NATP-2
BARC Component
Enhancing Agricultural Technology Generation

Annual Report
2018-19

National Agricultural Technology Program-Phase II Project
Project Implementation Unit
Bangladesh Agricultural Research Council
Farmgate, Dhaka-1215

Annual Report

(July 2018- June 2019)

Component-1
Enhancing Agricultural Technology Generation

Project Implementation Unit
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Bangladesh Agricultural Research Council
Administrative Building (2nd Floor)
Farmgate, Dhaka-1215

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Preface

The World Bank, International Fund for Agricultural Development, The United States Agency for International Development and the Government of Bangladesh funded National Agricultural Technology Program Phase II Project (NATP-2). It is a comprehensive project with focus on revitalizing the agricultural technology system and increasing agricultural productivity in Bangladesh. It is a development program for the period of 15 years in three phases. The overall objective of the longer term program is to improve national agricultural productivity, market and farm income, with a particular focus on small, marginal and female farmers. The development objective of the Phase II of the NATP is to strengthen the capacity of research of the national agricultural technology system in Bangladesh. The second phase officially began in October 2015 and is scheduled to end in September 2021.

Out of the five components of NATP, the Project Implementation Unit (PIU) of BARC is the prime national agricultural research component and is the implementing arm of all NATP activities on behalf of the Bangladesh Agricultural Research Council. In attaining the project objectives concerning BARC/NARS, the PIU-BARC in close collaboration with the NARIs and related other organization is undertaking activities to transform agricultural research more participatory and demand-driven and develop technologies to promote sustainable intensification, diversification mechanization of agriculture through efficient natural resources management.

The Annual Report for the year 2018-19 consists of implementation progress ol CRGs and PBRGs, monitoring and evaluation, environmental and social safeguard management, human resource development, procurement and financial management. Different chapters of this report describe the progress of technology generation, development and validation and other related issues. This piece of the report would be useful for all the stakeholders and others.

I appreciate the contribution and sincere efforts of all the researchers of NARS and universities. I acknowledge the hard work of the PIU-BARC personnel and the technical divisions of BARC to visualize the hard work through this report.

Executive Chairman
BARC

Foreword

National Agricultural Technology Program-Phase II Project (NATP-2), a national project of the People's Republic of Bangladesh jointly funded by GoB and IDA/IFAD/USAID has been started its interventions through the coordinated efforts of Ministry of Agriculture (Lead Ministry) and Ministry of Fisheries and Livestock to improve national agricultural productivity, market linkage and farm income, with a particular focus on small, marginal and female farmers. The agricultural research component - Enhancing Agricultural Technology Generation of NATP-2 is being implemented by the Project Implementation Unit (PIU) of BARC since 2016 in order to generate demand-driven technologies on crops, fisheries and livestock through executing basic, strategic, applied and adaptive research including research on cross cutting issues with NARS and non-NARS institutes for increasing the productivity and production of agricultural commodities.

A total number of 190 Competitive Research Grant (CRG) and 40 Program Based Research Grant (PBRG) sub-projects are being implemented by the 27 different NARS and non- NARS institutes. Although, implementation activities of the CRG sub-projects are on-going but till date, some of the sub- project shows encouraging results. It may be expected that with the proper implementation of CRG and PBRG sub-projects, demand-driven agricultural technologies will be generated which will help to achieve the food and nutritional security of Bangladesh.

Human resources are the vital force of national development. Thus agricultural manpower development is essential and more emphasis should be given to the NARS scientists. It is essential to develop scientists in such a way that they can face the future research challenges in all sub-sectors of agriculture. PIU-BARC, NATP-2 has already selected and awarded 120 PhD programs (60 foreign & 60 local) to the scientists of NARS and Ministry of Agriculture against the targeted 140. Out of 20 local PhD programs allocated for DAE, DLS and DoF, 10 PhD programs for DAE and 05 PhD programs for DLS have already been awarded. Selection of candidates for the PhD programs of DoF is under process. This annual report includes the activities performed by PIU-BARC, NATP-2 during FY 2018-19. I hope this publication will be useful to the scientists, extension workers, teachers, students and other stakeholders.

I gratefully acknowledge the direct and indirect contribution and support of all concerned extended in carrying out the activities of PIU-BARC component successfully during the FY 2018-19 as well as publishing this annual report.

Director
PIU-BARC, NATP-2

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Abbreviations and Acronyms

AERS	:	Agricultural Economics and Rural Sociology
AI	:	Artificial Insemination
AIF-1	:	Agricultural Innovation Fund
ARS	:	Agricultural Research Station
BARC	:	Bangladesh Agricultural Research Council
BARD	:	Bangladesh Academy for Rural Development
BARI	:	Bangladesh Agricultural Research Institute
BAU	:	Bangladesh Agricultural University
BFRF	:	Bangladesh Fisheries Research Forum
BFRI	:	Bangladesh Fisheries Research Institute
BFRI	:	Bangladesh Forest Research Institute
BIM	:	Bangladesh Institute of Management
BINA	:	Bangladesh Institute of Nuclear Agriculture
BJRI	:	Bangladesh Jute Research Institute
BLRI	:	Bangladesh Livestock Research Institute
BRRI	:	Bangladesh Rice Research Institute
BSRI	:	Bangladesh Sugar crops Research Institute
BSRTI	:	Bangladesh Sericulture Research and Training Institute
BTRI	:	Bangladesh Tea Research Institute
BSMRAU	:	Banghabondhu Sheikh Mujibur Rahman Agricultural University
CA	:	Conservation Agriculture
CDB	:	Cotton Development Board
CN	:	Concept Note
Co-PI	:	Co-Principal Investigator
CRG	:	Competitive Research Grant
CSO	:	Chief Scientific Officer
CT	:	Conventional Tillage
CU	:	Chittagong University
CVASU	:	Chittagong Veterinary and Animal Science University
DAE	:	Department of Agricultural Extension
DLS	:	Department of Livestock Services
DoF	:	Department of Fisheries
DPP	:	Development Project Proposal
DU	:	Dhaka University
EC	:	Executive Council
EMF	:	Environmental Management Framework
ERD	:	Economic Relation Division
FRP	:	Full Research Proposal
FY	:	Financial Year
GDP	:	Gross Domestic Product
GIF	:	Gender and Inclusion Framework
GoB	:	Government of Bangladesh
GTI	:	Graduate Training Institute
HOPE	:	Head of Procuring Entity
HRC	:	Horticulture Research Centre
HRD	:	Human Resource Development
HSTU	:	Hajee Mohammad Danesh Science and Technology University
IDA	:	International Development Association

IFAD	:	International Fund for Agricultural Development
IPM	:	Integrated Pest Management
KU	:	Khulna University
ISM	:	Implementation Support Mission
LoA	:	Letter of Agreement
M&E	:	Monitoring and Evaluation
MD	:	Member Director
MoA	:	Ministry of Agriculture
NARS	:	National Agricultural Research System
NATP	:	National Agricultural Technology Project
NARI	:	National Agricultural Research Institute
NATA	:	National Agricultural Training Academy
NRM	:	Natural Resource Management
NGO	:	Non-Governmental Organization
NIB	:	National Institute of Bio-technology
NSTU	:	Noakhali Science and Technology University
OFRD	:	On Farm Research Division
P&E	:	Planning and Evaluation
PAD	:	Project Appraisal Document
PBRG	:	Program Based Research Grant
PCR	:	Project Completion Report
PDO	:	Project Development Objective
PhD	:	Doctor of Philosophy
PHTD	:	Post Harvest Technology Division
PI	:	Principal Investigator
PIM	:	Project Implementation Manual
PIU	:	Project Implementation Unit
PMP	:	Project Management Plan
PMU	:	Project Management Unit
PSO	:	Principal Scientific Officer
PSTU	:	Patuakhali Science and Technology University
R & D	:	Research and Development
RADP	:	Revised Annual Development Program
RARS	:	Regional Agricultural Research Station
RPA	:	Reimbursable Project Aid
RU	:	Rajshahi University
SAU (Dhak)	:	Sher-e-Bangla Agricultural University
SAU (Syl.)	:	Sylhet Agricultural University
SDA	:	Sustainable Development Associates
SMF	:	Social Management Framework
SoE	:	Statement of Expenditure
SRDI	:	Soil Resources Development Institute
SUST	:	Shahjalal University of Science and Technology
SSURDA	:	Society for Sustainable Development for Rural Urban Area
USAID	:	United States Agency for International Development
VAT	:	Value Added Tax
WB	:	World Bank

Executive Summary

The National Agricultural Technology Program Phase-II Project (NATP-2) has five inter related components of which Component 1: Enhancing Agricultural Technology Generation is being implemented by PIU-BARC with NARS and non-NARS institutes (Public universities, NGOs and other organizations). The research component supports technology generation on crops, fisheries and livestock by executing Competitive Research Grant (CRG) and Program Based Research Grant (PBRG) sub-projects. PIU-BARC is also shouldering programs for improvement of research and training facilities in outreach stations (RARS/ARS) including human resource development (80 local PhDs, 60 foreign PhDs, short-term training, study visit, etc.) of NARIs. This report highlighted the detailed progress of activities made by the Component-1 (PIU-BARC) from July 2018 to June 2019.

The planned activities of PIU-BARC designed in the DPP are to implement a) 100 CRG, b) 33 PBRG, c) 80 local & 60 foreign PhDs, d) short-term training, workshop/seminar, study visit, etc. and e) improvement of research and training facilities in NARIs, particularly in outreach stations (RARS/ARS).

PIU-BARC completed the 190 CRG sub-projects against the target of 100. The shorter duration of each of the sub-projects than the original plan made scope for increased numbers of awards. Most of the PIs of CRGs submitted their PCR and accordingly the PIU-BARC completed review of each of the PCRs by external reviewers. Based on the reviewers' comments, the hired short-term consultants revised the PCRs and prepare 69 technology factsheets for the purpose of technology transfer to the end users. Most of the CRG sub-projects have developed leaflets/booklets on their scalable technologies and about 35 submitted them to PIU-BARC.

The PIU-BARC along with PMU-consultant identified 69 scalable technologies for validation in the farmers' fields. The developed technologies are categorized under crops, livestock and fisheries sub-sectors considering their contribution towards agricultural development. The identified technologies selected based on their potentiality on enhancement of agricultural production through increasing yield or by reducing the cost/unit area, which will induce production that would increase farm income and thereby improve the livelihoods of farmers. The identified technologies would directly or indirectly satisfy the Project Development Objective (PDO)-2 of NATP – 2. As for example under CRG sub-projects. BRRI has developed 3 super high yielding rice lines one for T. Aman season (BR9292-6-2-1B yielded 7 t/ha) and two for Boro season (BRH11-9-11-4-5B, BR10238-5-1 with higher yield ranged 6.9 to 8.1 t/ha). BSMRAU identified salt tolerant wheat genotype BU 2008-4 while BARI developed 02 sunflower (GP-4030 & BARI Surzumukhi-2) and 03 mustard (Jun-0536, BARI Sarisha-11 & BARI Sarisha-16) genotypes selected against varying levels of salinity (8-12 dSm^{-1}). BARI has also developed mechanical coconut tree climber and de-husker of coconut under CRG sub-projects. BRRI developed Head feed mini combine harvester to reduce the emerging cost of labor for manual harvesting. Under CRG sub-projects new crops like tomatillo (virus and saline tolerant vegetable), lilium recommended for cultivation in the country. Besides, ginger production in coco dust using fertigation technique, bagging technology in mango, IPM approach for tea production, water saving irrigation techniques, multiple ovulation and embryo transfer (MOET) in indigenous sheep, poultry vaccine development against egg drop syndrome virus, mixed culture technology with galda and two native cat fishes etc. have also been developed. Each of the identified technologies have their specific advantages over the

existing production systems in respect of yield/production or stress tolerance or new crop or mechanical systems over manual practice. Indeed technologies developed by CRG sub-projects would be useful in ensuring food and nutritional security of the country.

Seed production and multiplication of the developed technologies is to be done under on-going (BADC or private seed company) production systems. The leaflets/booklets of the identified technologies are to be finalized and distributed to the DAE, DLS, DoF and other private extension agencies for wider adoption of technologies. Technologies like coconut tree climber/de-husker, paddy harvester etc. to be promoted through engaging private entrepreneurs and BARI/BRRI has already communicated with some of the service providers for manufacturing and marketing of farm machineries. PIU-BARC would organize Research-Extension linkage workshops inviting officials of DAE, DLS, DoF and other private companies engaged in extension services like ACI, Lal Teer etc. to discuss the technologies and to distribute the leaflets/booklets.

Out of 33 planned PBRGs, by June 2019 the PIU-BARC awarded 40 PBRG sub-projects mostly to the NARS and universities with progress of 121%. The number of awards exceeded the planned numbers due to less cost required per sub-project than the allocation. The PBRG sub-projects have started operation in Jan 2018 and are being implemented by recipient organizations. The monitoring team (10 numbers) formed by BARC is making extensive field visits at the implementing sites of all of the sub-projects. By this time almost 80% field visits have already been completed by the M & E Team. All these sub-projects are at the stage of their 1st year implementation period, all moving well and expected to generate valuable knowledge. Still there is balance of almost BDT 24 crores for PBRG implementation and PIU-BARC planned to collect new proposals through technical division of BARC for numbers of fresh awards further. Allocated budget would be burnt through awarding 10-11 proposals could be processed by November 2019.

For PhD programs, the DPP target was 80 local and 60 foreign, of which 75 local and 60 foreign PhDs have already been awarded to the concerned scientists/officials with 94% and 100% progress respectively. Rest 05 local PhDs are under processing for DoF officials. Of 75 awarded local PhDs all got admission and 59 of foreign PhD awardee have admitted in different foreign universities. Due to delay in hiring of international consulting firm, PIU-BARC suffered in awarding, admission, and money transection for the foreign PhDs. Progress in organizing foreign training, workshop/seminar and study visit is low (>20%) due to unavailability of International consulting firm. However, the hiring of firm is almost done and expected to be completed by December 2019. PhD programs would certainly developed capacity of the NARS scientists to face the future research challenges in all sub-sectors of agriculture to achieve the national goal through generating and transferring the technologies at the farmers' levels.

Out of the total target 3520 person the project till Jun 2019 provided local training to 2690 with a progress of 76%. Similarly against the target of 7000 participants in local workshop by June 2019, 5558 (79%) persons participated in different workshops organized by PIU-BARC.

A total of 41 skill development local training programs were organized in 2018-19 on different areas like i) integrated pest management for major crops, ii) research methodologies, iii) agronomic research and technology development, iv) phyto-sanitary measures, v) climate change carbon sequestration and adaptation strategies, vi) quality processing and preservation of agro-products, vii) quality production of dried fish by herbal methods, viii) reproductive health management in ruminants

etc. have been conducted. 1911 participants attended in those events. In FY 2018-19, 18 local workshops/seminars were conducted and 3146 participants attended in those programs. Three foreign training programs on i) financial and office management, ii) public procurement management and iii) modern breeding & cultivation technology for vegetables were organized in Malaysia, Italy and China respectively having 15 participants from NARS and MoA. Moreover 12 scientists of NARS institutes have attended in 9 workshops in different foreign countries. The local and foreign training programs improved the skill and attitude of NARS scientists in respect of designing research programs, financial/procurement management, leadership & administrative development and use of ICT in agriculture. The execution of training/workshop also improved the capacity of NARS institutes.

The environmental and social safeguard management including gender and grievance redress mechanism (GRM) issues have been addressed adequately through selection of CRG and PBRG sub-projects, workshop, training, seminar, field days etc.

The ICT facilities had been developed at BARC and seven NARS institutes i.e. BARI, BRRI, BJRI, BLRI, BFRI, BSRI, SRDI under NATP-1 project. Similar facilities are planned to be developed for remaining 5 NARS (CDB, BFRI, BTRI, BINA & BSRTI) and few more substations (RARS/ARS) of NARS under NATP-2 project. The hardware/software has already been identified and awaiting for floating tender. Till now 9 consultant/specialist has been procured of which procurement specialist has left the job. In addition, 3 short term national consultants on ICT hardware, ICT software and fisheries have been procured. 16 core contractual staff has also been procured for smooth operation of component-1 activities.

In this financial year, Out of 17 total packages, 15 (88%) have been procured of which goods 10, works 1 and service 4. The cumulative achievement of procurement, 57% progress has been made against the target of the component-1 of which goods package made 51% progress, works package 50% and services package 70%.

The total budget of PIU-BARC is BDT 40273.20 lakh including GoB of which till June 2019 the component-1 (PIU-BARC) spent BDT 11858.09 lakhs with the cumulative financial progress of 29%. During the year 2018-19 the revised budget of PIU-BARC was BDT 7643.00 of which the component-1 incurred BDT 7509.52 with progress of 98%.

Chapter 1

Component – 1 (Research) in Brief

1. Introduction

The PIU-BARC is one of the components of NATP-2 project deals with enhancing agricultural technology generation through implementing CRG (Competitive Research Grant) and PBRG (Program Based Research Grant) sub-projects. The component has the provision for human resource development of NARS institutions through awarding local & foreign PhD programs and local & foreign training programs, workshops, seminars, study visits etc. Capacity development of research systems of all NARS institutions by providing modern lab equipment and establishing ICT facilities is another planned activity of the component. The Bangladesh Agricultural research council (BARC) as an apex body of the NARS is implementing the research component (Component-1) of NATP program phase II project. The component has started functioning in Sep 2016 and completed field implementation of large numbers of CRG research sub-projects. The Director, who is deputed from BARC acted as an administrative head of the component. Numbers of PBRG research sub-projects have also been awarded to the scientists of NARS institutions, universities and other relevant organizations, those are currently in operations at the field.

This report described the detailed activities of 2018-19 of the research component, NATP program-phase II project,and highlighted the cumulative progresses of major intervention of the component.

1.1 Specific Objectives

- One hundred (100) Competitive Research Grant(CRG) proposals to be undertaken;
- Thirty three (33) Program Based Research Grant(PBRG) proposals to be undertaken;
- Forty (40) improved technologies to be demonstrated in the farmers' fields of project areas;
- Targeted HRD Programs (80 local PhDs, 60 foreign PhDs, short-term training, study visit, etc.) to be implemented and
- Research and training facilities in NARIs, particularly in outreach stations (RARS/ARS) will be improved.

1.2 Project Components

PIU-BARC is one of the five inter-related components of National Agricultural Technology Program-Phase II Project (NATP-2). The components are specifically responsible for addressing a wide range of constraints to technology generation, to technology transfer and adoption at farm level, and to farmers' access to markets. The components are:

Component – 1: Enhancing Agricultural Technology Generation is being implemented by the Project Implementation Unit (PIU) of Bangladesh Agricultural Research Council (BARC);

Component – 2: Supporting Crop Development is being implemented by the PIU of Department of Agricultural Extension (DAE);

Component – 3: Supporting Fisheries Development is being implemented by the PIU of Department of Fisheries (DoF);

Component – 4: Supporting Livestock Services is being implemented by the PIU of Department of Livestock Services (DLS) and

Component – 5: Project Management is being implemented by the Project Management Unit (PMU), NATP-2, MoA.

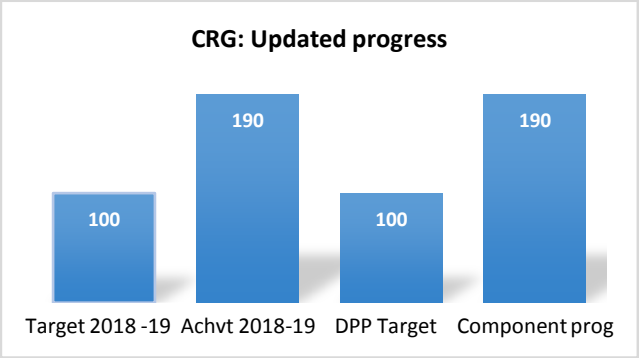
1.3 Activities of PIU-BARC

The major activities of the PIU-BARC (Component – 1) of the NATP phase II project includes:

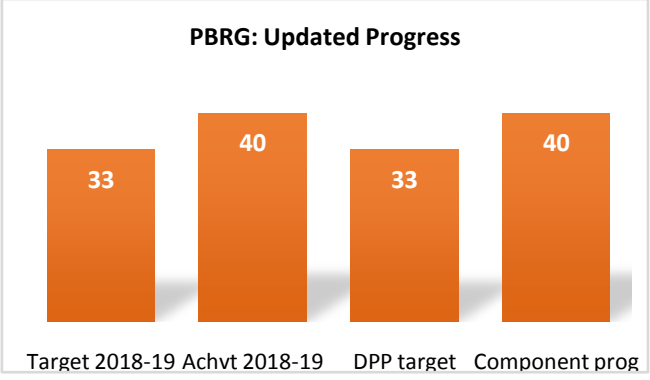
A) Awarding 100 (one hundred) CRG sub-projects;
B) Awarding 33 (thirty three) PBRG sub-projects;
C) Arrangement for effective supervision, monitoring and evaluation of the on-going CRG and PBRG sub-projects by the respective recipient research organizations and BARC as well as PIU-BARC;
D) Improving research and training facilities in outreach stations (RARS/ARS) of NARIs;
E) Implementing HRD Programs – 80 local PhDs, 60 foreign PhDs, Short-term training, Study visit, etc.;
F) Organizing need based workshop, seminar, consultation meeting, etc;
G) Strengthening ICT facilities at the NARS institutes to establish information network connectivity between Head Quarter and Regional Stations of NARIs.

1.4 Updated Progress

A) CRG Sub-Project: Out of the DPP target of 100 CRGs are to be implemented, the PIU-BARC funded 190 CRGs. All physical and financial activities of CRG sub-projects completed in Sep 2018. The bar chart (right) shows the progress.

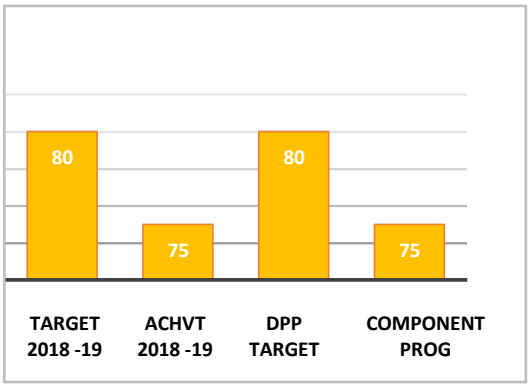


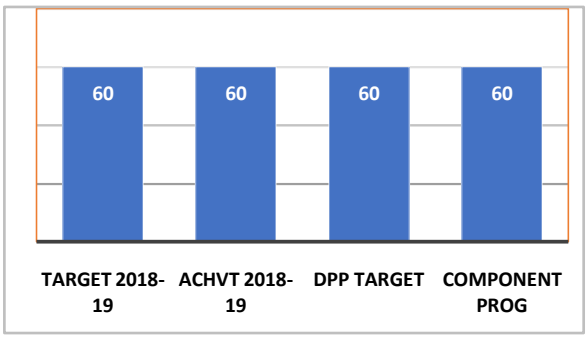
B) PBRG Sub-Project: Out of DPP target of 33, the PIU-BARC funded 40 PBRGs. The sub-projects have completed more than one year tenure. Most of the PIs of PBRGs submitted annual reports. The sub-projects are in good shape of implementation. The bar chart (right) shows the progress. The cost of sub-projects was lower than allocation, which



increased the number than target.

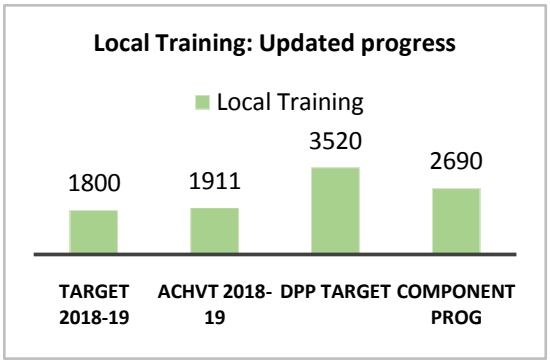
C) Local PhD: Out of DPP target 80, by June 2019 all 80 scholarships offered to the selected scientists but until now 75 scholars admitted in different local universities. The rest 05 from DoF are under process of admission and expected to be completed by Sep 2019.

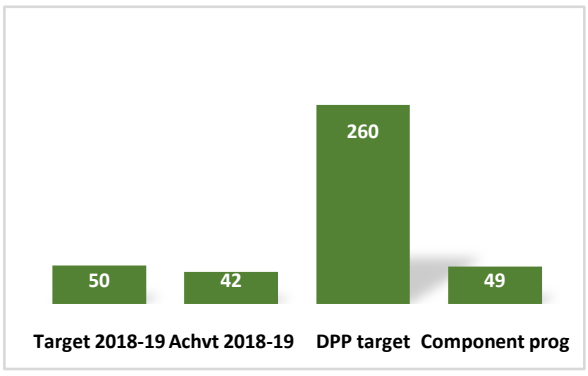




D) Foreign PhD: Out of DPP target 60, by June 2019 all 60 scholarships offered to the selected scientists and all of them admitted in different foreign universities including Malaysia, India, Philippines, Thailand, Germany, USA, UK etc. The foreign PhD programs are running well.

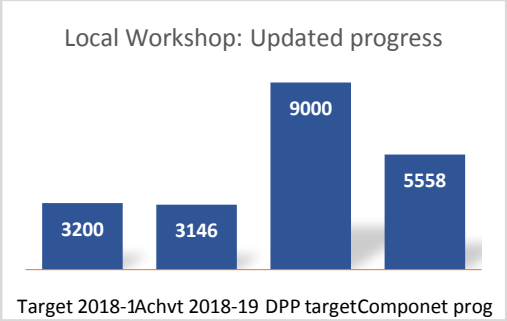
E) Local Training: Out of DPP target 3520 scientists to be given training on different technical issues, by June 2019 PIU-BARC provided training to 2690 scientists with cumulative progress of 76%. Annual (2018-19) target has exceeded and progress reached to 106%.

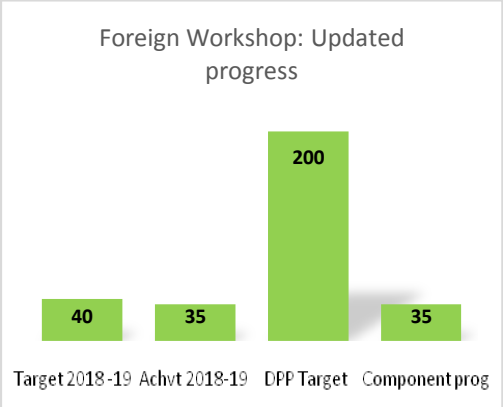




F) Foreign Training: Out of DPP target 260 scientists to be given training abroad on different technical issues, by June 2019 PIU-BARC provided training to 49 scientists with cumulative progress of 19%. Annual (2018-19) target almost achieved with progress of 84%.

G) Local workshop: Out of DPP target 9000 scientists to be attended local workshop on different technical issues, by June 2019 PIU-BARC organized workshop where 5558 participant attended with cumulative progress of 62%. Annual (2018-19) target almost achieved with progress of 98%.





H) Foreign workshop/seminar/visit: Out of DPP target 200 scientists to be attended in foreign workshop on different technical issues, by June 2019 PIU-BARC has sent 35 participants to attend workshop abroad with cumulative progress of 18%. Annual (2018-19) target almost achieved with progress of 88%.

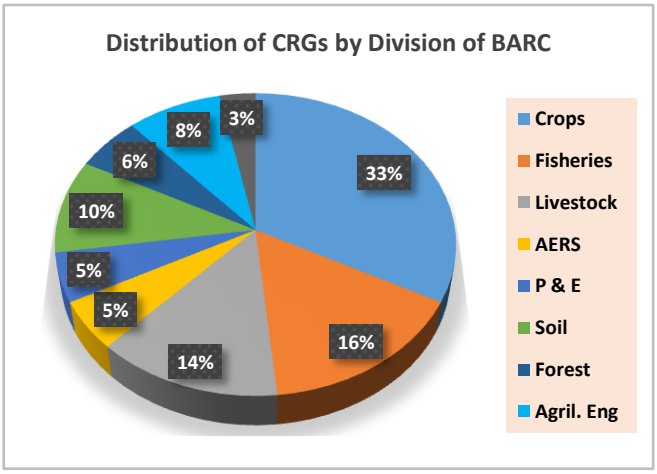
Chapter 2

Progress of CRG Sub-Project

The PIU-BARC awarded 190 CRG sub-projects against the target of 100 allotted in DPP during Mar to Jun 2017. All physical and financial activities of those sub-projects completed in Sep 2018. During the current fiscal year (2018-19), the PIU-BARC identified 68 scalable technologies from the implemented CRG sub-projects. All PIs of CRG sub-projects submitted annual reports and most of them submitted project completion reports (PCR) to the PIU by June 2019. Many of the PIs of CRG sub-projects published and distributed leaflets/booklets on the technologies generated by the sub-projects. After proper review of the PCRs by external reviewers, the PIU-BARC started to finalize the PCRs of all CRGs and initiated to draft technology factsheets. The technology factsheets are expected to be completed by Dec 2019 and planned to be handed over the technologies to the public (DAE, DLS, DoF) and private (seed companies etc.) extension agencies by organizing national workshop in Jun 2020.

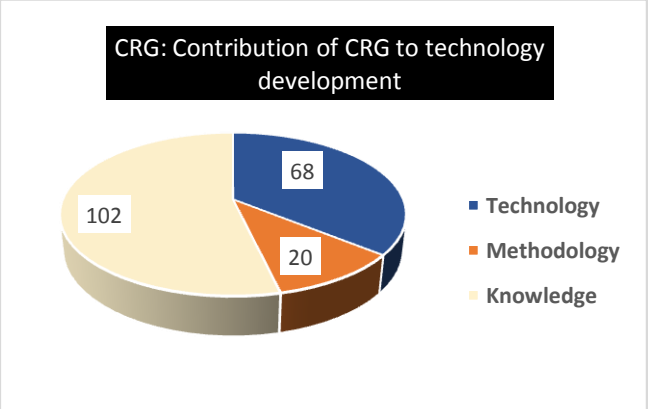
2.1 Distribution of CRG Sub-Project by Division of BARC

The distribution of CRG sub-projects by disciplines or thematic areas of researches are shown in the pie chart (right). Large numbers of sub-projects (33%) executed under crops sub-sectors followed by fisheries 16%, and livestock 14%. The rest 37% executed by other 6 disciplines like Soil Science (10%), Agricultural Engineering/Mechanization (8%), Forest (6%), AERS (5%), Planning & Evaluation (5%) and Nutrition (3%).



2.2 Contribution of CRGs to Technology and Knowledge Development

The PIU-BARC identified numbers of CRG sub-projects that could produce possible technologies expected to be contributed towards the improvement of agricultural productivity and production of the country. Based on the reviewing of annual report, project completion report and monitoring of field trials, the PIU-BARC team assessed 190 CRG sub-projects and identified 68 potential technologies those would assumed to be contributed in agricultural development of the country. As observed, out of 68 selected possible technologies, 52 contributed by crops sub-sector, 08 each by livestock and fisheries sub-sector.



Analyzing the thematic areas of the CRGs and technology selection, it has been observed that large numbers of sub-projects (102) contributed to valuable knowledge generation for further investigation while 20 sub-projects contributed for developing methodologies for future research projects. Due to shortage of time (15-18 months), numbers of CRG sub-projects have validated the findings of earlier researches at different locations, and indeed those grouped under knowledge generation sub-projects.

2.3 Technologies Developed under Crops Sub-Sector

a: Production and Management

1. Ginger production in soilless culture using fertigation technique (ID 323)

Technology features:

- Ginger can profitably be cultivated in Coco dust substrate with BARI Ada-1using fertigtion techniques
- The highest rhizome yield (45.2 t/ha) and benefit cost ratio (2.40) is obtained from plants of BARI Ada-1 grown in Coco dust media
- This production system would be useful for production of quality rhizomes (seed) of ginger

2. Maize based cropping patterns for sustaining soil fertility and enhancing income (ID 382)

Technology features:

- In the existing Maize-Fallow-T.aus cropping pattern Mungbean/Blackgram can be grown successfully
- Maize-Mungbean-T.aman/T.aus cropping pattern produced 14-20% higher maize equivalent yield compared to existing Maize-Fallow-T.aus pattern
- Farmers income increased 10-15% by adopting the improved Maize-Mungbean-T.aman/T.aus cropping pattern

3. Tobacco replacement in char land through high value crops (ID 440)

Technology features:

- BARI Gom-28, 30, & 33, BARI Hybrid Maize-9, BARI Chinabadam-8, BARI Kalozira-1 are recommended for charland for higher yield as replacement of tobacco cultivation
- Charland farmers would be benefitted economically due to higher yield and market price of those crops

4. Bagging technology for safe and quality mango production(ID 444)

Technology features:

- Brown paper double layered bag and white paper single layered bag are promising to improve physio-chemical properties and shelf life of mango fruits
- Bagging provided physical barrier between fruit and pests, it is to be put at 35-40 days of fruit setting
- Bagging technology is useful for producing safe and quality mango

5. Non-chlorine sanitizers for safe and quality betel leaf production (ID 452)

Technology features:

- Safe and quality betel leaf production practices at field level have been developed
- Non-chlorine sanitizers and washing practices to eliminate pathogens from betel leaf surfaces at commercial level have been developed
- Low cost hygiene improvement materials to improve personal hygiene practices of farmers at the field level have been introduced
- This technology would be useful to produce exportable betel leaf

6. Production and bulb preservation technology of Lilium (ID 479)

Technology features:

- Among the collected 19 colored lilium germplasm 14 are suitable for cut flower (vase life 10-12 days) and 5 suitable for pot culture
- Genotype Lil-001 can be cultivated under various shade (UV poly film and shade net) and open condition

- It has longest stalk and rachis (80 cm and 26 cm respectively)with maximum florets/stick (10)
- It would be a new addition in the flower industry in Bangladesh

7. Improved cropping patterns for productivity enhancement in Sylhet Region (ID 490)

Technology features:

- Mustard, Mungbean and Wheat grown successfully in existing Fallow-T. Aus-T.Aman cropping pattern in Sylhet region under residual soil moisture
- BARI Gom-28 & 31, BARI Sarisha-14, BARI Hybrid Maize-9, and BARI Mungbean-6produced higher yield under residual soil moisture
- BARI Mashur-8 performed better in relay cropping with T. Aman rice under residual soil moisture
- Liming @1.5 t/ha increase soil PH and grain yield of wheat
- Total productivity of Improved cropping patterns increased by 60-70% due to inclusion of mustard, wheat and mungbean over the existing cropping pattern

8. Safe vegetable production in urban area through vertical farming (ID 521)

Technology features:

- Vertical space in multilayer vertical frame on rooftop can be used for the production of year round safe, nutritious and short duration vegetables in urban areas
- Growth and nutrient contents of Lettuce, Pak choi, Red amaranth, French bean, Spinach, Indian spinach, Mint, Thankuni, Water spinach can be significantly improved by using vermi-compost as an organic substances
- Coconut coir can also be used for the growth and nutrients improvement in French bean

9. Crop yield enhancement in saline soil using polythene mulch and potassium fertilization (ID 570)

Technology features:

- Polythene mulch is very much useful in reducing salinity in coastal soils and beneficial for the farmers
- Use of polythene mulch showed several fold higher yield of bitter gourd, snake gourd, sweet gourd, water melon than their existing yields
- Potassium application @ 100% recommendation was found suitable to obtain better yield of vine crops in Rabi season at south coastal saline soils of Bangladesh
- Growing T. Aman rice in coastal region with 100% K

supported optimum yield over the locations (Amtoli, Taltoli and Kalapara Upazila)

- The technology is recommended for widescale adoption in the coastal areas

10. Cotton production in the drought prone Barind Tract (ID 583)

Technology features:

- The highest seed cotton yield (3.23 t/ha) obtained from 10 Jul sowing followed by 25 Jul (3.14 t/ha) and the lowest seed cotton yield (2.81 t/ha) produced in 10 August sowing
- Straw mulch produced higher seed cotton yield (3.13 t/ha) than without straw mulch (2.99 t/ha)
- No positive effect of straw mulch observed on lint quality
- Different locations of Barind Tract had effect on seed cotton yield and lint characters

11. Crop productivity enhancement in beel areas (ID 688)

Technology features:

- BARI Sarisha-14 & 15 are found suitable before boro rice in Chalan Beel area producing higher yield (1.60-1.67 t/ha)
- BARI Gom-30 is found superior in upper land of Chalan Beel (yielded 5.02 t/ha)
- BARI Piaj-4 and local cultivar of onion produced higher yield (19.61-20.02 t/ha) in Monglar Beel area
- Cultivation of boro rice is recommended after harvest of mustard, onion or garlic

12. Bio-Organic Fertilizer: A green technology to improve soil health and rice yield (ID 707)

Technology features:

- Application of bio-fertilizer (BRRI-Bio-Organic Fertilizer) @ 2 t ha-1 in T. Aman and Boro rice met the requirement of 25-30% urea and eliminate 100% TSP for rice production
- The bio-fertilizer is suitable for wide range of soil including saline soil (6-8 ds/m) and its application improved soil health
- Marketing, dissemination and use of bio-fertilizer will improve soil health and rice yield all over the country

13. Healthy seedling raising of boro rice against blight disease (ID 708)

Technology features:

- Seedling blight can be controlled by spraying of fungicide, seed treatment with fungicide and standing water
- Seedling growth is influenced by Polythene cover but not effective for disease control
- Spraying of urea (1-2%) at 15 days after sowing is favorable for growing healthy seedling
- Use of these techniques would help to produce quality seedlings and enhance production

14. Productivity enhancement of Kenaf in char lands (ID 755)

Technology features:

- Potato-Kenaf-T.Aman cropping pattern found suitable over existing Potato-Jute-T. Aman in Char areas
- Gross return and gross margin is observed higher with kenaf pattern over existing one, so kenaf is profitable in charland areas
- The average highest seed yield (1036.17 $kgha^{-1}$) of Kenaf was recorded in BJRI Kenaf-3 from mechanical method of threshing

15. Fertilizer doses for rooftop gardening (ID 499)

Technology features:

- Soil and organic fertilizer (vermicompost) combination by 1:1 ratio is recommended for vegetables (Capsicum & Bottle gourd), fruits (Strawberry) and flowers (Periwinkle, Gladiolus &Gerbera) cultivation in rooftop garden
- Red Amaranth, Amaranth, Chinashak, Tomato, Spinach, Batishak, Periwinkle, Tuberose, Marigold, Papaya, Lemon, Gerbera, Rose, Gladiolus, Capsicum, Brinjal, Chilli, Bottle gourd, Strawberry & Kangkong have been produced suucessfully in roof gardening

16. Improved cropping patterns for productivity enhancement in enclaves (sit mahal) of Northern Bangladesh (ID 672)

Technology features:

- IPNS based fertilizer packages have been developed for 3 improved cropping patterns at 3

previous enclaves (Dasiar Chhara, Dahala Khagrabari & Banskata)

- Across the locations, crop productivity has been increased about 70-109% by adopting improved/alternative cropping patterns including modern varieties and proper fertilization
- Number of crops increased from 2 crops to 3 crops by introducing mustard and potato in existing rice-rice patterns
- Among the tested varieties, BARI Sarisha-14 and BARI Alu-53 (red skin) was found more suitable and profitable across the locations

17. Improved cropping pattern for productivity enhancement in coastal areas (ID 442)

Technology features:

- In saline eco-system, sunflower performed better in respect of yield, net benefit and BCR
- In saline ecosystem, the highest net benefit (Tk.191835/ha), Rice Equivalent Yield (17.87 t/ha) and BCR (1.82) obtained from T. Aus rice (BRRI dhan55)-T. Aman rice (BRRI dhan73)–Sunflower (Pacific Hysun33) cropping pattern
- The farmers practice produced lowest net benefit, REY and BCR

18. Enhancing crop productivity by gypsum in saline area (ID 656)

Technology features:

- Application of gypsum fertilizer improved the yield of T. A*man* rice by 10%
- Maize and Sunflower had higher response to gypsum fertilizer
- Gypsum fertilizer improved maize and sunflower yields more than 30% by using mulch
- Furrow transplanting in *Boro* rice along with gypsum fertilizer application has been appeared as a very promising technology for increasing the grain yield more than 1.5 t ha^{1}

19. Quality seed production of BRRI released rice varieties at farmers' level (ID 716)

Technology features:

- Sixteen up scaling programs in 12.8 ha were conducted using BRRI dhan70, 71, 75, 76 and 77 in Aman and BRRI dhan58, 60 and 63 in Boro seasons
- About 73.8 tons rice grains were produced of which 32.7 tons retained as seeds by the farmers. Sixteen Field Days were conducted and 40 plastic

drums (Capacity ~ 75-80 kg paddy) distributed among the innovative farmers

- Ninety farmers were trained in 3 batches in 2 upazilas of Mymensingh and 1 upazila of Netrakona district

20. Productivity enhancement in saline areas through underutilized crops (ID 768)

Technology features:

- Proso millet, Safflower, Sorghum and Linseed have been found more suitable for cultivation in moderate to strong (6.1 to 12 dSm^{-1}) saline areas
- Barley is found suitable for moderate (6.1to 8 dSm^{-1}) saline areas

21. Management of acid soils for sustainable crop production (ID 419)

Technology features:

- Application of lime (Dolomite@2t/ha) showed an increase in grain and straw yields of crops in tested cropping patterns (T. Aman rice - Wheat– Mungbean, T. Aman rice -Maize – Fallow, and T. Aman rice -Mustard – Boro)
- Addition of lime and organic manure to acid soils has been found beneficial for achieving sustainable crop productivity in the areas of Madhupur Tract and Northern & Eastern Piedmont Plains

22. Gummosis management of shade trees in tea garden(ID 815)

Technology features:

- Chemical fungicides Autostin, ARBA, Knowing and Bordeaux mixture have been found effective to control gummosis disease of shade trees (*A. procera, A. lebek* and *Samanea saman)*
- *Trichoderma harzianum* is effective as a biocontrol agent against gummosis disease of *A. procera, A. lebek* and *Samanea saman*

23. Improvement of soil fertility and crop productivity using vermi-compost and organic manure (ID 802)

Technology features:

- Mixtures of cow dung (CD), rice straw (RS), poultry manure (PM), giant mimosa residue (GMR) at the

ratio of 2.2:1.33:1.33:1.33 with the red wigglers earthworms has been found more suitable for the production of nutrient rich vermicompost

- Red wigglers earthworms (Eisenia fetida) have been observed more effective than mixture of local earthworms (Perionix excavates, Lumbricus rubellus, Eudrilus eugeniae etc.)
- About 15-25% chemical fertilizer (NPKS) could be saved either with the application of 75% NPKS with 4 t ha^{-1} vermicompost or 85% NPKS with 2 t ha^{-1} vermicompost for mustard (Binasarisha-10) and Boro rice (Binadhan-14) cultivation

b: Plant Protection

24. Integrated pest management (IPM) for sustainable tea production (ID 337)

Technology features:

- IPM techniques developed by including Plucking, Pruning and Field Sanitation as cultural control measures against major pests of tea
- Resistant or susceptible clones/agro-types against major pests of tea have been screened out
- Solar power light traps, yellow and blue sticky traps as mechanical control measures against major pests of tea have been developed
- Garlic plant extracts, *Bacillus thuringiensis* and commercial bio-pesticides PEAK MOTI and PEAK MONA found most effective in controlling the red spider mite and looper caterpillar of tea

25. Eco-friendly integrated management of major insect pest and disease in chilli(ID 477)

Technology features:

- Some sucking pests (thrips/mite) and diseases (Fusarium wilt, Bacterial wilt and Choanephora) were found limiting the chilli production
- Spraying of Spinosad (Success 2.5SC) and Abamectin (Toximite 1.8EC) along with blue and yellow sticky traps found effective for controlling sucking insect pests of chilli
- Alternate spraying of Carbendazim (Autostin) and Pyraclostrobin+Metiram (Carbio Top) along with seed treatment found effective for controlling wilt disease of chilli

26. Suitable host plant selection for successful lac production (ID 528)

Technology features:

- Apple Kul and BAU kul, Sirish and Babla have been found as good hosts of lac production
- Lac production efficacy of ber is highest

- Spraying of Neem seed extract and Azadirachtin reduced the predator population effectively and increased lac yield

27. Integrated rodent management of rice and wheat (ID 729)

Technology features:

- Trapping followed by acute poison showed up to 82% success for rodent control
- About 50% success has been found in case of using only live trap and kill trap

28. Management of bacterial diseases of silkworm (*Bombyxmori* L.) (ID 518)

Technology features:

- Some bacteria (*Streptococcus faecali, Straphylococci and Bacilli*) have been isolated from the infected silkworm
- Bleaching powder, Para formaldehyde, Ammonia. Benzoic Acid, Calcium carbonate, and Sodium carbonate have the potentiality to control the bacterial diseases

29. Management of insect and disease of rice under changing climate in southern region (iD 698)

Technology features:

- Gall midge infestation increased in BRRI dhan52 at temperature 28-30^{o}C, 80-90% humidity and rainfall
- Neck blast disease incidence was higher during November when maximum average air temperature was 29.8^{o}C, minimum 19.7^{o}C and rainfall 22 mm
- BRRI recommended N-fertilizer along with chemical (Azoxistrobin+Propiconazol) spray reduced False Smut disease incidence in rice field transplanted before mid-August
- Perching, sweeping, light trapping, optimum use of urea and spraying of appropriate insecticide reduced the infestation of insects

30. Bio-rational management of fruit flies of fruits and vegetables (ID 526)

Technology features:

- Among fruit flies three group viz. *Bactrocera dorsalis, B. tau* and *B. cucurbitae* were most abundant
- *B. dorsalis* out numbered all other species and can be considered as the most prevalent species of fruit flies in Bangladesh
- Sanitation + Pheromone Mass Trapping followed by sanitation + attract & kill method is very much effective against cucurbit fruit fly, while sanitation + attract & kill method can effectively control fruit fly complex in different fruit crops

31. Optimization of Pre harvest interval (PHI) of commonly used pesticides in tomato and country bean (ID 529)

Technology features:

- Pre harvest interval (PHI) of selected pesticides were optimized for selected vegetables
- The determined PHI was 10 DAS for fenvalerate in tomato and 14 DAS in hyacinth bean and for dimethoate 10 DAS in tomato and 12 DAS in hyacinth bean and for cypermethrin 5 DAS in cauliflower and 4 DAS in eggplant and cabbage
- About 12% of the total tested brands were below 80% purity and the remaining around 4% brand was sub-standard level (≤ 50%) of purity

32. Integrated management of major insect pests of soybean (ID 732)

Technology features:

- IPM technologies validation revealed that Hand picking+ Perching +Release of bio-control agent (Bracon) @1bunker/ha reduced the highest insect infestation (80-90%)
- Soybean yield increased about 30% through adoption of IPM technologies and reduced production cost (30%) and net profit was calculated Tk. 30000-35000/per hectare (BCR 2.75)

33. Eco-friendly management of sucking insects in cotton (ID 584)

Technology features:

- Application of Azadiractin (Bioneem plus 1% EC) @ 1 ml/ L of water) + Spinosad (Success 2.5 SC) @ 1 ml / litre of water) + Yellow sticky trap has been found effective against jassid population
- Application of Azadiractin (Bioneem plus 1% EC) @1ml/litre of water) + Yellow sticky trap has been observed effective for controlling white fly population

c. Agro-forestry

34. Agar-based agro-forestry system for Sylhet region (ID 439)

Technology features:

- Promising climate-smart Agar based agro-forestry production technologies i.e., Pineapple+Agar, Tea+ Agar, Bilatidhania+Agar, ginger+Agar, Turmeric+Agar, Malta+Agar based agro-forestry model have been developed for Sylhet region
- Additional pineapple, ginger, turmeric, Malta and / or tea could be grown without hampering the growth and development of agar tree

35. Improvement of rice – cotton based hill farming system with banana and papaya (ID 582)

Technology features:

- Inter-cropping of Rice and Cotton with Banana and Papaya are found more profitable
- Banana and Papaya covered the land after harvesting of main crops
- Farmers can earn throughout the year by producing Papaya or Banana

36. Jackfruit based multistoried agroforestry systemfor increasing diversified products (ID 595)

Technology features:

- Turmeric-papaya-jackfruit has been found with highest BCR (51.42%) followed by cabbage-papaya-jackfruit (32.71%)
- Jackfruit orchard has been added 23.03 kg of leaf litter to the ground, which might add 10.40 and 90.15 g/kg of N and organic matter respectively in a year
- All of the crop-associated jackfruit based multistrata agroforestry systems have been observed to augment soil-N, organic carbon, organic matter and pH
- Shade loving crops have been grown well in multistrata agroforestry systems in compared to open fields

37. Moringa based agro-forestry system for increasing productivity (ID 432)

Technology features:

- Six vegetables namely red amaranth, stem amaranth, chilli, okra, mung bean and brinjal have been grown with Moringa saplings and found all the crops can successfully be grown up to 6 months in association Moringa without significant yield loss
- The highest diversity of Moringa plant found in Rajshahi (4 types, seasonal, year round, pinkish colored, and thin) followed by Pabna, Bogura and Mymensingh with lowest diversity in Manikgonj

d. Post-Harvest Technology

38. Shelf stable value added products of onion, garlic and ginger (ID 728)

Technology features:

- The traditional storage practices of onion, garlic and ginger has not been found good enough to minimize the postharvest losses
- High quality shelf-stable onion, garlic and ginger products have been developed by utilizing available low cost dehydration processes and post-harvest losses of these spices have been reduced to an acceptable level
- The storage stability and organoleptic acceptability of these developed products have been found satisfactory

39. Fresh cut processing technologyies of fruits and vegetables (ID 465)

Technology features:

- Fresh cut (FC) cauliflower without packaging and vacuum packed good for 4 and 20 days respectively during storing at refrigerator
- FC pineapple washed with tap water and no wash pineapple after slicing is good up to 4 and 5 days respectively during storing at refrigerator at 4±1°C temperature
- FC jackfruit bulb washed with tap water was good up to 6 and 9 days respectively
- Fresh strawberry responded as of jackfruit

e. Mechanization

40. Mechanical coconut de-husking machine (ID 307)

Technology features:

- Improved coconut de-husking machine has been fabricated with stainless steel by BARI
- The weight of the de-husker is 258 kg
- The average capacity of de-husker is 309 nuts per hour at the speed of 25 rpm
- The dehusking cost of the dehusker was found to be 0.28 Tk./nut
- The payback period of the dehusker was 116 days and benefit cost ratio was 2.0.

