Considering priorities for research improvement, two research for development project proposals, namely "Strengthening of Research and Development of Bangladesh Agricultural Research Council" and "Research and Development of Seaweed Cultivation" were proposed and submitted to the Ministry of Agriculture. In addition, two special funded projects of NARS institutes were prioritized by the Planning and Evaluation Division of BARC. However, BARC along with NARS institutes and agricultural universities are implementing a good number of programs including BARC's prominent role in NATP-2. As Bangladesh is a densely populated country, we must look into options seeking food alternatives that supersedes conventional ones. With this perspective, some activities and projects like "Seaweed Cultivation in Coastal Areas" were slated for implementation that serve medicinal value and nutrition which commercially viable too.

Thrust on bio-technological interventions for developing varieties and products suitable to address biotic and abiotic stress gained importance both nationally and institutionally. Crop improvement through conventional methods, and developing varieties by conventional approach is time consuming and remains as a challenge. Hence, several crop improvement programs and adaptive trials for developing varieties through advanced breeding techniques of important crops have been focused. Maximization and intensification of land use is another important area that focusses on cropping patterns improvements and soil health management. Another important area that has been prioritized for research and extension is nutrition; hence we keep focus on nutritional improvement of consumers through plant and animal sources. Cost effective livestock production with increased supply of animal based food and productivity remains as targets to achieve. I appreciate that FRG-2018 has been published. The publication is available in Bengali Version also for the benefit of farmers. The facts mentioned above were some of the milestones achieved by the council. However, the report has narrated the success of several activities that BARC has accomplished. Every division, unit and the center has contributed greatly to achieve the targets framed during 2018-2019.

The innovative, collaborative and inclusive approaches of the scientists, officers, and staff of BARC were impressive. I congratulate and thank them all for their whole-hearted dedication and cooperation during the reporting period. Since this Annual Report reflects the spirit of continuous innovation, I believe, it will pave way for new strategies in the up-coming year. Finally, I thank those associated in compiling, editing, and printing of this report.

**(Dr. S. M. Bokhtiar**)
Executive Chairman

# Executive Summary

This report contains the annual activities and accomplishments during 2018-2019 of the Bangladesh Agricultural Research Council (BARC) with regard to governance, management, development of research programs & its monitoring, and coordination as the Apex Body of the National Agricultural Research System (NARS). The progress of various programs undertaken and program planning & monitoring, human resource development, progress of the ongoing projects, technology transfer and training activities, information gathering and dissemination, administrative and financial management and other activities have been highlighted in this report.

Two Executive Council (EC) meetings, such as the 30$^{th}$ and the 31$^{st}$ were held on 29 October 2018 and 9 June 2019, respectively, at BARC. In these meetings, some of the very important issues related to overall performances of research and development of NARS including promotion were considered and executed. BARC made proposal for the release of fund from the Government on quarterly basis as per approved annual allocation of budget.

BARC performs its activities through six divisions, such as Crops Division, P & E Division, Fisheries Division, NRM Division, Livestock Division, and Agric. Economics and Rural Sociology Division. Executive Chairman acts as the chief of the organization while each division has a Member Director as head of respective division. There are unit(s) under each division for specialized areas of works to perform. The units, such as Technology Transfer and Monitoring Unit of Crops Division, Manpower and Training Unit of Planning & Evaluation Division, Nutrition Unit of Fisheries Division, Computer and GIS Unit of AERS Division, and Agriculture Information Centre perform various activities in its respective areas. Administration & Finance Division performs administrative and financial activities of the Council.

Crops Division of BARC was engaged in improvement and adoption of various crops like cereals, vegetables and fruits, spices and condiments, jute, sugar crops, sericulture, etc.,including ornamental and flowers. For maximizing land utilization, various cropping patterns, intercropping, and mixed cropping practices were put to trials, and those found promising were recommended for adoption. The division also provided technical support through arranging research progress review of 2018-19 and program planning for 2019-20. In order to make the research progress review and the program planning a success, workshops were organized on (i) crop improvement, (ii) crop production, (iii) disease management, (iv) insect management, and (v) biotechnological research. Crops Division also monitored and evaluated different research projects, such as CRG projects and special allocation projects of MoA. To implement the activities like technology transfer, manpower development, etc; funds were released to the Agricultural Research Institutes (ARIs) and associated organizations according to the budget plan. Planning and Evaluation (P & E) Division monitored special fund projects of NARS institutes and CRG and PBRG sub-projects under PIU NATP-2, BARC. Two Development Project Proposals (DPP) titled “Strengthening of Research and Development of Bangladesh Agricultural Research Council” and “Research and Development of Seaweed Cultivation in Coastal Areas of Bangladesh” have been submitted to Ministry of Agriculture (MoA). The project on “Capacity Building for Conducting Adaptive Trials on Seaweed Cultivation in Coastal Areas” funded by Krishi Gobeshona Foundation (KGF), which had been initiated in 2016 was completed successfully. Under this project, seaweeds were cultivated in “Land-based” (Nursery) and “Open-seawater” using “One-step” (a portion of the seaweed that is attached to ropes) and “Multi-step” (producing spores) “seeds” attached to synthetic floating ropes. BARC coordinated by the Crops Division along with eight components, such as BARI, BRRI, BINA, BJRI, BSRI, BSRTI, CDB, and BAU have implemented the

PBRG Project titled, "Collection, Conservation and Characterization of Important Plant Genetic Resources" which was funded by NATP Program-2, PIU. A number of workshops were organized including the 'Fall Armyworm, an Invasive Pest: Future Threat to Bangladesh' and the "Biotechnology Research Programs of NARS Institutes". The project titled, "Agricultural Technology Information Network in Asia (ATIN)" has been successfully completed. Under this project, E-content of agricultural production technologies of 19 crops were developed and uploaded to AFACI website. Five crop calendars were prepared and published. Thirty thousand copies of the calendars were printed for distribution. A project on "Development of Upazila Land Suitability Assessment and Crop Zoning System of Bangladesh" is being implemented in coordination with the Crops Division of BARC.

Soil Unit of NRM Division, BARC has updated the English version of "Fertilizer Recommendation Guide-2018" (FRG-2018). While a Bengali version of the guide incorporating the most useful subjects for the farmers was prepared and published for the first time. Nutrition Unit performed different activities, such as contamination and adulteration of food and food products, process, chain and mollification; value addition and standardization of nutritional level in selected food items to mitigate malnutrition, food-based initiative for improving household food security, income generation and minimizing malnutrition, value addition and standardization of nutritional level in selected food items from poultry origin, fortification and standardization of nutritional level in selected food items and efficacy test of polyphenolic compounds as quality livestock feed production.

Different projects developed under the Fisheries Division include Sustainable Fisheries Development for *haor* and *beel C*ommunity through Improved Management Approach; Improvement of Existing Fattening Technology of Carp and High Valued Small Indigenous Species (SIS) through Good Aquaculture Practices (GAP) in Different Agro-ecosystems; Development of *In-situ* Breeding Technology of Prawn (*Macro brachiumrosenbergii*) and Adoption of Sustainable Eco-Friendly Culture of Prawn and Shrimp (*Penaeusmonodon*; Up-scaling of Mud Crab (*Scylla olivacea*) Aquaculture in Bangladesh: Adoption of Improved Techniques from Seed Production to Fattening and Health management.

The Livestock Division is working to achieve the goal of improving nutritional status of the general mass through cost-effective livestock production for increased supply of animal origin food, supporting increased crop production through providing healthy draft animals and biological manure, and helping the rural poor in the generation of employment, income and fuel supply through profitable livestock rearing.The division is also engaged to support National Avian Influenza/Bird Flue Prevention and Control Programs, to recruit scientists/officers in NARS institutes, to support different research activities of NARS institutes, and to support different activities of National Agricultural Technology Project (NATP), BARC and DLS units.

Two PBRG subprojects titled, "Groundwater Resources Management for Sustainable Crop Production in Northwest Hydrological Region of Bangladesh" and "Up-scaling and Application of Solar Photovoltaic Pump for Smallholder Irrigation and Household Appliances in the Central Coastal Region of Bangladesh" are under implementation by BARC, and sufficient progress has been made. AERS Division of BARC organized a training program on "Applications of Econometrics in Agricultural Research" which was held during 10-14 March 2019 at BARC.Twenty scientists (Agricultural Economist) of NARS institutes attended the training program. Agricultural Information Centre (AIC), BARC organized "Asia Open Access Workshop Dhaka 2019" *at BARC* during 6-7 March 2019 in association with Confederation of Open Access Repositories (COAR), with a view to learning global trends and share information across Asian countries.

# HIGHLIGHTS OF RESEARCH AND DEVELOPMENT

## Crops Division

### Research Program Development of NARS Institutes

- Provided technical support through the workshop on Research Progress Review 2018-19 and Program Planning 2019-20 in such areas as (i) Crop Improvement, (ii) Crop Production, (iii) Disease Management, (iv) Insect Management, and (v) Biotechnological research in line with National Agriculture Policy 2018 in which Climate Resilient technology development received priority.
- Member Director (Crops) of BARC gave technical directions and guidelines in internal and the central reviews of different crop research institutes. The Member Director also delivered valuable suggestions and advices that the National Policy be taken into account while preparing the research programs. Other member directors of BARC paid due attention to the concerned areas of research program planning and development. Above all, the Executive Chairman of BARC played the very viatal role and became concerned as to whether the programs will contribute to implement the National Policy.

### Monitoring and Evaluation of Research Projects: (1) CRG Projects and (2) Special Allocation Projects of MoA

a. Scientists of Crops Division of BARC monitored 62 CRG sub-projects implemented by different NARS institutes and universities. They reviewed half-yearly and annual reports of CRG sub-projects (2018) implemented by different institutes. They also reviewed seven completion reports of seven projects..

b. Crops Division monitored 12 PBRG sub-projects those implemented by different NARS institutes and universities.

c. Under NATP Phase-II projects, Crops Division recruited 03 consultants, 05 scientific officers, 12 scientific assistants, 01 accountant, 06 lab technicians, 01 lab attendant during last financial year (2018-19) for different CRG and PBRG sub- projects.

d. Scientists directly monitored research project activities under special budget of MoA (2018 and 2019) implemented by different organizations. They also monitored activities of 53 projects as team members and submitted reports on these to the Planning and Evaluation Division of BARC.

Monitoring team observed coffee grinder and cashewnut sheller

# Regional and International Collaboration and Cooperation

## a. Regional Workshop on the Preparation of National Reports under Implementation of the International Treaty

A regional workshop on the preparation of national reports on the implementation of the International Treaty was held in New Delhi, India from 11 to 13 December 2018. Dr. Md.. Abdus Salam, Principal Scientific Officer (Crops), BARC and National Focal Point of ITPGRFA attended the workshop.

Inaugural session of the regional workshop on the preparation of national reports under implementation of the international treaty

The overall objective of the workshop was to identify the methods and techniques for enhancing quality reporting and successful data coverage of plant genetic resources for food and agriculture.

## b. Seventeenth Session of the Commission on Plant Genetic Resources for Food and Agriculture

Dr. Md. Abdus Salam, Principal Scientific Officer (Crops), BARCl and National Focal Point (NFP) of ITPGRFA, Bangladesh attended the Seventeenth Session of the Commission on Plant Genetic Resources for Food and Agriculture (CGRFA 17) held at FAO Head Quarters, Rome, Italy during 17-22 February 2019.

Seventeenth session of the Commission on Plant Genetic Resources for Food and Agriculture in Rome, Italy

Dr. Salam, on behalf of the Asia region, made the following statements on nutrition and genetic resources for food and agriculture.

Dr. Salam said: ‘ I have the honor to deliver this statement on behalf of the Asia Regional Group”. He remarked that the Group wish to further highlight several important issues. According to Dr Salam, the issues to be addressed and considered most important are to:

1. promote biodiversity.

2. Provide further support to strengthening nutrition information systems, and food-based indicators derived from gender and age disaggregated data on individual food consumption.
3. invest in women's nutrition will promote health and well-being of women and their children (SDG 3), as well as boost gender equality and good education (SDGs 4 and 5).
4. promote the multidimensional benefits of neglected and underutilized species (NUS) and their potential contribution to achieving Zero Hunger.
5. identify orphan crops that are nutrition-dense, climate-resilient, economically viable and locally available or adaptable as "Future Smart Food" (FSF).
6. to encourage creation of an enabling environment across value chain i.e. to promote sustainable production, processing, marketing and consumption of FSF.

### c. Seventh Meeting of the BIMSTEC Expert Group on Agricultural Cooperation

Dr. Md. Aziz Zilani Chowdhury, Member Director (Crops), BARC and Dr. Shah Md. Monir Hossain, Principal Scientific Officer, Crops Division, BARC participated Seventh Meeting of the BIMSTEC Expert Group on Agricultural Cooperation which was held in Dhaka, Bangladesh during 24-25 April 2019. Delegates from seven member countries (Bangladesh, Bhutan, India, Myanmar, Nepal, Sri Lanka, and Thailand) attended the meeting.

The meeting was inaugurated by Mr. Md. Nasiruzzaman, Secretary, Ministry of Agriculture, Government of the People's Republic of Bangladesh. The meeting reiterated the importance of sharing agricultural information and best practices among BIMSTEC member states and decided to cooperate with agricultural information for uploading in BIMSTEC Secretariat's website. The Meeting reviewed the progress made in agricultural cooperation in relation to the implementation of the nine identified common projects and decided that the number of common projects for implementation in BIMSTEC Agricultural Cooperation would be reduced to seven. The meeting acknowledged the lack of fund to implement the common projects and encouraged BIMSTEC member states to consider contributing to a corpus fund for common identified projects and enhancing agricultural cooperation. The Myanmar delegation informed the meeting that the First BIMSTEC Ministerial Meeting on agricultural cooperation to be held on 11-12 July 2019 in Nay Pyi Taw, Myanmar. The Eighth Meeting of the BIMSTEC Expert Group on Agricultural Cooperation will be hosted by India in early 2020. It also discussed ways and means to deepen agriculture cooperation among the member states.

### d. Seed Industry Program

Dr. Shah Md. Monir Hossain, Principal Scientific Officer, Crops Division, BARC participated the `Seed Industry Program' organized by 'Feed the Future Biotechnology Partnership (FtFBP)'at Hyderabad, India during 21-24 January 2019.

### e. Conservation Agriculture-based Sustainable Intensification (CASI): Experiences and Prospects under the CIMMYT funded Project and Sustainable and Resilient Farming Systems Intensification (SRFSI) in the Eastern Gangetic Plains

The program was held at BARC on 27 May 2019. Among the dignitaries, Md. Nasiruzzaman, Secretary, Ministry of Agriculture, Government of the People's Republic of Bangladesh, Dr. Md. Akram Hossain Choudhury, Chairman, BMDA, Dr. Md. Kabir Ikramul Haque, Executive Chairman, BARC, Dr. Mahesh K. Gathala, Senior Scientist, CIMMYT, Dr. TP Tiwari, Country Representative and Project Leader, SRFSI, CIMMYT-Bangladesh and Dr. Md. Aziz Zilani Chowdhry, Member Director (Crops), BARC were present.

Dr. Tiwari delivered a presentation on CIMMYT activates at the beginning. He also presented the project goals, activities and achievements of the project. He clearly showed the benefits of CASI over traditional

farmers' practice in respect to productivity, economics, and climate issues. Different components of the project presented its detailed achievements.

A general discussion on importance and benefits from CASI technologies and finding ways of large scale promotion of the technologies were followed by the presentation


Inaugural session of the CIMMYT funded projects under CASI

## f. Fourth Meeting of the SAARC Agriculture Ministers

The fourth meeting of the SAARC Agriculture Ministers and the preceding meetings were held in Thimpu, Bhutan, during 23 to 27 June 2019. The third multi-stakeholders dialogue on agriculture, Nineth meeting of the Technical Committee on Agriculture and Rural Development (TCARD), senior agriculture officials' meetings were held during 24-26 June. . The 4th meeting of the SAARC agriculture ministers was held on 27 June. The minister of Agriculture and Forest of the Royal Bhutan chaired, and the minister of Foreign Affairs of Royal Bhutan was present as the Chief Guest. The delegates of SAARC countries, TCARD members, representatives of CGIAR organizations and donor agencies such as FAO and IFAD attended the meeting. A six- member Bangladesh delegate attended the meetings. Dr. Md. Harunur Rashid, Principal Scientific Officer (Crops) of BARC attended the meeting as a member of TCARD.

Group photo of fourth meeting of the SAARC agriculture ministers

## g. Inter-governmental Technical Working Group on Plant Genetic Resources for Food and Agriculture Held in Rome, Italy

Nineth Session on Building Linkages to Strengthen on Farm Management of Farmer's Varieties/Landraces: Community Seed Banks and 9th Session of the Intergovernmental Technical Working Group on Plant Genetic Resources for Food and Agriculture was held in Rome Italy during 23-28 July 2018. Dr. Md. Aziz Zilani Chowdhury, Member Director (Crops), BARC attended the session.

## h. Meeting and Knowledge Sharing on Flower Species Identification

Dr. Md. Aziz Zilani Chowdhury, Member Director (Crops), BARC attended the "Bilateral Meeting and Knowledge Sharing on Flower Species Identification: Biotechnology of Flower Development and Orchids in the U.K. The program was organized by the University of Greenwich, United Kingdom during 11-18 April 2019 under National Agricultural Technology Program Phase II project (BARC part).

## i) Linkage with International Organizations and Development Partners in Bangladesh (MoUs implementation)

**Memorandum of Understanding and JAWG:**

- Joint Agriculture Working Group (JAWG) of Bangladesh visited Amman, Jordan and Singed an MoU between the People's Republic of Bangladesh and the Hashemite Kingdom of Jordan during 17-21 November 2018.
- Bangladesh team bought five each of olive and pomegranate germplasm to introduce in Bangladesh.

Pomegranade germplasm

Olive germplasm

**Memorandum of Understanding (MoU):**

- Prepared draft MoU between BARC and International Life Sciences Institute Research Foundation (ILSRF) and sent to MoA.
- Drafted MoU between Bangladesh and Tanzania in the field of Agriculture for MoA.
- Outlined MoU between Bangladesh and Kuwait based on MoFA comments.
- Prepared MoU on agriculture cooperation between Bangladesh and Lithuania based on MoFA and ERD comments.
- Drafted MoU for cooperation in agriculture between Bangladesh and Afghanistan.
- Drafted MoU for cooperation in agriculture between Bangladesh and Bhutan.

- Sketch out work-plan based on signed MoU between Bangladesh and Brunei.
- Drafted MoU between Centre on Integrated Rural Development for Asia and the Pacific (CIRDAP) and Bangladesh Agricultural Research Council (BARC), Ministry of Agriculture (MoA), Government of the People's Republic of Bangladesh for cooperation in the field of agriculture.
- Prepared a draft MoU between Bangladesh and United Arab Emirates.

**MoU Signing:**

- Signed MoU between BARC and Khuzestan Water and Power Authority (KWPA) .
- Signed MoU between BARC and Bhutan
- Signed MoU between Bangladesh and Brunei

**Policy & JWG:**

- Provided suggestions on investment opportunities in KSA, Sudan, Uganda, and Eritrea.
- Passed comments on draft MoU between Bangladesh and South Africa.
- Organized training program for SLCARP scientists on 07-11October 2018.
- Organized meeting on sublicense agreement between BARI and MAHYCO.
- Formation of Joint Technical Working Group (JTWG) under the MoU between BARC and Michigan State University, USA.
- Formation of Joint Agricultural Steering Committee (JASC) based on signed MoU between BARC and Khuzestan Water and Power Authority, Iran.
- Outlined Joint Working Group (JWG) between Bangladesh and KSA.

## AFACI Projects

### a. Selection and Dissemination of Elite Salinity Tolerant Rice Varieties of AFACI Member Countries

Dr. Md. Harunur Rashid, PI and Dr. Mohammad Akhlasur Rahman, PSO, BRRI and Co-PI, attended kick-off workshop on **Selection and Dissemination of Elite Salinity Tolerant Rice Varieties of AFACI Member Countries** at IRRI, Philippines on 31 August 2018.

A total of 15 genotypes along with 10 advanced lines including BRRI dhan67 were evaluated both at on-station (BRRI) and on-farm (Satkhira Sadar, Kaligonj and Ashashuni) by BRRI and BINA. At early tillering stage, the entries T9008A, T9118A, T9021A, T5103A-1-B) and SVIN374 escaped salinity at vegetative stage where BRRI dhan67 was damaged. At reproductive phase, all the entries could not tolerate high salinity. Therefore, all the tested entries were damaged and no yield was obtained


Meeting of salt tolerant rice project, Philippines, 31 August 2018

### b. AFACI Program Workshop on Horticulture (GAP)

Dr. Shah Md. Monir Hossain, Principal Scientific Officer, Crops Division, BARC participated in the AFACI Program Workshop on Horticulture (GAP) held in Thimphu, Bhutan during 03-07 July 2018. Principal Investigator (PI) and Representative of the AFACI-GAP project from 13 countries presented their progress and future plan.

Participants of AFACI Program Workshop on Horticulture (GAP)

## Research Project Development for National and International Funding (PBRG)

### a. DPP and PBRG Project Concept Note Evaluation

- DPP evaluation: A project on Development and Dissemination of Varieties and Region Specific Seed Production Technology of High Yielding Jute and Allied Crops submitted by Bangladesh Jute Research Institute was evaluated.
- Technical Committee of Crops Division, BARC evaluated two PBRG projects.

### b. Collection, Conservation and Characterization of Important Plant Genetic Resources

Program-based research grant project on "Collection, Conservation and Characterization of Important Plant Genetic Resources" funded by NATP Program-2, PIU, BARC and coordinated by Crops Division, BARC with eight components, namely BARI, BRRI, BINA, BJRI, BSRI, BSRTI, CDB, and BAU was implemented.

**Four Coordination Meetings and Three Times Monitoring and Evaluation have been Completed by BARC**

**Coordination Meeting**

i. 1st meeting held on 20 September 2018
ii. 2nd meeting held on 23 January 2019
iii. 3rd meeting held on 01 April 2019 and
iv. 4th meeting held on 13 June 2019

**Monitoring and Evaluation**

i. Cotton Development Board, Jessore, on 22-24 March 2019
ii. BINA and BAU Mymensingh on 08 April 2019
iii. BARI & BRRI, Gazipur on 25 June 2019

**Major activities of the Implementation Unit are shown in following table**

| Name of the Institutes | Major Activities | | | | | |
|---|---|---|---|---|---|---|
| | GP Collection | GP Conservation | Characterization | | GP Regeneration / Growing | Plantation |
| | | | Morphological | Molecular | | |
| BARI | 285 landraces (Pumpkin, cucumber, bitter gourd, brinjal, mustard and mungbean) | 285 | 70 (Pumpkin and cucumber) | 30 (Brinjal) | - | - |
| BRRI | 104 | 104 | 96 (T.Aman and Boro rice) | 96 (T.Aman and Boro rice ) | - | - |
| BINA | 48 landraces (rice,vegetables, oil seed, pulse seed and spices) | 16 | 23 (Rice) and 2 (Vegetables) | 10 (Rice) | - | - |
| BJRI | 27 (Jute and allied fiber crops) | 24 | 24 | - | 100 (Regeneration) | - |
| BSRI | 18(Cultivated and wild sugarcane) | - | 10 | - | - | 15 |
| CDB | - | - | 117 (Cotton) | - | 117 (Growing) | - |
| BSRTI | 45 (Mulberry) | - | 45 | 45 | | - |
| BAU | 30 (Yam) | 30 | 125 (65 ananas, 30 aroids and 30 yams) | 95 (65 bananas and 30 aroids) | - | 30 (Yam) |

### c) Coordination of Seaweed & Crop Zoning Project

Member Director (Crops), BARC coordinated the project on "Capacity Building for Conducing Adaptive Trials on Seaweed Cultivation in Coastal Areas' and the project titled 'Development of Upazila Land Suitability Assessment and Crop Zoning System of Bangladesh' is under implementation.

### Preparation of Policy Documents and Providing Inputs for Policy Documents of MoA or other Ministries

### Reports:

- Prepared monthly progress report as per directives of Hon'ble Prime Minister and sent to Planning and Evaluation Division, BARC.
- Improved and developed the Guidelines for establishing tissue culture laboratory for potato in Bangladesh.
- Crops Division, BARC arranged five meetings contributing to drafting an act on 'Bangladesh Centre for Agricultural Genomics' for the Ministry of Agriculture toward capacity enhancement in genome research.
- Crops Division, BARC organized a meeting and prepared a format after organizing a meeting to collect data from the NARS organizations on existing human resources and laboratory facilities and scope for further improvement. Dr. Md. Aziz Zilani Chowdhury and Dr. Md. Harunur Rashid have been working as a Convener and the Member Secretary of the project formulation committee, respectively.
- Crops Devision of BARC has been assigned by the Ministry of Agriculture to prepare an 'Ecosystem Based Rice Production Plan' for enhancing rice productivity through adoption of newly released rice varieties.

- A committee has been formed including members from NARS, DAE, BADC, and SCA with Dr. Md. Aziz Zilani Chowdhury and Dr. Md. Harunur Rashid as Convener and Member Secretary of the committee, respectively. In total, six meetings were organized for format development of collecting data from each upazila on rice variety under cultivation, area under varieties, growth duration, average yield and maximum farm yield.
- Some other formats were also developed for seed production capacity and rice variety adoption plan through different media, such as participatory demonstration, training and farmers' field day, etc. Data from the selected Upazilas were collected and compiled by DAE and submitted to the Crops Division, BARC. The data were validated and analyzed on season and ecosystem basis and submitted to the Ministry of Agriculture.

**Inputs:**

- Interministerial meeting on the occasion of Hon'ble Prime Minister's visit to Brunei.
- Hon'ble Prime Minister's visit to Japan
- Drafted inputs in the field of Agriculture for bilateral discussion with Canada
- Prepared inputs for bilateral discussion with Russia
- Talking points for bilateral discussion between Bangladesh and Poland
- Bangladesh and Bhutan 2nd Foreign Office Consultation (FOC) meeting.
- Prepared progress report for 4th Bangladesh-Turkey Joint Economic Commission and drafted inputs for forthcoming fifth meeting.
- Drafted inputs for Bangladesh and Turkey Foreign Office Consultation (FOC) meeting.

**Inputs/Comments:**

- Drafted inputs for national report on Istambul Programme of Action (IPoA) for presention in the LDC national focal points organized by OHRLLS.
- Input on various activities of CGIAR organizations, Centre for Agriculture and Bio-science International (CABI), Asia Pacific Association of Agricultural Research Institutions (APAARI).
- Prepared specific crop production plan of major crops to be achieved by 2021 and submitted to the Ministry of Agriculture.
- Compiled a training requirement of NARS institutes in biotechnology for MoA
- Prepared speeches of chief guests and special guests for different events organized by the BARC and MoA.
- Suggestions/comments provided on SME Policy 2018 (draft)
- Offered comments on Biotechnology Action Plan based on 'Biotechnology Policy' by National Institute of Biotechnology

**Policy Documents:**

- Dr. Md. Harunur Rashid, PSO, Crops Division of BARC participated 10 meetings held at MoA contributing to finalizing the Pesticide Law 2018.
- Prepared the draft act on 'Bangladesh Centre for Agricultural Genomics' after four meetings and has been submitted to MoA.
- A Committee formed for preparing a DPP led by BARC for the improvement of Genome research of NARS.
- Drafted mustard production plan for MoA after a meeting chaired by the hon'ble Minister for Agriculture.

## Workshop/Meeting/Seminar

### a. Review workshop on Crop Improvement Program of NARS Institutes: Research Progress 2017-18 and Research Program 2018-19

Two-day long review workshop on "Crop Improvement Program of NARS institutes" was held at BARC during 01-02 August 2018. Respective scientists of seven NARS institutes presented their research progress (2017-18) and research programs (2018-19) on crop improvement.

Finally, some general and institute-wise comments were compiled following comments and suggestions from experts and forwarded to respective institute for implementation.

Inaugural session of the review workshop on crop improvement program

### b. Workshop on 'Fall Armyworm an Invasive Pest: Future Threat to Bangladesh'

Crops Division of BARC organized a workshop on 'Fall Armyworm - an Invasive Pest: Future Threat to Bangladesh' on 5 December 2018 at BARC, Dhaka. Mr. Md. Nasiruzzaman, Secretary, Ministry of agriculture was present as chief guest, Dr. Abul Kalam Azad, Director General, Bangladesh Agricultural Research Institute was present as special guest and Dr. Md. Kabir Ikramul Haque, Executive Chairman of BARC chaired the workshop. Dr. Syed Nurul Alam, Director (Planning and Evaluation), Bangladesh Agricultural Research Institute, Gazipur presented a keynote paper. The objective of the workshop was to create awareness regarding management of the insect among stakeholders. About 80 participants representing policy makers, scientists and officers from public and private sectors attended the workshop. After keynote presentation, a lively open discussion was followed and a few recommendations were documented.

Technical session of the workshop production program of NARS institutes

### c. Review Workshop on Crop Production Program of NARS institutes

Two-day long review workshop on "Crop Production Program of NARS institutes" was held at BARC during 05-06 August 2018. Total 80 participants attended from NARS institutes and BARC. Scientists and academia of the relevant fields of research institutes and agricultural universities were present as expert members in the workshop. Finally, some general as well as institute-wise comments were compiled after comments and suggestions from experts and these were forwarded to respective institute for implementation.

Technical session of the workshop on Fall Armyworm

### d. Review workshop on Biotechnology Program of NARS Institutes

A day-long review workshop on "Biotechnology Research Programs of NARS Institutes, Universities and Private Sector: Research Progress 2017-18 and Research Programs 2018-19" was held for the first time separately at BARC on 9 August 2018. In total, 14 institutes participated in the workshop and presented their annual research progress reports of 2017-18 and programs of 2018-19. At the end of the workshop, some recommendations were made as follows:

Technical session of the workshop on Biotechnology Program of NARS Institutes

- The facilities and vector construct of NARS institutes might be shared in coordination of BARC. At least one scientist from each institute to be trained on bioinformatics either from home or in abroad
- Develop skill of scientists on biotechnology.

### e. Review workshop on Insect Management Program of NARS Institutes

A day-long annual review workshop on Insect Management Program of NARS institutes: Research Progress 2017-2018 and Research Program 2018-19 was held on 8 August 2018 at BARC. The workshop was aimed to avoid duplication of programs, develop programs based on the national priority and to bring into notice of NARS scientists of current research activities through a participatory discussion. The inaugural session of the workshop was chaired by Dr. Md. Aziz Zilani Chowdhury, Member Director (Crops), BARC. In the inaugural session, Dr. Shah Md. Monir Hossain, Principal Scientific Officer (Crops), BARC presented the last year's (2017-18) expert opinion and recommendation. Scientists of seven NARS institutes viz. BARI, BRRI, BIRI, BSRI, BINA, CDB, and BTRI presented their research progress (2017-18) and research programs (2018-19) on insect management of different crops. Four attending expert members put forward their opinions on research program based on current perspectives. Proceedings prepared based on the comments and opinions was forwarded to the respective institutes for necessary actions.

### f. Review workshop on Disease Management Program of NARS Institutes

A day-long annual review workshop on Disease Management Program of NARS institutes for research progress 2017-18 and research program 2018-19 was held on 7 August 2018 at BARC. The workshop was aimed to avoid duplication of programs among NARS institutes and to develop programs based on national priority. Scientists of seven NARS institutes viz. BARI, BRRI, BIRI, BSRI, BINA, BWMRI and BTRI talked on their research progress (2017-18) and research programs (2018-19). Expert members offered their opinions which after compilation were forwarded to the respective institute for necessary action.


A view of the Annual Review workshop on Disease Management Program of NARS Institutes

### g. Biotechnology Research Based on Biotechnology Policy 2012

A view of the workshop on Biotechnology Research Based on Biotechnology Policy 2012

A Progress Review Workshop on Biotechnology Research based on Biotechnology Policy 2012 was held on 20 May 2019 at Bangladesh Agricultural Research Council (BARC) sponsored by Project Implementation Unit-BARC, National Agricultural Technology Program Phase II project.

The objectives of workshop was to review the progress of short (2 years), Medium (3-5 years), and long-term (10 years) planned activities based on the Biotechnology Action Plan.

The scientists/officers from crop based NARS institutes, BRRI, BARI, BINA. BSRI,BJRI, CDB agricultural universities, BAU, SAU, BSMRAU private sectors and NGOs, ACI, and BRAC participated in the workshop and shared their plan of activities with progress made so far. It was decided to revise the progress report using the supplied format in measurable form. Collaborative research to be initiated coordinating with NARS, universities, and industries. It was suggested to submit report following the style of BRRI.

### h. National Workshop on Seed Research, Development and Quality Seed Production in Bangladesh

Inaugural ceremony of the National workshop on Seed Research, Development and Bangladesh

The workshop on 'Research, Development and Production of Quality Seed in Bangladesh' was held during 20-21 March 2019 at BARC jointly sponsored by Project Implementation Unit-BARC and National Agricultural Technology Program Phase II project. The objectives of the workshop were delineating an action plan to produce quality seeds and its development priorities, future research and development, especially quick dissemination of newly released varieties. This is in relevance to 7$^{th}$ Five Year Plan and Sustainable Development Goals to achieve food and nutrition security parallelled to sustainable food security in context of increasing population. In the inaugural session, hon'ble Minister for Agriculture, Government of the People's Republic of Bangladesh Dr. Md Abdur Razzaque, MP was present as chief guest, Mr Md. Nasiruzzaman, Secretary, Ministry of Agriculture and Mr Md. Fazle Wahed Khondaker, Chairman, BADC were present as special guests. The session was chaired by Dr. Md. Kabir Ikramul Haque, Executive Chairman, BARC. The key note paper was presented by Professor Dr. Md. Moynul Haque, Department of Agronomy, Bangabandhu Sheikh Mujibur Rahamn Agricultural University, Gazipur. Ways of ensuring quality seed to meet future demand were highlighted in 26 papers presented in inaugural session and four technical sessions. Two hundred fifty participants from MoA, NARS institutes, DAE, BADC, SCA, universities and private organizations attended the workshop.

### i. Coordination meeting on Dissemination of Elite Salinity Tolerant Rice Varieties of AFACI Member Countries

The Crops Division of BARC organized two coordination meeting for reviewing the plans and the progress of the AFACI-funded Salt Tolerant Rice project. The first meeting was organized to plan the project activities and modality among the coordinating and implementing organizations. In the second

meeting, it was decided to continue the trial in the next Boro season in usual planting time. IRRI has assured to supply the required volume of seeds for the implementation of the project.

**j. Sub PTAC Meeting**

Dr. Md. Abdus Salam, Principal Scientific Officer (Crops); Dr. Md. Harunur Rashid, Principal Scientific Officer (Crops), Bangladesh Agricultural Research Council participated in Sub-PTAC Committee Meeting.

**k. Meeting on Ecosystem Based Rice Production Plan**

A number of meetings were held to finalize the formats for collecting data on ecosystem- based rice production data (area coverage, major rice varieties in the field and their maximum and average grain yield), selection of suitable rice varieties to be adopted over the time, and projection of production increment in different ecosystems.

**l. Meeting on National Biotechnology Action Plan**

A good number of meetings were conducted to finalize the time bound biotechnology action plan. The compiled action plan was sent to the Ministry of Agriculture for necessary action.

**m. Meeting on Establishment of BCAG**

Organized two meetings for developing a draft act on establishment of Bangladesh Centre for Agricultural Genomics (BCAG).

**n. Meeting on Potato Late Blight Disease**

A meeting was organized on 23 December 2018 at BARC for controlling the potato late blight disease in Bangladesh through development and distribution of a fact sheet on potato late blight disease and its management (1.5 lac) among field level extension; and BADC personnel, and farmers for increasing awareness**.**

**o. Coordination Meeting on PBRG-PGR Project**

As a coordinating organization, BARC organized meetings on 20 September 2018, 23 January 2019, 1 April 2019, and 13 June 2019 to review the technical and financial progress of the project.

**p. NTCCB Core Committee Meeting**

Organized three NTCCB Core Committee meetings for reviewing and evaluating the documents of submitted application of BRRI regarding Golden rice and BARI regarding Transgenic potato research. Recommendations through review and evaluation have been prepared for MoA.

**q. National Biotechnology Technical Committee Meeting**

Dr. Md. Abdus Salam, Principal Scientific Officer (Crops), BARC participated in three National Biotechnology Technical Committee Meeting with a view to strengthening biotechnology research.

**r. National Seed Board Meeting**

Dr. Md. Aziz Zilani Chowdhury, Member-Director (Crops), BARC participated in five NSB meetings for the purpose of variety release.

**s. NSB Technical Committee Meeting**

Dr. Md. Aziz Zilani Chowdhury, Member-Director (Crops), Bangladesh Agricultural Research Council, participated in five NSB *Technical Committee* meetings as a Member Secretary to prepare and forward recommendations for MoA.

**t. PTAC Meeting**

Dr. Md. Aziz Zilani Chowdhury, Member-Director (Crops), Bangladesh Agricultural Research Council participated in two PTAC meetings as a member of the committee.

**u. Seminar on National Seed Fair**

Inaugural ceremony of the National Seed Fair 2019

A seminar on *National Seed Fair 2019* was held on 28 June 2019 at BARC auditorium where hon'ble Minister for Agriculture, Dr. Md Abdur Razzaque, MP was present as chief guest, and Mr Md. Nasiruzzaman, Secretary, Ministry of Agriculture and Mr Md. Fazle Wahed Khondaker, Chairman, BADC as special guests. The seminar was chaired by Mr. Md. Asraf Uddin Ahmed, Additional Secretary and DG (Seed), MoA. The key note paper was presented by Dr. Md. Iftekharuddula, Chief Scientific Officer, Plant Breeding Division, BRRI. Five hundred participants from MoA, NARS institutes, DAE, BADC, SCA, universities and private organizations participated in the seminar.

## Training

**a. Training on Global Plan of Action of International Treaty on Plant Genetic Resources for Food and Agriculture**

A view of the training on Global Plan of Action of International Treaty on Plant Genetic Resources for Food and Agriculture

A training on *Global Plan of Action of International Treaty on Plant Genetic Resources for Food and Agriculture* was held on 9-10 April 2019 at BARC with the financial support from PIU, BARC. The overall objectives of the training was enhancing quality and coverage of reporting on the Second Global Plan of Action and capacity development of the stakeholders. About 40 participants from different NARS institutes, agricultural universities and private sectors attended the training. The training focused on Overview of the Second Global Plan of Action for Plant Genetic Resources for food and agriculture. New reporting format of the Second Global Plan of Action for Plant Genetic Resources for food and agriculture, PGR reporting for the Sustainable Development Goals (SDGs) and role of biodiversity in food Security.

**b. Training on Mutation Breeding of Field and Horticultural Crops**

A training on *Mutation Breeding of Field and Horticultural Crops* was organized on 8-9 April 2019 at BINA, Mymensingh which was coordinated by BARC to equip the NARS scientists with mutation methodology, handling and management process. In total, 30 participants from BARI, BRRI, BSRI, BJRI, BSRTI, BTRI, CDB, and BINA attended the training. Scientists from different divisions of BINA served as resource persons and covered the following topics:

Inaugural session of the training on mutation Breeding of Field and Horticultural Crops

- Mutation breeding its history and some success stories.
- Basic nuclear concepts and safety measure.
- Basic concept and knowledge on mutagenic agents.
- Effect of mutagen on the treated materials and determination of viable dose/concentration.
- Handling of segregating mutants for notified and non-notified crops.
- Improvement of horticultural crops though induced mutation techniques.
- Plant tissue culture and haploid production through nuclear technique in forticultural crops.
- Use of nutron prove moisture meter for determination of soil moisture.
- Pre-breeding and variety release procedure of notified and non- notified crops.
- Collaboration/memorandum of understanding (MoU) for mutation breeding with BINA.

**c. Training on Collection and Documentation of Plant Genetic Resources**

Crops Division, BARC organized a training on "Collection and Documentation of Plant Genetic Resources" under Co-ordinated Program Based Research Project on *Collection, Conservation and Characterization of Important Plant Genetic Resources* during 19-20 November 2018 at BARC.

Dr. Md. Abdus Salam, Principal Scientific Officer, Crops Division, BARC and Dr. Md. Aziz Zilani Chowdhury, Member Director (Crops), Crops Division, BARC served as course coordinator and course director, respectively.

Inaugural session of the training on Collection and Documentation of plant genetic resources

The overall objective of the training is capacity development of stakeholders on PGR management and enhancing quality and coverage of data reporting related to plant genetic resources.

- Deliberations in the training focused on the following topics:
- Role of biodiversity in food security.
- Plant genetic resources and its national &iInternational perspective.
- Exploration and collection of plant genetic resources.
- Passport data collection & descriptor of different crops.
- Characterization and evaluation of plant genetic resources.
- Characterization and evaluation of geographical indication crops.
- Conservation and utilization of plant genetic resources.
- Plant genetic resources: Legal issues.

**d. Training on Awareness Building on Act and Policies was Held at BARC**

A training on *Awareness Building on Act and Policies* was held on 26-27 during 26-27 February 2019 at BARC, Dhaka sponsored by PIU-BARC, NATP Phase II project.

The objective of the training was to expedite awareness of scientists and officials of different organizations on act and policies related to Bangladesh Agriculture Development.

In total, 40 scientists and officers from NARS institutes (BARI, BRRI, BJRI, BSRI, CDB, BWMRI, BSRTI and BARC), BADC, DAE, SCA, NATA and other private organizations (BRAC, ACI Seed, Lal Teer Seed, and Supreme Seed) attended the training program.

Inaugural session of the training program of Awareness Building on Act and Policies

**e. Participation of Crops Division Scientists as Resource Persons in different Training courses**

- Dr. Md. Abdus Salam, Principal Scientific Officer participated as a resource person in a training on "Project Development and Management" at BARC.
- Dr. Md. Harunur Rashid acted as a resource person in a training titled *Development of Resource Conservation Technology for Sustainable Agriculture* and also in a training on *Agronomic Research and Technology Development of Major Crops* for NARS scientists organized by Agronomy Division, BARI.
- Dr. Md. Harunur Rashid acted as a resource person in a training titled *How to Publish a Paper in an Impact Factor Journal* in the training on *Technical Report Writing and Editing* for the NARS scientists organized by AIC, BARC.
- Dr. Md. Harunur Rashid acted as a trainer on *Good Agricultural Practices and Monitoring and Review of Field Research* for the 25$^{th}$ and 26$^{th}$ Foundation Training for the NARS scientists.

**f. Training, Workshop, Seminar etc. Attended (Local)**

- Dr. Shah Md. Monir Hossain, Principal Scientific Officer (Crops), participated in co-celebrating 22 years of BIMSTEC on 25 June 2019 at BIMSTEC Secretariat, Dhaka.
- A country paper along with project plan was presented on Selection and Dissemination of Elite Salt Tolerant Rice Varieties to AFACI member countries held at IRRI, Philippines.

**g. Training, Workshop, Seminar etc. Attended (Overseas)**

- Dr. Md. Harunur Rashid attended the training course on Public Procurement and Contract Management held at ILO-ITC, Turin, Italy

**h. Worked as a Member and Member Secretary**

**Scientists of Crops Division worked actively in different committees:**

- Member Secretary for the committee of Ecosystem Based Rice Production Plan.
- Contributed to the Monitoring and Evaluation of MoA special funded demonstration and adoption of crop varieties of NARS institutes.
- Worked as Expert Member in the Asia-Pacific Consortium on Agricultural Biotechnology and Bioresources (APC on AB).
- Worked as Mmember for the tobacco and tobacco products of BSTI.

- Performed activities as a member for the Agricultural Research Award 2015 policy revision committee.
- Worked as Focal point of the Technical Committee on agriture and rural development of SAARC.
- Worked as members in different committees for observing/celebrating National Days and other events (Vegetables Fair, Fruit Fair, Food Day, Seed Fair).

**Regular/Routine Activities**

A good number of regular/routine activities performed by the scientists of Crops Division:

- Prepared monthly progress report on implementing activities according to the direction of Hon'ble Prime Minister's office.
- Writing speech for the high officials of BARC and MoA for different national and international events (e.g. World Food Day, Vegetables Fair, Fruits Fair, AFACI Review Workshop, Organic Farming Workshop, etc.)
- Scientists of Crops Division worked as Member/Member Secretary in different committees formed for observing/celebrating national and international days (World Food Day, National Independence Day, National VictoryDay, International Mother Language Day, etc.).
- Scientists worked as rapporteurs in different workshops conducted by BARC and MoA (e.g. Annual Research Review Workshops of NARS institutes for different disciplines)
- Preparation of proceedings of different meetings and seminars.
- A good number of regular/routine activities were performed by the Crops Division.
- Prepared monthly progress report on the implementing activities according to the direction of Hon'ble Prime Minister's office.
- Biotechnology time bound action plan (short: 2 years, medium: 5 years, long- term: 10 years) finalized through conducting several meetings of Plant Biotechnology Technical Committee following the Biotechnology Policy 2012
- Actively participated in different workshops/seminars organized by different divisions/uuits of BARC and other national and international organizations.
- Prepared rapporteur's report for different workshops and seminars organized by different divisions/units of BARC, KGF and other national and international organizations.
- Participated discussion meeting on design of MIS Module for NARS.
- Attended the Sub-PITAC meeting
- Attended project workshops (Incption, review and completion) arranged by different Divisions/Units of BARC and other organizations
- Participated in the National Technical Committee on Human Resource Development in Biotechnology organized by the Ministry of Science & Technology
- Worked in the National Technical Committee of Biotechnology organized by the Ministry of Science & Technology.

**Offering Inputs for Hon'ble Agriculture Minister's Meeting with Counterparts Delegates**:

- Vice-Minister of Agriculture and Rural Affairs, People's Republic of China
- Agriculture Minister of the Uzbekistan
- State Minister for Food Security of the United Arab Emirates
- Ambassador of the People's Republic of China
- Ambassador of the Slovenia
- Agriculture cooperation between Bangladesh and Netherlands
- Meeting on agriculture cooperation between Bangladesh and Denmark
- Cooperation in agriculture between Bangladesh and Canada
- Cooperation in agriculture with New Zealand
- Talking points for cooperation in agriculture with Palestine
- Talking points for cooperation in agriculture between Bangladesh and France
- Ambassador of Russian Federation in Bangladesh

- Inputs for high level meeting with delegates from Russian Federation
- High Commissioner of Republic of Gambia
- Inputs for 2nd Bangladesh-Finland Consultation Meeting on Agriculture

**Inputs for Hon'ble Prime Minister's Visit to different Countries:**

- Visit to Japan in May 2019
- South Korea Visit: Inputs for Bangladesh & South Korea bilateral relations in agriculture
- China Visit: Inputs for updated Bangladesh & China bilateral relations in agriculture
- Visit to Brunei
- Input for 10th D-8 Dhaka Summit held in December 2019
- Arranging side events of 10th D-8 Dhaka Summit held in December 2019

**Country Paper:**

- Bangladesh Country Paper: 59th workshop Meeting of Heads of NPOs during 2-4 October 2018 in Indonesia
- Prepared activity based project proposal for COMCEC Funding

**Other activities:**

- Prepared a work-plan for 100th birthday celebration of Father of the Nation Bangabandhu Sheikh Mujibur Rahman.

## Publications:

**a. Annual report preparation and newsletter**

Prepared annual report (2017-18) and newsletter documents (2018-19) and submitted to AIC, BA**RC.**

**b. AFACI-IMPGR project completion report**

Prepared AFACI-IMPGR project completion report titled 'Collection, Characterization and Promotion of Rrice, Chilli, Cucumber, and Melon in Bangladesh'.

**c. Catalogue on collected germplasm of rice, chilli, cucumber and melon**

Published a Catalogue on rice, chilli, cucumber and melon germplasm collected in Bangladesh under AFACI-IMPGR Project.

**d. Scientific publications**

Rashid, M. H., P. C. Goswami, M. F. Hossain, D. Malhalder, M. K. I. Rony, B. J. Shirazy, T. D. Russell. 2018. Mechanised non-puddled transplanting of boro rice following mustard conserves resources and enhances productivity. *Field Crops Research*, **25**: 83-91

Rashid, M. H., M. K.I Rony, D. Mahalder, P. C. Goswami. 2019. Rice production technology adoption in coastal region of Bangladesh through community training. *International Journal of Agricultural Sciences and Veterinary Medicine*, **7**(2):1-7.

Rashid, M. H., M.K.I Rony, D. Mahalder, P. C. Goswami. 2019. Adoption of improved production practices in lowland rice through community training. *SAARC Journal of Agriculture* (Accepted).

**e. Other publications and technology transfer activities**

Prepared the following Training Manuals:

1) "Collection and Documentation of Plant Genetic Resources";

2) 'Global Plan of Action of International Treaty on Plant Genetic Resources for Food and Agriculture';

3) Phytosanitary Measures and Food Safety Issues in Bangladesh and

4) Published a folder on Achievements of BARC in last ten years for 4th National Development Fair 2018.

**Review of Reports**

- Review of periodical reports of NATP funded CRG and PBRG sub-projects.
- Reviewed and edited two CRG sub-project PCR.
- Progress Report of activities on time bound plan following the 12th National Executive Committee of Biotechnology Meeting.

## Technology Transfer and Monitoring Unit (TTMU)

According to the Work-plan 2018-19 of BARC (July 2018 – June 2019),Technology Transfer and Monitoring Unit (TTMU) organized three training programs and three workshops. The detailed activities conducted by TTMU during 2018-19 have been described below:

**Project Implementation**

A PBRG sub project of NATP-2 ID- 005 titled *Transfer of Agricultural Technologies to Farmers' Level for Increasing Farm Productivity* is being implemented underTTMU. Ten NARS institutes (BARI, BINA, BFRI, BJRI, BLRI, BSRI, SRDI, BRRI, CDB, BWMRI) are the components of this project. The date of LoA of PBRG sub project singing was 11 July, 2018 and will be continued until June 2021.

The Objectives of the project are as follows:

i. To transfer NARS institutes' generated economically viable technologies rapidly for higher agricultural productivity and profitability with solving problems at farmers' level.

ii. To assess the data base scenarios of transferred and non-transferred technologies generated by the researchers from the inception of NARS institutes.

## The Achievements of 11 Components of the Project

**Inception Workshop**

A day- long Inception workshop on PBRG sub-project *Transfer of Agricultural Technologies to Farmers' level for Increasing Farm Productivity* organized by TTMU, BARC was held on 4 October 2018 at the Training Building (2nd Floor), BARC. A total of 50 participants (Scientists, professionals, specialists, PIs and Co-PIs of respective project) attended the Inception Workshop. Dr. Paresh Chandra Golder, Member Director, Planning and Evaluation of BARC was present as chief guest and Dr. Mian Sayeed Hassan, Director, PIU-BARC, NATP-2 was present as special guest. Dr. S. M. Bokhtiar, Director, TTMU and Co-ordinator of the project chaired the inaugural session. Dr. Fauzia Yasmin. PSO, TTMU and Associate Coordinator of the project delivered welcome speech and presented the detailed program of BARC part of the project. Principal Investigators of 10 NARS institutes (BARI, BRRI, BJRI, SRDI, BFRI, BINA, BSRI, BLRI, BWMRI, and CDB) attended and presented the detailed program of the project.

Inaugural session of the InceptionWorkship on PBRG

**Field Monitoring (PBRG ID-005)**

Field monitoring activites of ten NARS institutes under PBRG ID-005.

**BARI**

Dr. FauziaYasmin, Associate Coordinator monitored BARI: 20 BARI superior varieties (Mango (BARI Aam-2, 3, 4, 8), Banana (BARI Kola-1,3,4,5), Pummelo (BARI Batabilebu-3, 4), Sweet orange (BARI Malta-1), Lemon (BARI Lebu-1,2 and 3), Golden apple (BARI Amra-1/2), Sapota (BARI Safeda-3), Aonla (BARI Amloki-1), Carambola (BARI Carambola-1), Guava (BARI Peyara-2), Wax jambu (BARI Wax Jambu-1), Litchi (BARI Litchu- 3, 4), Coconut (BARI Narikel-1, 2) and 04 other associate technologies at Sariatpur (Damuda and Goshairhat Upazilla) sites on 29-9-2018.

Sariatpur, BARI

**CDB**

Coordinator Dr. S. M. Bokhtiar monitored CDB generated package of four technologies (CB-14 variety, Application of mepiquat chloride, Removal of vegetative branches and Detopping) at Khagrachari and Bandarban sites on 17 November 2018- 19 November 2018. Dr. Fauzia Yasmin, Associate Coordinator and Dr. R.M. Morshed, SSO, PBRG-005 monitored:

Khagrachari, CDB

**BJRI**

BJRI generated BJRI Tossa Pat-8 (Robi-1)/ BJRI Tossa Pat-7 and BJRI Kenaf HC-95 for fiber production and BJRI Tossa Pat-8 (Robi-1) for seed production along with other technologies like line sowing method, recommended fertilizer doses, weed management, pest and disease control, improved retting technique etc. at Manikganj on 27/12/18.

Manikganj, BJRI

**SRDI**

Balanced fertilizer on the basis of updated Upazila Nirdeshika data base on Boro-T. Aman cropping pattern at Tangail site on 7 January 2019 under SRDI component.

Tangail, SRDI

**BSRI**

BSRI Akh- 42 for chewing and BSRI Akh- 45 for gur production at Sirajganj (Sadar Upazila) site on 13 January 2019 under BSRI component.

Sirajganj, BSRI

**BINA**

BINA Improved Cropping pattern:

**Mymensingh** (one upazilla): Early T. aman rice (variety: Binadhan-7/ Binadhan-17), - mustard (variety: Binasarisha-9) - Late boro rice (variety: Binadhan-14) at Mymensingh (Sadar Upazila,17/1/19) site under BINA component.

Mymensingh, BINA

**Faridpur:** Early T. aman rice (variety: Binadhan-7/ Binadhan-17) - lentil (variety: Binamasur-8) - late boro rice (variety: Binadhan-14)/Aus rice (variety: Binadhan-19) but not yet monitored.

**BRRI**

Latest BRRI varieties (BRRI Dhan58, 74, 81, 84, 86 and 89) at Mymensingh (Valuka and Muktagasa Upazila, 28/01/2019) sites under BRRI component.

Mymensingh, BRRI

**BLRI**

Preservation of Green grasses/fodder through Silage Technique. Fodder Varieties**:** BLRI Napier 1 and 4 at Sirajgonj (ShahjadpurUpazila, 31/1/19) site under BLRI component.

Sirajganj, BLRI

**BFRI**

Culture of Pabda (*Ompok pabda*), Gulsha (*Mystus cavasius*) with Rui at Sherpur (Naklaupazila,) site on 21 /4/2019 under BFRI component

Nakla, BFRI

**BWMRI**

Associate Coordinator monitored BWMRI generated technologies (BARI Gom 29, BARI Gom 32 and BARI Gom 33) at Dinajpur, Thakurgaon and Panchagar sites during 9-11 Februray 2019

Dinajpur, BWMRI

T information of technologies from five institutes (BRRI, BSRI, BJRI, CDB, SRDI) has neen collected and analysis is going on. The total number of transferred BRRI genereted technology of 14 divisions from 1970 to 2019 is 444, BSRI genereted technologies of 10 divisions from 1967 to 2018 are total 194, BJRI genereted technologies of 4 divisions from 1910 to 2019 are 143 and CDB genereted technologies of five divisions from 2000 to 2018 are 68. Female scientists of all institutes had been involved in generating technologies.

**Recruitment:**

For the smooth continuation of the project, one Senior Scientific Officer (SSO) and an Accountant was recruited in November 2018.

**Reporting:**

Inception report, half yearly report, annual report of the project are compiled and sent to PIU-BARC. All procurements have been completed as per approved plan of 1st year.

**AFACI Funded Project**

A meeting on formulation of work-plan for 2018-19 of AFACI Seed-Extension Project was held on 20 September 2018 at BARC. Dr. S. M. Bokhtiar, PI, AFACI-Seed Extension, Dr. F.Yasmin, PSO (TTMU) and Dr. Suriya Parvin, SSO (TTMU) attended the meeting.

AFACI, BARC

Dr. Md. Kabir Ikramul Hoque, EC, BARC and Dr. S. M. Bokhtiar, PI, AFACI-Seed Extension, attended the field day on 23 March 2019 at Moddho Shahapur, Rajshahi.

AFACI, Rajshahi

Dr. S. M. Bokhtiar attended as Chief guest in the inaugural session of the training programme on 3 November 2018 in Natore under AFACI Seed-Extension project.

AFACI, Natore

**Activities of Innovation Team, Computer & GIS, BARC for Agricultural Ministry**

**An Innovation Idea:** Innovation workshop was held on "Innovation Idea" organized by MoA. Team Leader, Fauzia Yasmin, Director (TTMU), and Dr. Zakiah Rahman Moni, SSO (TTMU) submitted Innovation idea regarding "Strengthening Training of Trainers (ToT) and monitoring system" on 25 November.2018. Fauzia Yasmin, Director (TTMU) attended the monthly meeting at Computer and GIS Unit.

**Research Management/Financial Management and Coordination**

**Coordination (TTMU):**

Transfer and Monitoring Activities: BARI developed fruit saplings and sweet potato vines for Green Economy.