The price of the de-husker is Tk. 100000 per unit

41. Improved coconut tree climber (ID 307)

Technology features:

- Improved coconut tree climber machine has been fabricated with stainless steel by BARI
- The climbing speed of the climber is 5-7 meter/minute
- The weight of the climber is 9 kg per unit
- The price of the climber is Tk. 8800 per unit
- The payback period of the climber was 25 days
- The benefit cost ratio of the climber was 1.60

42. BRRI head-feed mini combine harvester (ID 705)

Technology features:

- BRRI developed head feed mini combine harvester has been improved through manipulating gear system, working speed and cleaning performance
- A Prototype of head feed mini combine harvester was finalized and fabricated

43. Sugarcane power crusher for gur production (ID 748)

Technology features:

- Four types of sugarcane power crusher have been designed and fabricated
- Juice extraction capacity of developed BSRI sugarcane power crusher has been observed 50 to 60% of cane weight
- Crushing capacity of BSRI sugarcane power crushers have been found 250 kg to 500 kg per hour
- Power requirement of BSRI sugarcane power crusher has been observed lesser than conventional crusher

44. Power operated oil palm fruit stripper(ID 576)

Technology features:

- Power operated Oil Palm fruit stripper has been designed, fabricated and assembled
- The best performance has been resulted from the sterilization time 15 minutes at 120^0 c
- The efficiency and capacity of the machine has been found 98.89% and 0.81 ton/hr, respectively for the sterilization time 15 minutes at 120^0c
- The inclination of the fruit outlet adjusted to 20^0 and the diameter would be 460 mm for small bunch and 550 mm for large bunch

f: Variety Development

45. Super high-yielding rice genotypes (ID 765)

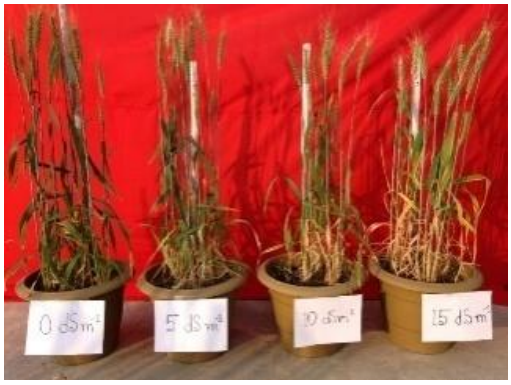
Technology features:

- Two genotypes have been developed (BRH11-9-11-4-5B (7 t/ha) and BR10238-5-1) with higher yield (6.9 to 8.1 t/ha)through farmers participation in boro season
- One genotype (BR9292-6-2-1B) produced 7 t/ha yield during Aman season
- These three lines recommended for release as super high yielding rice varieties

46. BU 2008-4: A promising salinity tolerant wheat genotype (ID 809)

Technology features:

- Among five promising wheat genotypes,BU-2008-4 has been selected against salinity (0-15 dS/m)
- Genotype BU 2008-4, BU 1370-7 and BU 2050-2 showed low value of yield reduction under saline stress condition
- Further field trial of the selected saline tolerant wheat genotype in saline-prone area is recommended



47. Shattering tolerant Brassica napus genotypes (ID 767)

Technology features:

- 26 lines of *Brassica napus* has been developed through crossing between B. juncea and B. napus
- NAP-15020, NAP-16041 and NAP-0733-1 have been found moderately shattering tolerance as well as produced good yield

48. Salt tolerant mustard genotypes (ID- 459)

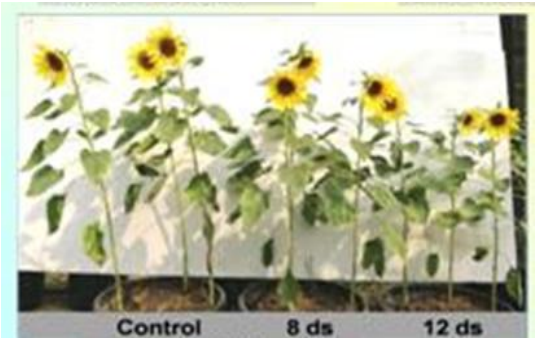
Technology features:

- Three mustard(Jun-0536, BARI Sarisha-11 & BARI Sarisha-16) genotypes have been selected against different levels of salinity (8-12 dSm^{-1})
- The findings would contribute in mustard breeding programs for producing resistant genotypes to salt stress
- The selected genotypes are recommended for registration and cultivation under saline stress conditions

49. Salt tolerant sunflower genotypes (ID- 459)

Technology features:

- Two sunflower(GP-4030 & BARI Surjumukhi-2) genotypes have been selected against different levels of salinity (8-12 dSm^{-1})
- The findings would contribute in sunflower breeding programs for producing resistant genotypes to salt stress



- The selected genotypes are recommended for registration and cultivation under saline stress conditions

50. Drought and Salt tolerant sugarcane clones (ID 746)

Technology Features:

- Through Zonal yield trial, 3 clones (I 85-10, I 101-10 & I 127-09) of sugarcane have been selected for drought stress
- Under similar trial, 2 clones (I 198-11, I 127-09) are identified for salinity (12 dS/m) condition
- These selected clones are recommended for registration as variety and cultivation under drought and saline areas

51. BTRI Tea clones for enhancing quality seed production (ID 342)

Technology features:

- Two nucleus clone plot (NCP) have been established
- Planting materials have been supplied to different tea estates for establishing seedbari
- A nursery has been established in which a total number of 8800 plantlets of different improved cultivars e.g. BT1, BT9, BT11, BT12, BT13, BT15, BT16, BT17, B207/39 and TV1 have been raised for further supplying to the tea estates for establishing NCP and Seedbari

52. Tomatillo: A unique introduction as new crop (ID 376)

Technology features:

- Tomatillo which is an eco-friendly and short-duration (75 days) crop has been introduced as new species
- A tomatillo line **(PI 003)**, which is a new addition in vegetable crops, and recommended for cultivation under drought and saline stress (8 dS/m)

2.4 Technologies Development under Livestock Sub-Sector

a: Breed Improvement

53. Manipulative reproduction technologies for quick genetic improvement in cattle(ID 603)

Technology features:

- Relation among graffian follicular size, serum level of progesterone and estrogens and pregnancy of cows was identified in cows
- Morphology of sperm head collected from different breeds of bulls and different swim up fractions was observed
- 72% male calves from swim up separated sample's fraction 1& 2, 63-65% female calves from fraction 3 & 4 have been obtained

b: Feed and Fodder

54. Pro-biotic food products for human and poultry (ID 532)

Technology features:

- Forty pro-biotic isolates collected from yogurt showed significant tolerance against low pH, bile salt, NaCl and phenol as well as showed antimicrobial activity against human and animal enteric pathogens and positive sugar fermentation patterns

55. Floating bed fodder production in submerged and flooded areas(ID 647)

Technology features:

- Production of green fodder (German grass) in floating bed found superior than land; growth is higher in rainy season than winter
- In vitro degradability of fodders found higher in rainy season than winter
- Floating bed may be used as an alternative of land for fodder production in submerged and flooded area

56. Cost effective complete pelleted feed for commercial goat and sheep production (ID 788)

Technology features:

- Cost effective complete pelleted feed has been developed by using rice straw and some other agro industrial by-products for commercial goat and sheep production

- The body weight gain has been increased and FCR and feed cost has been reduced considerably by pellet feeding
- No clinical symptoms and other health hazards recognized due to complete pellet feeding
- Developed complete pellet could be an alternative ready feed for commercial goat and sheep production

57. Probiotic feed supplement for calves (ID 790)

Technology features:

- Four pro-biotic feed supplements have been formulated as potential to be used for calves
- Pro-biotic feed supplements based on rice polish and wheat bran may be recommended considering their quality and shelf life
- Wheat bran based pro-biotic feed upon feeding to milk-fed calves from 15-90 days after birth has been resulted improved fecal characteristics, lesser E. coli load, but higher pro-biotic microbes have shown shedding in feces, lower diarrheal incidence and improved metabolic profile

58. Low-cost technology for making processed cheese (ID 661)

Technology features:

- In processed cheese (40% moisture and 50% fat in solids) percentage of microbial rennet has been standardized to be 0.05 g/liter milk
- Organoleptic evaluation revealed that `25% Short + 50% Medium + 25% Long + 3% ES + 2% salt' produced best quality cheese (better flavor, body/consistency, color/ appearance)
- But `25% Short + 25% Medium + 50% Long + 4% ES + 2% salt' has been found to be the most cost effective (Tk 535/kg)

59. Suitable bone bone fracture management technologies in animals (ID 533)

Technology features:

- The sub-project focused on application of modern state of the art bandage approaches for animal fracture management
- One technique is Modified Robert Jone's Bandage (cotton and bandage roll applied in internal rotation with moderate pressure and outer crepe bandage) on affected limb up to proximal and distal joint which is a novel approach used first time in the country

- Further techniques like intramedullary pinning which is suitable for long bone fracture management specially hemerus and femur fracture was an innovation in the local perspective

60. Suitable estrus synchronization protocols for treating anestrus cow (ID-313)

Technology features:

- 90% of anestrus cows have been come to estrus by using PG-GnRH-PG treatment protocol followed by PG-PG and PG-PG-PG fixed time AI (85 %)
- The ELISA has been found effective pregnancy diagnosis method in dairy cows with minimum cost (285 TK. per cow)
- Ultrasound method has been found good technique for early pregnancy diagnosis in dairy cows (from 28 days)
- Generally ensuring good housing system, good quality feed, good health care, regular medication, regular preventive measure, consistent de-worming reduced chances of anestrus in cows

2.5 Technologies Development under Fisheries Sub-Sector

a: Breeding and Seed Production Management & Aquaculture Production

61. Hygroryzaaristata: A floating grass utilized as fish feed for sustainable aquaculture (ID 410)

Technology features:

- Aquaculture system has been established in the open water of low-lying agriculture land through maintaining water quality for good aquaculture practice by exchange water daily through tidal action
- Fish production has found possible without fish feed cost by using *Hygroryzaaristata* floating grass except labor cost, and this technology might reduce the cost of fish production by 4 (four) times and may be benefited 6 (six) times more

62. Captive culture of Seabass in the coastal brackish and freshwater of Bangladesh (ID 464)

Technology features:

- Higher final weight has been recorded at a density of 25 seabass / decimal in monoculture system
- Final weight has been found higher in polyculture than monoculture
- Higher final weight in fresh water environment has been observed through adding Nacl with artificial feed

63. Mixed culture of Galda and native Cat fish in south-western coastal ghers (ID 827)

Technology features:

- Highest growth performance of shing (47.0 g), magur (112.0g) and galda (77.0g) have been obtained from 400, 50 and 30 stocking density/decimal after 06 months culture
- Highest survival rate have been exhibited for magur (39.0%) followed by galda (30.0%) and shing (20 %). Highest growth performance of magur (33.0g), shing (22.0 g) and galda (28.0g) obtained after 5 months culture

64. Hill lake creek aquaculture technology for increased fish production and livelihoods of lake fishers (833)

Technology features:

- Fish production technology in the creeks has been adopted by the people of Chittagong Hill districts
- Targeted beneficiaries have been involved with fish culture as their alternative means of income
- Growth and production performance of carps and tilapia have been found good (Production found 7986-8287 kg/ha)
- Alternate livelihood opportunity has been created due to fish culture in the fishing ban period in Kaptai Lake

b: Climate Resilient Technology

65. Culture of short cycle high valued fish species in the drought prone areas of Bangladesh (ID 825)

Technology features:

- Polyculture of tengra (*Mystus vittatus*) and shing (*Hetero pneustes fossilis*) in seasonal waters at the drought prone areas found economically viable
- Considering growth and survival, tengra and shing @500 no. dec^{-1} has been observed suitable stocking density in polyculture system

- Tengra polyculture has been found a bit better than the shing polyculture on the basis of economic aspects
- Shing polyculture has been found higher than the tengra polyculture on the basis of production

c: Feed Management

66. Development of probiotic feed supplements using potato and wheat as growth promoter for roi and Catla(ID 497)

Technology features:

- Wheat and potato as probiotic feed supplement has been enhanced the growth performance of rohu and catla
- In both cases inclusion of 15% potato and wheat has showed the best performance
- 15% probiotic feed compound has showed the most bacterial load
- Potato and wheat may be used as probiotic feed supplement to enhance the growth performances of rohu and catla and may be used for other species

67. Productivity enhancement of coastal ghers through year round Shrimp-Tilapia alternate culture (ID 778)

Technology features:

- Highest average yield in 90 days cultured tilapia has been obtained in on-station pond- was 4755 kg/ha with a net benefit of BDT 65026/ha and BCR 1.16
- Highest average yield in 120 days cultured tilapia has been obtained in on-station pond was 5997 kg/ha with a net benefit of BDT 1072180/ha and BCR 1.22

68. Improvement of nutrient rich live feed (micro algae) culture for larval feed for brackish water fish (ID 779)

Technology features:

- Under indoor condition in 2 liter conical flask the highest average density has been observed 6.91×10^6 for *Tetraselmis* sp. while in 60 Liter white container in indoor condition highest average density 3.31×10^6 has been observed for *Nannochloropsis* sp

- Under outdoor condition in 300 liter culture tank the highest average density 3.11 $\times 10^6$ has been observed for *Nannochlorum* sp. while in 300 liter plastic tank in 20/ml inoculum density with different media the highest average density of rotifer (*Brachionus plicatilis*) 189 ind/ml has been observed for yeast+microalgae
- In 300 liter plastic tank in 300-400/ml inoculum density with different media in outdoor condition the highest average density of rotifer (*Brachionus plicatilis*) 721 ind/ml has been observed for microalgae+ fish oil media and no rotifer has been found in fish oil media

2.6 Leaflets/Booklets Published under CRG Sub-Projects

Different types of publications (Booklet, Leaflet, Factsheet, Poster and Scientific article) have been published from the achievements of the implemented Competitive Research Grant (CRG) sub-projects. Some of the received publications along with the sub-projects ID number are shown below.

1. Roof gardens provide a solution to heat waves and air pollution in urban area (ID 623: Published in English)
2. Screening sugarcane genotypes under induced drought stress (ID 746: Published in English)
3. Screening sugarcane genotypes under induced salinity stress (ID 746: Published in English)
4. Screening sugarcane under natural salt and drought prone areas (ID 746: Published in English)
5. Development of a sustainable agricultural risk management technology in areas affected by flash flood using numerical climate modeling data analysis (ID 512: Published in English)
6. Dry direct seeded rice based cropping patterns for producing more with less water (ID 777: Published in English)
7. Bio-organic fertilizer: A green technology to improve soil health and rice yield(ID 707: Published in English)
8. Development of eco-friendly management of sucking insects of cotton (ID 584: Published in English)
9. Seroprevalence and identification of associated risk factors of Q-fever (*Coxiella burnetii*) in ruminants, an emerging zoonotic disease in Bangladesh (ID 321: Published in English)
10. Technique on agricultural disease detection and classification using image processing in agro-field (ID 554: Published in English)
11. Wireless sensors networking for image and data acquisition for the agriculture field management (ID 554: Published in English)
12. Maize production under salinity and drought conditions: Oxidative stress regulation by antioxidant defense and Glyoxalase systems (ID 389: Published in English)
13. Handbook on Fertilizer Recommendation-2018 (ID 666: Published in English)
14. Handbook on Fertilizer Recommendation-2018 (ID 666: Published in Bengali)
15. ঔষধি ঘাস ব্যবহার করে কম কোলেস্টোরেল ও স্বাস্থ্যকর ভেড়ার মাংস উৎপাদন (Production of low cholesterol healthy mutton by using natural hurbs: ID 719: Published in Bengali)
16. মাটির উর্বরতা বৃদ্ধি, স্বাস্থ্য রক্ষা ও অধিক ফলনের জন্য পরিবেশ বান্ধব বায়োফার্টিলাইজারের ব্যবহার (Use of Bio-fertilizer for soil health improvement and rice yield: ID 707: Published in Bengali)
17. ফল ও সবজির ফ্রেশ কাট প্রসেসিং (Fresh cut processing of fruits and vegetables: ID 465: Published in Bengali)
18. লিলিয়াম: বাণিজ্যিক ফুল চাষে নতুন সংযোজন- উৎপাদন কলাকৌশল ও সংগ্রহোত্তর ব্যবস্থাপনা (Lilium: A new addition in commercial floriculture-production technology and postharvest management: ID 479: Published in Bengali)
19. ড্রাগন ফলের উৎপাদন কলাকৌশল (Production techniques of dragon fruit ID 538: Published in Bengali)
20. মরিচের পোকামাকড় দমন ব্যবস্থাপনা: Management of insect mites of chilliID 477: Published in Bengali)

21. হাঁকালুকি ও টাঙ্গুয়ার হাওড়ের হাঁসের রোড-বালাই পর্যবেক্ষণ ও নজরদারি এবং উপযুক্ত টিকাদানের মডেল ও অন্যান্য প্রতিরোধক কৌশলের উন্নয়ন:(Monitoring and Surveillance of Duck Diseases in Hakaluki and Tanguar Haor and Development of Suitable Vaccination Models and other Preventive Strategies: ID 448: Published in Bengali}
22. ব্রি-হেডফিড কম্বাইন হারভেস্টার চালনা ও রক্ষণাবেক্ষণ নির্দেশিকা (Operation and maintenace guideline of BRRI head-feed combine harvester:ID 705: Published in Bengali)
23. গুড়া ইউরিয়া এপ্লিকেটর "সারের ব্যবহার দক্ষতা ও ফসলের উৎপাদনশীলতা বৃদ্ধিতে মাটির গভীরে ইউরিয়া সার প্রয়োগ যন্ত্র উদ্ভাবন ও বিস্তার" (Development of Fertilizer Deep Placement Applicator for Increasing Fertilizer Use Efficiency and Farm Productivity:ID 811: Published in Bengali)
24. হাওর প্লাবনভূমিতে খাঁচায় মনোসেক্স তেলাপিয়া চাষ (Production of monosex tilapia under case culture in haor flood plain: ID 674: Published in Bengali)
25. বারি ব্যাটারি চালিত নিড়ানি যন্ত্র (BARI **battery operated weeder: ID 774: Publishe**d in Bengali)
26. স্বল্প খড়চে ড্রিপ-ফার্টিগেশন সেচ পদ্ধতিতেফসল উৎপাদন (Crop production through low cost drip irrigation technique**:**ID 814: Published in Bengali)
27. শুকনো পদ্ধতিতে বোরো ও আউশ ধান চাষ: একটি সেচ সাশ্রয়ী আধুনিক প্রযুক্তি (Boro and Aus rice production under dry seeded condition: A water savings irrigation technology: ID 777: Published in Bengali)
28. ধান ও গম ক্ষেতের সমন্বিত পদ্ধতিতে ইঁদুর দমন ব্যবস্থাপনা (Integrated rodent management in rice and wheat field:ID 729: Published in Bengali)
29. নারিকেল গাছে উঠার যন্ত্র ও নারিকেলের ছোবড়া ছাড়ানো যন্ত্রের পরিচিতি ও ব্যবহার নির্দেশিকা (Guideline of coconut tree climber and de-husking machines: ID # 307- Published in Bengali)
30. ফার্টিগেশন পদ্ধতিতে মাটি ছাড়া আদা চাষ (Ginger production under soilless culture using fertigation technique:ID 323: Published in Bengali)
31. শাক-সব্জিতে কীটনাশক: কতটা নিরাপদ বা ক্ষতিকারক (Insecticide in vegetables: Degrees of safety or harmful: ID 638: Published in Bengali)
32. বোতলজাত ও জার পানির গুণগতমান: জনস্বাস্থ্য ঝুঁকি (Qualitative Assessment of Bottled Drinking Water: Risk of human health: ID # 638: Published in Bengali)
33. বাংলাদেশের শোভাবর্ধক উদ্ভিদেও সন্ধীপদী আপদ ও তাদের ব্যবস্থাপনা (Management of arthropod pest in ornamental plants: ID 705: Published in Bengali)
34. স্মার্ট ফোনে 'সার সুপারিশ অ্যাপ' ইনস্টল করার পদ্ধতি (Offline fertilizer recommendation through Mobile Apps: ID 787: Published in Bengali)
35. ঘরে বাণিজ্যিকভাবে দেশি বাহারি জেব্রা মাছের পোনা উৎপাদন কৌশল (In-house/in-doorfingerling production of zebra fish:ID 363: Published in Bengali)

2.7 Technology Fact Sheet of CRG Sub-Projects

To disseminate the technology to the end users through public and private extension agencies of the country the PIU-BARC is to make extension message. leaflets, booklets, posters prepared on the tested technologies stated in the earlier section. In addition, of the leaflets/booklets/posters the PIU BARC planned to prepare technology factsheet on each of the selected technologies from the CRGs. Template/format for developing technology factsheet has been drafted. Factsheet development on the technologies generated through CRGs would be completed after finalization of PCRs.

Chapter 3

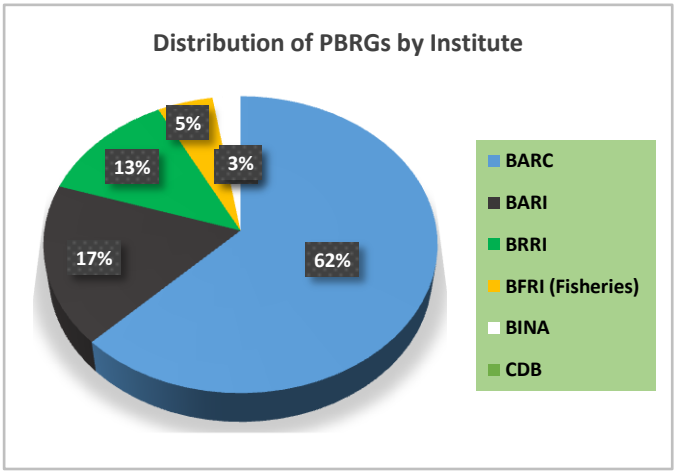
Progress of PBRG Sub-Project

The coordinated PBRG program amongst NARIs expected to make wider scopes in integrating multiple organizations for jointly address national agricultural problems and strengthening their research and its management capacity apart from effective and proper resource uses in national perspectives.According to operational guideline AIF-1, PIU-BARC advertised/invited Concept Note (CN) for PBRG sub-projects on 03 October 2016 (First Call). PIU-BARC received 150 CN of PBRG research proposals.Nine Technical committees of different Technical Divisions of BARC reviewed 150 CN of PBRG research proposals and selected 48 CN for submission of Full Research Proposals (FRP). According to Project Implementation Manual (PIM), two independent reviewers reviewed each Full Research Proposal (FRP). After rigorous review, Executive Council (EC) of BARC approved 42 but offered 40 PBRG sub-projects against the DPP target of 33 with BDT 103.54 crore as per LOA signed. Another 11 PBRG sub-projects are under process of awarding with an amount of around Tk 24.88 crore.

The duration of the PBRG sub-project is maximum 4 (Four) years or less i.e. up to June 2021. The PIs have to be completed the field/lab research activities within December 2020 and provide draft Project Completion Report (PCR) along with necessary data and information to the Coordination Component within February 2021. The Coordination Component is to submit the final PCR to the PIU-BARC, NATP-2 within June 2021. All activities of PBRG sub-projects are to be completed no later than one year prior to NATP-2 closing date in order to allow enough time to adequately disseminate the research results.

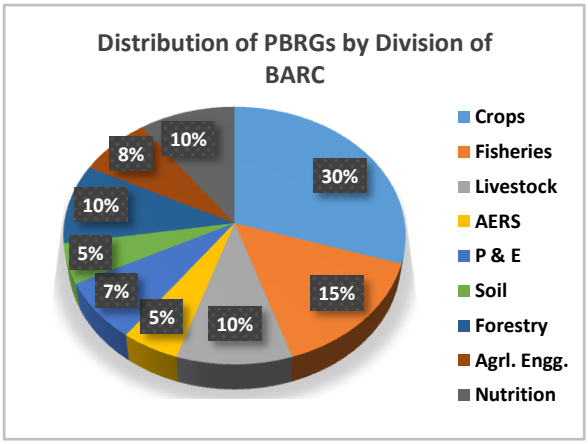
3.1 Distribution of PBRG Sub-Projects by Institution

Unlike CRG sub-projects the PBRG sub-projects are mostly coordinated ones and different NARS institutes, universities and NGOs are carried out the researches on the same researchable issue (s). Though, the numbers of PBRG sub-projects are 40 but considering the implementing organizations as component the total number of sub-projects are 155. The coordinators are mostly from different technical divisions of BARC who are coordinating and synchronizing the research works among the line NARS organizations. It has been observed from the chart that BARC alone coordinating 62% PBRG research programs while BARI 17%, BRRI doing 13% sub-projects and BFRI (Fisheries) 5%, and BINA 3% PBRGs respectively. The implementing organizations are mostly NARS institutes and universities.



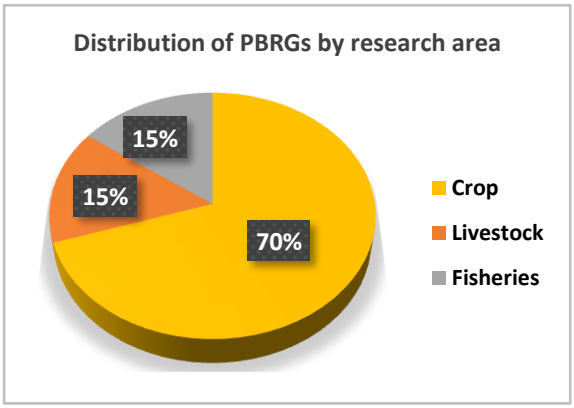
3.2 Distribution of PBRG sub-Projects by Discipline

The pie chart showed the distribution of PBRG sub-projects by disciplines (areas of researches). It has been observed that maximum numbers of sub-projects (30%) are being executed under crop sub-sectors followed by fisheries 15%, and livestock 10%. Out of 40 PBRG sub-projects executed during current year (until Jun 2019), 22 (55%) carried out under the major disciplines (crop, livestock and fisheries) of agriculture. The rest 45% are being executed by other six disciplines like Soil Science (05%), Agricultural Engineering/Mechanization (08%), Agricultural Economics and Rural Sociaology (05%), Planning & Evaluation (07%), Nutrition (10%) and Forest (10%).



3.3 Distribution of PBRG Sub-Projects by Sub-Sector

The pie chart shows the distribution of PBRG sub-projects by sub-sector of researches adopted. It has been observed that maximum numbers of sub-projects (70%) are being executed by crop discipline followed by fisheries 15%, and livestock 15%. Of 40 PBRG sub-projects executed during current year (until June 2019),11 (28%) carried out under production and management, three PBRGs each under variety development, agril. econ, post-harvest, mechanization and climate resilient of crop sub- sector. In livestock sub-sector,four PBRGs are executed under feed and fodder; while Fisheries sub-sector executed three PBRG sub-project under breeding and seed production.



3.4 Updated Progress

After completing the awarding processes (signing of LOA), the PIU-BARC started releasing fund for the PBRG sub-projects from Feb 2018 – June 2018. A complete list of PBRG sub- projects is attached as **Annex I** with full addresses of coordinators, PIs and Co-PIs. By June 2019, all PIs of the PBRGs submitted 1st half-yearly reports and most of them submitted annual reports. Reviewing the half-yearly reports it has been observed that all PIs of PBRGs completed inception reports and maximum sub-projects completed baseline data collection while few of them are at the stage of undertaking survey works for data generation, some sub-projects harvested 1st seasoned crops. None of the sub-projects have reached in a stage of technology generation, some more crop seasons would be needed to draw any conclusive inferences as per sets development objectives. As observed with few exceptions maximum sub-projects able to consume 30-50% of the annual budget while some sub-projects used more than 80% resources. Most of the PBRG sub-projects completed more than one

implementation year. So, noticeable progress has been made by many of the PBRGs being implementing in the field. The updated progress and results achieved by PBRGs are as follows:

1. Sub-Project Title: Up-scaling and Application of Solar Photovoltaic Pump for Smallholder Irrigation and Household Appliances in the Central Coastal Region of Bangladesh (ID 001)

Coordinator: Member Director (NRM), BARC, Farmgate, Dhaka

Implementing Organization: BARI, BRRI

General Objective: Up-scaling of solar pump for smallholder irrigation in the central coastal region of Bangladesh;and application of solar photovoltaic panel to operate household appliances for year round uses during off irrigation period

Duration : Feb 2018 to Jun 2021

Budget : Tk 2,83,82,520/-

Background: There is about 62% irrigation coverage of which 82% operate on diesel engine and 18% on electric motor operated pumps. The diesel-run irrigation pumps consume more than half a million tons of diesel per annum. Solar photovoltaic power production is recognized as an important issue for generation of future energy requirement. There are about 320 solar power operated irrigation pumps in Bangladesh. In order to promote more solar pumps, the government has targeted to install about 15,000 solar pumps by 2025. Most of the farmers in the southern coastal region are small and marginal tenant farmers who has limited access to ground water utilization for crop cultivation and grow only rainfed aman rice during monsoon, so, lands remain fallow in dry season. Farmers are not interested to cultivate boro rice due to lack of suitable low lift surface pumps and high irrigation cost. Solar pump which is pollution free and environment friendly could be an alternative to diesel and electricity operated pumps for irrigating in the off-grid areas. Using solar pumps on a large scale, energy demand in irrigation systems can be reduced substantially. The sub- project is aligned with the government policy of Bangladesh as well as SDGs of the United Nations.The sub-project is being implemented by BARI and BRRI under the coordination of Natural Resources Management Division of BARC.

Progress: BARI (component 1) has completed base line survey in the sub-project area (Kalapara and Galachipa upazilas of Patuakhali district, Borguna Sadar and Amtali of Borguna district and Charfassion and Lalmohon of Bhola district).The survey was conducted with a) solar pump users, b) solar pump service providers and c) general farmers. In each upazila, 30 farmers were interviewed through pre-tested interview schedule. The average literacy was found 97% and the average area of farm house, homestead and vegetable cultivation were 183, 41 and 48 decimals, respectively. The main source of irrigation water was surface water (Canals and ponds). No solar pump found to use in the study areas. Knowing the demand of farmers from base line survey, solar pump fabricated with a 51 mm

centrifugal pump directly coupled with 900 W dc motor. The average discharge of the pump was found to be 180 L/min. Necessary solar panels and pump fittings have been procured and are ready for installation at farmers' fields.

The component 2 of BRRI completed a field survey in the selected upazilas (Ujirpur and Bakerganj of Barishal, Sadar & Nalcity upazilas of Jhalkati and Sadar & Nazirpur upazilas of Pirojpur district). Farmers are using low lift pumps for irrigating rice crops and reluctant to use electric power to run the pumps due to complex rules and regulations of the providers. A portable 2.56 kW capacity panel has been designed that can run a 2 HP irrigation pump comfortably. The designed solar pump performed similar to those of other diesel pumps operating in the field. No significant difference was observed between the performance characteristics of the solar pump during manual and no tracking because of rapid variations in irradiance. At a particular delivery head, discharge increased with the increase of solar radiation and vice versa. Average operating times were found between 8.06 to 8.31 hours, respectively, at off and manual tracking conditions when the suction head was constant. As an additional activity, the solar system was tested to operate a 1.5 kW BRRI open drum paddy thresher and the threshing output was found 200-300 kg paddy/hr.

2. Sub-Project Title: Groundwater resources management for sustainable crop production in northwest hydrological region of Bangladesh (ID 002)

Coordinator: Member Director (NRM), BARC, Farmgate, Dhaka

Implementing Organization: BARI, BRRI, and BINA

General Objective: Plan sustainable use of groundwater to optimize groundwater abstraction for irrigation and crop production by assessing groundwater availability and recharge pattern in northwest hydrological region

Duration **:** Feb 2018 to Jun 2021

Budget **:** Tk 3,72,79,896/-

Background: The country's agriculture is responsible for more than 65 percent of total fresh water withdrawal, where nearly 80 percent of this irrigation water comes from groundwater resources. The contribution of groundwater has increased from 41% in 1982-83 to 77% in 2006-07. The ratio of groundwater to surface water use is much higher in northwestern districts of Bangladesh compared to other parts of the country. Climatically, this area belongs to dry humid zone with annual average rainfall vary between 1,400 and 1,900 mm. Though the groundwater dominates the total irrigated area, its sustainability is at risk in terms of quantity in the northwest region. Decline of groundwater in the central part, moderately declining trend in western, northwestern and northeastern areas during dry season is a threat of water resources for future. The substantial declination of groundwater level during the last decade causing threat to the sustainability of water use for irrigation in this region. If the over-utilization continues, it may result in its exhaustion after few years so, emphasis should be given on the sustainability of these valuable resources. The PBRG sub-project (ID 002) has been coordinated by Natural Resources Management (NRM) Division of Bangladesh Agricultural Research Council (BARC), with 3 components, namely Bangladesh Agricultural Research Institute (BARI),

Bangladesh Rice Research Institute (BRRI) and Bangladesh Institute of Nuclear Agriculture (BINA) to assess groundwater availability and recharge pattern in northwest hydrological region.

Progress: BARI (component 1) was responsible for assessing groundwater at Rajshahi & Joypurhat while BRRI (componnet 2) at Rangpur&Pabna and BINA at Chapainawabganj & Naogaon districts. The activities done are: site/farmers' selection, recruitment of sub-project staffs, procurement of equipment, collection of long-term ground water level and river stage data, rainfall and other meteorological data, lithological data, etc. Field trials with rabi crops and water saving irrigation technologies at farmers' field, installation of observation well were done. The major activities included soil and irrigation data, calibration and validation of groundwater model,trend analysis of groundwater level for boundary and inside wells, trend analysis of phreatic surface from predicting model, scenario development for sustainable groundwater use for crop production using groundwater model, organization of training for field workers and farmers, organization of meeting, seminar and workshop, preparation of reports, etc.

3. Sub-Project Title:Transfer of Agricultural Technologies to Farmers' level for Increasing Farm Productivity (ID 005)

Coordinator: Director, TTMU, BARC, Farmgate, Dhaka

Implementing Organization: BARI, BINA, BSRI, BLRI, BFRI, SRDI, CDP, BJRI, BRRI, BWMRI

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

Duration : May 2018 to Jun 2021

Budget : Tk 3,24,60,000/-

Background: Every year 13 NARS institutes are performing different researches on agricultural development of the country. BARI, BRRI, BJRI, BSRI, BLRI, BFRI, FRI, BTRI, BSRTI,SRDI, BINA, BWMRI and CDB innovate technologies on rice, jute, sugar crops, livestock, fisheries, forest, tea, sericulture, soil, fruits, wheat and cotton respectively. Numbers of matured technologies from different NARS institutes have been transferred through the National Agricultural Technical Co-ordination Committee (NATCC) meeting to DAE, DLS, DoF for dissemination in different ways (demonstration, training, workshop, publication, newspaper, fair, rally, social media. etc.) but the adoption rate is low. Some of matured or promising important technologies are still not using in field needs to transfer at farmers' level. So, immediate transfer of technology at farmers' level is needed for farm productivity enhancement. The procedures of popularization of these technologies to the farmers, researchers and

end users need to follow appropriate, economic and effective ways. Agricultural productivity could be increased significantly by transferring technologies rapidly.

Technology transfer related research information mainly the proper transfer way from all the NARS institutes to farmers level needs to be analyzed. So, it is a burning issue to invent the ways of transferring technology economically. With this view in mind, the present research has proposed to analyze the rapid transferring modeling of technologies from all NARS institutes in Bangladesh for farm productivity enhancement. The sub-project proposal for Programme Based Research Grant (PBRG) was submitted by the coordination of the Technology Transfer and Monitoring Unit (TTMU) of Bangladesh Agricultural Research Council (BARC) and a Letter of Agreement (LoA) was signed on 11 July, 2018. The Field activity was done in ten sites: Manikganj site under BJRI component, Tangail by SRDI, Mymensingh (Sadar Upazila) by BINA, Sirajganj (Sadar Upazila) under BSRI component, Mymensingh (Bhaluka and Muktagacha Upazila) by BRRI, Sirajgong (Shahjadpur Upazila) by BLRI, Bandarban site under CDB component, Shariatpur and Barishal by BARI, Sherpur site under BFRI component and Dinajpur, Thakurgona and Panchagar districts by BWMRI.

Progress: The **BWMRI component** sets experiments with newly developed high yielding and disease resistant wheat varieties (BARI Gom-29, 30, 32 and 33) at 6 locations and showed complete production technology to the farmers. BARI Gom-32 was the highest yielder (4.94 to5.93 t/ha) followed by BARI Gom-33 (14.45 to 4.69 t/ha). BWMRI collected (procured) 3.6 tons seed of BARI Gom-33 and 01 ton seed of BARI Gom-32 from those farmers for a USAID seed multiplication project.

BARI has selected Shidda village of Dmmuda Upazila; Nagerpara, Idilpur and Tin Khamba villages under Gosairhat Upazila of Shariatpur district; Kazirchar and Saidergao union under Muladi Upazilla in Barishal district for setting experiments on BARI released fruit varieties at farmer's level and demonstration of improved modern technologies of different important major and minor fruit cultivation practices. The important fruits are mango, litchi, banana, lemon, guava, dragon fruit,ber, Burmese grape, aonla, carambola, malta, coconut, pummelo, wax jambu, golden apple etc.The average plot size of 28 decimal in Dammuda upazila and 33 decimal under Gosairhat Upazila in Shariatpur district whereas the average plot size of 35decimal under Babuganj Upazila and 50 decimal under Muladi Upazila in Barishal district. In July to September 2018, all targeted farmers were selected (those have 25 to 33decimal of land)and fruit saplings distributed among them. Moreover, a socioeconomic survey has been conducted to know the present livelihood status of the farmers and to find out the problems and potentials of the households.

BINA conducted cropping pattern trials to replace the existing one by improved one with modern varieties released recently. In Kh II season T. Aman rice (var. Binadhan-17) was transplanted in two locations (Sadar, Mymensingh from 30 July to 8 August, 2018 and at Madhukhali, Faridpur from 9 to 18 August, 2018). The yield was 3.68 t/ha with maturity period 112 days and 4.51 t/ha with 110 days duration at

Mymensingh and Faridpur respectively. In rabi season, Binasarisha-9 yielded 1.35 t/ha at Mymensingh and Binamasur-8 yielded 1.8 t/ha at Faridpur while in Kh I season Binadhan-14 yielded 4.51 t/ha at Mymensingh and Binadhan-19 yielded 3.47 t/ha at Faridpur.

The **BSRI** component conducted socio-economic (baseline) survey to know the present livelihood status of the farmers and find out the problems and potentials of the farmers. As per programme, four locations were selected i.e. Sirajgonj district (Sirajgonj Sadar, Kazipur, Raigonj and Tarash Upazilla) for the transfer of BSRI released latest modern sugarcane varieties with the help of UAO and SAAOs. Five farmers were selected in each selected location, so total 20 farmers had 20 bighas of land for demonstration. Demonstration plot of BSRI Akh 45 (gur), BSRI Akh 42 (chewing) was established. Potato, onion and cabbage were planted as inter crop. The highest tiller was found in gur varieties than chewing and early plantation in both cases. Overall crop condition is good.

The **BLRI** conducted validation trials on the technology entitled 'Preservation of green grasses/fodder through silage' in the farmers' field of Shajadpur (Sirajgonj) and Godagari (Rajshahi). Baseline survey was conducted among 150 farmers in two locations.The education level of farmers were 8% illiterate, 82% primary level and 9% secondary level. The land use such as housing area were 50 decimal, cultivated area 95 decimal, uncultivated area 08 decimal and fodder land area 20 decimal per family. Thirty selected farmers were provided training on fodder cultivation and silage technology.Perennial high yielding fodders like Napier stem cutting (Var. BLRI Napier 1, 4) were planted in November/2018. First cut was made 60 days after the establishment with biomass yield at Shajadpur and Godagari were 27 and 26 t/ha respectively.The total fertilizer cost (Tk/ha) for fodder production of Shajadpur and Godagari were Tk 15856/- and Tk 16344/- respectively.

The **BFRI** (fisheries) selected Gorddar village under Nakla Upazilla, Sherpur district. The trial entitled Validation & Demonstration of Culture of Pabda (*Ompok pabda*), Gulsha (*Mystus cavasius*) with Rohu (*Labeo rohita*) was demonstrated (Aug 2018) in 03 farmers' pond having the average pond size of 36 decimal. After preparing with lime and fertilizer the ponds were stocked with Pabda, Gulsha and Rohu at density of 125000, 50000 and 1250/ha respectively. Fishes were fed with supplementary feed at the rate of 4-6% of estimated body weight. For maintaining suitable water quality, ponds were fertilized with lime at the rate of 25.0 kg/ha at fortnightly interval. After six months rearing, the production obtained were 1154, 774 and 724 kg from Pond-1, pond-2 and Pond-3, respectively. The higher production was obtained from Pond-1. The relative contribution of Pabda and Gulsha in total production was 87%, 85% and 78% from pond-1, pond-2 and pond-3, respectively. While in case of Rui, the relative contribution of pond-1, pond-2 and pond-3 were 13%, 15% and 15%, respectively. Socioeconomic survey observed farm size of the trial farmers ranged from 190 to 240 decimal, pond size ranged from 35-60 decimal and total average annual income Tk.656666 per household. During baseline survey, the farmers pointed that unavailability of good quality fish feed is the main problem of aquaculture in Sherpur Region.

The **SRDI** component validated Upazila Nirdeshika (FRG 2018, BARC) based balanced fertilizer application technique in Boro-Fallow-T.Aman cropping pattern in Cumilla and Tangail. Baseline data of 24 farmers of 4 Upazilas (Sadar, Bhuapur in Tangail and Sadar Dakshin, Burichong in Cumilla) have

been collected by interviewing farmers using a questionnaire. BRRIdhan 58 and BRRIdhan 72 were the test crop. Average age of respondent in Tangail was 54 years (range 48-61) and in Cumilla 50 years (range 33-70). Small sized family (<5 members) dominates in Tangail while medium sized family (5-7 members) dominates (67%) in Cumilla. Farm size in Tangail varies from 0.13-0.53ha (average 0.29ha) and in Cumilla 0.16-1.13ha (average 0.46ha).Adaptive trial and control plots were established in farmer's field in Tangail Sadar, Bhuapur Upazila of Tangail district and Sadar Dakshin, Burichong Upazila of Cumilla district. Recommended fertilizers were applied in adaptive trial plots while in control plot,farmers used fertilizer as their own practice. Crops were harvested in 1st week of May 2019. The cropping pattern Boro-Fallow-T.Aman with HYV found as dominant CP in the selected area. In Tangail Boro yield was found positively correlated with application of Urea, TSP, MoP and Cowdung but negatively correlated with Gypsum and Zinc Sulfate. On the other hand, T.Aman rice yield was positively correlated with Urea, TSP, MoP and Gypsum. Most of the respondent farmers do not use Zinc Sulfate and cowdung in T. Aman.In Cumilla Boro yield was found positively correlated with application of TSP, Zinc Sulfate and Cowdung but negatively correlated with Urea and MoP. This may be because farmers use more Urea than actually required in Boro. On the other hand, T.Aman rice yield was positively correlated with Urea, TSP, MoP and negatively correlated with Gypsum. Most of the respondent farmers do not use TSP and Gypsum in T. Aman and Zinc Sulfate in Boro and T. Aman.Yield of BRRIdhan 58 in adaptive trial plots were 20-25% higher over control in Tangail and 4.7-5.2% higher over control in Cumilla.

The **CDB** recently has generated 4 technologies:i) CB-14 variety, ii) application of mepiquat chloride, iii) removal of vegetative branches and iv) De-topping at 90 DAS(Day after sowing). These four technologies have the potentiality to increase per hectare yield. CB-14 is a disease resistant full-season variety with high yield potential (4-5 t/ha) better than existing varieties and with high fiber quality.Four sprays of Mepiquat chloride, at the rate of 1.75 ml/10 liter of water starting from 30 DAS at 15 days interval, suppress excessive plant growth and increase cotton yield (25%) over control. In the first year, field trials (Demonstration) were conducted on 08 farmers' field under 03 Zonal offices of CDB. Two field trials conducted at Thakurgoan and khagrachari zone and 4 field trial conducted at Bandarban Zone.In the first year, results found that yield of 08 trials ranged from 575 kg(14.38 mound) per 33 decimal to 685kg (17.13mound) per 33 decimal.Converted in ton ha^{-1} yield ranged from 4.31 to 5.14 t/ha which was higher/ equal to Chinese hybrid varieties. In this study, CDB generated 04 technologies found more profitable and increase per hectare yield.

BJRI conducted base line survey following a structured questionnaire. A total of 36 farmers were selected from 3 locations i.e., Manikganj, Rangpur and Faridpur. Information related to socio economic condition, agricultural activities and jute and jute seed production was recorded.Two locations (Manikganj and Rangpur) were selected for seed production in the first year. But seed crop production was conducted with 5 farmers in only Manikganj site in Sep2018.Improved techniques of seed production like direct seeding and line sowing method, recommended fertilizer doses, weed management, pest and disease control were applied in each field. In total 150 Kg seeds were produced from 50 decimals land under seed production program at Manikganj. The program of variety

demonstration was conducted at Faridpur and Rangpur in the first year. Six (6) farmers were involved in variety demonstration program from each location. The variety of BJRI Tossa Pat-8 (Rabi-1) and BJRI *Kenaf* (HC-95) along with other technologies like line sowing method, recommended fertilizer doses, weed management, pest and disease control have been demonstrated at farmers' field. The improved retting technique of jute has planned to be demonstrated at farmers' level after harvesting of crop for fibre and stick yield will also be reported.The crop not yet harvested.

BRRI tested the latest released six varieties i.e., BRRI dhan58, BRRI dhan74, BRRI dhan81, BRRI dhan84, BRRI dhan86 and BRRI dhan89 at Bhaluka & Muktagacha upazilas of Mymensingh and Sadar & Sarishabari upzillas of Jamalpur under the sub- project. Six farmers were selected in each location. Land area of each location was 200 decimal (2 acre) having 33 decimal of land for 1 farmer. So, total no. of farmers was 24. Total demonstration area was about 800 decimal (200 decimal x 4 locations). Transplanting was completed in all locations within January/2019. Beyond the quantitative data, farmers' reaction/ feedback about the varieties were collected. The average grain yield of BRRI dhan58, BRRI dhan74, BRRI dhan81, BRRI dhan84, BRRI dhan86 and BRRI dhan89 were 6.67, 6.51, 5.83, 5.81, 5.51 and 7.44 t/ha respectively. Among the varieties, BRRI dhan89 produced highest grain yield 7.44 t/ha followed by BRRI dhan58 (6.67 t/ha) and BRRI dhan74 (6.51 t/ha). However, the lowest grain yield (5.51 t/ha) was found in BRRI dhan86. The average growth duration of BRRI dhan58, BRRI dhan74, BRRI dhan81, BRRI dhan84, BRRI dhan86 and BRRI dhan89 were 154, 147, 145, 143, 142, & 157 days respectively.The highest total paddy production (4028 kg) harvested from BRRI dhan89 and the lowest (2950 kg) by BRRI dhan86. A considerable number of farmers observed the performance of six BRRI released recent rice varieties and among them 562 farmers were motivated for the next year cultivation.

4. Sub -Project Title:Value addition and standardization of nutritional level in selected food items from animal and plant origin (ID 007)

Coordinator: Member Director (Fisheries), BARC, Farmgate, Dhaka

Implementing Organization: PSTU,HSTU

General Objective: **F**inding out the ways of producing poultry and poultry products for safe human consumption for mitigating malnutrition by identifying the health-hazards materials in poultry industry and their effects on nutritional quality of poultry and poultry products

Duration **:** Apr 2018 to Jun 2021

Budget **:** Tk 3,49,16643/-

Background: Consumption of chemically treated and/or adulterated foods those causes various serious diseases (like cancer, asthma, ulcer, etc.) has become a threat for the national health. Fish, meat, milk and their products including processed foods are also adulterated in different stages of processing and marketing. Food safety nowadays has become an important topic in Bangladesh as consumers of the country have become victim due to serious adulteration in food. Poultry meat and eggs are the two popular and easy-to-afford protein sources to the people. Most of the chemicals and

veterinary drug residues, either from feed or other exogenous uses, in animal foods may have some noxious effects on human health. Like fruit and vegetables, the use of health-hazard materials in livestock and poultry products became a serious issue in Bangladesh in the recent years. But, their usages are not been controlled. Under these circumstances, poultry feeds and poultry products need to be analyzed. Efforts should be given to identify the extent and steps of use of the hazardous materials, chemicals and their derivatives, and microbial contamination in poultry feed and their residual effects in raw and value added poultry products. The research initiatives under the PBRG sub-project were initiated with a goal at ensuring safe and nutrient enriched food production from poultry sources for increasing human nutrition intake.

Progress: A detailed baseline survey was carried out through structured questionnaire in five different locations namely Barishal, Dinajpur, Khulna, Savar, Chattogram and Rajshahi to document the present state of broiler and layer farming practices. Total 50 broiler farmers, 50 layers, 10 chick and feed dealers, 5 pharmacy owners, and 5 practitioners in each site were interviewed. The HSTU conducted survey at Rajshahi and Dinajpur/Parbortipur while the PSTU surveyed at Barishal, Khulna, Savar, and Chattogram. Poultry feed and chick dealers, poultry practitioners, and pharmacy owners in each locality were interviewed independently. Direct interviewing was used to collect the required information. Some broiler and Sonali breeds are selected for further trials on broiler to know quality of chicken meat. Now one experiment is being done. The next trial will be started on next month. Based on the findings, all the stakeholders regarding broiler and Sonali farmer and product manufacturers will be conscious to produce safe meat production and their value-addition. Total 19 commercial compound broiler and layer feed samples were collected from Barishal, Dinajpur and Savar. All feed samples were analyzed for various lincomycine, oxytetracycline, 4 epioxytetracycline, chlortetracycline, 4 epichlortetracycline, Pb, Cr, As, CP/CN, Ca, and P etc. Results indicated that some of the feed samples contained high amount of hazardous chemicals and toxic heavy metals; while some feed samples had low levels of nutrients especially CP compared to the requirement. Based on the laboratory analysis, some compound commercial poultry feeds are selected for further trials on broilers and layers to quantify their effects in chicken meat and eggs. The preparation for the first experiment is almost completed and trial will be started on next month. This will be the first step of implementation of planned research activities under the sub-project. Field and laboratory data is expected to collect and collate by a month time and subsequent necessary steps will be initiated.

5. Sub-Project Title: DNA marker-assisted breeding for producing highly stress tolerant elite rice varieties for coastal Bangladesh by introgression of multiple salt tolerance loci (QTLs) into commercial cultivars (ID 010)

Coordinator: Director (Research), BRRI, Joydebpur, Gazipur-1701

Implementing Organization: BRRI, DU

General Objective: To establish a fluorescent-based quick and easy system for target allele in a breeding program

Duration **:** Apr 2018 – Mar 2021

Budget **:** Tk 1,41,83,075/-

Background: Bangladesh is both one of the biggest producers and largest importers of rice in the world. Rice is not only a major staple food for millions of Bangladeshi but also contributes most of the total calorie intake (HIES, 2010). Bangladesh has a land area of 148 million hectares (Mha) and a population of over approx. 166 million with a density of 1128 persons per km^2. The population is going to grow about 200 million by 2050. Rice production will reduce by 14% than demand by 2050 (Kirby et al., 2016). Bangladesh, is a country of high population density, wrapped up by natural disasters like floods, cyclones as well as tornadoes. Moreover it has scarcity of natural resources and persistent poverty.Even though it has attained food security in recent years with the self-sufficiency in rice, more is needed for the rising population. This is particularly true for stress-prone areas like the South, where subsistence farmers are able to grow only a single annual crop of rice. According to the Bangladesh Bureau of Statistics (BBS, 2013); rice is produced on nearly 77% percent (11,528,261 Hectares**)** of total cultivated land in all three seasons.In Boro (in the dry season of November- May), Aman (in the main monsoon season of July-December) and Aus (in the early summer season of April-August) in all eight divisions of the country. BRRI scientists have already developed 81 modern varieties with diverse properties. However, by tackling various problems, particularly stress-prone zones, additional rice production in fallow lands can help in increasing rice productivity and can be one of the strategies for the country to reduce poverty and achieve its food security goals in target areas (BRRI, 2014; Regmi et al., 2016)

Progress: BRRI Component: The performance of the selected best 16 populations was tested in the saline prone area of Kaliganj, Satkhira, Bangladesh (Latitude: 22.453097; Longitude: 89.034659). For marker-assisted backcrossing, at first hybridization between donor and recipient was done separately. Two donor lines (I-71 and I-14) were simultaneously crossed with BRRI dhan63, BRRI dhan67 and BRRI dhan74 to generate F_1 seed (BRRI dhan63/I-14 & BRRI dhan63/I-71, BRRI dhan67/I-14 & BRRI dhan67/I-71, and BRRI dhan74/I-14 & BRRI dhan74/I-71) during Kh II season (T. Aman) 2018. Crossing was done in hybridization block of Plant Breeding Division at BRRI, Gazipur. Total 316, 133, 108, 123 and 119 F_1 seeds were produced from three different crosses of BRRI dhan63/I-14, BRRI dhan63/I-71, BRRI dhan67/I-14, BRRI dhan67/I-71 and BRRI dhan74/I-14, respectively. Then both positive plants (BRRI dhan63/I-14, BRRI dhan63/I-71, BRRI dhan67/I-14, BRRI dhan67/I-71 and BRRI dhan74/I-14) were selected by polymorphic SSR markers. Positive F_1 plants (BRRI dhan63/I-14 & BRRI dhan63/I-71, BRRI dhan67/I-14 & BRRI dhan67/I-71, and BRRI dhan74/I-14 & I-71) were crossed to develop double crossed F_1 seed (BRRI dhan63/I-14//BRRI dhan63/I-71, BRRI dhan67/I-14//BRRI dhan67/I-71 and BRRI dhan74/I-14//I-71) with combination of three QTLs in single recipient parent (BRRI dhan63, BRRI dhan67 and BRRI

dhan74) during Boro 2018-19. Total 975, 972 and 173 F_1 seeds were produced from double crosses of BRRI dhan63/I-14//BRRI dhan63/I-71, BRRI dhan67/I-14//BRRI dhan67/I-71 and BRRI dhan74/I-14//I-71, respectively. Later positive plants will be selected by foreground SNP markers for all three QTLs.

DU Component:

- **F_1 Confirmation by polymorphic SSR markers**
  Two separate crosses with selected donors i.e., I-14 and I-71 and three recipient cultivars (BRRI dhan63, BRRI dhan67 and BRRI dhan74) were done to produce two different F_1 for each recipient. DNA isolation of 330 F_1s was done by CTAB method.
  - A total of 75 and 17 F_1 plants were obtained from BRRI dhan63/I-14 and BRRI dhan63/I-71 crosses for recipient BRRI dhan63, respectively.
  - A total of 67 and 113 F_1 plants were obtained from BRRI dhan67/I-14 and BRRI dhan67/I-71 crosses for recipient BRRI dhan67, respectively
  - A total of 58 F_1 plants were obtained from BRRI dhan74/I-14 cross for recipient BRRI dhan74

Numbers of selected positive F_1 plants (heterozygous) with polymorphic SSR markers from each cross are shown in the following table.

Selected positive F_1 plants (heterozygous) with polymorphic SSR markers

Sl#	Recipient parent	Donor parent	Cross combination	No. of positive F_1 (heterozygous) plant
1	BRRI dhan63	I-14	BRRI dhan63/I-14	54
2	BRRI dhan63	I-71	BRRI dhan63/I-71	12
3	BRRI dhan67	I-14	BRRI dhan67/I-14	54
4	BRRI dhan67	I-71	BRRI dhan67/I-71	77
5	BRRI dhan74	I-14	BRRI dhan74/ I-14	50
Total				**247**

6. Sub-Project Title: Food-based initiative for improving household food security, income generation and minimize malnutrition (ID 011)

Coordinator: Member Director (Fisheries), BARC, Farmgate, Dhaka

Implementing Organization: BLRI, NSTU

General Objective: Identify the present socio-economic situations and livelihood pattern of the ethnic and coastal people by studying pattern and biological productivity of homestead resources (livestock and fisheries) with a view to increase food security and adequate dietary intake in terms of energy, protein, fat, vitamin and other micronutrients

Duration **:** Apr 2018 to Mar 2021

Budget **:** Tk. 74,16,980/-

Background: Fish, meat, milk and their products including processed foods are also adulterated in different stages of processing and marketing. The foods of animal origin also adulterated by mixing or

adding non-food ingredients, using preservatives, additives, coloring, flavoring chemical adulterants. Rice grain contaminated due to heavy metal contamination, pesticide contamination, fungal colonization and mycotoxin contamination, which may affect the public health. Significant improvements in food consumption and behavior have also been observed since 1992, with per capita daily calorie intake rising (from 2266 Kcal in 1991-92, to 2318 Kcal in 2010), as well as increases in the consumption of protein (from 62.72 g in 1991-92 to 66 g in 2010). The long-term solution to this problem is a food-based approach. Therefore, a food-based initiative to improving nutrition for household food security in Bangladesh should be undertaken with a long-term goal for sustainable improvement of food and nutrition of the rural poor. Fish and aquatic animals are much healthier source of protein compared to livestock commonly consumed by human (FAO, 1997). However, the production of fishes is not in harmony with the population growth. Polyculture is now the most common practice of carp culture and several species combinations and stocking rate have been developed. The greater Noakhali is situated in the central coastal zone of Bangladesh along the northeastern coast of the Bay of Bengal. Therefore, aquaculture practices in the new settlement area like the news chars are complex. Therefore, a food-based initiative to improving nutrition for household food security in Bangladesh have undertaken by the BLRI component of the sub- project with a long-term goal for sustainable improvement of food and nutrition of the rural poor. The eastern hill district Khagrachari is comparatively less developed area due to natural position and agro-ecosystem, low level of management in agriculture, migratory nature of people and distance form headquarters of development agents.

Progress: The technical activities completed are: recruitment of supporting staffs (01 scientific officer, 01 computer operator, 04 enumerators), selected 60 beneficiaries hh through 04 Participatory Rural Appraisals and baseline survey. The technological interventions made: distribution of goats, sheep, winter vegetables seeds and saplings, different seasonal vegetables (capsicum, broccoli, potato, sweet potato, yard long bean, sweet gourds etc.), year round creeper vegetables (cucumber, bitter gourd, bottle gourd etc.), and fruit orchards for year round fruit production (papaya, lemon, malta, dragon) to the selected household.

The NSTU component made field surveys on present status of polyculture, nutritional health and socioeconomic condition and fish diversity of the study area (120 homestead pond fish farmers) and selected 27 farmers based on their pond size, depth and ownership. Data analyses on these aspects are being continued. An experimental/ demo site was also selected for carp polyculture. Total 240 kg fish seed (*Catla catla, Labeo rohita and Cirrhinus mrigala and Hypophthalmichthys molitrix*) were distributed to the selected pond owners. After drying, fertilization and preparation, the ponds were stocked with

fish seed weighing 100- 250 g at the rate of 0.5kg per decimal. Formulated floating feeds were provided periodically to the pond owners twice a month. Besides this, a compost media made by urea, TSP, Rice bran, Maize, Cowdung, Molsase was supplied and periodically applied in the pond to *Labeo rohita* enhance the natural plankton. Water quality parameters were monitored and mean values were found not always in the suitable range for fish farming. Temperature, salinity and pH were within the suitable range. However, Dissolved Oxygen (DO) and transparency were very low. DO vary from 1.23 to 9.22 mg/l and transparency from 2-15 cm. Growth rate for fish was monitored every 10 days. For a period of 3 months culture period, the final weight of Rohu (*Labeo rohita)* varied from 250-300g, Catla (*Catla catla*) from 860-1100g, Mrigel (*Cirrhinus mrigala)* from 300-350g and Silver Carp (*Hypophthalmichthys molitrix)* from 600-650g. The growth rate for Catla was quite higher compare to other cultured species. In this culture cycle, only hatchery seed was used due to unavailability of natural seed at the culture time.

Micro-nutrients compositions of 11 normal and fermented rice varieties like BRRIdhan28, Najir, Pari, Miniket, Biroi, Aus, Tepi Boro, Guti, Sorna, Aman and Red Balam were analysed for Calcium (Ca), Iron (Fe), Potassium (K) and Sodium (Na) and to understand the level of contents under the changing fermentation process. This study is still under process.

7. Sub-Project Title: Development of lean season fruit varieties and management packages (013)

Coordinator: Chief Scientific Officer, Pomology Division, HRC, BARI, Gazipur-1701

Implementing Organization: Pomology, Pathology and Entomology Divisions of BARI

General Objectives: Development of lean season, high yielding and good quality fruit varieties and management technologies including insects and diseases to Improve income and livelihood of the people

Duration **:** Jun2018 to May 2021

Budget **:** Tk 20000000/-

Background: Except banana and papaya, most of the fruit species in the country are seasonal. As a result, more than 60% fruits are available during mid-May to mid-August and less than 40% during the rest eight months. Bangladesh has an immense diversity of 70 various fruit species. People get adequate quantities of fruits during the four summer months. In other months, there is an acute shortage of native fruits. At that time, Bangladesh imports a huge quantity of fruits at a cost of hard-earned foreign currency. The present annual production of fruit is about 45.80 lakh metric tons from an area of 1.40 lakh hectares (BBS, 2016), which is far behind of total requirement. The present availability of fruits is only 79 g/person against the requirement of 200 g. Fruits provide adequate quantity of vitamins, minerals, phytochemicals, organic acids, enzymes etc. Without nutritional security, food security can never be achieved. As a result of accomplishing intensive research through the proposed project, lean season fruit varieties as well as improved management packages are planned to be developed, to ensure availability of fruits in the lean period of the year with a view to mitigate the nutritional requirements and give additional income to the people. The sub- project is

being implemented by Pomology Division, Horticulture Research Centre, BARI, Gazipur; Breeder Seed Production Centre, Debiganj, Phanchagarh; Hill Agriculture Research Station, Raikhali, Rangamati and Regional Agricultural Research Station, Rahmatpur, Barishal.

Progress: The physical and financial activities of the sub-project actually started after the fund release by PIU-BARC in October 2018. The inception workshop of the sub- project involving three components was organized on November 26, 2018. The manpower recruitment like Scientific Officer-1 at Debiganj, Panchagarh; Scientific Assistant-2 one at Debiganj and another at Joydebpur, and 05 labors (at 4 sub-project locations) has been completed.

Collection, characterization and evaluation of the promising lean seasoned fruit germplasm has been started at all the sub- project locations under BARI. At Hill Agriculture Research Station, Raikhali, 3 germplasm of bullock's heart, 2 of pear and 1 each of ber, pummelo, pear, strawberry, avocado and mango were collected and planted in the research field. At Breeder Seed Production Centre, Debiganj, 4 germplasm of wood apple, 2 each of sapota, bullock's heart, custard apple, pummelo and jaboticaba and one each of burmese grape, ber, elephant's foot apple, phalsa and river ebony were collected from the northern part of Bangladesh. In-situ selection and characterization of one monkey jack germplasm is being continued at RARS Rahmatpur, and two off-season jackfruit germplasm were collected and planted in the research field.

Two fertilizer experiments on golden apple were completed at the Fruit Farm, Pomology Division, HRC, BARI, Gazipur. A study on propagation standardization at the BSPC, Debiganj, Panchagarh under the Component-I has been set and the data collection is continued. The fertilizer experiment with three doses (F_1: 100 % of the recommended dose; F_2: 150 % of the dose and F_3: 200 % of the recommended dose per plant mentioned in the FRG, 2012) and four different application methods (I_0: once in Sep/Oct; I_1: twice in Sep and Apr; I_2: thrice in Sep, Mar/Apr and May/Jun; and I_3: four times in Sep, Nov, Mar/Apr and May/Jun) was conducted during Sep 2018 to Jun 2019.In BARI Golden Apple-1, due to fertilizer application final plant height increased by 130 to 197%. The increase in N-S canopy spread and E-W canopy spread ranged from 179 to 387% and 208 to 505%, respectively. Maximum fruits retention per panicle was 3.08 in F_3I_3 followed by F_2I_2 (3.03). Maximum (31.92) fruits were harvested from F_2I_2 and minimum (10.00) fruits were harvested from F_1I_0. Finally, the yield/plant varied from 0.29 kg to 0.95 kg where the highest yield was noticed in F_2I_2 and the lowest yield was recorded in F_1I_0. In BARI Golden Apple-2, maximum (151.00) fruits were harvested from F_3I_2 and minimum (53.67) fruits were harvested from F_1I_0. Finally, the yield/plant varied from 2.30 kg to 7.59 kg with highest found in F_3I_2 and lowest from F_1I_0.

A survey and identification of major diseases and insect-pests of lean seasoned fruit crops were conducted in Barishal, Panchagarh and Gazipur regions under Component- II and Component-III, respectively. A study on the gummosis management of golden apple has been started at the Regional

Agricultural Research Station, Rahmatpur, Barishal under Component-II. Gummosis disease of golden apple and wood apple are the major problems in all the regions. Fruit dropping and die back of sapota, burmese grape (*Baccaurea sapida*) and gray leaf blight caused by *Pestalotiopsis* sp. were observed as minor diseases. Under Component-II, hogplum beetle and trunk borer of hogplum tree were noted as major insects in Barishal region.

8. Sub-Project Title: Integration of Postharvest Technologies and Best Practices in the Value Chains of Fruits and Vegetables (016)

Coordinator:CSO, Post-harvest Technology Division, BARI, Joydebpur, Gazipur

Implementing Organization: BARI, Joydebpur, Gazipur and DU

General Objective: To improve the quality and safety of fruits and vegetables by introducing new tools, machinery and means of harvesting, handling, packaging and cool chamber facilities to reduce post-harvest losses

Duration **:** Jun 2018–Jun 2021

Budget **:** Tk: 18477763/-

Background: Postharvest quality and produce safety are considered very important and prioritized by the government of Bangladesh. The country has enormous potentials of fruits and vegetables for domestic and foreign investments if critical requirements are maintained in the entire supply chain. Proper postharvest handling practices are important to reduce postharvest losses and improve overall harvest quality of fruits and vegetables. For the purpose, existing technologies should be improved and new technologies to be intervened. Growing populations of the country continue to create demand for fresh produce and processed horticultural products. Meeting these requirements as well as those of export markets necessitates assuring quality and safety in both domestic and export supply chains. Capacities must therefore be developed in order to respond to consumer and market demands. The integration of improved technologies such as use of simple postharvest tools and equipment, use of plastic crate or innovative packaging system along with the use of sanitizer and best practices would be able to reduce the postharvest losses to minimum. Mango is very much popular, nutritionally rich, commercially cultivated high value fruit. Bananas are available round the year and have the highest per capita consumption (BBS, 2014). Brinjal, cauliflower and carrot are high value vegetables and have significant role in agribusiness sector in Bangladesh. High postharvest losses of these crops are reported in the supply chain of country (BARI Annual report, 2008-2013). The present sub-project is designed on up-scaling and validation of potential postharvest technologies of the mentioned crops. Thus, this proposed sub-project ultimately aims in integrating improved tools for harvesting, handling, packaging and storage operations, cleaning and sanitization practices, and building capacity of stakeholders who directly involved in the value chain of selected crops.

Progress: In Postharvest Technology Section, HRC, BARI preparation of questionnaires for baseline survey, conducting survey in the value chains of target crops, data collection, compiling and analysis

of collected data, site selection for establishment of model pack house were the of major technical activities in 1st year. Survey was conducted on brinjal, cauliflower and carrot in target areas. Data were collected from the value chain actors (growers, beparies/suppliers and wholesalers) in the village and surroundings of Vatra, Mirazapur Bazar, Phulbari Bazar, Sherpur Bazar and Mahastan Bazar of Bogura district. Survey on mango and banana will be conducted in peak harvesting season of respective crop in 2nd year of sub-project period. Two sites were selected primarily for establishing pack house at the adjacent area of assembles market of selected fruits and vegetables. One was at Baneswar Bazar, Rajshahi for fruits (mango and banana) and another was at Vatra, nearby Mirzapur Bazar, Sherpur Upazila, Bogura. The latter was targeted for vegetables (brinjal, cauliflower and carrot). Procurement of office equipment were almost completed. It is expected, procurement of laboratory equipment and establishment of pack house and cool bot cold storage will be accomplished within the 1sthalf of 2ndyear. However, it will depend on fund release. Target studies on intervention of postharvest technologies in the value chain i.e. Execution of research programs on target crops will depend on establishment of pack house. All the research programs will be completed within the timeframe of 2nd year.

The FMP, BARI component done structural improvement of carrot washing machine and modification and fabrication of leafy and fruit vegetable washing machine during year of 2018-2019. The study on effect of temperature and humidity for different packaging on shelf-life and quality of carrot in cold storage was conducted during Mar 2018 and Mar 2019. Washed (sanitizer—CCA and NaOCl) and unwashed carrot 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, Saver, Dhaka at 0-1°C and 97-99% RH for long term storage. Generally, unwashed and washed carrot were stored in cold storage up to 2 months without occurring of any rotting and microbial load during Mar –May 2018. After 2 months storing of carrots, rotting and microbial load were observed in most of the treatments by DU. CCA washed carrots showed better performance in respect of colour and microbial load than unwashed and water washed carrots. The brightness of yellow colour of washed carrot prior storing was found better than that of unwashed carrot. It revealed that better yellow color was found in washed carrot by CCA than washed with NaOCl. The aerobic bacterial count (ABC) 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. 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 non-washed 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 parameter analyzed, non-washed carrot showed higher values compared with washed carrots. Washing cost of harvested carrot and stored carrots were 0.40 and 0.50 Tk/kg respectively. The storage charge of carrots was 10 Tk/kg for storing

4-6 months (March to June) in commercial cold storage. The market selling price of washed and unwashed carrots varied from 30 to 40 and 28 to 37 Tk/kg respectively. The purchase market price of harvested carrot was 15 Tk/kg. The benefit cost ratio was found to be 1.26 for storing in jute sack with polyethylene lining. Carrots were collected from commercial cold storage remained marketable condition (fresh, colour) up to 3 days at ambient condition (30° C and 60-65% RH). Carrot washing machine was improved adding larger wheel, auto delivery mechanism and replacement of pump. The developed leafy and fruit vegetable washing machine was used for washing brinjal, mango and banana.

9. Sub-Project Title: Development of Production Package for Export and Processing Potatoes to Sustain Productivity and Food Security in Bangladesh (020)

Coordinator: Director, Tuber Crops Research Centre (TCRC), BARI, Joydebpur, Gazipur

Implementing Organization: BARI, Joydebpur, Gazipur; SAU, Dhaka; Giant Agro Cold Storage, Dhaka and Quasem Food Products, Gazipur

General Objective: Development of processing and export quality potato through in-country hybridization and exotic variety selection in suitable locations with minimum cost

Duration : Nov 2018 – Jun 2021

Budget : Tk: **3,39,83,990/-**

Background: Exporting of fresh potato is in nascent stage for Bangladesh. Many neighboring and Middle Eastern countries need fresh potatoes for table consumption. There is also possibility of exporting potatoes to Russia and European countries; because their harvesting time is quite different from Bangladesh. Potato processing has come up with a little progress in last 15 years. More than 15 processing industries have been established, but most of those are out of operation due to shortage of quality raw materials. The produced potato in Bangladesh is not as good as that of the temperate countries. For economic processing and export, the fresh potato tubers should be of larger size, high in dry matter content, low in reducing sugar, good in crispiness and better in keeping qualities. As the duration of crop production period is short in Bangladesh, the tuber size is small and dry matter production is relatively low. As such, it is not well-accepted for export and processing. So, it is very much essential to develop varieties locally with high dry matter and low reducing sugar through positive selection. For immediate solution, available exotic varieties must be tested for suitability of the varieties for export and processing. Similarly, crop production techniques such as planting time, seed size, plant population, fertilizer dose, water application, etc. should be standardized to meet up with the required qualities of the processing tubers. In addition, the use of CIPC for storing potatoes at relatively higher temperatures can reduce storage cost as well as suppression of sprouts, but that has to be standardized through experimentation. The sub-project has been designed with a complete set of activities for present and future, which include variety development under Bangladesh condition, variety introduction from outside for selection, and testing of existing varieties for immediate use, agronomical studies for accelerated production of dry matter, enzymatic and biochemical analysis of the processed products at SAU (including a Ph.D. research fellowship for in-depth studies), cost

reduction studies at Giant Agro cold storage in Thakurgaon, and commercial viability study at Quasem Food Products Ltd. in Gazipur.

Progress: TheTCRC of BARI has already variety development programs of potato at BARI HQ, Joydebpur. The hybridization, clonal selection and variety screening experiments have been completed, and some experiments partially completed from TCRC set programs. Full set of experiments will be set up in the month of Oct, 2019. In the meantime next year's plan of work have already been approved; Technical Expert, Scientist and field staff have been appointed, Inception workshop and report completed, procurement plan has already been approved and submitted for purchase to the Procurement Section of BARI. At Joydebpur, among 109 genotypes, 64 produced flowers indicating 59% genotypes/varieties were able to flowering where 216 crosses were made. 77 crosses produced berries that mean 36% crosses were successful to form berry. In total 40 g seeds were obtained from 77 cross combinations. At Debigonj, 82% varieties produced flowers with varying degrees and 744 crosses out 2289 became success to form berry. A total of 320 g seed was obtained from 744 cross combinations. In total, 360 g hybrid seeds were produced from 2 locations (Table 3.1). Extracted seeds were dried and preserved at normal temperature in desiccators with silica gel.

Table 3.1: Performance of hybridization activities during 2018-2019

Items	Joydebpur	% Success	Debigonj	% Success
Number of variety planted	109	-	168	-
Number of variety flowered	64	58.72	138	82.14
Number of crosses made	216	-	2289	-
Number of crosses formed berry	77	35.65	744	32.50
Amount of TPS produced	40 g	-	320 g	-
Total Amount of TPS produced	360 g			

10. Sub-Project Title: Cost and Return Analysis of Selected Crops in Bangladesh (ID 021)

Coordinator: Member Director (AERS), BARC, Farm gate Dhaka - 1215

Implementing Organization: BARI, BINA

General Objective: To generate a complete socioeconomic database on major agricultural crops (except rice & sugarcane) cultivation practices at farm level

Duration **:** Jan 2018 – Jun 2021
Budget **:** Tk: 23199597/-

Background: Reliable data on costs and returns of crop production are needed to understand the underlying processes that influence the output and productivity of crop sector, and how these are impacted by new policies and regulations. Cost-return data can serve as a means of understanding and assessing farm operations. It allows producers to question their own operations and to benchmark it against the best practices of farms in the same region with similar physical characteristics. This in turn can lead to better farm-level decisions and improved market efficiency and performance. Resource

scarcity has led the production economists to think about the reallocation of existing resources to have more output with given level of input combinations or to produce a prescribed level of output with the minimum cost without changing the production technology. But there is a lack of information about the efficient use of inputs in crops production. Similarly, measurement of productive efficiency in agricultural production is an important issue, because it gives pertinent information for making sound management decision in resource allocation. Except for a few descriptive studies, econometric analysis has yet to be conducted to examine the production function for crops cultivation and its potential for future improvement. To formulate appropriate planning for the sustainable development of agriculture sector, reliable data on crop production are urgently needed. The proposed study will generate socioeconomic database on crop production which can be used by policy makers and extension personnel to fill up the knowledge gap in this sector. The sub-project is coordinated by AERS Division of BARC with two implementing partners: i. BARI Component and ii. BINA Component.

Progress: Until 1st year (June 2019) BARC, BARI and BINA completed site (district) and farmers selection, questionnaire preparation and pre-testing, manpower recruitment and related activities in compliance of the sub-project proposal. Required actions have also been taken by all participating organizations (BARC, BARI and BINA) under the sub-project to carry out field surveys. Under BARC component, data collection for Tossa Jute has been completed surveying 675 respondents in Faridpur, Jamalpur and Pabna districts. BARI completed data collection of 3960 respondents (for 8 crops viz. Wheat, Maize, Potato, Lentil, Bitter gourd, Garlic, Onion and Pineapple) in selected study areas. Similarly BINA accomplished survey of Mustard from a total 450 respondents in Tangail, Jashore and Sirajganj districts. Until Jun 2019, data collection was completed from 5,085 (43.46% of total) respondents out of 11,700 selected for the field survey of the sub-project. Alongside data editing, coding and computer entry of collected data for analysis are in progress as per schedule stated in the sub-project proposal. All these activities conducted simultaneously in the present year and to be continued afterwards. This report is principally based on information collected from activities/programmes conducted up to now under the sub-project during first year (Mar 2018 to Feb 2019). After completion of data analysis details result/information to be published/incorporated in the forthcoming reports.

11. Sub-Project Title: Development of Integrated Crop Management Technologies for Higher Production of Coconut in Bangladesh **(ID 026)**

Coordinator: Dr. Debasish Sarker, CSO & Head, Entomology Division, BARI, Joydebpur, Gazipur

Implementing Organization: Entomology, Pomology and Pathology Divisions of BARI, SSURDA

General Objective: Development of integrated crop management packages on production and protection aspects of coconut through on-farm validation and up-scaling of ICM packages

Duration **:** Jun2018–Dec 2020

Budget **:** k: **1,30,00000/-**

Background: In Bangladesh, coconut is considered as a crop of high economic value for its diversified uses. However, the yield is about 21 nuts per tree per year, which is very low, compared to other coconut-growing countries. Among the coconut growing countries of the world, Bangladesh ranked 19 in case of areas, while production status ranked 30 and yield 77 (FAOSTAT 2012). So, it is clear that there is enough space to increase production and yield of coconut in Bangladesh. This poor yield is due to lack of high-yielding varieties, inadequate nourishment with lack of pests and diseases management. Recently coconut farmers are seriously suffered by coconut **e**riophyid mite, along with other insect pests**,** viz. red palm weevil and rhinoceros beetle. **B***ud rot, grey leaf spot etc. are prevailing major disease problem, while root wilt and leaf rot diseases may be the serious threats for its future production.* Unfortunately in spite of the importance of coconut in the national economy, due importance has not been paid for the improvement of this crop. Recently steps has been taken to import high yielding varieties from different countries like Vietnam and India but very few works has so far been done on integrated nutrient, water and pest management.

Progress: Entomology Division, BARI coordinated the sub-project and surveyed insect pest and mite problems of coconut in seven locations viz. Barishal, Patuakhali, Jashore, Satkhira, Kushtia, Meherpur and Chuadanga. In addition conducted two experiment on `Bio-rational Management of Coconut Eriophyid Mite and Red Palm Weevil' using spray schedule of chemical and bio-pesticides. Pomology Division of BARI surveyed management practices (fertilizer, irrigation, hormone etc.) used in controlling bite attack in coconut. In addition, the Division set two experiments on `Effect of fertilizer and irrigation on flowering, fruiting and yield of coconut'. Similarly,Plant Pathology Division surveyed on disease incidence on coconut in the selected districts and conducted experiment on `Integrated Management of coconut diseases'. The SSURDA surveyed the present status of coconut production and management system in those districts. The findings/results of the experiments conducted by Entomology, Pomology and Pathology Divisions of BARI are yet to be available. In all the surveyed locations nut infesting eriophyid mite emerged as the most damaging pest of coconut. Rhinoceros beetle and red palm weevil were found as potential threat in all the surveyed locations. Incase of disease, pestalotia leaf blight, bud rot, stem bleeding and wilt diseases were recorded in different locations. In all the locations growers do not apply recommended fertilizers and follow standard cultural management practices. The survey findings are shown in the following table 3.2%

Table 3.2: Incidence and severity of major insect and diseases of coconut in surveyed locations in 2018-2019

Location	Mean percent plant infestation						
	Mite	Rhinoceros beetle	Red palm weevil	Leaf blight	Bud rot	Stem bleeding	Wilt
Barishal	96.67	30.00	8.33	75.00	0.00	0.00	0.00
Patuakhali	98.33	36.67	6.67	48.33	0.00	0.00	0.00
Jashore	100.00	68.33	2.67	28.33	5.00	1.00	1.67
Chuadanga	88.33	35.00	1.33	45.00	0.00	0.00	0.00
Shatkhira	73.33	11.67	2.33	20.00	0.00	0.00	0.00
Meherpur	60.00	65.00	6.33	0.00	0.00	0.00	0.00
Kushtia	75.00	5.00	5.00	0.00	0.00	0.00	0.00

12. Sub-Project Title: Up-scaling of Mud Crab (*Scylla olivacea*) Aquaculture in Bangladesh: Adoption of Innovative Techniques from Seed Production to Fattening and Health Management (ID 029)

Coordinator: Dr. Khan Kamal Uddin Ahmed, Chief Scientific Officer, Shrimp Research Station, BFRI, Bagerhat-9300, Mobile: +8801712103181; Email: kkuabd@yahoo.com, kkuabd@gmail.com

Implementing Organization:BARC, BFRI, KU

General Objective: Development and establish a framework of mud crab aquaculture for sustainable production through conducting research on each critical stages of life cycle in accounting the pathogenic (microbial) threats on respective stages

Duration : May 2018 - Apr 2021

Budget : Tk: 2,62,54,768/-

Background: Mud crab (*Scylla* spp*)*, an uncommon export oriented aquaculture has been exploiting commercially in Bangladesh since early 1980's around the coastal belt (Hasanuzzaman et al., 2014). Mud crab from Bangladesh is being exported mostly in live forms and the soft shell crabs in frozen forms. In 2013-14, Bangladesh earned $22.91 million by exporting 8,520 tons of live crabs. The demand and price of mud crab in the international market is increasing tremendously (Shelley and shelly, 2013). The noteworthy contribution of mud crab in foreign exchange earnings and providing livelihood opportunities made the sector as an industry in Bangladesh. Besides the hard shell crabs, the recent interventions of soft shell crab shedding has opened a new arena in mud crab aquaculture in Bangladesh. A few number of commercial soft shell crab shedding farms are operated in South-east and South-west coastal region. Both hard shells grow out and fattening as well as soft shell shedding practices are spreading exponentially. Despite the potential role in the national economy and livelihood improvement, mud crab aquaculture is not well established in Bangladesh except fattening. About cent percent of the crabs are being caught from natural sources thus caused intense pressure on the natural stock. However, beside aquaculture, brood stock development in captive condition and seed production in hatchery level and diagnosis of diseases are the bottleneck in mud crab sector.Thus, a collaborative research sub-project was developed and implementing jointly by Brackishwater Station of Bangladesh Fisheries Reseach Institute (BFRI), Paikgacha, Khulna; and Fisheries and Marine Resource Technology (FMRT) Discipline, Khulna University. BFRI conducting research on brood stock development, seed production and various aspects of culture and fattening of mud crab. Khulna University is dealing with bacterial infection/diseases in mud crabs in natural stocks and also in each respective trial conducted by BFRI.

Progress: The Brackishwater station of BFRI conducted experiment for brood stock development simultaneously in earthen ponds and cemented tanks. Brood stocks were collected from three different locations (Khulna, Satkhira and Bagerhat) and reared for berried brood production. Highest

Healthy mud crabs

spawning success (61%) and production of viable larvae (2.2±0.2 million) was observed for brood stock collected from Khulna region than other two places. Findings of this trial suggested collecting the brood stock from nearby locations assist to reduce stresses. The 2nd experiment was carried out on larvae rearing with three different feeding protocols, *viz*, T1: larvae fed with live feed only (rotifer+Artemia); T2: larvae fed with liquid diet (liquid rotifer+liquid Artemia); and T3: larvae fed with live feed+liquid diet. Larvae in T1 and T2 failed to metamorphosis to the crablet stage. Meanwhile, larvae in T3 metamorphosis into crablet (C1) stage after 29 days of hatching with the survival of 1.5%. Results of this experiment recommended a feeding scheme of live feed co-feeding with liquid diet/commercial for better performance in mud crab larvae rearing. The 3rdexperiment was done on larvae rearing with different water treatment plans, *viz,* water treated with pre-biotics (T1), with probiotics (T2) and with both pre and probiotics (T3). Higher larval stage index (LSI), faster metamorphosis in each stage and significantly higher survival of 5% at crablet stage was achieved from T3 (water treated with both pre and probiotics) than other two treatments. Result of this experiment suggested using the pre and probiotics to enhance the survival rate with minimizing disease incidence in mud crab larvae rearing. However, all these 3 experiments will be repeated in the next year for improvement and fine tuning. Additional experiments will also be conducted as proposed in the sub-project.

Regarding the disease incidence, Khulna University already collected primary data from field visits, and secondary data form books, journals, report etc. Healthy and unhealthy crab samples were collected from fattening farms. Some samples which were apparently infected have been collected from natural sources. The microbial analysis showed that the total bacterial load and *Vibrio* spp. load were comparatively higher in infected mud crabs. Samples from BFRI hatchery were collected; there was no *Vibrio* spp. conatmination and/or infection in BFRI samples.

During the reporting period, the BFRI coordination component arranged coordination meeting with the PI's and Co-PI's at each research site of the sub-projects to link up their activities with one another. Routine *in situ* supervision of each research component will follow as per work plan.

13. <u>Sub-Project Title:</u> Investigation and Characterization of Viral and Bacterial Diseases in Highly Consumed Fin Fishes and Shrimp in Bangladesh and Development of their Vaccines and Validation **(ID 030)**

Coordinator: Member Director (Fisheries), BARC, Farmgate, Dhaka

Implementing Organization: BFRI, BAU

General Objective: To control and reduce mass mortality of fin and shell fish due to bacterial and viral diseases and characterization of the causative agents through biological and molecular methods to establish better health management practices in fin and shell fish aquaculture with increased productivity.

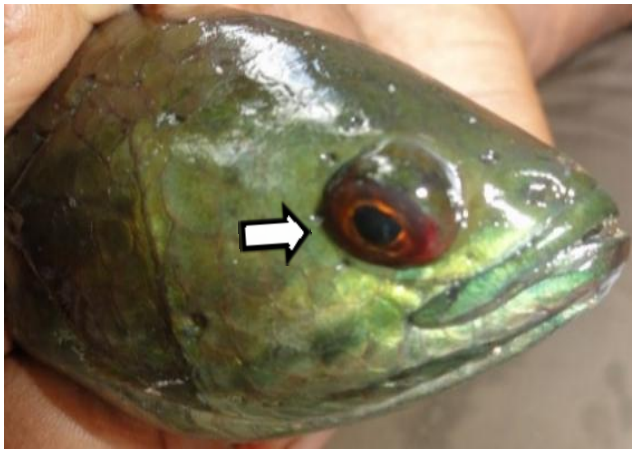
Duration **:** Dec 2017 - Jun 2021

Budget **:** Tk: 2,78,74,504/-

Background: Aquaculture in Bangladesh is growing rapidly with respect to both quantity and variety of fish species. From 2000 and 2016, aquaculture production increased from 712,640 and 2,060,408 metric tons which is much larger quantity than wild capture production (1.023 million tons) in 2015 (DoF, 2015). There are several viral, bacterial, parasitic and fungal diseases affecting total growth period (fry to adult) and their productivity in pond culture system. Though, most of the infectious diseases (parasitic and fungal) can be controlled easily but catastrophic viral and bacterial diseases which have not been detected or characterized and their control/preventive measures (through vaccination) are not available yet in Bangladesh. Freshwater fin fishes especially cat fishes, Tilapia and perch (Koi) fishes all over the world are reported to affect with the viruses of different families such as *Rabdoviridae, Orthomyxoviridae, Alloherpesviridae, Iridoviridae and Nodaviridiae* (Bowser *et al*., 1985). Among the infectious diseases, Bangladesh has the experiences of several outbreaks of bacterial and fungal diseases in cultured Tilapia. To sustain pond culture of Gulsha(*M. vittatus*) and their productivity at the farm level there is no alternative to isolate and identify the actual aetiological agent (yet unidentified) and to develop preventive measure against the agent which is responsible for mass mortality of Gulsha in pond culture although bacteria isolation has been failed from freshly collected dead fish.

Acute hepatopancreatic necrosis disease syndrome (AHPND), formally known as Shrimp early mortality syndrome, has recently caused serious problems in the shrimp culture industry. It occurs most frequently within the first 30 days after stocking a newly prepared shrimp pond. The aetiological agents of this disease of shrimp need to be identified and an effective preventive measure should be taken against the disease to sustain the productivity of Shrimp culture in Bangladesh. Considering the prevailing disease threats of fin and shell fish industry in Bangladesh, the principal aims of the present research has been set to know fin fish and Shrimp culture strategies and to investigate their diseases occurrence and health management problems in pond aquaculture through field observation and to isolate and characterization existing and emerging viral and bacterial agents from infected fish species and Shrimp using different cell lines (primary and continuous cell lines) and selective media. Finally, to develop highly effective vaccines with the isolated viral and bacterial agents with a view to control and eradicate the existing and emerging viral and bacterial diseases and develop specific pathogen free (SPF) fishes for future generation.

Progress: A total of five different species of fin fishes (*Koi, Tilapia, Shing, Gulsha and Pungash*) and *shrimp* mostly considered as highly consumed fishes those are generally affected with deadly bacterial & viral agents and causing high rate of morbidity &mortality. These species were selected for this study. A new disease of Vietnamese Koi known as **Popped eye disease** outbreak had been reported from cultured ponds of four different districts namely Mymensingh, Gazipur, Netrokona and Kishoregang during April to June 2018. Due to popped eye disease of Vietnamese Koi, mass mortality of the fish had been reported form each district during outbreak period. As samples freshly, dead and moribund koi fish had been collected from different ponds of four districts. Of the three



different types of bacterial species (*Streptococcus* spp, *Staphylococcus* spp and *E. coli* spp) a highly pathogenic bacteria *Streptococcus agalactiae* has been isolated and characterized for the Vietnamese Koi fish suffering from **popped eye disease** using various cultural, morphological, biochemical and molecular tests. The isolated bacteria *Streptococcus agalactiae* revealed characteristics sign, symptoms and death pattern in the experimentally induced infected healthy Vietnamese Koi fish in aquarium based infection.

Under the BAU component, Vietnamese Koi has been isolated, characterized and the inactivated vaccine was developed and validated successfully at the farm level. From the date of commencement of the sub-project, one vaccine (inactivated) for Vietnamese Koi fish which is responsible for high rate of morbidity and mortality of the fish was developed successfully by the joint effort of the scientists of the BFRI and BAU. Research works on other finfishes are also running simultaneously. *Aeromonus* spp has been isolated meanwhile from infected and dead Koi and Singh fishes and characterization of the organism has not been completed yet.

14. Sub-Project Title:Development of *in-situ* Breeding Technology of Prawn and Adoption of Sustainable Eco-Friendly Culture of Prawn and Shrimp (ID 031)

Coordinator: Director (Research and Planning), Bangladesh Fisheries Research Institute, Mymensingh

Implementing Organization: BARC, BFRI, KU

General Objective: To boast up Shrimp/Prawn production using sophisticated breeding technique and grow out management with reference to disease diagnosis & preventive measures

Duration **:** May 2018 - Apr 2021

Budget **:** Tk: 2,77,63,193/-

Background: Disease is always a problem, which harasses the healthy development of shrimp aquaculture. Both virus and bacteria can be dangerous pathogens of shrimp in aquaculture. Application of traditional antibiotics can alleviate bacteria disease, but traditional strategy used to prevent virus disease in vertebrate is not effective to cure virus disease of shrimp since no adaptive immunity exists in them. WSSV is one of the most dangerous pathogen that is highly virulent in penaeid shrimp. WSSV infection of penaeid shrimp can result in mortality of up to 90–100%.

Baseline study carried out by Khulna University showed that farmers are producing 300 to 600 kg per ha from this traditional gher farming system. However, prawn production in semi intensive system at stocking density 4-20/m^2 ranged from 500 to 5000 kg/ha/yr (FAO, 2016). Thus, Bangladesh has huge scope to get higher production through intensification. In addition, freshwater prawn aquaculture is threatened due to variety of factors such as misuse of antibiotics and drugs, pollution of environment, and spreading of severe diseases caused by bacterial and viral agents. Some of those bacterial and viral agents are already known; however, many of them have not been reported yet in Bangladesh. Thus, it is now important to identify the new and unknown pathogens, and determination of virulence

factors with mitigation measures. There is a national and international concern for preventing and controlling the diseases through new scientific approaches in order to make health-safe aquaculture product. Probiotics can be one of the alternatives to improve culture friendly water and soil quality, prevention of disease producing pathogen, increasing digestibility and immune competence of prawn. Thus, it is also important to isolate potential probiotics bacteria from the culture environment and go for their mass production in laboratory and pond, and attempt will also be taken to produce at industrial level.

Progress: The first experiment was designed to investigate the quality of different commercial probiotics available in the local market and their effects in growth and feed utilization in prawn culture. Among the twelve collected probiotics, six were selected through *in vitro* bacterial quality assessment. Thereafter, the good quality probiotics was selected for tank and pond trials to justify their effect on growth performance and feed utilization of *M. rosenbergii* according to the designed plan. The experiment was conducted in four different trials, pond trial 1 and 2, and tank trial 1 and 2. In pond trial 1, combination of zymatin and superbiotic had better performance in growth of prawn compared to their single dose, except final weight and weight gain. However, in pond trial 2, AquaclearS treated prawns were found to have higher growth performance compared to animals treated with combination of Profs and AquaclearS, Profs and control respectively (Table 3.3). In tank trial 1, combination of zymetin and biotics were found to have higher WG. In tank trial 2, AquabackP was found to have higher WG in *M. rosenbergii* compared to combination of SuperPS and AquabackP, and SuperPS.

Table 3.3: Growth performance of M. rosenbergii larvae in different probiotics treatment**.**

Trial at	Treatment	Initial wt (g)	Final weight (g)	DWG (g/d)
Pond	C1 (Control)	8±6a	22±7a	0.15±0.12a
	T1 (Zymetin)	11±8 a	31±11ab	0.24±0.15ab
	T2 (Superbiotic)	10±7 a	37±16ac	0.28±0.20ac
	T3 (Zymatin+Superbiotic)	9±6 a	33±15ad	0.28±0.19ad
	C2 (Control)	7±4	22±0.3a	0.16±0.02a
	T4 (Profs)	7±4	32±10.4b	0.19±0.04a
	T5 (AquaclearS)	7±4	36±1c	0.27±0.03b
	T6 (Profs+AquaclearS)	7±4	29±1ab	0.20±0.04ab
Tank	C1 (Control)	5±1b	6±0.7b	0.12±1.00a
	T1 (zymetic)	2±0.4b	4±0.5b	1.77±1.24a
	T2 (Biotics)	5±0.5b	7±0.7b	-2.02±0.64a
	T3 (Zymetin+Biotics)	2±0.5b	5±0.5b	1.55±1.10a
	C2 (Control)	2±0.2a	2±0.3a	0.01±0.01a
	T4 (AquabackP)	3±0.4b	4±0.4b	0.02±0.01a
	T5 (SuperPS)	5±0.6c	6±0.6c	0.002±0.01a
	T6 (AquabackP+SuperPS)	2±0.2d	3±0.3d	0.01±0.01a

15. Sub-Project Title: Techniques Adoption and Formulation of guidelines for Sustainable Management of Haor and Beel Fisheries (ID 035)

Coordinator: Member Director (Fisheries), BARC, Farmgate, Dhaka

Implementing Organization: SAU, SUST, RU

General Objective: To ensure sustainable fisheries development for Haor and Beel community through improved community based management approach

Duration **:** Jul 2018 - Jun 2021
Budget **:** Tk: 350,000,00/-

Background: The North-East region of Bangladesh is blessed with a special type of inland water ecosystem called as '*haor*' and rich with plenty of fisheries resources from the time immemorial. The *haors* are enriched with various aquatic biodiversity along with 140 species of fish. Kura River is a 15 km long connecting canal between Aral *beel*, a part of Hakaluki *Haor* and Dhamri *Haor* with rich aquatic biodiversity. Again, Aral *beel* and Dhamri haor is connected with Kushiara River. Sari-Goyain River is another important river with rich biodiversity originated from Assam, India and comes through Japhlong area of Sylhet. Considering the importance of these wetlands the study has been designed to identify the causes of water pollution, impact of climate change on the bio-diversity of the water bodies of the study areas, nature of losses of bio diversity, socio-economic conditions of fishers and to conduct aquatic ecosystem management involving respective communities to enhance aquatic biodiversity as well as increase fish production and reduction of poverty of the fishers.The Chalan *beel* is the largest and most important watershed in Northern part of Bangladesh. The watershed serves about 5 million people, predominantly through fisheries and agricultural activities (Hossain et al. 2009). Present sub-project will investigate and recommend suitable techniques for increased fish diversity and production and improved livelihood through building fisher's capacity and developing effective sanctuary and caged fish farming in Chalan *beel* areas.

Progress: The local people informed that about 25 years back in Shari-Goyain River there were 93 species of fishes and 5 species of shell fishes where 8% are abundantly available (AA), 15% commonly available (CA), 23% moderately available (MA) and 39% rarely available species. The current catch assessment survey found only 67 species where maximum number of fish species were found during the month of Oct (48) followed by Nov (45), Apr (38), Dec (37), Jan (34), Jun (33), Feb (30), Mar (27) and May (26). Gulsha, *Mystus cavasius* (19%) is the highest contributory species throughout the year followed by Boal (9%), Sal Baim (7%), Ayre (7%), Ilish (6%), Kalibaosh (5%), Fulchela (5%), Ghagla (4%), Batasi (4%), Laccho (4%), Sarpunti (4%) and JatPunti (4%). In case of plankton analysis, only 33 genera of phytoplankton and 11 genera of zooplankton were identified from the selected sampling spots. The hydro-chemical parameters of the river water were found to be fluctuating and crossing the suitable limits for survival of aquatic flora and fauna in Apr 2019.