**Coordination for Green Economy:**

Dr. Fauzia Yasmin, PSO monitored the activities/implementation progress of one sub component out of 10 components on 29 September 2018 under the PBRG coordinated project by TTMU, BARC. BARI has been implementing the project. In the morning, she visited Damuda Upazilla and after lunch Goshairhat Upazilla of Sariatpur district. As Chief Guest Dr. Fauzia Yasmin delivered a speech and after that she distributed a total of 1500 fruit saplings among the selected 60 farmers'of Damuda Upazila and another 1500 fruit saplings were distributed among 60 farmers of Goshairhat. Each farmer got 25 fruit saplings.The PI discussed in FGD about production method of fruit cultivation. Mango (Variety-3) 3, Lebu (Variety-6 and 9), Banana (Variety-3) BARI Litchi-3,1; BARI Guava-2,4, BARI Dragon fruit-1,2; BARI Kamranga-1,1 BARI Safeda-3,1 fruit saplings were among the distributed varieties .

**Monitoring/ Reviewing and Evaluation Report of Programs/Activities of NARS Institutes**
**Special Funded Project:**
Research and Innovation Fund of MoA .Special fund Nitimala/2016 through utilization of GOB fund for research and innovation.

## Arranged monitoring Tour

**Group: 1**
Team leader: Dr. Md.Aziz Jilani Chowdhury, MD (Crops)
Team Members: Dr. Md. Abdus Salam, CSO (Crops)
Dr. Fauzia Yasmin, Director (TTMU) and
Md. Mostafizur Rahman, PTO (M &T) monitored
20 sub-projects on 4-6 March 2019
at BRRI & BARI, Gazipur.


BRRI Gazipur

**Group: 8**
Team leader: Dr. Md. Bakhtier Hossain, Director (Training)
Team Members: Dr. Md. Saifullah, CSO (Forest)
Md. Shohid Uddin Bhuyan, System Analyst and
Dr. Zakiah Rahman Moni, SSO (TTMU) monitored
five sub-projects on 27-30 March 2019 at Rajshahi, Natore, Chapainawaganj of BARI and BIRTAN.


BARI, Rajshahi

PBRG Sub-project Monitoring:

**Group: 07**
Team leader: Dr. Shah Md. Ziqurul Haq Chowdhury, MD (Livestock), Team Members: Dr. Fauzia Yasmin, Director and Md. Hamidur Rahman, Director (Com. & GIS) monitored a total number of 11 sub-projects 24-25 October 2019 at Rangpur, Thakurgaon, Panchagarh, Nilphamari.


BWMRC, Thakurgaon

**Group: 01**
Team leader: Dr. Md. Aziz Jilani Chowdhury, MD (Crops)
Team Members: Dr. Md. Harunur Rashid, PSO (Crops)
Dr. Zakiah Rahman Moni, SSO (TTMU) and
Md. Abdur Rahman, Monitoring Associate NATP-2,
PIU-BARC monitored a total number of 7 sub-projects
on 31 March 19 and 11 May 19 at BRRI and BARI Gazipur.


BARI, Gazipur

# Training, Workshop and Seminar Organized

## A. Training

### Three (ToT) Programs on Livestock, Fruits & Fisheries Technologies

A day-long Training of Trainers (ToT) program was organized by Technology Transfer and Monitoring Unit, BARC on 9 January 2019 at Bangladesh Livestock Research Institute (BLRI), Savar, Dhaka. Md. Azharul Amin, Additional Director, BLRI chaired the inaugural session. Dr. Fauzia Yasmin, Director (TTMU) was present as Special Guest in the inaugural session. The welcome address was delivered by Dr. Nasrin Sultana, PSO & Head of Training, Planning and Technology Testing Division, BLRI, Savar, Dhaka. The objective of the training program was to disseminate/transfer knowledge/information regarding livestock technologies generated by BLRI to the Upazila Livestock Officers in order to transfer those technologies to the farmers. BLRI and BARC scientists acted as resource persons on the training course.

**Following are the generated six technologies included in the training schedule:**

1. Annual selling method of livestock production
2. Preservation of green grass using dole silage technology
3. HA antigen for HI testing of Avian Influenza
4. Black Bengal goat selection on the basis of performance for establishing Black Bengal Goat farm
5. Scientific techniques for production of improved native chicken
6. Rearing technology of 'Shorna' BLRI layer strain-2.

Inaugural session of ToT Training Program, BRLI, Savar, Dhaka

Thirty Upazila livestock Officers received this training. The participants suggested that this type of training program could be conducted by BARC in another region for strengthening linkage between research and extension.

1. Training of Trainers (ToT) program on Fruit technologies held on 21 January 2019 at Bangladesh Agricultural Research Institute (BARI), Gazipur chaired by Dr. Madan Gopal Saha, Director (Support Service) BARI. Dr. Md. Sayed Nurul Alam, Former Director (Planning and Evaluation) of BARI and Dr. Fauzia Yasmin, Director (TTMU) of BARC was present as Chief Guest and Special Guest, respectively, in the inaugural session. The welcome address is delivered by Dr. Monoranjan Dhar, CSO of Horticulture Research Centre, BARI. The objective of the training program was to transfer the BARI generated fruit technologies to Upazila Agricultural Officers with a view to disseminating them at farmers' level under BARC coordination.

T0T at BARI

**The Following Technologies were Delivered in this ToT Program:**

Modern technology for Guava, Mango, Banana & Lichi production. Thirty Upazila Agricultural Officers from different upazila of DAE participated in this training program. The participants recommended that duration, quantity and region of ToT program should be increased. To enhancing nutrition security, this program can help by increasing fruit production and consumption awareness.

2. Addressing Blue Economy, another day-long Training of Trainers (ToT) training program was organized by Technology Transfer and Monitoring Unit, BARC on 6 March 2019 at Marine Fisheries

and Technology Station of Bangladesh Fisheries Research Institute, Cox's Bazar chaired by Dr. Md. Zulfikar Ali, CSO & Head, Marine Fisheries and Technology Station, Bangladesh Fisheries Research Institute and Dr. Fauzia Yasmin, Director (TTMU) was present as Chief Guest in the inaugural session. The objective of the training program was to transfer modern marine technologies generated by BFRI to Upazila Fisheries Officers. Thirty Upazila Fisheries Officers of the region took part in this training program. Researcher of BFRI and Director (TTMU) of BARC were the resource persons of the training course.

**Following are the generated technologies included in the training schedule:**

i. Hygienic, safe and healthy dry fish production using mechanical fish drier developed by Marine Fisheries and Technology Station, Bangladesh Fisheries Research Institute
ii. Breeding and cultivation technique of Mud crab
iii. Seaweed cultivation and management technique of coastal area of Bangladesh
iv. Development of live fish culture for marine fish cultivation

ToT at Cox's Bazar

The participants strongly acknowledged BARC for coordinating this program. This training will help transfer these technologies and also essential to build research extension linkage. The participants also recommended that duration of ToT program should be increased. These technologies advances marine fish culture in coastal area and contribute to blue economy of Bangladesh.

## B. Workshop

**a. Review Workshop on Matured Technologies Developed by NARS Institutes (July 2016-June 2018)**

A day-long Review Workshop on *Matured Technology Developed by NARS Institutes (2016-17 to 2017-18)* was organized by Technology Transfer and Monitoring Unit, BARC on 19 December 2018. Dr. Md. Kabir Ikramul Haque, Executive Chairman, BARC was present in the workshop as Chief Guest. Dr. Fauzia Yasmin, Director (TTMU) chaired the inaugural session. In two technical sessions, 60 scientists from NARS (BARI, BRRI, BINA, BSRI, BWMRI, BTRI, BJRI, CDB, SRDI, BSRTI, BFRI-forest, BLRI, BFRI-fisheries) institutes participated in this workshop and a total of 198 NARS developed matured technologies were presented.

Review Workshop on Matured Technology daveloped by NARS Institutes

### b. Workshop on Extension of Indigo Cultivation

A day-long workshop on *Extension of Indigo Cultivation* was organized by Technology Transfer and Monitoring Unit, BARC on 19 March 2019. Chaired by Dr. Md. Kabir Ikramul Haque, Executive Chairman, BARC, Dr. Md. Solaiman Ali Fakir, Professor, Department of Crop Botany, Bangladesh Agricultural University, Mymensingh was present as chief guest. The welcome address was delivered by Dr. Fauzia Yasmin, Director (TTMU), BARC. Participants were from BARI, BINA, BSRI, BWMRI, DAE, BADC, DAM and private organizations attended the two technical sessions. Four technical papers were presented in the technical sessions. Two presentations from BARI, one from Pataukhali Science and Technology University and one from private organization (CARE) ook part.

Workshop on 'Extension of Indigo Cultivation'

## C. Meeting Organized

### ATECC Meeting

Agricultural Technology Extension Coordination Committee (ATECC) Meetings organized on 17 and 18 October (Rabi season) and 7 April 2019 (Kharif-1 season)

### Training, Workshop, Seminar etc. attended

Officers of TTMU attended a good number of workshops, seminars, trainings and meetings in home and abroad.

Total 259 Participants among which 71 from 13 countries; Bangladesh (6), Bugaria (3), Cambodia(6), Ethiopia (4), India (1), Iiran (1), Japan(3), Myanmar(13), Nepal (6), Pakistan (3), Srilanka(6), Thailand(10), Vietnam (9) and International Organization in China (16), other organization in China (112) and YAAS (60) attended the 5-day long (16 -21July) symposium on *Exchange and Cooperation to Enhance Innovation for Agricultural Science and Technology in South and Southeast Asia* funded by Yunnan Academy of Agricultural Sciences, China. Dr. Fauzia Yasmin as National Secretary (ECCAST-CSA) attended the symposium and presented technologies on behalf of Bangladesh on 20 July 2018.

Training Workshop

**Inception Meeting-Kathmandu, Nepal**

Inception meeting of *Institutions to Support Intensification, Integrated Decision making and inclusiveness in agriculture in the East Gangetic Plan* funded by the Australian Centre international Agricultural Research (ACIAR).
Dr. Fauzia Yasmin attended the Meeting-Kathmandu, Nepal on 20th July, 2018.

Inception meeting in Nepal

**Seminar, Comilla: 31 July 2018**

A seminar of BARD, Kotbari, Cumilla on *Technology Selection and Dissemination* was held on 31 July 2018 for presenting Agricultural Technology generated by NARS institutes and selection of technologies to disseminate at farmers' level. From BARC, Dr. Fauzia Yasmin presented all NARS technologies in brief and NATCC, BARC approved two technologies named Annual Selling Method and PPR Thermastable Vaccine in detailed.

Workshop on Technology Selection and Dissemination at BARD, Cumilla

**Workshop on Extension Message:**

Dr. Zakiah Rahman Moni, SSO (TTMU) attended a workshop on *Extension Message* held on 11-12 December 2018 at Westin Hotel, Dhaka. Pest management decision guides were prepared in this workshop with the coordination of DAE, Plantwise, and CABI.

Workshop on extension message

**Third Young Scientist Congress:**

Dr. Suraya Parvin, SSO (TTMU) and Dr. Zakiah Rahman Moni, SSO (TTMU) attended *Third Young Scientists Congress* on 13-14 September 2018 at National Science Museum, Agargaon, Dhaka.

Third young scientist congress

**Training on Project Development and Management:**

Dr. Zakiah Rahman Moni, SSO (TTMU) attended training on "Project Development and Management" at BARC on 24-27 February and 2 March 2019 organized by Planning and Evaluation Division of BARC.

Training program on Project Development and Management

## Transferable Technology

- 198 Matured Technologies of NARS Institutes (2016-2018) were disseminated/ transferred through workshop. Publishing a book is in process for printing
- Fifteen technologies have been transferred through training programs (Mentioned above).

## Publication(s) by the Division/Section in different journals/ media

## A. Journal

S.S. Ela, Akteruzzaman, F. Yasmin and A.K.M M. R. Golap (2018). Transforming Rice Land to Fish Farming and Its Impact on Income Despirity. *International Journal of Business, Social and Scientific Research,5(3): 23-28.*

K. Talukdar, M. M. Rahman, S. Parvin, N. K. Talukdar, K. U. Ahamed, M. M. Islam. Response of Summer Tomato to Different Plant Growing Structures in the Rooftop Garden. Journal of Experimental Biosciences, 9 (1)-Accepted as full paper.

M.A. Rahman, T. H. Ansary, M. F. Alam, Z. R. Moni and M. Ahmed (2018). "Efficacy of *Trichoderma* against *Colletotrichumcapsic* causing fruit rot due to anthracnose of chili (*Capsicum annum* L.). *The Agriculturists* 16(2): 75-87

Suraya Bilkis Jahan, Md. Ansar Ali, Mohammod Shahidul Alam, Zakiah Rahman Moni and Md. Abdul Latif (2018). Morphological and molecular characterization of *Rhizoctoniaoryzae-sativae*in Bangladesh. *SAARC Journal of Agriculture* (SAC), 16 (2) 119-128, December 2018.

## B. Other Media

**1. Publications as Article/Input in Workshop Proceedings-2018/19:(2)**

**Article/Input in Workshop Proceedings:**

F. Yasmin, S.Parvin, Z.R. Moni (2019). "Annual progress (2018-19) and future work-plan (2019-20) of Technology Transfer and Monitoring Unit" *Proceedings of the workshop on Annual progress (2018-19) and future work-plan (2019-20), Planning & Evaluation Division, BARC, Farmgate, Dhaka,* 2019.

Problems and opportunities in Development Goals for Food Security and Nutrition based Information, June 2018.

**3. Publications as Training Manual-2017-18: (4)**

F. Yasmin, Z.R. Moni (2019).Training Manual of ToT programme for Officers of Marine Technology Transfer and Monitoring Unit, BARC, Farmgate, Dhaka , 06 March, 2019.

F. Yasmin, S. Parvin (2019).Training Manual of ToT programme for Officers of DLS.Technology Transfer and Monitoring Unit, BARC, Farmgate, Dhaka, 09 January, 2019

F. Yasmin, Z.R. Moni (2019).Training Manual of ToT programme for Officers of DAE.Technology Transfer and Monitoring Unit, BARC, Farmgate, Dhaka, 21 January, 2019

S. N. Mondal, P. K. Malakar, M. A. Z. Sarker, S. Parvin, S. M. Bokhtiar (2018). Wheat Production and Seed Preservation Manual , Technology transfer and Monitoring Unit, BARC, Farmgate, Dhaka, October 2018.

Pictorial view of published training manual

## 12. Publications as Report

### A. Field Monitoring Report:

i. Chowdhury, A. Z., Salam, M. A. and Yasmin, F. (2018). Report on Field Monitoring of Research Programme under "Special Budget of MoA" for the financial year 2018-19 of BARC implemented in 2018 at BRRI and BARI, Gazipur.

ii. Chowdhury, M. Z. H, Yasmin, F. and Rahman, M. H. (2018). Report on Field Monitoring of PBRG sub project NATP-2 of BARC implemented at Rangpur, Thakurgaon, Panchagarh, Nilphamari

iii.Chowdhury, A. Z., Rashid, M. H., Moni, Z.R., Rahman, A. (2018). Report on Field Monitoring of PBRG sub project NATP-2 of BARC implemented in at BARI, BRRI in Gazipur by (Monitoring Team-1).

iv.Saifullah, M., Moni. Z.R., Bhuyan, S.U.,(2018). Report on Field Monitoring of Research Programme under "Special Budget of MoAfor the financial year 2018-19" of BARC implemented in 2018 at BARI, BARI, BSRI and BIRTAN in Rajshahi, Natore, Sirajganj, Chapainawaganj by (Monitoring Team-8).

### B. Other Reports:

Annual Progress Report (2018-2019): "Annual progress", Technology, Transfer and Monitoring Unit, BARC, Farmgate, Dhaka.

Annual Progress and Work-plan Report: "Annual progress (2018-19) and Future Work-plan (2019-20)", Technology, Transfer and Monitoring Unit, BARC, Farmgate, Dhaka, 2019.

Budget Report according to Work-plan: (2018-2019):"Budget for future work-plan(2019-20)", Technology Transfer and Monitoring Unit, BARC, Farmgate, Dhaka.

Annual Plan Agreement (APA) Report: (2018-19): APA Report of Technology Transfer and Monitoring Unit, BARC, Farmgate, Dhaka

Three Months Progress Report (July-September' 2018), Prepared Three Months Progress

**Report of TTMU Sent to MoA:**

Three Months Progress Report (October-December' 2018), Prepared Three Months Progress Report of TTMU which was sent to MoA

Three Months Progress Report (January-March' 2019), Prepared Three Months Progress Report of TTMU which was sent to MoA

Three Months Progress Report (April-June 2019), Prepared Three Months Progress Report of TTMU which was sent to MoA.

## Others

Giving Input published in BARC News letter for 2017-18.

**Technical support:**

- Helped and gane cooperation to the activities of Executive Chairman, BARC and successfully carried out the different tasks given by him as part of Good Office Management.
- Provided technical and official support to other divisions of BARC as part of Good Cooperation and Good Interdivisional Relationship.

**Activities with Foreign Organization:**

- Attended Inaugural Session of SAC GB Meeting
- Participated and gane cooperation actively for SAARC Charter Day-2018

**Coordination of Extension Work-2018-19:**

Coordinated with the personnel of DAE, DoF, DLS

## Planning and Evaluation Division

**Project Development/Project Financing**

Two Development Project Proposals (DPP) and six research proposals have been submitted to Ministry of Agriculture. Two DPPs are as follows:

i. Research & Development of Seaweed in Coastal Areas of Bangladesh.

ii. Strengthening of Bangladesh Agricultural Research Council (BARC).

## Project Implementation

### 1. Integrated Farming Research and development for Livelihood Improvement in the Plain land Eco-system (PBRG Sub-projects (Project ID-061)

The activities of FSRD under PBRG sub-project was undertaken to develop location specific system based technology, validate the technologies generated by NARS institutes, integrate component technologies and thereby improve family income and livelihoods. The project has been coordinated by Planning & Evaluation Division of BARC in partnership with OFRD, BARI at five sites ((Ajodhapur, Rangpur; Gangarampurp, Pabna; Sholakundu, Faridpur; Atia, Tangail, and Tarakandi, Sherpur), BRRI at one site (Tengra, Gazipur) and BFRI at one site (Mokamia, Mynmensingh) from February 2018. Two villages of each seven FSRD sites have been brought under this project. For achieving those objectives, a total of 84 farmers have been selected, 12 from each site and about 84 research activities have been continuing since February 2018 to till date. The research areas were i) homestead production system, ii) Crops and cropping system, iii) Fisheries production system, and iv) Livestock production system, v) Sapling distribution, vi) Agroforestry system, and vii) and off- farm activates. A base line survey and PRA were carried out to understand the livelihood status in relation to existing crop, livestock, fisheries systems and other component. On the basis of base line survey report, farmers' need based technologies were intervened among small, marginal, and resource-poor farmers. In case of crop component, experiments were conducted through inclusion of short duration as well as high yielding crops varieties to improve the cropping patterns and also used the newly released high yielding crop varieties for production program. The overall result of

those experiments showed that farmers got higher yield and economic return than their local variety and pattern. The vegetable cultivation program at homestead area was carried out at seven FSRD sites following the "Homestead Vegetables Production" models developed by BARI from February 2018 to till date. Results of this program revealed that intake of vegetables were markedly increased by all families included in this program. In addition, most of the farmers distributed a portion of their products among their neighbors and relatives. They also sold some amount to get cash money. Women employment has increased which ensured women participation in agricultural activities as well as made positive effect on equity within the family. Different types of fruits and spices saplings were supplied among farmers at FSRD sites. Under livestock program, attempts were completed to eradicate major diseases from cattle and poultry through proper vaccination at project site. Deworming of cattle aimed at fattening program showed a great achievement in favor of body weight and market value increment. Moreover, rearing of poultry, turki, duck and pigeon in households, which could also be a good source of income, were created a good impact among the farm family, especially the semi-scavenging system for poultry rearing. In fisheries program, BFRI evolved fisheries technologies viz. refinement of carp culture technique of *pabda* and *gulsha* in farmers' ponds, polyculture of carps using over wintered fingerlings and refinement of Mono sex GIFT *tilapia* with *shing* were demonstrated at FSRD site during April to December 2018. Practices in seasonal small ponds which were usually not used for fish culture were selected for fisheries program. Fingerlings like Silver carp, Rajputi, Rui, Katla, Mrigel and Mirror carps were released maintaining the BFRI recommended stocking ratio. The ponds were completely harvested after six to eight months of rearing. The results revealed that the highest yield and BCR were obtained. On the other hand, among seasonal fish culture Gift Tilapia gave higher return. The study was carried out with a view to introducing monoculture technique of GIFT Tilapia as well as boost the production at farmers' level. The ponds were completely harvested after six months of rearing. The results revealed that highest yield and gross margin, gross return, BCR were obtained. Finally, it can be concluded that by implementing all the coordinated approach farming at FSRD sites has brought a tremendous success in the field of farmers' socio-economic condition and livelihood improvement.


Field activities of FSRD


Home stead farming systems activities

## 2. Improvement of Farm Productivity through Intervention with Improved Agricultural Technologies in Char land Eco-System (PBRG Sub-project ID-096)

A coordinated project on *Improvement of Farm Productivity through Intervention with Improved Agricultural Technologies in Char land Eco-System* has been coordinated by Planning & Evaluation Division of BARC in partnership with BARI, BINA, BSRI, and BLRI from February 2018. Project Implementation Unit (PIU)-BARC, NATP: Phase 2 has been financing the PBRG project. The main objective of the project was to increase farm productivity of Charland area through intervening whole farm activities. The project activities were conducted by OFRD, BARI at two sites (Char Kharicha, Mymensingh and Charpara, Bogra), BINA at one site (Naovanger char, Jamalpur), BSRI at one site (Saraghat and Pakshi Padma-char, Ishurdi, Pabna) BLRI at one site (Baghabari, Sirajgang) from February 2018. Two villages of each five FSRD sites have been brought under this project. For fulfilling those objectives, a total of 60 farmers have been selected, 12 from each site, and about 60 research activities have been continuing since February 2018 to till date. An inception workshop was arranged on 12 March 2018 before beginning of the project activates with 65 participants. The participants were project personel, Principal Investigators (PIs), and Co-Principal Investigators (Co-PIs) of respective project components from BARI, BINA, BSRI, and BLRI, BARC scientists, farming system specialists, Extension (DAE, DoF and DLS) and NGO personnel. A base line survey and PRA were carried out to understand the livelihood status in relation to existing crop, livestock, fisheries systems and other components. On the basis of base line survey report, farmers' need based technologies were intervened among small, marginal and resource-poor farmers. The research areas were i) Homestead production system, ii) Crops and cropping system, iii) Fisheries production system, and iv) Livestock production system, v) Sapling distribution, vi) and Off- farm activates. Intervention of new technologies in the Charland ecosystem vegetable and fruit production markedly increased (av. 236%) by all farmers included in this system. Two crop based cropping patterns improved by three crop based cropping patterns. Total crop productivity increased due to higher yielding and short duration crops included in the cropping system. Mortality rate significantly decreased after vaccination. Body weight, milk production and lactation period have been increased after deworming. Under beef fattening program, average net profit Tk.38000 was found per cattle after six months. Chicken rearing with improved breed sonali after three months rearing average body weight gain 1.33kg/bird. Average gross margin/farmer obtained was Tk. 2527 from 15 birds. In the fish component, polyculture and mono sex *tilapia* culture in the seasonal pond gave higher productivity as well as gross return. It can be concluded that by implementing all the coordinated approach, farming at FSRD sites has brought a tremendous success in farmers' socio-economic condition and livelihood improvement. Three field visits have been done during reporting period at three FSRD sites, Ishurdi, Pabna under BSRI component, Jamalpur under BINA component and Bogura under OFRD, BARI component.

Farms systems field activities

### 3. Climate Resilient Farming Systems Research and Development for the Coastal Ecosystem (PBRG Sub-project ID-098)

The activities of FSRD under PBRG sub-project was undertaken to maximize the farm productivity by the technologies generated by NARS institutes with efficient use of farm resources and integrate component technologies in the coastal area and thereby improve family income and livelihoods. The project has been coordinated by Planning & Evaluation Division of BARC in partnership with OFRD, BARI at two sites ((Jamla, Dumki Patuakhali, and Hazirhut, Noakhali), BRRI at one site ( Bishnupur, Kaliganj, Satkhira) and BINA at one site (Sonkorkati & Jadobpur, Satkhira) from February 2018. Two villages at each of the four FSRD sites were selected for carrying out project activities. For achieving the objectives, a total of 48 farmers were selected (12 from each site) and about 60 research activities were initiated in February 2018 which have been continuing till date. The research areas were i) Homestead production system, ii) Crops and cropping system, iii) Fisheries production system, iv) Livestock production system, and v) vegetable production at Ghare boundary. A base line survey and PRA was carried out to understand the livelihood status of the farm families in relation to existing crop, livestock and fisheries systems. On the basis of base line survey report, farmers' need based technologies were intervened among selected small, marginal and resource-poor farmers. In case of crop component, short duration as well as high yielding varieties of different crops were intervened to improve the cropping patterns. Newly released high yielding crop varieties were also introduced through production programs. Because of such interventions, farmers got significantly higher crop yields and economic return compared to that of their existing practices. The vegetable cultivation program at homestead area following BARI developed "Homestead Vegetables Production Models" was carried out at four FSRD sites during February 2018 to till date. Results of these interventions were very encouraging as intake of vegetables by all types of farm families increased remarkably. In addition, most of the farmers distributed a portion of their products among their neighbors and relatives. They also sold some amount to get cash money. Women participation in agricultural activities increased to a great extent that showed some positive effect on gender equity within the family. Different types of fruits and spices saplings were also supplied among farmers at FSRD sites. Under livestock program, attempts were made to prevent/control major diseases of cattle and poultry through proper vaccination at each project sites. Deworming of cattle, done before fattening of animal, showed remarkable

positive effect on body weight gain and market value of animal. Chicken, turkey, perion, and duck rearing, especially in semi-scavenging system in the homestead created a good impact among the farm families as a good source of income. In fisheries program, carp polyculture was introduced in the Ghare and seasonal medium and small ponds which were usually not used for fish culture. Fingerlings like Silver carp, Rajputi, Rui, Katla, Mrigel, and Mirror carps were released maintaining the BFRI recommended stocking ratio. Total fish production increased after intervention of new technology. On the other hand, among seasonal fish culture Gift Tilapia gave higher yield and economic return. Finally, it can be concluded that interventions made in different components exerted a visible positive impact in improving farmers' socio-economic condition and livelihood as well.

Feld activities of coastal ecosystem project

## 4. Capacity Building for Conducting Adaptive Trials on Seaweed Cultivation in Coastal Areas

The project is coordinated by Bangladesh Agricultural Research Council (BARC) funded by Krishi Gobeshona Foundation (KGF) from 1 January 2016 to 30 September 2019. Adaptive trials for cultivating seaweeds were conducted under the direct supervision of OFRD, BARI and in collaboration with the Department of Botany, University of Dhaka (for first six months). The technical endeavours were collection of selected seaweeds from the SMI and Inani beach, cultivation and determination of nutritional quality of harvested seaweeds ensuring food quality and extraction of phycocolloids as sources of several industrial products including Jam, Jelly, Chocolates, Ice creams, etc. Seaweeds were cultivated in "Land-based" (Nursery) and "Open-seawaters" using "One-step" (a portion of the seaweed that is attached to ropes) and "Multi-step" (producing spores) "seeds" attached to synthetic floating ropes. Cultivation at Noapara, Naf river estuary, Teknaf was carried out from 1 Jan 2016 to 30 June 2016 where *H. börgesenii* and *C. racemosa* were successfully grown using "One-step seeds" at 20 cm gap on floating ropes and 40 cm gap between rope lines. In the "Open-seawater" at Nuniachara sand-flat *G. tenuistipitata* was grown successfully using "One-step seeds" for seven months from October 2016 till September 2019 on "Single-line semi-floating rope" method. One-step seed production by *H. börgesenii* through tissue culture was attempted but abandoned as the process is highly time consuming requiring years to get expected results and root-like outgrowths at the tip of explants for using as "One-step seeds". Nine coordination meetings were

arranged by BARC followed by a number of constructive decisions. Four workshops were organized by BARC to build awareness among the researchers, extension personnel, farmers and other stakeholders. A monitoring team from BARC regularly visited the project site during planting, growing stage and collection of seaweeds from deep sea area. Logistic and financial support from BARC part was provided for smooth running of the research activities. A Manual in Bengali titled "Shamudrik Shoibal Porichity O Chashabad Kalakoushal" has been published. A manuscript titled "Adaptive Trials on Seaweed Cultivation" was composed published in the *Bangladesh J. Botany*. Three other manuscripts, namely "Spore Production in Ulva linza in the laboratory", "Spore Production in Ulva lactuca in the laboratory" and "Spore Production in *Caulerpa furgusonii* in the laboratory" are under preparation.

Cultivation of seaweed (*Gracilaria tenuistipitata*) in open sea at Nuniachara, Cox's Bazar

**Policy Level Contribution**

Five meetings were conducted as in Annual Performance Agreement (APA) one on 7 August 2018, one on 21 January 2019, one on 14 Feb 2019, and the other one on 24 February 2019. at BARC. A meeting on "Chesunut Research, Development and Extension" was conducted on 11 June 2019 at tje Conference Room-1 of BARC. A day-long meeting on Priority Development (2019-2023) was conducted on 30 January 2019 at yjr Conference Room, BARC. A seminar on the "Preparation of SDG road map of MoA" was arranged on 22 January 2019 at the auditorium of BARC.

**Research Management/Financial Management and Coordination**

Planning and Evaluation (P&E) Division coordinated the special funded projects of NARS institutes & Human Resource Development (HRD) activities under revenue budget. Under these activities, proposal was invited, reviewed, screened, and evaluated. Finally, 76 research proposals were screened out and sent to MoA for final approval under special fund. Seventy six research activities have been implemented by the different NARS institutes under coordination of P&E Division. Ten Competitive Research Grants (CRG) sub-projects of NATP-II have been coordinating by Planning & Evaluation Division of BARC. These are as follows:

1. Dissemination of BARI developed barley and millet varieties
2. Strengthening of drought, heat, and salt tolerance researches on indigenous vegetables

3. Strengthening research on drought, waterlogging, salinity and other stress tolerant indigenous fruit crops
4. Evaluation of sugarcane germplasm under salinity stress condition
5. Salinity and fertility management for cultivating chewing cane in saline prone soils
6. Selection of best suited salt tolerant cucurbit crop varieties managing saline soil and water
7. Assessment of irrigation efficiency in saline prone Upazilas in coastal Bangladesh
8. Strengthening laboratory facilities and capacity building to support breeding for climate resilient and disease resistant wheat variety
9. Enhancing quality wheat seed production and storage at farm level
10. Breeding for climate resilient wheat variety: identification, characterization and mapping of leaf rust and blast resistance and heat tolerance genes

The overall progress of these projects are satisfactory and successfully completed.

**Monitoring, Reviewing and Evaluation Report of Programs/Activities**

Planning and evaluation (P&E) Division have monitored special fund projects of NARS institutes & Human Resource Development (HRD) activities under revenue budget. CRG and PBRG projects were also monitored timely and properly. The overall progresses of the CRG projects were satisfactory and successfully completed. PBRG projects were continuing as activities schedule as mentioned in the project proposal.

Monitoring of PBRG sub-projects funded by PIU, BARC, NATP-2

## Training, Workshop, Seminar, etc. Arranged

A five-day-long training workshop on *Project Development and Management* was organized by the Planning and Evaluation Division, BARC during 24 February to 2 March 2019. Dr. Md. Kabir Ikramul Haque, Executive Chairman, BARC was present as Chief Guest in the inaugural session. Dr. Shaikh Mohammad Bokhtiar, Member-Director (Planning & Evaluation) presided over the inaugural ceremony. Senior Officers including member-directors, directors, CSOs, and PSOs from different divisions of BARC were present in the inaugural ceremony. Dr. Kabir Uddin Ahmed, Chief Scientific Officer (Planning & Evaluation), BARC and the course coordinator of the workshop delivered the welcome address. Thirty participants from different NARS institutes including BARC attended the training workshop.


Certificate giving ceremony of the training program on "Project Development and Management"

A day-long annual review workshop on *Progress of Activities 2017-18 and work-plan 2018-19* was conducted by P&E Division on 14 August 2018. Progress of the year 2017-18 and work-plan for 2018-19 were presented by Head or representatives of all divisions/units/centres of BARC. A training workshop was conducted under Farming System Research Project for scientist of NARS on 29 September to 1 October 2018 at Conference Room-1, BARC. Another training workshop was conducted under Farming System Research Project for Scientific Assistants of NARS on 27-29 October 2018 at Training Complex Building, BARC.

## Scientists Attended Training, Workshop, Seminar, etc. (Foreign and Local)

Dr. Kabir Uddin Ahmed, CSO (P&E) attended a regional knowledge forum workshop *Drought-Earth Observation and Climate Change for Food Security and Agricultural Decision Making in South and Southeast Asia* on 08-10 October 2018 in ICIMOD, Kathmandu, Nepal. Dr. Suraya Parvin, PSO (P&E) attended a workshop on *Principals and Application of GIS in Agriculture for Planning and Decision Making* on 11-14 March 2019 at Soil Resources Development Institute, Dhaka.

## Manpower & Training Unit

During the reporting period (July 2018 to June 2019), a total of 9361 scientists/officers from NARS institutes including Bangladesh Agricultural Research Council (BARC) and other organizations participated in funded trainings/workshops/seminars/higher studies at home and abroad. The fund for these programs was arranged from revenue and other sources.The major activities that Manpower and Training Unit did during the reporting period include as shown below:

## The 7th Meeting of the BIMSTEC Expert Group on Agricultural Cooperation held in Dhaka

The seventh meeting of the *BIMSTEC Expert Group on Agricultural Cooperation (7th EGMAC)* was held in Dhaka, Bangladesh during 24-25 April 2019 at the invitative of the Government of the People's Republic of Bangladesh. The meeting was organized by the Ministry of Agriculture in coordination with Bangladesh Agricultural Research Council, Ministry of Foreign Affairs and the BIMSTEC Secretariat in Dhaka. Delegations from all BIMSTEC member states attended the meeting. The Meeting was inaugurated by Mr. Md. Nasiruzzaman, Secretary, Ministry of Agriculture,. Ambassador M. Shahidul Islam, Secretary General of BIMSTEC, delivered the Special Remarks at the opening session.

7th Meeting of the BIMSTEC Expert Group on agricultural cooperation held in Dhaka

The Meeting reiterated the importance of sharing agricultural information and best practices among BIMSTEC member states and decided to provide with available information related to agricultural cooperation to be uploaded on the BIMSTEC Secretariat's website.

The meeting reviewed the progress made in agricultural cooperation in relation to the implementation of the nine identified common projects and decided that the number of common projects for implementation in BIMSTEC Agricultural Cooperation will be reduced to seven. The meeting acknowledged a lack of dedicated funds to implement the common projects and encouraged BIMSTEC member states to consider contributing to a corpus fund that would be created for funding common identified projects and for deepening agricultural cooperation. The meeting also discussed ways and means to deepen cooperation in agriculture sector among the member states. The eighth meeting of the BIMSTEC expert group on agricultural cooperation will be hosted in India in early 2020.

## Training on Bio-pesticide and Residue Analysis

Under an MoU signed between BARC and SLCARP, a five-day training on *Bio-pesticide and Residue Analysis* was organized by BARC during 7-11 October 2018 at Bangladesh Agricultural Research Institute (BARI), Gazipur**.** The trainees from SLCARP, Sri Lanka were (1) Ms. U S K Abeysinghe, Assistant Director Agriculture (Research) Registrar of Pesticide- Department of Agriculture, Sri Lanka, (2) Dr. A.D.N.T. Kumara, Research Officer, Coconut Research Institute, Sri aanka, (3) Dr. (Ms) P. D. Senanayake, Officer- in- Charge (Research Officer) Entomology and Nematology Division, Tea Research Institute, Sri Lanka, (4) Mr. K.M.D.W. Prabath Nishantha, Asst. Director of Agriculture (Res.), Horticultural Crops Research & Development Institute, Gannoruwa, Sri Lanka. As per the agreed work- plan of the MoU, the costs involving local hospitality, transport and training were covered by BARC.

Group photo of the training on Bio-pesticide and Residue Analysis

## Foundation Training of 25th and 26th Batches Held at NATA

As part of the Council's mandate for skill development of the NARS scientists, BARC continues to organize the four-month long foundation training with the batch of 40 participants. During the fiscal year 2018-2019, Foundation Training for two batches were conducted at National Agricultural Training Academy (NATA), Gazipur under the overall supervision and management of BARC. KGF financed for the 25th batch while the 26th batch was funded by BARC from its revenue budget. Mr. Md. Nasiruzzaman, Secretary, Ministry of Agriculture attended the concluding program of the 25th Foundation Training at NATA. The program was also attended among others by Dr. Md. Kabir Ikramul Haque, Executive Chairman, BARC, Dr. Abul Kalam Azad, Director General of BARI, Dr. Md. Shahjahan Kabir, Director General of BRRI, and Dr. Wais Kabir, Executive Director of KGF.

## Training on APA and APAMS

A two-day long training course on Annual Performance Agreement (APA) and Annual Performance Agreement Management System (APAMS) was organized by BARC during 19-20 February 2019 as per the instruction of the Ministry of Agriculture. As many as 45 officers/officials concerned with APA and APAMS from 17 organizations under the Ministry of Agriculture participated in this training program. APA related senior officers from the Ministry of Agriculture attended the training as resource persons.

## Training on Government Performance Management System (GPMS)

Under the revenue funding, a two-day long training program on *Government Performance Management System (GPMS)* was organized by the Manpower and Training, Unit on 27 April 2019 and 4 May 2019 at BARC Conference Room-1 as per the instructions of the Ministry of Agriculture. Forty five officers of BARC participated in the training course. Resource persons were from the Ministry of Agriculture, BARC and MRDI who discussed on the topics like Guidelines for Annual Performance Agreement (APA), APA Monitoring and Evaluation, Grievance Redress System, Concept of Government Management Performance System (GPMS), Innovations for Improvement of Service Delivery, E-filing and Right to Information Act 2009, etc.

A view of the GPMS training pragram

**Training on Fire Extinguishment, Emergency Exit and Rescue**

A five-day-long training on *Fire Extinguishment, Emergency Exit and Rescue* was organized by BARC on 15, 17, 19, 23, and 24 June 2019 for all the employees of BARC. The resource persons were from the Department of Fire Service and Civil Defense. A total of 174 officers and officials participated in the training in five batches (1st Class:45, 3rd Class: 51, 4th Class:78). The training topics include precautionary measures, use of fire extinguisher, primary measures to extinguish fire, ways of emergency exit, safety measures, earth quake and first aid.

Training on fire extinguishment, emergency exit and rescue

## Coordination for Preparing Two Supplementary Books for Class VI-VIII and Class IX-X

As per the direction of the hon'ble Prime Minister during her visit to the Ministry of Agriculture in 2015, two supplementary books for Class VI-VIII and Class IX-X have been published by the National Text Book Board (NCTB). These two books mainly contain the agricultural technologies/crop production technologies written by officers/scientists from the NARS institutes, Department of Agriculture and Bangladesh Agricultural Development Corporation (BADC). With the initiative of the Ministry of Agriculture, BARC coordinated the publication of the said two books by holding several meetings with the concerned writers and forming an editorial board.


Supplementary books for Class VI-VIII

Through a letter to BARC on 4 Septmber 2018 along with two copies of the books, the Ministry of Agriculture informed BARC that the printing, binding and distribution activities of the said two books have been completed.

**In Country PhD (Revenue)**

One of the major tasks of Manpower & Training Unit of BARC is to facilitate higher studies for NARS scientists in various disciplines of agriculture. A total of 19 NARS scientists were awarded PhD fellowship during the financial year 2013-2014 under revenue funding in the country. The financial management and performance monitoring activities in this connection are being carried out as usual. Ten researchers have already completed their study while eight are at final stage for thesis submission. One BJRI scientist could not continue PhD research on account of health reasons.

**In Country PhD (CSISA-BARC Scholarship Program):**

There was a provision of five slots for in-country PhD under CSISA-BARC Scholarship Program. The five PhD researchers include one from BARC and two from BARI, one from BINA and another from BFRI

(Fisheries). The program is being jointly funded by IRRI, CIMMYT, and WorldFish Centre under CSISA-BD project. The financial management and performance monitoring activities in this connection are being carried out as usual. Two scientists have completed their PhD research while the remaining three are at final stage for thesis submission.

**Foreign Training/Seminar/Workshop/Study Tour:**

During the reporting period, apart from in-country activities, Manpower and Training Unit initiated and implemented foreign training/seminar/workshop/meeting abroad. A total number of 67 research managers/scientists/personnel under different fields of agriculture and cross cutting issues attended 56 programs (training/seminar/workshop/study visit/meeting) to enrich their professionalism in order to achieve the country's ultimate goal to ensure food and nutrition security. This also includes information on foreign visit programs initiated and funded by PIU-BARC: NATP-2. Details are as follow:

**Foreign Training/Workshop/Seminar/Meeting (2018-2019)**

| Sl No. | Name, designation, organization | Program title | Date & duration | Country | Funding agency |
|---|---|---|---|---|---|
| 1. | Dr. Md. Baktear Hossain, PSO (Soils), BARC | Participation in the meeting on 'Capacity Development for Agricultural Innovation Systems (CDAIS). | 3-6 July 2018 | UK | CDAIS |
| | | International Symposium on Agricultural Innovation for Family Farmers | 20-24 Nov. 2018 | Italy | CDAIS |
| 2. | Dr. S M Khorshed Alam, Director (M & T), BARC | Participate in the AFACI Program Workshop on | 3-7 July 2018 | Thimphu, Bhutan | AFACI |
| | | Participate in the study visit on Biotechnology, Climate Smart Agriculture, Conservative Agriculture and Protective Agriculture | 25-31 July 2018 | Japan | BARC (Rev) |
| 3 | Dr. Kabir Uddin Ahmed PSO (P&E), BARC | Regional Knowledge Forum on Drought: Earth Observation and Climate Services for Food Security and Agricultural Decision Making in South and Southeast Asia | 8-10 Oct. 2018 | Nepal | ICIMOD |
| 4. | Dr. Shah Md. Monir Hossain, PSO (Crops), BARC | Participate in the AFACI Program Workshop on Horticulture (GAP) | 3-7 July 2018 | Thimphu, Bhutan | AFACI |
| | | Participate in the program on "Seed Industry Program" | 21-24 January 2019 | India | FtFBP |
| 5. | Dr. Md. Aziz Zilani Chowdhury, MD (Crops), BARC | Participation in the Informal Dialogue on Building Linkages to Strengthen On-Farm Management of Farmer's | 23-28 July 2018 | Rome, Italy | FAO |

| Sl No. | Name, designation, organization | Program title | Date & duration | Country | Funding agency |
|---|---|---|---|---|---|
| | | Participate in the Bilateral Meeting and Knowledge Sharing visit on Flower Species Identification, Biotechnology of Flower Developments and Orchids | 11-18 April 2019 | UK | BARC |
| 6. | Dr. Md. Monirul Islam, Director (Nutrition), BARC | Participate in the Food & Agric. Executive Management Program (AMP) | 22 July to 01 August 2018 | Ithaca, USA | USAID |
| | | Participate in the training course on Biogas Technology and Animal Waste Treatment and Utilization and Workshop on Experience Sharing and Lessons Learned in Animal Waste Treatment and Utilization. | 13-26 Jan 2019 | China | FAO |
| | | Participate in the 40th Session of Codex Committee Methods of Analysis and Sampling | 27-31 May 2019 | Budapest Hungary | NATP Phase-II: BARC Part |
| 7. | Dr. Md. Mosharraf Uddin Mollah, PSO (AERS), BARC | Participate in the training program on Proven Production Technology, Value Chain Development and Nutrition Security of Pulse in South Asia' | 23-26 July 2018 | India | SAC & BARC |
| | | Participate in the training course on Climate Smart Agriculture | 17-28 March 2019 | Philippine | NATP, BARC-Part |
| 8. | Dr. Paresh Chandra Golder MD (P&E), BARC | Participate in the study visit on Biotechnology, Climate Smart Agriculture, Conservative Agriculture and Protective Agriculture | 25-31 July 2018 | Japan | BARC (Rev) |
| 9. | Dr. Md. Abdus Satter, MD (A&F), BARC | Do | 25-31 July 2018 | Japan | BARC RE-Code 3257103 |
| 10. | Mr.Md. Mustafizur Rahman, PTO, BARC | The BIMSTEC Regional Workshop titled Public-Private Partnership to Develop Agricultural Value Chains | 30-31 July 2018 | Myanmar | Myanmer Govt. & BARC (Rev) |
| 11. | Mr. Md. Al Mobasher Hussen, STO, BARC | 2018 Training Course on Hybrid Rice Technology for Bangladesh | 30 July to 29 August 2018 | Changsha, China | China aid |
| 12. | Dr. Md. Harunur Rashid, PSO (Crops), BARC | Participate in the Kick off Workshop on Selection and dissemination of Elite Salt-Tolerant Rice Varieties to AFACI Member Countries | 30 Aug to 01 Sept. 2018 | Philippine | AFACI |

| Sl No. | Name, designation, organization | Program title | Date & duration | Country | Funding agency |
|---|---|---|---|---|---|
| | | Participate in the training course on Procurement Management in Public Sector Under NATP-II | 3-11 December 2018 | Truin, Italy | NATP Phase-II (BARC Part) |
| | | Participate in the 4th Meeting of the SAARC Agriculture Ministers and its Preceding | 24-27 June 2019 | Thimphu, Bhutan | Bhutan & MoA |
| | | International Rice Congress 2018 | 15-17 Oct. 2018 | Singapore | IRRI & BARC NATP-2 |
| 13. | Dr. Sultan Ahmmed, MD (NRM), BARC | Participate in the 6th Regional Forum on Sustainable Agriculture Mechanization in Asia and the Pacific | 25-28 Oct. 2018 | Wuhan, China | CSAM-UNESCAP |
| 14. | Dr. Fauzia Yasmin PSO (TTMU), BARC | Participate in the Inception Meeting of the Project of Institutions to support Intensification, integrated decision making and inclusiveness in agriculture in the East Gangetic Plain | 24-25 Oct. 2018 | Nepal | East Gangetic Plain |
| | Mr. Rafiq Mostofa Kamal Director (AIC), BARC | CABl's Asian-Pacific Regional Consultation | 16-18 Oct. 2018 | China | CABI |
| 15. | Dr. Mohammad Rafiqul Islam, PSO (Livestock) BARC | Participate in the Transforming Livelihoods in South Asia through sustainable livestock research and development | 13-14 Nov. 2018 | Nepal | ILRI |
| | | Participate in the Regional Workshop on Underutilized Animal Genetic Resources (AnGR) and their Amelioration | 04-06 March 2019 | Malaysia | APAARI |
| 16. | Dr. Mian Sayeed Hassan, Director (PIU-BARC), BARC | Participate in the Formation of Joint Agricultural Working Committee (Article-IV of MoU) & Project Field Visit | 10-15 Nov 2018 | Iran | KWFA |
| | | Participate in the Study Tour on Knowledge Sharing of Agriculture Project Management under NATP Phase-II | 9-17 April 2019 | Germany, France, Netherlands | NATP Phase-II BARC |
| 17. | Dr. Md. Abdus Salam, PSO (Crops) BARC | Participate in the Joint Agricultural Working Group (JAWG) meeting | 16-18 Nov. 2018 | Jordan | BARC (Rev) |

| Sl No. | Name, designation, organization | Program title | Date & duration | Country | Funding agency |
|---|---|---|---|---|---|
| | | Participate in the Regional Workshop on the Preparation of National Reports on the Implementation of the | 11-13 December 2018 | India | FAO |
| | | Participate in the 17th Regular Session of the Commission on Genetic Resources for Food and Agriculture | 17-22 February 2019 | Rome, Italy | PGRFA, FAO |
| 18. | Dr. Shaikh Mohammad Bokhtiar, Director, SAARC | Participation in the Annual Coordination meeting and Fifty-sixth Session of the programming Committee Meeting of SAARC | 10-12 December 2018 | Kathmandu Nepal | SAC |
| | | Participate in the Study Tour on Knowledge Sharing of Agriculture Project Management under NATP Phase-II | 9-17 April 2019 | Germany, France, Netherlands | NATP Phase-II BARC |
| | | Participate in the Study tour on Executive Visit on Sustainable Development Goals (SDG) in relation to Agriculture | 13-19 June 2019 | Australia | NATP BARC-Part |
| | | Participate in the 4th Meeting of the SAARC Agriculture Ministers and its preceding meeting's | 24-27 June 2019 | Thimphu, Bhutan | SAC |
| 19. | Md. Taibur Rahman, Senior Assistant Director, BARC | Participate in the training course on Procurement Management in Public Sector Under NATP | 3-11 December 2018 | Truin, Italy | NATP Phase-II (BARC |
| 20. | Dr. Mohammad Saifullah, CSO, BARC | Participate in the Workshop on Monitoring and Evaluation (M&E) for Climate-Smart Agriculture (CSA) | 13-15 March 2019 | Rome, Italy | FAO |
| | | Participate in the Bilateral Meeting and Knowledge Sharing visit on Flower species Identification, Biotechnology of flower developments and orchids | 11-18 April 2019 | UK | BARC |
| 21. | Dr. Md. Kabir Ikramul Haque, Executive Chairman, BARC | Participate in the Study Tour on Knowledge Sharing of Agriculture Project Management under NATP Phase-II | 9-17 April 2019 | Germany, France, Netherlands | NATP Phase-II BARC |
| | | Participate in the Study tour on Executive Visit on Sustainable Development Goals (SDG) in relation to Agriculture | 13-19 June 2019 | Australia | NATP BARC-Part |

| Sl No. | Name, designation, organization | Program title | Date & duration | Country | Funding agency |
|---|---|---|---|---|---|
| 22 | Mr. Hassan Md. Hamidur Rahman Director (Com & GIS) | Study visit program on ICT in Library Management | 9-16 June 2019 | Australia | NATP BARC-Part |
| 23 | Mr. Md. Shohid Uddin Bhuiyan, System Analyst, BARC | Do | Do | Do | Do |
| 24 | Dr. Susmita Das,PDO, BARC | Do | Do | Do | Do |
| 25. | Md. Amirul Islam Deputy Secretary MOA | Participate in the study visit on Biotechnology, Climate Smart Agriculture, Conservative Agriculture and Protective Agriculture | 25-31 July 2018 | Japan | BARC RE-Code 3257103 |
| 26. | Mr. S.M. Imrul Hasan, Senior Asst.Chief, MoA | Do | 25-31 July 2018 | Japan | BARC RE-Code 3257103 |
| 27. | Dr. Muhummad Nazim Uddin, SSO, BARI, Gazipur | Participate in the AFACI Program Workshop on Basic Agriculture and Animal Science. | 27-31 August 2018 | Combodia | AFACI |
| 28. | Dr. Bimal Chandra Kundu, PSO,Tuber Crops Research Centre, BARI | Participate in the AFACI Program Workshop on Food Crops | 11-15 Sept. 2018 | Vietnam | AFACI |
| 29. | Dr. Md. Mofazzel Hossain, PSO, BRRI | Do | 11-15 Sept. 2018 | Vietnam | AFACI |
| 30. | Mst. Arifun Nahar, SSO, SRDI | Participate in the Training of Asia-Oceania GEOSS Network for Capacity Bulding | 17-21 September 2018 | Nepal | ICIMOD |
| 31. | Dr. Md. Sorof uddin, RARS, BARI, Akbarpur | Participate in the Overseas Learning and Exposure Visits on Capacity Development for Agricultural Innovation Systems (CDAIS) Cluster (Pineapple) | 15-19 January 2019 | India | CDAIS |
| 32. | Mr. Md. Altaf Hossain Deputy Director, DAE | Do | 15-19 January 2019 | India | CDAIS |
| 33 | Dr. Md. Jamal Uddin, SSO, RARS, BARI, Hathzari | Participate in the Overseas Learning and Exposure Visits on Capacity Development for Agricultural Innovation Systems (CDAIS) Cluster (Pineapple) | 15-19 January 2019 | India | CDAIS |

| Sl No. | Name, designation, organization | Program title | Date & duration | Country | Funding agency |
|---|---|---|---|---|---|
| 34 | Mr. Md. Nurul Islam Personal Officer, MoA | Do | 15-19 January 2019 | India | CDAIS |
| 35 | Mr. S.M. Aminuzzaman, Upazilla Agriculture Officer, DAE, Shibganj | Participate in the Overseas Learning and Exposure Visits on Capacity Development for Agricultural Innovation Systems (CDAIS) Cluster (Mango) | 15-19 January 2019 | Thailand | CDAIS |
| 36 | Mr. Md. Nurul Islam, District Marketing Investigator, DAE | Do | 15-19 January 2019 | Thailand | CDAIS |
| 37 | Dr. Mohammad Mainuddin Molla, CSO, BARI, Gazipur | Participate in Kick-off Workshop on Agricultural Products Processing Technology Development (APPT) | 11-16 March 2019 | Korea | AFACI |
| 38 | Mr. Ashfak Ahmed Sabuz, SO, BARI | Do | 11-16 March 2019 | Korea | AFACI |
| 39 | Mr. Mohammad Moshiur Rahman Akonda, SO, BTRI | Participate in the Climate Smart Agriculture | 25 Feb. to 06 March 2019 | Philippine | BARC Part: NATP-2 |
| 40 | Mr. Aminur Rahaman, Joint Secretary, MoA | Participate in the Bilateral Meeting and Knowledge Sharing visit on Flower species Identification, Biotechnology of flower developments and orchids | 11-18 April 2019 | UK | BARC Part: NATP-2 |
| 41. | Dr. Kabita Anzu-Man-Ara, CSO, BARI, Gazipur | Do | 11-18 April 2019 | UK | Do |
| 42 | Mr. S M Imrul Hasan, SAC, MoA | Do | 11-18 April 2019 | UK | Do |
| 43 | Mr. Kamalaranjan Das, Additional Secretary, MoA. | Participate in the Study Tour on Knowledge Sharing of Agriculture Project Management under NATP Phase-II | 09-17 April 2019 | Germany, France, Netherlands | BARC Part: NATP-2 |
| 44 | Sharifa Ahmed, Deputy Secretary, MoA. | Do | 09-17 April 2019 | Germany, France, Netherlands | Do |
| 45 | Dr. Md. Shahjahan Kabir, DG, BRRI | Do | 09-17 April 2019 | Germany, France, Netherlands | Do |
| 46 | Dr. Md. Abdul Wohab, Director (Research), BARI | Do | 9-17 April 2019 | Germany, France, Netherlands | Do |

| Sl No. | Name, designation, organization | Program title | Date & duration | Country | Funding agency |
|---|---|---|---|---|---|
| 47 | Dr. Md. Abu Hena Sorwar Jahan, PSO, BARI, Gazipur | Participate in the training course on Climate Smart Agriculture | 17-28 March 2019 | Philippines | NATP, BARC-Part |
| 48 | Dr. Md. Abdur Razzaque, SSO, BARI, Gazipur | Do | Do | Do | Do |
| 49 | Md. Sirajul Islam, PSO, BRRI, Gazipur | Do | Do | Do | Do |
| 50 | Abul Basar Md. Zahid Hossain, SSO, BRRI, Gazipur | Do | Do | Do | Do |
| 51 | Sushan Chowhan, SO, BINA, Mymensingh | Do | Do | Do | Do |
| 52 | Dr. Md. Mahbubur Rahman, SSO, BSRI, Pabna. | Do | Do | Do | Do |
| 53 | Md. Mamun Al Ahsan Chowdhury, SO, SRDI, Dhaka | Do | Do | Do | Do |
| 54 | A F M Ruhul Quddus, SO, BARI, Gazipur | Do | Do | Do | Do |
| 55 | Md. Nazmul Hasan Mehedi, SO, BINA, Mymensingh | Do | Do | Do | Do |
| 56 | Md. Mostake Ahmed, SO, BSRI, Pabna. | Do | Do | Do | Do |
| 57. | Mahmuda Khatun, SO, BJRI, Dhaka | Do | Do | Do | Do |
| 58 | Ms. Sharifa Ahmed, Deputy Secretary, MoA | Participate in the SAARC Regional Training on Building Resilient Agriculture: Package of Solutions for Communities in SAARC Member States | 27-30 May 2019 | Kathmandu, Nepal | SAC & ICIMOD |
| 59 | Dr. Munshi Rashid Ahmad, PSO, BARI, Khagrachari | Do | 27-30 May 2019 | Kathmandu, Nepal | SAC & ICIMOD |
| 60 | Md. Abdur Rouf Additional Secretary, MoA | Participate in the Study tour on Executive Visit on Sustainable Development Goals (SDG) in relation to Agriculture | 13-19 June 2019 | Australia | NATP BARC-Part |
| 61 | Md. Hanif Uddin, Deputy Secretary, MoA | Do | 13-19 June 2019 | Australia | NATP BARC-Part |

| Sl No. | Name, designation, organization | Program title | Date & duration | Country | Funding agency |
|---|---|---|---|---|---|
| 62 | Azam Uddin Talukder, Asst. Secretary, Prime Minister's Office | Do | 13-19 June 2019 | Australia | NATP BARC-Part |
| 63 | Md. Nasiruzzaman, Secretary, MoA | Participate in the 4th Meeting of the SAARC Agriculture Ministers and its Preceding Meetings | 24-27 June 2019 | Thimphu, Bhutan | Bhutan & MoA |
| 64. | Dr. Md. Abdur Rouf, Additional Secretary MoA | Do | 24-27 June 2019 | Thimphu, Bhutan | Bhutan & MoA |
| 65 | Md. Abubakar Siddique, Joint Secretary, MoA | Do | 24-27 June 2019 | Thimphu, Bhutan | Bhutan & MoA |
| 66 | Israt Ara, Director (SAARC & BIMSTEC) | Do | 24-27 June 2019 | Thimphu, Bhutan | Bhutan & MoA |
| 67 | Dr. Abul Kalam Azad, DG, BARI | Do | 24-27 June 2019 | Thimphu, Bhutan | Bhutan & MoA |