Placement of R.C.C. hexapods in the sanctuary

During flash flood with coal mining effluents massive mortality occurred 3 times (Low: 24-26 Dec 2018, High: 8-11 Apr 2019 and Medium: 1-4 May 2019) in the Shari-Goyain River with estimated fish damage of 1,845, 12,474 and 3,248 kg, respectively during the study period where 14% of fishes were dead, 56% highly injured and rest 30% were less affected. Two sanctuaries and two pens have been

established in the study area to enhance fish biodiversity. About 60 kg mola and 10 kg dhela were stocked in each pen. After one month of its propagation both the pens open to allow all the mola and dhela along with offspring's for wider distribution in the open water. As an alternate livelihood options of the fishers' 9 cages have been set up in Ratargul Swamp Forest and 9 cages in Gurukchi River of Gowain gaht upazila. Pabda, Thai Pangus and Magur were stocked in the cages to observe the comparative production performance and economics. The fishes will be harvested at the end of July.

Considering the importance of this water body the study under SUST research is designed to identify the causes of water pollution, impact of upstream coal mining and climate change on the bio-diversity of the water bodies and nature of losses of bio diversity of the study areas. After assessing socio-economic conditions and occupational behavior of fishers, the study also aims to develop aquatic ecosystem management involving respective communities to enhance aquatic biodiversity as well as increase fish production and reduction of poverty among the fishers.

Laboratory experiments are conducted for determining water quality, climate change impacts will be accessed through measuring water temperature, salinity of water, rainfall records and rate of annual siltation on the river floor. Baseline survey has been conducted to know the socio-economic condition of fishers, market access and governance, their understanding about the conservation of bio-diversity and fish production in the study area.

A base line survey was conducted by RU to know the causes of failure of previously established fish sanctuaries and know the present status of diversity of fishes in Chalan beel. A total of 4 classes, 53 genera and 63 species which belongs to Chlorophyceae (25 species), Bacillariophyceae (17 species), Cyanophyceae (16 species) and Euglenophyceae (5 species) and a total of 4 groups, 20 species belonging to the group Rotifera (9 species), Cladocera (5 species), Copepoda (5 species) and Ostracoda (2 species) were recorded during the study period. For first year experiment (selection of suitable species for cage culture), 4 fish species (Pangus, Pabda, Magur and GulshaTengra) were selected for trial of cage culture. Medium sized cage (6 m x 3 m x 2 m) was used for this trial. A total of 12 cages were installed for this experiment. After a culture period of 120 days, a significantly ($P<0.05$) higher total and net production per cage were recorded form the cages with Pangas fish and lowest from the cages with the species of Pabda fish. However, based on the economic analysis, significantly higher benefit cost ratio (BCR) was found for Gulsatengra (0.73±0.09) followed by Magur (0.19±0.04), Pabda (0.12±0.01) and Pangas (0.03±0.01). Therefore, findings of the present experiment suggested selecting Gulsatengra for cage farming in Chalan beel area as alternative livelihood option for fishermen.

16. Sub-Project Title: Post-harvest Losses, Supply and Value Chain Analysis of Fisheries Sub-sector in Bangladesh (ID 036)

Coordinator: Member Director (Fisheries), BARC, Farmgate, Dhaka

Implementing Organization: BARC, BAU, PSTU,

General Objective: To assess post-harvest losses in each nodes of supply and value chain of capture, culture and marine fisheries in Bangladesh

Duration **:** Dec 2017 - Jun 2021

Budget **:** Tk: 3,77,03,559/-

Background: Fisheries sub-sector contributes 3.69% to the Gross Domestic Product (GDP), 22.60% to agricultural GDP and 2% to the foreign exchange earnings (BBS 2016; Ministry of Finance 2015). Post-harvest loss of fish in Bangladesh is also enormous. About 20- 30% in different fish and fishery products losses after harvesting, and 50 % reduction of such loss can save Tk.8,000-10,000 crore per annum (Nowsad at el. 2015, Nowsad, 2010). A problem in the supply chain for fish in Bangladesh is that the knowledge about post-harvest handling is limited and post-harvest losses are high. Losses occur in all post-harvest activities such as handling, storage, processing, packaging, transportation and marketing. Long distance between production and consumption areas is also one of the main causes of post-harvest losses. Post-harvest losses occur within the whole supply chain due to limited resources such as post-harvest technology, knowledge and infrastructure (Parfitt et. al 2010). Analysis of post-harvest losses, supply chain and value chains requires detailed micro-level data. But there is no countrywide in-depth study on these issues. Previous research works provide only the amount of losses and supply chain of some specific species in a specific area. Thus, the present study is being conducted to generate countrywide information on post-harvest losses, supply chain and value chain structure of capture, culture and marine fisheries which will enhance production, processing and marketing of different species of fishes and reduces post-harvest losses of fish in Bangladesh.

Progress: Total progress so far done under the coordination component is about 32%. Reporting activities (like inception report, submission of SoE, half yearly reporting etc.) has been performing as per prescribed schedule of work and reporting.

Bangladesh Agricultural University (BAU) and Patuakhali Science and Technology University (PSTU) jointly conduct this research. Both components (BAU and PSTU),data and necessary information were collected from primary and secondary sources covering all 64 districts. Considering the conveniences the study area divided between BAU and PSTU component. BAU component covered four divisions viz. Dhaka, Rangpur, Rajshahi and Sylhet. PSTU covered Dhaka (5 districts), Barishal, Khulna and Chattogram divisions. PSTU component covering capture, culture and marine fisheries under these four divisions. The BAU component selected 14250 (apprx) samples following multi-stage stratified random sampling technique from 32 districts of Dhaka, Rangpur, Rajshahi and Sylhet division. Total sample are divided into culture and capture fisheries based on the share of production according to DoF statistics (DoF, 2015-2016). A set of survey questionnaires were developed and pre-tested in Mymeningh, Kishoreganj, Sirajganj, Rajshahi, Pabna and Natore district for capture and culture fisheries, and associated markets. To date, 1661 respondents from different stakeholders were interviewed by the enumerators.

PSTU selected 18320 (apprx) samples following multi-stage stratified random sampling technique from different actors of fish supply and value chain. Total sample are divided into culture, capture and marine fisheries on the basis of share of production according to DoF statistics (DoF, 2015-2016). A set of survey questionnaires has been developed to collect necessary information on hatchery and nursery production, fish farming, catching fish from inland and marine water, fish processing and exporting, postharvest losses in every stages of every species of fishes, etc. The developed survey questionnaire were pre-tested in Barishal, Patuakhali, Jashore, Satkhira, Khulna, Feni, Cumilla, Chattogram and Cox's Bazar district for capture, culture and marine fisheries, and associated markets. After necessary correction, the survey questionnaire has been translated into Bangla for the better understanding of the enumerators and then started data collection accordingly. The study is under the stage of data collection, analysis and reporting to done in successive years.

17. <u>Sub-Project Title:</u>Improvement of Existing Fattening Technology of Carp and High Valued Small Indigenous Species (SIS) through Good Aquaculture Practices (GAP) in Different Agro-Ecosystems **(ID 037)**

Coordinator: Member Director (Fisheries), BARC, Farmgate, Dhaka

Implementing Organization: RU, PSTU,

General Objective: Improve food security, income and livelihoods of fish farming community through enhanced training and capacity of the entrepreneurs/farmers by developing sustainable carp fattening and SIS fish farming following good practices along with live fish transportation technique and marketing strategies and promoting viable solutions to market constraints

Duration **:** Dec 2017 - Jun 2021

Budget **:** Tk:3,79,98,612/-

Background: The fisheries sub-sector of Bangladesh as an important component of agricultural activity consider as the most potential source of economic and employment generation and a vital source of animal protein provider, as well. The sector is highly diverse in resource and species type. In the recent years though there has been a steady and rapid growth of aquaculture and fish food production, income generation and livelihood improvement of fishers but in spite of that there still prevails/exists fish production gap in the country which has been widening every year because of higher population growth rate. The scientist community and the policy makers of the country indicate the weakness in research capacity of the institutes and research-extension linkage are the two most vital and responsible causes for this. Thus to address the situation through establishing strong research support and linkage, as NATP-II thoughts, all research and extension institutes need to make strong footing with team building holistic research culture to achieve desired output. With this consideration, as an effective approach, the Program Based Research Grant (PBRG) of NATP-II is particularly aimed to support coordinated research program amongst NARI to jointly combating national agricultural problems and strengthening the research and research management capacities of the institutes. Therefore, under the principal objective of NATP-II, the fisheries division co-

ordination component shall have to play the role to ensure smooth and efficient implementation of sub-project activities to achieve the desired project output through coordination of activities and strong and effective monitoring of research progress under an additional increased research support against each institute.

Progress: Total progress so far done under the coordination component is about 28%. Reporting activities (like inception report, submission of SoE, half-yearly reporting etc.) has been performing as per prescribed schedule of work and reporting. Rajshahi University (RU) and Patuakhali Science and Technology University (PSTU) jointly conduct this research. Both for RU and PSTU components, data and necessary information collected from both primary and secondary sources covering all the 64 districts for this research.

Under the specific objectives, the RU component so far conducted two separate experiments on carp fattening and SIS fish farming followed by a baseline survey.

Recommendations are also made for suitable species combination in carp fattening and suitable species in SIS fish farming. The PSTU component, in addition to study the water quality parameters and planktons of the selected research ponds, has also completed study on specific growth rate, survival, weight gain of the selected fish species like Catla, Common carp. Silver carp, Magur, Gulsa and Shing etc. in the pond of selected farmers and rural distress women.Other observations on growth studies of fish species are: a) Common carp showed highest Specific Growth Rate (SGR) among the carp ponds, whereas Silver carp and Catla showed the second and third highest SGR respectively and mrigal showed the lowest, b) Mean survival rates of various species ranged from 93-96%, silver carp showed the highest survival rate while mrigal showed the lowest, c) Common carp gained maximum weight but Mrigal showed the lowest, d) Significant differences of SGR were found in SIS ponds. Magur (3.92) showed the highest SGR followed by Shing and Gulsha and e) Magur showed the highest survival rate (95%) and Gulsha found the lowest %.

18. <u>Sub-Project Title:</u> Adaptation and Scaling up Agroforestry for Livelihood Improvement of farmers in Agricultural Ecosystem of Bangladesh(ID 049)

Coordinator: Chief Scientific Officer, On-Farm Research Division, BARI, Gazipur

Implementing Organization: OFRD, BARI, Gazipur; OFRD, Pabna; OFRD, Rajshahi; OFRD, Rangpur; OFRD, Patuakhali; OFRD, Bandarban

General Objective : Farmers livelihood improvement and ensuring food security through adoption of innovative agro-forestry technologies

Duration **:** Dec 2017- Jun 2021

Budget **:** Tk 10000000

Background:

Agroforestry system can contribute stable income, food and nutrition security, savings and insurance and a potential means of risk management under climate change induced stress (Akteretal.1989; Evans1988). At present there search addressing soil and water conservation, reduce soil erosion,livestock feed management, fuel energy, tree-crop interaction for higher productivity and environmental benefit under integrated agroforestry system are getting high priority to combat climate change challenges (SAC,2015). In hill ecosystem, agroforestry (contour hedge rows) on steep hill slopes (40-50%) can reduce soil erosion by 55-80% and runoff by 30-70% compared to shifting cultivation (Khisa,2001). BARI developed Multi-Strata Fruit Orchard (MSFO) found suitable for preventing soil erosion and degradation and in-creased cropping intensity in hill areas (Paul and Hossain,2001). On-Farm Research Division of Bangladesh Agricultural Research Institute (BARI) has developed homestead based agroforestry model through holistic approach in its 9 FSRD sites in different ecosystem increased production (50.93 and 146.56%), food intake (68.67 and 124%) farm net income (326% and 115%) from homestead agroforestry with year-round vegetables and fruits respectively over existing farmers practice (OFRD, 2015). Presently the research on screening of crops and their management under the niche of rapidly growing fruit orchard in rural areas is gaining increasing demand by the farmers.

The Bangladesh Agricultural Research Council (BARC) has identified new potential area of agroforestry research and development at cropland, homestead, hill, coastal, rainfed and charland under different ecosystem and given priority on coordinated research aiming food and nutrition security of peoples in those stress environments. Therefore, the proposed research concept is designed to conduct research aiming to find out innovative technologies and dissemination of developed agroforestry in different ecosystem of Bangladesh.

Progress: Different agro-forestry systems were conducted under study. Guava based systems conducted at FSRD site, Gongarampur, Pabna; Litchi based system at FSRD site Ojoddapur, Rangpur Sadar, Rangpur and Mango based agro-forestry system at FSRD site Bashantapur, Godagari,Rajshahi. Under guava at Pabna the production of tomato, cauliflower and cabbage were recorded 71.60, 64.75 and 92.50 ton ha^{-1} respectively. Fruit yield of guava during off season was recorded 1.85, 3.17, 2.38 and 2.46 ton ha^{-1}respectively. Maximum fruit equivalent yield was obtained from guava+ tomato (26.20 t ha^{-1}) followed by guava+ cabbage and guava+ cauliflower. Probably due to higher market price of tomato, guava+ tomato system exhibited remarkably higher fruit equivalent yield. Regarding economic benefit, all vegetables grown in guava based agroforestry system exhibited remarkably higher gross return and gross margin compared to sole guava orchard. However, guava based agroforestry system with tomato demonstrated very handsome return due to high market price of tomato.

Under litchi system at Rangpur the production of napa, radish, Indian spinach and garlic were recorded 17.78, 8.65,19.51 and 4.94 t/ha respectively. Relatively higher crops production was noted in Indian spinach. Fruit yield of litchi during season was recorded 6.72, 6.87, 6.34, 6.82 and 6.46 t/ha respectively. However, relatively higher fruit yield of litchi 6.87 was observed when radish was grown in

association with litchi trees. Maximum fruit equivalent yield was obtained from litchi + garlic (13.50 t/ha) followed by litchi + Indian spinach and litchi + napa shak.Probably due to higher market price of garlic, litchi + garlic system exhibited remarkably higher fruit equivalent yield.Regarding economic benefit, all vegetables grown in litchi based agroforestry system exhibited remarkably higher gross return and gross margin compared to sole guava orchard. However, litchi based agroforestry system with garlic demonstrated very handsome return due to high market price of garlic.

Under mango based agro-forestry system at Rajshahi the higher seed yield was obtained from lentil (1.36 t/ha) which was identical with that of chickpea (1.35 t/ha) and grass pea (1.25 t/ha); and the lowest one was recorded from pea (1.15 t/ha). These different is mainly due to yield potentiality of different pulses. As the crop were different, lentil equivalent yield (LEY) was considered for economic yield. The LEY was the highest in chickpea (1.53 t/ha) as its market price was maximum among the said pulses. The lentil ranked second and its LEY value was 1.36 t/ha. The grasspea gave the lowest LEY (0.82 t/ha) and it was identical to pea (0.87 t ha^{-1}). Cost-return analysis was done for assessing portability. The highest gross return (Tk. 91800/ha), gross margin (Tk. 62270/ha) and BCR (3.10) were recorded from chickpea. The lentil gave the second highest values for the said parameters. The grasspea recorded the poorest performance regarding the said parameters. However, production cost was the maximum in lentil mainly due to pesticide cost. The chickpea production cost was second and the lowest one was in pea (Tk. 19715/ha).

Table 3.4: Gross margin obtained from different agro-forestry systems at varying locations

Pabna		Rangpur		Rajshahi	
Agroforestry system	**Gross margin (Tk/ha)**	**Agroforestry system**	**Gross margin (Tk/ha)**	**Agroforestry system**	**Gross margin (Tk/ha)**
Guava+ Tomato	1199200	Litchi+ Napashak	712946	Mango + Pea	238135
Guava+ Cauliflower	621800	Litchi+ Radish	626855	Mango +Grass pea	241100
Guava+ Cabbage	693800	Litchi+ Indian spinach	866924	Mango + Chickpea	300070
Guava mono	18000	Litchi+ Garlic	938125	Mango + Lentil	267450
		Lichi mono	441880	Mango mono	210250

19. Sub-Project Title:Validation of Crop Intensification Technologies for Improving System Productivity, Soil Health and Farm Income in South Central Coastal Region (ID 051)

Coordinator: Director (Res), BARI, Joydebpur, Gazipur

Implementing Organization: Soil Science Division, BARI; Oilseed Research center, BARI and Agrarian Research Foundation, House # 48, Road # 5, Pisciculture Housing, Mohammadpur, Dhaka- 1207

General Objective: Increasing farm income through intensive crop production and improving farmers' knowledge and skill through training, conducting on-farm trials and demonstrations on improved agricultural production technologies in south central coastal region

Duration : Oct 2018 - Jun 2021

Budget : Tk: 1,56,25,000/-

Background: Coastal agriculture relies heavily on rainfall and tidal water. Irrigation remains scarce. Rainfall is becoming more erratic probably because of climate change. High rainfall variability and recurrent drought/flood cycles disrupt food production, particularly where crops are grown in marginal lands with low inputs. Sea level rise and increased frequency of storm surges are aggravating the problem of coastal flooding, hitting the most vulnerable hardest. Bangladesh in general and coastal region in particular is vulnerable to climate change. Impact of climate change is increasingly visible through frequent cyclones and tidal surge that damage crops, properties, and lives imposing additional stresses to already delicately balanced agro -ecosystems. Vulnerability of rice production to climate change in the coastal regions have been documented. Given the current prediction of temperature increase and sea level rise, there will be a substantial decrease in future agricultural productivity in the region. It is against this backdrop climate resilient agricultural production system needs to be developed. Adapting to climate change and stimulating agriculture to drive development require greater agricultural research, integration of natural resource management into agricultural production, knowledge, education and skill development, and use of collective action to organize, engage and drive rural communities into production. This research sub-project seeks to gain better understanding of the bio-physical and socio-economic factors constraining and promoting crop production, developing and adopting better crop production technologies in order for increasing agricultural production and improving rural economy in selected six southern central districts. The sub-project proposal is in line with the governmental policies, objectives and strategies of improving agricultural production.

This sub-project was developed in order for increasing cropping intensity in the south central coastal region incorporating dry season crops (grasspea, mungbean and sesame) in fallow-transplanted aman rice system. Beginning Jan 2019, the sub-project is being implemented by two components of BARI i.e. Soil Science Division and Oilseeds Research Center, and Agrarian Research Foundation (ARF) under the leadership of Director Research, BARI.

Progress: The BARI component (Soil Science) started the sub-project in Jan 2019 and completed baseline survey by collecting the existing yields of T. Aman, mungbean, mustard, kheshari etc. with socio-economic profiles of surveyed farm households. After baseline survey the institute introduced three crop based cropping pattern like kheshari – kangkong – T. aman and mustard – mungbean – T. aman against the existing two or single crop based cropping pattern in the region

(Gopalgonj) like rabi – jute – fallow or rabi – fallow – T. Aman or rabi – boro –fallow or boro – fallow – fallow. By Jun 2019 the component planted kangkong and mungbean crops in Kharif I season (17-19 Mar 2019) and harvested with good yields. Under cropping pattern trials, two levels of treatments viz. variety (Kangkong: BARI Gimakalmi-1, Sabuj pata (local), Golden seed (local); Mungbean: BARI Mung-6, BARI Mung-8, Binamung-8) and fertilizer rate (FRG 2018, IPNS on STB and Farmers practice) were taken as variables to measure the highest yield levels of the crops under consideration. The experiemnts were set in two locations/Upazila i.e. Sadar and Kashiani of Gopalgonj district. The yields of crops in different locations are shownin table 3.5 and 3.6.

Table 3.5: Yield of Kangkong (t/ha) in Sadar and Kashiani Upazila of Gopalgonj during 2018-19

Kangkong (Crop variety)	**Yield (t/ha) by Location**		**Mean (t/ha)**
	Sadar	Kashiani	
BARI Gimakalmi-1	105	90	98
Sabuj pata (local)	95	79	87
Golden seed (local)	96	72	84

Table 3.6: Yield of Mungbean (t/ha) in Sadar and Kashiani Upazila of Gopalgonj during 2018-19

Mungbean	**Yield (t/ha) by Location**		**Mean (t/ha)**
	Sadar	Kashiani	
BARI Mung-6	1.60	1.52	1.56
BARI Mung-8	1.42	1.36	1.39
BINA Mung-8	1.48	1.40	1.44

It has been reported that among the fertilizer trials IPNS found better than farmer practice. On the other hand BARI Gima Kalmi-1 yielded better than local varieties (15% higher). Among the mungbean varieties, BARI Mung -6 yielded better than Bina mung-8 and BARI Mung -8.

As third crop of both the cropping pattern, T. Aman has been planted in last week of Jul 2019. As reported, the growth performance of T. Aman rice (BRRI dhan 57, BRRI dhan 71 and BRRI dhan 75) is better than the locally adopted variety (long duration local variety like Sarna etc.).

The ARF component conducted baseline survey drawing 31(16+15) farm households in Apr 2019. Results revealed that nearly 100% farmers in two surveyed Upazilas used to grow T. Aman rice during wet season while only 29% planted dry seasoned crops dedicating smaller areas. Farmers preferred crops are grasspea and mungbean; but productivity of dryland crops is very low (table 3.7).

Table 3.7: Results of baseline survey conducted in Apr 2019

Season	Crop (s)	% Farmer grown	Area (ac) planted/hh	Yield (Kg/ha)
Wet Season	T. Aus	26	0.86	2588
	T. Aman	100	1.98	2863
	Vegetables	10	0.28	3600
Dry Season	Boro rice	23	0.65	2570
	Kheshari	39	0.64	206
	Mungbean	55	0.40	439
	Sweet potato	06	0.07	30348
	Sweet gourd	03	0.01	6175
	Others	45	0.23	2405

20. Sub-Project title: Introduction of Profitable and Agro-Ecologically Suitable Crop Varieties and Development of Marketing Systems for the Charlands of Northern Bangladesh (ID 054)

Coordinator: Chief Scientific Officer, On-Farm Research Division, BARI, Gazipur

Implementing Organization: OFRD, Rangpur; OFRD Gaibandha and BAU, Mymensingh

General Objective: Farmers livelihood improvement through introduce of high value crops and development of marketing system in northern charland

Duration : Apr 2018- Jun 2021

Budget : Tk: /- 10000000

Background: Charlands are highly dynamic as they disappear or reappear due to erosion or accretion. Since the chars are formed through the continual process of land erosion and deposition on the major rivers and coastal areas, the whole of the char land is unstable and prone to annual flooding. The soils are deficient of most of the plant nutrients, have very low organic matter contents and minimum moisture holding capacity, especially in the northern and middle region chars (SRDI, 2001). Bangladesh has acquired 5471 square kilometres of new land until 2010 since independence in riverine areas (Hasan et al., 2013). This has been a blessing for the small country where agricultural land is less than 14 decimals/capita (Ministry of Land, 2015) and it is shrinking every year at an alarming rate of 0.005 ha/capita/year since 1989 (Hossain and Bari, 1996). The total charland area in Rangpur, Kurigram, Gaibandha and Lalmonirhat districts are 77895 hectares and among them about 79% are cultivable (DAE, 2016), but unfortunately those are mostly underutilized or used for low-value crops production. In general, the agricultural productivity in charland is less due to low fertility, river bank erosion,

poverty, less intervention of modern agricultural technologies/varieties and also minimal services from government and NGOs. The farmers are also getting less product price due to non-diversified and low-value crops, improper marketing channel, middle man, inefficient transportation system etc. Therefore, addressing the above situation, utilization of vast northern charland for increased high-value crops production, income generation and livelihood improvement would be possible by generating and adopting appropriate technologies/approaches including promotion of business, and these are the aspiration of the sub-project.

Progress: The sub-project activities have been designed to implement in a participatory approach in the farmer's field at three locations from three northern districts i.e. Char Begumganj, Ulipur of Kurigram district; Char Jagatber of Lalmonirhat district and Char Chandanpat and Nalsia of Saghata, Gaibandha district. The locations of the study has been selected on the basis of season, stable and unstable char, communication, climatic, edaphic, social, vegetation and economic conditions of the regions so that the sites be representative.

The trials were designed to assess the suitability of BARI released high yielding crop varieties for the char lands, where improve varieties were compared with locally adapted cultivars/varieties. The execution of the trials was started on Sep 2018 and continued until Mar 2019. The yield of the tested crops are shown in the following table 3.8. In all locations, the production of crops per unit area exceeded the existing yield of the respective crops. Highest yield increase obtained from foxtail millet followed by sweet potato, blackgram and potato. During the occasion of field day the farmers assured to change their existing crops by the tested BARI varieties in next cropping season.

Table 3.8: Yield of crops grown in different locations

Name of crop	Gaibandha		Kurigram		Lalmonirhat		Mean		Change (%)
	Sub-Project	Control	Sub-Project	Control	Sub-Project	Control	Sub-Project	Control	
Potato	21.88	19.06	20.76	17.36	24.44	21.59	22.36	19.34	14
Sweet potato	36.35	23.26	21.38	16.33	31.53	20.54	29.75	20.04	33
Corn	9.39	8.94	9.19	8.66	9.26	9.73	9.28	9.11	2
Sweet gourd	16.88	11.36			28.41	31.70	22.65	21.53	5
Bitter gourd			4.00				4.00	0.00	
Lentil	1.13	0.68	1.34	0.90	1.38	1.32	1.28	0.97	25
Onion	8.56	7.12	8.46	7.40	3.60	3.38	6.87	5.97	13
Blackgram	1.12	0.99	1.68	1.32	1.33	1.03	1.38	1.11	19
Chili	8.46	8.66			8.60	7.57	8.53	8.12	5
Peanut	3.05	2.80	2.29	1.79	2.10	1.98	2.48	2.19	12
Foxtail millet	2.83	1.35	2.45	1.85	1.69	1.42	2.32	1.54	34

21. Sub-Project Title: Integrated Farming Research and Development for Livelihood Improvement in the Plain land Eco-system (ID 061)

Coordinator: Member Director (P&E), BARC, Farmgate, Dhaka

Implementing Organization: BARI, BRRI, BFRI

General Objective: To improve livelihood of rural households through generation and adoption of Farming System Technologies

Duration : Feb 2018- Jun 2021

Budget : Tk: 37000000/-

Background: The study area comprises Active Tista Flood Plain (AEZ 2- medium high land 72%: Rangpur); Karatoya- Bangali Flood Plain (AEZ 4- high land 23%, medium high land 44%, medium low land 14%: Pabna); Active Brahmaputra and Jamuna Flood Plain(AEZ 7- medium high land 37%, medium low land 20%: Tangail); Young Brahmaputra and Jamuna Flood Plain(AEZ 8- high land 18%, medium high land 42%, medium low land 19%: Sherpur) and Madhupur Tract (AEZ 28- high land56%, medium high land 18%) and Gazipur. Major crops grown in these areas are rice, wheat, maize, jute, pulses and oil seed. Under irrigated situation major cropping pattern are Boro- T. Aman, Mustard, Wheat-Jute-T.Aman, Maize- Mungbean-T. Aman, Potato- Boro- T. Aman etc. BARI and BRRI have already developed improved cropping pattern with management practices involving 3 or 4 crops. Besides,BFRI and BLRI also developed improved technologies on calf rearing, poultry rearing and high value fish culture. Verification of new technologies, integration of different farming components for livelihood improvement and dissemination of proven technologies developed by NARS institutes on crops, cropping pattern, climate resilient options, resource conservation technologies, plantation crops, homestead production systems, fish, livestock and poultry production as well as other income generating activities will be included in this sub-project under plain land ecosystem.This sub-project has been coordinating by Planning & Evaluation Division of BARC in partnership with On-Farm Research Division (OFRD) of the Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur, Bangladesh Rice Research Institute (BRRI), Joydebpur, Gazipur and Bangladesh Fisheries Research Institute (BFRI), Mymensingh from Feb 2018 .

Progress: After completing the baseline survey Homestead Vegetables Production models are established in Feb 2018 to Jan 2019. Vegetables production increased by 225-280% with intake by 188% as compared to before intervention (79 kg per farm family per year). Average intake of fruits/year was also increased (57%) after intervention of the technology compared to before intervention (239 kg per farm family per year).

Only one or two crops under three (Mustard-Boro-T. Aman) or four crops based cropping pattern (Potato/Sweet gourd- T. Aus- T.aman) were harvested during the reported period, and results revealed that farmers obtained higher yield and economic return from their alternative or improved cropping pattern with improve varieties and better management practices.The overall result of those experiments

showed that farmers got higher yield and economic return than their previously used variety and cropping pattern.

Attempts were made to eradicate major diseases from cattle and poultry through proper vaccination at sub-project site. Due to deworming and vaccination program of cattle gross margin was increased around 35-45% over pre intervention.Mortality of poultry reduced (76-88%) after vaccination.

Under fisheries program, fingerlings like Silver carp, Rajputi, Rohu, Catla, Mrigel, Mirror carp, Pabda and Shing 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 among the seasonal fish culture carp polyculture gave a satisfactory gross margin (Tk.7880-9300 $pond^{-1}$). Pabda culture at pond gave higher gross margin (Tk.7700-9550 $pond^{-1}$) relatively more profit than Shing (Tk.4900-6125 $pond^{-1}$).On the other hand, among seasonal fish culture Gift Tilapia gave higher gross margin.

Women were engaged with weaving *Katha*, sewing cloths with machine, making different handicrafts with jute rope and plastic Bag, Mat, coconut stick,kumra bora and preparation of pickle.

BRRI undertaken total 15 activities during Feb 2018 to Jan 2019. The research activities were on homestead production system, crops and cropping system, livestock system, fisheries system, sapling distribution, fruit tree management in the homestead and women empowerment. In crop component, high yielding newly released aus varieties were introduced. Through on-farm trial BRRI dhan 48, BRRI dhan 82 and BRRI dhan 83 yielded on an average 4.6, 4.41 and 4.27 t/ha, respectively. In livestock component, turkey rearing under scavenging system seems to be a promising option to increase farmers' income. Homestead productivity was also increased. Farm income as well as consumption of vegetables also increased through homestead production. Other activities like semi-aquatic vegetables, fish and fruit production in mini pond, utilization of fallow land under orchard is in progress. Fruit sapling distributions, chewing type

sugarcane cultivation at homestead, Palmyra seed sowing at road side create positive impact in this area.

In Fisheries component, BFRI evolved fisheries technologies viz., Refinement of Culture technique of Pabda & Gulsha in farmer's 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. Polyculture with Pabda, the average production was 7382 kg/ha/5 months where the contribution of Pabda and Gulsha was 88.49%. Whereas, in the demonstrations of polyculture of carps using over wintered fingerlings, the average production of 7170 kg/ha was obtained within six months rearing. Mixed culture of Monosex GIFT Tilapia with Shing were demonstrated in two farmer's pond. The range of fish production was found 13275 to 15250 kg/ha after four months of rearing.

22. Sub-Project Title:Design and development of fertilizer deep placement mechanism for existing rice transplanter (ID 064)

Coordinator: Director (Admn and CS), BRRI, Joydebpur, Gazipur

Implementing Organization: Farm Machinery and Postharvest Technology (FMPHT) Division and Soil Science Diovisons of BRRI, Joydebpur, Gazipur

General Objective: To incorporate fertilizer deep placement (FDP) technology in the existing walking and riding type rice transplanter for simultaneous application of fertilizer mixture with rice seedlings transplanting

Duration : Jan 2018–Dec 2020

Budget : Tk: 1,10,00000/-

Background: Manual transplanting is tedious and time consuming which often the causes of delayed planting. As a result, mechanized rice transplanting is seen as a solution of labour problems. Likewise, using mechanized rice transplanting ensures uniform plant spacing (both the line to line and plant to plant) as well as fast and efficient planting. It has potentiality and gaining popularity in Bangladesh due to intervention of different private and government programs. BRRI believes that there is good scope for adoption of transplanter in Bangladesh. Incorporation of the fertilizer mixture (Urea, TSP, MoP and Gypsum) deep placement (FDP) technology with the existing mechanical rice transplanter (both the walking and riding type) will help to accelerate the adoption of both the technologies to the end users.

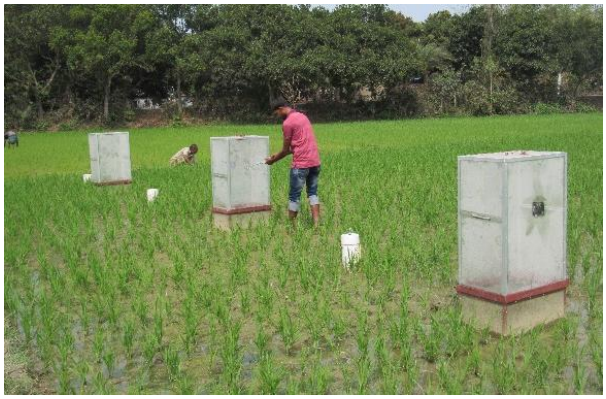
The farmers of Bangladesh normally apply the urea fertilizer as prilled formed by hand broadcasting method. The prilled formed a smaller and softer substance than other materials commonly used in fertilizer blends. As a result, major portion of urea fertilizer losses in different ways after top application to the field while deep placement of urea (either granule or prilled form) in transplanted rice is an agronomically efficient and environmentally safe as compared with the traditional

application method of prilled urea. Based on this concept, BRRI has been developed a push type prilled urea applicator. It was found suitable during field trials in different soil conditions and seasons though laborious to operate manually. In addition, farmers need additional one machine for fertilizer application. This is also not suitable for other basal fertilizer (TSP, MoP and Gypsum). Hence, an attempt has been under taken to incorporate the fertilizer deep placement technology (suitable for either urea alone or combination of urea, TSP, MoP and Gypsum together) to the existing mechanical rice transplanter (both the walking and riding) without sacrificing the merit of transplanting to ensure both the mechanized rice transplanting and fertilizer deep placement simultaneously.

Progress: Under the sub-project, the Farm Machinery and Postharvest Technology (FMPHT) Division of BRRI incorporated mixed fertilizer deep placement mechanism with the walking (ARP-4UM) and riding type (S3-680) rice transplanter. In both type rice transplanters, spiral type mechanism was incorporated as metering device to receive and dispense desired amount of mixed fertilizer. While the Soil Science Division of BRRI conducted research experiment to incorporate the fertilizer deep placement mechanism (FDP) with greenhouse gas emission (GHG) determination under different management at different districts in Bangladesh.

The FMPHT division has developed walking type rice transplanter, which has been evaluated in the laboratory, soil bin, research field and farmer's field. In the lab test, it was found that fertilizer control lever can control fertilizer dispensing rate according to pre-calibration. In the soil bin test, it was observed that mixture fertilizer dispensed uniformly in the furrow and covered effectively. Agitator, which was used in the fertilizer hopper, rotated smoothly to prevent the bonding of fertilizer mixture. Power transmission from engine to the applicator main shaft through different stages was also found smooth, safe and heavy duty.

In Boro 2018-2019 season, the developed walking type rice transplanter was also evaluated in the BRRI research field, Kushtia and Habiganj. RCB design was followed with thee replications where treatments of the study are: i) mechanical transplanting with fertilizer deep placement mechanism, ii) mechanical transplanting without fertilizer deep placement mechanism and iii) traditional practices. During field trial, fertilizer dispensing rate, deviation from calibration, field capacity and field efficiency were found statistically similar with the mechanical transplanting without fertilizer deep placement mechanism. Crop performance data is collecting continuously as per design to compare the efficacy of fertilizer deep placement as well as of the developed machine.



The Soil Science Division of BRRI collected initial soil samples and stored for nutrient analysis. Soil sample analysis are on-going in the soil science lab. Different static greenhouse gas chambers were made for collected and analysis of GHG during study period under existing and modified fertilization systems during Boro rice cultivation at Kushtia region. The partial result indicated that there is no significant difference of methane and nitrous oxide emission among the treatments during Boro rice cultivation. Therefore, it concluded that the research is needed for complete and further evaluation on greenhouse gas emission and mitigation option at different region in Bangladesh.

23. Sub-Project Title: Economic Viability and Production Efficiency of Rice: A Macro Level Study in Bangladesh (ID 070)

Coordinator: Director (Admn and CS), BRRI, Joydebpur, Gazipur

Implementing Organization: Agricultural Economics Division, BRRI, Gazipur and Department of Agricultural Economics, BAU, Mymensingh

General Objective: The study will assess the economic viability of Aus, T. Aman and Boro rice for three farm types in the different ecosystem of Bangladesh by evaluating the profitability, risks, production efficiency and constrains of rice cultivation to generate important information for different stakeholders for boosting main staple production in future

Duration **:** Jan 2018 – Jun 2020

Budget **:** Tk: 2,11,93,260/-

Background: Considering its dense population and climate vulnerability, Bangladesh has to face a great challenge to ensure main staple rice security for the growing population in the latter half of the century which has reached its land use in frontier level already (Ahmed et al., 1999, MoEF, 2009, WB 2013). Thus, strategic adaptation policy needs to be included with the future economic and social development planning for ensuring food security and improving well-being of the people in a sustainable manner (WB, 2013). It is also the case that farmers' decision to adopt a new technology or crops or rotations is most likely to be influenced by the level of profitability and risk associated with the respective crops or rotations (Dillon, 2003; Kabir et al 2016). Therefore, ensuring availability of information about profitability, risks, resource use efficiency and constraints of rice farming for the different ecosystems (e.g., saline coastal, drought prone, submergence, haor, char, hilly and favorable) is critically important to undertake appropriate decision about crop choice and/or land utilization/production of combination of crops. Thus, an assessment of the profitability, risks, production constraints and production efficiency of rice is grown in the different ecosystem is timely. It can be noted that the study could be generated a comprehensive set of data for the various stakeholders including policy planners for formulating the suitable policies to expedite the growth of rice production for meeting the growing demand of staple food grain of population in the future.

Progress: BRRI component visited Cumilla, Mymensingh, Chattogram and Dinajpur to get a comprehensive idea in order to conduct the field survey. The designed methodology was properly followed to select the survey site and collect necessary data. Pre-testing was conducted to validate the questionnaire as per field requirement and methodology. Data collection and data entry of the collected information are on-going in full swing. Procurement of computer accessories, furniture and electronic equipment (photocopier, camera, GPS and projector) had already been completed. Recruitment of computer operator was completed through proper procedures. The selected and trained data enumerators are continuing data collection from the farmers in study regions. During the 1st year of implementation, the sub-project collected 700 samples from Cumilla and Chattogram regions, data are under process and to be reported soon.

The BAU component selected 4 out of 14 agricultural regions namely Dhaka, Bogura, Faridpur and Rangamati for the survey. Total 8 districts were selected from 4 regions, two from each of the regions. Purposive sampling technique used in selecting the locations namely districts and upazilas with due consideration of different rice ecosystems *(e.g., saline coastal, drought prone, submergence, haor, char, hilly and favorable).*Two stage sampling frame-work used for selecting the respondents for this survey. Stratified random sampling technique applied for selecting the respondents of three farm household types (e.g., small, medium and large). Fifty Aus rice growers, 150 T. Aman rice growers and 150 Boro rice growers who were interviewed from each Upazila. Total 2800 farm households interviewed from 4 agricultural regions taking 700 from each region. During 1st year, BAU collected 700 samples from Dhaka region and data coding, input and processing are on-going. The survey report to be prepared soon.

24. Sub-Project Title:Germplasm conservation and farm productivity enhancement through the interaction of shade trees and tea based agroforestry system to mitigate the climate change (ID 072)

Coordinator: Member Director (NRM), BARC, Farmgate, Dhaka

Implementing Organization: SAU(Sylhet Agricultural University), and BTRI (Bangladesh Tea Research Institute), Sreemangal, Moulvibazar-3210

General Objective: Sustainable production of tea through the integration of climate resilient tea and shade trees in tea based agroforestry system

Duration **:** Jan 2018 – Jun 2021

Budget **:** Tk 2,38,000,00/-

Background: The annual production/ha of tea in Bangladesh is 1275 kg, which lower than India (1668 kg), Kenya (2321 kg) and Sri Lanka (1763 kg). It is assumed that by 2025 the domestic requirement of tea would be about 84.06 million kg (461g per capita) against the production of 73.63 million kg (Ahammed, 2012). Tea production is decreasing in the country due to age-old tea estates and lack of modern production technologies, while domestic consumption is gradually increasing (Ahammed, 2012. So far BTRI has developed 18 clone varieties but the adaption of new varieties/cultivars has not yet been satisfactory. Appropriate measures are to be taken to promote HYV tea cultivation to increase tea production. Moreover, traditional forest trees (*Albizzia* spp.) are now being used as shade

trees in tea estates/gardens. So, economically important fruit and timber trees especially Moringa, Jujube, Acacia, Koroi (*Albizia lebbeck*), Neem (*Azadirachta indica*), Black pepper and Yam and some climbing plant species, *eg*., betel leafs need to be evaluated to select new alternative climate resilient shade trees for tea estates/gardens. The research activities of the sub-project has been conducted at SAU, Sylhet and BTRI, Sreemangal, Moulvibazar&Panchagarh district in coordination with Natural Resource Management Division, Bangladesh Agricultural Research Council (BARC). The LoA has been signed on 28 December 2017 and will be completed in June 2021.

Progress: About 800 tea cuttings were collected and planted in 2.024 ha hillock for establishing a Tea and Shade Tree Germplasm Center at SAU. Total of 20 tea estates at Sylhet, Moulovibazar and Hobigang districts were visited and collected information about tea production and management technologies, problems, prospects and probable solutions through designed questionnaire. Total 525 saplings of 21 Bangladeshi Tea clones (25 saplings for each clone) have been planted in the germplasm center. A total of 225 saplings of Indian Tea vegetative clones have been planted.

Established tea and shade tree

Determination of morphological and biochemical features of tea germplasm: A total of 504 tea saplings have been planted, 24 each for BT1 (T1), BT8 (T2), BT19 (T3), BT20 (T4), BT21 (T5), TV1 (T6) and BT2 (T7) (Check). To assessing the interaction effects of tea based agroforestry models with climatic parameters: a total of 432 (shade tree) saplings have been planted, 24 each for Conventional shade tree (*Albizzia odoratissima*) with black pepper (T_1), Conventional shade tree (*A. odoratissima*) with *Chui jhal* (T_2), Moringa (*Moringa oleifera*) (T_3), Moringa (*M. oleifera*) with black pepper (T_4), Moringa (*M. oleifera*) with *Chui jhal* (T_5) and Conventional shade tree (*A. odoratissima*) (Control) (T_6).

BTRI collected 15 test clones through random samplings from different selected tea estates. Established and standing clones were pruned as per traditional breeding method and tagged 200 cuttings from 15 bushes. Eco-friendly tea shade tree germplasm collected from BTRI nursery considering plant girth, rooting tendency, top shoot, etc. Data are being recorded. For collection and conservation of tea genetic resources, total 20 tea estates in Moulvibazar, Hobiganj and Panchagarh districts have been selected to survey for screening of elite lines on the basis of yield, flavor, and quality performance. Survey has already been carried out in 04 tea estates and a total of 50 desirable genetic materials (bushes/test clones) have been selected. Top six elite lines among these 50 test clones were also selected for flavor and quality performance. Drought tolerant tea clones are to be screened at nursery conditions. *Derris robusta, Albizzia lebbek, Albizzia odoratissima* and *Albizzia procera* in standing tea are to be considered and *Cinnamomum tamala*, *Melia azadirachta*, *Mangifera indica* also be incorporated as tea agroforestry models.

25. Sub-Project Title: Exploration, Identification, Characterization, Multiplication and *Ex-situ* Conservation of Endangered Forest Genetic Resources including Medicinal plants of Bangladesh(074)

Coordinator: Member Director (NRM), BARC, Farmgate, Dhaka

Implementing Organization: BAU, BFRI, University of Chittagong

General Objective: Collection, identification and characterization of forest genetic resource and medicinal plants of Bangladesh and Documentation of the status, scope and *Ex-situ* conservation of the selected Forest Genetic Resources (FGR) including ethno-medicinal plant in Bangladesh

Duration **:** Jun 2018 – Jun 2021

Budget **:** Tk2,71,61,506/-

Background: Forest Genetic Resources(FGR) refers to the heritable materials maintained within and among tree and other woody plant species that are of actual or potential economic, environmental, scientific or societal value. Conserving forest genetic resources (FGR) is vital for a nation, as they are unique and irreplaceable resources for the future. Trees are the dominant structural element in forests and several other terrestrial ecosystems (agroforestry, woodlands and gardens), intercepting much of the radiant sunlight, dominating photosynthetic processes and carbon flows, and comprising a large proportion of the biomass.The biodiversity of the forest, however, has been heavily degraded during last few decades due to rapid population growth, energy deficit, over exploitation, poor management and lack of motivation on the needs of biodiversity conservation.One of the essential elements of the convention on biological diversity (CBD) is a commitment by Government to survey their natural living resources, both domesticated and wild and to conserve noted sites for their biological diversity as well as threatened species and domesticated varieties. But, identification of various important components of biodiversity through systematic and scientific approach is still inadequate in Bangladesh.

Bangladesh is an immense reservoir of medicinal plant resources. Medicinal plants constitute a very important component of plant diversity particularly the biodiversity rich areas in the Chittagong Hill Tracts (CHTs) comprises of three hill districts namely Bandarban, Rangamati and Khagrachari. CHT is the south eastern part of Bangladesh covering an area of 13,295 square kilometer with an inhabitant of 11 tribal communities. Herbal medicine has been widely and effectively used for the remedy of various diseases in the region by the tribal people over generations. Thus this valuable indigenous wealth of the plant species for medicinal values including knowledge of their uses in the CHTs to be explore, identify and measures to be taken for their conservation. The present sub-project is designed to consider the above facts and to document the selected Forest Genetic Resources (FGR) including ethno-medicinal plant in Bangladesh.

Progress: The field survey were done in the natural remnant forests of Chattogram, Cox's Bazar, and Tangail for identification the status of threatened tree species in these forests. Fruit/seed of **25** tree species were collected for recording of phenological characteristics and transferred to the conservation stands at CU campus. 25-36 seedlings each species were planted in the pre-selected site after clearing, burning and proper soil work. The species planted in the conservation stand are shown in table 3.9. Seed biology experiments of the species were established in the propagator house, poly-

pots, seedbed and in seed germination trays. At the end of June, conservation stand of about 25 threatened tree species (25-36 seedlings for each species) were established in the University campus. In addition, seed biology and nursery experiments of about 6 tree species are on-going in the seed laboratory and nursery. The stands shall conserve the threatened tree species and shall be the source of fruits/seeds for future regeneration programs.

Table 3.9: Seedlings of the species planted in the Conservation Stand

No.	Vernacular name	Botanical Name	Planted seedlings	Average ht. (cm)
1	Baruna	*Crataeva magna*	36	44.2
2	Batna	*Lithocarpus acuminata*	36	60.8
3	Bhela	*Semecarpus anacardium*	25	22.2
4	Bhutum	*Hymenodictyon orixensis*	36	15.2
5	Boilam	*Anisoptera scaphula*	36	54.5
6	Bon-amra	*Spondias pinnata*	36	42.4
7	Chikrassi	*Chukrasia tabularis* .	36	33.8
8	Civit	*Swintonia floribunda*	36	73.2
9	Dharmara	*Stereospermum personatum*	36	29.5
10	Elena	*Antidesma ghaesambilla*	36	49.9
11	Euveria	*Uvaria hirsuta*	36	30.4
12	Faisa udal, Mula Udal	*Firmiana colorata*	36	40.0
13	Haritaki	*Terminalia chebula*	36	39.1
14	Jalpai	*Elaeocarpus floribundus*	36	40.7
15	Jamalgota	*Croton tiglium*	36	48.8
16	Kala-huja	*Ehretia serrata*	36	74.7
17	Kanaidinga	*Oroxylum indicum*	36	52.5
18	Kechhra bhadi	*Engelhartdia spicata*	36	45.2
19	Latkon	*Baccaurea ramiflora*	36	42.3
20	Ormosia	*Ormosia robusta*	36	17.2
21	Paduak	*Pterocarpus indicus*	36	31.9
22	Pitali pitagola	*Trewia nudiflora*	36	102.0
23	Raktachandan	*Adenanthera pavonina*	36	22.8
24	Sada Garjan	*Dipterocarpus alatus*	36	78.5
25	Sonalu	*Cassia fistula*	36	31.2
Total seedlings planted			**889**	

26. Sub-Project Title:Upliftment of Farmers Livelihood and Enrichment of Environment through Improved Agroforestry Practices in Char Land Ecosystem of Bangladesh (077)

Coordinator: Member Director (NRM), BARC, Farmgate, Dhaka

Implementing Organization: Department of Agroforestry, BAU; RARS, BARI, Jamalpur Department of Agricultural Economics, BAU, Mymensingh

General Objective: Poverty alleviation of the people of char area and environment enrichment through agroforestry

Duration **:** Jan 2018 – Jun 2021

Budget **:** Tk2,90,103,56/-

Background: The charland people generally use their indigenous knowledge to adapt at the diverse environment. These communities are most vulnerable; least served, and chronically marginalized which require a different approach by the service providers like government, NGO_S, etc. So, it is important to improve the indigenous knowledge of forestry/agroforestry with modern practices to adapt with the char environment. The important elements of agroforestry systems can play a significant role in the improvement of livelihoods through changes in homesteads and croplands. The anticipated activities of agroforestry practices could increase the biodiversity and reduce the temperature fluctuation in the selected charland as well. The research activities of the sub-project on "Upliftment of farmers livelihood and enrichment of environment through improved agroforestry practices in char land ecosystem of Bangladesh"is being conducted at Department of Agroforestry, Bangladesh Agricultural University (BAU), Mymensingh; Regional Agricultural Research Station (RARS) Jamalpur, Bangladesh Agricultural Research Institute (BARI) and Department of Agricultural Economics, Bangladesh Agricultural University (BAU), Mymensingh in coordination with Forest Unit, Bangladesh Agricultural Research Council (BARC). The goal of the project is to uplift farmers' livelihood and enrichment of environment through modern agroforestry practices in the char areas of Bangladesh.

Progress: The BAU-AF component of the sub-project completed selection of study area with farmers & research plots, baseline survey, and started plantation of fruit/medicinal tree seedling/sapling by providing training to the selected farmers. The selected chars are: South Char Kalibari, North Char Kalibari, Char Vatipara and Char Gobadia in Sadar, Mymensingh. By interviewing 100 farmers 25 from each selected char the baseline survey revealed that average income per family was Tk. 94677/- mainly contributed by crops, vegetables, service, duck/hen, and business. Total 35 tree species were recorded in the study area of which mango (100%), mahogony (85%), betelnut (70%), kanthal (65%), raintree (58%) and coconut (55%) are the dominant tree species. Total nine different existing agroforestry models were recorded of which turmeric and mahogony tree based model was very common. Considering resources base (land, knowledge etc.) 30 farmers were selected for

practicing agroforestry practices and different fruit and medicinal trees were planted on those selected research farms/plots. Some plots were also selected where seven years old lombu and mahogony plants already planted (NATP Phase-1). Six different experimental studies were carried out in these newly planted and existing plots of which two experiments were completed during the year 2018 and rest are ongoing. In 1st completed experiment five different leafy vegetables, *viz*., red amaranth (BARI Lalshak-1), mustard (Tori-7), coriander (BARI Dhania-1), spinach (Copi Palong) and radish (BARI Mula-1) were cultivated with four different fruit tree species viz. mango, guava, malta and sajna trees. Yield of leafy vegetables did not varied significantly with and without tree combination, which indicate during the establishment period of mango, guava, malta and sajna tree species did not affect the yield of winter leafy vegetables. In 2nd completed experiment rice was cultivated in association with seven years old boundary planted mehogony tree during aman season under irrigated condition. In this experiments interaction effects of mehogony tree viz. shade effect and root competition was observed in different side of the plot. It was found that rice yield gradually decreased in all side towards the mehogony tree base and highest yield reduction was found in west direction as 78%, 64% and 45% in 0-12, 12-24 and 24-36 ft. distance from tree base.

Winter vegetables cultivation in association with different timber tree species and winter vegetables cultivation in association with different fruit tree species was conducted at farmers field of Nao Vangar char, Laximir char, Jamalpur Sadar and Bolaier char, Sherpur Sadar in Jamalpur by Component-2 (BARI-Jamalpur). These experiments were also conducted at Regional Agricultural Research Station, Jamalpur. Timber and fruit seedlings/saplings were collected from different authentic sources. Land and pit preparation was done.After pit preparationMahogony, Akashmoni, Eucaliptus and Mango seedlings/saplings were planted.

The component-3 (BAU-Socio-Economic) analyzed economic benefits and impact of agroforestry practices on livelihood of char lands people. Total 300 farm households have interviewed for the current sub-project where 150 are from agroforestry intervention and 150 from control areas. Twelve focus group discussions conducted one for each of the villages. The cost-benefit analysis of summer, winter and year-round vegetables/crops are being done. The potential barriers and opportunities for farmers of char areas in adopting agroforestry intervention would be identified and possible recommendations planned to be made.

27. Sub-Project Title: Eco-friendly Rodent Management Through Owl Conservation (087)

Coordinator: Director (Admin& Common Services) current charge, BRRI, Gazipur-1701

Implementing Organization: BARI, BRRI

General Objective: Sustainable rat management through owl conservation

Duration **:** Feb 2018 – Jun 2021

Budget **:** Tk1,73,17,575/-

Background: Rodents are major agricultural pest in Bangladesh for crop production, both before and after harvest. Estimated loss in Bangladesh is about Tk. 1360 million per year (field and store) with average loss of rice 53 kg/farm family/year. The rat damaged crops amounting 1% of the total crops produced in a year. Owls (pecha) are nocturnal birds of prey. The barn owl (*Tyto alba,* family Tytonidae, order Strigiformes) is the most widely distributed species of owl. It is found almost

everywhere in Bangladesh and considered as the bio-control agents of rats. Rats have a large territory in rice and wheat field. A rat may move up to 200 meters in one night. In contrast, barn owls serve important function in the natural ecosystem over a large area for rat control. Natural rat control using barn owls can reduce the use of rodenticides and their indiscriminate use that can be retained as negative effects on the environment. Utilization of natural predators like barn owl is an environment friendly solution to pest control (Singleton 1994; Johnson *et. al.*, 1996). In May 2012, it was revealed that farmers in Israel and Jordan had, over a period of ten years, replaced rodenticides by barn owls in a joint conservation venture called "Project Barn Owl" (Santorelli, 2012). The Malaysian Department of Agriculture has successfully implemented a program to control rats using barn owls in paddy fields throughout Peninsula Malaysia (Hafidzi *et. al.*, 1999). Therefore, barn owl has been found to be a very effective biological agent for controlling rats. Its use not only increases farmers' income by reducing crop losses, but also saves the cost of rodenticides as well as the fields from chemical pollution.

Progress: Three species of owl were collected from sub-project sites and brought to the owl aviary to identify at species level with the reference sources or with an aviary taxonomist / ornithologist for proper documentation. The collected sample(s) are now reared in small aviary at BRRI, Gazipur for further study. Some pellets were collected from the reared owl species as well as from owl watching towers. For this, different age categories of rice field ratsi.e. juveniles, sub adults and adults were collected from the field and were kept in confine situation and reared for 7-10 days to check the presence of any chronic rodenticide inside its body. The safe and selected rats were weighted and released into the feeding box to a single captured owl in an aviary separately. The daily prey uptake as well as the number, shape and color of regurgitated pellets by different age category of owls were recorded.

Owl nest

Four effective eco-friendly rat management (EFRM) techniques has been tested at BRRI farm, Gazipur to catch and kill the rice field rats without using any rodenticide(s) in rice field eco-system. The rat capture devices, used in rice field bunds or close to the bund burrow systems were very effective. The collected data are processing.Owl watching towers (WT) are effective from dusk to down and the collected and observed pellets of owl from WT confirmed the rat predation. It can also be used as perching device during day time for insect feeding birds, black drongo (*Dicrurus adsimilis*). Pellets collected from the watching towers showed that most of the pellets consists of rat bones, skins, exo- skeleton of insects. Among the five different types of owl nest boxes, triangular shape nest box is more preferable one than others for owl nesting.

28. <u>Sub-Project Title:</u> Establishment of profitable cropping pattern through crop intensification inunderutilized unfavorable ecosystem**(089)**

Coordinator: CSO, Plant Breeding Division, BINA, Mymensingh-2202

Implementing Organization: Adaptive Research and Extension Division, BINA; Agricultural Economics Division, BINA

General Objective: Increasing cropping intensity through introducing improved cropping patterns for improving the farmers' livelihood

Duration **:** May 2018 – Jun 2021

Budget **:** Tk 1,60,00,000/-

Background: Present cropping intensity of Bangladesh is 194% (BBS 2017) which is the average of 23.55 lakh ha of one cropped, 38.47 lakh ha of two cropped and 17.11 lakh ha of three cropped area. The share of land areas for pulse and oilseed in this cropping intensity are 8.53 lakh ha and 8.86 lakh ha only; and the productions are 377 and 933 tons which meet 20% and 30% of country's demand, respectively. Increase of cropping intensity is the only way to boost up pulses and oilseed production. By incorporating short duration pulse and oilseed varieties in rice based cropping sequence, cropping intensity is possible to increase from 194 to 400%.Cultivation of traditional varieties, imbalance use of fertilizers, seed sowing in inappropriate time, non-adoption of modern production technologies, natural calamities, socio-economic barrier, large yield gap (20-60%), nutrient mining in existing cropping pattern, unavailability of seeds of suitable HYV varieties, drought, flash flood and other biotic and abiotic stresses are the main constraints of maximizing farm productivity.On the other hand, according to the 7th Five Year Plan and SDGs, poverty alleviation, end hunger, achieve food security and improved nutrition and promote sustainable agriculture are the new challenge for researchers, extensionists and farmers.BINA and BRRI developed short duration T. Aman and Aus rice varieties that mature within 90-120 days and producing grain yield of 5-6 t/ha, which created opportunity of crop intensification. BINA and BARI already developed pulses and oilseeds varieties with high yield and less crop duration that could be fitted in the cropping sequence of the area of underutilized and unfavorable ecosystems. Based on above facts, some areas like Sunamganj, Rangpur, Gopalganj, Nalitabari (Sherpur) and Mymensingh are considered for establishing alternative profitable cropping pattern(s). Proposed activities are adaptation trials, farmers motivation to adopt improved technologies, their knowledge & skill development and up-scaling using suitable varieties and proper time of sowing/transplanting technique based on integrated nutrient management, identification of suitable area for mustard, lentil, grass pea, sesame etc. cultivation. To address the constraints above rice, oilseeds, pulses and other crops cultivation following appropriate technologies in proper time will maximize the farm productivity and profitability by reducing yield gap and improving cropping pattern in the above areas having unfavorable and underutilized ecosystem.The sub-project is being executed by Adaptive Research and Extension Division of BINA in collaboration with four sub-stations and Agricultural Economics Division since Jul 2018.

Progress: In 1st year (2018-19), all the six proposed cropping patterns comfortably accommodated an additional Rabi crop in between T. aman and Boro/Aus rice at all five locations of Bangladesh except the early T. aman- Maize- Aus rice pattern at Rangpur. In Mymensingh, for early T. aman rice-

Mustard-late Boro rice cropping pattern, the crop variety sequence: Binadhan7-BARI Sarisha-14-Binadhan14 ranked top (51.28 kg per day yield) in terms of yield per day. But in Sherpur, Binadhan17-BARI Sarisha-14- Binadhan14 ranked top (48.69 kg). At Muktarpara, Rangpur, for (i) early T.aman rice-Mustard-late Boro rice pattern no significant difference was found between the crop variety sequences of Binadhan17- BARI Sarisha-14- BRRI dhan28 (46.17 kg) and Binadhan17- BARI Sarisha-14-Binadhan14(46.15 kg). Similarly, for (ii) early T.aman rice-Potato-late Boro rice pattern, Binadhan17 – Asterix- Binadhan14 had the highest per day yield (116.88kg). At Bishwambharpur Upazilla, Sunamganj, for (i) early T. aman rice-Mustard-late Boro rice cropping pattern, Binadhan17-Binasarisha-4- Binadhan14 was the best (51.35 kg/day) and at Sunamganj Sadar for (ii) early T. aman-Khesari-Aus rice pattern, Binadhan17- Binakhesari-1- Binadhan19 ranked top(45.26 kg/day).At Kashiani, Gopalganj, for (i) early T. Aman rice - Mustard - Aus rice pattern, Binadhan16- Binasarisha-9-Binakhesari-1 19(48.85 kg/day), for (ii) early T. Aman rice - Khesari - Aus rice pattern, Binadhan17-Binakhesari-1-Binadhan19 ranked top (47.46 kg/day) and for (iii) early T. aman-Lentil- Binadhan-19, Binadhan16-Binamasur-8-Binadhan-19 ranked the top (52.73 kg/day). The top ranking crop variety sequences in all the patterns took almost the lowest crop days (305-339) and field durations, (252-274) respectively. However, for confirmation, these patterns will be further tested during 2019-20 along with economic analysis based on the difference between the baseline survey and the results of the trials.

29. Sub-Project Title: Identification of novel resistant gene(s), gene pyramiding and sustainable management of bacterial blight (BB) disease of rice (ID 091)

Coordinator: Director (Admin & Common Services), BRRI, Gazipur-1701

Implementing Organization: BRRI, BAU

General Objective: To manage bacterial blight disease through gene pyramiding and biological approaches

Duration **:** Jan 2018 - Dec 2020

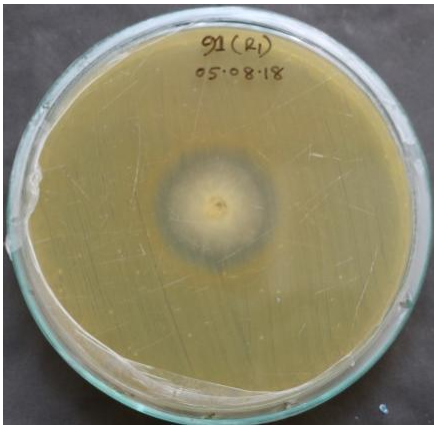
Budget **:** Tk: 15438152/-

Background: Rice plant infected by 32 diseases of which ten are major and three bacterial diseases are frequently occurred in Bangladesh. Among them, Bacterial blight (BB) considered as the most destructive disease occurs in all AEZs. The disease may reduce 30-60% rice yield and observed as chief factor limiting rice productivity worldwide because of its high epidemic potential (Khan *et al.* 2014, Verdier *et al.* 2012, Xia *et al.* 2012). Increased application of nitrogen fertilizer in rice encourages the occurrence and the severity of this disease. The disease is also influenced by some climatic factors such as rainfall, humidity, temperature, flood and stormy weather during the rice-growing season (Soga 1918, Fujikawa *etal.* 1957 and Mizukami and Wakimoto 1969). Heavy rain, high humidity and temperature provide the favorable conditions for high incidence and the severity of the disease (OCTA 1970). In this study, novel or known BB resistant gene(s) will be identified from native germplasm and implement the successful use of near isogenic lines along with molecular markers to identify races and its' distribution as well as to introgress minimum three bacterial blight resistance genes into the popular rice varieties BRRI dhan63. BRRI dhan81 or BRRI dhan49 having high yield potential through

marker-assisted backcrossing. Simultaneously, environment friendly and sustainable management package will be developed against BB of rice.

Progress: For the identification of existing bacterial blight races, 350 BB infected samples were collected from different regions of Bangladesh. From the collected samples 150 isolates were isolated, purified and preserved for further use. A total of 550 germplasm were collected from BRRI Gene Bank and 347 germplasm were screened against bacterial blight isolates. Disease reaction patterns were recorded on near isogenic lines by inoculating 50 BB isolates (preserved isolates) at maximum tillering stage during T. Aman, 2018 for identifying new races of bacterial blight. A total of 10 BB races were identified from these isolates.

In total 120 F_1 seeds were harvested from the crosses involving BRRI dhan81 and IRBB60, BRRI dhan81 and IRBB58 or IR 129336:11-4, BRRI dhan63 and IRBB58, BRRI dhan49 and IRBB60 as hybridizing parents. To manage the bacterial blight disease, healthy rice plants with root system of different rice cultivars were collected from different districts representing 30 AEZs of Bangladesh. Around 300 bacterial isolates were isolated and purified from both rice phylloplane and rhizosphere and 100 fungal isolates were isolated and purified from both rice phylloplane and rhizosphere. Out of 300 bacterial isolates, 19 bacterial isolates were identified as antagonist to *X. oryzae* pv. *oryzae.* Out of 100 fungal isolates, two isolates were identified as antagonist *to X. oryzae* pv. *oryzae.*



The assessment of plant growth promoting determinants revealed that 9 antagonistic bacterial isolates out of 19 were found to produce Indole acetic acid (IAA), 12 bacterial isolates out of 19 were found to show phosphate solubilizing capability and 18 bacterial isolates were able to produce siderophore production. These results indicate that some of the antagonistic bacterial isolates seems potential in both growth inhibition of *X. oryzae* pv*. oryzae* and in increasing growth of rice plants. Nine antagonistic bacterial isolates out of 19 were found to produce Indole Acetic Acid (IAA), 12 bacterial isolates out of 19 were found to show phosphate solubilizing capability and 18 bacterial isolates were able to produce siderophore production.

Some of the selected bacterial and fungal antagonists were formulated and seeds were treated. Treated rice seeds were sown in the field for raising seedlings and for subsequent field experiment. These results indicate that some of the antagonistic bacterial isolates seems potential in both growth inhibition of *X. oryzae* pv*. oryzae* and in increasing growth of rice plants. To assess the field performance of the identified bacterial and fungal antagonists in controlling BB, seeds of two inbreed rice varieties (cv. BRRIdhan28 and BRRIdhan29) and two hybrid rice varieties (Hybrid Hera-2 and Arize Tej Gold) were treated with the eight

formulated bacterial antagonists viz. BDISOB04P(*Pseudomonas putida*), BDISOB05P *(Pseudomonas putida)*, BDISOB219R (*Pseudomonas taiwanensis)*, BDISOB221R (*Pseudomonas* sp.),BDISOB222R (*Pseudomonas plecoglossicida)*, BDISOB258R (*Pseudomonas putida)*,BDISOB186R (*Pseudomonas* sp.), BDISOB283R (*Pseudomonas fluorescens*) and two formulated fungal antagonists viz. BDFISO67 (*Trichoderma paraviridescens*)and BDFISO91 (*Trichoderma erinaceus*).The treated seeds were then sprouted and were sown in the respective seed beds. After 5 weeks the raised seedlings were transplanted in the experimental plots.

30. Sub-Project Title: Improvement of Farm Productivity through Intervention with Improved Agricultural Technologies in Char land Eco-System (ID 096)

Coordinator: Member Director (P&E), BARC, Farmgate, Dhaka

Implementing Organization: BARI, BINA, BSRI, BLRI

General Objective: To increase farm productivity of char land area intervening whole farm activities

Duration **:** Feb 2018 - Jun 2021

Budget **:** Tk: 37000000/-

Background: Char dwellers inhibit under extremely marginal environments out of necessity, moving from one char to another in the face of river and island erosion. Access to markets and wager employment is limited, whilst agricultural work is especially scares during unpredictable floods and the period between planting and harvesting of rice. Still large number of people stay in the chars taking high risk of natural vulnerability. According to the 7th Five Year Plans and SDGs, poverty alleviation, end hunger, achieve food security and improved nutrition and promote sustainable agriculture is the new challenge for researchers, extensionists and farmers. Considering the complex factors the char dwellers often could not choice the best farming practices to be followed in their lands. As a result their income becomes lower. From the activities of some projects and NGOs it is clearly understood that, integrated farming approach is one of the best way for income generation of char dwellers. But this integrated farming system approach may play a vital role to overcome the above mentioned situation in charland eco-system. The sub-project has been coordinated by Planning & Evaluation Division of BARC in partnership with On-Farm Research Division (OFRD) of the Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur, Bangladesh Sugar Crop Research Institute (BSRI), Bangladesh Live Stock Research Institute (BLRI) and Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh from February 2018.

Progress: As reported by BARI in Charland ecosystem of Mymensingh and Bogura intake of vegetables and fruits were markedly increased by 236 % and 250% respectively after intervention of the technology. Two improved cropping pattern a) Mustard-Boro-T.Aman and b) Potato-Boro-T.Aman trials were conducted in FSRD site, Char Kharicha, Mymensingh and one improved cropping pattern Mustard-Boro-T. Aus-T. Aman trials in FSRD Site, Sonatola, Bogura. Newly released high yielding crop varieties were also

introduced through on farm validation program where farmers obtained higher crop yields and gross margin 35486-214710 Tk/ha. Due to deworming and vaccination program body weight and milk production of dairy cows was increased. Mortality rate of poultry reduced (80-86%) after vaccination. Goat rearing and beef fattening technology has introduced in the area. Turkey and sonaly chicken rearing in semi scavenging system create positive impact among the farmers.Among the seasonal fish culture carp polyculture gave higher gross margin (Tk. 20072/pond) at farmers' level.

BINA undertaken 10 activities like homestead production system, crops and cropping system, livestock system, fisheries system, and sapling distribution, fruit tree management in the homestead and off farm activities. Three improved cropping pattern: (i) Jute (JRO 524) -T. Aman (Binadhan-11)-Mustard (BARI Sarisha - 14/ Binasarisha-9), (ii) Jute (JRO 524) -T. Aman (Binadhan-11) - Wheat (BARI Goam - 26) and (iii) Jute (JRO 524) -T. Aman (Binadhan-11) - Maize (Hybrid 981) were established against farmers existing pattern Jute – T. Aman – Grass pea. Vaccination reduced mortality rate significantly and increased body weight, milk production and lactation period. 12 HH selected for beef fattening program and given one cattle/hh. Average net profit was Tk. 38000.00 was found per cattle after 6 month. One pair Pigeon and one sonali chicken given/family for 10 and 15 hh respectively. 256 different types of fruit sapling were distributed to the hh.

BSRI undertaken 14 activities during reporting period as homestead production system, crops and cropping system, livestock system, fisheries system, , agro forestry and off farm activities. Before intervention vegetable production was 60 kg and after intervention 115 kg. In case of fruit, it was 12 kg and 30 kg. Thus vegetable production increased by 91% and fruit production by 150%. Chewing type sugarcane were planted at the 12 homestead. Newly developed BSRI Sugarcane (BSRI Akh 46), Chewing cane variety (Turag) and new cropping pattern were introduced. De-worming and vaccination were done to improve cattle and poultry health and higher income. The milk production was increased about 50%. Six species of carp fishes e.g. Rohu, Catla , Mrigel, Grass carp, Silver carp and Bata were stocked in the ponds during March 2018. The fish were harvested after 9-10 months. Average yield was found 16.25kg per decimal and survivability percentage was 86%. About 750 different type of fruit and tree saplings were distributed among the 12 farmers. In addition 200 Palmyra palm seed were sown at the road side. Survivability rate of saplings were about 85-95%. Farmer's response were very encouraging and growth of saplings were satisfactory during reporting period.

BLRI undertaken 10 research and development activities: integrated livestock program rearing 03 native sheep, 02 goats, 72 turkey and 09 pair of pigeons were distributed among the farmers of FSRD site. Body weight gain, mortality rate and other relevant data are being recorded regularly. The beef fattening, calf rearing and milking cow management have been started with supplementary feed, logistic and technical supports. BLRI maintained prevention and control of diseases through routine vaccination program of all species of livestock against FMD, BQ, Anthrax, PPR and poultry against NCD, fowl pox, gumboro, and duck plague in the selected areas. BLRI-developed HYV Napier fodder were distributed among the four farmers, average yield was found 2.0- 2.5 t/ha from first two cut. The institute also practiced year round vegetable production and working on improved cropping patterns under the sub-project.

31. Sub-Project Title: Climate Resilient Farming Systems Research and Development for the Coastal Ecosystem (ID 098)

Coordinator: Member Director (P&E), BARC, Farmgate, Dhaka

Implementing Organization: BARI, BRRI, BINA

General Objective: Maximizing farm productivity with efficient use of farm resources

Duration **:** Feb 2018 - Jun 2021

Budget **:** Tk: 36000000/-

Background: Cropping intensity in the coastal areas is far below those achieved elsewhere in the country. In the coastal region, especially in tidal submerged areas cultivation of vegetables is difficult to some extent because of water stagnation caused by tidal water. Under this situation, homestead vegetables production may be an alternate option in reducing malnutrition and to create job opportunity for women. One of the economic activities in the coastal ecosystem is aquaculture (Islam, 2003). A vast network of river systems, beels, haors, floods and ponds provides opportunities for both capture and culture fishes. The main land uses are pond aquaculture and shrimp farming. But in these ponds fishes are not cultivated scientifically. Most of the cattle are poor health due to worm and poor feeding. Besides, a large number of chicken and ducks die every year from different kinds of infections and non-infectious diseases. Through application of appropriate technology in right time and by creating awareness among the farmers, productivity of this sector could be improved. BARI, BRRI and BINA have already developed some salt tolerant rice varieties and non-rice crops (Wheat, pulses, oilseed and vegetables) and BFRI has recommended rice-fish culture suited to the coastal area which need to be validated and disseminated to the disadvantageous areas to increase productivity and farmers' income. The sub-project has been coordinating by Planning & Evaluation Division of BARC in partnership with On-Farm Research Division (OFRD) of the Bangladesh Agricultural Research Institute

(BARI), Bangladesh Rice Research Institute (BRRI), and Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh from February 2018.

Progress: BARI undertaken 24 research activities involving 24 farm households in two villages (12 from each village) of sites Noakhali and Patuakhali. The research areas are: i) Homestead production system, ii) Improvement of Crops and cropping system, iii) Fisheries production system and iv) Livestock production system. Based on the results of baseline survey the farmers' need were identified and set experiments on year round vegetable cultivation at homestead using `Homestead Vegetables Production Models'. The gross margins of vegetable production was doubled for medium and small farm hh whereas it became triple for marginal farm hh. Two saplings of each improved varieties of BARI Aam-4, BARI Sapota-1, BARI Guava-2, BARI Malta-1, BARI Narikel -2 and Bay leaf were supplied among the 12 cooperative farmers. The supplied saplings are in good condition and mortality percentage was very minimum. The existing cropping pattern Mungbean (BARI Mung-6) – Fallow - T.aman (Local) was replaced by improved cropping pattern Potato (BARI Alu-72) - Mungbean (BARI Mung-6) - T. Aman (BRRI dhan 49). The gross return of improve pattern was Tk. 305550 (157% higher than the existing pattern. Production program on BARI Surjomukhi-2, BARI Mung - 6 using BARI Seeder, BARI Hybrid Maize-9 and BARI Bt Brinjal-2 were at the FSRD sites. Considering social nutrition, 180 different fruit-saplings like Mango (BARI Aam-4), Guava (BARI Peyara-2), litchi (BARI Litchu-3), Malta (BARI Malta-1),Chewing type sugarcane and Dragon fruit were supplied to 12 hh, at FSRD site, Jamla, Dumki, Patuakhali. Growth of fruit sapling was satisfactory and mortality percentage was 10-16% during reporting period. Besides of agricultural production, some farms families' especially the women were engaged with sewing *Katha* at patuakhali site.

Deworming of cattle, done before fattening of animal, showed remarkable positive effect on body weight gain and market value of animal. Vaccination improved chicken and duck rearing especially in semi-scavenging system in the homestead. Two types of fodder napier and sorghum were cultivated when napier grass as green fodder harvested three times and highest yield obtained in 2nd harvest (67 days DAS) whereas 5.32 t ha^{-1} green fodder harvested from Sorghum grass after 53 to 55 DAS.

Under fisheries program, fingerlings like Silver carp, Rohu, Catla, Mrigel, Mirror carps and Grass crap were released

maintaining the BFRI recommended stocking density. Total production of fish was higher after intervention with new technology.Farmers were very impressed with the performance of mixed poly culture.

32. Sub-Project Title: Fortification and Standardization of Nutritional level in Selected Human Foods and Efficacy Test of Polyphenolic Compounds in Livestock (ID 099)

Coordinator: Member Director (Fisheries), BARC, Farmgate, Dhaka

Implementing Organization: BRRI, BARI, BAU

General Objective: To control qualitative reduction/loss of food value and improvement of nutritional quality of rice, selected fruits/vegetable/herbal products through value addition

Duration **:** Aug 2018 to Jul 2021

Budget **:** Tk. 2,75,00,000/-

Background: Fish, meat, milk and their products including processed foods are also adulterated in different stages of processing and marketing. The foods of animal origin also adulterated by mixing or adding non-food ingredients, using preservatives, additives, coloring, flavoring chemical adulterants. Rice grain contaminated due to heavy metal contamination, pesticide contamination, fungal colonization and mycotoxin contamination which may affect the public health. The present research thus aims to generate new technology on the basis of available information on food contaminants, adulterants and other hazardous chemicals and to dissemination of ideas for awareness of consumers and towards establishing food safety. Value addition to seasonal crops is advantageous from many corners starting from loss minimization (loss 40%) to job creation. However, processing of seasonal produces into traditional products like jam, jelly, squash, sauces and different dried & dehydrated products have limited industrial interest due to slow and limited market coverage. Chips prepared from different fruits and vegetables are well known and popular snack food in the country. Jack-fruit, pineapple, mango, guava and papaya are some of the seasonal fruits which are susceptible to huge post-harvest loss. If they are processed into high quality popular snack products like chips, their post-harvest loss will be minimized, farmers will get fair price, production of them will be increased and finally food and nutrition security of producers and consumers will be obtained. Secondly fresh fruits and vegetables are rich in carbohydrates, fibre and vitamins. Thirdly, traditional deep fat oil frying results in low quality chips in terms of color especially from high sugar fruits (banana chips as an example). Deep frying develops deep brown and blackish color. This harness can easily be overcome by employing vacuum frying technology. By this method, frying will be carried out under vacuum pressure at low temperature and hence, product quality will be improved, nutrition loss will be minimized, degree of fried oil deterioration will be reduced and finally processing cost will be minimized. Rice is our staple food and the people of our country are taking nearly cent present of carbohydrate. As a result, there are a lot of people especially young kids and women are suffering from malnutrition mainly for vitamins and minerals. Hence, the fortification with vitamins and minerals are carrying need in the country for mitigation of malnutrition.

Progress: The BRRI component completed field works for baseline study on street children of Dhaka city to assess their overall nutritional intake. Total 224 samples were interviewed of them 61% male and 39% female street children whose age ranged from 4-12 years of old. In this study, recommended dietary intake (RDI) gap of male and female were found 33-50% and 42-60% respectively irrespective

to age. Energy dense rice biscuit (EDRB) may play a vital role in this regards. In addition, a total of 50 local germplasm of rice were also characterized physicochemically and based on their antioxidant properties. Few essential parameters such as physicochemical, cooking, eating, proximate and antioxidant properties but few more parameters are yet to be finished such as fatty acid profiling (FFA), water soluble vitamins and minerals. Based on necessity of street children, the sub-project will formulate low cost and nutritionally balanced rice based food items from nutritionally enriched selected brown and pre-germinated brown rice varieties which might supplement maximum up to 40% of their daily required energy.

To investigate the risk of human health hazards of chips, BARI component collected baseline information from producer and distributer in 07 selected locations (Dhaka, Gazipur, Tangail, Mymensingh, Bogura, Munshigonj and Jashore). Few samples were drawn from hawkers and producers level. Few samples were analyzed to the accredited lab, SGS Bangladesh for identification and determination of Acrylamide content. Most of the hawkers of Bogura was above 40 years old (80%) followed by Dhaka who were 25-39 years old (60%). Between two districts of producer level selling information, 80% people were above 40 years old engaged in producing fried chips from Bogura. In Bogura all aged people like fried chips (100%) and among fried chips consumption by child, maximum child were from Dhaka (40%) and all respondents from Bogura and Munshigonj were unknown about healthiness knowledge of fried chips consumption. In Munshigonj most of the hawkers (100%) were illiterate. In all of the survey area processors used deep frying technique (100%) and 80% small processors used soya bean oil during deep oil frying of potato chips. Most of the respondents of both locations informed, they changed oil during frying when oil turned into cloudy. A simplified vacuum frying machine was almost designed by the local manufacturer with the help of Farm Machinery and Postharvest Process Engineering Division of BARI and few trials were conducted to find out appropriate frying time with frying temperature of Jackfruit chips. Also, a simplified de-oiling machine was designed and locally fabricated to reduce excess oil from the fried chips product. De-oiling machine which adopts advanced centrifugation to maximize de-oiling from the surface of the fried chips and it made the product more attractive than greasy or oily.

BAU component planned undertake the study to identify different available medicinal herbs in the country which have growth enhancing capability and would enhance the production of safe livestock products. The study would detect plant phytochemicals like organic phenol, flavonoids, saponin, tannin, carotenoids contents from different herbs that are locally available by thin Layer Chromatography and after that preliminary screening, quantification of phytochemical profiles in most potential herbs by using LC-MS for nonvolatile, GC-MS for volatile known compound and NMR for unknown compound. The analysis is yet to be done.

33. Sub-Project Title: Contamination and adulteration of food and food products, process, chain and mollification (ID 103)

Coordinator: Member Director (Fisheries), BARC, Farmgate, Dhaka

Implementing Organization: BARI, BFRI

General Objective: Prevention or minimization of hazards through improved culture and post-harvest practices and ensure food and food chain safety in fruits, vegetables and fish products

Duration **:** Jan 2017 - Jun 2021

Budget **:** Tk: 31991600/-

Background: The food chain is a complex, concentrated and dynamic chain of activities that onsets with the production of raw agricultural commodities on field and moves to value-added fresh, processed and manufactured products and then to retail food stores, wholesale market, and food service establishments (restaurant and institutions). During harvesting, preparation, processing, packaging, storage, and distribution food is contaminated with soil, air, and water borne microorganisms.As a relatively "high-risk" food, fish and fishery products are subject to a range of food safety requirements related to general hygiene and specific microbiological and chemical contaminants.There are always a potential for fish and fish products to be contaminated by pesticides, heavy metals and pharmaceutical compounds either from direct or indirect sources. These potential problems can occur on the farm, during processing, or at the wholesale/retail levels. The lack of knowledge concerning the effects and fates of chemicals and their residues, antibiotics in farmed fishes and fish products lead this research concept with the major concern of food safety in fisheries sub-sector. Therefore, this study is important to determine the effects of growth hormone in aquaculture and to determine heavy metal contaminants' in marine fish and fish products from the coastal water. Furthermore, data of this study could also be used to economically protect local and export market of the fish industries in Blue economy of the country. In addition, it also gives important information on the safety aspect of local fish as consumer now-a-days is aware on the beneficial intake of fish particularly for its nutritive values.

Progress: The BARI component conducted survey in seven districts (Cumilla, Narshingdi, Chattogram, Bogura, Jashore, Gazipur and Dhaka). Total 210 samples having 30 samples from each of the seven districts were randomly selected. Farmers belonged to the age group of 21-60 years. Literacy rate was found higher in Chattogram (43%) compared to other selected districts.Most of the farmers did not receive any training on vegetable pest management although some of them were engaged with various NATP program. Among the farmers, nobody followed IPM approach in pest management program. Generally, farmers applied pesticides with higher dosages and frequencies (10-15 times) per season. The pesticides used are Sulcox, Tafgar, Vertimec, Sumicorn, Karahin, Boron, Emma etc. Sample of Narshindi, showed 50% *Salmonella spp*.in amaranth, country bean,

cauliflower and okra. *Escherichia coli* was found in 42% sample of amaranth, country bean, cauliflower and red amaranth. 92% sample was contaminated by *shegella* which was unsatisfactory level of hygienic indicator. In case of Cumilla sample, 27% of cauliflower and country bean were contaminated by *Escherichia coli. Shegella* was present in 27% cabbage, cauliflower and tomato sample. *Salmonella spp.* was observed in 64% cabbage, cauliflower and tomato. In case of Chattogram sample, okra and tomato (14%) were contaminated by *Escherichia coli. and Shegella* was observed in 86% sample of okra and tomato. Similarly,*Salmonella spp.* was noted in 86% okra and tomato sample. For Jashore samples, 63% sample of tomato, red amaranth and okra contaminated by *Escherichia coli*. *Shegella* was present in 50% sample of tomato, red amaranth, okra and country bean. *Salmonella spp.* was present in almost 100% sample of tomato, cabbage, red amaranth, okra and country bean. In samples analyzed for Gazipur, *Escherichia coli*c ontaminated by 63.6% and *Salmonella spp.* was present in 100% of red amaranth, Indian spinach, bitter gourd, okra and brinjal. Another experiment was conducted to detect naturally produced formaldehyde in fruits and vegetables based on spectrometric analysis. The naturally occurring formaldehyde was detected in banana 19.26±4.26 ppm, litchi 6.04±1.03ppm, pineapple 19.76±2.52 ppm, ripe papaya 50.48±3.37 ppm and guava 30.33±3.33 ppm. In vegetables, the formaldehyde was estimated in carrot 10.26±2.99 ppm, radish 6.02±1.34 ppm, cucumber 7.22±1.44 ppm, green papaya 43.72±4.11 ppm, cauliflower 26.46±4.29 ppm and potato 15.26±2.84 ppm.To control microbial growth 1.0% tri sodium phosphate and 0.5% acetic acid were more effective sanitizer for tomato fruit during 15 days of storage at ambient condition (26±2^{o}C, 80±5%RH).

The BFRI component addressed preventing or minimizing the hazards through improved culture and post-harvest practices in fish production, product development by using growth-promoting agents like probiotics, hormones, antibiotics etc. Growth promoters also applied for fattening fishes and improving the utilization of food to obtain production and economic benefits. Field observation showed that several compounds were mixed with feed to ensure optimal diet quality and to improve the immunological status of the cultured species. The farmers are using those aqua-drugs without knowing their efficacy due to lack of information regarding consequence of aqua-drugs used in aquaculture.

34. Sub-Project Title:Development of knowledge hub on Feed Resources for efficient feeding management of livestock (ID 108)

Coordinator: Member Director (Livestock), Livestock Division, BARC, Farm gate, Dhaka-1215

Implementing Organization: BLRI, BAU, SAU

General Objective: To generate information for establishing national feed inventory on detailed feeds and fodder available in the country, their chemical composition and nutritive value, which would ultimately help to model the specific feeding program in different regions and seasons over the year

Duration **:** May2018- Jun 2021

Budget **:** Tk: 1,69,32,244/-

Background: Feed is the foundation for efficient livestock production and linked with major inputs and outputs. Estimation of feed balance at national and farm level would help to identify the feed vis-à-vis nutrient balances (Dry Matter, Crude Protein and Metabolizable Energy). This also helps in spatial and temporal assessments of current and forecasted feed resources which ultimately would help for efficient feed management strategies and in establishing feeding standards.The information rights and access to right information is the top priority areas of the government's mission for Digital Bangladesh. To exploit this policy, Access to Information (***a2i***) is on-going process for increasing the service provisions to the people of all concerns based on reduction of TVC (TVC stands for Time, Visit and Cost). However, this is not yet sure whether the information on feed and nutritional value would be ensured or not. The proposed sub-project would address this as this study would launch online database which would be interactive so that all farmers can get easy access to the right information on feeds.

The farmers who are treated as the center of the livestock development wheel as they will steer the wheel of progressing the livestock sub-sector, will get benefit from this study. Therefore, the proposed sub-project is of high relevance to the nutritional, economic and development perspectives of the country. The proposed study will address those limitations and would provide an excellent basis for developing interactive and dynamic knowledge hub on animal feed resources and related issues as well as also help to make step forward for locally applicable feeding standards.Considering the fact the sub-project is designed to generate information for establishing national feed inventory on detailed feeds and fodder available in the different agro-ecological zones in the country along with their chemical composition and nutritive value of feeds.

Progress: BAU component conducted field survey to collect information on feed availability, feeding pattern and feed inventory from Rajshahi, Rangpur and Mymensingh Division covering four districts: Rajshahi, Mymensingh, Lalmonirhat and Kurigram and six Upazilas. From each location, 30 feed samples were collected for chemical and nutritive analysis. The available feed ingredients of both roughages (legume, non-legume, fodder, forages, foliage, crop residues, preserved feed etc.) and concentrates (grain, grain by-products and agro industrial residues) were collected, processed and preserved for chemical and nutritional analysis. The Harvesting Index (HI) for roughage such as rice straw, bagasse and wheat straw and Extraction Ratio (ER) of selected crops for estimating livestock feed production are under progress. A template for managing comprehensive database of all kinds of feed resources along with its chemical composition and nutritive value for academia, scientists, business person and farmers (especially educated farmers) are also in progress. Apart from the research, recruitment of staff, a number of coordination meeting among BLRI, BARC, BAU and SAU were performed. The monitoring and evaluation were also performed.

BLRI component completed survey in four Upazila out of six and collected 50 livestock feed samples of local grasses like shama, durba, hatchi and arali grass. Determination of chemical composition of

collecting feed samples are on-going with 50% progress. Extraction ratio and harvest index of some feed samples like wheat, rice etc.have been completed.

The SAU component covered Sylhet region and reported that 1-5% farmers are accustomed to cultivation of fodder and that is why animals fed on rice straw with or without rice polish as unique supplementation. Very few farmers are practicing commercial farming. In most cases, their education level was below the high school level. They are used to rear their animal traditionally without having any technological knowledge. Native animal herd usually comprises with 3-4 number except commercial herd. The average milk production of native cow was observed from 1.84 L/d to 2.2 L/day. Higher productive cows were found in coastal area than that of in haor areas. However, provision of high yielding cow rearing was very rare and the trend of milk production was 8.37-8.42 L/d in both haor and coastal area. Duration of milk laid down were significantly varied in native cows ranged from 160 to 240 days per lactation. On the contrary, hybrid cow capable of 150 to 177 days to extend her lactation reflecting a significant variation due to locations as well as genetic variation.

35. Sub-Project 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(ID 110)

Coordinator: Member Director (Livestock), Livestock Division, BARC, Farm gate, Dhaka-1215

Implementing Organization: BLRI, BINA

General Objective: To develop stress tolerant fodder varieties for southern part of Bangladesh

Duration **:** May 2018 - Jun 2021

Budget **:** Tk 93,18,569/-

Background: More than 30% cultivable lands which are located in coastal area of Bangladesh. Out of them, 1.056 million hectare lands are affected by different degrees of salinity (BARC, 2013). Salinity intrusion increased by 27 % from 1973 to 2009 (SRDI, 2010). Northwestern regions of Bangladesh are particularly exposed to drought. Among the drought prone areas of Bangladesh, the Barind region, the majority of households involved in livestock farming. The agricultural drought, linked to soil moisture scarcity, occurs at different stages of crop growth, development and reproduction. Apart from the agricultural loss, drought has important effect on livestock population, land degradation, health and employment. The northeastern part of Bangladesh is known locally as the *hoar* area (water-logging/wetlands) and consists of mainly the districts of Sunamganj, Moulovibazar, Sylhet, Kishoreganj and Netrokona. Virtually all of this land is below 8 meters and is flooded for 7- 8 months to depths of 5 meters or more during the monsoon. Feed shortage is the major reason for low productivity of livestock in Bangladesh especially in these areas. Livestock mainly survives on the common local grasses. More than 93 % farmers fed paddy straw to their cattle and cut & carry of natural grasses are common in these area that is not available throughout the year. The demand of fodder production is increasing today because of limited listed livestock feed resources in the country which is suitable for climate change adaptation. Improvement or development of new stress tolerant fodder germplasm will help to increase production and productivity of farm animals in the country.

Progress: Gamma ray irradiation is an efficient tool to produce mutants in different crops. Irradiation- induced mutations have also succeeded in forage grasses and turf grasses. In order to get good quality and high biomass yielding fodder, an experiment was set with seven BLRI Napier cultivars: Napier-1, Napier-2, Napier-3, Napier-4, Rokona, Pakchong and Markiron including one Para and one German grasses. The cuttings of each cultivar was irradiated with four doses of Gamma rays as 20Gy, 30Gy, 40Gy and 50Gy from ^{60}Co source from BINA. These irradiated cuttings were transplanted at 60 cm x 60 cm plant to plant and row to row distance along with control (non-irradiated). Irrigation and fertilizer were applied as and when necessary. 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 9 fodder cultivars, 20 Gy 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. On the basis of higher fresh weight and plant type (bushy and compact growth), 28 plants (17 from 20Gy and 11 from 30Gy) were selected with a view to re-grow in next season. Among these selected lines (clones), better lines will be further selected to release as mutant fodder variety(s) in future. In order to verify the extent of genetic variability among contrasting irradiated fodder cultivars, selected cultivars will be analyzed through DNA markers. For selection of salt and drought tolerant fodder clones, artificial screening will be conducted under hydroponic culture. For identification of salt, drought and flood/water logging tolerance gene(s) some potential genes such as NHX, DREB and HKT family genes will be selected and a set of forward and reverse primer for each gene will be designed for screening these genes from the salt tolerant clones. In this sub-project, BARC coordinate and monitor the activities of other components like BINA and BLRI with their Specific objectives

36. Sub-Project Title: Collection, Conservation and Characterization of Important Plant Genetic Resources (ID 128)

Coordinator: Member Director (Crops), BARC, Farmgate, Dhaka

Implementing Organization: BARI, BRRI, BJRI, BSRI, BINA, CDB, BSRTI, BAU

General Objective: Collection, Characterization and Documentation of Plant Genetic Resources including released varieties and GI crops of Bangladesh for Establishing their Intellectual Property Rights (IPR).

Duration : Jan 2018 to Dec 2020

Budget : Tk 3,79,94,220/-

Background: A wide genetic base is important in plant breeding research aimed in developing new varieties for increasing production. The wider the range of choice a breeder will have in selecting the appropriate kind of diversity. There is a pressing need for more genetic diversity to work upon, to cater to varied kind of problems and needs. Genetic diversity gives species the ability to adapt to

changing climates and environments, and to new pests. Nationally, proper documentation of genetic resources particularly GI crops is very important in respect of IPR issues. Therefore, the GI crops, released varieties and landraces need to be further characterized. Genetic diversity is in danger of being lost due to natural calamities, habitat loss, unplanned urbanization, industrialization, human population pressure, deforestation, etc.Considering the present situation and future need, Bangladesh should address the importance of plant genetic resources management and immediately undertaking program on collection, characterization and conservation. To address the issue 08 NARIs are involved in carryout the present research sub-project.

Progress: Collection, characterization, conservation and documentation of popularly grown crops with a view to establish IPR (Intellectual Property Right) is being done under the sub-project. BARI as largest research institute has collected 200 germplasm (GP) of 27 crops from 15 upazilas of 9 districts. Out of the collected GP, morphological characterization has done for 64 pumpkin and 102 cucumber while molecular characterization completed for 30 brinjal germplasm. BRRI collected 103 landraces of rice from 07 Upazilas of Bandarban, 03 exotic GP received from Cumilla and 02 from Jashore. Morphological characterization has been completed and molecular characterization is on-going. BJRI collected 27 JAF germplasm from 06 districts and characterization is under process. 18 sugarcane germplasm collected by BSRI from 9 upazilas of 8 districts, characterization of the collected germplasm is yet to be done. BINA has collected 33 rice, 5 chilli, 2 bitter gourd, 3 groundnut, 3 brinjal, 1 black gram and 1 turmeric GP from 6 upazilas of 5 districts, characterization is continuing. The collected 60 accessions regenerated at Jagodishpur, Jashore and 57 at Sreepur, Gazipur Cotton Research Farm, and characterization is on-going. BSTRI started data collection for the 1st season on morphological, reproductive, fruits and bud characters of 45 mulberry genotypes. BAU completed morphological characterization of 62 indigenous germplasm of banana, 30 yam and 30 aroids. The table 3.10 showed the progress of germplasm collection of different crops by participating research institutes.

Table 3.10: Collection of germplasm by the participating research institutes

NARIs	Target (#)	Achievement (#)	Crop coverage
BARI	200	200	Pumpkin, cucumber, brinjal etc.
BRRI	70	166	Rice
BJRI	30	27	Jute
BSRI	25	18	Sugarcane
BINA	50	48	Rice, chilli, bitter gourd, peanut, brinjal, black gram and turmeric
CDB	120	117	Cotton
BSRTI	45	45	Mulberry
BAU	30	30	Banana, yam and aroids

37. Sub-Project Title: Determination of Critical Limit of Nutrients for Major Soils and Crops (ID 134)

Coordinator: Member Director (NRM), BARC, Farmgate, Dhaka

Implementing Organization: BARI, BRRI, BINA, BAU

General Objectives: Delineation of the present status of different nutrients in calcareous, non-calcareous, piedmont and terrace soils and to validate critical limit of different nutrients for cereal, vegetable and oilseed crops through field experiments

Duration : Mar 2018 to Jun 2021

Budget : Tk 3,28,61,110/-

Background: Soil testing is a useful tool for measuring extractable (available) quantity of a nutrient in soil which would help predict the crop yield response to an application of that nutrient through fertilizers/manure. As soil test value for a particular nutrient increases, the crop yield response to an addition of that nutrient decreases. A good soil test should be able to predict the amount of plant-available nutrient as well as the fertilizer responsiveness of crops growing on a wide range of soils. In this regard, determination of critical limit (C.L.) is important to determine optimum fertilizer requirement for a crop. Now the country's soils are reported to be deficient in N, P, K. S, Mg, Zn and B.Critical limit of a nutrient in plant refers to a level at or below which plant either develops deficiency symptoms or causes reduction in crop yields as compared to optimum yields.Critical limit is useful for delineating responsive (deficiency) sites from non-responsive (sufficiency) sites. The C. L. of a nutrient varies with crops, soils and extraction methods.Hence, the situation justifies a need to design the sub-project to determine and update the critical limit of different plant nutrients in order to formulate an optimum fertilizer dose of deficient nutrients for different crops and soils for achieving satisfactory crop yield.