## In-country Training/ Workshop/ Seminar

During the reporting period, 72 training programs and 46 workshops/seminars were arranged by the divisions/units of BARC in which 3151 scientists/officers participated. Under revenue funding, 26 training programs and 23 workshops were organized. The participants for the training and workshops/seminars were 3151 and 6000, respectively. Detailed lists are given below:

### Programs Implemented During 2018-2019

### Training (Revenue)

## In-House Training

| Division/ Unit | Training Title | Training venue | Date | No. of participants |
|---|---|---|---|---|
| Finance Unit | Financial Management & Procurement (Project staff) | BARC | 30 Oct. to 1st Nov. 2018 | **23** |
| Computer & GIS | Training Workshop on Development of innovation capability | BARC | 17-18 Nov. 2018 | **43** |
| Man. & Trn. Unit | Training on GPMS (All BARC Officers) | BARC | April 27 & May 4, 2019 | **45** |
| Admin & Finance | Training on ICT (3rd class employees) | BARC | 14-16 May & 19-20 May 2019 | 30 |

| Division/ Unit | Training Title | Training venue | Date | No. of participants |
|---|---|---|---|---|
| Admin & Finance | Training on performance enhancement for 4th class employees | BARC | 14-20 May & 21-27 May 2019 | 60 |
| Admin. & Finance | Training on performance enhancement for 4th class employees (Driver & Technical Employees) | BARC | 28 May to June 3, 2019 | 16 |
| Manpower & Training Unit | Training on Fire Extinguishment, Emergency Exit and Rescue (1st Class:45, 3rd Class: 51 4th Class:78) | BARC (15,17,19,23,24 June/2019) | five days | 174 |
| Admin & Finance | Financial and Administrative Management (3rd Class) | BARC | 7 days 12-18 June/2019 | 17 |
| Admin. & Finance | Financial and Administrative Management (3rd Class) | BARC | 7 days 19-25 June/2019 | 16 |
| Admin. & Finance | Training on APA, SDG, Right to Inf. Act for 4th Class employees | BARC | 2 days 28-29 June/2019 | 62 |
| | **Total (Program 10)** | | | **486** |

## B. Training Organized for NARS Scientists and Others (Revenue)

| SL No. | Training title | Training venue | Date | No. of participants |
|---|---|---|---|---|
| M&T Unit | Foundation Training (25th Batch) | NATA | 05 Aug.-2 Dec. 2018 | 40 |
| | Foundation Training (26th Batch) | NATA | 17 Feb. to 16 June 2019 | 40 |
| | Training on APA & APAMS | BARC | 18-19 Feb 2019 | 45 |
| AERS | Training on Application of Econometric Model in Agricultural Research | BARC | 10-14 March/2019 | 20 |
| NRM (Soils) | Training program on Use of Fertilizer Recommendation Guide-2018 (3 days 3 Batches) | BARC | 22-24 June/2019 (3 batches) | 120 |
| NRM (Forest) | Training on Forestry Technologies for Professionals | BARC | 24-25 March/2019 | 40 |
| | Training on Climate Smart Agriculture | BARC | 29-30 Apr/19 | 40 |
| TTMU | Training (TOT) on matured Technology of Maize (Fruits) | BARI, Gazipur | 21 Jan/2019 | 30 |
| | Training (TOT) on matured Technology of Fisheries | BFRI, Coxes Bazar | 13 Feb/2019 | 30 |

| SL No. | Training title | Training venue | Date | No. of participants |
|---|---|---|---|---|
| | Training (TOT) on Matured Technology of Livestock | BLRI, Savar | 9 Jan/2019 | 30 |
| AIC | Technical Report Writing and Editing | BARC | 3-7 Feb/19 | 25 |
| P&E | Training on Project Development and Management | BARC | 24-28 Feb/19 | 30 |
| Nutrition | Training on Awareness building on the Importance of nutrition information (2 batches) | District/ Upazilla Level | April-May/19 | 70 |
| | Training on Quality Processing and preservation of Agro-products and Nutritional Benefits (2 batches) | District/ Upazilla Level | April-May/19 | 70 |
| Com. & GIS | Principle & Application of GIS in Agriculture Planning and decision making" | SRDI | 11-14 March 2019 | 20 |
| **Total ( Program=15)** | | | | **650** |

## Training Organized by BARC for Foreign Nationals

| Division/Unit | Training Title | Training venue | Date | No. of participants |
|---|---|---|---|---|
| M&T Unit | Pesticide & Residue Analysis (For Sri Lankan Scientists) | BARI | 7-11 October 2018 | **04** |

## Training Organized From Other Funding Sources ( NATP, AFACI, ICIMOD, FAO)

| Division/ Unit | Activity | Venue | Duration | No. of participants |
|---|---|---|---|---|
| Div/ Units | Total 43 training programs held under NATP Funding | - | - | **1921** |
| Com & GIS | Training Workshop Crop Calender (20 officer +20 Farmers) | Tangail | 08 Nov. 2018 | 40 |
| | Principle & Application of GIS in Agriculture Planning and decision making | SRDI | 11-14 March 2019 | 20 |
| NRM (Soils) | Organizational Training Program under CDAIS/FAO | BARC | 23 March 2019 | 30 |
| | **Total (Program=46)** | | | **2011** |

**Total Training (Program Number 72) : ( A+B+C+D): Participant Number: 3151**

## A. Workshop (Revenue)

| Division/ Unit | Activity | Venue | Duration | No. of participants |
|---|---|---|---|---|
| Crops | Review Workshop on Crop Improvement Programme of NARS Institutes: Research Progress (2017-18 & 2018-19) | BARC | 1-2 August/2018 | 75 |
| | Review Workshop on Crop Production Program of NARS Institutes: Research Progress 2017-18 & Research Program 2018-19 | BARC | 5-6 August-2018 | 80 |
| | Review Workshop on Disease Management Program of NARS Institutes: Research Progress 2017-18 & Research Program 2018-19 | BARC | 07 August-2018 | 70 |
| | Review Workshop on Insect Pest Management Program of NARS Institutes: Research Progress (2017-18 & 2018-19) | BARC | 08 August-2018 | 70 |
| | National Workshop on Biotechnology Program of NARS Institutes: Research Progress (2017-18 & 2018-19) | BARC | 09 August 2018 | 70 |
| | Awareness Workshop on False Army Worm Outbreak and Giant Milibug Managemnt | BARC | 28 Oct.2018 | 80 |
| TTMU | Workshop on Matured Technologies of NARS Institute | BARC | 19 Dec.2018 | 60 |
| | Workshop on Neel Cultivation | BARC | 19 March/19 | 50 |
| AERS | Workshop : Review of Socio-Economic Research Programs of NARS Institute | BARC | 24-25 June/2019 | 70 |
| Computer & GIS | Workshop on 3rd Showcasing on Service Innovation in Agriculture | BARC | 1 (One) day Nov./18 | 55 |
| NRM (Soils) | Research Review and Planning Workshop of Soils Management Programs of NARS Institute- 2018 | BARC | 28-30 Aug. 2018 | 80 |
| NRM (Engg.) | Annual Workshop on Research Review 2017-2018 & Research Program 2018-19 on Agril Engineering of NARS Institutes | BARC | 12-13 Aug.2018 | 80 |
| | Workshop on Agricultural Mechanization | BARC | 04 April 2019 | 75 |
| NRM (Forestry) | Workshop on Climate Smart Agriculture | BARC | 02 June 2019 | 400 |
| P&E | Annual Review Workshop on Implementation of Approved Program (2017-18) and Annual Action Plan for 2018-19 | BARC | 14 Aug.2018 | 50 |
| | Capacity Building for Conducting Adaptive Trials on Seaweed Cultivation in Coastal Areas | Cox'sbazar | 20 Dec.2018 | 50 |

| Division/ Unit | Activity | Venue | Duration | No. of participants |
|---|---|---|---|---|
| M & T Unit | Workshop on the Rise of Landless Tenancy In Bangladesh | BARC | 30 April 2019 | 70 |
| Nutrition | Additives and Preservatives in Processed foods: Health Consequences | District/ Upazilla Level | April-May/19 | 240 (120+120) 02 Batch |
| A & F | NIS Planning (2018-19) | BARC | 25 July 2018 | 30 |
| | **Sub-total (19)** | | | **1755** |

## Workshop/Seminar ( NATP, AFACI, KGF)

| Division/ Unit | Activity | Venue | Duration | No. of Participant |
|---|---|---|---|---|
| Different Division/ Unit | **Total 20 workshop/ seminar (organized under NATP funding** | **BARC** | **-** | **3041** |
| Crops | Workshop on Crop Zoning: Upazila Land Suitability Map | RDA, Bogra | 26 April 2019 | 110 |
| P&E | Capacity Building for Conducting Adaptive Trials on Seaweed Cultivation in Coastal Areas | Coxesbazar | 20 Dec.2018 | 50 |
| NRM (Soils) | CDAIS Bangladesh National Forum: Strengthening capacities to innovate in Farming and Food Systems: Sharing Success and Identifying Opportunities for wider adoption | BARC | 03 April 2019 | 60 |
| | **Sub-total (23)** | | | 3261 |

## Seminar (Revenue)

| Divisi | Activity | Venue | Duration | No. of participants |
|---|---|---|---|---|
| M&T Unit | 7th BIMSTEC Meeting on Agricultural Cooperation | MoFA, MoA, BARC | 24-25 April, 2019 | 24 |
| | Seminar on Hilsha Whole Genome Sequencing and Exploiting Potentials and RDF Award Giving Ceremony | BARC | 14 Nov. 2019 | 70 |
| | Seminar on Krishibid Day Observation: Awareness Generation on consumption of Nutritious Food. | | 12 Feb 2019 | 390 |
| P&E | Seminar on SDG Road Map Preparation | BARC | 22 Jan.2019 | 500 |
| | **Total (4)** | | | **984** |

**Total Workshops/Seminars (Program Number 46) : ( A+B+C): Participant Number: 6000**

**5. Higher Education: (Summary of Higher Study at BARC (PhD) (2018-2019)**

| Sl. No. | | PhD | | Total | Remarks |
|---|---|---|---|---|---|
| | | Foreign | Local | | |
| 1. | 2013-2014 (Revenue) | - | 18 | 18 | 10-Completed |
| 2 | 2011-2012 (CSISA-BARC) | - | 5 | 5 | 02: completed<br>Others: About to complete |
| 3. | PIU-BARC: NATP-2 | 60 | 60 | 120 | 120 Ongoing |
| | **Total** | **60** | **83** | **143** | |

**HRD Status of BARC (2018-2019)**

| Events | No. of programs | No. of participants | Remarks |
|---|---|---|---|
| Training | 72 | 3151 | Rev: 26; Others: 47 |
| Workshop/ Seminar | 46 | 6000 | Workshop/ Seminar<br>(Rev):23;Workshop (others): 23 |
| Foreign Visit | - | 67 | seminar/workshop/study visit/training (56 events) |
| Higher Study (PhD)- in-Country | - | 143 | Revenue funding |
| **Total** | **118** | **9361** | **-** |

## Fisheries Division

Fisheries Division of BARC is working for sustainable fisheries and aquaculture research and development. The key activities of this division include (a) project development, (b) supervision, (c) execution, (d) technology development, (e) monitoring and evaluation of the research projects, and (f) coordinating research programs with the NARS institutes, universities, BFRI, DoF, and the agencies which are engaged in nutritional research and development like FAO, WorldFish, etc. Also, it's a part of regular activities to organize and attend in national and international seminars, workshops, symposium, conferences, meetings, and trainings in the field of fisheries and aquaculture, value addition, etc., reporting national issues, review of scientific papers, expert opinion and advisory services, etc. Also, maintaining liaison with national and international agencies for collaboration and strengthening national research and developmental program in fisheries along with agriculture and livestocks. Moreover, the technical advisory services also provided to the Ministry of Agriculture (MoA) on different issues related to agricultural research with special emphasis on fisheries & aquaculture development.

A brief description of the activities done by the Fisheries Division during 2018-2019 are given below:

## Program/Project Developed

During the reporting period, a number of projects have been developed under the Fisheries Division, BARC which are as follows. All of these projects are implementing under the direct supervision of the Fisheries Division.

- Sustainable fisheries development for Haor and beel community through improved management approach
- Improvement of existing fattening technology of carp and high valued small indigenous species (SIS) through good aquaculture practices (GAP) in different agro-ecosystems
- Development of *in-situ* Breeding Technology of Prawn (*Macrobrachium rosenbergii*) and Adoption of Sustainable Eco-Friendly Culture of Prawn and Shrimp (*Penaeus monodon)*
- Up-scaling of mud crab *(Scylla olivacea)* aquaculture in Bangladesh: Adoption of improve techniques from seed production to fattening and health management

## Annual Progress Review Workshop of PBRG Sub-Project

Annual Progress Review Workshop of the PBRG Sub-Projects, Nutrition Unit, BARC were done on 3 June 2019 at Conference Room-1, BARC. Principal Investigator, co-investigators, expert members including senior official from BARC and universities were present in the workshop and put on valuable suggestions and advice. Later on, all of these suggestions and advice are incorporated in the respective project activities. It is noted that, review workshop was chaired by Dr Md. Kabir Ikramul Haque, Executive Chairman, BARC.

### Policy Level Contribution

The Fisheries Division contributed a good deal in several programs on aquaculture advocacy, motivation of rural fish farmers and project design by the NARS Institutes, Bangladesh Directorate of Fisheries (DoF), Bangladesh Fisheries Research Institute (BFRI), WorldFish and few NGOs working at the grassroots level. However, Member Director (Fisheries) isworking as an expert member in different organisation, some of which are as follows:

### Expert Committee:

a. Acting as a expert Member of the Directorate Fisheries (DoF)
b. Tender Evaluation Committee, NATP Project, PIU, DLS component
c. Acting as a Member of the 'Fish and Fisheries Products (AFDC -23)' Committee of BSTI;
d. Acting as a one of the examiner of the Department of Fishries and Technology, Patuakhali Science and Technology University (PSTU), Dumki, Patuakhali.
e. Acting as a Member, Recruitment Committee, BFRI

### National Level Collaboration and Linkages

Fisheries Division continued to be closely involved in the process of program development, review mechanism of various food and aquaculture related activities of NARS, relevant institutes and universities. Besides, the unit is also involved in planning and organization of activities undertaken by the institutions like, DoF, WorldFish, BFRI, DAE, BIRTAN, FAO, etc. working in the field of fisheries and aquaculture..

### Research Management and Coordination

As a part of the regular yearly activities, Fisheries Division was involved in the review, monitoring and participatory program development of the fisheries and aquaculture research and development activities of the DoF, BFRI and Member Director (Fisheries) took part in BARC's centrally monitoring of the

supplementary research funding program implemented by the different NARS institutes and universities during the reporting year.

### Field Monitoring and Evaluation

Fisheries Division, BARC also regularly monitor and evaluate the project activities at field level. Dr. Md. Monirul Islam with his team member visited to monitor the BARC funded different ongoing project activities under BARI, BRRI and other NARS institutes during the reporting period. The activities done under the core research program reported to the Planning and Evaluation Division in prescribed format and finally presented the field observation in the workshop organized by BARC in the presence of principal investigators of the project and other relevant scientists.
This division also monitors the ongoing PBRG sub-project activities which are being implemented by BFRI, SUST, SAU, KU, and BAU under the supervision of Fisheries Division, BARC.


Different field monitoring activities


Field visit paid by Directot Nutrition and hsi team

## Nutrition Unit:

Nutrition Unit of BARC is working for better human nutrition. The major activities done by the unit are project development, supervision, execution, technology development, monitoring and evaluation of the research projects, coordinate research program with the NARS institutes, universities, BCSIR, BFSA, BIRTAN and the agencies which are engaged in nutritional research and development like FAO, WHO, World Vision, WorldFish, IFRI, Hellen Killer, etc. Also, it's a part of regular activities of the job to organize and attend national and international seminars, workshops, symposium, conferences, meetings and trainings in the field of nutrition in agricultural research and technologies, food adulteration, contamination and mitigation measures; reporting national issues, review of scientific papers, expert opinion, advisory services, etc.

In addition, maintaining liaison with national and international agencies for collaboration and strengthening national research and development program in nutrition along with agriculture, fisheries, and livestocks.

Moreover, the technical advisory services also provided to the Ministry of Agriculture (MoA) on different issues related to agricultural research (including crop, livestock, fisheries and nutrition as a whole) and development.
A brief description of activities done by the Nutrition Unit during the reporting 2018-2019 period are given below:

**Programs/Projects Developed**
During the reporting period, a number of projects have been developed under the nutrition Unit of BARC are shown below. It I worth mentioning that these projects are implementing under the direct supervision of the Nutrition Unit.

- Contamination and adulteration of food and food products, process, chain and mollification
- Value addition and standardization of nutritional level in selected food items to mitigate malnutrition
- Food-based initiative for improving household food security, income generation and minimize malnutrition
- Value addition and standardization of nutritional level in selected food items from poultry origin
- Fortification and standardization of nutritional level in selected food items and efficacy test of polyphenolic compounds as quality livestock feed production

**Workshop, Seminar, Training-Workshop, etc**.

**Training Program:**
As a part of the human resource development, Nutrition Unit of BARC conducted trining (Table 1) in Syedpur, Bagerhat, Khulna, and Gaibandha to create awareness building on nutrition knowledge, promote nutrition rich agricultural crop production and means to increase the knowledge of nutrition through capacity building.

**Table 1: Training program implemented by Nutrition Unit**

| Title | Places/Venue | Targeted | Achieved |
|---|---|---|---|
| Role of Food Based Nutrition to Reduce Stunting and Underweight‘ | Syedpur | 02 | 02 |
| Balanced Diet for Young Children, Pregnant Women and Lactating Mother | Bagerhat | 02 | 02 |
| Awareness building on the importance of nutrition information | Khulna | 02 | 02 |
| Quality processing and Preservation of Agro - Products | Gaibandha | 02 | 02 |

A total of 35 participants took part in each training program from different sectors and professions, such as SAAOs, health workers, formal and non-formal teachers, local journalists, producers, family farmers, traders, and consumers and other government agencies, extension workers.

The program was organized to disseminate the messages focusing on food based nutrition so that acquired knowledge would be further transferred to neighbors and other stakeholders. The courses were designed with multidisciplinary sectors covering and emphasizing the following areas *viz.*, agriculture products, gardening, small-scale fish culture, livestock; food hygiene, sanitation, quality safe food, food securit, micronutrient benefits, food utilization, cooking process, food adulteration and mitigation measures, improvement of nutrition level, processing to restore food value, nutrition care of lactating and pregnant women as well as adolescent girls and preservation techniques of fruits and vegetables, quality control, etc.

In these programs, resource speakers were selected from multidisciplinary sectors like agriculture, fisheries, and livestock. However, Dr. Md. Monirul Islam, Director (Nutrition), BARC attended as a key speaker in all of these training programs to facilitate and make the entire training program a success.


Pictorial view of the training activities

## Organizing Workshop/Seminars

Like a training program, the unit also organized a number of workshops over the country (Table 2). In all of the programs, key note paper was presented by Dr. Md. Monirul Islam, Director (Nutrition), BARC. With a view to creating awareness to the mass people, the participants viz., Upazilla Agriculture Officers including other officials at Upazilla level, extension workers, teachers, magistrates, mango growers, traders, pesticide dealers, and reporters from the print and electronic media were invited in both the workshops from the said regiondistricts.

**Table 1: Workshop program implemented by the Nutrition Unit**

| Title | Places/Venue | Targeted | Achieved |
|---|---|---|---|
| Causes of Food Contamination and Methods of its Prevention | Noakhali | 02 | 02 |
| Food Adulteration and Contamination: Inside Fact and Consumer Responsibilities | Ishwardi | 02 | 02 |
| Additives and Preservatives in Processed Foods: Health Consequences | Norshingdi, Savar | 02 | 02 |

However, in these workshop programs, Deputy Commissioner of Noakhali, Deputy Director of DAE Ishwardi, Norshingdi and Director General of BLRI were present as Chief guest, respectively.


Pietorial view of the training program

Pictorial views of the workshop activities

**Annual Progress Review Workshop of PBRG Sub-Project**

Annual Progress Review Workshop of the PBRG Sub-Projects, Nutrition Unit, BARC was held on 23 June 2019 at the Conference Room-1 of BARC. Principal Investigator, co-investigators, expert members including senior officials from BARC and universities were present in the workshop and gave valuable suggestions and advice. Later on, all of these suggestions and advice are incorporated in the project activities. Noted that, review workshop was presided over by the Dr. Md. Kabir Ikramul Haque, Executive Chairman, BARC.

**BCC or Communicable Materials and Mass Media**

Based on the field and research experience, a sufficient number of behavior change communicable materials like t-shirt, mugs, sticker , message stones, etc. with the key information on safe food and nutrition, food utilization, food adulteration, etc were distributed. A good number of t-shirts, mugs, message stones including food plate have been distributed by the nutrition unit through trainings, workshops, seminars among different stakeholders like researchers, academicians, traders, farmers, health workers, school teachers, NGO/extension workers as well as policy makers with necessary guidelines to disseminate the nutrition information and knowledge. It is worthwhile to mention here that all of these bcc tools are well accepted by every quarter.

Plate 4. Awareness Creating BCC Tools on Balanced Diet and Safe Food


Communicalbe materials

Director (Nutrition) also attended telecast program and talk show to share and disseminate nutrition knowledge, food safety, food adulteration, mitigation measures in different electronic media viz., Channel 24, Atn News, Jamuna tv., Ntv, Rtv, Channel 71, DBC, Samoy tv, Boishakhi tv, etc. including radio furti. In addition, a number of print media published the research results done by the Nutrition Unit, BARC.

**Key Research Activities done by Nutrition Unit**

**Safety over pesticides usages and Public health:**
In this study, cooked vegetables samples were collected from the different classes of hotels like (a) Top (5-star hotel), (b) Improved/Medium, and (c) General Class in Dhaka city to investigate the remaining pesticide residue level (if any). A total of 30 types of pesticides residue were analyzed during the study for each sample. In this regard, collected the sautéed vegetables samples from Radisson hotel and was found only 'Imidaclorpid' residue in particular was at the level of 0.014 mg/kg. The maximum MRL and ADI level of imidaclorpid is 0.50 mg/kg and 0.02 mg/kg, respectively (Table 3).

In the same way, half boiled and or steamed vegetables sample were collected from the Hotel Intercontinental and found only the pesticides 'Fenvelerate' residue at the level of 0.012 mg/kg, which are blow the MRL level (2.0 mg/kg). However, ADI of Fenvelerate is 0.02 mg/kg (Table 3)

**Table 3: Residue level of pesticides in cooked vegetable of different Categories hotels of Dhaka city**

| Restaurant /collection point | Cooked Vegetable type | | Result (mg/kg | | |
|---|---|---|---|---|---|
| | | Test pesticides | Test Results | MRL | ADI |
| Mohammadpur | Malabar Spinach (Pui Shak)- Cooked | - | - | - | - |
| Shyamoli | Mixed leafy vegetable (Water spinach, Red amaranth, Spinach) | - | - | - | - |
| Krishnochura reasturant, Shyamoli | Ladies Finger | Chlorpyrifos | 0.030 | 0.2 | 0.01 |
| | | Thiamethoxam | 0.011 | 5.0 | |
| Intercontinental Hotel | Mixed Vegetable Bhaji (Long yard bean, Snake gourd, Potato) | Fenvelerate | 0.012 | 2.0 | 0.02 |
| Maa shubuhi Restora, Tejgaon | Brinjal | - | - | - | - |
| Tripti Bilash, Sher-e-Bangla Road | Jute spinach (Pat shak) | - | - | - | - |
| Cafe surma hotel, Karwan Bazar | Red amaranth/ | - | - | - | - |
| Bohubrihi, Karwan Bazar | Bitter gourd (Usta) | - | - | - | - |
| Raddison | Mixed (Cabbage, carrot, country bean, long yard bean, pumkin)- Sautéed (no added spices) | Imidaclorpid | 0.014 | 0.50 | |
| Dhaba Restaurant, Dhanmondi | Mixed Vegetable (carrot, cauliflower, cabbage, onion leaf, baby corn, Long yard bean, cucumber, tomato, lettuce, capsicum)- Steamed | - | - | - | - |
| Karwan | Cabbage (Purple) | Chlorpyrifos | 0.046 | 0.2 | 0.01 |
| | | Cypermethrin | 0.063 | 2.0 | 0.05 |
| Karwan Bazar | Broccoli | - | - | - | - |


Vegetables Samples

However, samples collected from improved/medium and general class hotel and no pesticide residue was observed above MRL in any sample. In case of improved/medium class hotels, only Chlorpyrifos and Thimethoxam residue were recorded at the level of 0.030 and 0.011 mg/kg, respectively. Subsequently, samples Chlorpyrifos and Cypermerthrin residue were recorded at the level of 0.46 mg/kg and 0.063 mg/kg, respectively, in general class hotels (Table 3), which is below the MRL (0.2 mg/kg).

**Antibiotic Residue in Commercial Poultry Feeds**

A total of 15 brands of poultry feed samples ( 9 samples of broiler feed and 6 samples of layer feeds) were collected from different parts of Bangladesh. The samples were then analyzed by the internationally recognized accredited Laboratory SGS (Chennai). The study made observation that 12.5% of analyzed feed samples contain the antibiotics residue, namely Lincomycin and Oxytetracycline above MRL level (Table 4). Moreover, in case of layer feeds, only one sample contain oxytetracycline and epioxytetracycline but the level was found below MRL(Table 4).

**Table 4 : Antibiotic residues in different poultry feed samples**

| **Product Type** | **Antibiotics Residue** (ug/kg) | | | | | **Permissible limit (ug/kg)** |
|---|---|---|---|---|---|---|
| *Compound Poultry feed (Pellets)* | | | | | | |
| | Lincomycine | Chlortetracycline | Oxytetracycline | 4 Epichlortetracycline | 4 Epioxytetracycline | |
| CBF-007-A | ND (DL:10.0) | ND (DL:5.0) | ND (DL:5.0) | ND (DL:5.0) | ND (DL:5.0) | Chlortetracycline/ Oxytetracycline :0.2-1.6 ppm Lincomycin: 0.5-1.5 ppm |
| CBF-007-B | ND (DL:10.0) | ND (DL:5.0) | ND (DL:5.0) | ND (DL:5.0) | ND (DL:5.0) | |
| CBF-007-C | ND (DL:10.0) | 5066.85 | ND (DL:5.0) | 2608.66 | ND (DL:5.0) | |
| CBF-007-D | ND (DL:10.0) | 15.44 | ND (DL:5.0) | 12.85 | ND (DL:5.0) | |
| CBF-007-E | ND (DL:10.0) | ND (DL:5.0) | ND (DL:5.0) | ND (DL:5.0) | ND (DL:5.0) | |
| CBF-007-F | 10.81 | ND (DL:5.0) | ND (DL:5.0) | ND (DL:5.0) | ND (DL:5.0) | |
| CBF-007-G | ND (DL:10.0) | ND (DL:5.0) | 3860.59 | ND (DL:5.0) | 11536.83 | |
| CBF-007-H | ND (DL:10.0) | ND (DL:5.0) | ND (DL:5.0) | ND (DL:5.0) | ND (DL:5.0) | |

| *Compound Poultry feed (Mash)* | | | | | |
|---|---|---|---|---|---|
| | Lincomycine | Chlortetracycline | Oxytetracycline | 4 Epichlortetracycline | 4 Epioxytetracycline |
| CBF-007-AA | ND (DL:10.0) | ND (DL:5.0) | ND (DL:5.0) | ND (DL:5.0) | ND (DL:5.0) |
| CBF-007-BB | ND (DL:10.0) | ND (DL:5.0) | ND (DL:5.0) | ND (DL:5.0) | ND (DL:5.0) |
| CBF-007-CC | ND (DL:10.0) | ND (DL:5.0) | ND (DL:5.0) | ND (DL:5.0) | ND (DL:5.0) |
| CBF-007-DD | ND (DL:10.0) | ND (DL:5.0) | ND (DL:5.0) | ND (DL:5.0) | ND (DL:5.0) |
| CBF-007-EE | ND (DL:10.0) | ND (DL:5.0) | 9.12 | ND (DL:5.0) | 12.40 |
| CBF-007-FF | ND (DL:10.0) | ND (DL:5.0) | ND (DL:5.0) | ND (DL:5.0) | ND (DL:5.0) |

**Micronutrient in Fermented Rice (Pantha Vat)**

Rice varieties BRRI-28, Najir, Pari, Miniket, Aman and Balam (Brown) rice samples were collected from the local market to analyze the micronutrients like Fe, Ca, K, and Na in particular. Firstly, all of the rice samples were cooked and soaked over night (app. 10-12 hours) and then analyzed. The results showed remarkable amount of increase in Ca and Fe content in case of fermented rice compared to normal rice. The Fe and Ca level were found to increase up to 55.83 % and 492% (Table 5)

**Table 5: Micronutrient content of normal and fermented rice**

| Rice varieties | Unit (mg/kg) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Calcium (Ca) | | | Iron (Fe) | | | Potassium (K) | | | Sodium (Na) | | |
| | N | F | % increase (g) | N | F | % increase (g) | N | F | % increase (g) | N | F | % increase (g) |
| BRRI-28 | 369.60 | 492.0 | + 33.12 | 3.26 | 5.08 | + 55.83 | 215.05 | 117.69 | -45.27 | 26.56 | 36.94 | +39.08 |
| Najir | 327.87 | 313.93 | - 4.25 | 2.47 | 2.33 | - 5.67 | 201.88 | 73.04 | - 63.82 | 25.40 | 23.90 | - 5.91 |
| Pari | 206.35 | 355.94 | + 72.49 | 1.38 | 1.44 | + 4.35 | 163.43 | 99.10 | - 39.36 | 21.47 | 16.36 | - 23.80 |
| Miniket | 69.29 | 313.15 | + 351.94 | 1.63 | 1.82 | + 11.66 | 114.78 | 75.29 | - 34.40 | 14.18 | 20.92 | + 47.53 |
| Amon | 228 | 246.50 | +8.11 | 2.69 | 3.48 | +29.37 | 196.34 | 191.40 | -2.52 | 123.00 | 107.36 | |
| Balam Rice (Brown) | 198.22 | 241.99 | +22.08 | 6.51 | 5.66 | -13.06 | 569.74 | 500.32 | -12.18 | 146.37 | 169.17 | +15.58 |

**Quality of Rice Bran Oil**

Rice bran oil is gaining popularity among consumers due to health benefits. Nutrition Unit, BARC collected 12 branded rice bran oil samples from different parts of Dhaka City and carried out the test in Ahmadabad, India. The results so far obtained revealed that 25 percent of the oil lacks beneficial ingredients gama oryzanol in particular (Table 6) as well as unequilibriuium ratio of Omega-3 and Omega-6 fatty acids. Besides, it contains almost all essential fatty acids, and is free from monosodium glutamate, one of the main culprits behind obesity. It also found that none of the products matched their claims on the labels.

**Table 6. Quality analysis of rice bran oil**

| Parameters | Samples | RV |
|---|---|---|
| | Rice bran oil (Lowest to Highest) | |
| Saponification Value (mg KOH / g) | 182.67 - 185.64 | 180-195 |
| Iodine value (g / 100gms) | 98.69 – 103.77 | 90-105 |
| γ- Oryzanol (%) | 0.85 - 1.47 | 1% (minimum) |
| Fatty Acid Composition | | |
| Palmitic acid | 18.99 - 21.04 | |
| Stearic acid | 0.58 - 0.83 | |
| Oleic acid (omega 9) | 44.37 – 45.81 | |
| Linoleic (omega- 6) | 32.52 – 34.74 | |
| Linolenic acid (omega- 3) | 0.23 – 0.97 | |
| Eicosenoic acid (Omega-9) | 0.11 – 0.16 | |
| Other fatty acids | 0.18 -0.30 | |

Samples of rice bran oil

## Policy Level Contribution

The Nutrition Unit contributed much in several programs on nutritional advocacy, motivation of rural households and project design by the NARS Institutes, Bangladesh National Nutrition Council (BNNC), Bangladesh Food Safety Authority (BFSA), Institute of Food Science and Technology (IFST) of BCSIR, ICDDR'B and few NGOs working at the grassroots level. However, Director (Nutrition) working as an expert member in different organization, some of which are as follows:

**Expert Committee:**

f. Acting as a expert Member of the Tender Evaluation Committee, NATP Project, PIU, DLS component
g. Acting as a Member of the 'Fish and Fisheries Products (AFDC -23)' Committee of BSTI;
h. Acting as a Member of the "Oils, fats and allied products" Sectional Committee of BSTI, Dhaka.
i. Acting Member, Agriculture and Food Division Committee (AFDC), BSTI, Dhaka

j. Acting as a one of the examiner of the Department of Fishries and Technology, Patuakhali Science and Technology University (PSTU), Dumki, Patuakhali.
k. Acting as expert member of the "Food Safety Authority (FSA)" (Fruits and vegetables Committee/crop sector)
l. Member of the National Plan of Action on Nutrition (NPAN)
m. Member, Nutrition Working Group (NWG)

**Ntional Level Collaboration and Linkages**

Nutrition Unit continued to be closely involved in the process of program development, review mechanism of various food and nutrition related activities of NARS, relevant institutes and universities. Besides, the unit is also involved in planning and organizing activities undertaken by the institutions like, DAE, BIRTAN, BNNC, IFST, BFSA, ICDDR'B WFP, INFS, FAO, etc., working in the field of food and nutrition, food safety, food adulteration and mitigation, primary health care, food habit, food utilization and cooking practices.

Director (Nutrition) actively contributed to the BSTI to provide quality products and developing standards of these different products and to play the key role by providing suggestion/expert opinions to the BSFA to minimize food adulteration and its mitigation measures.

Dr. Md. Monirul Islam, Director (Nutrition) was also actively engaged with BFSA and contributed to produce the Recommended Level/MRL of Pesticides Residue and Food additives and Preservatives for Bangladesh standards.

**Research Management and Coordination**

As a part of the regular yearly activities, Nutrition Unit was involved in the review, monitoring and participatory program development of the nutritional activities of the BFSA, DAE, DAM, BIRTAN, BNNC, IFST, HK, and ICDDR'B. Director (Nutrition) usually took part in BARC's centrally monitoring of the supplementary research funding programs implemented by different NARS institutes and universities during the reporting year.

**Field Monitoring and Evaluation**

Nutrition Unit, BARC also regularly monitor and evaluate the project activities at field level. Dr. Md. Monirul Islam with his team member visited to monitor the BARC funded different ongoing project activities like BLRI, BRRI, BAU, BFRI during the reporting period. The activities done under the core research program, reporting to the Planning and Evaluation Division in prescribed format was accomplished, and finally presented the field observation in the workshop organized by BARC in the presence of Principal investigators of the project and other relevant scientists.
However, the ongoing PBRG sub-project activities implementing by BARI, BFRI, BLRI, PSTU, HDSTU, and BAU were monitored. By the Unit.


Field monitoring activities

**Publication(s)**
Depending on the research finding and other activities, Nutrition unit has produced and or published Scientific papers, reports, proceedings of the seminars, symposium, etc. as a regular basis. During the reporting period following documents were published.

## ***Training Manual Preparation***
Food based Nutrition and Health Training Manual

**Attended the Trainings, Workshops, Seminars, etc. (Foreign and Local)**

- Participated in the 40th Session of 'CODEX COMMITTEE Methods of Analysis and Sampling at Budapest, Hungary, 27 - 31 may 2019
- Participated in the Training Course on " Biogas Technology and Animal Waste treatment and utilization at BIOMA, Chengdu, China, 13-26 January 2019

## Narural Resources Management (NRM) Division
## Agricultural Engineering Unit

**A. Policy level contribution:**
Different policy oriented comments were prepared for appropriate steps on emerging problems and prospective issues in the field of Agricultural Engineering and other related fields. All comments were submitted to the Ministry of Agriculture as per their request through EC, BARC. Some of the activities are given below:

1. Providing information for 'BIMSTEC-India Week 2019, exhibition on Agriculture, Farm Machinery, Equipment and Agri Processing Technologies'.
2. Comments furnished oncontributions to ESCAP Programme of Work and Regional Institutions
3. Providing information on sustainable uses of technologies and agricultural mechanization.
4. Sending draft to MoA on National Standardization Committee (NSC) and Technical Sub Committee (TSC) for revival of Sustainable Mechanization with Indigenous and Imported Machinery.
5. Sending proceedings to MoA on the workshop of Low Powered Tiller and Fertility Management.
6. Sending Comments to concerned ministry on the Recommendations Made with Bangladesh Investment Development Authority on Enhancing Women Entrepreneurs Participation in Investment.
7. Sending information to concerned authority on the progress of Work-plan on National Women Policy.
8. Sending comments/opinions to MoA on the progress of draft Work-plan on the National Policy for Prevention of Torture on Women and Children in Bangladesh.
9. Sending Opinions/Comments to the concerned authority on national policy on management of e-waste created from electric and electronic products.

**B. Monitoring, Reviewing, and Evaluating Report of Activities of NARS Intitutes**
Conducted Desk Monitoring of PBRG Projects of Agricultural Enginering Unit During July 2018-June 2019

Conducted Field Monitoring of special fund project of Ministry of Agriculture in Bangladesh Jute Research Institute (BJRI) on 24 December 2018 (Fig. 1). Discussed with the concerned scientists of projects were as 'Development of Solar Energy Driven Lighter Jute Auto Power Ribboner to save cost of Energy and Environment', 'Application of Enzyme Technology for improvement of jute fiber and Jute-based product' and 'Development of Eco-friendly Storage system for Controlling Storage Diseases in Jute Seed'. Collected updated information on the progress of activities compared with planned activities, problems and their suggestion/action needed for smooth running of the project. Provided some on the spot suggestions regarding project activities for smooth running of the project.

Pictorial views of monitoring of research program of MoA
at Bangladesh Jute Research Institute

Conducted field monitoring of special fund project of Ministry of Agriculture in Bangladesh Agricultural Development Corporation (BADC) on 7 January 2019. Discussed with the concerned scientists of projects were as 'Purification and improvement of short duration rice (Aus/Aman) cultivars and quality seed supply for climate change adaptation', 'Seed quality determination of different climate resilient crop varieties and there seed quality improvement', 'Standardization of sieve sizes for grading of different Crop seeds to minimize the wastage during seed Cleaning and Grading', 'Assessment of irrigation efficiency in some selected Upazilas in Bangladesh', 'A comparative study of quality seed demand assessment by public sector with actual usage of quality seed by farmers', 'Apply of different techniques in different climatic conditions for year round mango production' and 'Rainwater banking for family farming in coastal areas of Bangladesh'. Collected updated information on the progress of activities compared with planned activities, problems and their suggestion/actions needed for smooth running of the project. Provided some on the spot suggestions regarding project activities for smooth running of the project.

Conducted Field Monitoring of special fund project of Ministry of Agriculture in Cotton Development Board (CDB) on 14 January 2019 (Fig. 2). Discussion was held with the concerned scientists of the projects. The projects were 'Cotton Mutation Breeding for Improving Tolerance to Drought', 'Optimization of Plant Density and Sowing Time for Sustainable Intensification of Rabi Cropping in Coastal Areas of Bangladesh' and 'Productivity and Economics of Cotton based Cropping Pattern in char land areas'. Collection of updated information on the progress of activities compared with planned activities, problems and their suggestion/actions needed for smooth running of the project was done. On the spot suggestions regarding project activities for smooth running were provided.

Pictorial views of monitoring of Research Program of MoA
at Cotton Development Board (CDB)

Conducted field monitoring of special fund project of Ministry of Agriculture in Soil Resource Development Institute (SRDI) on 30 January 2019. Discussion was held with the concerned scientists of projects. The project were 'Selection of Best Suited Salt Tolerant Cucurbit Crop Varieties Managing Saline Soil and Water', 'Estimation of soil degradation in tea growing areas of Moulvibazar and Sylhet', 'Management of Acid Soils Through Lime for Sustainable Agriculture in Sylhet Region', 'Assessment of Heavy Metal Contamination of Soils, waters and crops in the industrial areas of Dhaka District' and 'Climate Smart Agriculture Practice by adding Organic Matter and Lime for Sustainable Crop Productivity

in Barind Soil (AEZ-25 & 26)'. Collection of updated information on the progress of activities compared with planned activities, problems and their suggestion/action needed for smooth running of the project were done. Some on the spot suggestions regarding project activities were provided.

Conducted field monitoring of special fund project of Ministry of Agriculture in Bangladesh Institute of Research and Training on Applied Nutrition (BIRTAN) on 24 February 2019. The projects on which the discussion with the concerned scientists held were 'Increasing Food and Nutrition Security at Sunamganj Haor Homestead Area of Bangladesh' and 'Increasing Food and nutrition Security at Chittagong Hill Tracts (CHT) Homestead Area of Bangladesh'. Collection of updated information on the progress of activities as against planned activities, problems and their suggestion/actions needed for smooth running of the project was done. Some on the spot suggestions regarding project activities for smooth running of the project were given.

Conducted field monitoring of PBRG project as 'Up-scaling and Application of Solar Photovoltaic Pump for Smallholder Irrigation and Household Appliances in the Central Coastal Region of Bangladesh' at Bangladesh Agricultural Research Institute and Bangladesh Rice Research Institute on 20 January 2019 (Fig.3). Collection was done about the updated information on the progress of activities compared with planned activities, problems and their suggestion/action needed for smooth running of the project. Some on the spot suggestions regarding project activities for smooth running of the project were provided.

Pictorial views of monitoring of PBRG project at BARI & BRRI, Gazipur

**1.** Evaluated Annual Report, leaflet and 7 PCR of CRG projects.

**2.** Evaluated Annual Reports of KGF projects**.**

**C. Coordination and Implementation of PBRG Projects (PIU-BARC, NATP-II)**

- Implementing two PBRG projects under Coordination of BARC and funding of PIU-BARC, namely
- Groundwater resources management for sustainable crop production in northwest hydrological region of Bangladesh
- Up scaling of solar pump for smallholder irrigation and household appliances in the central coastal region of Bangladesh

**Project activities:**

- Recruitment of project staff
- Procurement of capital items like, furniture and office equipment
- Monitoring and evaluation of benchmark information
- Preparing SoE, quarterly, half yearly and annual reports

- Monitoring and evaluation of project activities
- Organizing coordination meeting
- Organizing Inception Workshop and Annual Review Workshop

**D. Workshop, Training, Seminar (Foreign and local) Organized**

A two- day long workshop on Research Review 2017-18 and Research Program 2018-19 on Agricultural Engineering of NARS Institutes and NARS Research Planning Workshop on Agricultural Engineering which were held during 12–13 August 2018 with the participation of the scientists of the NARS institutes (BARI, BRRI, BINA, and BSRI), officials from the Department of Agricultural Extension (DAE), Rural Development Academy (RDA), scientists from International Rice Research Institute (IRRI), Bangladesh Rural Advancement Committee (BRAC), and academicians from agricultural universities (Fig. 4). The objectives of the workshop were to review the status and needs of agricultural engineering research in farm machinery, irrigation & water management and postharvest technology. Ninety agricultural engineers from NARS institutes, universities and other organizations participated in the workshop. Participants and expert members gave valuable suggestions on Agricultural Engineering Research Reports (2017–18) and Planning Future Research Program (2018-19) of NARS institutes and placed recommendations on various issues.

Pictorial views of Research Review 2017-18 and Research Program 2018-19 on Agricultural Engineering of NARS Institutes workshop

**Workshop:** Inception Workshop on PBRG Sub-project "Groundwater Resources Management for Sustainable Crop Production in Northwest Hydrological Region of Bangladesh (ID-002)"

An inception workshop on PBRG Sub-project "Groundwater Resources Management for Sustainable Crop Production in Northwest Hydrological Region of Bangladesh (ID-002)" was held at Bangladesh Agricultural Research Council on 30 July 2018 with the scientists/experts' participation from BARC, BARI, BRRI, BINA, BAU, BADC, BMDA, RDA, BRAC, IWM (Fig. 5). The workshop was divided into inaugural, technical and concluding sessions. After thorough discussions in the inaugural, technical and concluding session, recommendations were finalized and sent to respective stakeholders.

Inception workshop on PBRG Sub-project

**Workshop:** Inception workshop on PBRG Sub-project "Up-scaling and Application of Solar Photovoltaic Pump for Smallholder Irrigation and Household Appliances in the Central Coastal Region of Bangladesh (ID-001)"

The inception workshop of PBRG sub-project titled "Up-scaling and Application of Solar Photovoltaic Pump for Smallholder Irrigation and Household Appliances in the Central Coastal Region of Bangladesh (ID-001)" was held at BARC on 31 July 2018 with the participation of scientists/experts from BARC, BARI, BRRI, BINA, BAU, DAE, KGF, IDCOL and Electro Group (Fig. 6). The Workshop was divided into inaugural, technical and concluding sessions. After thorough discussions in the inaugural, technical sessions and concluding session, recommendations were finalized and sent to respective stakeholders.

Pictorial views of inception workshop

**Workshop:** Workshop on "Low power and Soil Fertility based Agricultural Machinery"

The workshop on *Low power and Soil Fertility based Agricultural Machinery* was held at BARC on 4 April 2019 with the participation of the Ministry of Agriculture, institutes from the NARS (BARI, BRRI, BINA, and BSRI), DAE, BAU, RDA, BADC, BMDA, farmers, service providers, other agricultural universities, etc (Fig. 7). Three papers were presented by Dr. M. Jahiruddin, Dean, Faculty of Agriculture, BAU; Dr. Md. Abdul Wahab, Director (Res.), BARI and Professor Dr. Md. Monjurul Alam, Dept. of Farm Power and Machinery, BAU.

Pictorial views of workshop on "Low power and Soil Fertility Based Agricultural Machinery"

**Workshop:** Annual Review Workshop on PBRG Sub-project "Groundwater Resources Management for Sustainable Crop Production in Northwest Hydrological Region of Bangladesh (ID-002)"

Annual Review Workshop of PBRG Sub-project on "Groundwater Resources Management for Sustainable Crop Production in Northwest Hydrological Region of Bangladesh (ID-002)" was held BARC on 23 April 2019. Participants were scientists/experts from BARC, BARI, BRRI, BINA, BAU, BADC, BMDA, BRAC, IWM, CEGIS, PIU-BARC and PMU, NATP-II (Fig. 8). The Workshop was divided into inaugural, technical and concluding sessions. After thorough discussions in the sessions, some recommendations were finalized and sent to respective stakeholders.

Annual Review workshop 2019, BARC

**Workshop:** Annual Review Workshop on PBRG Sub-project "Up-scaling and Application of Solar Photovoltaic Pump for Smallholder Irrigation and Household Appliances in the Central Coastal Region of Bangladesh (ID-001)"

The Annual Review Workshop on PBRG Sub-project *Up-scaling and Application of Solar Photovoltaic Pump for Smallholder Irrigation and Household Appliances in the Central Coastal Region of Bangladesh (ID-001)* was held BARC on 24 April 2019. The participants were scientists/experts from BARC, BARI, BRRI, BINA, BADC, DAE, PIU-BARC, PMU, NATP-II), Infrastructure Development Company Limited (IDCOL) and Electro Group (Fig. 9). The Workshop was divided into inaugural, technical and concluding sessions. After thorough discussions in the inaugural, technical and concluding sessions, recommendations were finalized and sent to respective stakeholders.

Pictorial views of Annual Review Workshop

**Training:** Training Program on "Solar Pump Irrigation System"

Organized training course on *Solar Pump Irrigation System* during 12-14 March 2019 at BARC, Dhaka (Fig. 10). In this training programme, thirty five participants from NARS scientists of BRRI, BARI and BINA; Universities, DAE; RDA; BADC and BMDA participated to upgrade their skill on design, installation and maintenance of solar irrigation pump, fault finding and troubleshooting of solar systems, basic electrical for solar devices and grid feeding system, Solar panel measurement, array sizing and string selection and setting of solar arrays, business model and cost calculation of solar irrigation system etc.

Training course on "Solar Pump Irrigation System", 2019

## E. Training, Workshop, Seminar (Foreign and local) attended

Attended training programs organized by BARC:

| Course Title | Institution | Location | Period | |
|---|---|---|---|---|
| | | | From | To |
| Fire Control, Safety and Emergency Exit Related Fire Safety Training | BARC | Dhaka | 15 June 2019 | |
| Training on Government works implementation Management | BARC | Dhaka | 27 April 2019 | 4 April 2019 |
| Citizen service innovation related Training | BARC | Dhaka | 17 November 2018 | 18 November 2018 |

### Attended workshops organized by BARC and other institutions:

| Workshop | Institution | Location | Date |
|---|---|---|---|
| Annual Review Workshop on "Improvement of Soil health and Crop Productivity of Major Problem Soil of Bangladesh through Organic Amendments" under PBRG sub-project | BARC | Dhaka | 26 June 2019 |
| Annual Review Workshop on "Determination of Critical Limit of Nutrients for Soils And Crops" under PBRG sub-project on | BARC | Dhaka | 25 June 2019 |
| Workshop titled "Upliftment of farmers livelihood and Enrichment of environment through Improved practices in char Land ecosystem of Bangladesh" | BARC | Dhaka | 24 June 2019 |
| Annual Progress Review of PBRG Sub-project arranized by Nutrition Unit | BARC | Dhaka | |
| Workshop on "Problems, opportunities and Need to Do on the inoreme of land less farmers" | BARC | Dhaka | 23 June 2019 |
| Annual Monitoring workshop on "PBRG Sub-project arranged by PIE-BARC, NATP-2." | BARC | Dhaka | 17-18 June 2019 |
| Workshop on Conservation Agriculture-based Sustainable Intensification: Experiences and prospects | BARC | Dhaka | 27 May 2019 |
| Development of Upazilla Land Suitability Assessment Crop Zoning System of Bangladesh | BARC | Dhaka | 26 May 2019 |
| Progress Review of the project Development of Upazila land Suitability Abetment and crop Zoning system of Bangladesh | BARC | Dhaka | 30 April 2019 |
| Seminar on Role of Non-States Actors in Agriculture and food sector to achieve SDGs | BARC | Dhaka | 28 April 2019 |
| Strengthening institutional Capacities for Sustainable management of Solar Power Irrigation Systems in Bangladesh | BARC | Dhaka | 11 April 2019 |
| National Workshop on "Research Development and Production of quality seed Bangladesh" | BARC | Dhaka | 20-21 March 2019 |
| Progress review workshop on Development of Upazilla Land Suitability Assessment and Crop Zoning System of Bangladesh | BARC | Dhaka | 18 February 2019 |

| Workshop | Institution | Location | Date |
|---|---|---|---|
| 1st year progress Review Workshop Nutrient Management for Diversified Cropping in Bangladesh | BARC | Dhaka | 4 February 2019 |
| Drafting Road Map of SDGs Related to Ministry of Agricultural | BARC | Dhaka | 12 February 2019 |
| Review Workshop on Matured Technology Development by NARS Institutes" | BARC | Dhaka | 19 December 2018 |
| Inception Workshop "Exploration, Identification, Characterization, Multiplication and Ex-situ Conservation of Endangered Forest Genetic Resources including Medicinal plants of Bangladesh" | BARC | Dhaka | 5 November 2018 |
| Inception workshop on PBRG Sub-projects under Fisheries Division | BARC | Dhaka | 6 November 2018 |
| Establishment of Profitable cropping pattern through crop intensification in underutilized unfavorable ecosystem | BARC | Dhaka | 25 October 2018 |
| Regional Symposium on Sustainable Agricultural Mechanization And Post-harvest Practices in Bangladesh | Gulshan-2 | Dhaka | 24 October 2018 |
| Annual Research reverent and program planning 2018 BARI | BARI | Gazipur | 22 October 2018 |
| Inception workshop on PBRC Sub-projects under Nutrition Unit | BARC | Dhaka | 15 October 2018 |
| Inception Workshop on "Transfer of Agricultural Technologies to Farmers Level for Increasing Farm Productivity (ID-005)" | BARC | Dhaka | 8 October 2018 |
| Workshop on Annual Program review of CRGDC projects under Natural Resources member gement division | BARC | Dhaka | 18-20 September 2018 |
| Workshop on Annual Research planning of BFRI 2018-19 | BFRI | Dhaka | 29-30 August 2018 |
| Progress revies workshop on approved work plan for 2017-2018 and 2018-2019 | BARC | Dhaka | 14 August 2018 |
| Research Review 2017-18 and Research Program 2018-19 on Agricultural Engineering of NARS Institutes | BARC | Dhaka | 12-13 August 2018 |
| PBRG sub-project named Germplasm Conservation and Climate change, ID-072 Inception Workshop | BARC | Dhaka | 1 August 2018 |
| Inception Workshop on "Upliftment of Farmers' Livelihood & Enrichment of Environment through Improved Agroforestry Practices in Char Land Ecosystem of Bangladesh." | BARC | Dhaka | 2 August 2018 |
| Inception work shop on Improvement of soil health and crop productivity in climate vulnerable & polluted areas through organic amendments (NATP Phase-2). | BARC | Dhaka | 9 August 2018 |
| Inception Workshop on "Up-scaling & Application of Solar Photovoltaic Pump for Smallholder Irrigation & Household Appliances in the Central Coastal Region of Bangladesh (ID-001)" | BARC | Dhaka | 31 July 2018 |

| Workshop | Institution | Location | Date |
|---|---|---|---|
| Inception Workshop on "Groundwater Resources Management for Sustainable Crop Production in Northwest Hydrological Region of Bangladesh Project-002" | BARC | Dhaka | 30 July 2018 |
| Workshop on Promoting Pulses, Oilseeds, Maize and Other Crops in the stress Prone Areas of Bangladesh in Partnership with Australia | BARC | Dhaka | 29 July 2018 |
| Seminar on Agricultural Mechanization: Status, Challenges & Policy Issues in Bangladesh | IEB | Dhaka | 24 July 2018 |
| Workshop on "On-farm & On-station Validation of Some Summer Onion Mutants" (BAS-USDA- PALS-BINA-CR4) & "Transforming Nutritionally Deficient Agriculture to Nutritionally Rice Agriculture" | BARC | Dhaka | 17 July 2018 |
| Towards Better Integration of R4D for Improved Food Production Systems & Livelihood in the Coastal Zone of Bangladesh | BARC | Dhaka | 15-16 July 2018 |

## F. Linkage

The Unit maintained strong linkage with the engineering professional bodies (at home and abroad) like CIMMYT, IRRI, IEB, BWDB, CSAM, WARPO, BSTI, NGOs (IDE, BWP /GWP), FAO, BANCID, BRAC, CEGIS, IWM, BCSIR, SERDA, KIB, and the Universities.

**Worked as member in the different committees as mentioned below:**

i. Technical Committee, Agricultural Mechanization Project of DAE, Dhaka.
ii. Technical Committee of Bio-gas, Infrastructure Development Company Limited (IDCOL), Dhaka.
iii. Board of Management, National Museum of Science and Technology (NMST), Ministry of Science and Technology.
iv. Governing Council of CSAM, United Nations Economic and Social Commission for Asia and the Pacific
v. BANCID Study and Publication Sub-Committee
vi. Technical Advisory Committee (TAC) of KGF
vii. Advisory Committee of Appropriate-scale Mechanization Innovation Hub- Bangladesh
viii. Governing Board of the lnter disciplinary Centre for Food Security (lCF), Bangladesh Agricultural University (BAU)
ix. Focal Point of Women in Development
x. Recruitment Committee of PBRG projects
xi. PEC Committee of PIU-BARC

- Exposure visit on Resource Recovery Option on Faecal Sludge Management Value Chain during 23-26 July 2018 at Bangkok, Thailand. This program was organized by Asian Institute of Technology and SNV Netherlands Development Organization.
- Participated in 6$^{th}$ Regional Forum on Sustainable Agricultural Mechanization in Asia and the Pacific of CSAM during 25-28 October 2018 at Wuhan, China.

- Participated in "The 14th Session of the Governing Council of the Centre for Sustainable Agricultural Mechanization (CSAM) during 29-30 November 2018 at Yogyakarta, Indonesia. This program was organized by UNESCAP- FAO, CSAM.
- Attended meetings/seminar/ workshops organized by FAO, DAE, CEGIS, IWM, WARPO, BARI, BRRI, World Bank and BARC.

**Published research papers in different scientific journals and newsletters:**

i. Estimation of ctual crop evapotranspiration and supplemental irrigation for Aman rice cultivation in the northern part of Bangladesh. *Fundamental and Applied Agriculture*. 2019. Vol. 4(3), pp. 873–880: doi: 10.5455/faa.34264.

ii. Potentialities of growing upland row crops in water scarce area using alternate furrow irrigation water saving technology. BANCID Yearly Newsletter 2018. pp. 11-13.

1. Contributed materials for BARC Annual Report 2017-18.
2. Contributed to publish BARC Newsletter.
3. Publish Training Manual 2019 on Solar Pump Irrigation System.
4. Activities of Natural Resources Management Division – Published in 'The Reflector' in December 2018. pp. 36-42.
5. Worked as a member in different committees of BARC (Goods Receiving Committee, Recruitment Committee of NATP-II, World Food Day 2018 Committee, Vegetable Fair Committee 2019, Fruit Tree Plantation Committee 2019, Seed Fair Committee 2019 etc.).
6. Attended meetings/seminars/ workshops organized by BARC.
7. Attended meetings/seminars/ workshops organized by BARC.

**G.** The Unit has the responsibility of research management in the three distinct areas under Agricultural Engineering,, namely Farm Machinery, Irrigation and Water Management and Post Harvest Processing Engineering. The Unit oversees the major program being undertaken by the NARS institutes for the purpose of further improvement.

## Brief Highlights of R & D of the Concerned NARS Institutes

### 1.1 Farm Machinery

**Evaluation and improvement of four-wheel tractor operated zero till drill for cereal crops**

The research work has been undertaken to evaluate the performance of 4W tractor operated zero till drill and improvement of the seeder for completing seeding operation in a single pass. Five zero till drills were imported from India. One of them was sent to OFRD, Rajshahi for evaluation of field performance with maize (NK40) and wheat (BARI Gom-30) at Godagari and Poba upazilla of Rajshahi district. The zero till drill was operated with 4W tractor with 2.05 to 2.40 km/h forward speed. Effective field capacity and efficiency of zero till drill varied from 0.31 to 0.36 ha/h and from 81.64 to 84.13 %, respectively. The planting depth (4-5 cm) of maize and seeding depth (2-3 cm) of wheat were desirable.

**Design and development of a power tiller operated vegetable seedling transplanter**

A power tiller operated vegetable seedling transplanter was designed and fabricated with locally available iron materials at Farm Machinery and Postharvest Process Engineering Division of Bangladesh Agricultural Research Institute, Gazipur during 2018-19. The transplanter consisted of dibbler, dibbler pressing sprocket, chain, press wheel, seat, depth adjusting wheel, etc. The machine can transplant seedling two rows at a time and distance between the rows is adjustable up to 40-100 cm. Seedling spacing was adjusted and irrigation water was supplied at a time.

**Development and adoption of two-wheel tractor operated potato planter**

An experiment was taken to improve the potato planter and evaluate the performance. During 2017-18, some modification of the planter was done. Mould casted metallic cups of 40mm size were used instead of plastic cup. There were 10 cups instead of 13 pairs of potato cups fixed on a 40 mm flat belt forming an endless loop. According to the design criteria, potato cups were positioned 110mm apart from each successive cup which was changed to 90 mm with transmission ratio 1.15 in the improved model. Forward speed of 2.4 km/h was the best in respect of uniformity of spacing and missing seeds. Potato planter was evaluated at ten locations of Bogura and Jashore and there was a special program at Panchagarh during 2018-19. Similar yield was found in machine planted field and manual planted field in all locations with BARI ALu 36 and BARI Alu-41 except Jashore with BARI Alu-36. Total 7.11 ha area was planted with potato planter in different districts of Bangladesh.

**Improving the performance of mechanized seeding through innovations in seed metering and delivery system**

A precision metering system for adoption in two-wheeled tractor operated maize planters was developed. The project tested three types of conventional maize seed meters used in Bangladesh (BARI, WRC, and VMP) and an imported precision seed meter (CPM) at low, medium, and high rotational speeds and inclination angles of seed meters. The tests were conducted using seeder test rig and soil bin facility of the FMPE Division, BARI. Two tests were conducted– one at steady state (zero vibrations) and the other at dynamic state (running prototype seed boxed on a PTOS to take in vibrations). Data collected were singles, doubles, multiples, missings, bridgings and gaps. The CPM seed meter outperformed other seed meters for the maize varieties tested (NK40, Elite and BHM9) giving a minimum of 92% single seeds that went up to as high as 97% depending on the operational settings. The CPM is a highly desirable seed meter that can be used on seeders to improve precision of maize planting. All these tests were repeated as dynamic tests to identify the seed meters' effectiveness under vibrations (due to engine and roto-tilling). The performance of the CPM seed meter did not change significantly due to vibrations compared to the other seed meters. Under the vibrations, the CPM seed meter resulted in 93–97% singles, <3% doubles, and ≤5% gaps which indicates its suitability for maize seeding. Comprehensive field testing and fine tuning of the precision seeder for maize, wheat, pulse, and oil seed crops in different soil and copping conditions are thus suggested.

**Appropriate conservation machinery for rice based cropping pattern in the Southern Delta of Bangladesh**

The field experiment was conducted at Dhamshar, Wazirpur, Barishal; Holdibari, Kolapara, Patuakhali and Charwapda, Subarnachar, Noakhali and Baratia, Dumuria, Khulna during 2018-19 for testing, adoption and popularization of different conservation machinery, such as zero till planter(ZT), strip till planter (ST), and power tiller operated seeder (PTOS) along with conventional tilling and of sowing method (CT). Mungbean (BARI Mung-6) was planted in Barishal and Patuakhali, and soybean (Shohag) was planted in Noakhali during the Rabi season of 2018-19. Jute variety Nabin was planted in Baratia, Dumuria, Khulna during the Kharif-1 season of 2018-19. The average effective field capacities of ZT, ST, PTOS, and power tiller were found 0.11, 0.10, 0.12, and 0.09 ha/h and the average tilling depths were 3.10, 4.27, 4.69, and 5.55 cm, respectively. CA planting methods (ZT, ST, PTOS) saved 60-65% fuel (Diesel) than power tiller. CA planting methods saved 36-39% planting cost of mungbean, 53% planting cost of soybean and 50% planting cost of jute than CT. Significantly highest grain yields of mungbean were found for PTOS. ST and ZT did not perform well for mungbean yields in both Barishal and Patuakhali. Significantly highest grain yield of soybean was obtained from PTOS followed by that in dibbling and CT methods in Noakhali. Significantly highest dry stalk and fiber yields were found from ST planted jute followed by PTOS and CT. Yields of jute fiber and jute stalk from PTOS were significantly lower than ST but significantly higher than CT.

**Improvement and validation of BARI seeder for grain crops under different cropping patterns and soil conditions**

The improved seeder was found suitable for planting different types of crops, such as wheat, maize, lentil, mungbean, sunflower, cowpea, etc. During rabi, 2018-19, 4.22 ha of wheat maize, mustard, and lentil were planted by the improved seeder in Godagari and 8.04 ha of wheat and lentil were planted in Tanore, Rajshahi. Maize, mungbean, and sunflower were planted about 1.32 ha of land in Kalapara and 2.66 ha of maize, mungbean, and cowpea were planted in Dumki, Patukhali by the improved seeder. Slightly higher depth of tillage and field capacity were found in soft soil in Patuakhali than hard soil in Rajshahi. So, the field performance of seeder was found satisfactory in both Rajshahi and Patuakhali. There were four treatments (PTOS, strip tillage, zero tillage and conventional method) in field experiments of Rajshahi and Patuakahli. Significantly highest crop yields were found from reduced tillage (PTOS) than strip tillage, zero tillage and conventional methods. PTOS is effective in crop planting method in all project locations. In four project locations (upazila), 120 operators and farmers were trained through four practical trainings on operation, repair and maintenance of improved seeder. Awareness of 160 farmers were created through four field days in the project locations. Farmers of Rajshahi liked strip tillage but in Patuakhali they liked full tillage for planting of crops.

**Energy use analysis of CA tillage systems for rice-maize cropping pattern**

A study was undertaken to assess productivity, quantify energy flow and financial profitability of CA tillage methods for Rice-Maize cropping pattern. Treatments were Conventional Tillage (CT) T. Aman-CT Maize, CT Machine transplanted T. Aman- CT Maize, CT T. Aman- Strip Tillage (ST) Maize, CT T. Aman-Zero Tillage (ZT) Maize, STMT T. Aman-ST Maize, Strip till followed by manual transplanting (STMT) T. Aman-ZT Maize, Unpuddled Tillage (UPT) T. Aman-ST Maize, UPT T. Aman-ZT Maize. Crops were cultivated in the cropping pattern during last Rabi season of 2017-18 and 2018-19. Yield of maize and T. aman for different treatments were not significantly varied. Direct energy consumption was accounted for only a small proportion of the total energy consumption during maize cultivation. Indirect energy of maize shared lower amount in CT than ST and ZT. Direct energy of T. aman rice cultivation was highest in CT and the lower ST and ZT. The highest energy output-input ratio was found for unpuddled T.aman-ZT maize cropping systems. The highest input cost and return was recorded in CT T. aman- CT Maize cropping pattern but the highest BCR was found in Unpuddled T.aman-ST Maize cropping pattern. The experiment will be continued in the next year for completion of the cycle.

**Less tillage and optimum water use of wheat and mungbean with residue retention of a rice-based cropping system by using farm machinery**

An experiment was carried out at RARS, Rahmatpur, Barishal to evaluate the performance of different tilling and seeding machines to reduce turn-around time of a rice based cropping system and to determine the effect of different water stresses on wheat at different cultivation practices. There were two treatments. Tillage and seeding practices are in the main plot and irrigation in the sub plots. The tillage and seeding treatments were: $T_1$= Conventional tillage (Power tiller for tillage & broadcasting), $T_2$= Power tiller for tillage & Power operated Seeder for sowing seeds and $T_3$= High speed rotary tiller for tillage & power operated seeder for sowing seeds. The four irrigation treatments were: $I_1$ = Farmer practice, $I_2$ = 100% irrigation at CRI stage, $I_3$ = 100% irrigation at CRI Stage, 50% irrigation at 55-60 DAS and 50% irrigation at 75-80 DAS and $I_4$ = 100% irrigation at CRI Stage, 75% irrigation at 55-60 DAS and 75% irrigation at 75-80 DAS. The cropping pattern was wheat-mungbean-aus rice-aman rice. The wheat variety used was BARI Gom-30. By testing the tilling and seeding operations, it was stated that high speed rotary tiller along with power operated seeder is more effective than power tiller with broadcasting techniques. The performance of power tiller along with power operated seeder gives higher performance than power tiller with broadcasting techniques. From interaction, it was observed that the grain/spike, 1000- grain weight and grain yield sequentially higher at $T_3$ treatment. In case of irrigation treatments, $I_4$ gave higher results at 1000-grain weight and grain yield. The water productivity was high at $I_2$, due to less irrigation water applied than other treatments. Among the water stress treatments ($I_3$ and $I_4$), $I_3$ gave higher water productivity than $I_4$.

**Use of farm machinery for increasing cropping intensity and crop productivity in southern region of Bangladesh**

This research work was executed from the special allocation budget under Ministry of Agriculture under four districts, namely Faridpur (Sadar Upazilla), Rajbari (Baliakandi Upazilla), Barishal (Babuganj Upazilla), and Patuakhali (Sadar Upazilla) from July 2018 to June 2019. The research area of the project was farm machineries and the crops were wheat, pulse, oilseed, spices, and jute. The main objectives of the research was to reduce the turn-around time, production cost, and postharvest loss, increasing cropping intensity of the single cropped southern region and to develop entrepreneurship of the local manufacturers. The two treatments of the research work were $T_1$- Farmer's practice (Power tiller operated tilling system and broadcasting of seeds) and $T_2$- Tilling by high speed rotary tiller (to reduce turn-around time) and seeding operation by newly developed multi crop seeder (for quick seeding operation). Design of the research work was randomized complete block. The seed rate and fertilizer rate were applied according to BARI recommended doses and fertilizer recommendation guide. For all crops (wheat, pulse, oilseed, and spices) the yield was highest at $T_2$ (tilling by high speed rotary tiller and seeding by multi crop seeder) than farmer practice ($T_1$). The grain yield was observed highest (1.47 t/ha) in treatment $T_2$ for BARI Mosur-6. The grain yield was observed highest (3.90 t/ha) in the treatment $T_2$ for BARI Gom-28. The grain yield was found highest (1.80 t/ha) in treatment $T_2$ for BARI Mug-6. The grain yield was found highest (1.49 t/ha) in treatment $T_2$ for BARI Felon-1. The grain yield was found highest (1.10 t/ha) in treatment $T_2$ for BARI Sorisha-14. For increasing cropping intensity of southern region, HSRT and Multi crop seeder have better option in this changed climatic condition.

**Performance evaluation of a battery operated rotary type low cost weeder for upland weed management**

The specific objective of this experiment was to remove weeds by using power operated weeder rather than manual, mechanical, and chemical use of weeding to reduce time, save money and environment and increase work effort of labor. Adverse effects on environment and cost of chemical weeding are making farmers to consider and accept mechanical methods of weed control. Manual weeding is common practices in the farming system of Bangladesh. It is the most widely used weed control method, but it is labor intensive. The mechanical weeder is to reduce drudgery and cost which ensure a comfortable posture of the farmer or operator during weeding. The costs associated with mechanical weeding, such as operating cost can be lowered; as such mechanical weeding can represent a viable and cost effective option to majority of medium and small scale farmers in developing countries like Bangladesh. Weeder is designed and fabricated considering methodological steps. The performance of battery operated weeder was acceptable for wide row crop. Field trial on maize, chili, and eggplant was conducted at FMPE research field of Bangladesh Agricultural Research Institute, Gazipur. Weeding index of battery operated weeder for maize, chili, and eggplant was 92.52%, 95.85%, 92.79%, respectively, which was similar to chemical weeding. Again effective field capacities of battery operated weeder for maize, chili, and eggplant were 0.046 ha/h, 0.022 ha/h, 0.046 ha/h, respectively. Plant damage ratio was very limited for maize which was only 0.50% but it grew a little up to 2.8% for chili and eggplant. Cost of weeding by battery operated weeder was almost half compared to that of BARI weeder and just about one third compared to that of manual weeding but equivalent to chemical weeding. But there was no significant difference in yield among three methods except eggplant. Adaptive trail in farmers' field can help this technology more acceptable among the farmers.

**Design and development of prilled urea applicator for up-land crops**

An experiment was conducted at the research field of Regional Agricultural Research Station, Bangladesh Agricultural Research Institute, Rahmatpur, Barishal during Rabi season (2018-19) to develop prilled urea applicator for increasing fertilizer use efficiency and to increase crop production with saving of fertilizer and environment pollution with three treatments ($T_1$: Prilled urea broadcasting (Farmers' Practice), $T_2$: Prilled urea deep placement by applicator and $T_3$: N, P, K deep placement by applicator). The design of the experiment was randomized complete block (RCBD) with three replications. The variety of potato was BARI Alu-41. The fertilizer use efficiency of urea was more in deep placement treatments than

broadcasting. The highest yield was found (34.40 t/ha) at $T_3$ treatment followed by that in $T_2$ (32.75 t/ha) and $T_1$ (27.43 t/ha). The yield increase percentage was higher in deep placement treatment ($T_3$: 25.4% and $T_2$: 19.4%) than that in broadcasting of urea. The benefit cost ratio (BCR) was greater in $T_3$ (1.15) and $T_2$ (1.04) than $T_1$ (0.77).

**Development and adoption of two-wheel tractor operated potato harvester**

A two-wheel tractor driven potato harvester was developed and improved with locally available materials at Farm Machinery and Postharvest Process Engineering Division of BARI, Gazipur to facilitate small farmers to harvest their potatoes at low cost. The harvester was a semi-automatic digging machine consisting of digging blade, conveyer flat chain, guide plate and power transmission arrangement. The dimension of the potato planter was 900 mm × 850 mm × 950 mm. Field performance of potato harvester was evaluated at Regional Agricultural Research Station, Jashore, Tuber Crop Research Substation, Bogura, ten farmers' fields in Bogura and Jashore and Breeder Seed Production Station, Panchagarh during the Rabi season of 2018-19. Field performance of potato harvester was better than manual method at different locations of Bogura and Jashore. The highest field capacity was obtained at Gazipur (0.12 ha/h) followed by that at Bogura (0.109 ha/h) and Jashore (0.107 ha/h). Potato harvester required labor 21 per ha compared to 60 laborers per ha in traditional manual method. Total cost of potato harvesting by the potato harvester was Tk. 12023 per ha but in manually harvesting method, the cost was Tk. 29,600 per ha. Lifted tuber was found 94% for potato harvester whereas for manual method, it was 66%. Damage tuber was 2% higher in manual harvesting method than the mechanical harvesting method. The experiment will be conducted next year.

**Improvement of coconut dehusking machine**

Flat type blades were designed instead of spike type teeth, reduced the gap between the rollers from 45 to 40 mm, added rubber finger/lug instead of presser handle and added helical bar on the rollers for reducing breakage of coconut. An improved coconut dehusking machine was fabricated with locally available materials at Farm Machinery and Postharvest Process Engineering Division, Bangladesh Agricultural Research Institute, Gazipur. The overall dimensions of the dehusker was 920 × 750 × 1120 mm and its weight was 258 kg. The machine has to be placed on plain surface, open space, and shady place. The motor has to be started by means of OFF-ON switch, machine is running. Later one operator has to be placed one by one coconut between the two rollers and immediately press the coconut upper surface by rubber lugs. Coconut is dehusked action of two blades rollers those are rotating opposite direction. The husk is drained out in the basket through delivery path. The price of the machine was Tk.100000.00. The capacity of dehusker was 300 nuts per hour at the speed of 27 rpm of the machine roller. The breakage percentage of coconut was found to be 4. The dehusking cost of the device was found to be 0.28 Tk./nut. It was also estimated that benefit cost ratio was 1.28. Therefore, coconut dehusking by the dehusker could be profitable to traders when the annual use of the dehusker exceeds 750 hours. The machines would be useful for commercial purpose in coconut growing areas and coconut oil industry, wholesale and retail market for shelling coconuts.

**Development of a power operated sunflower thresher**

A study was conducted for solving the problem faced by the farmers in separating the seeds from the sunflower. Farmers use the manual methods due to unavailability of suitable machinery for sunflower threshing. During manual sunflower production, the most time and labor consuming operation is the threshing of sunflower by beating the sunflower heads with a stick, rubbing wear heads against a rough metal surface or power tiller treading machine. The aim of the experiment is to design and develop a power operated machine which will separate the seeds from the sunflower. An orthographic projection was drawn with SolidWorks 2016 Software. The sunflower seed thresher was then fabricated at FMPE Divisional workshop with available local materials during 2017–18. The developed sunflower thresher was modified during 2018-19. The space between the pressing rollers (38mm to 35mm) were reduced. The cover of the machine was redesigned to primary hopper. A threshing fan was incorporated in the improved version to separate the dust part from the grains. The capacity of the power operated sunflower thresher was 115 and 197% higher compared to that of pedal thresher and manual threshing respectively. Capacity of the thresher

varied with moisture content. Capacity of the thresher was varied from 89 to 125 kg/h within 31 to 62% moisture content (wb).

**Design and development of a sunflower seed dehuller**

Dehulling of sunflower seed is an important process prior to its oil extraction. Manual dehulling of sunflower seeds is a time consuming and tedious operation. Therefore, an experiment was conducted to design and fabrication of sunflower seed dehuller. An orthographic projection was drawn with SolidWorks 2016 Software. The dehuller was then fabricated at FMPE Divisional workshop with available local materials during 2017-18. The sunflower seed dehuller was modified during 2018-19. The disks were made of wood which were previously made of steel metal. Dehulling was done with the friction of two wood made disks instead of metallic disk. The weight of the dehuller was reduced from 80 kg to 71 kg. The capacity of the dehuller was 20.56 kg/h. Capacity of the machine increased compared to that in last year. Whole kernel recovery was 11.06% and broken kernel was 16.63%. Though the observed capacity was increased in improved model but still the capacity and efficiency are lower than the expectation.

**Design and development of a small scale millet dehuller**

Millets are considered as minor cereals of Bangladesh and commonly grown in marginal land areas (saline coastal areas and chars). Its production contributes to the food security, nutrition and income of the resource poor farmers in these marginal areas. Dehulling of the millet is traditionally done manually using mortar and pestle. This traditional dehulling is a labor and cost intensive operation and involves human drudgeries. In order to reduce the cost and drudgeries, a low cost millet dehuller was fabricated and tested at the FMPE Division, BARI, Gazipur. The batch type dehuller was feed with either 125 g, 167 g, 208 g and 250 g of millet grains at 9% moisture content and dehulled for either 90 s or 120 s (single pass only). The dehulling efficiency was as high as 99% up to the feed rate of 167 g. At these low feed rates, higher dehulling time did not improve the dehulling efficiency any further. Although, total milling recovery and head grain recovery were a bit low at these low feed rates, any higher feed rate would not be preferable as it reduces the dehulling efficiency. The dehulling time did not have any considerable effect on total milling recovery or head grain recovery at any of the feed rates.

**Design and development of a chilli seed separator**

The mechanical method of chilli seed extraction is a better solution to this problem. Therefore, a power operated chilli seed separator was designed and fabricated at FMPE Division, BARI. Extracting capacity of machine was 7-10 times higher than in manual extraction. It saved time of 4.5 times than manual method. The cleaning efficiency for dry chilli was 67.62% and 76.39% for fresh ripe chilli. Power extraction of chilli seeds was 5-6% cost effective. No seed injury was observed as well as no significant effect was found in germination or seedling emergence due to machine extraction.

**Design and development of power tiller operated onion harvester**

The research work has been carried out to bring out the reliable solution for harvesting of onion crop. The harvesting of onion crop is the labor intensive operation. The attempt has been made to design the harvester for the low power capacity, especially power tiller. The size of the harvester has been decided with respect to the agro- technical features of the crop. The working width of the harvester has been worked out to be 30 cm. The depth of operation for the onion crop has been decided up to 5 cm. The width and depth ratio was 12:1 which is fit to the design. The estimated capacity of the harvester in respect of the working in the soil has worked out to be 1 t/hr. Accordingly the materials for the fabrication has been decided as per the BIS standard. The drawbar power requirement for effective working of the harvester has been optimized from the travel speed, the total soil load and the discharge of soil mass and the capacity of soil. The estimated power requirement for the onion harvester is comes to 11 to 13 hp. The estimated total weight of the machine was calculated as per the proposed engineering drawing comes to be 20 kg. The estimated cost of the onion harvester was worked out to be Tk. 12000.

**Design and development of a low cost power driven tomato and potato grader**

Tomato and potato are sold without grading in the markets of Bangladesh. Potato is graded manually, and there is no mechanical grader available in the country. A rotating cylinder type tomato and potato grader was developed in Farm Machinery & Postharvest Process Engineering Division, Bangladesh Agricultural Research Institute in 2017-2018. The grader was made of locally available MS angle bar, MS flat bar, MS rod, MS sheet, MS shaft, ball-bearing, V-belt, V-pulley, and chain-sprocket, etc. An electric motor of 1 kW was used to rotate cylinder at 17 rpm. Few modification was done during 2018-19 as machine inclination was increased from 15 to 20 º angels, increased the gap between tray and cylinder, etc. The overall dimension of the grader is 3350mm×950mm×1300mm. Four graded tomatoes were obtained from the grader through four outlets of three cylinders. The average capacity of the grader for tomato and potato are 1260 kg/h and 1504 kg/h, respectively. During 2017-18, injury of potato and tomato reduced from 30 to 6% and 11 to 3%, respectively. Now, injury of potato and tomato reduced 0.5% and 0.24%, respectively. The benefit-cost ratio of the grader was found to be 1.54 and the payback period was 1.2 year. Therefore, the tomato and potato grader is economically profitable for custom hire business or industries. The grader is suitable for grower and traders as well as women-friendly.

**Design and development of a cream separator**

A prototype of cream separator machine was designed and fabricated at Farm Machinery and Postharvest Process Engineering (FMPE) Division, BARI, Gazipur during 2017–2018. The machine was made of a motor, SS rod, SS sheet, and SS bar, etc. Two types of milk sample named control (fresh milk) and treated (fermented) were prepared for churning in the machine for testing. The control milk (Cow milk) sample produced ghee of 0.08 kg (1.6% of total milk) from 0.26 kg (5.2%) cream which was derived from 5 kg milk sample after 15 minutes of churning. The treated sample yielded 0.140 kg ghee from 0.160 kg butter which was also derived from 5 kg of milk sample. The fresh milk fat was determined at 3.30% while the amount down to 1.57% when churned in the machine and the separation efficiency was found 52%. However, for the treated milk sample, the separation efficiency was 85%, while the fat down from 3.25% to 0.47%. This control sample need 58 kg milk to prepare 1 kg ghee while the treated milk need only 36 kg. This year another type of cream separator was developed, because capacity of previous machine was low compared to that of the current one. Current cream separator capacity was to produce 10.25 kg cream (Ghee 6.2 kg/h) from 180 kg fresh milk per hour. About 3.36% of Ghee can be obtained from fresh milk. The average machine capacity was 180 kg/ha.

**Preparation of maize stalk fodder for cattle**

Shortage of feed supply of the cattle during the dry season or flood period is an important issue which could be partially solved by maize stalk. An experiment was conducted to prepare maize stalk fodder for cattle during 2018-19. The BARI chopper was improved for chopping maize stalk in smaller size (7-8mm). Total chopping cost per hour was 0.23 Tk. per kg. The chopped maize stalk in both fresh and dried conditions with different combinations were served to the cattle and found that smaller sized chopped piece of both dried and fresh maize stalk could be feed in both raw and mixing with salt, wheat bran and water with little molasses. Maize stalk block also prepared with different combinations and found that block made by liquid Gur was better in both physically and cattle likeness during 2017-18. Total cost of block per kg was 13.85, 31.35, 28.85 and 36.35 Tk. for MS block 1(Molasses+ maize stalk), MS block 2 (Sugar + maize stalk), MS block 3 (Liquid Gur + maize stalk) and MS block 4 (Solid Gur + maize stalk), respectively. Chopped and dried maize stalk were preserved in polybag, open place and stored in room were liked by the cattle up to six months of the storage. Flatten and dried maize stalk were not liked by the cattle due to their long size and hardness. Changes in color of stored stalk were found of open floor and store room stored stalks. Fungal growth was observed which caused the changes in color. Chopped maize stalk and maize stalk block three stored in polythene bag in airtight condition could be store up to nine months.

**Development of soymilk making machinery**

The experiment was conducted to develop soyamilk making machinery to increase consumption of soybean as human foods during 2018-19. A blender and a pasteurizing unit was designed and developed for making

soyamilk. Capacity of the blender and pasteurizing unit was 2 liters and 6 liters, respectively. The operational time 50 seconds was selected with 69.69% blending efficiency to prepare soyamilk for each batch. Time for heating the interlayer water up to 100 $^0$C was 39 to 41 minutes. Time for reaching milk temperature up to 100 $^0$C required five minutes only. The soyamilk was prepared with 20 minutes pasteurizing.

**Improvement and validation of postharvest machinery for reduction of postharvest loss of fruits in the hilly region of Bangladesh**

The study was conducted to know the status of coffee and cashew nut processing machinery in Bandarban, Khagrachari, and Rangamati Hill districts during 2018-19. Good quality of cashew nut is produced in the hilly region mainly in Bandarban district. But there is no good shelling machine available in this region. The performance test of coffee pulping cum grinder with fresh harvested coffee and dry coffee was evaluated. One litre of water was required for pulping of 500 g fresh harvested coffee. The pulping capacity of the pulper was 8.5 kg per hour. Dehulling capacity of the pulper was 23 kg per hour. Structural configuration and operation technique of coffee grinder and cashew nut sheller were modified. Manual and power operated higher capacity coffee cherry pulper was developed and fabricated with locally available materials. The overall dimension of the pulper is 950×649×910 mm. The hand operated cashew nut sheller was modified into both the hand and pedal operated sheller for easy operating and increasing capacity. The capacity of the sheller was 2.97 kg/h. One batch field demonstration was done at Khagrachari on 6 January 2019. Three batches (20 participants per batch) trainings were conducted at Bandarban (2 Upazila) and Khagrachari (one Upazila) on 8-10 April 2019. Farmers and traders showed positive response on use of coffee and cashew nut processing machinery.

**Integration of postharvest technologies and best practices in the value chains of fruits and vegetables**

The structural improvement of carrot washing machine, and modification and fabrication of leafy and fruit vegetable washing machine were done at Farm Machinery and Postharvest Process Engineering Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur during 2018-2019. Washed (sanitizer-CCA and NaOCl) and unwashed carrots were packed in jute sack, plastic crate, CFB carton with polyethylene lining, polyethylene bag and perforated polyethylene bag stored in commercial cold storage of ASKEO MSP Centre Limited, Ashulia, Savar, Dhaka at 0-1°C and 97-99% rh for long term storage. The better yellow color of peel of carrot was found in washed carrot by CCA than washed of NaOCl. In case of the hue angle (h°), unwashed carrot was found highly significant followed by washed carrot by sanitizer at significant level of 5%. The aerobic bacterial count (APC) count and total coliform count (TCC) were recorded as 5.6 log CFU/g and 3.8 log CFU/g, in unwashed carrot samples in 0 month of storage during March 2019. However, no E. coli nor any salmonella were detected in the samples. Yeast and mold count was recorded as 4.7 CFU/g at 0 month storage. When carrot was washed with NaOCl followed by water wash, 1.3 log CFU/g of APC count and approximately 1.0 log CFU/g reduction of TCC counts, and 1.5 log CFU/g of Y & M counts were observed. On the other hand, higher reduction of APC and TCC counts were observed with CCA washed carrot compared to NaOCl washed carrot. Similar reduction of yeast and mold counts were observed in CCA or NaOCl washed carrot. The CCA washed carrot showed higher total phenolic content than that of NaOCl washed carrots. Irrespective of washing materials the total phenolic content reduces. The total carotenoid content of the harvested matured unwashed and washed carrot samples were significantly ($P<0.05$) different on day 0. The ascorbic acid (Vitamin C) content of unwashed and washed carrot was significantly ($P<0.05$) lower for non-sanitized carrot. The total soluble solids (TSS) ranged from 8.7 – 9.3 %. The TA (citric acid) values ranged from 0.07 – 0.11% on day 0. In all the chemical parameters analyzed, unwashed carrot showed higher values compared to washed carrots. Carrot washing machine was improved adding larger wheel, auto delivery mechanism and replacement of pump. The leafy and fruit vegetable washing machine was developed for washing of brinjal, mango and banana. The capacities of the machine were 990-1260 kg/h for mango, 1864 kg/h for banana, 1020 kg/h for brinjal and 516 kg/h for red leaf.

**Design and development of a jackfruit peeler**

The aim of the research was to develop a jackfruit peeler and to solve the problems. A power operated jackfruit peeler was designed and fabricated in the workshop of FMP Engineering Division of BARI,

Gazipur during 2017-18. The peeler was modified to improve the performance during 2018-19. The peeler was made with locally available materials. The peeler is electric power operated machine where power transmitted to the cutting blades and jackfruit was rotated. Mechanical peeling was done with two phases: in first phase minimum thickness was peeled and optimum peeling was done in second phase. Capacity of the mechanical peeling was 3.7, 3 and 6 times higher than the manual peeling for unripe jackfruit, papaya and sweet guard, respectively.The experiment will be conducted in the following year to evaluate the performance of the peeler for different fruits and vegetables.

**Development and application of a low cost mechanical lifter for safe handling of agricultural products**

A lifter is designed and fabricated for the purpose of lifting materials like sack, basket, crate and carton from ground to truck for loading purpose and vice versa. It is a simple mechanical device used to raise element or object from ground level to a certain height to perform a specific work with maximum load and minimum efforts. Conventionally lifter is used for lifting loading and unloading agricultural products, such as fertilizer, rice, wheat, vegetables, and rice husks and non-agricultural products, cement, coal, gravels, etc. Considering the circumstances of safe work environment of the laborer in transportation activities, low cost mechanical lifting equipment was developed for reducing the drudgery of the laborer and safe handling of agricultural products. Information collection and fabrication of lifter were completed. Mechanical lifter was designed by coupling principles of hydraulic power and mechanical power of electric motor. There is a horizontal base frame which is supported by 4-number of rubber tyre wheels. It is a walking type lifting device. The main component are (i) main frame (ii) stacker with fork, (iii) hydraulic pump, (iv) electric motor, (v) counterbalance assembly, (vi) push/pull handle with accessories. Primary target of weight (100 kg) and lifting height from 3 to 2.5 m i.e. up to the floor of transportation truck. Dimension of lifter is 6.096 $\times$ 0.854 m.

**Up-scaling and application of solar photovoltaic pump for smallholder irrigation and household appliances in the central coastal region of Bangladesh**

Base line survey was conducted in six Upazila, namely Kalapara and Galachipa of Patuakhali district, Borguna Sadar and Amtali of Borguna district and Charfassion and Lalmohon of Bhola district. In each Upazila, 30 farmers were interviewed with pre-tested interview schedules. Among the selected Upazilla, average age of farmers was 75 years. Among 166 interviewed farmers, 75.90% had primary education, 15.07 % were illiterate, 2.41% had secondary, 3.61% had higher secondary and rest 3.01% were qualified up to degree and higher kevel. The average literacy in the study areas was 96.76%. The average area of farm house, homestead and vegetable cultivation was found 183, 41 and 48 decimals, respectively. The vegetables-based cropping pattern was 10-15%. The main source of irrigation water in the study areas was surface water (Canals and ponds). About 1.91 m deep fresh water was always found available in the water sources throughout the dry season. Farmers of the study areas were found to use low lift pumps for irrigating. There was no solar pump in the study areas. Average solar home system (SHS) package was found as $40W_p$ panel capacity with at least three DC tube light and a single DC fan. Matching the demand of farmers, solar pump and SHS were designed fabricated for and irrigation and operation of household appliances at FMPE Division, BARI, Gazipur. The new solar pump was made with 51 mm diameter centrifugal pump directly coupled with 900 W dc motor. The performance of the solar pump was tested and average discharge was found to be 180 L/min. Six solar pumps along with SHS were installed for field trials in the six Upazila along with 1300 $W_p$ solar panel for each pump. Two field experiments were conducted in the research field of FMPE Division, BARI, Gazipur for testing of solar pump drip irrigation system during the rabi season of 2018-19. The tested crops were tomato (Roma VF) and brinjal (BARI Begun-8).Significantly the highest tomato and brinjal yields were found from drip irrigation than furrow irrigation method. There were no significant differences of yields among 3 days, 5 days, 5 days intervals of water application in drip irrigation method. Drip irrigation saved about 50% and 45% water than furrow irrigation for irrigation in tomato and brinjal, respectively.

**Development of handy solar dryer for drying of potato chips**

A handy solar dryer was developed for drying of small-scale fruits and vegetables, especially potato chips. The dryer was fabricated at FMPE Division, BARI using MS frame, plastic sheet, CI sheet, dc blower, solar

panel, plastic net, etc. The temperature in the dryer (45-50 °C) was about 10 °C above ambient temperature. The capacity of the dryer was to dry 2.5 kg of potato chips in 6-7 hours. Blanched sample of processing varieties of potato produced good quality potato chips. But table potato produced dark color potato chips. Non-blanched potato slices produced inferior quality in terms of color and shrinkage. Potato chips dried in the open sun took at least two sunny days for drying. If bad weather exits, potato chips are infected by fungus and damaged. Ten potato varieties, such as BARI Alu-7 (Diamant), BARI Alu-8 (Cardinal), BARI Alu-25 (Asterix), BARI Alu-28 (Lady Roseta), BARI Alu-29 (Courage), BARI Alu-35, BARI Alu-41, BARI Alu-68, BARI Alu-70 (Destony) and BARI Alu-71 (Dolly) were tested for suitability of chips making. BARI Alu-25 (Asterix), BARI Alu-28 (Lady Roseta) and BARI Alu-70 (Destiny) were found suitable for good quality chips preparation. The handy solar dryer may be used for drying of small quantity of potato chips as well as other fruits and vegetables in household level.

**Development and performance evaluation of a solar assisted cabinet dryer for vegetable seeds**

A solar cabinet dryer was designed and fabricated at Farm Machinery and Postharvest Process Engineering Division, Bangladesh Agricultural Research Institute during 2018-19 for drying of 10-15 kg of moist vegetable seeds. It was fabricated with locally available materials, such as MS box, MS flat bar, MS angle bar, MS sheet, GP sheet, SS net, insulation materials, dc fan, PV module, polyethylene sheet, cork sheet etc. It is an indirect solar cabinet dryer that consisted of drying chamber, collector and auxiliary heating source (electric heater). The dryer was designed to generate desirable temperature (<45°C) from solar radiation suitable for vegetable seed drying. The dryer was tested with harvested semi dry moist okra seeds (9.72 kg). After drying, final weight of okra seeds was 9.305 kg. Inside air temperature of the drying chamber varied from 31.3 to 44.4 °C (first day) and 30.2 to 44.7 °C (2$^{nd}$ day). Ambient relative humidity varied from 41 to 68% (first day) and 42 to 57% (second day), where the relative humidity in the drying chamber varied from 36 to 50% (first day), and 32 to 53% (second day). Lower relative humidity is important in drying for higher moisture carrying capacity of the air. Collector outlet air relative humidity was found lower than the ambient air relative humidity. The global solar radiation varied from 120 to 928 W/m$^2$ during testing period (January 2019). Semi dried okra seeds dried in the dryer attained final moisture content of 8% (wet basis) from an initial moisture content of 12% (wet basis) after15 hours of drying. There were significant differences between top and bottom layers by statistical t-test. The dryer was tested with red amaranth seeds (9.27 kg). Final weight of dried seeds was 7.907 kg. Drying chamber inside air temperature varied from 40.6 to 42.8 °C. The highest (848 W/m$^2$) and lowest (211 W/m$^2$) solar radiation was measured at 12:20 am and 4.00 pm respectively. Dryer relative humidity was about 50% lower than the ambient relative humidity. The moisture content was reduced from an initial moisture content of about 20.78% (wb) to the final moisture content of about 7% (wb) in 6 hours. The capacity of the dryer was 10-15 kg/batch. Germination rate of red amaranth seeds after drying up to 7% moisture content (wb) was 78%.

**Development of solar energy powered air ventilated natural onion storage system**

This experiment was conducted to increase the storage life of onion using solar powered forced air ventilated storage system rather than traditional storage method to reduce storage loss. Onion was stored in four different methods to know the storage behavior of onion bulbs. BARI Piaj-1 were kept in bulk at ambient conditions (25°C ± 3°C and 75% RH) in solar powered forced air ventilated storage system for 60 days of storage period. Physiological weight loss, total soluble solids (TSS), decay and moisture content were measured at an interval of 15 days. Forced air ventilated storage system observed significantly the lowest decay (6.275%) and it was closed to traditional storage system (7.45%) but net and jute bag storage system found the highest decay (8.067%) and (8.64 %), respectively. Forced air ventilated storage system was observed significantly the highest moisture content (76.59%) than traditional storage system (71-72%). The physiological loss ranged from 2 to 5% in forced air ventilated storage after 60 days of storage period. The physiological weight loss of onions stored under traditional method was more than 5%.

**Present status of using dies, jigs and figs by local manufacturers in Bangladesh**

This study was taken to determine the status of the tool and die available in the local manufacturing workshop. The survey was done at 20 different agricultural machinery manufacturers and 20 foundry workshop located at different parts of Bangladesh during 2018-19. Education level of 94% and 98% of the

workers in the agricultural machinery manufacturers and foundry workshops were below SSC. All surveyed agricultural machinery manufacturers used lathe machine, drill machine, welding machine and grinding machine as key working machine. All agricultural machinery manufacturers used templates whose are being used in their 40% production. Use of dies, jigs ,and figs were found as 60%, 20%, and 20% in agricultural machinery manufacturing. Agricultural machinery manufacturers have collected the highest amount (59%) of raw materials from Nawabpur and Dholaikhal of Dhaka followed by local spare parts shop (13%). Agricultural machinery sold mainly to farmers and dealers by the manufacturers. Most encouragingly found that 2% agricultural machinery were sold by on-line marketing. Most of the foundry workshop have collected their 37% raw materials from the locally collected scrap market (37%) followed by supplier (30%). Foundry workshop usually did not sell their product directly to the farmers. They mainly sold to their dealers. The manufacturers were demanding technical training, specialized land for workshop, chemical laboratory and heat treatment plant for foundry and development of dies, jigs, figs for each machine from research institute as the priority need. This study will be continued in the next year in others manufacturer to find status of the manufacturers in Bangladesh.

**Validation and Adaptive Field Trial of BRRI Developed Solar Light Trap**

Solar light trap manufactured, distributed and adaptive field trials were done in farmers' field under special research budget allocation of the Ministry of Agriculture. Aiming to validate and adaptive field trial of BRRI solar light trap to the end users, manufacturer and resource poor farmers that reduces the need for application of insecticides. Five sides, namely Gazipur Sadar (Rice), Chowgacha of Jashore (Vegetable and rice), Sherpur of Bogura (vegetable and rice), Shibpur of Narsingdi (vegetable and rice), and Koyra of Khulna (Rice and fish) were selected for research cum adaptive trial programme. A total 120 solar light traps were distributed to the farmers' fields. Rice insect pests, including yellow stem borer (YSB), green leafhopper (GLH), white leafhopper (WLH), leaffolder (LF), caseworm (CW) and rice bug (RB) were the dominant in each of the solar light trap test cases. The highest number of insect pests was trapped in may than that of April month. In brinjal field, significantly higher number of brinjal fruit and shoot borer (BFSB) were recorded in the solar light trap than in pheromone trap. A total 25 of awareness cum demonstration and training programs were conducted along with more than 1,000 potential farmers, manufacturers, and NGO personnel participated. Use of solar light trap both in rice and vegetable crops was found effective in controlling insect pests. It also reduces chemical insecticide application and save environment.

**Design and development of a head feed combine harvester**

A study was aimed to design, fabricate and test the performance of the developed prototype of head feed mini combine harvester with locally available materials in the Janata Engineering Workshop, Chuadanga under Public Private Partnership (PPP). BRRI provided engineering design, drawing, technical and financial support to develop and fabricate the machine. The second prototype of combine harvester was redesigned and fabricated according to the identified faults in the 1$^{st}$ prototype. The field test of 2$^{nd}$ prototype was conducted to find out the performance, efficiency, operation fault, etc. It was found that harvesting capacity and fuel consumption were 1.23~1.25 bigha/h and 3.84~3.96 l/h, respectively. There are still some problems in the 2$^{nd}$ version. When straw thickness is more than one inch, some un-threshed panicle remained in the upper layer of the rice stalk. The developed combine harvester is appropriate in both dry and muddy fields with plough pan up to 15-20 cm. This machine can also be used in agriculture in a number of ways to increase productivity, mitigate labor shortages, and reduce production cost.

**Design and development of a whole feed combine harvester**

A second prototype of whole feed mini combine harvester was fabricated using locally available materials in the Janata Engineering workshop, Chuadanga under Public Private Partnership (PPP). BRRI provides design, drawing, technical and financial support to develop and fabricate the machine. The faults of first prototype were taken into consideration to fabricate the second prototype. The field test revealed a functional problem in gear system and cleaning mechanism. The harvesting capacity and fuel consumption were found 0.15~0.20ha/h and 2.75~3.25 l/h respectively. The success of this machine may create a new era in Bangladesh agriculture for harvesting and also mitigate the labor shortage.

**Incorporation of prilled urea deep placement mechanism in the mechanical rice transplanter**

A research was conducted to incorporate the prilled urea fertilizer deep placement (FDP) technology with the existing rice transplanter (ARP-4UM) to accelerate the adoption of mechanized rice transplanting and FDP technologies to the end users. Walking type 4-row rice transplanter was selected for FDP technology based on power transmission facility and available space for necessary attachment. Engine power available at high rpm (more than 1800 rpm) was conveyed to the applicator with the arrangement of belt-pulley, worm gearing, shaft-bearing, rotary cam and bevel gear with an engage-disengage facility resulting in about 22 rpm of the FDP injector. Worm gear is used to reduce the power at a ratio of 1:35. Bevel gear of 13 teeth also used in the gear box to change the direction of power at $90^0$ intersecting shaft. Single start worm gear of 35 teeth is used having 12 mm shaft diameter. Power transmitted from the output shaft of the gear box to the applicator main shaft with the ratio of 10:9 by chain-sprocket arrangement. The impellor type mechanism was connected to the main shaft of the applicator to dispense the prilled urea fertilizer to the output channel. The developed rice transplanter cum prilled urea applicator performed well in the lab, research field as well as a farmers' field by transmitting power from the engine to the applicator, receiving and placing the prilled urea to the furrow and covering the placed fertilizer properly.

**Multi-location trials of the BRRI developed rice transplanter cum prilled urea applicator**

A separate study was conducted to evaluate the performance of BRRI developed rice transplanter cum prilled urea applicator (RTPUA) in the farmers, fields at Chadgaon, Madan, Netrakona; Bahirbag, Muksudpur, Gopalganj; Tarapur, Kumarkhali, Kushtia and Vararul, Dhirashrom, Gazipur districts, respectively, during Boro season 2018. BRRI dhan28 was used to conduct the study except Kushtia where BRRI dhan58 was used as study material. Soil textures of the study areas were clay, silty loam, clay loam and silty clay loam, respectively. The experiment was laid out in a randomized complete block (RCB) design with three replications. About one meter of buffer spacing was maintained among the sub-plots whereas experimental plot sizes were 75, 82, 105, and 54 decimal in Netrakona, Gopalganj, Kushtia, and Gazipur, respectively. The treatments were $T_1$: Mechanical transplanting (MT) along with urea deep placement (70% urea), $T_2$: MT + hand broadcasting of urea (UHB) at three equal splits, $T_3$: Hand transplanting (HT) and UHB at three equal splits, and $T_4$: Control (-N). Mechanical transplanting along with deep placement of urea fertilizer (70% of the recommended dose) gave a significantly higher yield compared to manual transplanting and hand broadcasting of urea except Kumarkhali, Kushtia. RTPUA accounted the highest BCR (1.55, 1.67, 1.79, and 1.49 at Netrakona, Gopalgonj, Kushtia and Gazipur, respectively) for 70% of the recommended urea fertilizer application in non-oxidize zone followed by mechanical transplanting plots along with hand broadcasting of urea fertilizer (1.35, 1.38, 1.70 and 1.25).

**Comparative study of BRRI developed weeders**

A study was conducted to evaluate BRRI developed different weeders, such as BRRI weeder, power weeder, conical weeder, and double row weeder. These weeders were tested in wet land condition in BRRI research field and a farmers' fields, Jogitola, Gazipur. The performance of the newly developed power weeder was compared to that of BRRI weeder, BRRI conical weeder, double row weeder and hand weeding techniques in wetland condition. The average weeding efficiency of the BRRI weeder, power weeder, conical weeder, and double row weeder were 72.94, 80.82, 81.39, 78.6%, respectively. But the percent of tiller damage was found high for BRRI power weeder. The effective field capacity of BRRI weeder, power weeder, conical weeder, and double row weeder were 247, 669, 228, 373 $m^2$/h, respectively.

**Performance evaluation of power operated automatic seed sower machine**

The uniform seedling density 2-3 seedlings per square centimeter is a prerequisite condition for smooth operation of mechanical rice transplanter. Seed sowing in a uniform density by hand broadcasting is difficult, time consuming and laborious work. Thereby a power mechanical seed sower machine was collected and calibrated to perform seed sowing mechanically. The uniformity of seed dispensing rate and depth of soil in the tray were measured in different positions of the lever. The recommended depth of bed soil and depth of cover-up soil were found in the middle position of 3-4 and 2-3 of the adjusting lever, respectively. The desired seed rate was found in the middle position of 3-4 of the adjusting lever for long

and short grain varieties (120~150 g germinated seeds per tray) and uniformity of seedling (3-4 seedling per $cm^2$). About 440 trays per hour can be prepared at desired condition. Therefore, it is an appropriate and time saving technology to prepare seedling trays for mechanical rice transplanter.

**Test, evaluation, and modification of rubber roll de-husker**

A de-husking machine was developed to improve the milling performance of rice processing, and brown rice was polished in MNMP polisher. The capacity of the de-husker was 675 kg/h and the husking efficiency was found 92.3% for BRRI dhan80. The milling recovery was 64% when it was polished in a friction type polisher. The average head rice recovery based on input paddy was 55.8%, which was found promising for processing of premiere quality rice. Existing engelberg huller can be replaced with the combination of de-husker and polisher. Besides, this combination gives similar milling recovery of the semi and automatic rice mill. In addition, separately collected husk and bran can be used for making briquette and extracting edible oil, respectively.

**Effect of degrees of milling (DoM) on rice quality**

Farm Machinery and Postharvest Technology (FMPHT) Division, BRRI and HarvestPlus jointly conducted research on "Processing of Rice for Zn Efficacy Study". The aims of this study were to determine the percentage of milling effect on weight loss, head rice recovery, Zn and Fe loss of rice. Two rice varieties, such as BRRI dhan28 (no Zn enrich) and BRRI dhan42 (bio-fortification) were used in this study. Grain zinc and iron content were estimated in the brown rice (dehusked unpolished grain) and different degrees of polished rice (7.5, 10, 12, 13.75, and 15%). The zinc content was calculated by using X-ray fluorescence (XRF) at HarvestPlus laboratory in Bogura. It was observed that the zinc content of both varieties decreased with the increase of the degree of milling (passing number 1 to 5). Zinc content of two varieties was varied up to 12 DoM and after 13.75 DoM there have no difference in Zn content, both bio-fortification and no Zn enrich verities. A similar trend was found in iron content in the parboiled grain of these two varieties. During the milling process, the broken percentage increases with increasing of DoM, due to low surface hardness which leads to low quality and recovery of milled rice. It was also observed that there had negative relationship between DoM and head rice yield. DoM affects not only the quality but also the appearance of rice kernels. This study showed that the DoM and whiteness are positive correlated. It was clearly shown that more food loss occurred due to more degree of milling, which is great, hampered the food security of a nation. It can be concluded from these results that, over DoM affect the losses of Zn and Fe content as well as lower head rice recovery.

**Study on milling recovery of BRRI dhan42 under different moisture content**

Parboiled BRRI dhan42 was processed in the air blow type engelberg huller with six different moisture levels (9.3%, 10.4%, 11.3%, 12.2%, 13.2%, and 13.9% wb.) to find out the optimum moisture content for milling. Under parboiled condition, around 10-11% moisture content (wb) was found suitable for milling of parboiled paddy processed in the air blow type engelberg huller and around 10% moisture content (wb) was found best in terms of head rice recovery (62.5%).

**Agriculture mechanization and technology dissemination in three selective haor districts**

An awareness program was taken in haor areas (Kishorganj, Habiganj, and Netrakona) in the Boro 2018 season to adopt seedling raising technique and transplanting seedling mechanically in the field. Field demonstration cum training on seedling raising technique and mechanical rice transplanting were conducted at farmer's field. A total of 18 bighas of farmers, land was transplanted in the demonstration cum training program. Participant farmers prepared seedling tray in their own hand and these seedlings were used for transplanting. Most of the participants observed this type of machine for the first time and become very confused about the use of rice transplanter for transplanting the seedling in the field. The participants were made aware about the basic idea (how to prepare seedling tray, operate the transplanter machine, how many adjustable functions were there and in which condition these functions needed to be adjusted) on the operation, repair and maintenance. The participants become confident over the use of rice transplanter after observing the performance of the machine.

**Modification of reaper travelling wheel for wet-land condition**

In dry land, reaper performed well in harvesting of rice. But in wet land, its performance was not smooth. Thus, the reaper travelling wheel was modified increasing the width of the wheel and fabricated at BRRI Research Workshop. The width of reaper travelling wheel was increased to resist the soil resistive force. It has been tested in the wet paddy field at BRRI farm, Gazipur. It performed well at wet land condition due to the increased contact area between the reaper travelling wheels.

**Determination of tilling efficiency of power tiller at selected areas of Bangladesh**

The effect of tillage depths on the productivity of paddy were determined in field experiments in Aman 2018 at BRRI R/S, Rajshahi and in Boro 2019 season at research farm of BRRI R/S Rajshahi and Rangpur in different tillage depths. There were four tillage depths i.e. 3-4, 4-5, 6-7, and 7-8 inches. Tillage depths affected dry bulk density of soil, tiller, panicle number, and yield of BRRI dhan34 in Aman 2018 and BRRI dhan28 in Boro 2018 in BRRI R/S, Rajshahi; and BRRI dhan63 in BRRI R/S, Rangpur in Boro 2019 season. Dry bulk density of soil decreased slightly with the increase of tillage depth. Tiller and panicle number of plant also increased with the increase of tillage depth. Plant height, plant dry weight, root length, and root dry weight of cultivated paddy was increased with tillage depth at both Aman and Boro seasons. The highest grain yield was found 2.55 t/ha in the tillage depth of 6-7 inches and lowest was 2.06 in the control treatment (minimum tillage) of BRRI dhan34 in Aman season. The highest grain yields were found 5.22 t/ha and 7.10 t/ha in the tillage depth of 6-7 inches and the lowest yields were found 3.98 t/ha and 6.58t/ha in the control treatment (minimum tillage) of BRRI dhan28 and BRRI dhan63 in Boro 2019 season, respectively. The highest grain yields of all the seasons were found under higher tillage depths of 6-7 inches and the lowest yields were obtained in the control (minimum tillage). Number of tillers, panicles, yield of both varieties were found more or less same in both the seasons at 6-7 and 7-8 inches tillage depth. Farmers of Bangladesh practiced usually 4-5 inches depth of tillage. Fuel consumptions were calculated in different plots at different tillage depths during ploughing in Aman 2018 and Boro 2019. Fuel consumptions were varied little bit in different plots at different tillage depths in Aman season but these were more or less same in different plots at different tillage depths in Boro season.

**Survey on status and constraint of farm machinery used in farmer's fields in selected areas**

Different kinds of farm machinery have been used in the farmers' fields and these are power tiller, shallow tube well, pedal thresher, open drum thresher, sprayer, etc. The questionnaire survey was conducted on machinery used in farmer's field, Dhara bazar, Netrokona district. A little number of machinery was used in the village. There were 18 power tillers, 22 shallow tube wells, 10 pedal threshers, 16 open drum threshers and 28 sprayers. There were no rice transplanter, reaper, combine harvester, and close drum thresher at the farm level of these areas. So, there is a scope to introduce these machineries in the area. The problem is that the operator of the machine is not skilled. They never follow proper machinery maintenance schedule which increase operation and repair cost. So, proper training should be arranged for the machinery operator.

**Potentiality of engineering workshop for enhancing farm mechanization in selected areas of Bangladesh**

Arafat Engineering Workshop, Dinajpur was visited to know its potentiality in farm machinery manufacturing. The facilities of machinery of the workshops were foundry, lathe, shaper, drill, milling, grinding, welding, metal cutting and power press. It produced different kinds of agricultural machinery using locally available materials. Close drum thresher, open drum thresher, and bed planter are the common machinery produced by the workshop. Combine harvester, reaper were developed by virtue of its own merit. Specialty of Arafat engineering workshop, Dinajpur have an innovation i.e. close drum thresher which threshed paddy remaining straw intact.

**Feasibility study of solar energy use in agricultural machinery**

Pedal thresher was modified to use solar energy in threshing of paddy. 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. Solar operated grain cleaner was designed and developed. DC motor (0.5 hp) and an accelerator were incorporated to operate the blower of the cleaner. Then it was tested in cleaning of threshed paddy in Boro 2019 in. Its capacity was found 560 kg/hr.

**Design and development of a tropical sugar beet diffuser**

In the last few years, Bangladesh is trying to cultivate sugar beet and consequently successful in growing sub-tropical sugar beet. Sugar is produced from sugar beet through diffusion process which is done by diffuser machines. In this study, two types of diffuser- manual and automated diffuser were designed and fabricated. Diffusing capacity were 100 kg/h and 200 kg/h, respectively. Diffusing temperature 70 $^{0}$C was maintained in both the cases. In automated diffuser, temperature was controlled by thermo couple. An agitator was run by electric motor where worm gear was used to reduce rpm. Also a steam generator was included to supply heat in the chamber. Diffuser has a diffusion chamber made of three layers. The internal layer was made by stainless steel sheet and outer two layers were of mild steel sheet. Space between external two layers was filled by insulating materials to protect heat loss and space between middle (internal) layer were used as steam chamber for heating the water of diffusion chamber. A boiling chamber was attached with this machine to produce and supplied steam to the steam chamber. A thermal sensor was placed in diffusion chamber to control temperature. A stirrer was placed with this machine for stirring cosetts and water mixer. After completion of diffusion process water remained in the drum called as raw juice collected from an outlet which was set at the bottom of a drum. Through boiling and evaporation collected juice was concentred for making goor.

**Design and Development of Efficient Sugarcane Power Crusher for Goor Production**

At present, juice extraction capacity of sugarcane crusher is around 45% of cane weight. Due to low extraction capacity of crusher processing loss is high. A study was under taken to increase juice extraction rate and crushing capacity by less power consumption. For achieving the targets, a ten (10) hp diesel engine, four numbers of rollers having 4- inch diameter were used to develop a crusher. For improving feeding chevron groove was introduced to the cutting roller. And Knurling operation was done on other rollers for improving crushing capacity as well as feeding also. Central pressing roller had fixed up with collar at both sides of roller for jamming free operation. Other pressing rollers were run within this collar made by 10mm MS plate. A semi-automated lubricating system was added to the machine. Several parts of the crusher can be easily dismantled hence it can be carried easily to long distance and any remote area of Bangladesh.BSRI Akh 39, BSRI Akh 41, BSRI Akh 42, BSRI Akh 43, BSRI 45 were selected for crushing purposes to evaluate the performance of this BSRI power crusher. In results the juice extraction capacity were found 59-63% for BSRI Akh 39, BSRI Akh 43 and BSRI 45, beside 65-69% for BSRI Akh 41 and BSRI Akh 42 respectively. Feeding capacity were found 450-500kg/hr for BSRI Akh 39, BSRI Akh 43 and BSRI 45. On the other hand feeding capacity were 500-525kg/hr for BSRI Akh 41 and BSRI Akh 42. 10-15% processing loss could be reduced by this improved BSRI power crusher.