Progress: The sub-project is implementing by BARI, BRRI, BINA and BAU under coordination of BARC. The nutrient status in soil, critical limit and crop responses have been measured by each of the organization in different AEZ, locations and different crops. The distribution of crops and AEZ are 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

BARI conducted three experiments in different AEZ, locations, crops and nutrients:

1. Delineation of different nutrients status in calcareous, non-calcareous and terrace soils
2. Determination of critical limit of K and Zn for soils and crops (wheat, maize and cabbage)- Pot trial
3. Response of cereal and vegetable crops to K and Zn applications (Field experiment)

BARI is working on determining critical limit of K and Zn for 12 soils and 3 crops (maize, wheat and cabbage). BARI has collected 150 soil samples so far from 5 upzillas out of 180 samples based on land type and soil texture covering 3 AEZs (11, 13 and 28) and representing calcareous (AEZs 11 & 13) and

terrace soils (AEZ 28) of intensively cropped areas.Soil samples are being analyzed primarily for determining the status of P, K, Mg, S, Zn & B, following the standard extraction methods. Soil analysis also includes texture, pH, organic matter and N, Ca, Fe, Mn & Cu contents. Soil type and soil series are also being identified.To determine the critical limit of K and Zn for soil against the crops of wheat, maize and Pot trials are to be conducted with top soils in glass house from the next rabi season, 2019-20. Twenty top soils from 20 selected areas planned to be used in one pot trial. The critical limit from pot experiments is to be validated by field experiments in AEZ 28 using wheat and maize crops.

BRRI has collected 180 soil samples based on land type and soil texture from intensively cropped areas of three AEZs (AEZs 18, 19, 20).Soil samples are being analyzed primarily for determining available status of P, K, Mg, S, Zn & B, following the standard extraction methods. Soil analysis included texture, pH, organic matter and N, Ca, Fe, Mn & Cu contents. Soil type and soil series also identified. To determine the critical limit of P, K, S and Zn for rice crops, pot trials are to be conducted with top soils in glass house. Twenty top soils from 20 selected areas planned to be used in one pot trial. The critical limit from pot experiments is to be validated by field experiments in AEZ 28 and 11 using rice crop.

BINA has collected 180 soil samples based on land type and soil texture covering 3 AEZs (25, 26 and 27). Soil samples are being analyzed primarily for determining the status of P, K, Mg, S, Zn & B following the standard extraction methods. Soil analysis will also include texture, pH, organic matter and N, Ca, Fe, Mn & Cu contents. Soil type and soil series are also being identified.To determine the critical limit of P and Mg for soil against the crops of maize and mustard. Pot trials are to be conducted with top soils in glass house from the next rabi season, 2019-20. Twenty top soils from 20 selected areas planned to be used in one pot trial. The critical limit from pot experiments is to be validated by field experiments in AEZ 25, 26 and 27 using maize and mustard crops.

BAU has collected 180 soil samples based on land type and soil texture covering 3 AEZs (1: Old Himalayan Piedmont Plain, 3: Tista Meander Floodplain and 9: Old Brahmaputra Floodplain).Soil samples are being analyzed primarily for determining available status of Mg, S, B following the standard extraction methods as mentioned. Soil analysis will also include texture, pH, organic matter and N, Ca, Fe, Mn & Cu contents. Soil type and soil series will also be identified. Soil type and soil series are also being identified. To determine the critical limit of Mg, S and B for soil against the crops of wheat and mustard. Pot trials are to be conducted with top soils in glass house from the next rabi season, 2019-20. Twenty top soils from 20 selected areas planned to be used in one pot trial. The critical limit from pot experiments is to be validated by field experiments in AEZ 1, 3 and 9 using wheat and mustard crops.

38. Sub-Project Title: Improvement of soil health and crop productivity of major problem soils of Bangladesh through organic amendments (ID 135)

Coordinator: Member Director (NRM), BARC, Farmgate, Dhaka

Implementing Organization: BARI, BRRI, BINA, BAU, BSMRAU, SAU

General Objective: Bio-physicochemical characterization of soil in the climate vulnerable and polluted areas by examine the potentiality of different organic materials for amending problem soils and improving crop yields in the study areas

Duration : Mar 2018 to Jun 2021

Budget : Tk 3,71,26,906/-

Background: Climate change, buildup of soil salinity and acidity, development of heavy metals including arsenic are major concerns which degrade soil health and hinder crop production. High concentration of different heavy metals in soils of industrial areas and arsenic in soils mainly in the Ganges Floodplains may cause reduction in crop yields as well as long term risks to ecosystems and humans health. Intensive cropping with modern crop varieties and use of less or no organic manures and crop residues results in decreased soil organic carbon and plant nutrients leading to severe land degradation. Applications of different organic materials transform into stable forms of carbon with high adsorption sites which might help heavy metal adsorption and organo-mineral complexion and ultimately helps in environmental amelioration. It is hypothesized that resource conservation technologies comprising soil and crop management practices (minimum tillage, vermi-compost, tricho-compost, poultry manure, household wastes, organic fertilizers, crop residues, biochar etc.) can improve soil resilience and increase its productive capacity in the climate vulnerable and polluted areas and therefore studies are needed in these issues.The sub-project is being coordinated by BARC; and BARI, BRRI, BINA, BAU, BSMRAU and SAU are working as the implementing organizations.

Progress: BARI selected 03 vulnerable sites a) saline soil at Dumuria, Khulna; b) drought soil at Godagari, Rajshahi and c) acidic soil at Belabo, Narshingdi for bench mark survey and field experiments. Field experiment has designed with six treatments viz. i) absolute control, ii) 100% chemical fertlizer, iii) biochar @ 2 t/ha + 100% chemical fertilizer, iv) vermicompost 3 t/ha with IPNS based inorganic fertilizer, v) poultry manure 3 t/ha with IPNS based inorganic fertilizer and vi) Mazim organic fertilizer 3 t/ha with IPNS based inorganic fertilizer. The crops used are cauliflower (at Belabo), mustard (at Rajshahi) and sweet gourd (at Dumuria). Soil samples collected from all locations to measure the nutrient status. Field experiment on organic amendments on improving acidic, drought and saline soil were conducted. Production of biochar was started using rice husk, poultry manure through pyrolysis system. Mineralization study of organic materials and assess their effect on carbon sequestration, soil properties improvement and crop productivity in the Belabo, Godhagari and Dumuria are on-going.

Soil sample collection

BRRI planned to have a lab incubation experiment on `mineralization rate of nutrient after organic amendment in the industrial contaminated soil under field capacity and CSW conditions. For benchmark survey 20 samples were collected form Mirzapur and Pirojali union and 10 samples were collected from Sreepur industrial area. Initial soil conditions of the experimental plot are shown in the following table 3.11.

Table 3.11: Initial soil properties of experimental field

Location	Soil depth	pH	%OC	%OM	%N	K meq/100 g soil	%Na	%Ca
Mirzapur	0-15	4.40	2.42	4.18	0.22	0.13	0.03	0.03
Pirojali	0-15	4.68	1.91	3.28	0.19	0.19	0.03	0.04
Sreepur	0-15	6.20	1.54	2.65	0.11	0.26	0.05	0.05

Total 9 field experiments were conducted to improve the soil conditions at three different locations of Mirzapur, Pirojali and Sreepur.The treatment used in the experiments are: T_1=Vermi-compost 3 ton/ha + IPNS (N-P-K-S @40-0-48-10), T_2 = Biocher 2 ton/ha + Chemical fertilizer (N-P-K-S @100-20-80-10), T_3 = Mazim OF 3 ton/ha + (N-P-K-S @40-0-35-10), T_4 = Chemical fertilizer (N-P-K-S @100-20-80-10) and T_5 = No Fertilizer. By this the boro rice has been planted and the crop is in harvesting stage with good conditions. The results are to be reported in next report, as the sub-project completed 1st year in March 2019.

BINA completed Benchmark survey to characterize bio-physicochemical properties of soil in the selected study areas. The characteristics of soils are:

Experiment	N (%)	P (ppm)	P (ppm)	P (ppm)
Expt. 1	0.09	14	30	20
Expt. 2	0.09	17	15	20

The soil characteristics of **BAU** experimental sites are given in the following table. The BAU planted mustard in the Madhupur site (acidic soil) and maize in Islampur (charland) sites. The results are yet to be reported.

Table 3.12: Initial soil characteristics of the experimental sites

Soil Site	Depth (cm)	Clay (%)	Sand (%)	Silt (%)	Textural Class	SOC (%)	TN (%)	Available P (ppm)	K (meq. $100g^{-1}$)	S (ppm)
Madhupur	0-15	34	29.33	36.67	Silty clay	0.99	0.07	17.63	0.12	17.28
Islampur	0-15	10	49.33	40.67	Sandy Loam	0.45	0.05	12.37	0.12	12.96

The **BSMRAU** conducted experiments in Bhaluka and Satkhira sites, collected and analyzed initial soil samples. Data from Bhaluka revealed that the soil of the study areas having extreme acidity to neutral soil, containing the pH ranges from 3.50- 6.99. In Satkhira site, soil pH did not vary appreciably between the sampling points and ranged from 6.87 to 7.95. The percent organic carbon content at Satkhira is very low to moderate (0.15-1.11%), soil total nitrogen are very low to medium (0.07-0.49%). High concentration of P was observed in the soil at saline affected area. The available phosphorus content of the saline affected area soils was varied from 23.0 to 68.0 ppm. The concentration of total potassium at various sampling points of saline affected study area ranged from 0.19-0.35 cmol/kg soil. While, the sulphur content of the studied saline soil was found comparatively higher ranging from 12.0 to 89.00 ppm. Meanwhile, the Zn content of the studied soils ranging from 0.21-1.34 ppm which was very low to optimum. The CEC at various sampling points of the industrial contaminated area were found to range from 17.39 to 20.99 (cmol/kg soil). The variation of the CEC was related to the organic matter content of the soil.

Three field experiments on boro rice were set up in the selected areas of Bhaluka, Faridpur Sadar and Batiagata using different 5 organic matters i.e. poutry manure, standard organic matter, vermi-compost and biochar. The results are to be discussed in next report.

SAU collected soil samples from Kalapara and analyzed. Samples of different organic materials (poultry manure, biochar, vermicompost and Mazim organic fertilizer) were collected and analyzed. SAU sets experiment on maize, data to be analyzed and reported in next report.

39. <u>Sub-Project Title:</u> Determination of Antimicrobial Resistance and Residues in Livestock and Poultry Food Products and Feed in Bangladesh**(ID 138)**

Coordinator: Member Director (Livestock), BARC, Farmgate, Dhaka

Implementing Organization: BAU, BLRI, RU, PSTU, CVASU, SAU, HDSTU

General Objectives: Assessment of antimicrobial drug residues in livestock and poultry food products & feed and its mitigation program, and to determine the antimicrobial resistance & associated genes

Duration **:** Jun 2018 to May 2021

Budget **:** Tk 3,09,68,710/-

Background: The slogan of Vokta Odhikar Dibash-2016 is “Antibiotics Jukto Khaddo K Na Bolun”. This slogan indicates that people are conscious about food for the presence of antimicrobial drug residues in food chain which may lead to the development of resistance strain of microbial agents. The increasing use of antimicrobials in humans and animals leading to develop resistance to these drugs, therefore many diseases are becoming difficult to treat. The spread of antimicrobial resistance among human cannot be dissociated in presence of resistant microbes with resistance-encoding genes in human, animals, food chain, and environment. The isolation, identification and characterization of microorganisms in different microbial diseases therefore have paramount important to identify resistance genes in microbial agents. To find out the alternatives are crucial important for the production of safe meat and egg. Probiotics and phytobiotics have already been used as alternative sources of antibiotics in the developed counties due to have no residual effects like antibiotics. There is sporadic report to use of low dose antibiotics drugs as growth promoter, containing several antibiotic drugs residues in food products and feed having detrimental effects in human health. In

addition, many studies have shown that antibiotics administered to poultry and livestock are poorly absorbed in the gut and usually excreted without metabolism. These residual antibiotics eventually accumulated and enter into human food chain resulting bioaccumulation of drugs residues in human body. As country wise data are not yet to be available in this regards, the sub-project would therefore be definitely acknowledge the status of antimicrobial drugs residue, resistance microorganism and detection of targeted resistance genes that contributes in antibiotic resistance, and its mitigation program would help safe food production in Bangladesh.

Progress: The project has 7 components (stated above) working in similar fashion in different locations like BAU collected required information through sample collection from Mymensing region, BLRI worked at Gazipur, Tangail, Manikgong, Rajbari, Madaripur and Faridpur locations; RU in Rajshahi district; PSTU in Patuakhali, CVASU in Chittagong region; SAU in Sylhet region and HDSTU in Dinajpur region.The design of experiments for all components are more or less similar but collected information from different locations of the country. According to the 1st year annual work plan,preparation of questionnaire for surveys are on-going for all 7 components with75% achievement. Antimicrobial sensitivity/resistance pattern study of each isolate is also ongoing. A total number of 18 antibiotics are used to analyses the sensitivity/resistance pattern. In addition, some of the components are already did partial PCR analysis which is 2nd year activities. Overall 100% achievement was done based on 1st year work plan.

40. Sub-Project Title: Preparedness for the control of PPR in Bangladesh(ID 139)

Coordinator: Member Director (Livestock), BARC, Farmgate, Dhaka

Implementing Organization: BLRI, BAU

General Objectives: Increase availability of safe and high quality livestock protein through controlling PPR in Bangladesh to meet global control strategy

Duration **:** Mar 2018 to Jun 2021

Budget **:** Tk 1,81,27,532/-

Background: Peste des Petits Ruminants (PPR) is popularly known as goat/ sheep plague, an important OIE listed trans-boundary animal disease (TAD) of small ruminants in Bangladesh. PPR in small ruminant causes much devastation in village farmers due to high morbidity (10-100%), high mortality (up to 100%) and heavy production losses (due to death of infected goats). In Bangladesh, PPR was first detected in 1993 in Meherpur district. Since then, the disease has spread all over the country resulting in severe socioeconomic consequences (Chowdhury et al., 2014). The eradication plan of PPR from Bangladesh is yet to start as effective way and it needs massive investigation and activities. There are limited studies onto the epidemiology of PPR in Bangladesh (Siddiqui et al., 2014). The epidemiological investigation is needed to develop a progressive preventive/control strategy. A progressive control strategy using intensive surveillance and mass vaccination program over 10±05 years may ensure the attainment. Regular and routine immunization against PPR viruses may generate

immune population of small ruminants in Bangladesh, which is necessary to block the transmission cycle of the virus. This intervention will contribute to increased household income, food and nutritional security, women empowerment and significantly reduce poverty which will contribute toward achieving MDGs. The proposed sub-project comprises nationwide Sero-survey, disease surveillance and outbreak investigation for epidemiological information's, development of PPR free zone with locally produced vaccine, development of biologics and socioeconomic studies. Above studies and outputs will give solid foundation to formulate disease control plan in Bangladesh.

Progress: BLRI conducted baseline survey by giving emphasis on socio-economic information of goat farmer, farming system and management issues, demographic information, profit and gain, economic impacts of PPR disease, problem and prospects. 1000 goat serum samples were collected from unvaccinated and vaccinated goats randomly selected villages of considering different age groups consisting 0-6 months, 6-12 months, 1-2 years, above 2 years. RNA were extracted from nasal swabs/faeces using Qiagen RNA extraction kit. PPRV gene fragment were amplified by RT-PCR.The PCR product is purified either with the EZ-10 Spin Column DNA Gel Extraction kit (BIO BASIC INC) or EZ-10 spin Column PCR purification kit (BIO BASIC INC). Outbreak investigation of the PPR in goat is planned to be conducted all over the country. Whenever the PPR outbreak will be occurred, team formed from BAU and SAARC RLDL-PPR will investigate the outbreak. During outbreak investigation, necessary samples are to be collected along with related epidemiological and economic impacts information's using appropriate questionnaire. Epidemiological studies are planned to be conducted throughout the year by BLRI team. Three upazillas will be selected for developing PPR free zone. Required PPR vaccine will be collected directly from vaccine production center, LRI, Mohakhali. BLRI will be responsible for collection and distribution to three selected Upazila Livestock Officer (ULO) office. The vaccination campaign, vaccinator and awareness development activities will be done jointly by the BLRI, BAU and BARC. So far BLRI collected total of 55 clinical goat samples from different districts, of them 30 samples (55%) are found positive for PPR virus by RT-PCR. For sero-survillence, 225 goat serum samples also collected from different parts of the country. Following eELISA, 32% were sero-positive for PPR infection.

BAU component completed appointment of staffs and selection of PhD Fellows. Collected relevant literature, procured research chemicals, and completed preparation of mice etc. Completed preparation of infrastructure and laboratory facilities. By the time of reporting, BAU collected lymph nodes from ten (10) infected goats for detection of F protein gene of PPR virus. The component slowly runs due to delay in procurement procedure and unavailability of research chemical. The known positive samples have been identified and preserved in refrigerator for future use. BAU collected 10 clinically PPR suspected goats from different villages of Mymensingh Sadar Upazila followed by postmortem examination, histopathology RT-PCR and primary goat kidney cell culture for isolation and identification of PPR virus.

Chapter 4

Human Resource Development

4. Human Resource Development

PIU-BARC has provision of higher studies (local and foreign) and skill development training for scientists of NARIs. Efforts were made to develop the quality of scientific manpower who are directly involved in technology generation to ensure food security of the nation by inducing stress tolerance gene in locally adopted crop genotypes and by mitigating the challenges of low yield potentials of local crop varieties/genotypes.

4.1 Status of Higher Studies (Local and Foreign PhD)

The DPP of NATP-2 has provision of 140 PhD programs of which 80 are allocated for local and 60 for foreign universities. Among the 80 local PhD programs, 60 allocated for NARS scientists and 20 for mid-level civil servants of DAE (10), DLS (05) and DoF (05). PIU-BARC, NATP-2 has already awarded 135 PhDs(60 foreign and 75 local) to the scientists of NARS Institutes 118, DAE 10, DLS 05 and Ministry of Agriculture 02. PhD scholars have been selected following Government rules and criteria depicted in PIM with preferences to emerging issues. Out of 80 local PhDs, 75 candidates completed their admission in different public universities. Out of 05 PhD programs for DoF, 3 candidates received permission from MoFL while 2 are under process of permission and expected to be completed by Sep 2019. Out of 60 foreign PhD programs, 45 and 15 are allocated for Developing and Developed countries respectively. But till now only 10 scholars have admitted in developed countries (USA, Germany, UK, Australia, and Japan) while 50 admitted in developing countries (Malaysia, Philippines, Thailand, China and India).

Due to the selection process and time adjustment of admission by semester, numbers of PhD scholars (both foreign and local) would exceed their completion time of PhD program than the project duration (Sep 2021). The selection/procurement of consulting firm for operating foreign PhDs, training, workshop/seminar etc. is yet to be completed by the PIU-BARC, NATP-2. The handle of foreign exchange without required firm also raised complexity of delaying the award of PhD scholarship to the NARS and non-NARS institutions. A way out is needed to continue the fund flow to the PhD scholars (local and foreign) after completion of the NATP-2 in Sep 2021.

4.2 PhD Fellowship Selection Procedure

According to the guidelines depicted in the PIM are:

1) The candidates evaluated based on parameters/weighted scale thereby taking into account the relevance of the area of study, the proposed research plan, academic records, achievements and past work experience of the candidates.
2) The selection made on the basis of evaluation score and subsequent interview by a Selection Committee (SC), constituted by BARC and duly empowered to judge the suitability of candidates with regard to the importance of the area of study.
3) After selection, BARC issue an award letter with terms of conditions of fellowship.

4) The awardees (candidates) must furnish deputation approval by their respective institutes to get scholarship.
5) Once selected, the candidates must register for the program within the specified time or the least possible time from the date of issue of letter of fellowship award.

As per guideline of PIM (10.2.3), PIU-BARC formed a Selection Committee headed by Executive Chairman, BARC, all Member Directors are member where Director, PIU-BARC act as member secretary. The PhD scholarship widely circulated through national daily newspapers, BARC website and through letter to respective institutes. Applications were submitted as prescribed form. All applications were evaluated on the basis of academic qualifications, service length, scientific publications, contribution in technology generation; age, training, research proposal and final viva voce. As indication of slots in the DPP, candidates were selected from respective institute. If suitable candidates were not found from the list; slots were given to that institutes for suitable candidates with rationale basis. After completion of the selection process, list of successful candidates were published in BARC website and a copy sent to TTL, WB. After completing all the procedures, award letter was issued to successful fellows to complete the admission and other necessary formalities.

4.3 Contribution of PhD programs to achieve NATP objectives

The set development objective of NATP-2 is to increase agricultural productivity of smallholder farm and improve smallholder farmers' access to market in the country. The PhD programs of NATP -2 offered basically based on the need assessed by NARS institutes i.e. need of country's current agricultural demands in respect of improving agricultural productivity and marketing of perishable crop products for the marginal and small farmers. Considering this national focus, majority of PhD scholarship offered on varietal development in context of different stresses like salinity, drought, water logging tolerant, shorter duration rice to address crop damages due to flash flood in haor belts etc. Out of 60 Foreign PhD programs, 51 allocated for crops development while 05 allocated for fisheries and 04 allocated for Livestock. The other important fields of PhD researches (thesis) are found on i) improving nutrition efficiency, ii) soil health improvement, iii) crop production, iv) pest management, v) farm modeling, vi) GIS, vii) breed development of livestock and fish, vii) socio-economic analysis for livelihood improvement, viii) climate change mitigation and on development of appropriate tools for technology dissemination. The PhD researches supported to the scholars of NARS institute, and extension agencies are directly related to increase the productivity and production of crops, livestock and fisheries that seems to be very close to the PDO of NATP -2.

4.3.1 Institute Wise Distribution of Local and Foreign PhD Programs

The table 4.1 showed the distribution of foreign and local PhD programs among the NARS and other institutions/organizations. BARI as large national research institute shared highest numbers of local (21 of 80 i.e. 26%) and foreign PhDs (19 of 60 i.e. 32%). The next highest share of local (06) and foreign (10) PhD programs has received by BRRI scientists. The details of distribution of local and foreign PhDs are shown in the following table 4.1.

Table 4.1: Institute Wise List of Awarded Local and Foreign PhD Programs

SN	Name of Institute	No. of Awarded PhD		
		Local	Foreign	Total
1.	Bangladesh Agricultural Research Institute (BARI)	21	19	40
2.	Bangladesh Rice Research Institute (BRRI)	06	10	16
3.	Bangladesh Institute of Nuclear Agriculture (BINA)	04	05	09
4.	Bangladesh Jute Research Institute (BJRI)	05	04	09
5.	Bangladesh Sugar Crop Research Institute (BSRI)	05	04	09
6.	Bangladesh Tea Research Institute (BTRI)	01	01	02
7.	Soil Resources Development Institute (SRDI)	04	03	07
8.	Bangladesh Sericulture Research & Training Institute (BSRTI)	03	-	03
9.	Bangladesh Fisheries Research Institute (BFRI)	06	05	11
10.	Bangladesh Livestock Research Institute (BLRI)	02	04	06
11.	Bangladesh Forest Research Institute (BFRI)	02	02	04
12.	Cotton Development Board (CDB)	01	01	02
13.	Ministry of Agriculture (MoA)	-	02	02
14.	Department of Agricultural Extension (DAE)	10	-	10
15.	Department of Livestock (DLS)	05	-	05
16.	Department of Fisheries (DoF)	05	-	05
Total		**80**	**60**	**140**

4.3.2 Discipline wise Distribution of Local PhD Programs

Unlike above distribution the following table 4.2 showed the distribution of local PhD programs as per disciplines (subjects/divisions). The PhD programs offered from the PIU-BARC, NATP – 2 covered 23 disciplines. It has been observed that Agronomy discipline shared the highest numbers (13 i.e. 19%) of local PhD programs followed by Soil Science (10 i.e. 14%), Plant Breeding (8 i.e. 11%), Fisheries (6 i.e. 9%), Plan Pathology (5 i.e. 7%) and so on. List of Awarded local PhD along with date of enrolment and name of university is given in Annex II

Table 4.2: Discipline Wise List of Awarded Local PhD Programs

S N	Name of Discipline	Scholars from institute	# Awardees
1	Agronomy	BARI-3, BRRI-1, BJRI-3, BSRI-3, BINA-1, BSRTI-1, DAE-1	13
2	Horticulture	BARI-4, DAE-1	5
3	Breeding	BARI-5, BRRI-1, BJRI-1, BSRTI-1	8
4	Entomology	BARI-1, BSRI-1, CDB-1	4
5	Pathology	BARI-3, DAE-2	5
6	Soil Science	BARI-1, BINA-2, SRDI-4, BFRI-1, BTRI-1, BSRTI-1, DAE-1	10
7	Biotechnology	BARI-1	1

S N	Name of Discipline	Scholars from institute	# Awardees
8	Agricultural Economics	BARI-1, BINA-1, BLRI-2	4
9	Post-Harvest	BARI-1	1
10	Agricultural Engineering	BRRI-1, BSRI-1	2
11	ICT	BARI-1	1
12	Agricultural Extension	BRRI-1, DAE-3	4
13	Agricultural Statistics	BRRI-1	1
14	Grain Quality and Nutrition	BRRI-1	1
15	Jute Textile	BJRI-1	1
16	Fisheries	Fish breeding-1, Aquaculture-2, Management-1, Biodiversity-2	6
17	Forest	BFRI-1	1
18	Agribusiness & Marketing	DAE-1	1
19	Environmental Science	DAE-1	1
20	Animal breeding	DLS-1	1
21	Parasitology	DLS-1	1
22	Microbiology and Hygiene	DLS-1	1
23	Animal Nutrition	DLS-2	2
Total			**75**

4.3.3 Discipline Wise Distribution of Foreign Ph. D Programs

The following table 4.3 showed the distribution of foreign PhD programs as per disciplines (subjects/divisions). The foreign PhD programs offered from the PIU-BARC, NATP – 2 covered 14 disciplines including women in Agriculture. It has been observed that Plant Breeding discipline shared the highest numbers (14 i.e. 23%) of foreign PhD programs followed by Soil Science (7 i.e. 12%), Agronomy (6 i.e. 10%), Fisheries (5 i.e. 8%), Plant Pathology (5 i.e. 8%) and so on. List of Awarded Foreign PhD along with date of encolment and name of uviversity/Institute is given in Annex III

Table4.3: Discipline Wise List of Awarded Foreign PhD Programs

SN	Name of Discipline	Scholars from institute	# Awardees
1	Agronomy	BARI-4, BRRI-2	6
2	Horticulture	BARI-3, BINA-1	4
3	Genetic Resources	BRRI-1	1
4	Breeding	BARI-5, BRRI-3, BJRI-2, BSRI-1, BINA-3	14
5	Entomology	BARI-1, BJRI-1, BTRI-1	3
6	Plant Pathology	BARI-1, BRRI-2, BJRI-1, BSRI-1	5
7	Soil Science	BARI-2, BSRI-1,BINA-1, SRDI-3	7
8	Biotechnology	BRRI-1, BSRI-1, CDB-1,BARI-1	4

SN	Name of Discipline	Scholars from institute	# Awardees
9	Agricultural Economics	BARI-1, MoA-1	2
10	Post-Harvest	BARI-1, BRRI-1	2
11	Livestock	Goat/Sheep production-1, Animal production-2, Microbiology-1	4
12	Fisheries	Fish breeding-1, Pathology-1, Breeding-2, Shrimp culture-1	5
13	Forest	Wood science-1, Wildlife-1	2
14	Women in Agriculture	MoA-1	1
		Total	**60**

4.4 Status of Training (Local and Foreign)

PIU-BARC, NATP-2 has DPP provision of local and foreign training for capacity development of NARS scientists to coordinate national research activities and to implement basic and adaptive researches at laboratory and field level. The project is also supporting workshops/seminar as per need on current issues and to disseminate the scientific information among the NARS scientists. The operation of foreign training and study visit facing difficulty due to non-engagement of consulting firm for the purpose. The project has provision of recruiting firm for operation of foreign training and Ph. D Programs but due to complexity in selecting International firm, the PIU-BARC is yet to complete the selection process. Details of training courses conducted during the project period till June 2019 with name of training and organizing institutions are given in **Annex IV**.

4.4.1 Training and Workshop

During 2018-19 more than 1900 scientists received training and more than 3000 officials attended workshop/seminar by the support of PIU-BARC. During organiging the local training programs, the major topic of courses have been selected by PIU-BARC based indications mentioned in the DPP (Development Project proposal).

The major courses of local training are: a) Research Methodology, b) Administrative and Financial management, c) Procurement Management, d) ICT in Agriculture, e) Financial Management, f) Project Development, g) Monitoring, Evaluation and Impact Assessment etc. The details of training courses and participants with venue are given in **Annex IV**.

Research Methodology training assisted the scientists in designing need based researches and to carryout the field research in more efficiaent way. It also helped them in collecting appropriate data, analysis the collected data to draw inferences and scientific report writing. Similarly the administrative and financial management training organized to develop skill on: strategic planning, good governance, team building, modern office management and tasks, qualities ethics of development managers, administrators, office record keeping, method of communications, coorespondace etc. The training also upgraded the knowledge on resolving personality conflicts, to

address negetive issues with patience. The scientists learned financial planning process, budgeting, financial reporting, annual accounts, interpreting financial statements, received and payment statements, income and expenditure statement, cash flow report and management reporting by attending financial management training courses. Procurement is a complex issue in project implementation, so scientists attended the course to learn: effective planning, risk assessment, execution and monitoring of procurement operations; understanding the rule of competition, non-discrimination and transparency in achieving value for money. The scientists also learned different ways of ICT in agriculture like: mobile ICT, GIS in agriculture, e-filing, use of essential software, national portal content management etc. How to develop project proposal has been tought to the scientist through project development training. They learned steps of project development, problem analysis, log frame, project proposal writing, project feasibility studies, concepts and rule of project management, scope and stakeholder management, project communication management and project financial management. Tracking of progress is very important in project implementation, scientists attended M&E cources and learned: need for M & E, basic concept of M & E, Log frame in project design, monitoring and evaluation methods and tools, report writing etc.

From the inception, 2690 participants from 13 NARS institutes were attended in these local training programs and 5558 attended local workshop/seminars.The venues of the local training programs were BARD, BIM, GTI, NATA, BAU, BARI and BARC while the duration of local training programs ranged from 3-14 days. The local training improved the skill and attitude of NARS scientists in respect of designing research programs, financial/procurement management, leadership & administrative development and use of ICT in agriculture. The execution of training/workshop also improved the capacity of 13 NARS institutes including BARC. Training has changed the institutional efficiency in designing and operation of research programs. Training also brought certain organization benefit like employee satisfaction, stakeholder satisfaction, owner satisfaction and work-forced productivity. Till now 49 officials received foreign training and 35 attended workshop/seminar at foreign countries.

Table4.4: Participants of training and workshop supported by PIU-BARC

Name of Event	DPP target (#)	Number of Participant		
		2017-18	2018-19	Total (%)
Local training	3520	779	1911	2690 (76)
Local workshop	7000	2412	3146	5558 (79)
International training	260	7	42	49 (19)
International workshop/study visit	200	0	35	35 (18)
Total	**10980**	**3198**	**5134**	**8332 (76)**

The following table 4.5 summarized the number of local training courses organized by NARS institutes. The table showed that of the training courses offered during 2017-18, BARC as coordinating body organized 40% followed by 20% by BIM, 10% each by BARI and GTI, and 5% each by other institutions. Similarly the training courses offered during 2018-19, BARC as coordinating body organized 33% followed by BARI 29% BIM 11%, PIU-BARC, 9%, GTI 5%.

Table 4.5: Sharing of NARS institutions in organizing local training program

SN	Institute	2017-18	2018-19	Total
		Event No	Event No	Event No
1	BARC	8	18	20
2	BARI	2	16	10
3	BIM	4	6	10
4	GTI	2	3	5
5	BARD	1	2	3
6	SRDI	0	2	2
7	PIU-BARC	1	5	6
8	BAU/BLRI	1	1	2
9	NATA/BFRI	1	2	3
All		**20**	**55**	**61**

4.4.2 International Training

In 2018-19, total 42 participants attended foreign training in different countries (Table 4.6). In 2018-19 PIU-BARC completed five batches of foreign training, the first one with a group of 6,2nd one with 2, 3rd one 13, 4th one with 8 and 5th one with 13 participants. The name of training subjects with participant numbers, duration (days) and country organized are shown in the following table 4.6. The foreign training improved the skill and attitude of NARS scientists in respect of designing research programs, financial/procurement management, leadership & administrative development and use of ICT in agriculture. The execution of training/workshop also improved the capacity of 13 NARS institutes.

Table 4.6: Status of Foreign Training programs in 2018-19

SL#	Name of Training	Participant No.	Organized by	Duration (days)
1	Advance contact management (Public Procurement Management)	6	Turin, Italy	9
2	Modern breeding and cultivation technology of vegetables	2	China	20
3	Climate smart agriculture	13	Philippines	12
4	Advance techniques of production and processing of spices	8	Indoneshia	10
5	Action research for SDGs localization on sustainable agriculture in Bangladesh	13	Australia	12
Total		42		

Advance public procurement management courses was attended by 6 scientists from MoA (1), Ministry of planning (1), BARC (2), BARI (1), and BSRI (1) at Turin, Italy who developed their skill and knowledge on: public procurement introduction, principles and institutional frameworks, procurement planning, building documents for goods, non-consulting services, consulting services, works procurement management, contract management for goods etc. The scientists who attended the course were involved in instituttional procurement process and after having training, they are continuing their works with better efficiency.Climate smart agriculture course were attended by 13 scientists from BARC (1), BARI (3), BRRI (2), BINA (2), BSRI (2), BJRI (1), SRDI (1), and BTRI (1) at Los Banos, Philippines who developed their skill and knowledge on: Principles and application of climate smart agriculture (CSA), impact and climate resilient agriculture, IPM, crop rotation and intercropping, challenges in using climate smart technology, advocacy of CSA etc. SDG training concentated to develop knowledge to the attendees from BARI (2), BRRI (2), BJRI (1), BINA (2), BSRI (1), SRDI (1), CDB (1), and BARC (3) on: sustainable agriculture, sustainability planning, the ago-economy, eco-tourism and local government, urban agriculture and home garden, waste management in agriculture, market analysis etc. Spices training attended by 8 scientists from BARI (7), BINA (1) who learned: post harvest management and processing of lemon grass and clove derivetives products, practice of making lemon grass and clove soap and clove balm, practice of making lotion based on lemon grass, post harvest processing of ginger, chilli, etc., cultivation and processing of medicinal plants and spices, practice on making harval medicine etc. The trainees were selected considering the cources like for spices training only spices scientists attended, for procurement traning procurement personnel attended the cources. So, it may assume that after attending the training courses abroad scientists develop their skill in implementing their researches in the field. Training impact assessment to be done to measure the improvement.

4.4.3 International Workshop/Seminar

PIU-BARC, NATP – 2 has fund provision for assisting outstanding scientists to attend workshop/seminar in the foreign countries. As part of the program during 2018-19, the component funded 11 scientists to participate workshop/seminar in the foreign countries on important scientific issues. As observed from the table below, all scientists attended conferences in Europe, Asia and North America. More than 50% participants attended different conferences during 2018-19 in Singapore. Detailed showed in table 4.7.

Table 4.7: Self-Initiative Conference/Workshop/Seminar for 2018-19

SL#	Name of Conference/Workshop/Seminar	Participant No.	Organized by	Duration (days)
1	International Conference on Earth Science	1	Netherlands	3
2	International Conference on Biological Control	1	Bengalaru, India	2
3	International Rice Congress	1	Singapore	3
4	International Congress on Plant Pathology and Plant Biotechnology	1	USA	2
5	International Congress on Plant Pathology and Plant Biotechnology	1	USA	2
6	3rd Organic Asia Congress	1	Philipines	3
7	International Rice Congress (IRC)	3	Singapore	3
8	Hybrid rice development consortium	2	Philippines	2
Total		**11**		

4.4.4 International Study Visit

Study visit is another event funded by PIU-BARC mostly for the senior officials of NARS institutes. During the year 2018-19 four events were funded where 24 scientists participated in fifferent countires (table 4.8). The duration of the programs ranged from 8-9 days. Details of the International visit programs funded by PIU-BARC are shown in the following table.

Table 4.8: International Study visit in 2018-19

Sl	Title	Participant No.	Country	Duration (day)
1	Knowledge sharing of agriculture project management	7	Germany, Franch and Netherland	9
2	Flower species identification, culture, bio-technology of flower development and orchids	5	UK	8
3	ICT in library management and archiving	7	Australia	8
4	Executive action research program on SDG: Bangladesh perspective	5	Australia	8
Total		**24**		

Chapter 5

Strenthening ICT Facility

5. Progress of ICT Facility

ICT facilities had been developed at BARC and seven NARS institutes i.e. BARI, BRRI, BJRI, BLRI, BFRI, BSRI, SRDI under NATP-1 project. Similar facilities are planned to be developed for remaining 5 NARS (CDB, BFRI, BTRI, BINA & BSRTI) and few more sub-stations (RARS/ARS) of NARS under NATP-2 project.

PIU-BARC hired two consultants (One for hardware & Networking and another for software) in January 2019 to collect requirement of hardware and software from different NARS institutes. For the purpose, Assistant ICT Specialist of PIU-BARC along with these two Short Term Consultants visited all 12 NARS, 5 sub-stations and BARC from 5thMarch to 4thApril, 2019. 20 separate sessions/meetings (for 9 MIS modules) were arranged at PIU-BARC conference room during March 2019. Experts from different NARS institutes participated in each session where MIS module was discussed.

Besides, of the above field assessment, a meeting was arranged on 27th June 2019 at BARC conference room-1 to share the progress of ICT infrastructures development activities. The related consultants of PIU/PMU, focal points of 12 NARS institutes and officials of computer & GIS unit, BARC were present in the meeting. The consultants showed their proposals through power point presentation. The meeting largely accepted the proposals proposed by the ICT consultants of PIU-BARC regarding the ICT infrastructure development activities in NARS institutes.

The hardware consultant documented all the hardware and networking requirements by different NARS institutes and sub-stations during his visit. He also prepared a budget to setup network infrastructure and required hardware devices. Summary of assessed equipment for different NARS institutes are shown below:

Table 5.1: List of hardware equipment to be provided for NARS institutes

Service Offer	Item Name
Server & Network Setup	Server with O/S
	Server & Network Rack (42U)
	Core Router-1 (Supports 200 mbps)
	Core Router-2 (Supports 100 mbps)
	Next Generation Firewall
	Unified Thread Manager (UTM)
	Core/Distribution Switch-1 (24 Ports SFP)
	Core/Distribution Switch-2 (12 Ports SFP)
	Access Switch (L-2, 24 ports)
	Fiber SFP Module (Single Mode)
	Fiber SFP Module (Multi Mode)
	Copper SFP Module
	UPS (6KVA Online)
	Wireless AP
	Internet Connectivity for 18 months
LAN Cabling &	UTP Cable

Service Offer	Item Name
Networking Accessories	Information Outlet
	Face Plate
	MK Type PVC/Steel Back Box
	Patch Cord (1 meter) for Rack Side
	Patch Cord (3 meter) for User Side
	Copper Patch Panel
	Cable Manager
	Optical Fiber Cable (Single Mode)
	Optical Fiber Cable (Multimode)
	Fiber Patch Panel (24 port)
	Fiber Patch Panel (12 port)
	Fiber Patch Cord (Single Mode)
	Fiber Patch Cord (Multi Mode)
	TJ Box
	12u Wall Mount Network rack
	PVC Conduit (Pipe/Channel/Flexible) with all Fitting & Fixing Accessories
	Installation Charge For UTP Cable Laying, Modular punching, Patch panel punching, Testing , Labeling & Commissioning
	Fiber Underground Laying Job (Trench Cutting with HDPE pipe and necessary accessories
	Installation Charge For Fiber Cable Splicing, Testing , Labeling & Commissioning
User-End Hardware	Desktop PC
	Laptop / Notebook
	UPS (Normal)
	ADF Scanner (For Legal/A4 paper)
	Scanner (Map Scanner)
	Normal Printer
	Color Laser Network Printer
	Heavy Duty Network Printer
Video Conferencing	VC System with Single Camera & Other Accessories
	VC System with Quad Camera & Other Accessories
	Call Control Server, Multipoint Conferencing Unit (MCU) and Call Control License
	Cloud based Meeting License
	Online (UPS 3KVA) for VC backup
	LED 55' screen
	LED 65' screen (Only for BARC)
Library Automation	Bar Code Printer
	Bar Code Reader
Automatic Book Scanner	Automatic book scanner for book digitization
Support person	HW & Network Support person for 12 months (50,000/- Tk. / month)
Surveillance System for BARC Data Center	Network Video Recorder (NVR)
	CC Camera for Data Center

Software consultant identified and documented features and functionalities for 9 MIS modules. List of MIS modules are:

i) Financial Management Information System

ii) Human Resources Management Information System
iii) Inventory Management Information System
iv) Procurement Management Information System
v) Library Management Information System
vi) Research Management Information System
vii) Training Management Information System
viii) Vehicle Management Information System
ix) Data Bank

On 15 May 2019, the hardware and software consultants of PIU-BARC made power point presentation on the requirement of NARS and BARC in BARC conference room-1. All concerned officials including Executive Chairman, BARC were present in the meeting.

Based on the assessment of consultants the PIU-BARC is now preparing tender documents for hiring firm to install software and hardware in NARS institutes and BARC.

Chapter 6

Improvement of Research and Training Facility

6. Improvement of Research and Training Facility

The PIU-BARC, NATP-2 has provision for improving the existing research and training facilities of BARC and NARS institutions as well as to ensure advance research in context of climate change and environmental pollution. So far PIU-BARC supported to establish electricity connection in newly constructed two floors of training building of BARC complex. The PIU-BARC also supported to install sub-station to facilitate smooth (non-interrupted) supply of power throughout the BARC complex. A comprehensive plan is made to equip the laboratories of NARS institutes to carryout advance research programs.

6.1 Laboratory Equipment

As per provision of the DPP, PIU-BARC has taken initiative to equip the research laboratories of NARS institutes. PIU-BARC collected the demand of the equipment from each of the NARS institutes. By this time numbers (02) of meetings have been conducted with the representatives of NARS institutes and reviewed the list of equipment and finalize the items to be purchased. The process of tendering is underway and expected to be completed by next fiscal year. The list of equipment so far selected in the meetings is shown in the following table by institutes.

Table 6.1: Estimated numbers of Lab-Equipment by NARS Institutes

Institute	Name of Instrument	Qty.
1. BARI	1. Amino acid analyzer with Accessories	1
	2. UV Vis Spectrophotometer	1
	3. Inductively coupled plasma optical emission spectrometer (ICB-OES)	1
	Sub-total	**3**
2. BRRI	1. Liquid Chromatography Mass Spectrophotometry (LC-MS/MS)	1
	2. Ultra-Pure Water Purification System HPLC and MS Grade	1
	Sub-total	**2**
3. BJRI	1. Kjeldahl Digestion System	1
	2. Protein Nitrogen Analyzer	1
	3. Spectrophotometer	1
	Sub-total	**3**
4. BINA	1. Real Time PCR with note book computer	1
	2. Note book for real time PCR	1
	Sub-total	**2**
5. BSRI	1. Stevia Extraction Equipment (for lab Scale Extraction of Steviosides)	1
6. SRDI	1. PC Based Spectrophotometer (Optically real double beam)	2
	2. Flame Photometer	1
	Sub-total	**4**
7. BFRI (fisheries	1. Packing Unit for vacuum and MAP	1
	2. Retort Packing Plant	1
	3. Double Chamber Vacuumed Scaler	1
	4. Semi-Automatic Vacuumed Can Seamer	1

Institute	Name of Instrument	Qty.
	Sub-total	**4**
8. BLRI	1. Real Time PCR System; Real Time PCR System	1
	2. Portable Biogas Analyzer	1
	Sub-total	**2**
9. BFRI (forest)	1. Digital Constant Temperature Kinematic Viscometer	1
	2. UV-VIS Spectrophotometer	1
	3. Digital brightness	1
	4. Image Analyzer	1
	5. Thermal cycler (PCR) with Gradient	1
	Sub-total	**5**
10. BTRI	1. Automatic absorption Spectrophotometer	1
11. BSRTI	1. Leaf Area Meter	1
	2. Flame Photometer	1
	3. Phase contrast Microscope	1
	Sub-total	**4**
	Grand Total	**29**

Chapter 7

Environmental and Social Safeguard Management

7. Environmental and Social Safeguard Management

The Environmental and social safeguard management in NATP-2 is considered as a major integral part of the project activities. Environmental and social safeguard are not viewed in isolation, but are integrated with the overall project activities. For addressing environmental and social safeguard management, Environmental Management Framework (EMF) along with Pest Management Plan (PMP) and Social Management Framework (SMF) were used. The EMF and SMF reports of the NATP-2 indicated that the project shall have no major adverse environmental and social impact. However, the environmental and social safeguards are to be applied to all the research sub-projects in different stages of the project cycle. Environmental and social safeguard management activities are being implemented as cross cutting issue in PIU-BARC throughout the project period through selection processes of CRG & PBRG sub-projects to end of the sub-projects, workshops, monitoring, trainings, field days, etc. The CRG and PBRG sub-projects have been selected considering the national research visions and themes across agriculture sub-sectors. During the reporting year (2018-2019), a number of environmental and social safeguard activities have been undertaken by the component as follows:

7.1 Environmental and social safeguard management activities performed under CRG and PBRG sub-projects

7.1.1 Categorization of Sub-projects

All the awarded CRG and PBRG sub-projects addressed environmental and social safeguard issues directly or indirectly to improve environmental and social development through sub-project interventions.These sub-projects were designed to develop sustainable production practices of crops, fisheries and livestock leading to end with environment friendly and climate smart innovative technologies. The sub-projects addressed possible all types of environmental issues which can be categorized as biodiversity, mangrove ecosystems, agro-forestry, water management, climate change impacts, methane emission in dairy farming system and its mitigation options, low carbon farming technique, soil health and strengthening of IPM approach leading to reduce the load of agrochemical uses at farm as well as at national level, improvement of soil quality & soil health, food safety issues, improvement of livelihoods of farmers and so on (Table 7.1).Hence, most of the sub- projects under CRG and PBRG are not only environment friendly but also improving the environment of the sub-project areas. All the information generated through the research component and disseminate to extension components will enhance crop, livestock and fisheries production in the country through promoting environment friendly technologies which is available in the website (www.natpbarc.gov.bd) and other publications of PIU-BARC, NATP-2.

Table 7.1: Major categorization of environmental and social safeguard issues addressed through CRG and PBRG subproject implementation.

SN	Areas of sub-projects	Environmental and social safeguard issues addressed	# Of Sub-projects
1	Biodiversity	Biodiversity will be conserved, social safeguard will be ensured and indigenous knowledge will be conserved through collection and characterization of important plant genetic resources including forest and medicinal plants. Small indigenous fish species (SIS) will be conserved, and farmers' income will be increased.	**15**
2	Unfavorable environmental (Char, Coastal, Haor & Beel, Drought, Madhupur garh) ecosystems	Soil organic matter (SOM) will be enhanced and livelihoods of ultra poor farmers in char areas will be improved and women empowerment will be enhanced through the introduction of improved agro-forestry practices and agricultural technologies along with adaptation of high-value crops and development of business model in char land ecosystem of Bangladesh. SOM will be enhanced and livelihoods of farmers will be improved through Climate Resilient Participatory Farming Systems Research. Highly stress tolerant rice varieties will be developed through introgression of multiple salt tolerance loci (QTLs) into commercial cultivars. Fish production will be increased and sustained and livelihoods of farmers and fishermen in haor and beel areas will be improved through adopting improved management approach.Biodiversity conserved, vegetation expanded and enhanced resources conservation through agro-forestry as well as improved livelihood of the farming community through system approach in Madhupur garh.	**15**
3	Soil quality /degradation	Soil pollution will be reduced and soil health will be improved through amendment of acidic, saline and heavy metal polluted soils using biochar for sustainable crop production.	**03**
4	Food safety issues/ pesticide related health and safety issues	Food and nutritional safety issues are being adequately addressed through improving crop, livestock and fish production in terms of quality and quantity. Food safety will be improved through identifying contaminants and adulteration in food chain and their prevention through improved postharvest practices. Post-harvest losses will be decreased and quality crop, livestock & fish production will be increased; and livelihoods of farmers will be improved by increasing farmer's income and food/nutritional safety will be ensured. Nutritional safety will be enhanced through determining critical limit of plant nutrients for major crops. Fish production will be increased and sustained and	**23**

SN	Areas of sub-projects	Environmental and social safeguard issues addressed	# Of Sub-projects
		livelihoods of farmers and fishermen in haor and beel areas will be improved through adopting improved management approach.Food safety will be ensured and farmers will be benefited through knowing adulterated pesticides and residual effects.	
5	Integrated Pest Management (IPM)	Pesticide use reduction targeted; conservation of beneficial insects promoted, enhanced safe food production and reduced health hazards. Use of IPM reduces environmental pollution and reduces the cost of production and increases the availability of safe vegetables in the market. Use of pesticide reduced; the livelihood of the farmers improved through increased vegetables, tea, soybean, cotton and fruits production.	**04**
6	Bio-fertilizer upscaling; and compost, vermicompost and tricho-compost production	Use of inorganic fertilizer reduced; enhanced soil heath, nutrient use efficiency and organic matter content; reduced GHG emission and increased rice yield. Improved organic farming, employment generating opportunities increased particularly for women. Improved soil health and reduced the use of chemical fertilizers resulting in reduced environmental pollution through the production of compost, vermicompost and tricho-compost from household organic waste.	**05**
7	Others (Up scaling of solar pump and lac production technology, Rooftop gardening)	Use of solar pump for surface water irrigation in southern region of Bangladesh will save energy and improve environment by reducing fossil fuel burning. Utilization of beneficial insect enhanced; employment opportunities generated for women along with poverty reduction of the ultra poor and marginal farmers through lac production. Rooftop gardening is popularizing, increased vegetables and fruits production, expanded vegetation, improved environment through reducing CO_2 and increasing O_2 in the air.	**05**

7.1.2 Climate Co-benefits

Any agricultural technology is usually tested before its release whether technology is economically viable, socially acceptable and environmentally sound. Technology should be climate resilient/climate smart, a new ideas in now-a-days. Besides, all the CRG and PBRG sub-projects can be classified into three groups such as (i) climate-neutral, (ii) having climate co-benefits and (iii) direct climate-related. Adverse climate change impacts can be overcome using mitigation or adaptation mechanisms in agriculture. So sub-projects having climate co-benefits are useful to face future climate change

impacts. In this regard, list of 15 CRG &5 PBRG sub-projects are shown in Tables 7.1a, b related to climate co-benefits as bellows:

Table 7.1 a: List of CRG sub-projects having climate co-benefits with sub-project Title & ID.

SN	Title of CRG sub-projects with ID	Climate co-benefits
1	Development of climate resilient mangrove ecosystems in the Sundarban (ID- 301).	Developed mangrove vegetation in the coastal areas to improve carbon sink. Promoted climate smart and sustainable management of coastal ecosystems.
2	Assessment of methane emission in dairy production systems based on existing feed resources through GLEAM model under different climatic zones of Bangladesh and their mitigation options (ID- 781).	Actual amount of enteric methane emitted from dairy animal in different climatic zones of Bangladesh has been estimated through GLEAM model. The suitable fodder which emits low quantity of methane has been identified.
3	Assessment of ecosystem services and benefits of rooftop gardening for climate-friendly city development using geospatial technology (ID- 413).	Air temperature in roof top garden has been reduced by 5.2 ^{o}C as compared to bare roof.
4	Rooftop Gardening: An Initiative to Spread Urban Horticulture with Changing Environment (ID- 623).	Roof top garden has reduced both the roof upper and lower surface temperature,oxygen percent has been observed higher and CO_2 concentration lower in the garden than the bare roof.
5	Achieving adaptation to climate change and sustainable livelihood through Moringa based agroforestry practice in Bangladesh (ID-432).	Improved vegetation and carbon sink through growing six vegetables with Moringa saplings and found all the crops can successfully be grown up to 6 months in association with Moringa without significant yield loss.
6	Evaluation of tree-crop interaction from existing agroforestry systems in Sylhet region for food security by the lens of climate-smart agriculture framework (ID- 439).	Improved vegetation and carbon sink with identifying critical issues and composition of existing agro-forestry systems in Sylhet region.
7	Development of a sustainable agricultural risk management technology in areas affected by flash flood using numerical climate modeling data analysis (ID- 512).	Although, there are variations in data of different models of flash flood, all models have their numerous potentialities on predicting flash flood and the test hypothesis of this research may be served as a key indicator of flash flood in this area.
8	Development of a business model on crops and cattle for low carbon farming technique: An initiative for farm level in coastal region of Bangladesh (ID- 593).	The low carbon has been decreased 25% production costs and enhance yield. Low carbon farming has been able to provide additional short and long-term co-benefits to the environment, including improving saline soil and resilience to climate change.
9	Up-scaling of Multistory Agroforestry System for Diversified Production, High Income and	All the crops associated with jackfruit based multistrata agro-forestry systems will

SN	Title of CRG sub-projects with ID	Climate co-benefits
	Ecosystem Services (ID- 595).	augment soil-N, organic carbon, organic matter and P^H in compared to control field.
10	Rice-based agroforestry in Bangladesh: Status and opportunities for sustainable land use system and combating future climate change challenges (ID- 596).	Rice based agro-forestry has been observed the 2nd most dominant land use practice in Rajshahi, Chapainawabgonj and Dinajpur because of higher profit. Farmers usually plant mango trees in the field and few cases in aile and aile plus field.
11	Floating bed fodder cultivation in submerged and flooded areas in Sylhet District: A tool for climate resilient livestock production (ID- 647).	Fodder quality has been observed a positive (r=0.746) with dissolved oxygen of water. Floating bed may be used as alternative of land for fodder (German grass) production in flood prone or haor area.
12	Assessment of the impact of climate change on arthropod vectors those transmitting vector borne diseases in Bangladesh (ID- 659).	Dominant species of arthropods in Bangladesh have been confirmed and seasonal prevalence of arthropods has been determined. Number of arthropods has been correlated with meteorological data.
13	Identification of climatic factors responsible for disease and insect outbreak and their appropriate management in southern region of Barishal (ID- 698).	Optimum time of transplanting and dose of urea has been found to decrease the False Smut incidence. Perching, sweeping, light trapping, optimum use of urea and spraying of appropriate insecticide has been reduced the infestation of insects.
14	Study of the climate change impact on fisheries resources and fishers' especially women and children in selected climate hotspot zone of Bangladesh (ID- 718).	The information generated will be useful to combat adverse climate change impacts on fisheries production. Physico-chemical parameters (temperatures, dissolved oxygen, P^H and salinity) and gonadal maturation cycle has been changed due to climate change.
15	Screening of sugarcane clones based on adaptive mechanisms under drought and salinity stress due to climatic change (ID- 746).	Selected 6 sugarcane clones tolerant to drought stress and 8 sugarcane clones tolerant to salinity stress that will be used to develop drought and salt tolerant sugarcrop varieties to augment climate change impact.

Table 7.1 b: List of PBRG sub-projects having climate co-benefits with sub-project title & ID.

SN	Title of PBRG sub-projects with ID	Climate co-benefits
1	Up-scaling and Application of Solar Photovoltaic Pump for Smallholder Irrigation and Household Appliances in the Central Coastal Region of Bangladesh (001).	Energy to be saved and environment to be improved by reducing fossil fuel burning.
2	Establishment of profitable cropping pattern through crop intensification in underutilized unfavorable ecosystem (ID- 089).	Vegetation and carbon sink to be improved.
3	Climate Resilient Farming Systems Research and Development for the Coastal Ecosystem (ID- 098).	Vegetation and carbon sink to be improved.

SN	Title of PBRG sub-projects with ID	Climate co-benefits
4	Upliftment of Farmers Livelihood and Enrichment of Environment through Improved Agro-forestry Practices in Char Land Ecosystem of Bangladesh (ID-077).	Vegetation and carbon sink to be improved.
5	Germplasm conservation and farm productivity enhancement through the interaction of shade trees and tea based agro-forestry system to mitigate the climate change (ID-072).	Vegetation and carbon sink to be improved.

7.2 Field monitoring on environmental and social safeguard management

Field monitoring was done on a number of PBRG sub-projects conducted in BRRI HQ at Gazipur and seven PBRG sub-projects conducted in the North Central Bangladesh (Mymensingh Region-2) covering Netrokona, Sherpur, Jamalpur, Tangail and Kishoregonj districts. On 19 March 2019, visited laboratory of Plant Pathology Division, green house of Entomology Division, workshop of FMPHT Division and seven experimental fields at BRRI HQ where PBRG sub-project activities were going on, collected required data, and gave suggestions regarding environmental and social safeguard issues. The overall sub-project activities were shown satisfactory. Visited laboratory, green house and experimental fields have shown neat and clean. All PI/Co-PIs have shown keen interest to implement environmental and social safeguard issues including gender and IP issues (if applicable). Visited five PBRG sub-projects in the North Central Bangladesh (IDs 005,061,077,089,096) and seven PBRG sub-projects in BRRI HQ, Gazipur (IDs 064,001,087,091,010,061,070) along with Environmental and social safeguard issues addressed are shown in Table 7.2.

Table 7.2: List of PBRG sub-projects visited with Environmental and social safeguard issues addressed along with sub-project title & ID.

SN	Title of PBRG sub-projects with ID	Environmental and social safeguard issues addressed
1	Transfer of agricultural technologies to farmers' level for increasing farm productivity, ID 005 (Crops)	Additional nutrition to be provided to farmers through increased fish production and livelihoods of farmers to be improved due to increased production of HYV rice using balanced fertilizer. Fish Ponds and rice fields were well managed.
2	Integrated farming research and development for livelihood improvement in the plain land eco-system; ID 061 (P&E)	Soil organic matter, and livelihoods and nutrition of farmers of the locality to be improved. Vegetation and carbon sink to be improved.
3	Upliftment of farmers livelihood and enrichment of environment through improved agro-forestry practices in char land eco-system of Bangladesh; ID 077 (Forest)	Forest resources, food security, sustainable environment and poverty alleviation to be improved through Implementing improved agro-forestry in charland of Jamalpur and Sherpur.

SN	Title of PBRG sub-projects with ID	Environmental and social safeguard issues addressed
		Vegetation and carbon sink to be improved.
4	Establishment of profitable cropping pattern through crop intensification in underutilized unfavourable eco-system; ID-089 (Crops)	Farmers' livelihood to be enhanced by increasing production in sub-project area through Implementing improved cropping patterns. Vegetation and carbon sink to be improved.
5	Improvement of farm productivity through intervention with improved agricultural technologies in char land eco-system; ID 096 (P&E)	Livelihoods and nutrition of farmers of the locality to be enhanced through implementing agro-forestry and homestead gardening. Vegetation and carbon sink to be improved.
6	Design and development of fertilizer deep placement mechanism for existing rice transplanter; ID 064 (Agri.Engg.)	Fertilizer use efficiency to be increased and human physical dependency to be reduced.
7	Up-scaling and Application of Solar Photovoltaic Pump for Smallholder Irrigation and Household Appliances in the Central Coastal Region of Bangladesh; ID 001 (Agri.Engg.)	Energy to be saved and environment to be improved by reducing fossil fuel burning.
8	Eco-friendly Rodent Management Through Owl Conservation; ID 087 (Crops)	Owl conservation to be ensured.
9	Identification of novel resistant gene(s), gene pyramiding and sustainable management of bacterial blight (BB) disease of rice for ensuring food security; ID 091 (crops);	Environment to be improved through reduction of pesticide use.
10	DNA marker-assisted breeding for producing highly stress tolerant elite rice varieties for coastal Bangladesh by introgression of multiple salt tolerance loci (QTLs) into commercial cultivars; ID 010 (crops)	Coastal environment and livelihoods of farmers to be improved.
11	Integrated Farming Research and Development for Livelihood Improvement in the Plain land Eco-system; ID 061(P & E)	Soil organic matter; and livelihoods and nutrition of farmers of the locality to be enhanced. Vegetation and carbon sink to be improved.
12	Economic Viability and Production Efficiency of Rice at Farm Level: A Macro Level Study in Bangladesh; ID 070 (AERS)	Factors responsible to improve livelihoods of farmers to be identified.

7.3 Implementation, coordination and institutionalization

Implementation, coordination and institutionalization are the key factors for success and sustainability of any project activity. In view of this, PIU-BARC organized series of workshops on implementation process, annual research progress, annual monitoring progress, etc. of CRG and PBRG sub-projects. In the Implementation process workshops of CRG & PBRG sub-projects, all the Coordinators / PIs / Co-PIs

have been advised to follow the environmental and social safeguard implementation guidelines in the sub-projects. A day-long workshop was organized by PIU-BARC, NATP-2 to build awareness on the Environmental and Social Safeguard issues among the stakeholders of the sub-project. The workshop was held on 12 February 2019 at 9.30 am in the Training Bhaban, BARC complex, Farmgate, Dhaka-1215. A total of 71 participants attended the workshop from BARC, Project Management Unit, NATP-2, DAE, DLS, DoF, NARIs (BARI, BRRI, BJRI, BINA, BLRI, BSRI, BFRI, CDB; BAU) and PIU-BARC, NATP-2. Following recommendations were adopted in the workshop:

1. Good Agricultural Practices (GAP) of crop, livestock and fisheries need to be published in the respective websites of all the Project Implementation Units (PIUs) for wider publicity.
2. Environment friendly technology and social safeguard information generated from CRG and PBRG sub-projects should be disseminated properly.
3. Training programs organized under PIUs and implementing agencies should have a topic/class/discussion on environmental and social safeguard management issues.
4. Awareness to be created on environmental and social safeguard issues among the stakeholders particularly to producers, packers, supply chain businesses, trainers, government representatives, consumers and others.
5. Research and development should be strengthened on environmental and social safeguard management to identify adverse environmental and social safeguard issues and to generate and implement their mitigation measures in integrated way.
6. Existing environmental and social safeguard related policies/laws/regulations need to be implemented properly and upgraded.

The workshops have sensitized the stakeholders and participants. Environmental and social safeguard management issues have been institutionalized through the focal persons of the research proponent institutes/organizations where research proponents were acted as focal persons.

7.4 Gender strategy

PIU-BARC always encourages women participation in all the activities undertaken in the unit as equal opportunity basis. Out of 190 CRGs,women are working as PIs in 22(12%) sub-projects and took part in the sub-project activities. Besides, some other women including female farmers in the sub-project areas are also involved in sub-project activities particularly training programs, workshops, field days, etc. CRG and PBRG research programs have created many opportunities for economic development; identify special requirements for enhancement of women activities, power sharing and leadership opportunity through women participation in the sub-project. The research programs have also developed women friendly technologies. No problem faced by women in the sub-project. Hence, mainstreaming of women is progressing through sub-project activities.

7.5 Environmental and social safeguard compliances

Reviewed and verified14 PBRG sub-projects covering different aspects of crop, livestock and fisheries showed satisfactory compliance with safeguard measures based on exclusion criteria and environmental screening matrix. PBRG sub-projects were selected on competitive basis following the guidelines described in AIF-1 and Project Implementation Manual (PIM). All the sub-project activities were performed in transparent way. Moreover, observations reveal that any PIU-BARC activity under PBRG sub-projects covering crops, livestock and fisheries does not involved in land acquisition,

involuntary resettlement, encroachment of reserve forests, and use of prohibited pesticides, etc. No complain has been received from any one either from female or male working under the sub-projects and any other stakeholder of the project due to any activity of the component. Finally, all the Coordinators/ PIs/Co-PIs are aware of environmental and social safeguard management than before.The above information reveals that all the project activities of PIU-BARC implemented in the reporting year are met with total compliances to environmental and social safeguards.

7.6 GRM management

PIU-BARC, NATP-2 is implementing all the project activities with transparency, accountability, risk reduction and effective way along with adopting Grievance Redress Mechanism (GRM). In this regard, following actions have been undertaken:

- Dr. Mian Sayeed Hassan, Director PIU-BARC, NATP-2 is acting as Grievance Redress Officer (GRO) and Dr. Shaikh Mohammad Bokhtiar, Member-Director (P & E), BARC is acting as Appellate Officer (AO) to action taken against any suggestion or complain submitted by any stakeholder of the PIU-BARC, NATP-2. Besides, there is a provision in PIU-BARC website (www.natpbarc.gov.bd) to lodge complain or constructive suggestion by any stakeholder to implement GRM in the component. Names, addresses, telephone number of GRO and AO are also placed in the website of PIU-BARC, NATP-2. It may be mentioned here that no suggestion or complain has been received since the inception of NATP-2 project.
- A complain box has been placed in office premise of PIU-BARC, NATP-2, BARC, Farmgate, Dhaka-1215.
- In the office premise of PIU-BARC a registrar note book has been kept for record-keeping to write complain/suggestion by stakeholders.

7.7 Indigenous People (IP) strategy

Technologies generated through research that can be used by anybody i.e. neutral to IP/plain land peoples. However, six CRG sub-projects were conducted in the Chittagong Hill Tract areas/hilly region, two CRG sub-projects in Madhupur Tract area, two CRG sub-projects in Sylhet region and one in Barind Tract area to address different aspects of agricultural production to solve the problems faced by the different tribal communities/Jhumia community (Shifting cultivators)/Indigenous People (IP) living in these areas. The CRG sub-project (ID-454) entitled “Agricultural practices and livelihood patterns of selected tribal communities in Bangladesh” depicted overall picture of IP community in terms of production potentials, constraints and mitigation measures. Similarly, CRG sub-project (ID-386) entitled “Agro-forestry for livelihood development of Jhumia community (shifting cultivators) in Chittagong Hill Tracts, Bangladesh” improved the capacity of household and jhum land agroforestry systems to enhance livelihoods of jhumia community, introduced sustainable land use system on hill farming for optimizing the yield of food, fodder, timber, fuel-wood, bamboo, cane, medicinal plants, etc and assessed socio-economic and environmental benefit based on sustainable hill farming practices in the Chattogram, Cox’s Bazar, Rangamati, Khagrachari and Bandarban regions. Several CRG and PBRG sub-projects were conducted on varietal adaptation trials trying to identify varieties suitable for these regions. Six PBRG sub-projects are being implemented in hill areas on transfer of agricultural technologies, household food security, lean season fruit variety development, agro-forestry and livelihoods, Ex-situ conservation of forest genetic resources and medicinal plants. The information generated through these sub-projects will enhance crop production in the hilly region where majority of the indigenous people are living.

Chapter 8

Monitoring and Evaluation

8. Monitoring of CRG and PBRG Implementation

Monitoring and Evaluation (M&E) is a process that helps improve performance and achieve results. Monitoring is a continuous collection of data on specified indicators to assess development intervention (project, program or policy). While evaluation is the periodic assessment of the design, implementation, outcomes and impact of development intervention/project. Desk Monitoring reviews financial, physical and technical progress of a project. Under desk-monitoring PIU-BARC reviewed the half-yearly and annual progress reports of CRG and PBRG sub-projects. While field monitoring usually conducted at an interval of 5-6 months using a given format to capture first hand information/data. PIU – BARC has taken enough steps to monitor the field progress of both CRGs and PBRGs.It has established central M&E Cell at BARC, Divisional M&E Cell of BARC, institutional M&E Cell at respective recipient organizations and PIU-BARC Monitoring Team to make field monitoring of on-going sub-projects. The following monitoring systems have been undertaken for monitoring of CRGs and PBRGs:

8.1 Desk Monitoring

Submission of half-yearly and annual reports of CRG/PBRGs to the PIU-BARC are the pre-requisite for fund release of the successive installments. Once the reports are submitted by the coordinators and PIs, the M & E Specialist of the PIU-BARC reviews the reports and assess them whether qualify for further funding. By June 2019 all half-yearly and maximum numbers of annual reports of 40 PBRG sub-projects have reviewed and recommended for fund release. Numbers of half-yearly and annual reports have returned to the authors for improvement based on the comments of the consultant. Reviewing of reports of CRG/PBRGs is one of the tasks of the monitoring section of the project.

8.2 Log Frame based Performance

Narrative Summary	Objectively Verifiable Indicator (OVI)	Updated Progress
Output level ▪ Improved performance of the NARS by supporting the development of innovative agricultural technologies and strengthening agricultural research institutions	▪ 100 CRG and 33 PBRG subprojects implemented ▪ 80 local PhD, 60 foreign PhD, short-term training, study visit etc. implemented ▪ Research and training facilities in outreach stations (RARS/ARS) improved ▪ ICT facilities developed and connectivity established among ARS, RARS and NARI-HQs	▪ 190 CRGs completed; 40 PBRGs are on-going with satisfactory performance; field monitoring completed for 82 sub-projects by 10 ME teams ▪ 75 local and 60 foreign PhD scholars admitted and started course works, 5 for MoFL/DoF got permission and under processing of admission; 2690 officials received local training, 5558 participated in local workshop/seminar, 42 attended foreign training and 11 participated workshop/seminar abroad ▪ For upgradation of lab facility, purchase and supply of modern equipment to NARS under process expected to be completed by Sep 2019 ▪ Assessment has been completed and tender documents are being prepared

8.3 Formation of Monitoring Cell/Team

Central M & E Cell at BARC: Central M & E Cell has been formed by the BARC for monitoring the implementation progress of CRG & PBRG sub-projects. Central M & E Cell of BARC is responsible for designing, organizing and managing the activities of M & E of PBRG sub-projects as well as to undertake necessary measures to any of the sub-projects' Coordinators/ PIs who failed to reach the milestones/ indicators mentioned in the sub-project proposals.

Division wise M & E Team at BARC: Division wise M & E team has been formed by the Technical Divisions of BARC for monitoring the implementation progress of CRG sub-projects.

Institutional M & E Cell: The CRG/PBRG recipient institutes have also formed their institutional monitoring team as well as nominated Focal Point for monitoring the implementation progress of CRG & PBRG sub-projects. Monitoring team of the recipient institute is responsible for feedback information to PIU- BARC including respective Coordinators/ PIs to undertake necessary measures. During field visit to the implementing organizations the M&E officials of PIU/BARC contacted the respective focal points to organize sub- project monitoring.

PIU-BARC Monitoring Team: PIU-BARC, NATP-2 assisted to form 9-10 Monitoring Teams headed by MDs of BARC for monitoring the field progress of CRG and PBRG sub-projects. The M&E section of PIU-BARC assisted to form the team and their ToR and organized other logistics for monitoring events of the sub-projects. The M&E Team used prescribed format for field monitoring of PBRGs. The M&E team for PBRG sub-projects completed field visit of each of the components of 40 PBRG sub-projects. The team has presented their finding to the workshop held on 17-18 June 2019 in presence of relevant experts. The recommendations of the workshop being transmitted to the PIs for further improvement of their lab and field researches.

8.4 Monitoring Workshop on the PBRG Sub-Projects

The Project Implementation Unit (PIU), Bangladesh Agricultural Research Council (BARC), NATP-2 organized a two day long workshop on Monitoring of PBRG (Program Based Research Grant) sub-projects at BARC auditorium from 17-18 June 2019. Dr. ASM Anwarul Huq, Executive Chairman (routine charge), BARC was present in the inaugural session as chief guest, and Mr. Manzur Hasan Bhuiya, Deputy Project Director NATP-2 as special guest. Dr. Mian Sayeed Hassan, Director, PIU-BARC chaired the inaugural session. The team leader and or representatives of each of the M & E Teams presented the present status (progress) of the PBRG sub-projects including the financial progress and the drawbacks faced by the PIs during field implementation of the programs. Besides the inaugural session, the workshop was divided into four technical sessions, two in each day. The 1st technical session was chaired by Dr. ASM Anwarul Huq, MD (A&F), BARC and 2nd session by Dr. Aziz Zilani Chowdhury, MD (Crops), BARC. The 2nd day of the workshop started by technical session III chaired by Dr. Sultan Ahmed, MD (NRM), BARC and the 4th technical session chaired by Dr. Mian Sayeed Hasan, Director, PIU-BARC. Six expert members from different disciplines were invited who critically reviewed the technical papers and providing their valuable remarks and suggestions on each of the presented sub-projects. All concerned PIs and Co-PIs were present in the workshop. The remarks and comments of participants including the invited expert members were captured by the rapporteurs and compiled by the M & E Specialist of PIU-BARC. The major recommendations of the workshop for the PIs are:

1) The Project investigator (PI) should bear the full responsibility of showing the field progress of PBRG sub-projects during monitoring visit of the Team;

2) The sub-project output will be relevant with the objective;
3) Financial reporting, cash book, register etc. should be maintained properly and monitored;
4) Expenditure to be made in accordance with the line items;
5) The sub-project ID # 005: This sub-project title could be changed to adaptive trial or on farm trial instead of transfer of agricultural technologies;
6) Farmers' feedback should be recorded for adopting new technologies;
7) Research extension linkages should be maintained with visible evidences;
8) Findings of farming system research and time of seed distribution should be mentioned (ID 098);
9) The crab should be collected from nature as well as farm (Objective 2 of ID 029);
10) Distribution of Pigeon should be stopped as per farmers' opinion;
11) Activity of poverty alleviation should be mentioned (ID 098);
12) After radiation treatment the variety for stress evaluation should be planted in specific locations;
13) Control plots are to be taken for comparison of farm productivity and
14) Economics or BCR should be calculated for each of the farming systems sub-projects/experiments.

8.5 Progress Review Workshop

Eight progress review workshops on the implementation progress of CRG sub-projects were organized by the respective Technical Division of BARC and PIU-BARC under the guidance of PIU-BARC, NATP-2 during September 2018. All the PIs of CRG sub-projects presented their updated progress in the workshop under the chairmanship of MDs of respective technical divisions of BARC. Large numbers of skilled high officials were present who made good contribution and provided valuable input to improve the technical output of the concerned sub-projects. Some of the general weakness and suggestions for CRGs are summarized below:

i) Project Proposal (PP) and prescribed format are to be followed in writing PCR;
ii) Any type of publication (booklet, scientific paper, etc.) under CRG project is to be acknowledged PIU-BARC, NATP-2;
iii) Video of sub-project activities have to be done by professional video cameraman;
iv) Project Completion Report (PCR) is to be submitted within the due time and
v) Color photo to be inserted in PCR.

8.6 Field Monitoring of PBRG Sub-Projects

The field monitoring of PBRG sub-projects conducted by the monitoring team of the Technical Divisions of BARC and PIU-BARC, NATP-2 using prescribed format. Out of 118 components of PBRG sub-projects assigned, 76 components have already been monitored by the monitoring teams. The monitoring reports and presentation of the team observed that the

implementation progress of almost all the sub-projects is satisfactory. The following table 8.1 elaborated the status of monitoring in the sub-projects.

Table 8.1: Field Monitoring Status of PBRG sub-projects

# Team	Name of Team Leader	# Sub-projects planned to monitor	# Sub-project monitored	Coverage of location
1	Dr. Md. Aziz Zilani Chowdhury, MD (Crops), BARC	21	8	Gazipur (BARI, BRRI & BSMRAU)
2	Dr. Mian Sayeed Hassan, Director, PIU-BARC	11	8	Dhaka (DU), Cumilla (SRDI), Manikganj (BJRI), Savar (BLRI)
3	Dr. ASM Anwarul Haque, MD (A&F), BARC	23	23	BAU and BINA, Mymensingh
4	Dr. Md. Abdul Jalil Bhuyan, Consultant, PIU, BARC	7	5	Netrokona, Sherpur, Jamalpur, Tangail and Kishoregonj District
5	Dr. Sultan Ahmmed, MD (NRM), BARC	11	11	Barishal, Bhola, Patuakhali, Barguna, Pirojpur, Jhalokati, Gopalgonj, Madaripur, Sariathpur, Faridpur, Rajbari
6	Dr. Md. Monwar Karim Khan, MD, BARC	9	6	Bagherhat, Khulna, Satkhira, Jashore and Kushtia
7	Dr. Md. Baktear Hossain, Director (AIC), BARC	7	7	Sylhet, Sunamganj, Moulvibazar, Habiganj, B, baria
8	Dr. Sheik Md. Bakhtiar, CSO (Soil), BARC	11		
9	Dr. Shah Md. Ziqrul Haque Chowdhury, MD (Livestock), BARC	11	7	Rangpur, Dinajpur, Thakurgaon, Panchagar
10	Dr. Md. Monirul Islam, MD (Fisheries), BARC	**7**	**7**	Chattogram, Cox's Bazzar, Rangamati, Bandarban, Khagrachari, Feni, Noakhali, Laxmipur (BARI, BRRI, BINA, RU, SAU, HSTU, CDB)
Total		**118**	**82**	

8.7 Field Monitoring of CRG Sub-Projects

Field monitoring of CRG sub-projects were conducted by the monitoring team of the Technical Divisions of BARC and PIU-BARC, NATP-2 as well as by the internal monitoring team formed by the respective recipient institutes through prescribed format. Out of 190 CRG sub-projects, 152 sub-projects have been monitored by the monitoring teams of the Technical Divisions of BARC and PIU-BARC through

prescribed format.Monitoring reports revealed that the implementation progress of almost all the awarded sub-projects are seems to be satisfactory. The following table 8.2 elaborated the status of monitoring in the sub-projects.

Table 8.2: Field Monitoring Status of CRG Sub-projects

SL #	Division/Unit	No. of Sub-projects	# of Sub-projects Monitored	Monitored by TD, BARC	Monitored by PIU-BARC
1	Crops	62	56	32	36
2	Fisheries	30	19	05	15
3	Livestock	26	26	26	10
4	AERS	10	10	10	04
5	Planning &Evaluation	10	08	05	04
6	Soil	19	09	-	09
7	Forest	11	06	03	03
8	Agricultural Engineering	16	12	03	09
9	Nutrition	06	06	06	03
Total		**190**	**152**	**90**	**93**

8.8 Coordination Build-up Meeting

The officials of PIU-BARC (Director, RM Specialist, M&E Specialist) attended five Coordination Build-up workshops organized by the respective institutions at BARI, BINA, BAU and SAU (Sylhet) to build up coordination among stakeholders and to share implementation progress and limitations. All respective PIs of recipient organizations presented findings of their CRG/PBRG sub-projects. After threadbare discussion with the PIs and institutional authority (DG/Director- Research/Director- BAURES/SAURES), the PIU-BARC team visited/monitored the field/lab activities of CRG/PBRG sub-projects. Some of the strengths of the Coordination Build-up workshops are:

- Accomplished close interaction between the PIs of CRGs/PBRGs and PIU-BARC
- Assisted to identify the gaps in lab/field implementation of the CRG/PBRG sub-projects and suggested the possible remedies
- Strengthened the management of coordinating body towards the implementation of sub-projects of CRGs/PBRGs
- The PIs of CRGs/PBRGs realized their liabilities for successful implementation of the sub-projects as per agreement signed with PIU-BARC
- Attaining good interaction between funding authority and implementing partners
- The team members of PIU-BARC, NATP-2 had opportunity to access the actual field-progress of large numbers of CRGs/PBRGs with shortest possible time

Chapter 9

Procurement Management

9. Procurement Progress

Considering the cumulative achievement of procurement, 57% progress has been made against the target of the component (PIU-BARC) of which goods package made 51% progress, works package 50% and services package 70%. Details are shown in the table 9.1 below. In this financial year, out of 17 total packages, 15 (88%) have been procured of which goods 10, works 1 and service 4.

Table 9.1: Cummulative Progress of Procurement of the PIU-BARC

Activities	Progress to date against Project Target (%)	
	Package Target	Package Progress (%)
a. Goods	35	18 (51)
b. Works	12	6 (50)
c. Services	24	17 (70)
Sub-Total	**71**	**41 (57)**

Table 9.2: Summary Progress of Procurement in the FY 2018-19

Activities	Progress		Remarks
	Package Target	Package Progress (%)	
a. Goods	10	10 (100%)	
b. Works	1	1 (100%)	
c. Services	6	4 (67%)	Two packages under Evaluation
Sub-Total	**17**	**15 (88%)**	

Table 9.3: Progress of Procurement in the FY 2018-19

Sl. No.	Package No.	Package Name	Procurement / Selection Method	Contract Price BDT	Name of the Supplier/ Contractror/ Consultant
1.	GD/PIU-BARC-05	Printing & Binding of Documents (Annual Progress Report and others Printing Materials)	RFQ	493,387.00	BENGAL COM-PRINT
2.	GD/PIU-BARC-06	Supply of Office Stationary-2	RFQ	499,695.00	A.S. ENTERPRISE
3.	GD/PIU-BARC-21	Hiring of Vehicle-2	OTM	1,196,562.21	SHERA RENT-A-CAR SERVICE

Sl. No.	Package No.	Package Name	Procurement / Selection Method	Contract Price BDT	Name of the Supplier/ Contractror/ Consultant
4.	GD/PIU-BARC-34	Purchase of computer consumable items	RFQ	498,440.00	MULTIPURPOSE TECHNOLOGY
5.	GD/PIU-BARC-36	Equipment : 86 inch Android/Windows Interactive TV for BARC Conference Room	e-OTM	930,000.00	RANGS ELECTRONICS LIMITED
6.	GD/PIU-BARC-13 Pooled	Air Cooler (2 ton-20, 5 ton-10)	e-OTM	4642600.00	Electro Mart Ltd.
7.	GD/PIU-BARC-11c Pooled	Office Equipment (Multimedia projector-15)	e-OTM	1290000.30	Unique Business Ltd.
8.	GD/PIU-BARC-9b Pooled	Computer, Printer & Accessories & Scanner	e-OTM	2611330.00	Global Brand Ltd.
9.	GD/PIU-BARC-11b Pooled	Office Equipment (Photocopier-2, Fax machine-1)	e-OTM	455554.00	North Vision Ltd.
10.	GD/PIU-BARC-24 Pooled	Purchase of Furniture-1	e-OTM	2196555.20	Promisco Ltd.
11.	WD/PIU-BARC/6D	Repair and Maintenance of BARC Banglow	RFQ	984,219.46	M/S. RAJ LINE
12.	SD/PIU-BARC-02	Monitoring and Evaluation Specialist	ICS (Open)	11,062,500.00	NOWSHER ALI SARDER
13.	SD/PIU-BARC/09	Assistant ICT Specialist	ICS (Open)	6,637,500.00	MD. FEROJ MAHMOOD
14.	SD/PIU-BARC/10D	Technical Assistance-National (Individual) Short term Consultant for ICT (Hardware)	ICS (Limited)	1,480,000.00	SYED MAHBUB AHMED
15.	SD/PIU-BARC/10C	Technical Assistance-National (Individual) Short term Consultant for ICT (Software)	ICS (Limited)	1,480,000.00	AHSANULLAH M DEWAN
16.	SD/PIU-BARC/19	Hiring of Firm for Design, Management and Supervision of Construction Works	QCBS	67,000.00	Evaluation under process
17.	SD/PIU-BARC/20	Hiring of International firm for providing Professional and Logistics Seervices for Implementation of International Higher Studies (PhD Program), Workshop Program etc.	QCBS	71,00,00000.00	Evaluation under process

Chapter 10

Financial Management

10. Financial Progress

Financial progress is the key of measuring the performance of any of the on-going project. In last week of every month MoA monitors the progress of development projects implementing by different agencies under the Ministry based on financial achievement against the target. The PIU-BARC, NATP – 2 is not out of the systems. In each of the months, the Director of PIU-BARC is to present the progress of the component to the meeting at MoA under the chairmanship of the Minister (MoA). So, financial progress is the most vital indicator of success of the Project.

10.1 Project Financial Management

The financial management of the PIU-BARC is governed by the existing Project Accounting Manual issued by Ministry of Finance of GoB. All transactions of the project are accounted by double-entry acconting systems and on a cash basis. Dollar Special Account (DOSA) Funds have been treated as PA which spent as local/foreign exchange. PMU of NATP – 2 disbursed fund quarterly to the PIU-BARC as per submitted SoE (Statement of Expenditure). PIU-BARC submit withdrawal applications to the PMU for onward transmission to World Bank (WB) and receive RPA fund accordingly. Transection of GoB fund is followed existing rules and regulation of the country for Government and semi-government offices.

The summary of DPP's financial allocation, current ADP allocation and corresponding achievement is furnished in the following table 10.1. So far till June 2019 the ADP expenditure of current fiscal year 2018-19 raized to 97% for GoB, 98% for RPA and gross achievement is 98%. The cumulative achievement observed 32% progress in GoB fund, and 29% for RPA and total 29%.

Table 10.1: Summary of Financial Progress of PIU-BARC till Jun 2019 (Tk in lakh)

Sources of fund	Progress against RADP 2018-19		Progress to date against Target (%)	
	Target (LT)	Achievement (%)	Target (LT)	Achievement (%)
GoB	99.00	96.15 (97)	1245.00	404.14 (32)
RPA	7544.00	7413.37 (98)	39028.00	11453.95 (29)
Sub-total	7643.00	7509.52 (98)	40273.00	11858.09 (29)

10.2 Financial Progress of PIU-BARC

The revised allocation in the ADP of 2018-2019 is BDT 7643.00 lakh of which GoB BDT 99.00 lakh and RPA BDT 7544.00 lakh). During the fiscal year 2018-19,PIU-BARC spent an amount of BDT 96.15 lakh (97%) under GoB funding and BDT 7413.37 (98%) lakh under RPA funding. The cumulative progress of the component has observed 32% for GoB and 29% for RPA allocation against the allocation of Tk 1245 lakh and Tk 39028 lakh for GoB and RPA respectively. The table 10.2 elaborated the allocation

and expenditure of the PIU-BARC against major investment items. As operation of CRG sub-projects has been completed the expenditure for the item raised to 78%. The total budget of CRG could not be burnt due to time shortage (18 months only). Detailed financial progress of the current year including cumulative progress of the component is shown in the following table 10.2.

Table 10.2: Financial Progress in FY 2018-19 (Tk in lakh)

Sl #	Item/Activity/Indicator	DPP Target		Target in 2018-19		Achievement in 2018-19		Prog (%) in 2018-19		Cumulative Prog till Jun 2018		Cumulative Prog (%) till Jun 2019	
		Phy	Fin	Phy	Fin	Phy	Fin	Phy	Fin	Phy	Fin	Phy	Fin
1	Cotractual core staff (mm)	1296	647	220	84.00	67	83.23	30	99	350	174.66	27	27
2	National Training/workshop (person)	10520	695	3366	269.00	2324	260.46	69	97	6868	391.70	65	56
3	International Training/workshop (person)	460	2160	170	398.50	15	382.79	9	96	21	407.67	5	19
4	Local PhD (#)	80	1100	26	247.00	2	244.16	9	99	25	342.59	31	31
5	Foreign PhD (#)	60	4710	16	1148.00	6	1147.23	37	100	16	1261.10	27	27
6	CRG Sub-project (#)	100	5951	35	1281.00	12	1279.33	34	100	190	4620.75	190	78
7	PBRG Sub-project (#)	33	12842	14	3611.50	3	3599.50	24	100	10	3767.71	29	29
8	Consulting Services (mm)	696	3310	49	241.00	16	234.26	33	97	78	370.55	11	11
9	Incremental Operating costs	LS	1582	LS	118.00	LS	113.81	LS	96	LS	236.61	LS	15
10	Vehicle (#)	7	366	LS	4.00	LS	3.19	LS	80	2	123.19	34	34
11	Capital Expenditure	LS	3472	LS	216.00	LS	161.56	LS	74.8	LS	161.56	LS	5
12	Civil works	LS	2125	LS	25.00	LS	0.00	LS	0	LS	0.00	LS	0
13	CD/VAT	LS	453	LS	0.00	LS	0.00	LS	0	LS	0.00	LS	0
14	Safeguard mitigation	LS	233	LS	0.00	LS	0.00	LS	0	LS	0.00	LS	0
15	Price contingency	LS	628	LS	0.00	LS	0.00	LS	0	LS	0.00	LS	0
Total			**40274**		**7643.00**		**7509.52**	**31**	**98**		**11858.09**	**47**	**29**

Chapter 11

World Bank (WB) Review Mission

11. WB Review Mission

The implementation support mission of WB supervise the field activities of the project at least once in every year since inception of NATP phase II project. Following matrix showed the time of mission visit in the project since start. The supervission team composed mostly by the sectoral experts working in the WB office at Dhaka including one member from IFAD side.

11.1 Matrix of mission visit

Sl #	Name of Mission	Duration
2	2nd Implementation Suport Mission (ISM)	16 – 23 Jul 2018
3	Mid Term Review Mission (MTR)	28 Apr – 09 May 2019

11.2 Review of Task and Assignment of WB Mission-MTR

The following table illustrated the actions taken by the PIU-BARC against the observation made by the WB/IFAD MTR Mission visited the project during 28 Apr – 09 May 2019.

Actions	Responsibility	Agreed timeline	Action taken
Update the number of technologies generated by CRGs and submit and review all PCRs for CRGs.	PIU-BARC	30 Aug 2019	The promising technologies generated by CRG sub-projects have been identified. Out of 190 CRGs 175 PCR already received by PIU-BARC and the rest are to be made available very soon
Select new proposals and contract beneficiaries using the unallocated PBRGs funds.	PIU-BARC	30 Aug 2019	For awarding new PBRG sub-projects, 11 proposals have already been received by the PIU-BARC which are being reviewed by the external reviewers and after completion of all formalities expected to be offered by Aug 2019
Organize workshops event at BAU and BARC for the local PhDs supported by NATP II.	PIU-BARC	30 Sep 2019	The said workshop is to be organized in mid Sep 2019, which has been decided in a monthly meeting (June 2019) of PIU-BARC
Develop factsheets on technologies generated through CRGs and provide the factsheet to DAE/DOF/DLS for demonstration.	PIU-BARC	28 Feb 2020	The template for the technology fact sheet has already been drafted. The PIU-BARC has recruited 2 short term consultants and other 2 will be recruited very soon to support finalization of PCR of CRGs and technology factsheets

11.3 Review of Task and Assignment of WB Mission-TM

The following table illustrated the actions taken by the PIU-BARC against the observation made by the WB/IFAD MTR Mission visited the project during 28 Apr – 09 May 2019.

Actions	Responsibility	Agreed timeline	Action taken
Update the number of technologies generated by CRGs. Assure that all PCRs for CRGs are submitted and reviewed.	PIU-BARC	August 31, 2019	• 68 promising technologies identified. • Out of 190 CRGs, 189 PCR received, 186 reviewed • 4 short term consultants recruited for correction and improvement of PCRs
Select new proposals and contract beneficiaries using the unallocated PBRGs funds.	PIU-BARC	August 31, 2019	• 11 new sub-projects awarded in Oct 2019 following all necessary review and formalities
Organize a workshop at BAU and BARC for the local PhDs supported by NATP II.	PIU-BARC	September 30, 2019	1st workshop held at BARC on 24 Oct 2019 and 2nd workshop on 11-12 Nov 2019 at BAU, Mymensingh
Appointment of Procurement Consultant for DoF and BARC.	PIU-BARC	July 31, 2019	Wll be joined on 28 November 2019
Submit a proposal on the way forward for farmers allowances.	PIU-BARC	July 31, 2019	PIU-BARC will organize stakeholder workshop for the purpose in July 2019 to solve the issue

Chapter 12

Conclusion and Recommendation

12.1 Challenges faced

The PIU-BARC faced difficulty in hiring International Consulting Firm for implementing overseas PhD, training/workshop and other programs. It delayed the processing of foreign PhD and raised complexicity in disbursement of foreign exchange to the PhD scholars. This issue may demand additional time for completion of PhD programs beyond present project period. The up scaling programs of scalable technologies into the farming community involving extension agencies (public and private) would also require additional time. Provision of issuing cheque for tiny payment (national training, workshop, seminar, purchase of small items etc.) creates inconveniences for the participants and other clients. Stringent requirements/eligibility criteria for the private research providers (NGOs & private organizations) restricted involvement of private companies (seed companies or fertilizer/pesticides distributors etc.) in execution of research sub-projects.

The specific challenges are:

a) Delayed start of the project reduced the duration of CRG sub-projects and their field trials
b) Lengthy process of International firm hiring for implementing overseas PhD amd training/study visits created extra workload
c) Sudden declaration (4th Jan 2019) of CRG closing (on 30 Sep 2018)
d) Delayed RPA fund release hampered field research activities
e) Delay of Pooled Procurement
f) Procurement activities hampared due to absense of procurement specialist
g) Stringent requirement for private research providers

12.2 Lessons learned

1. CRG and PBRG sub-projects are addressing specific research agenda that generate technology within specific timeframe involving inter and multi-disciplinary team members
2. CRG & PBRG sub-projects enable researcher to work on key problems, develop institutional linkages and capacities across organizations
3. PBRG programs have widen the scopes in integrating multiple organizations for jointly combating national agricultural problems and strengthening research and research management capability
4. Good numbers of useful technologies have been developed within shortest possible time
5. Generated technologies need to be further validated for refinement in collaboration with extension line agencies.