**Design and Development of hygienic sugarcane juicer for juice vendor of Bangladesh**

A study was under taken to develop a hygienic cane juicer for juice vendor of Bangladesh. BSRI developed a hygienic sugarcane juicer had an electric motor of 2hp, 1450 rpm. There were three different chambers of the juicer machine. One of them was crushing chamber which was contained three rollers where two were pressing roller and one was cutting roller. Second chamber was used to seal the glass face after filing cane juice in it. After washing sugarcane, it was kept in the third chamber to maintain its food grade quality and protected from dust and flies. It was also lidded by a transparent sheet over the chamber. All parts of the juicer machine were made of stainless steel to maintain food grade quality of cane juice all the time. Crushing capacity of the machine was 125-150kg/hr and juice extraction capacity was above 90 Lt/hr.

## 1.2 Irrigation and Water Management

### Effect of deficit irrigation on yield and water productivity of different maize varieties in southern areas

This study was conducted at the Regional Agricultural Research Station, BARI, Rahmatpur, Barishal to determine the experimental evidence of the effects of deficit irrigation on yield and water productivity of different maize varieties during 2017-2018 and 2018-2019. The experiment consisted of five irrigation treatments viz. Farmer's practice ($I_1$), Full irrigation at 20-25 days after sowing (DAS) ($I_2$), 50% irrigation at 20-25 and 50-60 DAS ($I_3$), 75% irrigation at 20-25, 50-60 and 75-80 DAS ($I_4$), 50% irrigation at 20-25, 50-60, 75-80 and 110-120 DAS ($I_5$). These irrigation treatments were tested on three maize varieties, namely BHM-9 ($V_1$), BHM-7 ($V_2$), and NK-40 ($V_3$). The yield and yield contributing parameters were affected significantly by irrigation and variety. The treatment with 50% irrigation at 20-25, 50-60, 75-80 and 110-120 DAS produced the highest grain yield of 10.83 and 11.87 t/ha whereas the variety NK-40 produced the highest grain yield of 10.73 and 10.03 t/ha in 2018-19 and 2017-18 DAS, respectively. In case of interaction effects, the highest grain yield of 11.87 t/ha was obtained from $I_5V_3$ in year 2018-19 and the highest (11.17 t/ha) grain yield was observed in $I_5V_2$ treatment in previous year. The average benefit cost ratio (BCR) was observed highest (2.92) in $I_3V_1$ 50% irrigation both at initial and vegetative stages at 20-25 DAS and 50-60 DAS from BHM-9. The water productivity (WP) production was obtained highest in $I_3$ i.e. 50 % irrigation both at initial and vegetative stages at 20-25 DAS and 50-60 DAS treatment 2.02 kg/m$^3$ and 2.73 kg/m$^3$, respectively, for first and second years, due to less irrigation water application whereas the lowest WP was observed at farmer's practice**.**

### Assessment of water use on the growth and yield of white grained hybrid maize

The experiment was conducted at the experimental field of IWM Division, BARI, Gazipur and farmer's field of Godagari, Rajshahi during 2016 -2017 and 2017-2018 to assess the water use on the growth and yield of BARI Hybrid Maize-13. Six levels of irrigation were applied for the experiment with four replications. The study was conducted at the research field of Regional Agricultural Research Station, Hathazari, Chattogram during the rabi season of 2018-19 to identify the critical stages of irrigation and optimize irrigation in cowpea production. Five treatments were applied: $T_1$ (rain-fed i.e. local practice), $T_2$ (irrigation at 3 weeks interval), $T_3$ (irrigation at flowering stage), $T_4$ (irrigation at pod formation stage), $T_5$ (irrigation at flowering and pod formation stages). The highest yield (2.2 ton/ha) and highest water stress coefficient ($K_s$= 1 to 0.6) were found at higher frequency irrigation ($T_2$). The maximum irrigation (182mm) was applied at $T_2$. In rainfed condition ($T_1$), cowpea yield was lowest (1.2 t/ha). Crop production function of cowpea was Y=1.08+0.006X, $R^2$ =0.89 at 95% confidence interval. The sustainability of cowpea in low water stress co-efficient (up to 0.05) indicated that field crop was drought tolerant. Irrigation at pod formation stage gave higher yield than flowering stage in case of only one irrigation. The flowering stage ($K_y$= 1.15) was more sensitive to deficit irrigation than pod formation stage ($K_y$= 0.93). Based on the economic analysis, irrigation at three weeks interval was more beneficial (BCR=1.47).

### Potentiality of biochar to enhance productivity of tomato under deficit irrigation

This study was conducted at the research field of Irrigation and Water Management Division (IWM) of Bangladesh Agricultural Research Institute (BARI), Gazipur during 2017-2018 and 2018-2019 to examine the potentiality of biochar in improving productivity of tomato cultivated under deficit irrigation regimes, and the effects of biochar on some soil properties. BARI Tomato-14 cultivar was used for the experiment. There were six different irrigation treatments comprising three levels of irrigations and two soil conditions [full irrigation ($F_I$), 75% of $F_I$ and 50% of $F_I$ with biochar ($T_1$ to $T_3$) and without biochar ($T_4$ to $T_6$)]. It was observed that plant height at different growth stages was lower in deficit irrigation (full irrigation > 75% irrigation > 50% irrigation). However, plant height was significantly higher in treatments with biochar compared to the non-biochar treatments ($T_1$>$T_4$, $T_2$>$T_5$ and $T_3$>$T_6$). In contrast to the plant height, root length was found higher in non-biochar treatments ($T_4$, $T_5$, $T_6$) than that of their parallel biochar treatments ($T_1$, $T_2$, $T_3$). Again, both wet and dry biomass weights were found highest in $T_1$, where the lowest values of both of these attributes were found in $T_6$. Moreover, the number of fruits per plant, unit fruit weight and the marketable yield in different treatments followed the usual trend, higher in biochar treatments, and reduced

significantly as lesser amount of irrigation was applied. About 3-4%, 6-7%, and 9-10% higher marketable yield of tomato was observed in $T_1$, $T_2$, and $T_3$ compared to $T_4$, $T_5$, and $T_6$, respectively. As less amount of irrigation water was applied in deficit irrigation treatments, water productivity (WP) showed an increasing trend with the increase in irrigation deficiency. Nonetheless, an improvement of WP by around 4-6%, 8-11%, and 11-12% was observed in $T_1$, $T_2$, and $T_3$ compared to $T_4$, $T_5$, and $T_6$, respectively. It was also observed that the soil moisture content dropped sharply in non-biochar treatments under deficit irrigation regimes compared to the treatments with biochar. Overall, biochar addition in the soil helped improve the growth and yield of tomato grown under deficit irrigation regimes as well as the water holding capacity, N-status and heterotrophic respiration of the soil.

**Effect of irrigation on growth, flowering and corm production of gladiolus in winter season**

The experiment was conducted at the experimental field of IWM Division, BARI, Gazipur during 2018 - 2019 to evaluate the effect of different irrigation systems and scheduling on the performance of gladiolus. Nine irrigation treatments were designed for the experiment with four replications. Results revealed that the drip system of irrigation ($T_1$, $T_2$, $T_3$) showed best performance than shower ($T_4$, $T_5$, $T_6$) and flood irrigation ($T_7$, $T_8$, $T_9$) system. Spike yield (22.42 t/ha), weight of single spike (84.07 cm), spike length (105.1 cm), rachis length (54.46 cm), yield of corms (1.04 t/ha) and cormel (0.94 t/ha), weight of single corm per plant (43.71 gm), diameter of corm (6.2 cm), number of cormels per plant (33.50) and weight of cormels per plant (12.33 gm) were found maximum with drip irrigation system ($T_1$, $T_2$, $T_3$). Maximum plant growth, spike yield attributes and flower production were obtained with gravity drip irrigation at 20% less N than recommended dose which were competitive with other two drip irrigation treatments along with shower irrigation with 80% of FC and flood irrigation at 10-days interval. However, maximum corm and cormel growth attributes was obtained from drip irrigation with recommended N along with the above treatments stated for spike yield. Whereas, the minimum plant growth, spike yield attributes, corm and cormel yield parameter were achieved with shower irrigation with 60% of FC along with shower irrigation with 100% of FC, flood irrigation at 15 days interval and flood irrigation at 20 days interval. The results of the study showed that the lowest irrigation water use, highest water productivity, and water and N savings through drip irrigation system, or shower irrigation with 80% of FC, or 10 days interval flood irrigation promotes flower growth and quality characters and corm production of gladiolus in comparison with optimal or scarce water applied through shower or flood irrigation system.

**Yield and water productivity indices of different onion varieties under sprinkler irrigation**

To evaluate the performance of four onion varieties under sprinkler irrigation and their sensitivity to water stress, a study was conducted at the experimental field of IWM Division, BARI during the winter season of 2018-2019. The experiment comprised of five irrigation treatments with sprinkler system based on 60%, 80%, 100%, 120%, and 140% of crop water use (ETc) laid out in split-plot design with three replications. Irrigation water was applied at a fixed 6-day interval with sprinkler system throughout the crops growing season. Onion sensitivity to water stress was determined using a yield response factor (Ky) derived from the linear relationship between relative evapotranspiration deficits (1-ETa/ETm) and relative yield decrease (1-Ya/Ym). Statistical analysis revealed that plant height was not much affected by the level of irrigation while leaf number, bulb diameter, bulb unit weight and total bulb yield was affected significantly ($P<0.05$) by the irrigation regimes. Among the four onion varieties, the highest plant height, bulb diameter and unit bulb weight contributed to the highest yield of 24.53 t/ha for BARI Piaj-4 ($V_4$) followed by 22.04 t/ha for Taherpuri King ($V_3$) under 120% water regime. Taherpuri super ($V_2$) produced the second lowest yield of 17.73 t/ha which was comparable to the lowest yield of 16.57 t/ha produced by the variety BARI onion -1 ($V_1$). Value of Ky determined for the whole growing season was found higher for $V_4$ (Ky: 1.18) and $V_3$ (Ky: 1.16) than other two varieties (0.85 for $V_1$ and 0.87 for $V_2$) indicating that both varieties $V_4$ and $V_3$ are highly sensitive to water stress. This fact is also evident by the water productivity (WP) with higher value obtained under higher water regimes (120% ETc) in case of $V_4$ and $V_3$; but for other varieties, higher WP was obtained from 80% ETc water regime. The amounts of water used for evapotranspiration under different irrigation regimes ranged from 151 to 253 mm, 153 to 256 mm, 158 to 260 mm and 161 to 262 mm, respectively, for $V_1$, $V_2$, $V_3$ and $V_4$ with minimum at 60% ETc and maximum at 140% ETc water regime. Though seasonal evapotranspiration was higher under wetter water regimes, yield was lower and

consequently WP was the lowest. Considering Ky as a limiting factor, application of irrigation at 80% ETc was a marginal for $V_1$ and $V_2$ and 100-120% ETc for $V_3$ and $V_4$, beyond that yield losses are insupportable.

**Performance of fertigation system on bottle gourd cultivation**

An experiment was conducted at the research field of Irrigation and Water Management (IWM) Division, BARI, Joydebpur, Gazipur during the rabi season of 2017-18 to determine the performance of bottle gourd (var. BARI Lau- 3) under fertigation systems. Six different irrigation treatments $T_1$= Ring Basin irrigation at 7 days interval with recommended fertilizer doses, $T_2$= Fertigation at an alternate day with recommended fertilizer doses, $T_3$= Fertigation at an alternate day with 20% less N and K than recommended doses, $T_4$= Fertigation at an alternate day with 35% less N and K than recommended doses, $T_5$= Fertigation at an alternate day with 50% less N and K than recommended doses were selected. The highest yield of 37.20 t/ha was obtained from treatment $T_4$ by applying 35% less N and K than recommended doses through drip system followed by treatment $T_5$ (33.02 t/ha) by applying 50% less N and K than recommended doses through drip system. Ring basin method required 404 mm of water during the season whereas only 107 mm water was needed in drip method. The economic analysis revealed that the highest benefit cost ratio (2.99) was obtained from treatment $T_4$ by applying 35% less N and K than recommended doses through drip system followed by treatment $T_5$ (2.67) by applying 50% less N and K than recommended doses through drip system. During the rabi season of 2018-19 the experiment was conducted but after two harvest the plants were damaged due to heavy rainfall and wind speed.

**Determination of relationship between soil salinity and irrigation water salinity**

This study was conducted under the poly shed house of Irrigation and Water Management Division, BARI, Joydebpur, Gazipur from May 2018 in pot to determine the relationship between soil salinity and irrigation water salinity. Three types of soil (Sandy loam, Clay loam and loam) were used with different levels of salinity where no crop was considered. Artificial salinity was prepared by using raw salt mixing with water through the trial and error method. To measure in situ soil salinity, direct soil EC meter was used. Irrigation water with different salinity level (4, 8, 12 and 16 dS/m) were applied up to field capacity at 15 days interval and soil salinity were measured at two depths (0-15 and 15-30 cm). The results demonstrate that soil salinity showed mostly increasing trend with time after applying different levels of saline irrigation water at 0-15 cm and 15-30 cm depth. Clay loam soil showed higher soil salinity compared to loam and sandy loam soil. A linear relationship was observed between irrigation water salinity and soil salinity at the end of the study for both depths. Though soil salinity at shallow depth rose higher than deeper depth but this trend was opposite at the end of the study for the highest level of saline water. However, further continuation and monitoring for this study is needed to get the final result.

**Conjunctive use of fresh and saline water in irrigation for wheat, barley and mustard in coastal areas of Bangladesh**

Conjunctive use of fresh water (low-saline) and saline water (medium saline) for irrigation is a strategy to irrigate rabi crops in the coastal salt affected areas of Bangladesh where fresh water is not available. In this study, the objectives were to assess the effect of fresh water (FW) and saline water (SW) irrigation on the crop performances, and the scope of fresh and saline water irrigation for rabi crops. Three field experiments were laid out in a randomized complete block design with four irrigation treatments for wheat, barley and mustard, and replicated thrice during 2018-2019. These field experiments were conducted in farmers' fields at Sikandorkhali village, Amtali upazila in Barguna and Tildanga village, Dacope upazila in Khulna district. Standard crop management practices and irrigation scheduling of different crops were followed. Results showed that the use of FW at early growth stages and SW at later growth stages had significant difference. Treatment $T_4$ (FW at early stage and SW at later growth stages of wheat/barley/mustard) produced significantly greater yield at around 2.2, 2.4, and 1.2 t/ha wheat, barley, and mustard, respectively, than other treatments. The effect of location had significant difference on the crops yield. At Amtali, wheat, barley, and mustard gave significantly higher yield than Dacope coastal regions. The highest salinity of field soil water ($EC_w$) and osmotic potential were occurred in mid to end of the February 2019 in all treatments in the soil profiles (0-60 cm). The exact soil salinity ($EC_e$) varied from around 2 to 13 dS/m at Tildanga and 2 to 7 dS/m at Amtali. On average, the osmotic potential was found -200 to -700 kPa at Amtali and -200 to -

1300 kPa from December 2018 to March 2019 and highest osmotic potential observed in February 2019 at both locations. Soil water contents substantially decreased in upper soil layers (0-15 cm) at mid February which affected the crop growth stages. The water salinity of the pond, canal and river ranged from around 1.5, 2 and 5 dS/m (November 2018) to 3.5, 4 and 20 dS/m (April 2019). The irrigation water (low saline) was not available to the pond/canal from mid-February to March during the crop growing season which hampered the crop production. However, the use of FW (low sanity of: ≤2 dS/m) at early growth stages and SW(2 ≥ salinity ≤ 4 dS/m) at later growth stages of wheat, barley and mustard could be an alternative option for intensifying cropping system in the coastal saline zones of Bangladesh.

**Controlled moisture and cracks of soil on salinity, crop growth and yield of maize and sunflower in no-tilled systems of coastal soils**

Crack formation in clay soils presents a major difficulty for movement of water, conserving soil moisture and the accumulation of salts on the soil surface through capillary from saline groundwater which restricts the crop growth and yield in no-tilled systems of coastal saline soils of Bangladesh. Therefore, the field experiments were conducted at the salt-affected areas of Bangladesh. The objectives of the study were to: (i) evaluate the effect of straw and irrigation frequency on crop growth and yield in maize and sunflower, and (ii) determine the combined effect of straw and irrigation frequency on the salinity, osmotic potential and moisture of soils. The experiment was carried out in farmers' fields with eight treatments and was replicated three times during the dry (rabi) season of 2018-2019. There were two rice straw treatments (with or without straw), and 4 irrigation frequencies (at intervals of 5-7, 10-12, 15-17 or 20-25 days). Maize and sunflower seeds were sown by dibbling in no-tilled systems. The results showed that rice straw significantly affected the crop growth and yield, increasing the yield of maize and sunflower by 22% and 4.3% compared to treatments of without residue. The irrigation treatments also significantly affected crop yields. There was no interaction between straw levels and irrigation. The causes of these effects appeared to be improved water relations: rice straw and more frequent irrigations both reduced the salinity and osmotic potential of soils compared with treatments without straw while the soil moisture was greater in rice straw treatments and increased with the increased soil layers. Therefore, it is concluded that straw mulching and irrigation management practice could be used in coastal saline of heavy soils to reduce soil salinity, osmotic potentials thereby increasing crop yields in no-tilled systems.

**Improving surface Drainage cum furrow irrigation technique for sunflower and maize cultivation in coastal saline soils**

Two field experiments were investigated to evaluate the rabi crops of sunflower and maize performances at two locations of Dacope and Amtali during 2018-2019. The specific objectives of this study were (i) to find out the effect of surface drainage cum furrow irrigation technique on crop growth and yield, (ii) to find out the effect of the surface drainage technique on salinity, osmotic potential and moisture contents of soils during crop growth periods. Four drainage treatments were imposed at all sites with three replications. The treatments consisted of (i) single row raised bed (furrow 15 cm drain), (ii) double row raised bed (furrow 20 cm drain), (iii) triple row raised bed (furrow 20 cm drain), and (iv) random field ditches (scattered)–Pothole. Sunflower seed and maize grain yield were ranged from 1.53 t/ha to 2.34 t/ha and 7.16 t/ha to 8.04 t/ha, respectively. The technique of single row raised bed with 15 cm drain obtained 2.34 t/ha greater sunflower seed yield than other drainage treatments. The treatment $T_1$ (single row raised bed with 15 cm drain) obtained (8.04 t/ha) significantly greater yield than other drainage treatments. On average, the changes exact salinity (ECw) of field soil water varied from around 2 to 12 dS/m at Tildanga and 2 to 9 dS/m at Amtali during the crop growing season. The salinity results indicated the salt accumulation was slightly lower in the treatment of single row raised bed planting and drainage technique than the other drainage techniques. The osmotic potential was found around -200 to -1100 kPa at Tildanga and -200 to -800 kPa at Amtali. Soil water contents substantially decreased in upper soil layers (0-15 cm) at later growth stages which affected the crop growth. However, the drainage technique would be optioned for sunflower and maize cultivation in the coastal areas of Bangladesh where salinity and waterlogging problems prevail.

**Assessment of groundwater quality for irrigation in the northwest region of Bangladesh**

The present investigation is aimed at understanding the temporal and spatial variability of groundwater quality for its use in irrigation purpose in the northwest region of Bangladesh. The groundwater samples from selected STWs and DTWs were collected during November – December of 2018 in pre-irrigation season and during March – April of 2019 in post-irrigation season. Water quality indices, namely sodium adsorption ratio (SAR), exchangeable or soluble sodium percent (SSP or %Na), residual sodium carbonate (RSC) and Kelly's ratio (KR) were calculated for the water samples of separate bore wells. Besides, the composite influence of different water quality parameters on the overall quality of water was also assessed using water quality index (WQI). The upper limit of SAR of 0.99 (less than 10), SSP 38.06% (less than 60%), RSC 2.54 and KR of 0.64 (<1) implies that all the groundwater samples were suitable for irrigation. According to the WQI values, all the samples were found to be "good" except few were found "poor" in post-irrigation season. Thus, the majority of the area is occupied by good water in both pre- and post-irrigation seasons.

**Prediction of groundwater level using a discrete space-state model as an alternative to physically based groundwater modelling**

Reliable and accurate prediction of groundwater level is an essential component of sustainable water resources management and designing remediation plans. Groundwater simulations and predictions are often performed by employing physically based models, which are not applicable in many parts of the world especially in developing countries like Bangladesh due to data limitations. On the other hand, data-driven statistical methods have proven their applicability in modeling complex and nonlinear hydrological processes with a view to forecasting short-term and long-term groundwater levels. The purpose of this effort was to develop a non-physical based approach by utilizing a discrete Space-State model as a prediction tool for future scenarios of groundwater level forecasting. In Space-State modelling approach, a model is identified to accurately compute a dynamic system with response to an input. The present study utilizes the prediction focused approach of the system identification process in which the overall goal is to create a realistic dynamic system model. The performance of the proposed approach was evaluated for groundwater level data at three observation wells of Tanore upazilla of Rajshahi district, Bangladesh. Historical weekly time series of water level data from the three observation wells for 39 (1980-2018) years was used to develop the time series model, which was used for future water level predictions for a period of the next 22 years (up to 2040). The results of the present study indicated the potential applicability of the proposed discrete Space-State modelling approach in forecasting future groundwater levels in the observation wells of the study area.

**Sustainable groundwater utilization for crop production in Rajshahi district**

This study was conducted in nine upazilas of Rajshahi district to investigate the groundwater level trend for sustainable groundwater use of crop production. Monthly water table data, data for irrigated crops, irrigated area, wetted area and meteorological data have been collected from Barind Multipurpose Development Authority (BMDA) and Bangladesh Meteorological Department (BMD). After collecting all relevant data, water table dynamics were analyzed with a model named "MAKESENS" and in excel. Results showed that groundwater abstraction as well as irrigated area decreased for the current year. But long term trend of water table depth indicates that water level decreased with time significantly in almost all upazilas and went below threshold level in the last few years for some upazilas. Future predictions based on the present declining trend demonstrates that if this abstraction is continued then groundwater level will go below threshold level as well as suction limit of shallow tube wells in most upazilas. Then withdrawing groundwater in this way will not be sustainable at all. So, some effective irrigation techniques will be needed to adopt in order to avoid over exploitation and consequently to promote the sustainable use of groundwater for crop production.

**Dissemination of BARI developed water saving irrigation technologies for enhancing crop production in drought prone, coastal, and hilly areas of Bangladesh**

This project was conducted during the rabi season of 2018-2019 to disseminate BARI developed water saving irrigation technologies in three distinct water stress regions; drought prone (Rajshahi and Naogaon), salinity affected (Patuakhali) and hilly (Khagrachari) region. Three different types of water efficient irrigation technologies were disseminated among the farmers: alternate furrow irrigation (AFI), drip fertigation, and deficit irrigation (DI). At Tanore Upazilla of Rajshahi, AFI technology was used to cultivate potato. AFI technology was found to increase the yield of potato by around 12% compared to the flood irrigation method, whereas it also increased the water use efficiency (WUE) by 84%. AFI technology was also tested to cultivate tomato at Godagari Upazilla of Rajshahi. Where farmers' practice had 35.5 t/ha of yield, use of AFI technology increased it to 40.7 t/ha. Irrigation water was also used significantly lower (about 45%) in AFI resulting greater water productivity than that of the farmers' practice. Wheat was grown using deficit irrigation (DI) technology at Shapahar, Naogaon. Here, two irrigation at CRI and grain filling stage was found to be the most effective one saving about 26% water but only sacrificed yield around 5%, eventually improved water productivity by 29% compared to the three irrigation treatments. In salinity affected Kuakata of Patuakhali district, maize was cultivated using AFI technology. On an average 7.53 t/ha yield of maize was found in every furrow irrigation (EFI), where under AFI it was 7.32, losing only 3% yield. But, significant amount of water was saved (around 24%) in AFI, thus water productivity was also found greater (30% higher) than that of the EFI. Similar result was also obtained in case of sunflower, where AFI technology saved about 30% of irrigation water that led to an improved (38% more) water productivity. Performance of drip irrigation was tested in watermelon cultivation at Kuakata. Where yield of watermelon was 35.7 t/ha in drip irrigation, ring basin and flood irrigation had only 28.9 t/ha and 25.6 t/ha, respectively. Drip irrigation also saved water use by around 11% and 18% than ring basin and farmers' practice. Drip fertigation method was found even more efficient in hilly area of Khagrachari, where marketable yield was 34% higher than that of the control treatment. Approximately 93% higher water productivity in drip fertigation method suggests that it could have significant effect on vegetable farming in hills, if properly practiced. Cabbage and cauliflower was also cultivated in hill, where both crop showed significantly higher water productivity under AFI technology (around 26% and 29% respectively) suggest that this could be a great option for crop production in this area. All the results obtained from this project suggest that BARI developed water saving irrigation technologies have potential to judicially utilize the limited water resources in the stress prone areas. Therefore, effective and large scale dissemination/transfer of these technologies can significantly increase crop productivity of the drought, saline, and hilly areas finally can contribute to the country's food security under climate change.

**Automated Alternate Wetting and Drying Irrigation System for Rice Production**

The study is currently ongoing in collaboration with Department of Computer Science and Engineering, United International University (UIU), Bangladesh. The primary objective of this study is to modernize the conventional or manual system of implementation of AWD technology by introducing digital irrigation application system. A sensor-based technique has been adopted for applying water efficiently and properly in AWD irrigation system. Sensors are developed to detect water level in installed PVC pipes. When depth of water level below soil surface reaches expected level, the pump starts automatically. The pump stops automatically when water level in the PVC pipe comes at the desired level above the ground surface. An Arduino pro mini as processing power, sonar sensor for measuring the water level and RF module for communication between field monitoring device and the base station (pump turning on/off) are the components of the automated irrigation system. The outcomes from this study are expected to reduce irrigation cost by 30% to increase water productivity and to reduce labor involvement in rice irrigation.

**Optimization of irrigation water use for Boro cultivation under different establishment methods**

The experiment was conducted in BRRI farm, Gazipur during Boro season 2018-19 to find out suitable method of Boro cultivation under water limiting condition. Performances of three crop establishment methods (Transplanting, dry direct seeding and wet direct seeding) was tested along with three water management practices (Continuous standing water, alternate wetting and drying practice and thin irrigation practice).

BRRI dhan28 was the tested variety. Treatments were $T_1$- Transplanting with maintaining continuous standing water (TP-CSW); $T_2$- Transplanting with alternate wetting and drying irrigation practice (TP-AWD); $T_3$- Transplanting with thin irrigation practice (TP-TIP); $T_4$- Dry direct seeding with maintaining continuous standing water (DS-CSW); $T_5$- Dry direct seeding with alternate wetting and drying irrigation practice (DS-AWD); $T_6$- Dry direct seeding with thin irrigation practice (DS-TIP); $T_7$- Wet direct seeding with alternate wetting and drying irrigation practice (WS-AWD) and T8- Wet direct seeding thin irrigation practice (WS-TIP). Each treatment was replicated thrice. Individual plot size was 80 $m^2$. Recommended fertilizer management practices were followed. Refit 500 EC was applied in treatments, $T_1$, $T_2$ and $T_3$ to control weeds infestation. Superpower 10 WP was applied in treatments, $T_4$, $T_5$, $T_6$, $T_7$ and $T_8$ to control weeds infestation. Water applied in irrigations was measured with a flow meter. Yield and yield components were measured following standard procedure. The total growth duration for transplanting, dry direct seeding and wet direct seeding were 130 days, 122 days, and 117 days, respectively. Irrigation frequencies were higher for plots under direct seeding methods compared to the transplanting method plots. This is due to longer field duration of the direct seeded crop. But irrigation depths were higher in treatments under transplanting methods compared to direct seeding methods. Highest yield was obtained under treatment $T_4$ (5.57 t/ha) followed by $T_7$ (5.50 t/ha), $T_6$ (5.26 t/ha), $T_5$ (5.24 t/ha) and $T_1$ (5.23 t/ha). It indicates that similar yield could be achieved with less irrigation by adoption of AWD and thin irrigation practice. The highest yield in direct seeded rice was obtained in $T_4$ (5.57 t/ha) followed by $T_6$ (5.26 t/ha) and T5 (5.24 t/ha). The experimental results show that good yield could be achieved with both dry direct seeding and wet direct seeding. Amount of irrigation was less in direct seeded plots compared to that in the transplanted plots. Maintaining continuous standing water condition was found good for both transplanting and direct seeding. Thin irrigation practice with wet direct seeding was found better for both irrigation water saving and satisfactory yield. Dry direct seeding was found good for all the water management practices.

**Study on water stress tolerance capacity for different advanced rice genotype of BRRI**

Worldwide freshwater scarcity for rice agriculture is threatened to feed the more growing population in future. Efficient use of water in rice production is now crucial issue. BRRI has addressed different location specific favorable and unfavorable conditions and has released new variety to overcome the situations and increase yield and yield potentiality. But water stress tolerance capacity (WSTC) of the variety was not determined. Therefore, this study has been taken with the objectives of quantification the tolerance capacity of soil moisture deficit for different advanced breeding lines that plant suffers during its growing period and determination of the yield variation under different water stress condition. The experiment was conducted in a net house during Aman season 2018. Two ALART material, namely BR (Bio) 8961-AC22-14 and BR (Bio) 8961-AC26-16 along with check variety BRRI dhan49 were supplied from Biotechnology Division to evaluate in the Aman season, 2018. Thirty-three days old seedlings were transplanted in tub (35 lit) containing 54 kg puddle soil. The soil was fertilized with urea-TSP-MP-Gypsum-$ZnSO_4$ @ 6-2-3-2-0.5 g/tub. Soil tension was measured using 30 cm long tensiometers installed in 3 replicate tubs of each treatment. The tensiometers were installed in the middle of the tub, and the middle of the ceramic cup was 10 cm below the soil surface. The experiment was conducted with 3 water treatments. In this experiment, -10 kPa water stress means AWD, -30 kPa water stress means maintaining water level at field capacity at 10 cm soil depth and -60 kPa water stress means maintaining water at 10 cm soil depth below field capacity. The treatments were as follows: $T_1$= Irrigation when water potential was -10 kPa at 10 cm soil depth, $T_2$= Irrigation when water potential was -30 kPa at 10 cm soil depth and $T_3$= Irrigation when water potential was -60 kPa at 10 cm soil depth. Water stress imposed throughout the growing season. Four hills were transplanted in a tub with 20 cm spacing. The experiment was laid out in a completely randomized design with three replications. The soil in the water stress treatments dried rapidly after each irrigation. Results showed that $T_1$ treatment received 17 number of irrigations by throughout the growing season whereas $T_2$ treatment received 13 and $T_3$ treatment received 8 number of irrigations, respectively. $T_1$ treatment took 2-4 days to reach the threshold level. In the same time, $T_2$ and $T_3$ treatments took 3-5 and 8-9 days to reach the threshold level, respectively. Grain yield were statistically significant difference by genotype and water stress during Aman season 2018. ALART BR(Bio)8961-AC26-16 gave significantly higher yield than ALART BR(Bio)8961-AC22-14 and check variety BRRI dhan49. Higher grain yield of two ALART lines

and check variety was observed when water stress imposed as -10 kPa. Grain yield were decreased 37 to 62% if the water stress imposed as 30 and 60 kPa. Therefore, both the ALART lines and check variety have water stress tolerance capacity of -10 kPa. ALART BR(Bio)8961-AC26-16 may be tested for further evaluation.

**Agricultural drought forecasting for mitigating drought in T. Aman rice**

The experiment was conducted at BRRI farm Gazipur in T. Aman, 2018. The objective of this research is to develop the method for forecasting of agricultural drought based on weather data as early warning systems in Bangladesh. BRRI dhan49 was used as test variety. Forecasted rainfall and evapotranspiration were used as input of drought model to quantify agricultural drought. Forecasted $ET_0$ was measured by CROPWAT 8.0. In case of rainfall, forecasted and observed values were made some deviation due to uneven distribution of rainfall. But this variation was found not more than 10%. The forecasted and observed drought were calculated from drought simulation model. Drought model measured the forecasted drought less than the observed drought. According to yield analysis it was shown that under rainfed condition ($I_0$) yield was found quite low (4.08 t/h) compare to supplemental irrigation based on forecasting ($I_1$) (5.20 t/ha) and supplemental irrigation in rainfed condition (5.46 t/ha) based on perch water table level ($I_2$). But, treatments $I_1$ and $I_2$ seemed to be found similar yield.

**Water resources assessment for dry season crop cultivation in selected polders of coastal region**

The study was conducted in polder number 43/1 situated at Amtali, Barguna to delineate suitable water resources during dry season and to determine the amount of fresh water available for crop production during the period. There are so many primary, secondary and tertiary canals run within this polder. During the reporting period, we could able to survey the canals having width >10 m. All primary, secondary and tertiary canals of the selected areas were surveyed during March to April, 2019. Width and depth of canals were measured at regular distance. Position of each point was taken by GPS meter (Garmin GPS meter). Length of canal was measured using Google earth tools. Volume of water stored in a particular canal section was calculated by multiplying length, width and depth of the canal section. Water salinity of each canal was monitored using EC meter. CROPWAT8.0 model developed by Food and Agricultural Organization (FAO) was used to calculate crop water and irrigation water requirement of different crops in the polder area. Total possible cultivated area by different crops was calculated with the available water resources in the polder. The peripheral length of the polder is about 66.9 km and the total area enclosed by the polder is 13,539 ha. Total 151 km long primary and secondary canals were surveyed in polder 43/1. Total stored volume of water was 7414503 m3 in April. Among the surveyed canal 11.1 km long canal was affected by salinity ranges from 1-2.2 dS m-1. Poor maintenance and broken sluice gates are the main causes of saline water intrusion from the river water into the polder area. Water salinity in the remaining canals were found <1.0 dS m-1. The highest gross irrigation requirement was found in Boro rice (1170 mm) followed by maize (412 mm). The lowest GIR 152 mm was found in sunflower. Considering all the canals was trapped with fresh water during dry season, the maximum cultivable area by different crops with this water was analyzed. It was observed that 4878 ha sunflower field can be successfully irrigated with the 7414503 m3 water. On the other hand, irrigation is possible 1800 ha and 634 ha land of Maize and Boro rice, respectively. There is a large possibility of dry season crop cultivation using canal water in polder 43/1. Large volume of water stored in the canal and water salinity remains in permissible limit. But proper operation of sluice gate is needed.

**Evaluation of smallholder surface water solar irrigation system for crop production**

We have designed and implemented a portable type 2.56 kW solar panel that can run a 2 Hp irrigation pump comfortably. The performance parameters of the designed solar pump represent similar performance of the many other diesel pumps operating in the field. For example, a 4-horse powered shallow tube-well has a discharge of 4-6 liter/sec when it is operating in the farmer's field, while this 2-horse powered solar pump had a discharge of 5-7 liter/sec even at a suction lift of 22.08 feet (surface water) and average operating hours found ranging from 7.48 to 7.53 both off and manual tracking conditions, respectively when delivery head is constant. We did not find significant difference on the performance characteristics of the solar pump both off tracking and manual tracking due to rapidly variation of irradiance during the period. According to

varying delivery head, discharge increases as solar radiation increases and an inverse relationship originates between delivery and discharge. Average operating times were found between 8.06 to 8.31 hours, respectively at off and manual tracking conditions when the suction head is constant. As an additional activity, the solar system can operate a 1.5 kW BRRI open drum paddy thresher at a rate 250-350 kg paddy/hr. On the other hand, it can generate about 7-10 KWHr energy per day when it is connected in on-grid at off season. Solar power is one of the cleanest sources of energy because it does not emit any pollution when it is produced or consumed, so it can help avoid the carbon dioxide ($CO_2$) and other air pollutant emissions associated with conventional electricity generation.

**Evaluation of different mulching materials in rice under saline areas**

This study was conducted to find out the reduction rate of salinity through mulching materials in rice production. The study also improves the productivity and profitability and cropping intensity of the coastal regions of Bangladesh. The study was conducted at Dacope, Khulna and Amtali, Barguna during the dry season of 2018-19. The trapped canal water was used for irrigation. The experiment was laid out in a Randomised Complete Block Design (RCBD) with three replications. In water management, alternate wetting and drying (AWD) water application were followed. The saline tolerant BRRI dhan67 were tested in this study. Forty-five days-old seedlings were transplanted with recommended fertilizer and agronomic management in both the locations. Irrigation water was measured with a flow meter. The experiments involved five mulching treatments, and these are, No mulch, mulching with Ash, mulching with Saw dust, mulching with Rice husk and mulching with rice straw. Water salinity was measured before and after irrigation water application. The highest grain yield was found in ash mulching and the lowest grain yield was found in saw dust mulching in both the locations. It was observed that the saw dust may be developed toxicity in the field after application and in both the location the water colour became red and crop appeared to stunt. Ash mulching treatment produced comparatively higher yield in both the location. It may be happened due to higher potassium content in ash, which may reduce the salinity effect from rice field. Ash mulching showed 3.25 to 7.35% yield advantage over the conventional no mulching treatment. Amount of applied water varied from 770 to 850 mm in both the locations. The highest water productivity was found on ash mulching and the lowest WP was found in saw dust mulching in both the locations. The data revealed that ash mulching reduced the field water salinity compared to no mulching. This may be the contributing factor for increasing rice yield in ash mulching treatments in both the locations.

**Salinity dynamics of water in coastal areas of Bangladesh**

Water availability during the dry season is the main constraints for crop production in coastal saline areas of Bangladesh. This study was conducted at Dacope, Khulna and Amtali, Barguna during 2016 to 2019 to determine salinity level of the river and groundwater in both the project sites and also to determine the soil and water salinity dynamics in field level during dry season. For monitoring river and trapped canal water salinity, three spots were selected at a certain distance in both the locations of Dacope, Khulna and Amtali, Barguna and measured water salinity of the selected points by EC meter. Irrigated rice field water salinity was measured at the same date and time. An observation well was installed in one corner of the experimental field within the weather station boundary at Pankhali village of Dacope, Khulna and very near to the experimental field at Sekandarkhali village of Amtali, Barguna to measure groundwater level and salinity. Soil salinity from rice field was measured weekly and non-rice field was measured at 15 days intervals after transplanting at 0-15, 15-30, 30-45 and 45-60 cm soil depth. Based on the three years monitoring data (2016-19), average salinity of the river water remained below 1.0 dS/m up to December and is considered highly suitable for irrigating crops in both the locations. Even river water remained suitable (<4.0 dS/m) for irrigation up to end of December. After that the river water salinity gradually increased and at the end of Rabi/Boro cropping season it reached about 24 dS/m in May. The canal water was trapped within December at the period of high tide making canal water salinity of about 1.0 dS/m. Its salinity increased in a slower rate and reached up to 3 dS/m in May due to evaporation and influence of groundwater flow. This limit was also permissible for crop cultivation. The field water salinity varied corresponding to canal water salinity and successfully grown the crops in both the regions. After the onset of rainy season i.e. in June the river water salinity sharply goes down and from July-December there was no salinity and after that it start to increase following the same trend. Generally, average groundwater level and

salinity in the experimental field at Pankhali, Dacope varied between 0.04-1.09 m below the field surface and 0.4-2.9 dS/m, respectively. The lowest value prevailed (about 0.4 dS/m) July to November and the highest (2.9 dS/m) in April to May. In Dacope, groundwater salinity remained less than 4.0 dS/m during the study period and is considered suitable for irrigation development. But, withdrawal of groundwater from the upper low saline aquifer is a risky venture for increasing salinity by intrusion of river high saline water in dry season. Whereas, average groundwater level at Sekandarkhali, Amtali varied between 0.8 to 1.8 m from ground surface and groundwater salinity at 3.24 to 10.8 dS/m. The lowest value of 3.24 dS/m was observed in November-December and the highest value of 10.8 dS/m in May-June and it's indicated that the upper aquifer groundwater in most cases is not suitable for irrigation. So, fresh river water entrapping into the existing canals of polder areas was found suitable for dry season crop cultivation in coastal saline areas of Bangladesh.

**Technological interventions for improving water use efficiency in the northwest region of Bangladesh**

The aim of the study was to improve the livelihood of woman, marginal and tenant farmers in the Eastern Gangetic Plains which includes northwest region of Bangladesh through improved water use and increased dry season agricultural production. This study discussed the results of some technological interventions such as the use of polythene pipe for water conveyance to the field, alternate wetting and drying (AWD), and introduction of new high yielding varieties to increase water use efficiency of rice in the region. The study was carried out during 2016-17 and 2018-19 crop season at 4 locations (Pabna, Bogura, Rangpur, and Thakurgaon districts) across the region. Results shows that use of polythene pipe irrigation water distribution system was found effective in minimizing conveyance loss of irrigation water. It may reduce water supply by 20-25% and saves irrigation time by 25%. Thickness of polythene pipe should be used to ensure longevity of the pipe. Check valve installation offer reduction of drudgery in STW start and ensures uninterrupted operation of the pump. Installation of check valve in STWs will encourage the owners to use polythene pipe for water distribution. Groundwater level in the study areas was the main concern for STW operation. There was no problem of STW operation in Pabna, Rangpur and Thakurgaon as the groundwater level did not drop below the suction limit. Only in Bogura water level fell below the suction limit (8.8 m) whereas deep set STW was needed for pumping of water. AWD technique for irrigation scheduling was found effective for reduction in irrigation water supply by about 14-18% in Boro rice cultivation. Overall water productivity in traditional farmers practice varied from 0.69 to 0.73 kg/m3 and that of AWD varied from 0.81 to 0.83 kg/m3. AWD irrigation method reduces 160 kg $CO_2$/ha emission and reduced 23-36% methane flux emission from rice field compared to continuous flooding. Mass adoption of this technology by the farmers will reduce significant amount of irrigation water pumping, fuel use and cost of irrigation in some areas. It will also reduce the greenhouse gas emission. The yield of newly released high yielding varieties varied from 4.53 – 9.88 t/ha and the farmers' choice of the variety depends upon the yield, grain quality, growth duration and price of local market. The study recommends field level training and demonstration of Polythene pipe distribution system and AWD to motivate the farmer for wide-scale adoption of these technologies.

**Evaluation of some Aus mutants (M4) for different 'soil moisture stress'/'drought tolerance level'**

The experiment was conducted in container (size: 1.5 m x 1 m x 0.28 m) at BINA HQ, Mymensingh to study the response of rice mutants to drought condition and to develop appropriate irrigation management strategy for the mutants.The scheduled treatments were: $T_1$ = Control (normal irrigation, 3 days AWD); $T_2$= Supplemental irrigation when ASM drops below 85% (throughout the growing season); $T_3$= Up to booting stage, irrigation at SM= 0.85 ASM; for the remaining period, irrigation at SM= 0.60 PASM; $T_4$ = Irrigation at 0.85 ASM (throughout the growing season), treatment beginning at 17 days after transplanting. Treatments were imposed after establishment (3 weeks from transplanting) except $T_4$.The cultivars were: $V_1$ = $N_4$/250/P-1(2) and $V_2$ = $N_4$/250/P-2(6)-26. Three series of container (3 replicates) were used. The design was RCBD, with split-plot. The seedlings (22 days old) were transplanted on 12 April 2018, and harvested on 28 June 2018. The cultivars showed insignificant difference. The irrigation treatments showed significant difference in grain yield, tiller/plant, plant height and seed/panicle. Interaction effects of irrigation treatments and cultivars on grain yield showed insignificant difference. The mutants produced lower yield under soil moisture stress.

**Response of sesame cultivars to different drainage provisions**

The objective of this experiment was to study the effect of different drainage spacing on sesame yield. The experiment was carried out under field condition at BINA HQ, Mymensingh, during March 2019 to June 2019. The test varieties were: $V_1$ = Binatil-2, $V_2$ = Binatil-3, $V_3$ = Binatil-4. Experimental design was

RCBD, with 3 replications. The imposed drainage treatments were: $T_1$ = Control (normal flat land, no special drain); $T_2$ = 100 cm wide beds and 30 cm drain (10 cm depth) between the beds; $T_3$ = 150 cm wide beds and 30 cm drain (10 cm depth) between the beds; $T_4$ = 200 cm wide beds and 35 cm drain (10 cm depth) between the beds. During the period of experiment, total 456.80 mm rainfall was occurred specially during vegetative and flowering stages of sesame. The treatments demonstrated significant effect on grain yield. Maximum yield (1101.8 kg/ha) was obtained in $T_2$ (100 cm wide beds and 30 cm drain between the beds), whereas $T_1$ (normal flat land, no special drain) obtained 456.8 kg/ha. The cultivars showed significant difference in grain yield.

**Evaluation of $M_4$, $M_3$ generation of sesame mutants**

It is a national demand to develop water-logged tolerant (different durations at different growth stages) sesame cultivar. According to the demand of Honorable Agriculture Minister and consequently by the direction of BINA authority, we collected local land-races from different regions of the country (and also BINA sesame varieties) and irradiated at different doses of Gamma Rays with a view to obtain desirable cultivar tolerant to water-logged condition. Some mutants ($M_2$) which appeared to be water-log tolerance but long duration (125-145 days), radiated again in different doses (350 to 700 Gray; 52 nos. samples) and produced $M_2R_1$ population in 2018. Including some $M_3$ and newly produced ($M_2R_1$ and $M_2R_2$ ) materials, 117 populations were sown in the first week of March 2019 in Lysimeter and field, and successfully produced seeds ($M_4$ and $M_2R_2$ Population) under natural rainfall as well as artificial water logging under control condition. Among 117, 30 mutants were selected for further water-logging test in pot, Lysimeter and field condition.

**Quantifying natural groundwater recharge using tracer technique and water balance method at Ishwardi area**

The objective of this experiment was to estimate the yearly recharge under field condition at Ishwardi. Chloride tracer was applied as a pulse at 20 cm depth within the soil profile (in the field, at 3 locations). Infiltration of precipitation transports the tracer downward. The subsurface distribution of applied tracers was determined in October by digging a trench for sampling. The Cl concentration was determined and recharge was estimated with standard procedure. Recharge was also estimated by water-balance method. The average recharge rate found (during 2017) under tracer technique was 49 mm, and 59 mm under water balance method; which in terms of percentage of rainfall, were 4.7% and 5.6%, respectively. During 2018, the average recharge rate found under tracer technique was 58.5 mm, and 33.2 mm under water balance method; which in terms of percentage of rainfall, were 5.6% and 3.2%, respectively. When averaged over two years, the recharge rate under tracer technique was found as 53.7 mm/year, and 46.2 mm under water balance method; which in terms of percentage of rainfall, were 5.14% and 4.42%, respectively.

**Irrigation management and chemical amendment for soybean cultivars under saline condition**

The experiment was conducted in the farmer's field at Noakhali (3 sites) to identify critical stage of soybean with respect to salinity, and to develop appropriate irrigation management practice for higher yield of soybean. The scheduled tratments were: $T_1$ = Control (farmer's practice/ no irrigation, no seed priming) ; $T_2$ = One irrigation at early/vegetative stage (20-22 DAS) ; $T_3$= One irrigation at flowering stage (45 DAS) ; $T_4$ = One irrigation at early stage + one irrigation at floweringstage ; $T_5$ = One irrigation early stage + one irrigation at pod formation stage (65 DAS); $T_6$ = No irrigation, with seed priming (18 hrs soaking in water, and then drying for 8 hrs) + 30% excess Gypsum; $T_7$ = No irrigation + Foliar application of Salicylic Acid (100 ppm, 20 DAS) + Sodium Silicate (100 ppm, at 45 DAS ; $T_8$ = 25% excess Gypsum and K + One irrigation at early stage + + Foliar application of Sodium Silicate (100 ppm, at 45 DAS ); $T_9$ = Foliar application of Salicylic Acid at 20 DAS + One irrigation at flowering stage + Sodium Silicate at 60 DAS (100 ppm). The varieties were:$V_1$ = Binasoybean-3; $V_2$ = Binasoybean-5; V3= BARI Soybean 6 (as

Check). The design was RCBD, with split-plot. In case of site 1, cultivars showed significant difference except Branch/ plant and Pod/ plant. The treatments showed significant difference in all yield attributing characters except grain yield. The interaction effect of treatment and variety was significant. In case of site 2, cultivars showed significant difference except Pod/ plant. The treatments showed significant difference in all yield attributing characters except grain yield.

**Determination of aquifer hydraulic properties (by pumping test)**

Pumping test was done at Niamatpur Upazila (of Naogaon district) following standard procedure (e.g. time-drawdown, distance- drawdown, recovery data) to generate information for safe groundwater withdrawal rate.Two observation wells were installed in line at 150 ft and 300 ft from the test (production) well (hereafter called 1st and 2nd observation well), at the same depth of the test well. The well was pumped at a constant rate until steady state condition reached (~48 hours). The water levels in the wells were checked and recorded at specific time interval. The discharge rate of the pump was measured with V-notch and cut-throat flume in the vicinity of the outlet. Pumping test has been performed at Niamatpur (during January 12-15, 2019). The static water level in the observation well was found as 33.23 m (109 ft).

**Estimation of groundwater recharges using tracer technique and water balance method**

The objective of this experiment was to estimate the yearly recharge under field condition (at Nachol, Chapai). Chloride tracer was applied as a pulse at 20cm depth within the soil profile (in the field, at 2 locations). Infiltration of precipitation transports the tracer downward. The subsurface distribution of applied tracers was determined in October by digging a trench for sampling. The Cl concentration was determined and recharge was estimated with standard procedure. Recharge was also estimated by water-balance method. From tracer technique, the yearly recharge was found as 180 mm; which in terms of percentage of rainfall was 12.4%. The yearly recharge was found as 96.5 mm under water balance method; which in terms of percentage of rainfall was 6.7%.

**1.3 Postharvest Technology of Crops**

Effect of blanching techniques and preservatives on quality and shelf life of tender green jackfruit slices: Tender green jackfruit (65-70 days) was harvested for using as vegetable during early spring and summer until the seeds harden. The fruit matures towards the end of summer in June. The optimum stage of maturity (harvest) of jackfruit has been reported to be 90-110 days after the appearance of the spike. The experiment was laid out with Complete Randomized Design (CRD) with six treatments namely, blanching at $95^0$C for 3 min and treated with 500 ppm KMS ($T_1$), blanching at $95^0$C for 3 min and treated with 1000 ppm KMS ($T_2$), blanching at $95^0$C for 3 min and treated with 1500 ppm KMS ($T_3$), blanching at $95^0$C for 6 min and treated with 500 ppm KMS ($T_4$), blanching at $95^0$C for 6 min and treated with 1000 ppm KMS ($T_5$ ), blanching at $95^0$C for 6 min and treated with 1500 ppm KMS ($T_6$). The results revealed that most of the target enzymes were inactivated when treated with 1000 ppm KMS and blanched at $95^0$C for 6 minutes ($T_5$). According to panel test result treatment $T_5$ also performed highest overall acceptability score (8.2).

**Effect of ethylene on postharvest quality of mango**

The experiment was conducted to evaluate the effect of ethylene application on postharvest quality of mango. It was laid out Complete Randomized Design (CRD) with three treatments namely control ($T_1$, not treated with ethylene), 100 ppm ethylene in ripening chamber for 24 hours ($T_2$) and 150 ppm ethylene in ripening chamber for 24 hours ($T_3$) were used. The fruits were assessed for physiological changes such as weight loss over the storage period, firmness, biochemical aspects like TSS ($^0$B), titratable acidity (%), ascorbic acid content (mg/100g), total carotenoids (µg/100g). The data were recorded at 2, 4 and 6 days interval over the storage periods. In treated mangoes ripening process began after 36 hours calculated from the time of exposure to ethylene. But in case of control the time duration was 72 hours. The experiment showed little difference in respect to biochemical aspect as well as in physical aspect. It was found that mangoes harvested at mature green stage can easily be exposed to ethylene gas(100-150 ppm) for 24 hours in order to uniform ripening

and early marketing maintaining better quality in all aspects though ripening chemical is used for ripening the fruits.

**Optimization of roasting technique for jackfruit seed**

Mature and full ripe jackfruit was collected from local cultivar to investigate and optimize the roasting time and temperature combination. Full ripe bulbs were first separated from the fruit and the seeds were collected from the inside of the bulb. After washing with clean tap water seeds were dried in sun at ambient condition until surface water removed. The experiment was laid out with Complete Randomized Design (CRD). All the seeds were treated as roasted at $150^0$ C for 10 minutes ($T_1$), roasted at $150^0$ C for 20 minutes ($T_2$), roasted at $200^0$ C for 10 minutes ($T_3$), roasted at $200^0$ C for 20 minutes ($T_4$), roasted at $250^0$ C for 10 minutes ($T_5$), and roasted at $250^0$ C for 20 minutes ($T_6$). Roasted seeds were then evaluated by forming ten judgment groups using 9 point hedonic scale to determine their optimum time and temperature combination for roasting. According to panel test result $T_4$ ($200^0$C for 20 minutes) scored highest overall acceptability (8.2) and regarded as best considering the quality parameters of roasted jackfruit seed.

**Optimization of processing method for plum pickle**

The study was undertaken to optimize the processing of plum pickle to enhance the diversified use of the plum. 6 treatments using various salt and sugar percentages were used for the experiments. After 12 months of storage, the pH was slightly increased during storage. The microbial growths of the plum pickle were seen in the formulation using plum with 3% salt and 10 to12% sugar after storage for 12 months but the absence of microbial growths was found in pickle using plum with 4 to 5% salt and 10 to12% sugar after twelve months of storage. Comparative sensory evaluation of different quality attributes of the plum pickle is judged and found the best formulation of plum pickle. The pickle is prepared using plum with 4 or 5% salt and 12% sugar scored highest overall acceptance.

**Optimization of processing method for plum chutney**

The study was undertaken to optimize the processing of plum chutney to extend the variegated use of the plum. There were 5 treatments using various sugar percentages were used for the experiments. The chutney will be stored for 6 month but after 2 months of storage, pH and TSS was slightly increased where acidity was decreased. No microbial growths of the plum chutney were seen in all the treatments. The intensity of light yellow color of the chutney were gradually increased and turned into light red color during storage. Sensory evaluation of different quality attributes of the plum chutney is judged and found the treatments $T_3$ (using 40% sugar in plum) scored highest in overall acceptance (8.2 e.g. like very much to like extremely) followed by treatment and $T_4$ (using 50% sugar in plum).

**Effect of pre-treatments and storage temperatures on the physico-chemical parameters and quality of plum**

The study was undertaken to compare physico-chemical parameters and quality of the plum at different pretreatments and storage temperatures for long time use of fresh plum. There were 9 treatments using various pretreatments and temperatures for the experiments. For analyzed stored plum firmness, pH, vitamin C and TSS data; it was noticed that in an ambient condition after 7 days stored plum was spoiled, but in cold room when the storage temperature was $10\pm1^0$C, the stored plum was good in condition upto 35 days; whereas the stored plum was also good in condition upto 70 days if the storage temperature was $5\pm1^0$C and the plum was wash with clean water as well as it wash with 150 ppm NaOCL solution.

**Preservation of plum using brine solution**

The study was undertaken to find out the effect of brining on plum to investigate the shelf life of plum in an ambient condition. There were 5 treatments using various brine solution for the experiments. The brining plum will be stored for 6 month but the stored plum firmness, pH, acidity, TSS, vitamin C and β-carotene data were analyzed up to 2 month; it was noticed that in an ambient condition the plum firmness, acidity, vitamin C and β-carotene content were decreased as compared to an initial values but for TSS up to 4% brine solution it was decreased then increased whereas, an initial pH was low with stored plum.

**Effect of harvesting time and storage periods on the starch content of potato**

The experiment was jointly conducted at the laboratory of Postharvest Technology Division and Tuber Crop Research Centre (TCRC), Bangladesh Agricultural Research Institute (BARI), Gazipur-1701, Bangladesh during December 2018 to July 2019 to study the effect of harvesting time and storage periods on the starch content of potato (Variety: BARI Alu 28). In field condition, the experiment was laid out in a 2 factors Randomized Completely Block Design (RCBD) with three replications and in the laboratory, it (experiment) was laid out in a 2 factors (Factor A: harvesting time with two levels namely 1. 90 DAP, 2. 100 DAP and Factor B: storage periods with 2 levels namely 1. Ambient condition and 2. Cool room temperature) Completely Randomized Design (CRD) with three replications. Potato harvest at 100 DAP and stored in cool room at 12±1°C yielded highest starch content (18.54%) than potato harvest at 90 DAP and stored at ambient condition (18.21%). But after 4 months of storage, the starch content was decreased gradually from 18.51 to 18.11% at cool room condition whereas it was decreased from 18.12 to 15.75% ambient condition. Total sugar content was significantly increased from 3.03 to 3.67% at cool room condition while it was increased from 3.03 to 4.00% at ambient condition with the advancement of storage periods. So, the results obtained from the study confirmed that potato harvest at 100 DAP yielded highest starch content (18.51%) and lowest total sugar content 3.67% at cool room condition (12±1°C).

**Effect of extraction method on starch content of selected BARI potato varieties**

The study was conducted to evaluate the starch content and dry matter content of the BARI developed selected 19 potato varieties viz. BARI Alu-7, BARI Alu-8, BARI Alu-13, BARI Alu-25, BARI Alu-28, BARI Alu-29, BARI Alu-34, BARI Alu-35, BARI Alu-36, BARI Alu-38, BARI Alu-40, BARI Alu-41, BARI Alu-43, BARI Alu-45, BARI Alu-54, BARI Alu-62, BARI Alu-68, BARI Alu-70 and BARI Alu-71 out of 81. The starch extraction and analytical work was carried out in the Postharvest Technology Division, Bangladesh Agricultural Research Institute (BARI), Gazipur-1701 and the selected varieties was grown in the research field of Breeder Seed Production Centre, Debiganj, Panchagar, BARI, Bangladesh. Data were recorded for its starch content (%), dry matter content (%), total sugar content (%), moisture content (%) and ash content (%) of the selected 19 potato varieties while statistically all the data were significant. Consequently their (19 BARI Alu varieties) starch, dry matter, total sugar, moisture and ash content ranged from 8.54 to 18.54%, 11.33 to 22.53, 1.26 to 4.15%, 77.47 to 88.67% and 0.55 to 1.76% respectively. The highest starch, dry matter and moisture content was recorded for the BARI Alu-28 (Lady Rosetta) whereas the lowest was for the BARI Alu-54. The highest total sugar and ash content was observed for the BARI Alu-25 (4.15%) and BARI Alu-70 (1.76%) respectively. The major findings of the study distinctly indicates that lower moisture content (77.47%) contributed to produce higher content of dry matter (22.53%) and likely higher dry matter contributed to obtain higher content of starch (18.54%) than other BARI Alu varieties.

**The nutritional analysis of selected minor fruits of Bangladesh**

Minor fruits are the cheapest nutritional source and nutrition database is of great importance in addressing nutritional health benefits of rural and urban communities of Bangladesh. Considering documentation, conservation and promoting nutritional health of the local inhabitants and urban people therefore the present study was carried out. Under this study, 10 minor indigenous fruits were analyzed for their phytochemical, minerals and nutritional compositions. Nutrient data obtained from the study have been compared with published data reported in recognized journals and books. The selected minor fruits namely Bilimbi (Averrohoa bilimbi L), Ber (Zizyphus Mauritiana Lam), Aonla (Phyllunththus emblica L), Elephant apple (Dillenia India L),Toikar **(**Garcinia pedunculata), Daophal (Garcinia xanthochymus), Satkora (Citrus macroptera), Hog plum (Spondias pinnata), Citron (Citrus medica) and Jengkol (Archidendron Pauciflorum**)** was collected according to the protocol of the sample. Results obtained from the study revealed that 10 primary metabolites (nutritional composition), 11 minerals and 19 secondary metabolites (phytochemical constituents) were detected in the selected fruits more or less. Most of the phytochemical constituents and minerals were rich sources of the selected minor fruits. All the selected fruits contained high quantity of total anthocyanin content, total flavonoid content, total ß-carotene content, ascorbic acid content, total antioxidant capacity, NO free radical scavenging activity, reducing power activity, ferric reducing

antioxidant property, DPPH radical scavenging activity, metallic chelating capacity, total phenolic, gallic acid, ferrulic acid and lutein content followed by other phytochemical constituents. In case of minerals, Ca, Mg, K, Na, P, S, B, Cu, Fe, Mn, Zn and B were present high or less quantity. But the Ca, Mg, K, Fe, Mn, Zn and B were predominant followed by other minerals. Among the nutritional compositions, protein, sugar and starch were higher followed by other primary metabolites. However, the study demonstrated that all the selected minor fruits were rich sources of phytochemical diversity and minerals. The phytochemical diversity and minerals are known to play an important role in the pharmaceutical industry and health benefits. Flavonoids exhibit as anti-inflammatory, antiallergic, analgesic and antioxidant as well. Rather than those flavonoids also exhibit a wide range of biological activities such as scavenges for hydroxyl radicals. The minimum daily requirement of ascorbic acid for preventing clinical symptoms of the specific deficiency-scurvy for adults is about 10 mg or little less. The data obtained from the study confirmed that the selected minor fruits contained ascorbic acid content from 22.29 to 664.92 mg/100 g. Therefore, the daily intake of 100 g minor fruits can prevent the scurvy in Bangladesh. Other phytochemicals obtained from the study like anthocyanin, carotenoid, ß-carotene and phenolic content can enrich and increase antioxidant activity. The strong antioxidant activities therefore could be able to reduce all kinds of cancer, anti-tumor, cell damage, carcinogenic, stroke, heart attack, coronary heart diseases, acute liver injury, diabetes and cardiovascular diseases.

**Standardization of guava jelly through natural and bioactive approaches**

Adulteration in foods is a serious problems and tremendously increasing in Bangladesh day by day. This is now in national issue to ensure and preserve human rights for safe food consumption for all ages of peoples. By consumption adulterated foods, the future generation will be seriously affected both in physical and mental health. The processed food is mainly adulterated by using various harmful chemicals and toxic artificial colors during processing. Therefore, the present research was conducted to develop chemical and preservative free natural and bioactive guava jelly. The experiment was laid out with Complete Randomized Design (CRD). There were 6 treatments viz. $T_1$= Guava extracted juice 1 L + sugar 650 g +citric acid 7g + potassium metabisulfite (KMS) 0.20 g (control), $T_2$= Guava extracted juice 1 L+ sugar 650 g + lemon juice 100 mL + potassium metabisulfite (KMS) 0.20 g (control), $T_3$= Guava extracted juice 750 mL+ pineapple juice 250 mL + sugar 400 g + lemon juice 100 mL + honey 35 g, $T_4$= Guava extracted juice 1 L + sugar 650 g +citric acid 7g + Agar 10 g, $T_5$= Guava extracted juice 1 L + honey 150 g + lemon juice 100 mL, $T_6$= Guava extracted juice 1 L+ sugar 400 g + lemon juice 100 mL + honey 35 g and $T_7$= market sample. Among different treatments, treatment $T_3$ and $T_6$ achieved highest organoleptic score. The water activity of the treatment $T_3$ and $T_6$ was 0.56 and 0.59 within the range of a good microbial stability for the product. The color of the treatment $T_3$ and $T_6$ was excellent with their good appearance. The highest vitamin-C content (43.00 and 23.52 mg/100 g) and lower sugar content (45.07 and 45.04) was also noted for the $T_3$ and $T_6$. It is noteworthy that $T_3$ and $T_6$ were totally free from chemicals and preservatives. It is mentioned that honey and natural fresh lemon juice was used as preservative instead of potassium metabisulfite (KMS) and citric acid and other chemicals that is used by the food company. Thus, our natural product ($T_3$ and $T_6$) achieved excellent fresh lemon and honey flavor. This technology could be applied to home scale processing level as it is very simple and easy technique. Finally it can contribute to mitigate the adulteration of jelly. In addition, unemployment youth and women could directly be involved with processing of guava fruit to make a profitable job especially to improve their income.

**Baseline survey on existing status of fried potato chips processing to marketing in selected locations of Bangladesh**

The baseline survey was conducted with a view to generating information on existing fried potato chips from processing to marketing status in selected locations of Bangladesh. The baseline information was collected from 7 selected districts namely Dhaka, Gazipur, Tangail, Mymensing, Bogura, Munshigonj and Jashore. 15 hawkers and 5 producers were randomly selected to collect the information by the pre-tested questionnaire from each location both from producer to consumer. Most of the hawkers of Bogura was above 40 years old (80%) followed by Dhaka who were 25-39 years old (60%). 80% people were above 40 years old engaged in processing fried potato chips from Bogura. All aged people in Bogura preferred fried potato chips (100%) whereas maximum child in Dhaka (40%) liked fried potato chips. Bogura and

Munshigonj people were unknown about healthiness knowledge of fried chips consumption. Bogura, Jashore and Munshigonj processors/producers were hawkers and they prepared the product and distributed the products to the market or direct involved in sale. Fried chips processing people in the survey area used deep frying technique (100%). Soya bean oil used for deep oil frying of potato chips by 80% small processors. Most of the respondents changed their frying oil during frying when frying oil turned into cloudy.

**Baseline survey on existing hazardous agents in selected vegetables in supply chain at selected areas of Bangladesh**

A survey was conducted in seven districts namely Cumilla, Narshingdi, Chattogram, Bogura, Jashore, Gazipur and Dhaka. A total of 210 samples having 30 samples from seven districts were randomly selected by the questionnaire. Data analysis from seven districts samples, the selected farmers were grouped into four categories based on the age distribution. Most of the farmers belonged to the age group as following in Cumilla 41-60 (59.38%) years, in Narsingdi 41-60 (51.43%) years, in Chattogram 21-40 (50%) years, in Bogura 21-40 (44.83%) years, in Jashore 41-60 (45.71%) years and in Gazipur 41-60 (77.42%) years. According to educational level, illiterate, primary, secondary and higher secondary levels of education were recorded. Literacy rate was found higher in Chattogram (43.33%) compared to other selected districts. However, most of the farmers did not receive any training on vegetable pest management although some of them were engaged with various NATP program. Different types of insect-pest and diseases attacked vegetables crops at different growth stages, which caused severe loss of yield in the study areas. Hence, almost all of the vegetables growers used synthetic pesticides for protecting their crops from insects and pests. Among the farmers, nobody followed IPM approach in his pest management program. Generally, farmers of the study areas applied pesticides with higher dosages and frequencies (10-15 times) per season than the recommendation level. Most of the vegetables growers used pesticides like Sulcox, Tafgar, Vertimec, Sumicorn, Karahin, Boron, Emma etc. during development stage of vegetables. Almost all the case they are unknown of the physical, chemical, microbial and cross contamination.

**Determination of formaldehyde in selected fruits and vegetables**

The experiment was conducted to detect naturally produced formaldehyde in fruits and vegetables based on spectrometric analysis in the laboratory of Postharvest Technology Division, BARI, Gazipur during 2018-2019. Some fruits (jackfruit, mango, grape, and apple) and vegetables (cauliflower, red amaranth, tomato, data shak, cabbage, brinjal, indian spinach and spinach) were collected from local market and analyzed to estimate the amount of formaldehyde which was produced naturally. Results revealed that naturally occurring formaldehyde was detected in jackfruit 9.633±0.187 ppm, mango 10.27±0.232 ppm, grape 2.426±0.662 ppm and apple 8.695±1.075 ppm. In vegetables formaldehyde was estimated in cauliflower 2.259±0.525 ppm, red amaranth 1.488±0.124 ppm, tomato 3.810±1.138 ppm, data shak 3.568±0.779 ppm, cabbage 2.341±0.489 ppm, brinjal 2.688±0.914 ppm, Indian spinach 1.766±0.707 ppm and spinach 2.623±0.516 ppm respectively.

**Determination of hazardous agents (microbial load) in selected vegetables in supply chain at selected locations in Bangladesh**

This experiment was conducted to find out hazardous agents (microbial load) in selected vegetables at different locations of Bangladesh. Different vegetables such as data shak, cabbage, cauliflower, country bean, pointed gourd, tomato, indian spinach, okra, spinach, red amaranth, brinjal and bitter gourd were collected from farmer's field and retailer market. All samples were analyzed to detect presence of different microbial agent such as Salmonella spp., Shigella, Escherichia coli (E. coli), Staphylococcus aureus, Listeria monocytogenes. Hundred percent sample of country bean, indian spinach, bitter gourd, pointed gourd and brinjal contaminated by Samonella Spp. but 91.5% of tomato, 14.28% of okra, 66.7% of cabbage, 25% of red amaranth ,50% of data shak, 50% of cauliflower and 100% sample of spinach were not contaminated by Salmonella Spp. Presence of Shigella was detected in all tested sample. 100% samples of pointed gourd and brinjal were not contaminated by Shigella. Escherichia coli (E. coli) was present in most of the collected sample. In cabbage and spinach Escherichia coli (E. coli) was found on border line of hygienic indicator.

**Effect of different sanitizer on postharvest quality of tomato**

This experiment was conducted to evaluate the efficacy test of selected sanitizers such as trisodium phosphate, acetic acid and succinic acid with three different concentrations (0.5%, 1% and 1.5%) on postharvest quality and shelf life of fresh tomato fruit. Green to tannish yellow colored tomato was collected and then dipped into the selected sanitizer solution with different concentration for the study. Salmonella spp. and E. coli was identified and quantified in treated sample upto 15 days storage at ambient condition (26±2°C, 80±5%RH). The result showed that 1.0% trisodium phosphate and 0.5% acetic acid were more effective of treated tomato fruit during 15 days of storage at ambient condition. In terms of nutritional quality in treated tomato fruit, TSS (%) and total acid (%) content were increased while vitamin C (mg/100g) was declined with storage period in most of the cases of the treated samples.

**Design and development of integrated waxing machine for fruits and vegetable**

The aim of the present study was to design and development of an integrated semi-automated waxing machine for fruits and vegetables with a view to enhance the shelf life with improving quality at an ambient temperature. The fabricated machine comprised 3 basic unit (such as washing, waxing and drying unit) which was made up of stainless steel. The dimension of washing and waxing unit were (1160 mm × 765 mm× 690 mm) while the drying unit was (1217 mm × 1310 mm × 420 mm). The washing unit consisted 5 brush pad rollers, the waxing unit had 5 foam pad rollers and the drying unit comprised belt conveyors (1210 mm × 400 mm), where speed can be adjusted by inverter. To evaluate the machine performance, lemon and tomato were used to wax coating with carnauba. Results revealed that 900 - 1000 fruits was waxed per hr. depending on the size and shape of the produce. The operating cost of the machine was reasonable with minimal time. The waxed sample was found to have shiny and glossy appearance with increased shelf life compared to the controlled sample (without waxed).

**Optimization of processing method for dried mango products (aam chur)**

This research experiment was conducted to optimize the dried mango products processing method with a view to improve product quality and to add value of green mango. Local variety of immature mango (var. Guti) were collected from commercial mango traders and then fruit washed with clorox (200 ppm) mixed water. Sorted and randomly distributed fruit were sliced and treated with 4 different concentrations of KMS (potassium metabisulphite) considered as treatment such as 500 ppm, 1000 ppm, 1500 ppm and 2000 ppm. Untreated fruit slices were assumed as control treatment. Fruit sliced were blanched into hot water at 90°C for 2 mins and then soaked into KMS mixed water for 50-60 mins. Mango sliced dried in a cabinet dryer for 48 hrs. Among the treatment, mango sliced/cubes treated with 1000 ppm KMS performed better color and maintain nutritional quality during 8 months of storage at ambient condition. Sensory panelists ranked higher score (6.8) and preferred $T_2$ (1000 ppm KMS) product in terms of color (7.0), flavor (6.8), sweet-sour balance (6.8) and overall acceptability (6.8).

**Effect of calcium chloride and storage temperature on quality and shelf life of fresh-cut jackfruit bulb**

This experiment was conducted to evaluate the different concentration of calcium chloride and selected storage temperature on the quality and shelf life of fresh cut jackfruit bulb (Dorosa type). Three different concentration of calcium chloride such as 0.2%, 0.4% and 0.6% and 3 storage temperature such as 20±1°C, 4±1°C, 2±1°C and one non treated control (fresh jackfruit bulb) were selected. Jackfruit bulb were separated and then seed were removed to make it edible. Almost uniform size and shape were sorted randomly and then dipped into different $CaCl_2$ solution for 800 g bulb/L solution for 5 mins. Jackfruit bulb were preserved in film packet at different storage temperature for physiochemical quality evaluation. Most of the panelists preferred fresh cut jackfruit bulb treated with 0.6% $CaCl_2$ and stored at 4±1°C and 2±1°C after 6 days storage in terms of appearance, flavor and overall acceptability as well as nutritional quality.

**Effect of calcium chloride and storage temperature on quality and shelf life of fresh-cut mango (var. Himsagar)**

This experiment was conducted to evaluate the different concentration of calcium chloride and selected storage temperature on the quality and shelf life of fresh cut mango. Three different concentration of

calcium chloride such as 0.2%, 0.4% and 0.6% and 3 storage temperature such as 20±1°C, 4±1°C, 2±1°C and one non treated control (fresh mango slice) were selected for the study. Mango slice were cut in almost uniform size and shape and then dipped into different $CaCl_2$ solution for 800 g mango slice/L solution for 5 mins and then slice were preserved in film packet at different storage temperature for physiochemical quality evaluation. After 6 days storage, the lowest weight loss (4.46%), flesh firmness (5.89), TSS ($16^0$B) exhibited better in mango slice treated with 0.6% $CaCl_2$ and stored at 2±1°C among the treatments whereas mango slice stored at 20±1°C is spoiled within 2 days of storage. Most of the panelists preferred fresh cut mango treated with 0.6% $CaCl_2$ and stored at 2±1°C after 6 days storage in terms of appearance (6.4), flavor (6.0) and overall acceptability (6.20).

**Optimization of processing method for osmotically dehydrated mango slices/cubes**

This experiment was carried out to optimize the osmotically dehydrated mango products processing method with a view to adding value to mango fruit. Local variety of immature mango (var. Himsagar) was collected from commercial mango traders and then the fruit was washed with clorox (200 ppm) water. Fruit were sorted and randomly distributed for the experiment. Fruit were sliced and were treated with 4 different concentrations of KMS (potassium metabisulphite) considered as treatment (500 ppm, 1000 ppm, 1500 ppm and 2000 ppm). Fruit sliced were then blanched into hot water and then soaked into KMS mixed water for 50-60 mins. Fruit sliced were dried in a mechanical cabinet dryer for 12 hrs. Dried slices were dipped into sugar solution at 45°B for 12 hrs. and then dried in the cabinet dryer and stored at ambient condition. Among the treatments, mango sliced/cubes treated with 500 ppm KMS performed better appearance and enhanced nutritional quality during 8 months storage. Sensory panelists ranked higher score (6.6) and preferred the treatment in terms of color (6.8), flavor (6.4), firmness (6.6) and overall acceptability (6.8).

**Detection and quantification of heavy metals and toxins in rice bran, rice bran oil and deoiled rice bran**

Heavy metals such as As, Pb, Cd, Cr, Ni, bacteriological assay such as bacterial load (cfu/g), fungal assay such as yeast and molds load (cfu/g) and fungal toxins specially aflatoxins (B1, B2, Gl and G2) were investigated for RB, RBO and DORB samples. 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.

**Effect of spent bleaching earth on sustainable rice production**

It was observed that 25% replacement of BRRI recommended fertilizer dose with spent bleaching earth (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.

**Determination of physicochemical properties and quality of puffed, popped and flattened rice from newly released BRRI varieties**

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 comparing with BR16.

**A study on the different components of rice in relation to the palatability**

The eating quality of rice, known as rice palatability, is a very important factor that determines the commercial value of rice. Similarly, texture of rice such as hardness, fluffiness, softness and stickiness are the most important indicators for determining the palatability of cooked rice. A total of 17 local cultivars and BRRI varieties were taken for identifying the palatability of cooked rice with different parameters. The parameters including alkali spreading value, amylose content, protein content and elongation ratio along with palatability parameters such as excellent test, very good test, good test and tasteless were considered to identify the best quality rice cultivars and variety. Considering the local varieties, ranisalute showed highest score (57%) followed by rataboro (37%) for excellent taste. Similarly, considering the HYV varieties, BRRI dhan49 showed the highest score (37%) for excellent taste followed by BRRI dhan50 and BRRI dhan73 (26% each). On the other hand, gangia as local variety showed the highest score (53%) for very good taste as well as BRRI dhan30 and BRRI dhan67 (58% each) as HYV variety fell under very good taste category.

## Forestry Unit

**Development and Coordination of Research Projects**

1. Germplasm Conservation and Farm Productivity Enhancement through the Interaction of Shade trees and Tea based Agroforestry System to Mitigate the Climate Change (ID-072)
2. Exploration, Identification, Characterization, Multiplication and *Ex-situ* Conservation of Endangered Forest Genetic Resources Including Medicinal Plants of Bangladesh (ID–074)
3. Upliftment of Farmers Livelihood and Enrichment of Environment through Improved Agroforestry Practices in Char Land Ecosystem of Bangladesh: (ID-077)

**Project Implementation**

Implemented FAO funded project titled “Addressing the 2030 Agenda on Climate Change and Food Security Through Climate Smart Agriculture" during 2017-2018.

**Policy Level Contribution**

Furnished Comments on the following aspects/ issues and sent to MoA:

1. Proposed Amendment of National Forest Policy, 2016
2. Bangladesh Climate Change Strategy and Action plan (BCCSAP) Updated
3. Nationwide Climate Vulnerability Assessment (NCVA) Document
4. Bangladesh National Action Plan for Reducing Short-Lived Climate Pollutants
5. Sheikh Kamal Wildlife Centre Act 2018
6. Manual on Letter of Agreement between FAO and DAE
7. Chemical and Technical Disaster Manual
8. Agricultural Important Person(AIP) Policy
9. Concurrence on the revised Grant Agreement and the revised Grand Design Documents (GDD) on the Project on “Consortium for Scaling-up Climate Smart Agriculture in South Asia’ to be supported by International Fund for Agriculture and Rural Development (IFAD)
10. Court of Environment Law 2010 (Amendment, 2019)
11. Bangladesh Environment Protection Amendment Act 1995 (Amendment, 2019)

## Research Management/Financial Management and Coordination

### Review of Forestry Research Program of BFRI

Rresearch program of Bangladesh Forest Research Institute (BFRI) and other organizations involved in forestry research and development were reviewed and necessary guidelines provided. It was observed that BFRI took about 70 research programs, BFRI was suggested to undertake research programs in future to cater to the needs of the end-users. Similarly, forestry activities of IFESCU and Khulna University were reviewed and a national program was developed.

### Monitoring, Reviewing and evaluation report of programs of NARS institutes

1. Monitored nine projects under special fund from MoA projects implemented by NARC institutes in Chapai Nobabgonj, Rajshahi, Ishwardi and Serajgong during 27-30 March 2019
2. Monitored three PBRG projects under Forest Unit, NRM Division in Jamalpur, Sherpur, Tangail, Mymensingh, Chattogram, Khagrachari, and Bandarban during July-18 to June 2019.

Farmer's field visit at Mymensingh, PBRG-NATP Phase-2 project

Visiting special funded project activities at Rajshahi

## Training Organized

## Conducted following trainings:

1. Organized Training on "Forestry and Agroforestry Technologies for Professionals" during 24-25 March, 2019(40 NARS scientist and NGO personnel were participated).

2. Organized Training on "Climate Smart Agriculture" during 29-30 April, 2019(40 NARS scientist and NGO personnel were participated).

Training on Climate Smart Agriculture

Training on agro-forestry technologies for professionals

## Workshops, Seminar (Local) Organized

### National Seminar on Fruit Tree Plantation Program

- Organized a national seminar under Fruit Tree Plantation Program on 16 June 2019 at KIB Auditorium, Farmgate, Dhaka titled Òcwi Kwí Z dj Pvl thvMv‡e cyóm¤úZ Lvevi Ó hon'ble Minister Dr. Md. Abdur Razzaque, MP attended as Chief Guest, Special guest was Krishibid Abdul Mannan, MP, hon'ble Member, Standing Committee, Ministry of Agriculture. Mr. Md. Nasiruzzaman, Secretary, Ministry of Agriculture., Chaired the occasion, Dr. Modan Gopal Saha, Director, BARI presented the keynote paper.

Seminar of National Fruit Fair, 2019 at KIB auditorium

Honarable Minister, MoA visited at a stall of National Fruit Fair-2019

- The Unit organized a national seminar on Our Actions are our Future, A Zero Hunger World by 2030 is Possible" to mark the World Food Day 2018 on 16 October 2018 at KIB Auditorium, Farmgate, Dhaka. Honorable Minister Mr. Md. Tofayel Ahmed, MP, Minister for Ministry of Commerce graced the occasion as Chief Guest, Motia Chowdhury, MP, hon'ble Minister for Agriculture was present as Special Guest. Mr. Md. Nasiruzzaman, Secretary, Ministry of Agriculture. Presided over the occasion. Prof. Dr. Md. Shamsul Alam, Member, Planning Commission was the keynote speaker.

- Organized a national seminar on the occasion of Vegetable Fair 2019 and the subject of which was " Production of Safe Vegetables for Nutrition Round the Year" held on 24 January 2019 at KIB Auditorium, Farmgate, Dhaka. Hon'ble Minister Dr. Md. Abdur Razzaque MP, Minister, for Agriculture graced the occasion as Chief Guest, Special Guest was Mr. Md. Tipu Munshi MP, hon'ble Minister for Commerce. Mr. Md. Nasiruzzaman, Secretary, Ministry of Agriculture. Chaired the occasion. Dr. G.M.A. Halim, Director, BARI was the keynote speaker.

Seminar of National Vegetable Fair, 2019 at KIB auditorium

Hon'ble Minister, MoA inaugurated the National Vegetable Fair-2019

- Organized Annual Review Workshop of PBRG Sub-project "Upliftment of Farmers' Livelihood and Enrichment of Environment through Improved Agroforestry Practices in Char Land Ecosystem of Bangladesh": BARC Component (ID-077)", NATP-2 under Forest Unit, NRM Division, BARC" on 24 June 2019
- Organized Annual Review Workshop on PBRG Sub-project "PBRG Sub-project "Germplasm Conservation and Farm Productivity Enhancement through Integrating Shade Trees in Tea Based Agroforestry System (ID-072)" NATP-2 under Forest Unit, NRM Division, BARC during 23 June 2019
- Research Review 2018-19 and Research Planning 2019-20 on Forestry and Agroforestry 25 July 2018

Review Workshop 2018-19 at BARC

Participants and guests in the review workshop 2018-19at BARC

**Linkage**

- FAO funded project "Addressing the 2030 Agenda on Climate Change and Food Security Through Climate Smart Agriculture" was launched by FAO. Dr. Md. Saifullah has selected as NPC (National Project Coordinator) in Bangladesh part. The project will be implemented within six member countries (Bangladesh, Laos, Mayanmer, Philppines, Cambodia, and Vietnam).

**Workshops, Seminar (Abroad) Participated**

- Participated workshop on "Doubling the Income of Farmers of SAARC Countries: Extension Strategies and Approaches" held during 20-23 September 2018, Khatmandu, Nepal.

International Workshop 2018 at Khatmondu, Nepal

Awarding ceremony of International Workshop 2018 at Khatmondu, Nepal

- Participated workshop on "Bilateral Meeting and Knowledge Sharing Visit on Flower Species Identification, Culture, Biotechnology of Flower Developments and Orchids" during 11-18 April 2019 in the University of Greenwich, United Kingdom.

Exposure visit in DNA Barcoding Laboratory at University of Greenwich, London, U.K..


Exposure visit in flower garden at University of Greenwich, London, U.K..

**Publications**

1. Training Manual on "Forestry and Agroforestry technologies for professionals"
2. Training Manual on "Climate Smart Agriculture"
3. Training Manual on " Safe Vegetable production technologies"

**Others activities (Official works, local meeting, participated in trainings, seminars, workshops, etc.)**

Participated in the following activities:

1. Annual Review Workshop on Crop Protection Program of NARS institutes
2. Annual Review Workshop on Soils Program of NARS institutes
3. Annual Review Workshop on Crop Improvement Program of NARS institutes
4. Annual Review Workshop on Crop Production Program of NARS institutes
5. Workshop on Understanding and Implementation of SDGs through APA
6. Worked as Member in the different committee of BARC
7. Annual Review Workshop of CGP Projects under Second Call Projects
8. Research Review 2017-18 and Research Program 2018-19 on Agric.. Engineering of NARS institutes
9. Annual Review Workshop of CRG Projects under NATP-2
10. E-filing workshops
11. Request for Expression of Proposal Opening, NATP II
12. Meeting on World Food Day 2018
13. Meetings on Vegetable Fair 2019
14. Meeting on Fruit Fair 2019

**Soils Unit**
**Project Development**

Project development is a major responsibility of BARC. The Soils Unit of BARC is working in line with the mandate of the Council. The Unit oversees the soil fertility and fertilizer management related programs in the country. The Soils Unit is involved in development of both national and international projects. The Unit developed one single component (Competitive Research Grant, CRG) Sub-Project under the National Agriculture Technology Project, Phase-2 (NATP-2) for updating and publication of Fertilizer Recommendation Guide-2018. The project was initiated in July 2017 and completed in September 2018. The Unit also developed two coordinated projects, namely Program Based Research Grant (PBRG) projects under NATP-2. Both the projects were initiated in March 2018 and are now on-going.

## National Projects

### Updating of Fertilizer Recommendation Through Interpretation of Research Results Generated by the NARS Institutes

It is a single component (CRG) project developed by Soils Unit of BARC with NATP-2 funding. The major objectives of the project were as follows:

- Updating of fertilizer recommendation for crops and cropping patterns under different Agro-Ecological Zones (AEZs)
- Publication of the updated FRG

The project was initiated on 17 July 2017 with signing of LoA between Soils Unit, BARC and PIU-BARC, NATP-2. The project continued until 30 September 2018. “Fertilizer Recommendation Guide-2018” (FRG-2018) was updated and published under this project. FRG-2018 has also been published in Bengali this year as “mvi mycvwikgvjv nvZeB-2018Ó in farmers’ friendly language in addition to English version. The Bengali version “mvi mycvwikgvjv nvZeB-2018Ó is not just the translation of the English version. Bengali version contains only some important chapters in the text part in different forms usable for the farmers. For wider circulation of Bengali version, web application and mobile apps have been developed and uploaded in BARC website (AbjvBb mvi mycvwikgvjv) and Google Play Store (frg.barcapps). Pdf copies of both English and Bengali versions of FRG-2018 have also been uploaded in BARC website (barc.gov.bd)

**Project title: Determination of Critical Limit of Nutrients for Soils and Crops**

It is a coordinated project developed by Soils Unit of BARC with NATP-2 funding under PBRG. The major objectives of the project are as follows:

1. Delineation of the present status of different nutrients in Calcareous, Non-calcareous, Piedmont and Terrace soils
2. Determination of critical limit of different nutrients for cereal, vegetable and oilseed crops
3. Validation of critical limits through field experiments

BARI, BRRI, BINA, and BAU are working as the implementing organizations, and BARC is working as the coordination unit of the project. The project was initiated on 11 March 2018 with signing of LoA between Soils Unit, BARC, and PIU-BARC, NATP-2. The project will be continued until June 2021. Critical Limits of different nutrients for different soils and crops will be determined under this project.

3. **Project title: Improvement of soil health and crop productivity in climate vulnerable and polluted areas through organic amendments**

It is a coordinated project developed by Soils Unit of BARC with NATP-2 funding under PBRG. The major objectives of the project are as follows:

1. Bio-physicochemical characterization of soils in the climate vulnerable and polluted areas
2. Examine potentiality of different organic materials for amending problem soils and improving crop yields in the study areas
3. Quantify the effects of different organic materials on carbon sequestration
4. Development of climate smart technology packages for major crops and cropping patterns in Bangladesh. BARI, BRRI, BINA, BAU, BSMRAU and SAU are working as the implementing organizations and BARC is working as the coordination unit of the project. The project was initiated on 11 March 2018 with signing of LoA between Soils Unit, BARC and PIU-BARC, NATP-2. The project will be continued until June 2021. The project will be implemented in different climate vulnerable and polluted areas of the country to achieve the above mentioned objectives.

## International Collaboration Project:

**Nutrient management for diversified cropping in Bangladesh (NUMAN)**

It is an international collaboration project between NARS institutes and public universities of Bangladesh and Murdoch University of Australia. The project is co-funded by Krishi Gobeshona Foundation (KGF) and Australian Council for International Agricultural Research (ACIAR). The objectives of the project are as:

**Broad objective(s)**

The broad objective of this project is to increase the profitability and sustainability of intensive and emerging cropping systems in Bangladesh through improved nutrient management.

**State specific objective(s)** succinctly, in the order in which they will be achieved. (Objectives should be precise, specific, and result-oriented, and achievable within the time frame).

i. Identify differences between current and recommended fertilizer use on farms, gather evidence of nutrient imbalance and identify barriers to adoption of more profitable and sustainable nutrient management practices.

ii. Develop and test tools for sustainable nutrient management in intensively cropped areas of north-west Bangladesh and in emerging cropping systems based on CA and on coastal zone soils of southern Bangladesh.

iii. Out-scale the use of tools and development of policies to advance practice change towards improved fertilizer use efficiency through engagement with farmers' groups, extension, the private sector and government policy.

iv. Improve the knowledge of soil resources and capability for nutrient management by research partners and key stakeholders.

**The project functions involving the following organizations and project components:**

| Organizations | Division/Department | Remarks |
|---|---|---|
| BARC | Soils Unit | Coordinator (KGF funding part) |
| Murdoch University, Australia | | Coordinator (ACIAR funding part) |
| BARI | Soil Science Division | Implementing organization |
| | On-Farm Research Division | Implementing organization |
| | Agricultural Economics | Implementing organization |
| BRRI | Soil Science Division | Implementing organization |
| SRDI | | Implementing organization |
| BAU | Department of Soil Science | Implementing organization |
| | Rural Sociology | Implementing organization |
| Khulna University | Agro-technology Discipline | Implementing organization |
| PSTU | Department of Soil Science | Implementing organization |

**Besides, there are three strategic partners in the project, which are as follows:**

1. International Plant Nutrition Institute (IPNI)
2. Bangladesh Fertilizer Association (BFA)
3. Conservation Agriculture Service Provider Association (CASPA)

Intensive cropping areas of Durgapur (AEZ-11) and Godagari (AEZ-25) Upazilas of Rajshahi and Sadar Upazilas of Thakurgaon (AEZ-1) and Mymensingh (AEZ-9) and coastal areas of Dakope of Khulna (AEZ-13) and Amtoli of Barguna (AEZ-13) have been selected as the research hubs under the project.

**Project Implementation**

During 2018-19, Soils Unit implemented the project titled "Updating of Fertilizer Recommendation through Interpretation of Research Results Generated by the NARS Institutes". English and Bengali versions of Fertilizer Recommendation Guide-2018 (FRG-2018) have been published under the project. Updated research information generated by different NARS institutes like BARI, BRRI, BINA, BSRI, BJRI, BTRI, SRDI and BFRI since publication of FRG-2012 were collected, compiled and edited and incorporated in updating of FRG-2018. A draft FRG-2018 was prepared and validated in a national workshop. A draft of Bengali version of the Guide titled " Fertilizer Recommundation Guide 2018" was also prepared and validated in a national workshop. Both the Guides have been published under this project. Besides, a 'Mobile app' of the Bengali version was developed under this project to make the Guide available on-line. Pdf copies of both English and Bengali versions of FRG-2018 and the Mobile apps have been uploaded in BARC website (barc.gov.bd).

## Project Coordination

The following three projects are being coordinated by Soils Unit during 2018-19:

## National Projects

### Determination of Critical Limit of Nutrients for Soils and Crops (ID: 134)

The project has been formulated to delineate the nutrient status of calcareous, non-calcareous, piedmont, and terrace soils; and to determine Critical Limit **(**CL) of different nutrients for cereal, vegetable, and oil seed crops, and their validation through field experiments. It is about three and half-year long project approved in March 2018 and will continue through June 2021. The LoA was signed in the second week of March 2018. The project is coordinated by BARC; and BARI, BRRI, BINA, and BAU are working as implementing organization. Work distribution among different components is as follows:

| Organization | AEZ | Nutrient | Crop |
|---|---|---|---|
| BARI | 11, 13, 28 | K and Zn | Wheat, maize and cabbage |
| BRRI | 18, 19, 20 | P, K, S and Zn | Rice |
| BINA | 25, 26, 27 | P (Bray & Kurtz) and Mg | Maize and mustard |
| BAU | 1, 3, 9 | Mg, S and B | Wheat and mustard |

Twelve AEZs have been selected as the study areas under the project. A bench mark survey was conducted in the study areas to know the present nutrient and fertilizer use. For the purpose, a total of 720 soil samples (4 components x 3 AEZs/component x 2 Upazilas/AEZ x 3 villages/Upazila x 10 spots/ village) were collected. Soil samples were analyzed for macro- (N, P, K, Ca, Mg& S) and micro- (Fe, Mn, Cu Zn & B) nutrients and basic soil characteristics like pH, organic matter and texture. Soils with different nutrient levels were identified, which will be collected for pot experiments. To determine critical limit of a particular nutrient and crop pot experiments will be conducted by the component organizations using soils with different levels of that particular nutrient and crop. At least 20 soils from 20 locations will be used for one nutrient, of which 12 soils will be from deficient areas, 4 soils will be from low fertility areas and the remaining 4 soils will be from medium fertility areas of the particular nutrient. Sprouted seeds will be sown in the pot and the crop will be harvested at 8-10 weeks of seeding. Dry matter (DM) yield will be recorded and plant samples will be analyzed for the particular nutrients under study. Critical limit for the particular nutrient and crop will be determined by Cate and Nelson method (1965) and also by statistical approach developed by Waugh et al. (1973). The results will be validated through field experiment at the farm level.

### Improvement of Soil Health and Crop Productivity in Climate Vulnerable and Polluted Areas Through Organic Amendments(ID: 135)

The project was initiated on 11 March 2018 with signing of the Letter of Agreement (LoA) and will continue through 30 June 2021. The project is being coordinated by BARC; and BARI, BRRI, BINA, BAU, BSMRAU, and SAU are working as the implanting organizations. Total cost of the project is Tk. 3,71,26,906/-. A number of studies have been planned under the project for climate vulnerable and problem soils of Dumuria and Batiaghata, Khulna, and Kalapara, Patuakhali (Saline soils), Godagari, Rajshahi, and Nachole, Chapai Nawabganj (Drought prone areas), Belabo, Narshingdi, and Modhupur, Tangail (Acidic soils), industrial areas of Sreepur, Gazipur and Bhaluka, Mymensingh (Heavy metal polluted soils). Different types of organic fertilizers/materials like vermicompost, trichocompost, poultry manure, standard organic fertilizer, biochar etc. will be used to observe their effectiveness for amendment of problem soils,

and improvement of soil health and crop productivity. These organic fertilizers/materials are being studied in combination with different chemical fertilizers in different ratio to identify the best organic fertilizers/materials and best combination with chemical fertilizers.

## International Collaboration Project

**Nutrient Management for Diversified Cropping in Bangladesh (NUMAN)**

It is a collaboration project involving four NARS institutes including BARC, BARI, BRRI, and SRDI; three national universities including BAU, Khulna University, and PSTU; and the Murdoch University, Australia. KGF funding part is being coordinated by BARC and ACIAR funding part being coordinated by Murdoch University, Australia through PIO/Liaison Office in Dhaka. There are also three strategic partners in the project including International Plant Nutrition Institute (IPNI), Bangladesh Fertilizer Association (BFA) and Conservation Agriculture Service Provider Association (CASPA). The Letter of Agreement (LoA) between BARC and KGF was signed in the first week of January 2018; and between BARC and implementing organizations in the second week of January 2018.

The activities of the project can be categorized into two; socio-economic and gender aspects of fertilize use; and soil fertility and fertilizer management activities. For the socio-economic and gender studies quantitative and qualitative research approaches are being employed. Research programs for the soil fertility and fertilizer management activities have been developed through identification of real field problems through field visit, discussion with farmers and rigorous discussion among the project team members. Research programs have been designed for the on-station, on-farm and laboratory-based studies. In addition to Principal Investigators (PIs) and Co-PIs, six Research Fellows (leading to in-country PhD) and 20 Research Assistants (leading to MS) have been engaged in implementation of the project activities. Existing research facilities of the respective implementing organizations are being used for the research. The project activities have been started since Kharif-1 season 2018.

## Policy Level Contribution

### Service to the Fertilizer Technical Sub-Committee

Fertilizer Technical Sub-Committee was formed by the Ministry of Agriculture (MoA) in 1997 to help the National Fertilizer Standardization Committee. Member-Director (NRM), BARC works as the convener and Additional Director (Implementation), DAE as the Member Secretary of the committee. The committee comprises of 19 (nineteen) members with the CSO (Soils), BARC, CSOs of Soil Science Divisions of different NARS institutes, CSO, OFRD, BARI; representatives from different concerned organizations like Departments of Environment, Livestock, Fisheries, BSTI, SRDI, BADC, BCIC etc. During 2017-2018, twomeetingsofFertilizer Technical Sub-committee were held with Member-Director (NRM) in the chair. A number of organic and chemical fertilizers and PGRs were evaluated in these meetings of which 4(four) organic fertilizers and12(twelve) plant growth regulators were recommended for standardization to the National Fertilizer Standardization Committee headed by the Secretary, Ministry of Agriculture. The Soils unit of BARC also performed the following activities during 2018-19..

Pictorial Views Organic Fertilizer Factory Visit

- PSO (Soils) has been serving as convener of 3-member Monitoring Committee for evaluating the capacity of quality organic fertilizer producing factories. The committee visited the factory of Matir PustiJaibo Sarat, Gazipur on 6 September 2018. The committee also visited 9 units of Bumper Organic Fertilizer of ACI Fertilizer Limited. The units are situated at (1) Chakpara, Maona, Gazipur, (2) Degree char, RajbariSadar, Rajbari, (3) Rajarkhola, Cumilla Sadr, Cumill, (4) Sirabazu, Birganj, Dinajpur,( 5) Roghunandanpur, FaridpurSadar, Faridpur, (6) Noupara (Laujani), Jhikorgacha, Jesore, (7) Dakra centre, Charghat, Rajshahi, (8) Kukhundi, Motihar, Paba, Rajshahi (9) Pabohara, Kahalu, Bogura from January–February 2019. After visit, the Committee submitted report to the Convenor of Fertilizer Technical Sub-Committee.

**Provided opinion/comments to the Ministry of Agriculture:**

1. Provided opinion on Mou between Marubeni corporation and SRDI
2. Provided comments on determining Accreditation for Bio-Agriculture to implement National Agricultural Policy (MD. NRM)
3. Provided comments on Support and Cooperation in Submitting the Draft Nitrogen Resolution for the upcoming UNEA- 4
4. Provided opinion on Soil, climate and technological prospect of Ethiopia.
5. Provided opinion on Designated Reference for Chemical Mesurement Drat Law, 2018.
6. Provided comments on different Mou of Department of Environment

## Research Management and Coordination

Soils unit of Natural Resources Management Division of BARC organized Annual Research Review and Planning Workshop on Soils Program of NARS institutes. In 2018-19, the workshop was held at BARC during 28-30 August 2018 with scientific professionals involved in soils and fertilizer management research in the NARS institutes of the country. Research programs conducted in all the NARS institutes during 2017-2018 were reviewed in the workshop. The workshop was divided into seven technical sessions and one recommendation session. The technical sessions were divided into different areas of soil fertility and fertilizer management research and environmental issues. Besides reviewing on-going research programs, new research programs proposed for 2018-19 were also discussed in the workshop. Scientists from different NARS institutes took part in the discussion, contributed and shared their knowledge, thoughts and experiences for improvement of the programs and avoid duplication.

## Monitoring and Evaluation

Soils Unit of BARC is actively involved in the regular monitoring and evaluation program of BARC. Scientists of Soils Unit worked as the team member of the Monitoring and Evaluation teams formed by the Planning and Evaluation Division of BARC. CSO (Soils) and Director AIC, (Addl. Charge) worked as the team leader (Team # 7) and monitored 7 PBRG Sub-projects (ID 035, 064, 072, 089, 108, 128, 138) in Sylhet Region: Sylhet, Sunamganj, Moulvibazar, Habiganj, B. baria during 10-12 April 2019. The committee presented report in the Monitoring Workshop of PBRG Sub-Projects held during 17-18 June 2019.

## Training, Workshop, Seminars and Symposium

### Training:

Soils Unit of Natural Resources Management Division, BARC organizeddifferent training programs for the NARS scientists, DAE Officers, and junior teachers of universities during 2018-19. The Unit conducted training programs on the following topics.

- Conducted training program on “Climate Change, Carbon Sequestration and Adaptation Strategies” during March 11-13, 2019. Forty Participants from NARS Institutes, Public Universities, BADC, and DAE participated
- Conducted Training Program on “Use of Fertilizer Inspection Manual” during 18-20 June 2019. Forty Participants mainly from DAE and NARS institutes were participated
- Conducted training program on “Fertilizer Recommendation Guide-2018” during June 22-24, 2019. Forty participants mostly from DAE and NARS institutes participated in the program

### Workshop:

- Organized Research Review and Planning Workshop on Soil Management Program of NARS Institutes during 28-30 August 2018. Eighty participants from different NARS institutes, public universities and Department of Agriculture Extension attended the workshop. Recommendations of the workshop were sent to respective institutes.

## Publications:

Following publications were prepared and published by the Soils Unit during 2018-19:

1. Proceedings of Research Review and Program Planning Workshop of Soils Program of NARS Institutes 2017
2. Fertilizer Recommendation Guide-2018 and mvi mycvwikgvjv nvZeB-2018
3. Two proceedings of Fertilizer Technical Sub-Committee meetings.
4. Training Manuals of the following Ttraining programs :
    a. Climate Change, carbon sequestration and adaptation strategies
    b. Training on Fertilizer Recommendation Guide-2018
    c. Training Program on Use of Fertilizer Inspection Manual

## Other Activities:

### Scientists worked as the members of different committees:

- CSO (Soils) has been working as Director SAARC Agriculture Centre (SAC) since May 2015 and Director (TTMU), additional charge from November 2016 to 2018.
- PSO (Soil) served as Director AIC (Addl. Charge) from 06.11.2018 to 23.06.2019
- PSO (Soil) has been working as convener of Organic Fertilizer factory investigation committee.
- CSO & PSO (Soils) participated as member/resource persons in various committees' meetings, training programs and development activities organized by ARIs, SRDI, DAE, and NGOs.
- CSO (Soil) and PSO (Soils) have been working as convenor and member, respectively, of Fertilizer Inspection Manual Amendment Committee.
- PSO (Soil) has been working as member of Fertilizer Analysis Manual Amendment Committee.
- PSO (Soils) worked as an external examiner of B. Sc. Ag (Hons.) and M. S. level examinations of BAU, PSTU, and SAU.
- Worked as an M. Sc. Ag. (Soil Science) thesis examiner.
- Worked as an examiner for Ph.D. examination of Department of Soil Water and Environment of University of Dhaka and Sher-e-Bangla Agricultural University.
- Worked as a member of Steering Committee for Establishment of Laboratory of SRDI & Project Management Committee of Soil Resources Management and Strengthening Farmers Services Project.

# Livestock Division

The Livestock Division of BARC is involved in organizing and managing various research and other related activities for developing the livestock sector in Bangladesh. This division is working to achieve the goal of improving nutritional status of the general mass through cost-effective livestock production for increased supply of animal origin food, supporting increased crop production through providing healthy draft animals and biological manure and helping the rural poor in the generation of employment, income, and fuel supply through profitable livestock rearing.

To carry out the mandated responsibilities of BARC and to ful-fill the national need, the division is entrusted with the duties of planning, reviewing, prioritizing, approving, monitoring, evaluating, supervising and coordinating of the livestock research programs implemented by the relevant NARS institutes including universities, Department of Livestock Services (DLS), and NGOs. The division is providing training and research support to the NARS institutes, DLS, relevant faculties of various educational institutions, and NGOs. The division is providing policy support to the relevant NARS institutes and extension agencies. It is arranging, conducting, and participating in training, meetings, and seminars/workshops. The division is also engaged to support national avian influenza/bird flue prevention and control programs to recruit scientists/officers in NARS institutes, to support different research activities of NARS institutes and to support different activities of National Agricultural Technology Project (NATP), BARC and DLS Units.

## Annual Progress of Work-plan 2018-19

Development of Research Plans

**Review and planning of annual research programs:**

- Reviewed progresses of on-going research projects and evaluated & approved the new research project proposals for 2018-19 in BLRI
- Helped prepare BLRI's future research plans

**Coordination of Core research Activities of NARS Institutes**

**Technical support:**

- Different research activities of BLRI.
- Twenty six CRG and 4 PBRG sub-projects under Livestock Division of BARC.
- Other programs: 2 ERD research projects

**Monitoring & evaluation of research studies/projects:**

- Eight PBRG sub-projects were monitored during 9 to 11 February 2019 and 10-11 March 2019.
- One ERD research projects was monitored during 10-11 March 2019

**Projects monitored:**

1. ID-005 (2 Components): A coordinated sub-project on Transfer of Agricultural Technologies to Farmers' level for increasing farm productivity
2. ID-007: Value addition and standardization of nutritional level in selected food items from animal and plant origin
3. ID-138: Determination of antimicrobial resistance and residues in livestock and poultry food products and feed in Bangladesh
4. ID-002: Groundwater resources management for sustainable crop production in northwest hydrological region of Bangladesh
5. ID-049: Adaptation and scaling up agro-forestry for livelihood improvement of farmers in agricultural ecosystem of Bangladesh
6. ID-061: Integrated farming research and development for livelihood improvement in the plain land eco-system

7. ID-089: Establishment of profitable cropping pattern through crop intensification in underutilized unfavorable ecosystem
   ERD Project:
8. Determination of antimicrobial resistance and residues in livestock and poultry food products and feed in Bangladesh

**Annual evaluation of completed studies**
**Review of research activities:**

- BLRI research activities were reviewed.
- At BARC, 26 CRG sub-projects were reviewed.

**Progress summaries of PBRG sub-projects (Livestock)**

**1.** Development of knowledge hub on feed resources for efficient feeding management of livestock (Project ID:108)
**2.** Application of gamma-ray irradiation to develop stress tolerant capability in fodder crops and their production performance under on-station and on-farm conditions (Project ID:110)
**3.** Determination of antimicrobial resistance and residues in livestock and poultry food products and feed in Bangladesh (Project ID:138)
**4.** Preparedness for the control of PPR in Bangladesh (Project ID:139)

**Annual report of PBRG sub-projects (Livestock)**

**Title: Determination of Antimicrobial Resistance and Residues in Livestock and Poultry Food Products and Feed in Bangladesh (Project ID:138)**

**BLRI component:**

- 130 questionnaire survey data were collected for qualitative and quantitative determination of antimicrobial drugs residue from 6 districts (Gazipur, Tangail, Manikgong, Rajbari, Madaripur, and Faridpur).
- 150 (Feces 90, feed 60) samples were collected for microbiological study and qualitative and quantitative determination of antimicrobial drugs residue.
- 70 *E. coli* isolate and 20 *Staphylococcus aureus*were isolated and stored in 20% glycerine for futher study. No antibiotic sensitivity test (AST) is yet ro be done. After AST, PCR will be done for molecular analysis of the resistant genes.

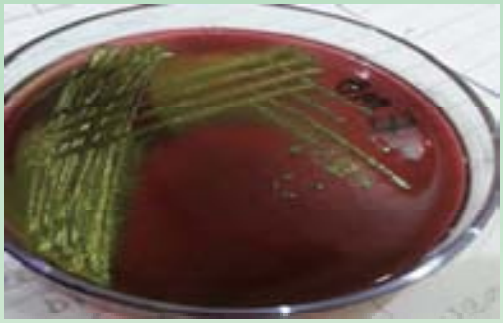
**BAU components:**

- Questionnaire survey were completed in four districts (16 upazillas) were completed. Approximately 75% sample collection is completed and are still now going. Antimicrobial sensitivity/resistance pattern study of each isolate is ongoing.
- A total number of 18 antibiotics are used to analyze the sensitivity/resistance pattern.

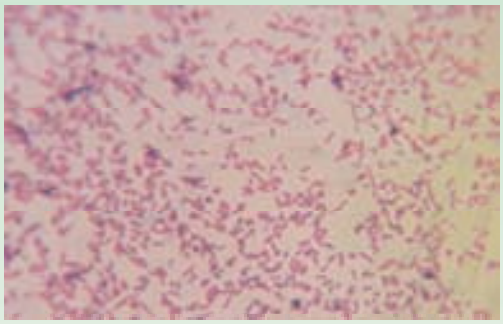
**HSTU Component:**

- One Hundred Ninty data were collected from stakeholders for baseline survey using structured questionnaire.
- One Hundred Thirty Seven samples were collected for detection of antibiotic residues and sent to BAU for detection of antibiotic residue.
- Thirty three samples were collected for microbiological study.
- Seven bacteria were isolated from 33 milk and other samples. These bacteria are *E. coli, Streptococcus* spp., *Staphylococcus* spp., *Corynebacterium sp., Klebsiella* spp., *Salmonella* spp., *and Pseudomonas* spp.

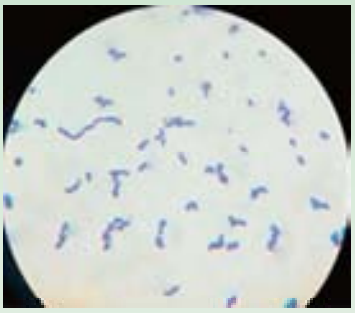
Lactose fermenting organisms produce bright pink coloured colony



Growth of E. coli on EMB agar showing greenish black coloniless with metallic sheen



*E. coli showing* Gram-negative (Pink colour) small rod shape, arranged in single or paired at 100x (Gram's staining)



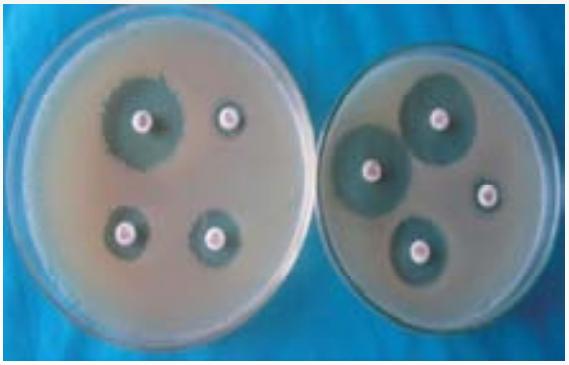
Gram positive shor chain shaped violet colour *streptococcus spp* under 100x microscopy.

**SAU Component:**

- Collected five samples of each type from four Upazilas of Sylhet district.
- Processing the samples and isolation and identification of the bacterial contamination are in progress.

**RU component:**

- A baseline survey was conducted in Rajshahi and Naogoan districts at farms, Vet practitioners and medicine sellers.
- A total of 226 samples (113 from Rajshahi district and 113 from Naogaon district) were collected which included 56 poultry products, 98 large and small animal product, and 72 poultry feed. Isolation and identification of bacteria was done by using different culture media, Gram's staining, and biochemical tests.



Antibiotic sensitivity pattern of isolated bacteria on Muller Hinton agar media. Bacteria showed sensitive to gentamycin, intermediate sensitive to ampicillin and amoxiallin, and resistant to penicillin (left). Isolated bacteria also showed sensitive to ciprofloxacin, streptomycin and nalidaxic acid, and resistant to gentamycin (right).

## CVASU Component:

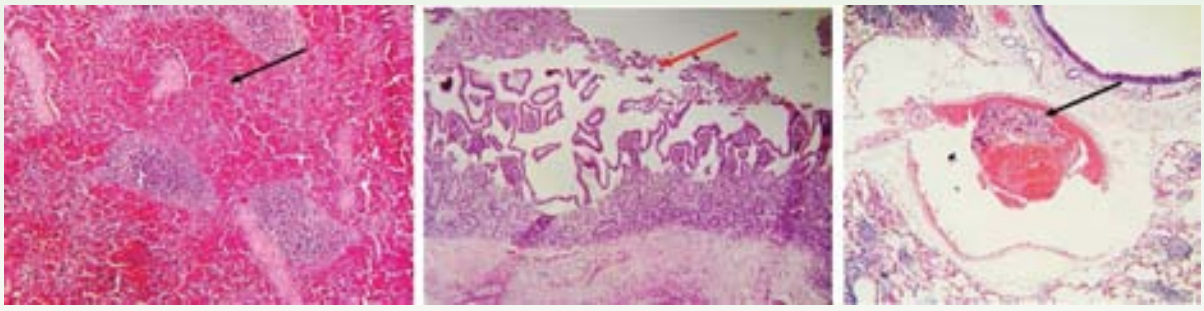
- Standard questionnaire was prepared and followed by CVASU component of this project. Survey was conducted among farms of the study area representing integrated farming, small, large-scale commercial poultry and dairy farmers of Chittagong. A similar survey with the veterinarian will also be carried out.
- Data were collected from a total of 150 farms (layer 50, cattle 100) and 20 vet practitioners from Chittagong city and Potiya upazila under Chittagong District. After collection of data from these farms a total of 210 samples (Milk and meat (160) and egg (50)) was taken to perform different laboratory tests. Thin layer chromatography (TLC) was performed on all samples.
- Antibiotic standards were procured to perform HPLC on the collected samples. For identification of resistant bacterial gene, sample collection is ongoing. Bacterial culture media preparation was completed and ready for bacterial passage.

## Preparedness for the Control of PPR in Bangladesh (Project ID:139)
## BLRI Component:

- A total of 55 clinical goat samples were collected from 5 different districts of Bangladesh.
- Among them, 30 samples (54.55%) were positive for PPR virus by RT-PCR.
- For Sero-survillence, 225 goat serum samples were collected from 5 different districts of Bangladesh. Following cELISA, 32.34% were sero positive for PPR infection.

## BAU Component:

- BAU component were collected about ten (10) clinically PPR suspected goats from different villages at Mymensingh Sadar Upazilla followed by postmortem examination, histopathology RT-PCR and primary goat kidney cell culture for isolation and identification of PPR virus.



Histopathological investigation of spleen (left), intestine (middle) and lungs (right). There was massive hemorrhages in spleen (left, arrow), severe enteritis (middle, arrow) and severe congestion and hemorrhages (right, right) in lungs.

Samples collected for histopathology (left) and for the isolation of viruses in culture (middle), RT-PCR result (right).

**Development of Knowledge Hub on Animal Feed Resources for Efficient Feeding Management of Ruminants to Enhance Productivity (Project ID:108)**

**BAU Component:**

- Questionnaire preparation and pre-testing has been done
- Baseline survey of Mymensingh for winter season and 30 feed samples have been collected during winter season
- Year wise variation of the analysis of the chemical composition and energy based on meta analysis

Project PI visiting straw market

Cows feeding local grass

Field level work

Storing samples for analysis

Checking local powder feed

Local grass

**BLRI component:**

- Conduction of survey within four upazilla out of six upazilla had been completed and remaining two selected upazilla survey conduction will be started very soon.
- Different types of livestock feed sample had been collected during conducting the survey. Already we collected fifty feed sample including local grass like shama, durba, hatchi and arali grass from selected four upazilla
- Determination of chemical composition of collecting some feed sample had been completed and remaining analysis is being continued.
- Extraction ratio and harvest index of some feed had been completed like wheat, rice, etc.

**SAU component:**

- The yield of rice (BR-49,44, 46) was 1.17 kg/sq.m while traw yield was 1.52 kg/sq.m in Sunamgong flood prone area and Patuakhali coastal area. Incase of harvesting straw, top harvesting pattern was observed and on an average 0.33-0.50 kg/m harvested straw was usually stored by the farmers for animal feeding. The harvest index ratio (Paddy and straw) was found on an average 1: 1.33. On the other hand extraction ratio of rice and rice bran (poliah+husk) was found 2.5:1.

- The average milk production of native cow was observed from 1.84 L/d to 2.2 L/d. Higher productive cows were found in coastal area than that of haor area. On the other hand, high yielding cow rearing provision was very rare and the trend of milk production was 8.37-8.42 L/d in both haor and coastal area.

Paddy harvesting

Measuring plant

**Title: Application of gamma-ray irradiation to develop stress tolerant capability in fodder crops and their production performance under on-station and on-farm conditions (Project ID:110)**

**BINA Component** :

- Experiment was conducted consisting of seven BLRI Napier cultivars, namely Napier-1, Napier-2, Napier-3, Napier-4, Rokona, Pakchong, and Markiron one Para and one German grasses.
- The cuttings of each cultivar was irradiated with four does of gamma rays as 2Gy, 30Gy, 40Gy and 50 Gy from $^{60}$Co source from BINA.
- It was observed that most of the cuttings of higher radiation dose like 40Gy and 50Gy didn't survive. Variations were observed in all the doses of gamma irradiations.
- Out of nine fodder cultivars, 20Gy treated plants (Clones) produced higher fresh weight in Napier-2, Napier-3, Rokona, Markoron, Para, and German grass. In case of 30Gy treatment Napier-1, Napier-4 and Pakchong produced higher fresh weight.


Field view of experimental plots of Gamma irradiated fodder crops, BINA, Mymensingh

**BLRI Component:**

- The cuttings of Napier cultivar, German and Para were irradiated with ten different doses of Gamma rays as 10 Gy, 20 Gy, 30 Gy, 40 Gy, 50 Gy, 60 Gy, 70 Gy, 80 Gy, 90 Gy and 100 Gy from $^{60}$Co source from BINA, Mymensingh.
- The seeds of barley was irradiated with seven dose of Gamma rays as 100 Gy, 150 Gy, 200 Gy, 250 Gy, 300 Gy, 350Gy, and 400Gy. Similarly, the seeds of oat fodder was irradiated with four different doses of Gamma rays as 100 Gy, 150 Gy, 200 Gy, and 250 Gy from $^{60}$Co source from BINA. The control cuttings/seeds were not irradiated.
- The highest biomass per hill of mutants of Napier-1, Napier-2, Napier-3, Napier-4, Packchong, Markiron, and Rokona were in 50Gy, 0Gy (Control), 50Gy, 90Gy, 30Gy, 20Gy, and 100Gy, respectively. For both barley and oat, the irradiation of Gamma ray at different dosages increased the tiller number except oat in 200Gy where the number of tillers were the lowest. Similarly, The Gamma ray irradiation also increased the tiller height for both the barley and oat fodder.

Evaluation and field monitoring by NATP expert members and Project Director

## Research Support:

**Review of project proposals for operational fund:**

- Research project proposals of BLRI were reviewed.

**Coordination and Review meeting/workshop:**

- Attended BLRI TC meeting to review the progresses of on-going research projects. monthly/quarterly/half yearly/annual progress report/project completion report evaluation:
- PCR of eight CRG sub-projects were evaluated
- Half yearly progress reports of four PBRG sub-projects

## Human Resources Development

### Training:

- Training course on Bioinformatics for Sustainable Development in Agriculture: March 19-21 2019 held at BARC. A total of 20 scientists/teachers of Crops, Livestock, and Fisheries discipline from BLRI, BARI, BRRI, BFRI, BSRI, BJRI, BINA, BAU, BSMRAU, and SAU (Dhaka) were present.
- Training course on Antimicrobial Resistance in Bangladesh: April 28-30 2019 held in Rangpur. A total of 27 veterinarians of DLS and HSTU and medical professionals from Rangpur Medical College were present.
- Training course on Peste des Petits Ruminants (PPR): Two batches- First batch in 20 May 2019, Second batch in 21 May 2019 held in Barisal. In each batch, a total of 20 veterinarians of DLS participated.

### Workshop/Seminar:

- Inception Workshop on PBRG Sub-project (ID-139), PIU-BARC, NATP-2 held on 7 August 2018
- Inception Workshop on PBRG Sub-project (ID-108 & 110), PIU-BARC, NATP-2, held on 08 August 2018
- Inception Workshop on PBRG Sub-project (ID-138), PIU-BARC, NATP-2 held on 6 December 2018
- Consultative workshop on Preparation of National Control Strategy for Peste des Petits Ruminants (PPR) held on 6 May 2019


Training Course on Bioinformatics for Sustainable Development in Agriculture: March 19-21, 2019, held in BARC.


Training course on Peste des Petits Ruminants (PPR): Two batches- First batch in 20 May 2019, Second batch in 21 May 2019, held in Barisal.


Training course on Antimicrobial resistance (AMR): 28-30 April 2019, held in Rangpur.


Consultation workshop on finalization of national strategic plan for control of Peste des petits ruminants in Bangladesh: 16 May 2019, held at BARC.

## Support to Other Activities

### Support to Recruitment & Research of BLRI:

- As a recruitment committee member, support given to recruit best scientists/officers and other staffs of BLRI throughout the year.
- As a TC member, support given to evaluate the progresses of on-going research projects and evaluate and approve new project proposals of BLRI.
- Support also given to other activities of BLRI.

## Publications


Sarker, M. S. A.; Rahman, M. T.; Mahmud, M. M.; Tagliamonte, M. S.; Chowdhury, S. M. Z. H.; Islam, M. R.; Rahman, M. B.; El Zowalaty, M. E.; Nazir, K. H. M. N. H. (2018). First genome sequence of *Pasteurella multocida* type B strain BAUTB2, a major pathogen responsible for mortality of bovines in Bangladesh. Microbiology Resource Announcements, 7 (9): e00901-18. *DOI: https://doi.org/10.1128/MRA.00901-18.*

Chowdhury, S.M.Z.H.; Mahmud, M.S.; Islam, M.R.; Nazir, K.H.M.N.H. (2019). Phylogenetic analysis of Black Bengal and Jamnapari goats in Bangladesh based on partial sequence of cytochrome B gene. *SAARC Journal of Agriculture*, 17(1): 23-35. DOI: https://doi.org/10.3329/sja.v17i1.42759

Rahman, M. M., Roy, K. J., Aktar, M. K., Islam, M. R., Abdul Kafi, M. (2019). Spectrochemical characterization of Vero cell line against PPR virus infection*.J. Adv. Biotechnol. Exp. Ther; **2**(1):10-16. . *DOI:* https://doi.org/10.5455/jabet.2018.d1


**Routine Works:**

- Preparation of annual work plan 2018-19: Done in July 2018.
- Preparation of Annual Report 2017-18: Done in August 2018.
- Preparation of various documents, etc.: Done throughout the year.
- Review of different documents and preparation of comments on them.
- Comments given on different documents came from MoA at different times.

# Agricultural Economics and Rural Sociology Division

**Project development/project financing:** Cost and Return Analysis of Selected Crops in Bangladesh (ID:021), PBRG Coordinated Sub-project, PIU-BARC, NATP-2 Project

**Project implementation:** Cost and Return Analysis of Selected Crops in Bangladesh (ID:021), PBRG Coordinated Sub-project, PIU-BARC, NATP-2 Project. Implementing Organization: Agricultural Economics Division of BARI and BINA

**Policy Level Contribution:**

Different policy oriented comments were sent to the Ministry of Agriculture according to its needs/requirements. Some of those are as follows:

i. Inputs for making English version of Bangladesh Economic Review 2018
ii. Prepared Brief for the delegates of Bangladesh to participate in the 73$^{th}$ UN General Assembly in New York.
iii. Comments on the report of D-8 Decennial Road Map for 2020-2030.
iv. Inputs for the 10$^{th}$ UNCTAD World Investment Forum 2018.
v. Comments on the report titled State of Bangladesh Economy and Upcoming National Elections Priorities for Electoral Debates.
vi. Comments on the Mid-term Review of the Perspective Plan (2010-2021).
vii. Inputs for making Bengali and English versions of Bangladesh Economic Review 2019.
viii. Inputs for the First Coordination Meeting between Bangladesh and India.
ix. Comments on the Agricultural Land Protection and Land Use Act 2019.
x. Comments on Introduction of Crop Insurance in *Haor* Area in Bangladesh.
xi. Comments on the MoU regarding purchase of jute goods from jute mills under BJMC.

**Monitoring, reviewing and evaluation report of programs/activities of NARS institutes**

Total 10 CRG sub-projects as well as one PBRG sub-project financed by PIU-BARC, NATP-2 project were monitored by the research personnel of AERS Division. The implementing organizations were BARI, BRRI, BSRI, BAU, SAU (Dhaka), SAU (Sylhet), and BINA, Mymensingh. Besides, 21 of research activities under special budget of Ministry of Agriculture were monitored during this period and the implementing organizations were BJRI, SRDI, BADC, and BIRTAN, Dhaka and BINA, Mymensingh. However, the expected research outputs were satisfactory in all projects.

**Training, workshop, seminar, training cum workshop, etc. ( Foreign and Local):**

**Training:** A training programme on "Applications of Econometrics in Agricultural Research" was held on 10-14 March 2019 at BARC. Twenty scientists (Agricultural Economists) of NARS Institutes attended the training program.

Pictorial view of the training program on Agricultural

**ii)) Workshop**:

A view of the review workshop on socio-eeonomic research programs of NARS institutes

**Review of socio-economic research programs of NARS institutes**

A workshop on "Review of Socio-economic Research Program (2018-19) and Future Research Program (2019-20) of NARS Institutes" was held on 24-25 June 2019 of BARC. In the inaugural session, Dr. Md. Kabir Ikramul Haque, Executive Chairman, BARC was presen as chief guest and Dr. A. S. M. Anwarul Huq, Member Director (AERS), BARC presided over the session. A total of 78 participants including scientists, professors, agriculture experts, and delegates attended the workshop from different research organizations, universities, and private sectors. The present and future research activities were presented by the Head or nominee of the related division of five NARS institutes (BARI, BRRI, BSRI, BINA, and BFRI) in Day-1 and Day-2, respectively. Technical session-1 and 2 were presided over by Dr. Jahangir Alam, Vice Chancellor, University of Global Village and Professor Dr. Rezaul Karim Talukder, Former Advisor, MUCH, FAO/MoFood, respectively. Five expert reviewers, namely Dr. M. Shahadad Hossain, Former Director General, BARI, Dr. Firoze Shah Sikder, Former Director General, BRRI, Dr. Shaikh Abdus Sabur, Professor, BAU, Mymensingh, Dr. Ferdous Alam, Professor, BAU, Mymensingh and Dr. M. Shahe Alam, Former CSO, Agricultural Economics Division, BRRI reviewed the presented research projects critically. The comments/suggestions made in the workshop by the expert reviewers and the participants are given below:

## Comments on the Research Programs for 2018-19

**BARI:**

- Wheat production is decreasing because wheat could not compete with maize. Therefore, the comparative study (competitiveness between wheat and maize) should be undertaken to develop new wheat variety. It is time demanding research.
- National dataset for postharvest loss is not available. Only region-wise study is not national representative.
- Improved supply chain should be identified from the experience of all existing channels.
- Study on comparative advantage of wheat import or production should be taken and answer should be shared with both researchers and policy makers.
- Consideration on change in cropping pattern over the times is important.
- Difference of set-circumstances between users and nonusers of BARI machineries should be investigated.
- Study on environmental suitability should be undertaken for combine harvester and transplanters.
- Policy implication between small chain and longer value chain should be clarified with the completion of the study.
- Adaptation study on crop and soil management should be clearly specified.
- The way of using random sampling should be followed.

**BRRI:**

- Time series data of adoption rate on rice varieties should be prepared for understanding the replacement of old varieties and competitiveness of new varieties. Why did the farmers not adopt more hybrid rice cultivation though the yield of hybrid rice is comparatively high?

**BSRI:**

- Study of food safety on sugarcane juice should be undertaken for sake of importance of health issue.
- The cost of crushing machine and subscription of juice seller for the place should be added to the cost.

**BINA:**

- Yield gap study should be done in more details. As the agricultural economics division is newly established, the researchers in this division are expected to improve themselves in the future.
- The real cause of the highest and lowest should be identified and given in the text of result for proper understanding.

**Bangladesh Forest Research Institute**

- Data set of real forest area should be developed. As scientists say, “cultivation of eucalyptus is harmful to environment”. Therefore, awareness of the farmers should be built up through different research programs.

## Comments on the Future Research Programs For 2019-20

**BARI:**

- To broaden the dimension of the study, less number of studies should be accomplished at the macro level.
- In-depth investigation for production, availability and scope of market for export should be done.
- Scope of mugbean cultivation and implication of public policy should be done.
- Study, which will highlight on the current issues and government policy, should be undertaken.
- Study in haor areas (especially case study) and study on cultivable land reduction should be taken.
- The previous study on potato should be carefully reviewed and the present study should be modified based on current production and distribution system. Study interval of potato cultivation should also be taken into consideration and compared with the present study.
- As user of BARI reaper and thresher will be fewer, comparative profitability, efficiency and problems of BARI machine should be carried out in comparison with imported combined harvester. The reflection of national discussion for mechanization should be given in the study. The merit and demerit in proper context should also be reflected.
- Cropping pattern study should be based on both land type and soil. The review of the cropping pattern study accomplished by BRRI should be done.
- Sampling size and study locations should be national representative and consistent with national level policy. More sample sizes should be taken to represent the macro level data.
- Pre-study for the intensity of roof top gardening should be investigated.
- If there is baseline survey, panel data can be considered for the study in enclaves.
- Comparative study and economic efficiency between user and nonusers of technology specially machineries can be undertaken.
- The validation of malta cultivation in submerged region “Patuakhali” should be done. Data on malta cultivation in Bandarban should be added to this study.
- National problem based study such as increase and decrease of potato production and stability of market price should be proposed.
- Comparative study on cold storage and conventional storage method of potato should be undertaken.
- Study on suitable combined harvester for haor areas should be considered to escape the occurrence of flash-flood.
- Economic feasibility study on early crop for haor areas should be taken.
- Procedure of crop diversification should be clarified. Economic profitability and risk analysis should be done simultaneously for viability analysis
- In BARI FP-11, why Faridpur, Jhinaidah were considered? To justify the selection of these sites, detailed and correct description should be given in the study.

**BRRI:**

- BRRI1 and BRRI2 should be combined.
- Study on zinc rice should be undertaken.

- Comparative cost and return of BRRI hybrid and china hybrid should be undertaken.
- Cost and return of aromatic rice should be undertaken.
- Study on variety specific information should be done.
- Emerging issue like price fall of paddy and multidimensional factor related to price fall should be investigated.
- Import and export parity price should be estimated.
- Comparative advantage study should be considered.
- Macro level study of constraint to adoption should be considered.
- Study on market price of rice and excess supply should be conducted and appropriate measures should be suggested in order to compensate the price fall of the paddy famers.
- Comparative study between Indian and domestic rice variety should be done.

**BSRI:**

- Input adoption index is different from adoption index. Calculation of adoption should be done accurately.
- Study on khejur gur and its prospect should be undertaken.
- Economic study on sugarbit can be done from field demonstration.
- Investigation of present practice of sugar mill can be undertaken.
- If possible, limited scale study of sugarcane with intercrop can be done.
- The study on entrepreneurship of gur production from sugar crops can be undertaken.

**BINA:**

- Oilseed should be specified by the name of crops.
- Comparative study between BINA varieties and BRRI varieties should be undertaken.
- In the study BINAFP-3, the study site "Cumilla" should be avoided. Greater Faridpur, Shariatpur and Madaripur should be included.
- Varieties of other research institute should be taken as check.
- The title of BINAFP1 should be modified such as "Yield gap analysis"

**BFRI:**

- Environmental impact of conversion of rubber wood into timber can be undertaken.
- Study on gur production from golpata or by-product of golpata and study on house made from golpata which is shortly destroyed due to salinity can be undertaken.
- Study on rain tree or rain economics and crop damage due to rain tree should be undertaken.
- Study on aromatic tree or scented plant should be taken.
- The title of BFRI-1 study should be changed.

**General Comments**

- The study on processed fruits and vegetables should be undertaken for exploring the export market in overseas country.
- Title, objective, and methodology of all studies must be clearly defined and inconsistency between them should be strictly avoided.
- The study on preservative used for ripening the mango should be undertaken whether the preservative is harmful to health or not.

- The study on fluctuation of rice price should be undertaken that will highlight the price fall of paddy in domestic market
- It seems that methodologies of all studies are not well developed and organized. Conceptual development of scientists is needed.
- Difference between supply chain and value chain should be properly clarified.
- Wide clarification is needed on how the factors of yield gap are connected with different types of yield gap.
- Strengthening economic research activities should be taken under action with the collective effort of executive committee of BAEA.
- All DG in NARS system should be invited to solve the poor condition of Agricultural Economics division.
- Training on methodology development should be imparted to young and fresh scientists.
- A workshop on supply chain and value chain can be organized.
- Methodological development must be appeared with the conceptual perfection.
- Rounding the percentage data should be made.
- Demand based training on socio-economic research was provided by AERS Division, BARC but no solid reflection was noticed in any research program.
- Logic and rationale for sample size should be correctly described.
- Above all, it is suggested that all the research institutes should undertake representative number of research programs depending on their manpower strength and also for their existence as socio-economic team leader to lead the policy planning of the country.

**Participation in the training, workshop, seminar, training-workshop, etc. (Local):**

All personel attended in many Trainings, Workshops, Seminars, Training-workshops, etc. (Local) organized by different organizations.

1. **National and international linkages (MoU/bilateral agreement, collaborative work plan signed during the year. Highlights of activities undertaken under the MoU/Agreement, etc.**

- Participation in the training program on "Proven Production Technology, Value Chain Development and Nutrition Security of Pulse in South Asia" held in ICRISAT, Hyderabad, India.


Participation in the training program on Climate Smart Agriculture held in Manila, Phillipines.

## Highlights of Research Findings

### BARI (Agric. Economics Division)

**Impact of wheat reasearch on adoption, return, and competitiveness**

The study has been conducted to prepare data base on the adoption of wheat technologies at farm level and find out the factors affecting their adoptions and sustainability, estimate the financial and economic returns and competitiveness of wheat cultivation along with its impact on the livelihood of the farmers and estimate the returns to investment (IRR, NPV, BCR) in wheat research and development in Bangladesh. Both primary and secondary data were used in this study. Primary data were collected through household survey while secondary data were collected from various published sources. The household survey was conducted in seven wheat growing districts, namely, Dinajpur, Rajshahi, Faridpur, Jamalpur, Tangail, Kushtia, and Madaripur. The findings of the field survey revealed that in the year 2016-17, the farmers adopted wheat varieties, such as BARI Gom-21 (Shatabdi) , BARI Gom- 23 (Bijoy), BARI Gom- 24 (Prodip), BARI- Gom 25, and BARI Gom-26. Among these, BARI Gom- 24 (Prodip) was highly adopted (32%) followed by BARI Gom- 26 (30%), and BARI Gom- 25 (18%), BARI Gom- 21 (Shatabdi) (10%), BARI Gom- 23 (Bijoy) (6%) and others occupied only 4% of the total wheat areas. For economic analysis under import parity, prices of wheat, the estimates of DRCs for wheat crops were observed to be less than unity implying that Bangladesh had comparative advantage in wheat production for import substitution. Due to adoption of BARI, high yielding varieties over Sonalika over years, change in consumer surplus and producer surplus were Tk 190,756/- million and Tk 65,591/- million. It was observed that consumers benefited 3.24 times higher than producers. Therefore, change in total surplus stands at Tk. 256,347/- million. Investment in wheat research and extension was Tk 1,5203/- million. Hence, net present value (net benefit) was found to be Tk 241,144/- million at 2016 price. Internal rate of return (IRR) was calculated 53% at current price. Benefit cost ratio (BCR) was calculated as 17 indicating that country gained 17 times return as against the investment in wheat research and extension over the years mentioned. Therefore, the investment on R&D of wheat is found to be encouraging in Bangladesh.

**Impact of mungbean research and extension in Bangladesh**

An ex-post rate of return analysis was conducted to estimate the internal rate of return (IRR) to BARI-released improved varieties of mungbean that have been replaced the local varieties. The growth rate of area, production, and yield before the release of improved mungbean varieties were 22.19, 23.30, and 1.11%, respectively. After the release of improved varieties of mungbean, the area and production were increased dramatically, but their growth rates were not satisfactory for many reasons. The IRR to total investment in both mungbean research and extension was calculated at 57%. The potential relative yield of BARI Mung-6 over the local varieties was 66% higher. Under various assumptions about the magnitude of the benefits and the research and extension expenditures, the IRR ranged between 45% and 67%. This indicates that the funding of mungbean research and extension was a good investment.

**Assessment of fertilizer using gaps between farmers' practice and recommendations**

A total of 750 different categories of farmers from Rajshahi, Thakurgaon, Mymensingh, Khulna, and Barguna districts were selected adopting stratified random sampling technique and interviewed them for collecting baseline data and information. Descriptive statistics were used to analyze the collected data. The study revealed that only 6% farmers had received nutrient management related training and 94.5% farmers did not test their soil due to lack of awareness (37.0%). About 23% farmers claimed to know about the optimum doses of fertilizer. They identified nutrient

deficiencies by observing leaf color (78.2%) and physical growth of crop (70.3%). Most farmers applied fertilizers without maintaining scientific recommendations. They used much higher amounts (10.9-58.2 kg/ha) of all nutrients (NPKS) in potato cultivation, but used much lower amount (7.1-18.8 kg/ha) in Kharif maize cultivation. Except maize, they applied much higher dose (1.0-29.5 kg/ha) of P in different crops compared to recommendations. However, the optimum dose of nutrients were used only for Aus rice. In farm categories, women managed farm households and small & marginal farmers used much lower dose of nutrients compared to medium and large category farmers. The major barriers of applying balanced fertilizer dose were lack of relevant knowledge and skills; higher price of fertilizers; lack of training on soil nutrient management; complexity to apply recommended fertilizer doses; lack of extension advisory services; non-availability of soil testing facilities, and put less importance on recommended dose. These problems could be overcome if technical assistance and financial support are made available by the government. This support could be channeled into five areas: awareness creation, technology development, strengthening extension services, assurance of input quality and supply, and financial support.

**Adoption and impact of BARI developed machinery**

The study was carried out to determine the impacts of adoption of BARI multi-crop seeder and BARI bed planter on productivity, farm income and livelihood of the farmers/service providers in Thakurgaon, Faridpur, and Rajshahi districts through collection of primary data from 83 adopters, 160 non-adopters and 30 service providers. Propensity score matching method was used to assess the impacts of BARI multi-crop seeder and BARI bed planter adoption. It was found that the rate of adoption of BARI multicrop seeder and BARI bed planter was 9% and 15% at farm level, respectively. Probit model showed that experience of the farmer, farm size, training, and extension contact enhanced the adoption of BARI multi-crop seeder and experience of the farmer, farm size, and extension contact were important variables that had an effect on the likelihood of farmers to adopt BARI bed planter. BARI multi-crop seeder adoption on average increased wheat productivity and farm income by 347 kg/ha and 37 to 41%, respectively, for adopters compared to non-adopters. BARI bed planter adoption on average increased lentil productivity and farm income by 128 kg/ha and 25 to 36%, respectively, for adopters compared to non-adopters. Again, all kinds of adopters' assets were also increased to some extent due to adoption of BARI multi-crop seeder and BARI bed planter. Ninety one percent, 79%, 69%, and 69% of the respondents responded that the number of mobile phones, chair, table and furniture were increased due to income earned from BARI multi-crop seeder in wheat farming. In the case of bed planter, electricity use increased by 95%, mobile phone increased by 90%, and furniture improved by 83%. Most farmers mentioned that non-availability of machine in peak period, and problem of seed meter were the major problems in cultivating wheat and lentil by using BARI multi-crop seeder and BARI bed planter. Most of the respondents opined that the non-availability of machine due to lack of capital of the respondents and complicacy of receiving subsidy to purchase machine as the constraints. The study recommended to provide training to the farmers/operators for more efficient operation, and demonstration program should be continued until adequate awareness is created among the farmers. Agricultural extension agents can play a crucial role in this regard.

**Study on scope of existing cropping pattern at south western saline region of Bangladesh**

The study was conducted in two districts, namely Satkhira and Khulna to know the scope and existing cropping pattern at south western region of Bangladesh where high salinity exist which is a challenge for crop production. Among the selected farmers, about 66% farmers were small and the average farm size was 0.83 ha. Most of the land of saline area covered by a single crop with T.aman. Average total cost of T.aman rice was Tk.92,189.40 per hectare. Most of the cost involved

for cost on labor for T.aman rice cultivation. If the farmers cultivate the land by share from owner then farmers give half of the crop to his land owner. Study found that T.aman-mustard-mungbean cropping pattern gained the highest net return (23,919.77 Tk./ha)followed by T.aman-mustard-sesame (20,879.77 Tk./ha). T.aman-sunflower gave the highest return Tk. 24,032.59 per hectare. Most of the farmers eager to cultivate more new crops.

**Study on extent of pesticide use on bitter gourd production in Jashore district**

The study was designed to assess the extent of pesticide use and profitability of bitter gourd production at farm level in selected areas of Jashore district. Average farm size was 0.79 ha and average bitter gourd cultivated area per farmer was 0.07 ha. Most of the farmers cultivated local variety called Gaj korola and some farmer cultivate hybrid korola, such as Gonggajoli, Tia, and BARI Korola-1. About 99% farmers sprayed insecticides in their fields to protect crops from different insects, pestes, and diseases. Thirty nine percent farmers used pheromone trap for crop protection. A farmer sprayed 13 times on average in his field and its range was 2-30 times in a season. On an average, the total cost of production of bitter gourd was Tk. 323550.47 per hectare in which total variable cost was Tk. 283657.13 per hectare and total fixed cost was Tk. 19946.67 per hectare. Among the cost item, cost of labor was highest which was about 41%, and it was Tk. 132371.00 per hectare. Average yield was 14.82 ton per hectare and average price was 27.67 Tk./kg. Gross return was Tk. 410069.40 per hectare and net return was Tk. 86518.93 per hectare. Benefit cost ratio was 1.27. Cent percent farmers said that IPM technology was time consuming method.

**Economic assessment of climate change adaptation strategies in maize farming**

The study assessed the economic impact of climate change adaptation strategies adopted in maize farming in the selected maize growing areas of Chuadanga, Jhenaidah, and Rajshahi districts. A total of 180 maize growers, taking 60 farmers from each district, were selected on the basis of having minimum 6 years' experience in maize farming. The average gross margin was estimated at Tk.74634/ha under the threshold climate, whereas it was Tk. 34,528/ha at non-adapted period. Compared to the threshold, the average gross margin drastically fell in the non-adapted period. The most common strategy followed in maize farming was the adoption of stress tolerant varieties (Strategy-1) (40%). The farmers of Chuadanga (57%) and Jhenaidah (58%) adopted this strategy, whereas shifting of Rabi maize to Kharif-1 maize (Strategy-9) was mainly adopted by Rajshahi farmers (35%). All options moderately increased the value of returns to land, but these are significantly lower than the threshold level. The highest possible net change occurs with adaptation strategy 6. Cost benefit analysis revealed that the value of BCR is higher than one for all the adaptation strategies which implies that the investment is feasible as the benefits exceed the cost. The cost-effective analysis (CEA) for the same adaptation is also supportive because Tk. 100 ensures 10.05 kg, 9.82 kg, 8.05 kg, 10.13 kg, 10.49 kg, 10.07 kg, 10.44 kg, 9.87 kg, and 8.83 kg maize, respectively, from 1 to 9 strategies. The estimates of climatic variables, such as temperature and rainfall are significant. The scores of the adaptation options provide strong significant evidence that the adaptation strategies undertaken by the maize farmers are correlated with farm profit and responsiveness to climate shocks.

**Cost and return analysis of selected crops in Bangladesh**

This study was conducted on the cost and return analysis of wheat, maize, lentil, onion, and garlic cultivation in selected growing areas. A total of 2700 farmers were randomly selected for the study. Profit function was used to estimate the cost and return of the selected crops. It was observed that farmers in the study areas used highest 358 man-days human labor per hectare in onion cultivation followed by 268 man-days in garlic, 124 man-days in maize, 81 man-days in

wheat, and 65 man-days in lentil cultivation. The highest total cost was incurred in garlic cultivation (Tk. 239535) and the lowest cost was estimated in lentil cultivation (Tk. 54919). Highest net return was found from onion cultivation (Tk.142446) followed by garlic (Tk.128951), maize (Tk.95110), lentil (Tk. 42992), and wheat (Tk.13465) cultivation. Per hectare average BCR was estimated 1.17, 1.86, 1.78, 1.71, and 1.54 for wheat, maize, lentil, onion, and garlic cultivation, respectively. For producing one kg of wheat, maize, lentil, onion, and garlic about Tk. 19, Tk. 10, Tk. 36, Tk. 15, and Tk. 32, respectively, are required.

**Adoption and profitability of BARI released garlic varieties in Bangladesh**

The study was conducted in three garlic growing districts, namely Rajbari, Natore, and Dinajpur to know the adoption status of BARI garlic varieties, its farm level profitability and constraints of the farmers. A total of 300 farmers taking 100 farmers from each district were randomly selected for this study. Data were collected through a pre-tested interview schedule during January-March 2019. The study revealed that the highest proportion (45%) of farmers adopted BARI Rosun-2 and the lowest proportion (14.67%) of farmers adopted BARI Rosun-1 variety. The other two varieties, namely BARI Rosun-3 and BARI Rosun-4 were not adopted in the study areas. Some local and exotic varieties, namely Italy, Patna, and Barma were cultivated by some farmers. Higher yield, higher profitability, and less insect-pests infestations were the prime reasons for choosing BARI Rosun-2 and BARI Rosun-1 at farm level. Besides, human labor, education, farm size, training on garlic cultivation, availability of quality seed, and influence of extension personnel had significant influence on BARI variety adoption. Farmers did not applied the recommended doses of manures and fertilizers due to lack of adequate knowledge on scientific recommendations. Human labor, seed, and rental value of land were the main cost items in garlic production. The highest yield was reported to be 7.65 tons per hectare at Rajbari followed by that of Natore (7.26 t/ha.) and Dinajpur (6.98 t/ha). Natore farmers received the highest net return (Tk 69631/ha), whereas the lowest return was received by Dinajpur farmers (Tk 38613/ha). Undiscounted BCR on variable cost and total cost basis were 1.31 and 1.24, respectively. Low market price at peck season, non-availability of improved or hybrid seed, unfavorable weather condition, and lack of technical knowledge were the major constraints to garlic cultivation. The study suggested to ban excessive import, introduce hybrid variety, provide hand-on training on production technologies and ensure low price of inputs for higher adoption of BARI released garlic varieties at farm level.

**Climate change and gender based vulnerability nexus: An evidence from cyclonic storm surges in Dhalghata, Moheshkhali of Bangladesh**

Dhalghata Union of Maheshkhali island is the most vulnerable in response to cyclonic storm surges. Women and girls are at most risk due to their differentiated role in the family and society and very weak coping strategy. This study explored the vulnerability of women's livelihood in Sapmarar Dail village of Dhalghata through adopting sustainable livelihood framework which based on five livelihood assets. In order to assess the level of vulnerability, the study applied livelihood vulnerability index (LVI) where assets are grouped into 10 major components and some other sub-components. Two Focus Group discussions (Men and women) along with questionnaire survey were done to collect necessary information. The maximum households (77%) were in marginal farm size category. Salt production was the primary sources of income of 68% of the respondents in Dhalghata. The 31% of the respondents were illiterate followed by 10% who can sign only. Beside this, 54% of the respondents completed their secondary level of education. Most of the households were male headed (98%). As they are living just beside the Bay of Bengal, so 91% of the respondents were well informed about the impact of climate change. Among the climate change related extreme events cyclonic storm ranks highest vulnerability concern for the women of Dhlaghata followed by iron in drinking water, salinity intrusion, tornado, etc. The

overall LVI of Dhlaghata is 0.44. It means that women livelihoods here are moderately vulnerable to cyclonic storm surges. The index was highest in financial capital and lowest in human capital. Among the components, finance and incomes, knowledge and skills and land are the most vulnerable components whereas social involvement and livelihood strategies are the least vulnerable components among the major components for women in Dhalghata. In order to reduce women's vulnerability, special attention is prerequisite for Dhalghata. Employment opportunities for the women and provision of healthy social safety net programs can be the best option to reduce their vulnerability within the shortest period of time. The study indicated that the LVI technique can be used to understand vulnerability in special geographical regions and can formulate policy by comparing actual scenarios.

**Vegetables marketing at traders' level with special reference to postharvest loss and food safety**

The study was conducted in six vegetable growing districts, namely Jamalpur, Mymensingh, Jashore, Rajshahi, Bogura, and Rangpur to assess the knowledge, attitude, and practice (KAP) of traders on postharvest practices and losses and investigate vegetable market chains to identify market opportunities for producing and marketing safe produces to the consumers. Four summer vegetables, namely brinjal, bitter gourd, yardlong bean, and teasle gourd were considered for this study. Data and information were collected from 320 farmers, 68 Farias, 103 Beparis, 12 Paikers, 100 retailers, and 177 consumers. Most intermediaries have adequate knowledge on different postharvest practices in relation to reduce postharvest losses and keep vegetables safe for the consumers and in most cases, they claimed to practice it. A huge amount of vegetables move from farmer to consumer through two major channels: (i) Farmer-Faria-Bepari-Paiker- urban retailer-urban consumer; and (ii) Farmer-Faria-Bepari-local retailer-local consumer. The total postharvest loss of brinjal, bitter gourd, yardlong bean, and teasle gourd are 13.32, 18.03, 16.47, and 6.40%, respectively, at traders' level. The annual financial loss incurred at national level are Tk.3433.05 million and Tk. 2596.40 million when vegetables move through the above two channels, respectively. The traders' level postharvest losses occured at various stages in the supply chain, such as sorting, cleaning, loading & unloading, packaging, and transportation. The highest marketing cost of selected vegetables was for urban retailer (Tk.610/quintal) followed by that of Bepari (Tk.608/quintal). The highest net margin was received by urban retailers for different vegetables. Middlemen traders received reasonable net margin (Tk.93.0-Tk. 889.0/quintal) from vegetable marketing. Local marketing channel (Chain-II) performed much better than urban channel (Chain-I) since the producer's share and marketing efficiency were higher and price spread was lower in the local channel. Return on operating capital for different intermediaries were also higher in local channel. The study suggested different stakeholders to adopt good agricultural practices in producing vegetables, certify available safe vegetables for developing consumers' confidence, and ensure premium price of the safe vegetables for encouraging farmers towards safe vegetable production. It also suggested government to construct different infrastructures, such as pack house, concrete floor, drainage, water & sanitation facility, and rest room for the distant traders at the market premises. Development of awareness among producers, traders, and consumers toward safe vegetable production, marketing, and consumption is equally emphasized in this study.

**Socio-economic impact of bagging rechnology for value addition in mango in the Chattogram Hill Tracts**

A survey was conducted in three selected areas of three hill districts of Chattogram Hill Tracts to gather information on the socio-economic impact of bagging technology through value addition of mango and know farmers' responses to bagging technology. Findings revealed that the average

size of mango orchard was reported to be 5.94 ha. BARI Mango-4 (Hybrid), BARI Mango-8, BARI Mango-3, Mallika, and Awshina were reported to be the most preferred varieties for bagging because of reduced pest attack, attractive color and higher market prices. About 76.00% respondents reported to have training on mango production and 64.00% received training on mango bagging. The major portion of the training was provided by KGF covering 40% on mango production and 44% on mango bagging. The average number of bags used by an individual respondent was 10843; whereas 60% of them bought from commercial companies. Almost all (96%) of the farmers preferred brown double layered bags for bagging. In the respondents opinions, 40-45 days after crowning was the right time for bagging for most of the mango varieties. About 96% of the respondents mentioned that they were able to control fruit fly trough bagging technique and 92% of them confirmed that the fruit was safe and free of toxicity. Most of the respondents thought that they found bagged mango more profitable (88%) as they were getting higher price at market (83.2 %). The net margin from bagging mango, training, research contact, extension contact, risk taking behavior and willingness of farmers influence to adopt bagging technology significantly. This technology should be disseminated through extension department with applying proper techniques and methods in time.

**Value addition and supply chain analysis of vegetable in Chattogram district**

The study was carried out in six villages under three Upazilas, namely Hathazari, Rangunia, and Sitakundu in Chattogram district during 2018-19 to identify the existing supply chain, production and value addition, causes of pre and post-harvest losses, gap of the chains and constraints to vegetables marketing covering 270 samples in all locations. The selected vegetables varied from location to location due to their priority. The vegetables were brinjal, tomato, lady's finger, cucumber, country bean, cauliflower, cabbage, bean, sweet gourd, snake gourd, teasle gourd, and radish. Results revealed that per household average cultivable land was 1.18 ha where vegetable cultivation was in 0.22 ha in all locations. About 21-23 vegetables were cultivated in three locations where brinjal got the highest ranked in Hathazari and Rangunia while country bean was the the highest in Sitakundu. The cent percent farmers collected seeds from local market and about 75.5% farmers were satisfied about the seed quality. Comparatively large plot size was estimated by 0.0.28 ha for country bean irrespective of all locations followed by brinjal 0.24 and tomato 0.11 ha.. The selling price of vegetable at different market places significantly differed from one place to another. The identified supply chain ''farmer-local market-consumer'' and ''farmer- bepary - whole seller'' were the common in all areas. The highest portion (87.5%) of market share belonged to farmer to local market and consumer. About 68.4% farmers claimed that pre- and post-harvest loss was occurred mainly due to insect and disease attack. Almost all farmers involved in value addition activities in vegetables except processing. Lack of proper coordination among the actors was the main gap of the chains. No permanent selling places, higher market taxes, market syndicate, transportation problem (in Sitakundu areas), multi handover of ownership of the market, lack of knowledge of marketing and market linkage, and 10% deduction vogue of the total weight (in Sitakundu) were the major constrains to marketing. All the stakeholders have to join hands to improve the supply chain which should be started from farmers to consumers. Thus, government support to group farmers in order to achieve a better focus on quality and customization of activities would be useful in the existing chains.

**Supply chain analysis of major vegetables produced in hilly and coastal regions of Bangladesh**

The study was conducted in hilly and coastal region of Bangladesh for understanding the input distribution system, profitability of different production practices, supply chain and marketing system and different drawbacks of production and marketing of selected vegetables. The study area

covered three hill districts, namely Rangamati, Khagrachari, and Bndarban and three coastal districts, namely Patuakhali, Satkhira, and Cox's bazar where vegetables production is very limited due to different stresses. Brinjal and yard long bean were selected from hilly areas and bittergourd and cucumber were selected from coastal areas. The study was conducted during the period of 2017-2018. Primary data were collected through face to face interview and ssecondary data were collected from different published sources. The study revealed that vegetables production and marketing both for farmers and traders were found profitable. Three production techniques were found in both regions, such as homestead, plain land, and Jhum cultivation in the hilly areas and plain land, sorjon method and gher based cultivation in coastal area. The net return of brinjal and yard long bean in plain land cultivation was Tk. 1, 92,265/ ha and Tk.82362/ha, respectively, in hilly region and the BCR was found 1.88 and 1.53, respectively. The net return of Jhum cultivation was found Tk.70,113/ha and the BCR was found 2.02. On the other hand, the net returns of bittergourd and cucumber were Tk. 2,24,530/ ha and Tk. 1,57,893/ha, and the BCR was found 2.08 and 1.82, respectively, in plain land of coastal area. The profitability of sorjon cultivation and gher based agriculture system was Tk. 91023/ha and Tk. 1,29,115/ha, respectively, and the BCR was 1.37 and 1.76, respectively. Five supply chains of vegetables were identified in hilly area of which four chains were dominant and 93.25% vegetables moved by those chains. On the other hand, four supply chains were identified in coastal areas of which three chains were dominant by which 94.43% vegetables moved from producer to consumer. Supply chain-I: Farmer-cum-retailer > Local Consumer is the most efficient chain for vegetables marketing in both hilly and coastal region of Bangladesh. Because no intermediaries were involved in the chain and farmer himself done retailing to the consumer. Highest marketing margin was found in supply chain-IV in hilly areas which was Tk. 647.60/qt. for brinjal. and Tk. 645.81/qt. for yard long bean whereas in coastal areas, it was also found highest in supply chain-IV, which was Tk. 777.41/qt. for bittergourd and Tk.554.65/qt. for cucumber. Farmers faced different production problems in the hilly areas, such as scarcity of irrigation water and quality seed, low yield, Insect & pest attack, poor technical knowledge and production practices, less use of farm machinery, etc. and in coastal belt, farmers also faced unavailability of fresh irrigation water, incidence of salinity in the soil, intrusion of salinity due to heavy rainfall and drought, scarcity of quality seed, poor yield, poor technical knowledge, etc. for vegetables cultivation. Trader's also faced some marketing problems, such as price fluctuation, high transportation cost, lack of market information, poor road & transport, unethical subscription, absence of permanent retail place and lack of storage facilities, etc. Training program on modern technology and post-harvest handling, improvement of transportation and communication system, development of salt tolerant variety and wider expansion of existing modern technology in coastal region and linking farmers with the extension personnel and researchers were the major recommendations of this study.

**Profitability, value addition and constraints to mungbean production in some selected coastal areas of Bangladesh**

Assessment of profitability, value addition and constraints to munbean production in two southern coastal districts- Barisal and Patuakhali was made through an extensive field survey during 20182019. The study revealed that few farmers of these areas used chemical as well as organic fertilizers. Total cost incurred for mungbean production was Tk.51850/ha of which 50% is variable cost and remaining 50 % was fixed cost. Average gross return was Tk. 54143/ha. Benefit cost ration on variable cost basis was 2.09 but on total cost basis it was 1.04. Considering variable cost per kg production cost was Tk. 24.62/kg but on total cost basis it was estimated at Tk. 49.05/kg. Highest value addition of fried mungbean was estimated for Amrita consumer's products and their price share was 69.57 %. Disease infestation, insect attack, uneven and heavy rainfall, flash flood,

unavailability of cultivating machine and inadequate labor during harvesting were found to be the major constraints to mungbean production in the study areas.

**Production, marketing and postharvest loss cucumber in selected areas of Bangladesh**

The study was undertaken to estimate the production, marketing, and postharvest loss of cucumber. The data were collected from 180 farmers and 45 intermediaries of Rajshahi, Rangpur, and Bandorbon districts of Bangladesh. Purposive sampling technique was used to select the cucumber producers and convenience sampling was used for selecting intermediaries. Production of cucumber is profitable in the study areas. Per hectare net margin of cucumber was Tk. 632576.49. Total marketing cost of cucumber was highest for Bepari (27.5%) and lowest for Paikers (13.75%). There were six marketing channels in the cucumber marketing. The net marketing margin was highest for retailers (Tk. 3.47) and lowest for Paiker (Tk. 0.84). Insect and disease were the major causes of cucumber postharvest loss in the survey areas. Due to postharvest losses of cucumber, farmers have to incur financial loss of Tk. 441.92 per decimal of cucumber cultivation. Farm level cucumber postharvest loss was found 9.93% per farm of which 6.17% was due to full damage and the rest 3.76% was due to partial damage of the cucumber.Total harvested amount, selling place and type of vehicle were some of the important factors for cucumber postharvest losses in the survey areas.

**Value chain study of turmeric in selected areas of Bangladesh**

The study was undertaken to identify value chain actors and their functions and interrelationship; determination of marketing and value chain system; value addition in different steps of value chain actors; marketing efficiencies; constraints to value chain and recommended intervention to overcome them. Primary data were used for this study. Primary data were collected from Panchagarh, Pabna, Rangamati, and Jhenaidah districts depending upon the concentration of production and commercially marketing of turmeric and consuming area Dhaka and Chattogram. Data were analyzed using arithmetic mean, percentage, ratio, margin, profit, efficiency ratio, and flow chart. Five major marketing channels were identified for domestic produced dry turmeric marketing. Channcel-4 was the most important supply chain through which 24% domestic produced turmeric reaches to consumers. Out of five marketing channels, Channel-3 was more efficient than those of other channels. Eight actors like; farmer, local trader, trader, commission agent, wholesaler, processing industry, distributor, retailer, and consumer were identified who were involved in the turmeric value chain systems. The study revealed that farmers added the highest amount of value Tk. 3451.00 per quintal in non-processed turmeric followed by trader (Tk. 2561.00), retailers (Tk. 1744.00), local trader (Tk. 1657.00) and wholesalers (Tk. 1472.00), respectively. In the case of processed turmeric, processing industry added the highest amount of value and it was Tk. 11432 per quintal. Sixteen marketing problems were identified, among them price fluctuation, higher transport cost and lack of loan facilities were the major and common problem for most kinds of intermediaries involved in turmeric marketing in Bangladesh. It is therefore, recommended that loan facilities should be provided to the intermediaries and price fluctuation should be kept in reasonable limit by the government intervention. Natural gas and frequent supply of electricity should be ensured to turmeric processing industries for continuous production of processed turmeric. Technologies should be developed for the identification and removal of alpha toxin and heavy metal and to develop technique against the deterioration of color of turmeric powder for enhancing export.

## BRRI (Agric. Economics Division)

**Farm level adoption and evaluation of modern rice cultivation in Bangladesh**

BRRI dhan28 and BRRI dhan29 were the leading varieties in Boro season which covered about 62% of total area. The adoption of modern varieties in this season was more than 99% of which BRRI varieties coverage was about 71%. In T. Aman season, BRRI dhan49 (11%) and BR11 (7%) occupied about 18% areas, where the coverage of the BRRI varieties was about 48%. In Aus season, the adoption of modern varieties was about 90% and the BRRI varieties covered almost 67% areas. BRRI dhan48 ranked the topmost (17%) position by the area coverage followed by BRRI dhan28 (15%). BRRI dhan29 was the utmost yielder (6.41 t/ha) followed by BRRI dhan58 (5.98 t/ha) in Boro season. Average yield of hybrids was 7.23 t/ha; whereas BRRI developed hybrids produced 7.58 t/ha in Boro season. In T. Aman season, BRRI dhan49 was the top yielder (4.60 t/ha) as followed by BRRI dhan52 (4.55 t/ha). On the contrary, BRRI dhan48 was found as the outyielder (4.04 t/ha) in Aus season.

**Constraints to adoption of BRRI released modern ricees in Bangladesh: A policy option**

**Outcomes of the model:**

The determinants that were presumed to assist setting the adoption choices of alternative rice varieties were included in censored regression (Tobit model). The selected variables were socio-cultural elements, access to information, and varietal specific traits. To check off the diagnosis of dataset, multi-collinearity does not affect at all the estimation of best parameters. However, heteroscedasticity was detected in the dataset and *'Robust'* command in the Stata was imposed in order to stamp out that problem. F value always pointed out the degree of model fitness and the present model displays higher level of overall significant. Moreover, both upper limit and lower limit were declared in the model. Seasonal effect on model of variety choice was avoided even though the combined data for both Boro and T. Aman seasons used in this model.

Only exception of age, most of the variables of the model had expected signs. Sign of age was negative with statistically insignificant. Aged people are more reluctant toward adoption of new rice varieties. Younger farmers preferred to take risk, particularly in choice of a new farm technology. In addition, assuming farm size has heterogeneous effect on making variety choice at the farm level. To single out such an effect, farm size categorized into three groups using dummy variables (marginal farm (<=49 decimal), small farm (>50 and <=249 decimal), and medium together with large farm (>250 decimal)). In the model, both marginal and small farm size (operated area) had significant effect on adoption of BRRI varieties. In heuristic approach, medium and large farm seemingly has scale effect on varietal choice implying that with the increase of farm size, devotion of plot number toward BRRI varieties would considerably decrease. The reason might be that larger farms choose more yielder like hybrid rice or Indian varieties and high value rice like aromatic variety for the purpose of high profitability. The model identified that the number of family members had significant effect on the selection of BRRI varieties. However, decreasing distance to Upazila Agriculture Office (UAO) and local market had significant and positive influence toward choices of BRRI varieties. This is because, lesser distance reduces the transaction cost of getting varietal information and selling their products to local market.

Paddy price is always a stronger determinant of farm profit and highly responsible to adopt BRRI varieties. In addition, adoption of more BRRI varieties is greatly subject to quality rice and good taste. More varieties give the farmers bigger number of choice options meaning that more number of BRRI varieties will increase the area coverage to them. Model exposed that, yield variation was

positive and statistically influenced toward increasing the area coverage of BRRI varieties in the farmers' fields significantly. Finally, it was commented that prospect for higher yield of any rice variety could easily motivated the growers to increase area coverage of the particular variety

**Evaluation of the propensity of Indian rice varieties adoption in selected areas of Bangladesh**

The findings revealed that Indian rice varieties are widely adopted in the study areas, where it was 43% in Rangpur and 48% in Dinajpur district; and the coverage of BRRI variety was about 50% in each of these two regions during T. Aman season 2017-18. Among all Indian rice varieties, *Guti Swarna* was leading cultivar covering 39% area in Rangpur district; whereas in Dinajpur region, it was 31% followed by Swarna5 (5%). BR11 had good coverage (18%) in Rangpur region. Most of the farmers continued to cultivate *Guti Swarna* due to its suitability in all types of lands; higher yield performance, better taste and quality straw, drought resistance as well as higher milling out-turn. Due to some extent earliness of *Guti Swarna*, which facilitated to cultivate the next crop (Robi crops) was also popularized it in both Rangpur and Dinajpur regions. Likewise; Swarna5, a higher yield potential short duration popular variety which ensured better market price due to medium slender grain, no shattering as well as lodging problem induced the farmers to grow it. All of the aforesaid traits were highly convincing factors to adopt *Guti Swarna* and Swarna5 in the surveyed areas.

Among BRRI varieties, BRRI dhan34, a fine grain cultivar with excellent aroma occupied highest (42%) area in Dinajpur region due to higher market price and good quality straw that might be the major drivers of widest cultivation of this variety; despite few negative traits like susceptible to false smut, strong lodging problem, vulnerable to drought and temperature. BRRI dhan49 and BRRI dhan52 are gradually getting popularity in both Rangpur and Dinajpur regions where BRRI dhan49 seemed to be a better option of substituting *Guti Swarna* for desirable traits, such as earliness, lodging resistance, medium slender grain, and longer panicle size, etc. However, occurrence of severe false smut, sheath blight, and low market demand become a critical barrier toward widespread adoption of BRRI dhan49. BRRI dhan52 could be hoped to compete with Indian varieties in the low land for bearing the submergence tolerant trait.

In Boro season, *Zira* (71%) was the most dominant variety followed by BRRI dhan28 (15%), and BRRI dhan29 (5%) in Naogaon district. It was observed that all *Upazilas* except Bodalgachi of this district was dominated by *Zira* which was due to yield advantage, grain quality, required low intensive care, less susceptible to insects and diseases, high demand to the millers and lucrative price. Nevertheless, BRRI dhan28 is still popular variety that covered 48% areas in Bodalgachi Upazila. It's noted that most of the farmers produce BRRI dhan28 for their home consumption only and Indian varieties for commercial purposes.

**Estimation of costs and return of MV rice cultivation at the farm level**

Boro growers obtained higher yield consequently higher gross returns followed by MV T. Aman and Aus growers. However, MV T. Aman growers received higher net return than that of Boro and Aus due to better market prices. Aus crop is riskier than Boro and T. Aman. The increase in adoption of the recommended practices, stress tolerant varieties, and reduced seasonal price variation may facilitate higher production and increase economic viability of rice production.

**Vertical price transmission of rice in Bangladesh**

This study found the price transmission scenario is asymmetry from farm to retail levels. The asymmetric relationships between price series are both long and short run. The empirical results suggest that processors (wholesalers/millers) enjoy a certain advantage over primary producers

(farmers) and that retailers enjoy a certain advantage over processors. Also, final consumers are more likely to experience a decrease in their surplus from a price increase rather than to experience an increase in their surplus from a price decrease at the upstream.

**Value hain analysis of aromatic rice (BRRI dhan34) in Bangladesh**

This study found that, on an average, costs of aromatic rice marketing for *bepari*, *aratder*, miller, *aratder* (rice), wholesaler and retailers were estimated at Tk. 102.08, Tk. 114.75, Tk.842.60 Tk. 81.65, Tk.108.60, and Tk. 87.88, per quintal, respectively. Share of net profit earned by the *faria/bepari*, paddy *aratdar*, miller, *aratdar* (rice), wholesaler and retailer was estimated at 7.37%, 9.11%, 45.80%, 11.33%, 12.00%, and 17.30%, respectively. Producer share and farm retail price spread were 67.03% and Tk. 2,613 per quintal, respectively. The study also identified some problems and constraints associated with aromatic rice marketing. The unavailability of labor, pest (BPH), and disease (neck blast and sheath rot diseases) problem, high costs of inputs, high cost of labor, lodging problems were the major constraints to producing aromatic rice in Bangladesh. Whereas, lack of storage facilities, lack of information, lack of regulated and co-operative market etc. were the constraints of aromatic rice marketing. Proper planning and measures from the government side to solve these problems in the production and marketing would encourage farmers for better production of aromatic rice in the country.

**Preference analysis of T. Aman rice varieties in the coastal areas in Bangladesh**

BRRI dha76 was the most preferred in Dacope due to potentiality of transplanting in the fields with over a feet depth of water, higher plants growth rate, longer growth duration so that matured for harvesting after drainage water from the fields, less or no infestation of disease and long panicle with large number of grains. On the other hand, BRRI dhan54 was the most preferred variety at Amtali because of higher yield than local checks. Besides, the variety is matured for harvesting about 25-40 days earlier than check varieties so that matured for food scared period and after drainage out the stagnant water from fields. BRRI dhan77 was second most preferred variety in Amtali mainly because of suitability of planting in stagnant water, matured for harvesting after drainage out stagnant water and long panicle so that expected higher yield. BBRI dhan73 was least preferred variety both in Dacope and Amtali, while BRRI dhan76 was second least preferred variety in Amtali.

**Welfare effect of adaptation policy for rice price variation under climate change in Bangladesh**

This study focused on the effects of the implementation of the adaptation policy in an attempt to reduce the variation in the price of rice due to climate change and to measure the welfare effect in terms of net change in social benefit. The policy framework is integrated into the supply and demand system of food market in order to evaluate its performance in terms of producer and consumer surplus in the era of climate change. The support price policy creates a positive change in producer surplus of US$ 1,981 million, which is substantially higher than the consumer surplus (US$–1,785 million) in the intervened years. Furthermore, the result shows that if the subsidized price policy is implemented, the price variation by 1.38% can be reduced and the change in consumer surplus (US$ 1,501 million) be obtained in the intervened years. To adapt the unavoidable climate change and eliminate the number of victims of food insecurity, public food policy is necessary even if result of food policy is costly and ineffective.

## BSRI (Agric. Economics Division)

**An economic analysis of yield gaps of sugarcane in Bangladesh**

- Yield gap between theoretical and experimental yield is 15 t/ha. On the otherhand, the gap between experimental and demonstration plot yield is 10.50 t/ha between experimental and demonstration plot yield.
- The gap between demonstration plot yield and actual farmers' yield is 37.47 t/ha.
- The farmers used less inputs compared to experimental farm and potential farm trial. As a result they got less yields.
- The farmers used 35.27- 27.24% less inputs compared to experimental and demonstration plot.
- BSRI varieties have the negative and significant impact on yield gap.
- Management practices like use of fertilizers, insecticides, irrigation and labor use for intercultural operation have the negative impact on yield gap.
- Farm size has the positive impact on yield gap.
- Family size, education level of farmers and contact with extension agents have the negative impact on yield gap.

**An empirical study of street marketing of sugarcane juice and its economic impact**

- In Rajshahi district, juice vendor sells on an average, 300 glass of juice per day. This amount of juice needs 150 pieces of sugarcane and Tk. 3,000/ day have been earned at the rate of Tk. 10/glass.
- In Dhaka district, juice vendor sells an average 300 glass of juice per day from 100 piece of sugarcane and they earn Tk. 4500/day. The price of one glass of juice was Tk. 15
- For making juice, 88% of juice vendors use their own crusher machine and rest of them used by rented crusher machine.
- Regarding experience of juice making business, 18% vendor has got 1 to 3 years, 50% has got 4 to 7 years and 32% for 7 and above.
- The working time of juice vendor is 5 to7 hours per day.
- Juice vendor received BCR 2.48 in Rajshahi and 2.50 in Dhaka city.
- There are only one sugarcane supply chain in Rajshahi district :

  Farmers (Kustia) ⟶ Paikar ⟶ Juice vendors
  Farmers (Rajbari) ⟶ Paikar ⟶ Juice vendors
  Farmers (Chapainababganj) ⟶ Paikar ⟶ Juice vendors

- The following sugarcane supply chain exists in Dhaka district:

  Farmers (Manikganj) ⟶ Paikar( Forashganj) ⟶ Juice vendors
  Farmers (Kapashia) ⟶ Paikar( Beribath) ⟶ Juice vendors

- Many problems are encountered by the juice vendors. In fact they do not have any specific place for making and selling sugarcane juice. They do this work at the crossroads. If they get a suitable place in the market, they can run their business smoothly.
- It was observed, the vendors were making and selling the juice in the open place which is not hygienic. However, if a clean net or cloth is placed around the crusher machine, it would be good for health aspects.
- There is a problem of drinking juice. Juice vendors used same glass repeatedly for drinking. The study suggested using one time glass or fresh bottle to solve the problem

## BINA (Agric. Economics Division)

**Exploring the potential and performance of the oilseed variety Bina Sharisha-9 in some selected areas of Bangladesh**

- The average cost of production of Binasarisha-9 was Tk. 44126.98 per hectare with an average yield was1.4 t $ha^{-1}$which indicate to a production cost of Tk.32.16/kg.
- Binasarisha-9 production the variable cost and fixed cost covered 62.91% and 37.09% of total cost, respectively
- The major production cost was for human labor (35.80%), followed by land use (22.13%), fertilizer cost (22.06%), power tiller (12.73%), and irrigation (4.24%). The cost of Binasarisha-9 cultivation was found highest in Rangpur (Tk. 47971.59/ha) followed by that in Mymensingh (Tk. 42692.19/ha), Sherpur (Tk. 41717.16/ha) respectively
- The highest yield was found at Rangpur (1497.24 kg /ha) followed by Sherpur (1328.11 kg /ha) and Mymensingh (1291.25kg/ha).
- The average selling price of Binasarisha-9 was Tk.45.15/kg. The highest price of Binasarisha-9 was found in Rangpur (Tk. 49.16/kg) and the lowest found in Mymensingh district (Tk. 42.10/kg).
- The average net return per hectare was Tk. 22278.34. The net return was highest in Rangpur (Tk. 30334.53/ha) followed by Sherpur (Tk. 20771.68/ha), and Mymensingh (Tk. 16519.40/ha) respectively.
- Thirteen explanatory variables were performed in logit regression analysis in this study.
- The result of logit regression model shows that experience of household head, farm size, annual income, yield, training, and extension contact were found as positively significant and earning person, duration and weather were found as negatively significant variables in explaining the variation in Binasarisha-9 adoption of farm households.
- About 20% mentioned about lack of training facilities and was top ranked followed by quality seed in timely (13.33%), Infestation of disease (11.11%), and other (9.99%) were found among the mustard growers.

**Yield gap of potential oil seed variety Binasharisha-4 in some selected areas of Bangladesh**

The results showed that the farmers' level highest yield was obtained from Magura (1.46 t/ ha) followed by Jashore (1.38 t/ha), Sirajgonj (1.26 t/ha), Rangpur (1.20 t /ha), and Tangail (1.17 t/ ha) district. The average yield of Binasharisha-4 was 1.34 t /ha.

- The estimated average yield gap I was 0.08 t/ha (4.72 %.) and average yield gap II was 0.20 t/ha (13.35 %.).
- The lowest gap was 0.19 t/ ha (11.52%) observed in Magura district and it was the highest 0.40 t/ ha (25.00 %) in case of Rangpur district. Considering all, the average yield gap was 0.28 t/ ha (17.46%) and much scope for yield enhancement in the variety.

**Profitability of Binamasur-8 cultivation in some selected areas of Bangladesh**

- The average age of the Binamasur-8 farmers was 46.5 years with minimum age of 17 years and the maximum of 79 years. About 87 percent of farmer's occupation was agriculture.
- Majority of the Binamasur-8 farmers (72% of the total farmers) had primary and secondary levels of education. Only four percent Binamasur-8 farmers' were found to have completed their higher level of education. Eighteen percent of the farmers had basically no education.

- The average farm size per household was estimated at 1.51 ha. The highest farm size was found in Faridpur (1.76 ha.) followed by Pabna (1.65 ha.), Magura (1.41 ha.) and Chapai Nawabganj (1.21 ha.), respectively.
- The average yearly household income was Tk. 239050. The highest household income was found in Pabna (Tk. 274356) followed by Magura (Tk. 251217), Faridpur (Tk. 236270) and Chapai Nawabganj (Tk. 194356), respectively.
- The average costs of Binamasur-8 cultivation were Tk. 58299 and Tk. 40272 per hectare on full cost and cash cost basis, respectively. The highest production cost was for human labor (36.8%), followed by land use (17.1%), power tiller (15.4%), seed and irrigation (6.8%). The cost of Binamasur-8 cultivation was found highest in Magura (Tk. 61266/ha) followed by that in Chapai Nawabganj (Tk. 59171/ha), Pabna (Tk. 57697/ha) and Faridpur (Tk. 55063/ha), respectively.
- The average yield of Binamasur-8 was 1691 kg/ha. The yield was highest at Pabna (1803 kg/ha) followed by Magura (1797 kg/ha), Chapai Nawabganj (1684 kg/ha) and Faridpur (1479 kg/ha).
- The price of Binamasur-8 was found the highest in Magura (Tk. 57.00/kg) and the lowest in Chapai Nawabganj (Tk. 54.00/kg).
- The average net return per hectare was Tk. 38536. The net return was highest in Pabna (Tk. 45835/ha) followed by Magura (Tk. 43936/ha), Chapai Nawabganj (Tk. 34965/ha) and Faridpur (Tk. 29382/ha), respectively.
- Benefit cost ratio was estimated at 1.66 and 2.40 on full cost and cash cost basis implying that the Binamasur-8 cultivation at farm level was highly profitable.
- The first ranked constraint was unavailability of Binamasur-8 varieties' seeds in all areas. Other constraints were lack of training (63%), lack of technical know-how (31%), insect infestation high (28%), attack of diseases (22%), crop loss due to diseases (11%) and high price of pesticides (9%).

**Cost and return analysis of selected crops in Bangladesh**

- The study was conducted in three intensively mustard growing areas of Bangladesh, namely Tangail, Sirajganj and Jessore district. From each district three Upazilla were selected purposively to conduct the study.
- The selected upazilla were Sadar, Delduar and Mirzapur from Tangail, Belkuchi, Ullapara and Shajatpur from Sirajganj and Sadar, Bagharpara and Jhikargacha from Jeshore district. Total sample size was 450, 150 from each district and 50 from each Upazilla.
- The highest yield 1487.96 kg/ha was found at Shajatpur, Sirajganj and it was lowest at Delduar, Tangail (1158.68 kg/ha).
- The average selling price of mustard was Tk 46.45/kg. The highest price was found in Shajatpur (Tk. 49.09/kg) and the lowest found in Jhikargacha district (Tk. 43.67/kg).
- The average return from mustard cultivation was Tk. 66169.81 and it was the highest at Shajatpur, Sirajganj Tk. 77564.08 / ha. The lowest return Tk. 59666.67/ ha was observed at Mirzapur, Tangail.

## BFRI (Forest Economics Division)

**Impact of participatory forestry on financial and livelihood of local people in northern region of Bangladesh**

Pilot survey was carried out to determine representative number of sample plots (area 100 $m^2$) as sample size for the forest resources assessment of selected strip plantations under Rangpur and Bogra SFD. Group discussions were arranged with local participants of three Forest Range areas in each SFD that were directly or indirectly have benefited from selected strip plantations.

The required number of sample plots as sample size for the study areas were determined as 190 plots at 7% and 171 plots at 9% margin of error in the SFD of Rangpur and Bogra respectively. Stratum (plantation year) wise that sample plots were allocated for data collection on the selected strip plantations year. The collected information Girth/Diameter were at 1.3 meter height of trees, number of tree species per plot, nursery and management cost, species and girth size wise tree round log prices, fuel wood price etc. The Stratified Random Sampling method was followed to assess the number of tree stocking, volume and biomass of trees and forest carbon storing in the selected year of plantations under the SFD of Rangpur and Bogra.

**Impact analysis of "Nursery Pest and Disease Management" technology of BFRI. Status of forest resources :**

- Average age of nursery business of nursery owners 17 year.
- Education status (%): Signature 19, Primary 22, Secondary 33, College 18, and Masters 8.
- Main occupation status (%) : Nursery 74 and others 26.
- Average nursery land area (dc.) : 151 (own 67, lease 76 and mortgage 8 dc.)
- Size of nursery (acre): Highest 30 and lowest 0.15. 63% nursery sizes are 50-250 dc.
- Average nursery raising cost (Tk/acre) : 3,35,704 (Soil 10690, cowdung 8,426, Polybag/tob 6,340, Seed/seedling 53,199, shade material 5,063, pesticide 8,599, fertilizer 10,783, labor 1,38,698, Watering 6,696, land rent 14,580 and others 15,784).
- Average number of seedling (acre) : 49,669.
- Average seedling sale price (Tk/acre) : 13,46,440 .
- Average profit (Tk/acre) : 10,11,430.
- Total nursery area (acre):268.23.[O. 118.65(44%), L.134.66 (50%, 39,10,900 ) and M.14.92 (6%, 87,00000)].
- Pesticide cost Tk./acre (trained): 7,895
- Pesticide cost Tk./acre (control): 10,001
- Total number of seedling/acre (control) : 65,585
- Mortality rate of seedling (control): 12%
- Mortality rate of seedling (trained): 4%
- Saving of seedling in trained owners: 8%.
- Saving of seedling number/acre : 5,247
- Sale price (Tk./seedling) : 27.00
- Total save value (Tk./year/acre) : 1,42,664/-

Pest and disease like leaf blight, leaf spot, stem/root rot,fruit rot, and white milli bug, stem borer, gall insect, leaf roller/insect roller were found in most of nurseries

## Computer & GIS Unit

The major responsibilities of the unit involves overall management of Information and Communication Technology (ICT) related activities of hardware, software, networking, etc. The ultimate goal was to establish BARC as information hub of NARS so that overall agricultural research system becomes strengthened and robust in terms of information availability, accessibility, dissemination, etc. through online system to cater information need of stakeholder in agriculture sector. The unit plays a vital role to establish strengthen ICT infrastructure to facilitate MIS related activities/services among NARS institutes. The activities also involved in assessing needs of computer hardware, software, network equipment, preparing technical specification for procurement of the goods/accessories, evaluating technical proposal, receiving and distributing ICT goods, etc. The unit also provides support for troubleshooting of hardware, software, network, internet/email and related services for smooth running of the system. In addition to that, it conducts various ICT based capacity building trainings, workshops, seminars for the personnel of BARC and NARS institutes. Besides, the unit conducts a lot of other activities, such as preparation of progress report, need assessment, review and evaluation of research program, recruiting of computer personnel, etc. Personnel of the unit are also working as innovation officer of BARC formed under Governance Innovation Unit (GIU) of Prime Minister's Office.

Geographic Information System (GIS) is another important functional part of the unit. Maintenance, necessary updating and output preparation of AEZ land resources database and local level Upazila Nirdeshika database (soil, land, nutrition and others) is an on-going activity of this unit. Land suitability assessment and crop zoning is an important outcome of GIS activity.

**The personnel of Computer & GIS Unit** accomplished the following activities during the period from July 2018 to June 2019:

### Data Centre Operation

Following activities regarding server and network administration performed:

Cloud based antivirus Bit Defender (no. of user license 140) was procured and installed in all computers (desktop, laptop, workstation and server) of BARC for the protection of computers from malware and virus. The Bit Defender antivirus is a light software and it is managed centrally from cloud. Ten PC, printer, scanner, etc. were procured from revenue budget and distributed among BARC officers.

Internet service availability and email account creation (email under barc.gov.bd domain) for BARC officers were done for newly recruited officers time to time. It is a part of routine activities. Availability of The Essential Electronic Agricultural Library (TEEAL) is ensured and it can be accessible to all users of BARC and NARS through LAN and VPN.

### National Agricultural Display Centre (NADC) Operation

Supervised, monitored, and provided technical support in ensuring smooth functioning of the digital part, such as Kiosk, Digital signage, TV screen, storage server for digital content, network devices, etc. through troubleshooting and maintenance activities.

### Establishment of Agricultural Technology Information Network in Asia (ATIN) project

Computer and GIS Unit has been implementing 3rd phase of the ATIN project from July 2016 to June 2019. During 2018-19, the following activities were performed:

- E-content of agricultural production technologies of 19 crops were developed and uploaded to AFACI website.

- Crop calendar for 5 (five) crops were prepared and published 30,000 copies (6000 copies for each crop).
- Updating of information in AFACI website (news and events, publications, technologies, etc.)
- Three trainings on "Crop Calendar" held at DD offices of Tangail, Chuadanga, and Comilla were held on 8 November, 2 December, and 13 December, respectively, where farmers, UAO, and SAAO took part.
- Publishing of "Directory of Annual Agricultural Research Program of NARS for 2018-19" is under process.


Crop Calendar training 2018 at DD office, DAE, Tangail

**Development of Upazila land suitability assessment and Crop Zoning System of Bangladesh project**

Crop Zoning project is being implemented with the coordination of Crops Division of BARC. Following activities were done during this period:

- Recruitment of manpower
- Procurement of goods, equipment and works planned for this financial year.
- Three awareness workshops have been conducted at BARI, DAE (Barishal, Bogura and Rajshahi region) and SRDI, and two consultation workshops were organized at BARC.
- Five meetings of which four expert committee and one consultation with the participation of senior officials of BARC has been conducted.
- Updated land and soil physical properties data of 72 upazilas and soil chemical data of 144 upazilas have been completed.
- Finalized 74 crops selected on priority basis (area coverage and importance) for suitability analysis under crop zoning study.
- Prepared crop rules (soil, climate, water requirements of crops) for 74 crops.
- Suitability limitation rating (edaphic and climatic) for 74 crops have been completed.

- Socio economic survey of 20 upazilas have been completed.
- Two software namely (i) socio economic data management and analysis & (ii) climate data management and analysis have been developed.
- Cropping pattern information collected from 286 upazilas through DAE.
- Daily weather data (max temp, min temp, rainfall, relative humidity, sunshine hour, wind speed and cloud cover) were collected from 35 BMD stations up to 2017. Rainfall data of 260 BWDB stations and ground water data of 1240 BWDB stations are also collected.
- Agro-climatic analysis (thermal and moisture regimes) using weather data are completed.
- Updating of soil sampling location map of 144 upazilas and soil mapping unit shapefiles of 83 upazilas soil maps have been completed.
- Preparation of Boro rice growing area map using satellite data has been done.
- Soil survey of 100 upazilas out of 150 has been done by SRDI (40 upazilas under crop zoning project and 60 upazilas under revenue budget).
- Development of Databases, web GIS based land suitability assessment and crop zoning software and Agri-advisory portal is ongoing by IWM.

Awareness workshop of Crop zoning project at BARI, Gazipur


Awareness workshop of Crop Zoning project for DAE officials, RDA, Bogra

Field validation of Crop Zoning map

**Establishment of climate service for agriculture management and crop monitoring system for Bangladesh project**

- Organized training workshop on "Principles and Application of GIS in Agriculture Planning and Decision Making" at Soil Resource Development Institute (SRDI) from 11-14 March 2019. Twenty participants attended from BARC, DAE, BARI, BRRI, BJRI, SRDI, BMD, BSMRAU, and SAU.
- Digitalized BBS district wise crop production data from 2007-2017 for 7 crops and 2014-2017 for 38 crops
- Collect and managed satellite based rainfall data from 1981-2018
- Field data collection (Dinajpur, Rangpur, Faridpur and Barisal) for crop area estimation
- Attended 2-days workshop at ICIMOD, Nepal

**Development and up-gradation of digital contents of National Agricultural Display Centre (NADC) at BARC project**

- Gathered/Collected the detailed information of displayed items in NADC including developed Agricultural technologies by NARS institutes and digitalize and/or developed contents through text, image & audio-visual format.
- Collected 162 technological information processed and incorporated with the web application.
- First version of web based application software developed & feedback from NARS institutes.
- Compiled NARS technological achievement for uploading the Software.
- Existing display centre renovation activities is done, Switch room up-gradation, replacement of 4 circuit breaker, Maintenance of Digital touch screen, Kiosk, Service Nine AC & Replacement of LED Bulb in two floor, Installation of 6 UPS.

**Database and apps development**

- Project monitoring system simplified and web based software developed. Piloting of the software on going.
- Developed Payroll System of BARC by Software Company.
- Previously developed applications are updated as needed during this period.

**Maintenance and Updating of BARC Website**

BARC web portal (www.barc.gov.bd) was updated regularly based on data received from different sections/division. Moreover BRRI cross checks BARC website as per instruction from MoA innovation team. It is update as per BRRI feedback and reported to MoA.

Website update related report sent to MoA within 7th day of each month.

**Climate database update**

Updated climate database of BARC (http://climate.barcapps.gov.bd) upto 2017. The daily weather data is purchased from BMD, processed and generated monthly data and uploaded in website.

**Continuation of GIS Activities**

Maintenance and necessary output preparation of AEZ land resources database and local level upazila nirdeshika database (soil, land, nutrition and others) has been continuing as an on-going activity. AEZ land resources data is used for earlier crop zoning study of Bangladesh. Also, the

information of 15 (fifteen) upazilas of upazila nirdeshika database were used in SPGR GIS sub-project for earlier crop zoning study.

- Crop zoning project is utilizing the AEZ database. The 32 newly created Upazila is demarcated using the data of AEZ database. Upazila map generated with updated administrative boundary, soil data, mapping unit etc.

**Support to BARC and different component of NATP as PEC and TEC member**

Necessary supports have been provided to BARC and NATP for procurement of goods, works and services. Attended number of meetings arranged by PIU-BARC, NATP-2 for procurement of Hardware, Network and MIS and provided necessary input.

**Support to divisions/sections of BARC for hardware/software; data analysis; information sharing and resource management**

Support provided to different divisions/sections to fix various types of computer hardware and software problems. Several types of maps, climatic etc. provided to scientists/researchers/ extensionists as per requirement.

**Support for planning, budgeting and procurement of computer resources (hardware, software & accessories, etc.)**

Support provided in the form of requirement assessment, specification preparation, budgeting for procurement of computer hardware, software and accessories under BARC and different projects i.e. NATP2 and KGF. Working as Focal point of BARC in ARMIS project implemented by KGF.

**Functioning of BARC innovation team**

Innovation team of BARC consists of 6 members including Innovation Officer. Director (Computer and GIS) worked as the Innovation Officer. According to the innovation work plan 2017-18, the team performed following major activities:

- Service innovation work plan-2019, Innovation Report-2018, Progress report of BARC activities according to ICT Policy 2015 were prepared and sent to MoA
- Conducted 12 Innovation meetings at BARC
- Attended 12 meetings arranged by MoA
- Information of innovation team and its activities uploaded to BARC website under the menu Innovation as per guideline of MoA
- Initiated the activities according to the Innovation workplan-2018-19. Payroll System has been developed hiring software firm.
- Piloting Online Project Monitoring System

**e-Filing administration and support**

- e-Filing administration activities including user creation, update, delete etc. performed
- Report generation and sent to MoA
- e-Filing training and support to different units/divisions.

**Human Resources Development**

| Sl. No. | Title | Duration | Participant | Venue | Founded |
|---|---|---|---|---|---|
| 1. | Training on "ICT For Office Management" (Staff) | 14-20 May 2019 | Total 30 participants attended in the training program | BARC | NATP-2 |
| 2. | Training on "Development of innovation capability" | 17-18 November 2018 | Number of participants-40, Duration-2 days | BARC | NATP-2 |
| 3. | 3rd Showcasing of innovation services | 25-06-2109 | Total 73 participants from 17 organizations under MoA attended in the training program | BARC | Revenue |
| 4. | Training workshop on "Principles and Application of GIS in Agriculture Planning and Decision Making" | 11-14 March 2019 | Twenty participants attended from BARC, DAE, BARI, BRRI, BJRI, SRDI, BMD, BSMRAU and SAU. | Soil Resource Development Institute (SRDI) | Drought Monitoring Project, ICIMOD |
| 5. | Hands-on training on "Crop Calendar" | 08-11- 2018 | 40 participants including Farmer, UAO, and SAAO attended in the training program | DD office, DAE, Tangail | ATIN, AFACI project |
| 6. | Hands-on training on "Crop Calendar" | 02-12-2018 | 40 participants including Farmer, UAO, and SAAO attended in the training program | DD office, DAE, Chuadanga | ATIN, AFACI project |
| 7. | Hands-on training on "Crop Calendar" | 13-12-2018 | 40 participants including Farmer, UAO, and SAAO attended in the training program | DD office, DAE, Cumilla | ATIN, AFACI project |
| 8. | Awareness workshop of crop zoning project | 26-09-2018 | 73 participants of Barishal region of DAE attended in the program | BRRI Regional Centre | Crop Zoning Project |
| 9. | Awareness workshop of crop zoning project | 12-11-2018 | 98 participants of SRDI attended in the program | SRDI | Crop Zoning Project |
| 10. | Overview and progress of Crop zoning project | 18-02-2019 | 56 participants from BARC, KGF | BARC | Crop Zoning Project |
| 11. | Awareness workshop of crop zoning project | 26-04-2019 | 114 participants of Bogra and Rajshahi region of DAE attended in the program | RDA, Bogra | Crop Zoning Project |

## Other Activities

**a. Report to MoA and Other organizations**

During this period, following ICT related reports/documents prepared and sent to related organization:

- Innovation activities report of BARC (half yearly and yearly) according to Innovation work plan 2018-19 to MoA
- Monthly e-Filing, e-GP reports to MoA
- Monthly website update/upload reports MoA
- E-Service list to MoA
- "Digital Bangladesher pothe ogrojatra" report to MoA
- "Innovation Sonkolon" report to MoA
- Input provided to admin section for monthly integration meeting of MoA
- Progress Report of BARC activities according to ICT Policy 2015 to MoA
- Progress Report of BARC activities according to Digital Bangladesh Taskforce to MoA
- Online service, Piloting service, Mentor list sent to MoA
- Opinion on e-Gov Master Plan to MoA
- Domain related report to MoA
- Service Process Simplification (SPS) report to Cabinet division
- Provided input in ICT based infrastructure development and MIS development of PIU-BARC, NATP-2
- Comments on Hardware and MIS procurement report of PIU-BARC, NATP-2
- BGISP guideline related opinion to BBS
- GIS meta data information to BGISP, BBS

**Publication**

- Publishing of Directory of Annual Agricultural Research Programme of NARS institutes 2018-19 under process

**Project Monitoring**

Mr. Hasan Md. Hamidur Rahman, Director (addl. charge), Computer and GIS monitored 7 PBRG projects as team member in northern part of the country (Rangpur, Dinajpur, Thakurgaon). Mr. Shohid Uddin Bhuyan, System Analyst monitored 5 projects (revenue) at Sylhet and 7 projects (PBRG) at Rajshahi as team member.

Field monitoring of NATP-2 project at Thakurgaon

**Meeting/seminar/workshop participation**

The personnel of Computer and GIS Unit attended various meetings/seminars/workshops under different capacity at BARC and other organizations during this period. Some of those are focal point meeting and workshop, PCR workshop, stakeholder workshop, monsoon and climate related workshop, innovation in service delivery workshop etc.

**Visit Abroad**

1. Mr. Hasan Md. Hamidur Rahman, Director (Addl. Charge), Computer and GIS attended in the **"AFACI Program Workshop on ATIN and Seed Extension"** during 17-21 July 2018 at Thailand.
2. Mr. Hasan Md. Hamidur Rahman, Director (Addl. Charge), Computer and GIS attended in the **"Regional Knowledge Forum on Drought: Earth Observation and Climate Services for Food Security and Agricultural Decision Making in South and Southeast Asia"** at ICIMOD, Nepal.

Digital World 2018 participation

Attended Digital World 2018 exhibition and showcase "Land suitability assessment and crop zoning of Bangladesh (*cropzoning.barcapps.gov.bd)"* from BARC.

## Agricultural Information Centre

Agricultural Information Centre (AIC), a knowledge management hub of BARC, is engaged in collecting, organizing and disseminating research generated information. It renders knowledge services to the stakeholders ranging from researchers to policy makers with a view to enhancing their capacity. This service is aimed to enhance agricultural productivity. The centre works on the principle of providing quality agricultural information in order to accelerate research and development. AIC provides knowledge services to the National Agricultural Research System (NARS) including documentation services. The documents generated in the institutes of NARS and beyond are huge in number subsequently deposited in the AIC library of BARC. Information in terms of quantity and quality is managed in an institutional repository. AIC maintains two sections: 1. Documentation and Publication, 2. Library and Reprography. The activities are performed by AIC during 2018-2019 are described below:

## Documentation and Publications

Agricultural Information Centre published the biannual Bangladesh Journal of Agriculture (BJA), Annual Reports, Quarterly BARC newsletter, technical directories, technical reports, telephone directory, yearly diary, greeting cards. It prepared a good number of reports on Agriculture Standing Committee and question-answers including supplementary, star-marked and non-star marked questions required by the Parliament Sessions and relevant ministers for Parliament Meeting. AIC also organized annual religious and national events through designing and distributing Eid, Bangla and English New Year Greeting Cards, Banner, taking part in advertisement for disseminating scientific information, and designs of different research publications. It monitored different research projects and participates in different National & International seminars, workshops, symposiums and other relevant programs. It was also involved in preparing notes for the events organized by BARC or ministries including guests of different national seminars, workshops, symposiums. Agricultural Information Centre acted as master of ceremonies or facilitator for different national and international seminars, workshops and symposiums.

Information was maintained by AIC in two ways: in the digital databases for easy access for the users and in printed inventory documents available in the library. The centre attempted in bringing out the printed inventory of the information resources in series publication. This inventory was hoped to help the users to identify the materials of their interest.

## Library and Reprography

This section consists of development of collection, literature search, update and maintenance of databases, news clipping services, resource exchange & sharing, and photography and photocopy services. This section is dedicated for scientific professionals, graduate students and policy makers.

AIC devoted considerable efforts and resources for the development of an outstanding library collection to meet the expanding needs of agricultural research and to serve as an information resource centre for NARS institutes. AIC library had a total collection of about 24,700 information materials in the form of 20,000 books and reports, pamphlets and 1100 bound journals and serial etc.

## Development of Collection

Every year new books, reports, pamphlets, bound journal etc. were added in professional manners to the existing ones. The AIC library maintained a total collection of about 24,700 information materials in the form of books, reports, pamphlets, bound journal etc. In the previous year, 173 new books and reports were procured and 20 current journals/Newsletters were published by AIC during 2018-2019.

## Literature Search

The centre rendered literature search services from digital full-text using CDS-ISIS and D-space database management- to satisfy the quarries of the researchers, agricultural scientists, planners and policy-makers. It also provided search services on specific requests by teachers, students and users from NARS institutes and

other organizations during 2018-2019. BARC and NARS scientists, teachers and students of Universities, NGO and private organizational personnel were the users of this library.

**Update and Maintenance of Databases**

Agricultural Information Centre updated and maintained the databases of different publications. It had its own repository using DSpace with database on Koha 6211 books and reports of different sorts out of which 273 records were added during the previous year. Its database was rich in Journals, Newsletters, and Periodicals of about 1130 records.

**News Clipping Services**

News clippings from daily newspapers both in Bangla and English on different research related issues or events, programs and ceremonies related to agriculture were identified and processed in different format and were circulated to the users for their attention. These had been compiled and prepared with a content list and finally preserved in the library. News clipping of 2,582 articles (Bangla and English) were identified and processed in different formats during 2018-2019. Later, these clippings were compiled with a content list and preserved in the library for users. One hard copy was prepared and preserved as a reference copy.

**Resource Exchange and Sharing**

The AIC library performed resource exchange and sharing activities with national and international organizations during 2018-2019 like the previous years. Recently the library has started collecting information materials from FAO, CGIAR Centres, BBS, BANSDOC and NARS institutes on a regular basis.

**Online Archive of Important Documents**

The AIC library developed a database driven online archive based on Content Management System (CMS) last year. The database contained digital contents of non-conventional documents of high archival value (policy documents, all kinds of reports, proceedings and other mimeographs).

**Photography and Photocopy Services**

AIC regularly provides photography and photocopy services to all the divisions and units. Last year, it captured photographs of 85workshops/trainings/seminars/meetings. It also supplied 1889 photos in digital and printed form to the concerned divisions and officials. Besides, it also provided photocopying services to different sections. During 2018-2019, it supplied 1,06,290 photocopies of official documents, reports, letters, scientific literature etc. under 4,830 requests.

**User Service**

During 2018-2019, 7,500 users of different categories used the library. Besides the BARC and NARS scientists, university teachers and students, NGO and private organizational personnel used the library for meeting their queries.

**CRG Sub-Project**

Agricultural Information Centre implemented PIU-BARC, NATP-2 Supported CRG sub-project on Enhancing Agricultural Research Services through Digitization of Research Outputs, BARC. Under this project, digital repository of important documents with Dspace and Koha software to serve the searchers, policy makers and other stakeholders was developed in the centre. A publication titled Resources in AIC Library was also published.

**International Linkage**

Agricultural Information Centre, BARC is linked with different international organizations. Dr. Susmita Das, Principal Documentation Officer (AC), AIC, acted as Asia Ambassador of Plan S- an International Expert Group of Open Access Research, a board member of the working group of AgriXiv- a preprint repository for agriculture in India and Core Member of YPARD Bangladesh.

**Training/Workshop/Seminar**

Agricultural Information Centre (AIC) also arranges different workshops, trainings, seminars and meetings for wider and quick delivery of agricultural scientific findings.

**National Training Program**

**1. Technical Report writing and Editing**

Agricultural Information Centre (AIC) organized different training programs, international workshops and one national workshop. The training courses cover various subjects including technical report writing and editing, communication, graphic design, impact on Krishi Media etc. In the reporting period, AIC organized a 5-day training program on *Technical Report Writing and Editing* held on February 3-7, 2019 at BARC premises. Twenty five scientists from the NARS institutes and DAE attended the training program. The inaugural ceremony of the training was graced by the chief guest Dr. Md. Kabir Ikramul Haque, EC, BARC. The program was chaired by Dr. Md. Boktiar Hossain, Director, AIC. In closing ceremony, as a chief guest EC, BARC distributed the certificates among the participants. In his speech, he highlighted the importance of technical report writing and editing. In the concluding program, Dr. Shaikh Mohammad Bokhtiar, MD, P&E, Dr. Aziz Jillani Chowdhury, MD, Crops and Dr. Sultan Ahmmed, Director, BARC were also present as special guests Dr. Md. Boktiar Hossain, Director, AIC chaired the concluding and certificate giving session.

Certificate giving ceremony of Technical Report Writing & Editing, 2019

**2. Krishi Media Workshop**

Agricultural Information Centre, BARC organized a *Validation Workshop for Krishii Media.* In the workshop, Dr. Md. Abdur Rouf, Additional Secretary (PPC), Ministry of Agriculture was present as chief guest, Dr. Kabir Ikramul Haque, Executive Chairman, BARC chaired the program. Mr. Amitava Das, DG, DAE, Mr. Nasrullah, Md. Irfan, Director, Farm Broadcast Unit, Betar and Dr. Md. Nurul Islam, Director, AIS were present as special guests. Dr. M. Boktiar, Director, AIC delivered the welcome address. Representatives from NARS, Media, Betar, BADC, DAE, Member Directors & Directors of BARC also attended the workshop. Dr. Susmita Das, Principal Documentation Officer (A.C) and Krishi media focal person BARC presented the keynote paper on *Apricultural Research Development activities*. About 70 Participants from NARS institutes, extension, AIS, Bangladesh Betar and other organizations attended the workshop and exchanged their opionions regarding different Krishi programs for broadcasting in Betar and Television.

Pictorial view of Krishi Media Workshop, 2019

## International Workshop

### Asia Open Access Dhaka -2019

AIC always takes part in the some success stories of Bangladesh Agricultural Research Council. AIC, BARC prided itself in organizing an international workshop *Asia Open Access 2019* in association with Confederation of Open Access Repositories (COAR) held at BARC on March 6-7 2019. The workshop was aimed in learning about global trends, share information across Asian countries and help with local strategies for increming the adoption of open aceess and open science in Asia. This International workshop was inaugurated by the chief guest Mr. Zunaid Ahmed Palak, honourable Minister of State for Information and Communication Technology Division, Government of the People's Republic of Bangladesh. In this workshop, participants from Japan, Singapore, India, Nepal, Canada and Bangladesh discussed the unique opportunities in the country that could be leveraged to move things forward, in particular, the strong support by the Government for 'Digital Bangladesh', a strategy to modernize and provided digital and open access to government services, data and information.


Inangual and Teehnical Session of Asia Open Aceess, Dhaka - 2020

Group Photo of Asia Open Access, Dhaka-2019

**Publications**

Three scientific papers, four monographs, one annual report, two training manuals and four issues of BARC newsletters were published from Agricultural Information Centre (AIC), BARC during 2018-2019.

**Scientific Paper (3)**

Das, S., Nasiruddin, M., & Kabir, W. (2019). Model for ICT based Agricultural Information Management System for the Agricultural Development in Bangladesh. *Asian Journal of Extension Education. 37*:116-127.

Das, R. K., Das, S., Rahman, R., & Mondal, P. (2019). Mapping of Agricultural Research in Bangladesh: A Scientometric Analysis. *Journal of Advanced Research in Library and Information Science, 6*(2):7-15.

Haque, K. I., & Das, S. (2019, June). *Bangladesh Agricultural Research Council in Food and Nutritional Security.* Krishikatha, Kartick, 1426, (2019), Special Issue: World Food Day.

**Monograph (04)**

Das, S., Ferdous, H. A., & Kamal, R. M. (2018). Agricultural Periodicals in AIC Library. A Publication of PIU-BARC, NATP-2 Supported CRG sub-project on Enhancing Agricultural Research Services through Digitization of Research Outputs. AIC, BARC.

Das, S., Ferdous, H. A., & Kamal, R. M. (2018). Resources in AIC Library. A Publication of PIU-BARC, NATP-2 Supported CRG sub-project on Enhancing Agricultural Research Services through Digitization of Research Outputs. V-1. AIC, BARC.

Das, S., Ferdous, H. A., & Kamal, R. M. (2018). Resources in AIC Library. A Publication of PIU-BARC, NATP-2 Supported CRG sub-project on Enhancing Agricultural Research Services through Digitization of Research Outputs. V-2. AIC, BARC.

Das, S., Ferdous, H. A., & Kamal, R. M. (2018). Resources in AIC Library. A Publication of PIU-BARC, NATP-2 Supported CRG sub-project on Enhancing Agricultural Research Services through Digitization of Research Outputs. V-3. AIC, BARC.

**Report (2)**

Hossain, B., and Das, S. (2018). Annual Report 2017-2018. Bangladesh Agricultural Research Council, Dhaka, Bangladesh.

Kamal, R. M., & Das, S. (2018). Enhancing Agricultural Research Services through Digitization of Research Outputs. PIU-BARC. Bangladesh Agricultural Research Council, Dhaka, Bangladesh.

**Training Manual (2)**

Hossain, B., & Das, S. (2019). Technical Report Writing and Editing 2019. Bangladesh Agricultural Research Council. Bangladesh, Dhaka.

Ali, M., S., Younus, M., Monalisha, N., Atikullah, S.M., Jaha, F.N.,Akbar, S.U, Das, S.,& Parvin,A. (2019). *BAEN Training Module on Gender and Nutition Sensitive Agriculture.* Society for Bangladesh Agricutural Extension Network, Bangladesh, Dhaka.

**BARC Newsletter (4)**

Kamal, R. M., & **Das, S.** (2018). BARC Newsletter. Bangladesh Agricultural Research Council. 16 (1&2): Dhaka.

**Das, S.**, & Hossain, B. (2019). BARC Newsletter. Bangladesh Agricultural Research Council. 17 (1&2): Dhaka.

**Additional Activities**

Agricultural Information Centre (AIC) also performs its other additional activities for meeting different requirements of Bangladesh Agricultural Research Council.

a. Agricultural Information Centre (AIC), BARC prepared a good number of reports on agriculture Standing Committee and Question-Answer including supplementary, star marked and non-star marked questions by the Parliament Members and other concerned ministers for 11$^{th}$ parliament sessions during 2018-2019.
b. Agricultural Information Centre designed and distributed two Eid cards, two greeting cards for Bangla New Year and English New Year during 2018-2019. I also designed the banners of different programs in the reported period. AIC took part in advertisement for disseminating scientific information, and designs of different research publications.
c. Different research projects and participates in different national and international seminars, workshops, symposiums and other relevant programs were mentored by Agricultural Information Centre during 2018-2019.
d. Last year, Agricultural Information Centre monitored different research projects undertaken by Bangladesh Agricultural Research Council.
e. As a member of different monitoring teams, Agricultural Information Centre participated in different field visits to various localities where projects have been undertaken by BARC and NATP-2 during 2018-2019.
f. Agricultural Information Centre, as a member of the BARC innovation team, contributed to generating innovative ideas and piloting and showcasing different innovations in BARC.
g. During 2018-2019, Agricultural Information Centre prepared speeches for chief guest, special guest of different national seminar and international conferences, seminars, workshops, symposiums.
h. AIC was involved in preparing notes for the events organized by BARC in the reported time.
i. Agricultural Information Centre acted as master of ceremonies or facilitator for different national and international conferences, seminars, workshops and symposiums organized by BARC during 2018-2019.
j. AIC worked as focal person of Krishi media in last year.
k. Agricultural Information Centre worked in the annual souvenir committee of 100 years celebration of Bangabandhu formed by the ministry of agriculture.

## Administration and Finance Division

**Administration Unit:**

**BARC Recruitment/promotion Comittee-1(DPC-1)**

In 2018-2019 fiscal year, five meetings were held. PSO (4th grade) from BARC, BARI, BRRI, BINA were promoted to CSO/Director (3rd grade) in these meetings.

**BARC Recruitment/promotion Comittee-2 (DPC-2)**

In 2018-2019 fiscal year, three meetings were held. Promotion of Assistant Director (Audit) & Viva Exam for Direct recruitment of Programmer was held in these meetings.

**BARC Recruitment/promotion Comittee-3 (DPC-3)**

Four meetings were held in 2018-2019 fiscal year, promotion of Accountant & Doptori and viva voce for direct recruitment for the post of Auditor, Stenographer cum Computer Operator, Driver, Office Assistant cum Computer Operator, Pump operator, Mechanic, Duplicating Machine Operator, Electrician, Account Assistant, Office Assistant were held in these meetings.

**Increment order, promotion order, retirement order and retirement benefit**

All increment orders, promotion orders, PRL orders were issued by Establishment Unit. Ten employees went on PRL in this fiscal year. Retirement benefits of all these employees were arranged to paid or at stages of payment.

**Executive Council Meeting**

The *30th and 31th meeting of Executive Council* were held on 29 October 2018 and 9 June 2019 at BARC Conference Room-1. These meetings considered among others the approval of the recommendation of promotion and the Recruitment Committee-1, promotion and the Recruitment Committee-2 and Promotion and the Recruitment Committee-3 and the approval of the projects under PBRG of PIU-BARC.

## Finance Unit

Bangladesh Agricultural Research Council (BARC) is the apex body of the National Agricultural Research System (NARS) comprising 12 national agricultural research institutes. As per the BARC Act 2012, it has the mandate to develop priorities in agricultural research, allocate resources and function as a coordinating body to improve the overall research activities of the NARS. BARC received funds from Development and Revenue Budgets of the Govt. to conduct its annual mandated activities like research management, coordination, monitoring, evaluation, technology transfer, and manpower development. In this respect, BARC's Finance Unit prepares the MTBF Budget and financial plan of Medium Term Activities and accordingly disburses fund for achievement of the goal. It keeps all the record of expenditure incurred during the year and reports to the ministries, CAO, IMED, Development Partners and other government offices in time. It also reconciles the accounts with CAO to prepare the final accounts which is submitted before the Public Accounts Committee (PAC) of the National Assembly.

## Budgeting and Expenditure Control

The Govt. has been implementing "Medium Term Budgetary Framework (MTBF)" for all the ministries including Ministry of Agriculture and its divisions, bodies and corporations since 2005-06. Accordingly, BARC prepared budget in the form of MTBF for Revenue Head and Development Projects and submitted to the Ministry of Agriculture for approval.

## Fund Release/Disbursement

BARC makes proposal for the release of fund from the Govt. on quarterly basis as per approved annual allocation of budget. In the financial year 2018-2019, BARC received Tk. 2808.05 lakh for salary and allowances, corer research, technology transfer , manpower development, and operational cost. To implement the activities like technology transfer & manpower development, etc. funds were released to the Agricultural Research Institutes (ARIs) and associated organizations according to the budget plan. The overall financial progress made during the FY 2018-19 is as follows**:**

**Financial progress under revenue budget** (Tk. in lakh)

| Sl. No. | Line items | FY 2018-19 | | Achievement (%) |
|---|---|---|---|---|
| | | Budget | Expenditure | |
| 1. | Salary and Allowances | 1236.05 | 1189.46 | 96.23 |
| 2. | Supply and Services | 425.00 | 423.60 | 99.67 |
| 3. | Research Grant | 140.00 | 51.48 | 37.77 |
| 4. | Training, Workshop, Seminar | 215.00 | 213.00 | 99.07 |
| 5. | Repair and Maintenance | 61.00 | 60.98 | 99.97 |
| 7. | Retirement Benifit | 547.00 | 547.00 | 100.00 |
| 8. | Capital Expenditure | 264.00 | 253.57 | 99.83 |
| | **Total** | 2878.05 | 2739.09 | 95.17 |
| | (-) Research Grant | 70.00 | - | |
| 9. | **(-)** Self Income | 8.50 | - | |
| | | 2799.55 | 2739.09 | 97.84 |

## AFACI projects & Others

| Sl # | Projects name |
|---|---|
| 1. | AFACI Post Harvest |
| 2. | AFACI ATIN Project BARC |
| 3. | AFACI Seed Extension |
| 4. | AFACI Salt Tolenent Rice |
| 5. | AFACI GAP |
| 6. | CCSISA Contribution to HRM in Agriculture |
| 7. | Feed the Future BiotechnologyPpotato Partnership |
| 8. | Collection, Conservation and Characterization of Important Plant Genetic Resources |
| 9. | Development of Upazilla Land Suitability Assessment and Crop Zoning System of Bangladesh (KGF) |
| 10. | Capacity building for conducting adaptive trials seaweed cultivation in coastal area (KGF) |
| 11. | Nutrient Management for Diversified Cropping in Bangladesh (KGF) |

### Accounting

BARC's Finance Unit maintained its accounts following standard accounting system. It has kept a well-printed Cash Book, General Ledger, Trial Balance, Bank Reconciliation, Advance Register, Budget Control Register, iBAS++ software posting (Budget and Expenditure), CPF, Gratuity, Leave Salary, Benevolent fund, Group Insurance and other related books to record all transaction during the year accurately.

### GOB Audit

GoB civil audit department not yet conducted audit for the FY 2018-2019.

### Settlement of Audit Objections

**During the year 2018-19, one audit objection was settled out of 15 audit observations:**

| Sl. No. | Particular | Settled audit objections | Amount (Tk.) |
|---|---|---|---|
| 1. | Revenue | 01 | 56,000.00 |
| 2. | Development | 0 | 0 |
| | **Total :** | **01** | **56,000.00** |

### Reporting

The Uunit has kept all the records of expenditure incurred during the year and reported to the Agriculture Ministry, IMED, CAO, Development Partners and other government offices monthly, quarterly, half yearly, and annually for revenue and development programs..

### Monitoring and Evaluation

Monitoring and Evaluation are the integral part of an effective planning and performance based budgeting plan became successful and the value for money was realized only when the proposed targets for outcomes/outputs were achieved. To attain the targets, BARC Finance section regularly maintained desk monitoring on the utilization of fund for planned activities including budgetary and expenditure control mechanism.

**Reconciliation**

BARC also reconciled the Accounts with CAO to prepare the Final Accounts which was submitted before the Public Accounts Committee (PAC) of the National Assembly.

**Retirement benifits**

During the year 2018-19, retirement benefits and CPF payment made to the Officer's and Staff of BARC are shown below:

**CPF Final payment**

| | | |
|---|---|---|
| **1.** | Officer's & Staff (14 persons) | Tk. 1,12,07,310.00 |
| | **Total.=** | Tk. **1,12,07,310.00** |

**CPF Non Refundable**

| | | |
|---|---|---|
| **1.** | Officer's & Staff (8 persons) | Tk. 42,00,59,000.00 |
| | **Total.=** | Tk. **42,59,000.00** |

**CPF Loan:** CPF loan provided to the Officer's and Staff during the year is as follows:

| | | |
|---|---|---|
| **1.** | Officer's (5 persons) | Tk. 18,36,000.00 |
| **2.** | Staff (27 persons) | Tk. 75,65,700.00 |
| | **Total.=** | Tk. **94,01,700.00** |

**Gratuity payment**

| | | |
|---|---|---|
| **1.** | Officer's & Staff (13 persons) | Tk. 2,28,20,770.00 |
| | **Total.=** | Tk. 2,28,20,770.00 |

**E) Leave Salary payment:-** Leave Encashment allowed to the Officer's and Staff during the year are as follows:-

| | | |
|---|---|---|
| **1.** | Officer's & Staff (10 persons) | Tk. 37,77,661.00 |
| | **Total.=** | Tk. 37,77,661.00 |

**Benevolent Fund**

| | | |
|---|---|---|
| **1.** | Officer's & Staff (22 persons) | Tk. 6,76,500.00 |
| **2.** | Medical Assistance(4 persons) | Tk. 1,01,850.00 |
| | **Total** | Tk. **7,78,350.00** |

**Income tax**

Salary statement provided to the Officer's and Staff for payment of Income tax during the year.

**Group Insurance**

BARC undertook Group Insurance scheme for well being of its Officers and Staffs for any unavoidable incident with Jiban Bima Corporation since 39 years.

There was no case during the year 2018-19..

# Annexure – I

## Personnel

| Sl | Name | Designation | Office | Phone (Office) | Fax | Email |
|---|---|---|---|---|---|---|
| 1 | Dr. Shaikh Mohammad Bokhtiar | Executive Chairman | Chairman's Office | 9135587 | +880-2-9128061 | ec-barc@barc.gov.bd |
| 2 | Dr. Sultan Ahmmed | Member Director | Natural Resources Management Division | 9111432 | +880-2-9128061 | md-nrm@barc.gov.bd |
| 3 | Dr. Md. Aziz Zilani Chowdhury | Member Director (CC) | Crops Division | 9126663 | +880-2-9128061 | md-crops@barc.gov.bd |
| 4 | Dr. Md. Monirul Islam | Member Director (CC) | Fish division | 9112815 | +880-2-9128061 | dir-nutrition@barc.gov.bd |
| 5 | Dr. Mian Sayeed Hassan | Director, SAARC Agriculture Centre (SAC) | | | | |
| 6 | Dr. Nazmun Nahar Karim | Member Director (CC) (Livestock) and Chief Scientific Officer (Agri. Eng.) | Agricultural Engineering Unit | 9131976 | +880-2-9128061 | nazmun.karim@barc.gov.bd |
| 7 | Dr. Md. Saifullah | Member Director (CC) | Administration and Finance Division | 9118226 | +880-2-9118226 | md-af@barc.gov.bd |
| 8 | Dr. Md. Abdus Salam | Member Director (CC) | Planning and Evaluation Division | | +880-2-9128061 | masalamsso@yahoo.com |
| 9 | Dr. Md. Mosharraf Uddin Molla | Member Director (cc) | Agricultural Economics and Rural Sociology Division | 9119906 | +880-2-9128061 | md-aers@barc.gov.bd |
| 10 | Dr. Md. Monowar Karim Khan | Member Director (CC) (Deputation) | BARC | 9122920 | | monowarkk@yahoo.com |
| 11 | Ajit Kumar Chakraborty | Director | Finance Unit | 58153053 | +880-2-9128061 | dir-finance@barc.gov.bd |
| 12 | Dr. Md. Abdus Salam | Chief Scientific Officer | Crops Division | 8110665 | +880-2-9128061 | masalamsso@yahoo.com |

| | | | | | | |
|---|---|---|---|---|---|---|
| 13 | Dr. Md Baktear Hossain | Chief Scientific Officer (A. C), NRM, Soil | NRM, Soil | 9127407, 913241 | +880-2-9128061 | m.baktear@barc.gov.bd |
| 14 | Dr. M. Baktear Hossain | Director | Training & Manpower Unit | 9112764 | +880-2-9128061 | m.baktear@barc.gov.bd |
| 15 | Dr. Fauzia Yasmin | Director | Technology Transfer and Monitoring Unit | 9122475 | +880-2-9128061 | f.yasmin@barc.gov.bd |
| 16 | Dr. Kabir Uddin Ahmed | Director | Agricultural Information Centre | 9127407 | | kuahmed@gmail.com |
| 17 | Dr. Kabir Uddin Ahmed | Chief Scientific Officer (A. C.) | Planning and Evaluation Division | 9122916 | +880-2-9128061 | kuahmed@gmail.com |
| 18 | Dr. Md. Saifullah | Chief Scientific Officer | Forestry Unit | | +880-2-9128061 | m.saif@barc.gov.bd |
| 19 | Dr. Md. Mosharraf Uddin Molla | Chief Scientific Officer | Agricultural Economics and Rural Sociology Division | 9131170 | +880-2-9128061 | mu.molla@barc.gov.bd |
| 20 | Md. Abdul Mottakin | Director(SS) | Support Service Unit | 9132418 | +880-2-9128061 | a.mottakin@barc.gov.bd |
| 21 | Hasan Md. Hamidur Rahman | Director | Computer and GIS Unit | 58152275 | +880-2-9128061 | h.rahman@barc.gov.bd |
| 22 | Dr. Md. Harunur Rashid | Director, PIU-BARC, NATP-2 | PIU-BARC | ৯১৩০৭০২ | ৮১৪৩২৩১ | directornatpbarc@gmail.com |
| 23 | Dr. Mohammad Rafiqul Islam | Principal Scientific Officer | Livestock Division | 9132413 | +880-2-9128061 | mrislam210@hotmail.com |
| 24 | Dr. Shah Md. Monir Hossain | Principal Scientific Officer | Crops Division | 9132416 | +880-2-9128061 | monirsmh@yahoo.com |
| 25 | Md. Mustafizur Rahman | Principal Technical Officer | Office of the Executive Chairman | 9132412 | +880-2-9128061 | m.rahman@barc.gov.bd |
| 26 | Dr. Susmita Das | Principal Documentation Officer | Agricultural Information Centre | 9132415 | +880-2-9128061 | susmitabarc@gmail.com |
| 27 | Md. Jashim Uddin Chowdhury | Deputy-Director (Budget) | Finance Unit | 8117110 | +880-2-9128061 | ju.chowdhury@barc.gov.bd |
| 28 | Md. Daloar Hossain | Deputy Director (Accounts) (Add. Charge) | Finance Unit | 58153053 | +880-2-9128061 | ddelowar@ymail.com |
| 29 | Mohammad Mahbubul Hassan | Deputy Director (Establishment) | Finance Unit | | +880-2-9128061 | m.hassan@barc.gov.bd |

| | | | | | | |
|---|---|---|---|---|---|---|
| 30 | Dr. Suraya Parvin | Senior Scientific Officer | Technology Transfer and Monitoring Unit | 912725 | +880-2-9128061 | parvin.su1980@gmail.com |
| 31 | Dr. Zakiah Rahman Moni | Senior Scientific Officer | TTMU | 9112815 | +880-2-9128061 | zrmoni@yahoo.com |
| 32 | Md. Taibur Rahman | Senior Assistant Director | Procurement Section | 9120795 | +880-2-9128061 | sad-proc@barc.gov.bd |
| 33 | Md. Al Mobasher Hussen | Senior Training Officer | Human Resource and Training Unit | 9132412 | +880-2-9128061 | mobasher1973@gmail.com |
| 34 | Mirza Tosaddeque Hossain | Executive Engineer | Engineering Section | 9132417 | +880-2-9128061 | exn@barc.gov.bd |
| 35 | K.M. Ali Haider | Senior Assistant Director (ac) | Support Service Unit | 8117110 | +880-2-9128061 | haideriu@yahoo.com |
| 36 | Dalil Uddin Basunia | Assistant Director (Common Service) | Support Service Unit | 8117110 | +880-2-9128061 | |
| 37 | Shohag Fakir | Assistant Director (Establishment) | Support Service Unit | 8117110 | +880-2-9128061 | shohag_1988@yahoo.com |
| 38 | Sontosh Kumar Roy | Assistant Director (Store) | Support Service Unit | 9120795 | +880-2-9128061 | sontosh.barc@gmail.com |
| 39 | Hosne Ara Ferdous | Bibliographic Officer (Add. Charge) | Agricultural Information Centre | 9132415 | +880-2-9128061 | hosnearaf768@gmail.com |
| 40 | Abu Hashem Mostofa Kamal | Security Officer | Support Service Unit | | +880-2-9128061 | |
| 41 | Mohammad Tawfiqur Rahaman | Transport Supervisor | Support Service Unit | 8117110 | +880-2-9128061 | tawfiqrml@gmail.com |

## Annexure – II

# THE GOVERNING BODY
# BANGLADESH AGRICULTURAL RESEARCH COUNCIL

| | | |
|---|---|---|
| 1. | Honorable Minister for Agriculture | Chairman |
| 2. | Honorable Minister for Fisheries and Livestock | Co-Chairman |
| 3. | Honorable Minister for Environment, Forests and Climate Change | Co-Chairman |
| 4. | Begum Matia Chowdhury, Parliament Member, Sherpur-2 | Member |
| 5. | Mr. Abdul Mannan, Parliament Member, Bogra-1 | Member |
| 6. | Secretary, Ministry of Agriculture | Member |
| 7. | Secretary, Ministry of Fisheries and Livestock | Member |
| 8. | Secretary, Ministry of Environment, Forests and Climate Change | Member |
| 9. | Member (Agriculture, Water Resourches and Rular Institutions), Planning Commission | Member |
| 10. | Vice Chancellor, Bangladesh Agricultural University | Member |
| 11. | Chairman, Bangladesh Agricultural Development Corporation | Member |
| 12. | Executive Chairman, Bangladesh Agricultural Research Council | Member |
| 13. | Director General, Department of Agricultural Extension | Member |
| 14. | Director General, Bangladesh Agricultural Research Institute | Member |
| 15. | Director General, Bangladesh Rice Research Institute | Member |
| 16. | Director General, Bangladesh Jute Research Institute | Member |
| 17. | Director General, Bangladesh Institute of Nuclear Agriculture | Member |
| 18. | Director General, Bangladesh Sugarcane Research Institute | Member |
| 19. | Director General, Department of Livestock Services | Member |
| 20. | Director General, Department of Fisheries | Member |
| 21. | Md. Habibur Rahman, Additional Secretary (Bindget-1), Finance Division, Ministry of Finance | Member |
| 22. | Joint Secretary (Discipline and Law), Ministry of Public Administration | Member |
| 23. | Chief Conservator of Forests, Forest Department | Member |
| 24. | Professor Dr. Mostafa Ali Reza Hossain, Fisheries Dept. Bangladesh Agricultural University | Member |
| 25. | Professor Dr. Alok Kumar Paul, Soil Scince Dept., Sher-E-Bangla Agricultural University | Member |
| 26. | Professor Dr. Haseena Khan, Dept. of Biochemistry and Molecular Biologey Dhaka University, Dhaka | Member |
| 27. | Mr. Motahar Hossain Mollah, President, Bangladesh Krishok League, Kapasia, Gazipur | Member |
| 28. | Dr. F.H Ansarey, MD, ACI, Dhaka | Member |
| 29. | Dr. Muhammad Musa ED, BRAC International, 65, Mohakhali, Dhaka | Member |
| 30. | Member Director (Administration & Finance), BARC | Member Secretary |

## THE EXECUTIVE COUNCIL

## BANGLADESH AGRICULTURAL RESEARCH COUNCIL

| | | |
|---|---|---|
| 1. | Executive Chairman, Bangladesh Agricultural Research Council, Dhaka | Chairman |
| 2. | Director General, Bangladesh Agricultural Research Institute, Gazipur | Member |
| 3. | Director General, Bangladesh Rice Research Institute, Gazipur | Member |
| 4. | Director General, Bangladesh Jute Research Institute, Dhaka | Member |
| 5. | Director General, Bangladesh Institute of Nuclear Agriculture, Mymensingh | Member |
| 6. | Director General, Bangladesh Sugarcrop Research Institute, Ishurdi, Pabna | Member |
| 7. | Director General, Bangladesh Livestock Research Institute, Savar, Dhaka | Member |
| 8. | Director General, Bangladesh Fisheries Research Institute, Mymensingh | Member |
| 9. | Director, Bangladesh Tea Research Institute, Srimongal, Moulvibazar | Member |
| 10. | Director, Bangladesh Forest Research Institute, Chittagong | Member |
| 11. | Director, Soil Resource Development Institute, Dhaka | Member |
| 12. | Director, Bangladesh Sericulture Research and Training Institute, Rajshahi | Member |
| 13. | Executive Director, Cotton Development Board, Dhaka | Member |
| 14. | Executive Director, Krishi Gobeshona Foundation, Dhaka | Member |
| 15. | Member Director (Crops), BARC | Member |
| 16. | Member Director (Planning and Evaluation), BARC | Member |
| 17. | Member Director (Natural Resources Management), BARC | Member |
| 18. | Member Director (Agricultural Economics and Rural Sociology), BARC | Member |
| 19. | Member Director (Livestock), BARC | Member |
| 20. | Member Director (Fisheries), BARC | Member |
| 21. | Member Director (Administration and Finance), BARC | Member Secretary |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