12.3 Manpower

The PIU-BARC of NATP phase II project is headed by the Director deputed from BARC. Except Director all other officers, consultants and support staff are recruited by the PIU-BARC under contractual services for the project period or as per design (DPP) of the project. A list of consolidated manpower presently working with the PIU-BARC has furnished as **Annex V.**

Annex -I

List of the approved PBRG sub-projects' Coordinator, Associate Coordinator and Principal Investigator along with details addresses

Sl #	Project ID	Sub-project title	Name of the Coordinator/PI	Designation in the sub-project
1	001	Up-scaling and Application of Solar Photovoltaic Pump for Smallholder Irrigation and Household Appliances in the Central Coastal Region of Bangladesh	Dr. Sultan Ahmmed Member Director (NRM), BARC, Farmgate, Dhaka	Coordinator, 0711571275
			Dr. Nazmun Nahar Karim CSO and MD (livestock, in-charge), BARC, Farmgate, Dhaka	Associate Coordinator, 01715013033
			Dr. Mohammed Ayub Hossain PSO, Farm Machinery and Postharvest Process Engineering Division, BARI, Joydebpur, Gazipur	Principal Investigator, 01716979034
			Dr.A. B. M. Zahid Hossain SSO, Irrigation and Water Management Division, BRRI, Joydebpur, Gazipur	Principal Investigator, 01712763359
2	002	Groundwater resources management for sustainable crop production in northwest hydrological region of Bangladesh	Dr. Md. Sultan Ahmmed Member Director, NRM Division, BARC, Dhaka	Coordinator, 01711571275
			Dr. Nazmun Nahar Karim CSO and MD (livestock, in-charge), BARC, Dhaka	Associate Coordinator, 01715013033
			Dr. Sujit Kumar Biswas Senior Scientific Officer, IWM Division, BARI, Gazipur	Principal Investigator, 01816-880562
			Dr. Md Towfiqul Islam PSO, & Head, Irrigation and Water Management Division, BRRI, Gazipur	Principal Investigator, 01715090879
			Dr. Md. Hossain Ali PSO & Head, Agricultural Engineering Division, Bangladesh Institute of Nuclear Agriculture, Mymensingh	Principal Investigator, 01818-486534
3	005	Transfer of Agricultural Technologies to farmers' level for increasing farm productivity	Dr. S. M. Bokhtiar Member Director, Planning & Evaluation Division, BARC, Farmgate, Dhaka	Coordinator, 01733955229
			Dr. Fauzia Yasmin PSO (TTMU), Bangladesh Agricultural Research Council, Farmgate, Dhaka -1215	Associate Coordinator 01711017571
			Dr. Md. Abdul Hakim SSO, Wheat Breeding Division, BWMRI, Dinajpur	Principal investigator, 01711788153
			Dr. Syed Md. Mizanur Rahman SSO, Pomology Division, Horticulture Research Centre, BARI, Gazipur-1701	Principal Investigator, 01819-448805
			Dr. A F M Feroj Hasan SSO and Head, Adaptive Research and Extension Division (ARED), BINA, BAU Campus, Mymensingh	Principal Investigator, 01712-861271
			Dr. Md. Nurul Kashem PSO & Head, Training and Technology Transfer Division, Bangladesh Sugarcrop Research Institute, Ishurdi, Pabna	Principal Investigator, 01716-472367
			Dr. Md. Zillur Rahman SSO, Training, Planning and Technology Testing Division, BLRI, Savar, Dhaka	Principal Investigator, 01677155641
			Dr. Yahia Mahmud Director General, Bangladesh Fisheries Research Institute, Mymensingh-2201	Principal Investigator, 01712566134

Sl #	Project ID	Sub-project title	Name of the Coordinator/PI	Designation in the sub-project
			Dr. Md. Altaf Hossain PSO, Soil & Land Classification Survey Section, SRDI, Dhaka	Principal Investigator, 01871039481
			Md. Mominul Islam SSO, Cotton Development Board Khamarbari, Farmgate ,Dhaka-1215	Principal Investigator, 01815885672, 01716330802
			Dr. Md. Ayub Khan CSO & Head, Jute Farming Systems Division, BJRI, Manik Miah Avenue, Dhaka	Principal Investigator, 01552414003
			Dr. Md. Humayun Kabir SSO, Adaptive Research Division, Bangladesh Rice Research Institute, Gazipur	Principal Investigator, 01924458605
4	007	Value addition and standardization of nutritional level in selected food items from Animal and plant origin	Dr. Md. Monirul Islam Director (Nutrition), Bangladesh Agricultural Research Council, Dhaka	Coordinator, 01777686866
			Dr. Swapon Kumar Fouzder Associate Professor, Department of Poultry Science, Patuakhali Science and Technology University, Babuganj, Barishal	Principal Investigator, 01716185959
			Dr. Mst. Afroza Khatun Professor, Department of Dairy and Poultry Science, Hazi Mohammad Danesh Science and Technology University, Dinajpur	Principal Investigator, 01741532174
5	010	DNA marker-assisted breeding for producing highly stress tolerant elite rice varieties for coastal Bangladesh by introgression of multiple salt tolerance loci (QTLs) into commercial cultivars	Dr. Tamal Lata Aditya Director Research (Current Charge), Bangladesh Rice Research Institute (BRRI), Joydebpur, Gazipur	Coordinator, 01715382329
			Dr.Zeba Islam Seraj Professor (Plant Biotechnology Laboratory) Department of Biochemistry and Molecular Biology, University of Dhaka, Dhaka	Principal Investigator, 01711595576
			Md. Ruhul Amin Sarker SSO, Plant Breeding Division, Bangladesh Rice Research Institute, Joydebpur, Gazipur	Principal Investigator, 01712674693
6	011	Food-based initiative for improving household food security, income generation and minimize malnutrition	Dr. Md. Monirul Islam Director (Nutrition), Bangladesh Agricultural Research Council, Dhaka	Coordinator, 01777686866
			Dr. Md. Abdul Jalil PSO, Bangladesh Livestock Research Institute, Savar, Dhaka	Principal Investigator, 01711155062
			Dr. Md. Belal Hossain Associate Professor, Department of Fisheries and Marine Science, Noakhali Science and Technology University, Noakhali	Principal Investigator, 01867563826
7	013	Development of lean season fruit varieties and management packages	Dr. Madan Gopal Saha CSO, Pomology Division, Horticulture Research Centre, BARI, Gazipur	Coordinator, 01552450182
			Dr. Babul Chandra Sarker PSO, Pomology Division, Horticulture Research Centre, BARI, Gazipur	Principal Investigator, 01716009319
			Dr. Md. Iqbal Faruk SSO, Plant Pathology Division, BARI, Gazipur	Principal Investigator, 01963533118

Sl #	Project ID	Sub-project title	Name of the Coordinator/PI	Designation in the sub-project
			Dr. Md. Kafil Uddin SSO, Entomology Division, BARI, Gazipur	Principal Investigator, 01552334879
8	016	Integration of Postharvest Technologies and Best Practices in the Value Chains of Fruits and Vegetables	Dr. Md. Miaruddin CSO, Postharvest Technology Division BARI, Joydebpur, Gazipur	Coordinator, 01713273806
			Dr. Md. Nazrul Islam PSO, Postharvest Technology Section HRC, BARI, Joydebpur, Gazipur	Principal Investigator, 01712528506, 01732682297
			Dr.Md. Nurul Amin SSO, Farm Machinery and Postharvest Process Engineering Division, BARI, Joydebpur, Gazipur	Principal Investigator, 01717734248
			Dr. Md. Latiful Bari, Principal Scientist, Food Analysis and Research Laboratory, Center for Advanced Research in Sciences, University of Dhaka, Dhaka	Principal Investigator, 01971 560560
9	020	Development of Production Package for Export and Processing Potatoes to Sustain Productivity and Food Security in Bangladesh	Dr. Tapan Kumar Paul, Director, Tuber Crops Research Centre (TCRC), BARI, Joydebpur, Gazipur-1701	Coordinator, 01712267604
			Dr. Bimal Chandra Kundu, PSO, Tuber Crops Research Centre, BARI, Joydebpur, Gazipur	Principal Inestogator, 01712681181, 01552418639
			Dr. Tuhin Suvra Roy Professor, Department of Agronomy, Sher-e-Bangla Agricultural University, Dhaka	Principal Inestogator, 01710515090
			A.T.M. Majharul Mannan Business Development Manager, Giant Agro Processing Ltd., Giant Business Tower, Level-13, Plot 3 &3/A, Sector-3, Uttara C/A, Dhaka	Principal Inestogator, 01678 006 319
			S. M. Sharif Hassan, Deputy General Manager (Factory), Quasem Food Products Ltd., Holding # 209, Block – D, Baimail, Konabari, Gazipur	Principal Inestogator, 01714046715
10	021	Cost and return analysis of selected crops in Bangladesh	Dr. A.S.M. Anwarul Huq, Member Director (AERS), BARC, Farmgate, Dhaka	Coordinator, 01558339433
			Dr. Md. Mosharraf Uddin Molla, PSO, AERS Division, BARC, Farmgate, Dhaka	Principal Investigator, 01552434792
			Dr. Md. Abdur Rashid, PSO, Agricultural Economics Division, BARI, Gazipur	Principal Investigator, 01711070110
			Syful Islam, SO, Agricultural Economics Division, BINA, Mymensingh	Principal Investigator, 01725371752
11	026	Development of integrated crop management technologies for higher production of coconut in Bangladesh	Dr. Debasish Sarker CSO, Entomology Division, Bangladesh Agricultural Research Institute, Gazipur	Coordinator, 01712274933, 01552-504614
			Dr. Nirmol Chandra Datta, PSO, Entomology Division, BARI, Joydebpur, Gazipur	Principal Inestogator, 01794714560
			Dr. Md. Jillur Rahman, Senior Scientific Officer, Pomology Division, BARI, Joydebpur, Gazipur	Principal Inestogator, 01715082555
			Dr. Md. Mynul Islam, Senior Scientific Officer, Plant Pathology Division, BARI, Gazipur	Principal Inestogator, 01783581022
			Mohammad Nasir Consultant, SSURDA, Dhaka	Principal Inestogator, 01921587830, 01723049599
12	029	Adoption of Innovative technology: Seed to	Dr. Khan Kamal Uddin Ahmed Chief Scientific Officer, Shrimp Research Station, BFRI, Bagerhat	Coordinator, 01712103181

Sl #	Project ID	Sub-project title	Name of the Coordinator/PI	Designation in the sub-project
		fattening of mud crab (*Scylla olivacea*) and health management in Bangladesh condition	Dr. Md. Monirul Islam Director (Nutrition), Bangladesh Agricultural Research Council, Dhaka	Principal Investigator, 01777686866
			Dr. Md. Latiful Islam, Senior Scientific Officer Bangladesh Fisheries Research Institute, Brackishwater Station, Paikgacha, Khulna	Principal Investigator, 01715645260
			Dr. Abul Farah Md. Hasanuzzaman, Associate Professor, Fisheries and Marine Resource Technology Discipline, Khulna University, Khulna	Principal Investigator, 01720107133
13	030	Investigation and characterization of viral and bacterial diseases in selected fin fish and Shrimp in Bangladesh, vaccines development and validation	Dr. Md. Monirul Islam, Member Director (Fisheries), Bangladesh Agricultural Research Council, Farmgate, Dhaka	Coordinator, 01558339433
			Dr. Md. Alimul Islam, Professor, Department of Microbiology and Hygiene, Faculty of Veterinary Science, BAU, Mymensingh	Principal Investigator, 01714325562
			Dr. Md. Saha Ali, Principal Scientific Officer, Bangladesh Fisheries Research Institute, Mymensingh	Principal Investigator, 01711705211
			Ashikur Rahman, Scientific Officer, Bangladesh Fisheries Research Institute, Mymensingh	Co-Principal Investigator, 01712127074
14	031	Development of *in-situ* Breeding Technology of Prawn (*Macrobrachium rosenbergii*) and Adoption of Sustainable Eco-Friendly Culture of Prawn and Shrimp (*Penaeus monodon*)	Dr. Mohammed Nurullah, Director (Research and Planning), Bangladesh Fisheries Research Institute, Mymensingh	Coordinator, 01711045889
			Dr. Md. Monirul Islam Member Director (Fisheries), Bangladesh Agricultural Research Council, Dhaka	Principal Investigator, 01777686866
			Dr. Khan Kamal Uddin Ahmed Chief Scientific Officer, Shrimp Research Station, BFRI, Bagerhat	Principal Investigator, 01712103181
			Dr. Khandaker Anisul Haq, Professor, Fisheries and Marine Resource Technology Discipline, Khulna University, Khulna	Principal Investigator, 01914325047
15	035	Techniques Adoption and Formulation of guidelines for Sustainable management of Haor and Beel Fisheries	Dr. Md. Monirul Islam Member Director (Fisheries), Bangladesh Agricultural Research Council, Dhaka	Coordinator, 01777686866
			Dr. Mrityunjoy Kunda Professor, Department of Aquatic Resource Management, Faculty of Fisheries, Sylhet Agricultural University, Sylhet.	Principal investigator, 01712083003
			Dr. Md. Abu Sayed Jewel Associate Professor, Department of Fisheries, University of Rajshahi, Rajshahi	Principal investigator, 01727144520
			Dr. Mushtaq Ahmed Professor, Department of Civil and Environmental Engineering, Shahjalal University of Science and Technology, Sylhet.	Principal investigator, 01711161075
16	036	Post-harvest Losses, Supply and Value Chain Analysis of Fisheries Sub-sector in Bangladesh	Dr. Md. Monirul Islam Member Director (Fisheries) BARC, Farmgate, Dhaka	Coordinator, 01558339433
			Dr. Md. Akhtaruzzaman Khan Professor, Department of Agricultural Finance, Bangladesh Agricultural University, Mymensingh	Principal Investigator, 01734128911

Sl #	Project ID	Sub-project title	Name of the Coordinator/PI	Designation in the sub-project
			Dr. Md. Mamun Or Rashid Professor, Department of Basic Science Patuakhali Science and Technology University, Babuganj, Barishal	Principal Investigator, 01711466430
17	037	Improvement of existing fattening technology of carp and high valued small indigenous species (SIS) through good aquaculture practices (GAP) in different agro-ecosystems	Dr. Md. Monirul Islam, Member Director (Fisheries), BARC, Farmgate, Dhaka	Coordinator, 01558339433
			Dr. Md. Akhtar Hossain Professor, Department of Fisheries University of Rajshahi (RU), Rajshahi	Principal Investigator, 01711576135
			Md. Jahangir Alam, Assistant Professor, Department of Fisheries Management, Faculty of Fisheries, Patuakhali Science & Technology University, Dumki, Patuakhali	Principal Investigator, 01722289078
18	049	Adaptation and Scaling up Agroforestry for Livelihood Improvement of farmers in Agricultural Ecosystem of Bangladesh	Dr. M. Akkas Ali, Cheif Scientific Officer, On-Farm Research Division, BARI, Joydebpur, Gazipur	Coordinator, 01718637801
			Dr. Madan Gopal Saha, CSO, Pomology Division Horticulture Research Centre (HRC), BARI, Gazipur	Principal investigator, 01552450182
			Dr. Md. Robiul Alam, Senior Scientific Officer, On-Farm Research Division, BARI, Pabna	Principal investigator, 01931665496
			Dr. Taslima Zahan, SO, On-Farm Research Division, BARI, Joydebpur, Gazipur	Principal investigator, 01914961057 01718426880
			Dr. Md. Shakhawat Hossain, On-Farm Research Division, BARI, Barind station, Paramedical Road, Laxmipur, Rajshahi	Principal investigator, 01733845030
			Dr. Mst. Selina Hasan Senior Scientific Officer, On-Farm Research Division, BARI, Rangpur	Principal investigator, 01711786400
			Gazi Nazmul Hasan Scientific Officer, On-Farm Research Division, Bangladesh Agricultural Research Institute, Sabujbagh, Patuakhali	Principal investigator, 01716-769666
			Mohammad Sarfuddin Bhuiyan Senior Scientific Officer, On-Farm Research Divison, BARI, Bandarban	Principal investigator, 01716581911
19	051	Validation of Crop Intensification Technologies for Improving System Productivity, Soil Health and Farm Income in South Central Coastal Region	Dr. Md. Abdul Wohab Director (Research), Bangladesh Agricultural Research Institute, Joydebpur, Gazipur	Coordinator, 01712007284
			Dr. Md. Ashraf Hossain, CSO and Head, Soil Science Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur	Associate Coordinator, 01712948871
			Mahbub Ul Islam, SO, Oilseed Research Center, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur	Principal investigator, 01719028614
			Md. Moksedur Rahman, Senior Researcher, Agrarian Research Foundation, Foundation, House No# 5/10B, Block-A, Lalmatia, Mollammadpur, Dhaka	Principal investigator, 01716644277
20	054	Introduction of profitable and agro-ecologically suitable crop varieties and development of	Dr. M. Akkas Ali, Cheif Scientific Officer, On-Farm Research Division, BARI, Gazipur	Coordinator, 01712598035
			Dr. Md. Mazharul Anwar, PSO, Region-1, On-Farm Research Division, BARI, Rajshahi	Principal investigator, 01916847240
			Dr. A.K.M. Zakir Hossain	Principal investigator,

Sl #	Project ID	Sub-project title	Name of the Coordinator/PI	Designation in the sub-project
		marketing systems for the charlands of northern Bangladesh	Professor & Head, Department of Crop Botany, Faculty of Agriculture BAU, Mymensingh	01713113559
21	061	Integrated Farming Research and Development for Livelihood Improvement in the Plain land Eco-system	Dr. S. M. Bokhtiar Member Director, Planning & Evaluation Division, BARC, Farmgate, Dhaka	Coordinator, 01733955229
			Dr. Quamrun Naher SSO, On-Farm Research Division, BARI, Joydebpur, Gazipur	Principal Investigator, 01673909488
			Dr. Abhijit Saha PSO, Rice Farming Systems Division, BRRI, Joydebpur, Gazipur	Principal Investigator, 01715101078
			Md. Shahidul Islam SSO, BFRI, Mymensingh	Principal Investigator, 01716193493
22	064	Design and development of fertilizer deep placement mechanism for existing rice transplanter	Dr. Md. Ansar Ali, Director (Administration and Common Service), BRRI, Gazipur	Coordinator, 01925053582
			Dr. Md. Anwar Hossen, SSO, FMPHT Division , BRRI, Gazipur	Principal investigator, 01712675130
			Dr. Md. Mozammel Haque, SSO, Soil Science Division, BRRI, Gazipur	Principal investigator, 01718133016
23	070	Economic Viability and Production Efficiency of Rice at Farm Level: A Macro Level Study in Bangladesh	Dr Md Ansar Ali, Director (Administration and Common Service), BRRI, Gazipur	Coordinator, 01925053582
			Dr. Md. Abu Bakr Siddique, CSO & Head, Agricultural Economics Division, BRRI, Gazipur	Principal investigator, 01718591857
			Dr. Md. Taj Uddin, Professor, Department of Agricultural Economics, BAU, Mymensingh	Principal investigator, 01714357803
24	072	Germplasm conservation and farm productivity enhancement through the interaction of shade trees and tea based agroforestry system to mitigate the climate change	Dr. Sultan Ahmmed, Member Director, NRM Division, BARC, Farmgate, Dhaka	Coordinator 01711571275
			Dr. A. F. M. Saiful Islam, Professor, Department of Crop Botany and Tea Production, Sylhet Agricultural University, Sylhet	Principal investigator, 01711978392
			Mr. Md. Ismail Hossain CSO, Crop Production Department, Bangladesh Tea Research Institute , Sreemangal, Moulvibazar	Principal investigator, 01749515305
25	074	Exploration, Identification, Characterization, Multiplication and *Ex-situ* Conservation of Endangered Forest Genetic Resources including Medicinal plants of Bangladesh	Dr. Sultan Ahmmed Member Director (NRM) NRM Division, BARC, Farmgate, Dhaka	Coordinator 01711571275
			Dr. Md. Habibur Rahman Professor, Department of Horticulture, Bangladesh Agricultual University, Mymensingh	Principal investigator, 01727735271
			Dr. Rafiqul Haidar, Divisional Officer, Minor Forest Production Division, BFRI, Sholoshahar, Chittagong	Principal investigator, 01720027505
			Dr. Mohammed Kamal Hossain, Professor, Institute of Forest and Environmental Sciences, University of Chittagong, Chittagong	Principal investigator, 01819837689
26	077	Upliftment of Farmers Livelihood and Enrichment of Environment through Improved	Dr. Sultan Ahmmed, Member Director (NRM) NRM Division, BARC, Farmgate, Dhaka	Coordinator 0711571275
			Dr. Md. Saifullah, Principal Scientific Officer, Forest Unit, NRM Division, Bangladesh Agricultural Research Council, Farmgate, Dhaka	Associate Coordinator, 01712722504

Sl #	Project ID	Sub-project title	Name of the Coordinator/PI	Designation in the sub-project
		Agroforestry Practices in Char Land Ecosystem of Bangladesh	Dr. G.M. Mujibur Rahman, Professor, Department of Agroforestry, Bangladesh Agricultural University, Mymensingh	Principal investigator, 01712614752
			Dr. Mohammad Saidur Rahman Senior Scientific Officer (Horticulture), Horticulture Research Centre, Regional Agricultural Research Station, Bangladesh Agricultural Research Institute, Jamalpur	Principal investigator, 01915675215
			Dr. Hasneen Jahan Professor, Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh	Principal investigator, 01712291417
27	087	Eco-friendly Rodent Management Through Owl Conservation	Dr Md Ansar Ali, Director (Administration and Common Service), BRRI, Gazipur	Coordinator, 01925053582
			Dr. Md. Mofazzel Hossain PSO, Entomology Division, BRRI, Gazipur	Principal investigator, 01731386113
			Dr. Md. Shah Alam, PSO (In-Charge) and Head, Vertebrate Pest Division, BARI, Gazipur	Principal investigator, 01911857586
28	089	Establishment of profitable cropping pattern through crop intensification in underutilized unfavorable ecosystem	Dr. Md. Abul Kalam Azad, CSO, Plant Breeding Division, BINA, BAU Campus, Mymensingh	Coordinator 01710-763003
			Dr. A F M Feroj Hasan, SSO and Head, Adaptive Research and Extension Division, BINA, BAU Campus, Mymensingh	Associate Coordinator, 01712- 861271
			Dr. Shamima Begum SSO, Adaptive Research and Extension Division, BINA, Mymensingh	Principal Investigator, 01711947179
			Md. Mohsin Ali Sarkar SSO, Agricultural Economics Division BINA, BAU Campus, Mymensingh-2202	Principal Investigator, 01712690707
29	091	Identification of novel resistant gene(s), gene pyramiding and sustainable management of bacterial blight (BB) disease of rice	Dr. Md Ansar Ali, Director (Administration and Common Service), BRRI, Gazipur	Coordinator, 01925053582
			Dr. Md. Abdul Latif, PSO and Head, Plant Pathology Division, Bangladesh Rice Research Institute, Gazipur	Principal Investigator, 01715034094
			Dr. Md. Rashidul Islam, Professor, Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh	Principal Investigator, 01741112529
30	096	Improvement of Farm Productivity through Intervention with Improved Agricultural Technologies in Char land Eco-System	Dr. S. M. Bokhtiar, Member Director, Planning & Evaluation Division, BARC, Farmgate, Dhaka	Coordinator, 01733955229
			Dr. Md. Faruque Hossain, SSO, On-Farm Research Division, BARI, Gazipur	Principal Investigator, 01711244091
			Dr. Reema Ashrafi, SSO, Planning and Development Section, BINA, Mymensingh	Principal Investigator, 01745749881
			Dr. Md. Jahangir Alam PSO, Agronomy and Farming Systems Division, Bangladesh Sugarcrop Research Institute, Ishurdi, Pabna	Principal Investigator, 01716229375
			Dr. Md. Abdul Jalil, Principal Scientific Officer, Bangladesh Livestock Research Institute, Savar, Dhaka	Principal Investigator, 01711155062
31	098	Climate Resilient Farming Systems Research and Development for the Coastal Ecosystem	Dr. S. M. Bokhtiar, Member Director, Planning & Evaluation Division, BARC, Farmgate, Dhaka	Coordinator, 01733955229
			Dr. M. Akkas Ali, CSO, On-Farm Research Division, BARI, Joydebpur, Gazipur	Principal Investigator, 01718637801
			Dr. Mohammad Ibrahim, PSO, Bangladesh Rice	Principal Investigator,

Sl #	Project ID	Sub-project title	Name of the Coordinator/PI	Designation in the sub-project
			Research Institute, Regional Station, Binerpota, Satkhira-9400	01716-284429
			Dr. Md. Munjurul Islam, PSO& Head, Agronomy Division, BINA, Mymensingh	Principal Investigator, 01716610995
32	099	Fortification and standardization of nutritional level in selected human foods and efficacy test of polyphenolic compounds in livestock products	Dr. Md. Monirul Islam, Director (Nutrition), Bangladesh Agricultural Research Council, Dhaka	Coordinator, 01777686866
			Dr. Muhammad Ali Siddiquee CSO and Head, Grain Quality and Nutrition Division, BRRI, Gazipur	Principal Investigator, 01711685653
			Md. Golam Ferdous Chowdhury SSO, Postharvest Technology Division Bangladesh Agricultural Research Institute Joydebpur, Gazipur	Principal Investigator, 01712271163
			Dr. Mohammad Al-Mamun Professor, Department of Animal Nutrition Bangladesh Agricultural University, Mymensingh	Principal Investigator, 01715051093
33	103	Contamination and adulteration of food and food products, process, chain and mollification	Dr. Md. Monirul Islam Director, Nutrition Unit; Bangladesh Agricultural Research Council, Dhaka	Coordinator, 01777686866
			Md. Hafizul Haque Khan PSO, Postharvest Technology Division, BARI, Gazipur	Principal Inestogator, 01556631691
			Dr. Md. Enamul Hoq PSO, Bangladesh Fisheries Research Institute, Mymensingh	Principal Inestogator, 01715132369
34	108	Development of knowledge hub on Animal Feed Resources for efficient feeding management of ruminants to enhance productivity	Dr. Shah Md. Ziqrul Haq Chowdhury, Member Director (Livestock), Livestock Division, BARC, Farm gate, Dhaka	Coordinator, 01712064831
			Dr. Mohammad Rafiqul Islam Principal Scientific Officer, Livestock Division, BARC, Farmgate, Dhaka	Associate Coordinator
			Dr. Nasrin Sultana, PSO & Head Training, Planning and Technology Division, BLRI, Savar, Dhaka.	Principal Investigator, 01914033344
			Dr. Mohammad Mohi Uddin Assistant Professor, Department of Animal Nutrition, Faculty of Animal Husbandry, BAU, Mymensingh	Principal Investigator, 01818429023
			Dr. Md. Jasim Uddin Professor, Department of Animal Nutrition Faculty of Veterinary, Animal and Biomedical Sciences, SAU, Sylhet.	Principal Investigator, 01911720221
35	110	Application of Gamma-ray Irradiation to develop stress tolerant capability in fodder crops and their production performance under on-station and on-farm conditions	Dr. Shah Md. Ziqrul Haq Chowdhury, Member Director (Livestock), Livestock Division, BARC, Farm gate, Dhaka	Coordinator, 01712-064831
			Dr. Mohammad Rafiqul Islam PSO, Livestock Division, BARC, Farmgate, Dhaka	Associate Coordinator, 01716350628
			Dr. Biplob Kumer Roy Senior Scientific Officer, Animal Production Research Division, Bangladesh Livestock Research Institute, Savar, Dhaka	Principal Investigator, 01935838874
			Dr. Md. Imtiaz Uddin CSO & Head, Biotechnology Division, Bangladesh Institute of Nuclear Agriculture, Mymensingh	Principal investigator, 01756926680

Sl #	Project ID	Sub-project title	Name of the Coordinator/PI	Designation in the sub-project
36	128	Collection and Characterization of Important Plant Genetic Resources	Dr. Aziz Zilani Chowdhury Member Director (Crops), BARC, Farmgate, Dhaka	Coordinator, 01552355393
			Md. Abdus Salam PSO (Crops), Bangladesh Agricultural Research Council, Farmgate, Dhaka.	Principal Investigator,, 01552398504
			Dr. Md. Nazirul Islam CSO (In-charge), Plant Genetic Resources Centre, BARI, Joydebpur, Gazipur	Principal Investigator, 01715855239
			Dr. Mohammad Khalequzzaman Chief Scientific Officer and Head Genetic Resources and Seed Division, BRRI., Gazipur	Principal Investigator, 01715752595
			Mr. Md. Rafiqul Islam CSO (cc), Genetic Resources and Seed Division, Bangladesh Jute Research Institute, Manik Mia Avenue, Dhaka	Principal Investigator, 01721266846
			Dr. Md. Anisur Rahman PSO (c.c.), Breeding Division, Bangladesh Sugar crop Research Institute, Ishurdi, Pabna	Principal Investigator, 01703488606
			Dr. Mirza Mofazzal Islam Chief Scientific Officer and Head, Plant Breeding Division, BINA, Mymensingh	Principal Investigator, 01716-280720
			M M Abed Ali SSO, Cotton Research Farm, Jagadishpur, Jessore	Principal Investigator, 01715-842500
			Md. Abdul Alim Research Officer, Bangladesh Sericulture Research and Training Institute, Baliapukur, Padma Abasik, Rajshahi	Principal Instigator, 01718577311
			Dr. M. A. Rahim Professor, Department of Horticulture Bangladesh Agricultural University, Mymensingh	Principal Investigator, 01711854471
37	134	Determination of critical limit of nutrients for soils and crops	Dr. Sultan Ahmmed Member Director (NRM), BARC, Farmgate, Dhaka	Coordinator, 0711571275
			Dr. S.M. Bokhtiar PSO (Soils), NRM Division, BARC, Farmgate, Dhaka	Associate Coordinator, 01733955229
			Dr. Md. Baktear Hossain PSO (Soils), NRM Division, BARC, Farmgate, Dhaka	Associate Coordinator, 01711201441
			Dr. Nirmal Chandra Shil PSO, Soil Science Division, Bangladesh Agricultural Research Institute, Gazipur	Principal Investigator, 01718201499
			Dr. A T M Shakawat Hossain PSO, Soi Science Division, Bangladesh Rice Research Institute, Gazipur	Principal Investigator, 01718261858
			Dr. Md. Habibur Rahman SSO, Soil Science Division, BINA, Mymensingh	Principal Investigator, 01711703171
			Dr. Md. Anwarul Abedin Professor, Department of Soil Science Bangladesh Agricultural University, Mymensingh	Principal Investigator, 01718031462
38	135	Improvement of soil health and crop productivity in climate vulnerable and polluted areas	Dr. Sultan Ahmmed Member Director (NRM), BARC, Farmgate, Dhaka	Coordinator, 0711571275
			Dr. S.M. Bokhtiar PSO (Soils), NRM Division, BARC, Farmgate, Dhaka	Associate Coordinator, 01733955229
			Dr. Md. Baktear Hossain	Associate Coordinator,

Sl #	Project ID	Sub-project title	Name of the Coordinator/PI	Designation in the sub-project
		through organic amendments	PSO (Soils), NRM Division, BARC, Farmgate, Dhaka	01711201441
			Dr. Sohela Akhter PSO, Soil Science Division, BARI, Gazipur	Principal Investigator, 01922242737
			Dr. Umme Aminun Naher PSO, Soil Science Division, BRRI, Gazipur	Principal Investigator, 01913151914
			Dr. Md. Belal Hossain SSO, Soil Science Division Bangladesh Institute of Nuclear Agriculture, Mymensingh	Principal Investigator, 01625899334
			Prof. Dr. Md. Mafizur Rahman Jahangir Department of Soil Science BAU, Mymensingh	Principal Investigator, 01719648448
			Prof. Dr. GKM Mustafizur Rahman Department of Soil Science, BSMRAU, Gazipur	Principal Investigator, 01718186642
			Dr. Alok Kumar Paul Professor, Department of Soil Science, SAU, Dhaka	Principal Investigator, 01715213083
39	138	Determination of Antimicrobial Resistance and Residues in Livestock and Poultry Food Products and Feed in Bangladesh	Dr. Shah Md.Ziqrul Haq Chowdhury Member Director (Livestock), BARC, Farmgate, Dhaka	Coordinator, 01712064831
			Dr. Mohammad Rafiqul Islam PSO (Livestock Division), BARC, Farmgate, Dhaka	Associate coordinator, 01687439415
			Dr. Kazi Rafiqul Islam Professor& Head, Department of Pharmacology, Bangladesh Agricultural University, Mymensingh	Principal Investigator, 01711-285766
			Dr. Md. Giasuddin PSO, Bangladesh Livestock Research Institute, Savar, Dhaka	Principal Investigator, 01711055597
			Dr. K. M. Mozaffor Hossain Professor, Department of Veterinary and Animal Sciences, University of Rajshahi, Rajshahi	Principal Investigator, 01716451593
			Dr. Farzana Islam Rume Associate Professor, Department of Microbiology and Public Health, Faculty of Animal Science and Veterinary Medicine, Patuakhali Science and Technology University, Babugonj, Barishal	Principal Investigator, 01711226056
			Dr. Sharmin Chowdhury Professor, Dept. of Pathology and Parasitology, Chittagong Veterinary and Animal Sciences University, Chittagong	Principal Investigator, 01554331355
			Dr. ATM Mahbub-E-Elahi Professor, Department of Microbiology and Immunology, Sylhet Agricultural University, Sylhet	Principal Investigator, 01711301042
			Dr. Md. Khaled Hossain Associate Professor, Dept. of Microbiology, Hajee Mohammad Danesh Science and Technology University, Dinajpur	Principal Investigator, 01706-877533
40	139	Preparedness for the control of PPR in Bangladesh	Dr. Shah Md.Ziqrul Haq Chowdhury Member Director (Livestock), BARC, Farmgate, Dhaka	Coordinator, 01712064831
			Dr. Mohammad Rafiqul Islam Principal Scientific Officer (Livestock Division),	Associate Coordinator, 01687439415

Sl #	Project ID	Sub-project title	Name of the Coordinator/PI	Designation in the sub-project
			Bangladesh Agricultural Research Council (BARC), Farmgate, Dhaka	
			Dr. Md. Ershaduzzaman, Director and Principal Scientific Officer, Bangladesh Livestock Research Institute, Savar, Dhaka	Principal Investigator 02-7791675
			Dr. Abu Hadi Noor Ali Khan Professor, Dept. of Pathology, Bangladesh Agricultural University, Mymensigh	Principal Investigator, 01727203934

Annex- II

List of Awarded Local PhD Along with date of enrolment and name of University

BARI

Sl #	Name with detail address	Date of enrollment	Name of University
1.	Mohammad Asiqur Rahman, Senior Scientific Officer,On-Farm Research Division, BARI, Tangail. Mobile: 01717-210374, E-mail: asiqurbari@ymail.com	27/03/2018	Bangladesh Agricultural University, Mymensingh-2202
2.	Most. Ummay Salma Khatun, Scientific Officer, OFRD, BARI, Rangpur. Mobile: 01717-314507 E-mail: salma_agron@yahoo.com	27/03/2018	Bangladesh Agricultural University, Mymensingh-2202
3.	Haimonti Barua, Scientific Officer, ARS, BARI, Pahartali, Chittagong. Mobile: 01712-197385 E-mail: haimobari79@gmail.com	18/06/2018	Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur
4.	Iftekhar Ahmed, Scientific Officer, Plant Genetic Resource Centre, BARI, Joydebpur, Gazipur. Mobile: 01766-957396 E-mail: ifti.bari@gmail.com	20/03/2018	Bangladesh Agricultural University, Mymensingh-2202,
5.	Md. Nur-E-Alam Siddquie, Senior Scientific Officer, OFRD, BARI, Shyampur, Rajshahi. Mobile:01718-281559 E-mail: nsiddquie@gmail.com	30/05/2018	University of Rajshahi, Rajshahi
6.	Mahmuda Ratna, Scientific Officer (Plant breeding), Spices Research Sub-center, BARI, Faridpur. Mobile: 01717-463599, E-mail: mahmuda.ratna@yahoo.com	09/04/2018	Patuakhali Science and Technology University, Patuakhali
7.	Shammi Akhtar, Scientific Officer (Plant Breeding), OFRD, BARI, Mymensingh. Mobile: 01716-281509 E-mail: shammiakhter_bari@yahoo.com	01/04/2018	Bangladesh Agricultural University, Mymensingh-2202
8.	Mohammad Mostafa Kamal, Scientific Officer (Entomology), Regional Spices Research Centre, BARI, Joydebpur, Gazipur. Mobile: 01818-285794 E-mail: mamunsrc@gmail.com	16/04/2018	Bangladesh Agricultural University, Mymensingh-2202
9.	Md. Nazmul Islam, Scientific Officer, Seed Technology Division, BARI, Joydebpur, Gazipur. Mobile: 01711-075229 E-mail: mni81@yahoo.com	16/08/18	Bangladesh Agricultural University, Mymensingh-2202
10.	Rummana Islam, Senior Scientific Officer, Plant Pathology Division, BARI, Joydebpur, Gazipur. Mobile: 01717-327437, E-mail: rummna77@yahoo.com	14/5/2018	Bangladesh Agricultural University, Mymensingh-2202
11.	Md. Abdul Wadud, Scientific Officer (Plant Pathology), Spices Research Centre, BARI, Shibgonj, Bogra. Mobile: 01743-073138, E-mail: wadudbari@yahoo.com	23/04/2018	Bangladesh Agricultural University, Mymensingh-2202
12.	Shamima Aktar, Scientific Officer (Soil Science), Pulses Research Sub-station, BARI, Joydebpur, Gazipur. Mobile: 01718-082516, E-mail: shamimaprc@gmail.com	20/5/2018	Bangladesh Agricultural University, Mymensingh-2202
13.	Mohammad Shamsul Hoq, Scientific Officer, Agricultural Economics Division, BARI, Joydebpur, Gazipur. Mobile: 01716-330898, E-mail: shamsul305@yahoo.com	16/04/2018	Bangladesh Agricultural University, Mymensingh-2202
14.	Mohammed Moniruzzaman, Scientific Officer (Horticulture), Plant Physiology Section, HRC, BARI, Joydebpur, Gazipur. Mobile: 01550-605705 E-mail: mzaman.hrcbari@yahoo.com	9/08/2018	Bangladesh Agricultural University, Mymensingh-2202
15.	Md. Moniruzzaman, Senior Scientific Officer, Agricultural Research Station, BARI, Pahartali, Chittagong. Mobile: 01711-947499, E-mail: badal_kbd@yahoo.co.in	16/05/18	Bangladesh Agricultural University, Mymensingh-2202
16.	Nizam Uddin Ahmed, Senior Scientific Officer (CC), TCRSC, BARI, Munshigonj. Mobile:01711054008 E-mail: nizamso92@yahoo.com		Bangladesh Agricultural University, Mymensingh-2202

Sl #	Name with detail address	Date of enrollment	Name of University
17.	Md. Faruq Bin Hossain, Scientific Officer, Postharvest Technology Division, BARI, Joydebpur, Gazipur. Mobile: 01712-577812, E-mail: yaminbari@gmail.com	30/09/2018	Bangladesh Agricultural University, Mymensingh-2202
18.	Mohammad Mukhlesur Rahman, Scientific Officer, ASICT Division, BARI, Joydebpur, Gazipur. Mobile: 01712-943897, E-mail: mukhlesur@bari.gov.bd	06/03/2018	Bangladesh Agricultural University, Mymensingh-2202
19.	Sabina Yesmin, Scientific Officer, Biotechnology Division, BARI, Joydebpur, Gazipur. Mobile: 01925-730011 E-mail: moly.mdp@gmail.com	03/04/2018	Bangladesh Agricultural University, Mymensingh-2202
20.	Shahnaj Pervin, Scientific Officer (Food Technology, Postharvest Technology Division, BARI, Gazipur Mobile: 01720049134, E-mail: spervin_bari@yahoo.com	29/03/2018	Bangladesh Agricultural University, Mymensingh-2202
21.	Abdul Hannan, Senior Scientific Officer, Seed Technology Division, BARI, Joydebpur, Gazipur.Mobile: 01715-483051 E-mail: hsag_04@yahoo.com	16/8/2018	Bangladesh Agricultural University, Mymensingh-2202

BRRI

Sl #	Name with detail address	Date of enrolment	Name of University
22	Niaz Md. Farhat Rahman, Senior Scientific Officer, Agricultural Statistics Division, BRRI, Joydebpur, Gazipur. Mobile: 01912700606, E-mail: niaz.sust@gmail.com	12/08/2018	Shahjalal University of Science and Technology, Sylhet
23	Nargis Parvin, Senior Scientific Officer, Rice Farming Systems Division, BRRI, Joydebpur, Gazipur. Mobile: 01816-938583, E-mail: nargisrfs@gmail.com	15/2/2018	Bangladesh Agricultural University, Mymensingh-2202
24	Shakir Hosen, Scientific Officer, Grain Quality and Nutrition Division, BRRI, Joydebpur, Gazipur. Mobile: 01819-501465, E-mail: shakir.roman@yahoo.com	11/6/2018	University of Dhaka, Dhaka
25	Md. Hannan Ali, Scientific Officer, Irrigation and Water Management Division, BRRI, Joydebpur, Gazipur. Mobile: 01936-953626, E-mail: hannan_aen@yahoo.com	06/06/2018	Bangladesh Agricultural University, Mymensingh
26	Sheikh Maniruzzaman, Scientific Officer, Plant Breeding Division, BRRI, Sagardi, Barishal. Mobile: 01712-996391 E-mail: skmonir85@yahoo.com	21/3/2018	BSMRAU, Gazipur
27	Mohammad Abdul Momin, Senior Liaison Officer, Office of the Director (Research), BRRI, Joydebpur, Gazipur. Mobile: 01716-540380, E-mail: smmomin80@gmail.com	08/01/2018	Sher-e-Bangla Agricultural University, Dhaka

BJRI

Sl #	Name with detail address	Date of enrolment	Name of University
28	Arju Miah, Senior Scientific Officer, Gene Bank Department, Genetic Resources & Seed Division, BJRI, Manik Mia Avenue, Dhaka. Mobile: 01720-296611, E-mail: arjumia146@gmail.com	18/03/2018	Bangladesh Agricultural University, Mymensingh-2202
29	Mohammad Shahadat Hossain, Senior Scientific Officer, Crop Management Department, Agronomy Division, BJRI, Manik Mia Avenue, Dhaka. Mobile: 01718-081885 E-mail: shahadatbjri@gmail.com	14/2/2018	Bangladesh Agricultural University, Mymensingh-2202
30	Md. Kamrujjaman, Senior Scientific Officer, Soil Science Department, Agronomy Division, BJRI, Manik Mia Avenue, Dhaka. Mobile: 01711-043282, E-mail: jony_orna@yahoo.com	18/03/2018	Bangladesh Agricultural University, Mymensingh-2202
31	Shamina Jafrin, Senior Scientific Officer, BJRI, Manik Mia Avenue, Dhaka. Mobile: 01913616150 E-mail: sjafrin@gmail.com	14/2/2018	Dhaka University of Engineering and Technology, Gazipur

Sl #	Name with detail address	Date of enrolment	Name of University
32	Md. Shafiqul Hasan, Senior Scientific Officer, Training Department, Planning, Training & Communication Division, BJRI, Manik Mia Avenue, Dhaka. Mobile: 01911-250553 E-mail: shafiqulbjri@gmail.com	07/2/2018	Sher-e-Bangla AgriculturalUniversity, Dhaka

BSRI

Sl #	Name with detail address	Date of enrolment	Name of University
33	Sayed Shams Tabriz, Senior Scientific Officer, Agricultural Engineering Division, BSRI, Ishurdi, Pabna. Mobile: 01719-862293, E-mail: tabriz_bsri@yahoo.com	08/04/2018	Bangladesh Agricultural University, Mymensingh
34	AKM Rashadul Islam, Senior Scientific Officer, Agronomy & Farming Systems Division, BSRI, Ishurdi, Pabna. Mobile: 01714-160909, E-mail: bsri_rashadul@yahoo.com	03/04/2018	Bangladesh Agricultural University, Mymensingh
35	Nilufar Islam, Senior Scientific Officer, Regional Station, Joydebpur, Gazipur, Mobile: 01711-146775 E-mail: inilufar@yahoo.com	21/03/2018	Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur
36	Md. Munir Hossain, Senior Scientific Officer, Training and Technology Transfer Division, BSRI, Ishurdi, Pabna. Mobile: 01711-846853, E-mail: bsrimunir@yahoo.com	28/03/2018	Sher-e-Bangla Agricultural University, Dhaka
37	Mst. Ismat Ara, Principal Scientific Officer, Entomology Division, BSRI, Ishurdi, Pabna. Mobile: 01711-959559 E-mail: ismatbsri@gmail.com	31/01/2018	Bangladesh Agricultural University, Mymensingh

BINA

Sl #	Name with detail address	Date of enrolment	Name of University
38	Mohammad Rashidul Haque, Senior Scientific Officer, Agricultural Economics Division, BINA, Mymensingh. Mobile: 01717-253073, E-mail: rashidul.bina@gmail.com	22/03/2018	Bangladesh Agricultural University, Mymensingh
39	Mohammad Elius Hossain, Scientific Officer, Soil Science Division, BINA, Mymensingh. Mobile: 01716-131689 E-mail: eliusbina09@gmail.com	27/03/2018	Bangladesh Agricultural University, Mymensingh
40	Rakhi Rani Sarker, Scientific Officer, Soil Science Division, BINA, Mymensingh. Mobile: 01722-460015 E-mail: rrssarker@gmail.com	14/03/2018	Bangladesh Agricultural University, Mymensingh
41	Tania Sarmin, Scientific Officer, Agronomy Division, BINA, Mymensingh. Mobile: 01716-157287 E-mail: sarmintania95@gmail.com	27/3/2018	Bangladesh Agricultural University, Mymensingh

SRDI

Sl #	Name with detail address	Date of enrolment	Name of University
42	Kazi Kaimul Islam, Senior Scientific Officer, SRDI, Dhaka.Mobile: 01716-684946 E-mail: kazisrdi@yahoo.com	05/02/2018	Sher-e-Bangla Agricultural University, Dhaka
43	Md. Harun-Or-Rashed, Scientific Officer, SRDI Regional Laboratory, Cumilla.Mobile: 01914-707369 E-mail: harun.srdi@gmail.com	04/04/2019	Bangladesh Agricultural University,Mymensingh
44	Nazmul Haque Khan, Scientific Officer, Central Laboratory, SRDI, Dhaka.Mobile: 01718-533730 E-mail: nazmulsrdi75@gmail.com	10/09/2018	Sher-e-Bangla Agricultural University, Dhaka

Sl #	Name with detail address	Date of enrolment	Name of University
45	ABM Masud Hasan, Scientific Officer, Salinity Management and Research Center, SRDI, Batiaghata, Khulna.Mobile: 01716-853126 E-mail: abmmasud76@yahoo.com	27/03/2019	Bangladesh Agricultural University, Mymensingh

BLRI

Sl #	Name with detail address	Date of enrolment	Name of University
46	Most. Mahfuja Khatun, Scientific Officer, Socioeconomic Research Division, BLRI, Savar, Dhaka. Mobile: 01716-576437, E-mail: mahfuja_1986@yahoo.com	11/10/2018	Sylhet Agricultural University, Sylhet
47	ASM Ashab Uddin, Scientific Officer, Training, Planning and Technology Testing Division, BLRI, Savar, Dhaka. Mobile: 01787-282862 E-mail: ashabvet12@gmail.com	08/03/2018	Sylhet Agricultural University, Sylhet

BFRI (Fisheries)

Sl #	Name with detail address	Date of enrolment	Name of University
48	Akery Nima, Senior Scientific Officer, BFRI, Reverine Station, Chandpur. Mobile: 01728949185 E-mail: nima07@gmail.com	13/05/2018	University of Rajshahi, Rajshahi
49	Mohammad Ferdous Siddique, Senior Scientific Officer, BFRI, Mymensingh. Mobile: 01722985525 E-mail: siddique.bfri@gmail.com	06/6/2018	Bangladesh Agricultural University, Mymensingh
50	Mohammed Ashraful Haque, Senior Scientific Officer, Maine Fisheries & Technology Station, BFRI, Cox's Bazar. Mobile: 01712-781357**,** ashrafbfri@yahoo.com	31/05/2018	University of Rajshahi, Rajshahi
51	Tayfa Ahmed, Senior Scientific Officer, BFRI, Reverine Station, Chandpur. Mobile: 01712-290950, 01816-546101. E-mail: tayfa.bfri@gmail.com	27/5/2018	Bangladesh Agricultural University, Mymensingh
52	S. Sanjib Basak, BFRI, Reverine sub-station, Rangamati. Mobile: 01718-942672, E-mail:sanjibbasak25@yahoo.com	12/09/2018	Bangladesh Agricultural University, Mymensingh
53	Mst. Sonia Sharmin, Senior Scientific Officer Bangladesh Fisheries Research Institute, Mymensingh Mobile: 01722-688910, Email:soniasharmin_bfri@yahoo.com	13/06/2019	University of Dhaka, Dhaka

BTRI

Sl #	Name with detail address	Date of enrolment	Name of University
54	Apu Biswas, Scientific Officer, Soil Science Division, BTRI, Sreemangal, Moulvibazar. Mobile: 01717-129217 E-mail: jlatdu_06@yahoo.com	25/04/2018	University of Dhaka, Dhaka

BFRI (Forest)

Sl #	Name with detail address	Date of enrolment	Name of University
55	Md. Motiar Rahman, Senior Research Officer, Soil Science Division, BFRI, Chittagong. Mobile: 01716-898222 E-mail: swapon_bfri@yahoo.com	28/5/2018	University of Dhaka, Dhaka
56	Md. Sah Alam, Research Officer, Minor Forest Product Division, BFRI, Chittagong. Mobile: 01719-777897 E-mail: sahalam25@yahoo.com	20/12/2018	Jahangirnagar University, Savar, Dhaka.

CDB

Sl #	Name with detail address	Date of enrolment	Name of University
57	H.M. Syfullah Azad, Senior Scientific Officer, Cotton Research Farm, Sadarpur, Dinajpur. Mobile: 01711-186833 E-mail: syfullahazad@gmail.com	08/05/2018	Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur.

BSRTI

Sl #	Name with detail address	Date of enrolment	Name of University
58	Faruque Ahmed, Research Officer, BSRTI, Baliapukur, Padma R/A, Rajshahi. Mobile: 01733-257913 E-mail: moistfaruk@gmail.com	09/10/2017	University of Rajshahi, Rajshahi
59	Rumana Ferdous Bint-A- Rahman, Research Officer, BSRTI, Baliapukur, Padma R/A, Rajshahi. Mobile: 01717-636522**,** E-mail: rumanabsrtigeb@gmail.com	18/10/2017	University of Rajshahi, Rajshahi
60	Md. Shakhawat Hossain, Research Officer, Seri-Chemistry Section, BSRTI, Baliapukur, Padma R/A, Rajshahi. Mobile: 01717-496400 E-mail: mithu400sh@gmail.com	30/09/2018	University of Rajshahi, Rajshahi

Department of Agricultural Extension (DAE)

Sl #	Name with detail address	Date of enrolment	Name of University
61	Mahbuba Moonmoon,Additional Deputy Director (Fruits & Flowers), Horticulture Wing,Department of Agricultural Extension, Khamarbari, Dhaka. Mobile: 01757950100, E-mail: moon.mdp@gmail.com	08/08/2018	Sher-e-Bangla Agricultural University, Dhaka
62	Sukalpa Das, Upazila Agriculture Officer, Fulpur, Mymensingh, Mobile: 01711488602 E-mail: sukalpa3333@yahoo.com	30/9/2018	Bangladesh Agricultural University, Mymensingh

Sl #	Name with detail address	Date of enrolment	Name of University
63	Md. Mozammal Hossain, Upazila Agriculture Officer (LR), Attached Control Room, Field Services Wing Department of Agricultural Extension, Khamarbari, Dhaka. Mobile: 01821505118 E-mail: mozammal.dae25@gmail.com	19/9/2018	Bonghobondhu Sheikh Mujibur Rahman Science and Technology University, Gopalganj
64	Md. Raquibuzzaman Khan, Additional Deputy Director (P.S. to DG), Department of Agricultural Extension, Khamarbari, Dhaka. Mobile: 01712007009 E-mail: raquib.2253@gmail.com	23/09/2018	Bangladesh Agricultural University, Mymensingh
65	Md. Abu Sayem, Regional Farm Broadcasting Officer Agricultural Information Service, Regional Office, Rangpur. Mobile: 01719547179 E-mail: sayemdae@gmail.com	15/11/2018	Hajee Mohammad Danesh Science and Technology University, Dinajpur
66	Md. Mamunur Rahman, Upazila Agriculture Officer, Kazipur, Sirajgonj.Mobile: 01718029004 E-mail: mamunur76@yahoo.com	26/09/2018	Bangladesh Agricultural University,Mymensingh
67	A. K. M. Amdadul Hoque, Senior Assistant Director, National Agriculture Training Academy (NATA), Gazipur. Mobile: 01720364979 E-mail: amdadhoque74@gmail.com	26/09/2018	Bangladesh Agricultural University, Mymensingh
68	Kaniz Suraya Sultana, Upazila Agriculture Officer, Delduar, Tangail, Mobile: 01915789601 E-mail: kaniz.dae2008@gmail.com	29/09/2018	Bangladesh Agricultural University, Mymensingh-2202
69	Mohammad Liakat Hossain Khan, Senior Monitoring & Evaluation Officer, Citrus Development Project Department of Agricultural Extension, Khamarbari, Dhaka. Mobile: 01712074443 E-mail: litonicm@gmail.com	25/09/2018	Bangladesh Agricultural University, Mymensingh
70	Md. Abu Zafur Al Munsur, Senior Instructor, Agricultural Training Institute, Sher-e-Bangla Nagar, Dhaka.Mobile: 01714104853 E-mail: almansurdae@gmail.com	01/09/2018	Sher-e-Bangla Agricultural University, Dhaka

Department of Livestock Services (DLS)

Sl #	Name with detail address	Date of enrolment	Name of University
71	DR. Mohammad Manjurul Hasan Upazila Livestock Officer, Department of Livestock Services, Gazaria, Munshiganj	17/06/2019	Bangladesh Agricultural University, Mymensingh
72	DR. Md. Abdus Sattar Bag, Veterinary Surgeon Upazila Livestock Office, Ramgati, Lakshmipur	18/06/2019	Bangladesh Agricultural University, Mymensingh
73	DR. Niladri Sikder Veterinary Surgeon, Central Veterinary Hospital, 48/Kazi Alauddin Road, Dhaka-1000.	Awarded	Chattogram Veterinary and Animal Science University, Chattogram
74	DR. Tarana Ahmed Scientific Officer, Ranikhet Section, Livestock Research Institute, Mohakhali, Dhaka.	Awarded	Bangladesh Agricultural University, Mymensingh
75	Anamika Roy Scientific Officer, Animal Breeding, Central Cattle Breeding and Dairy Farm, Savar, Dhaka.	Awarded	Bangladesh Agricultural University, Mymensingh

Annex- III

List of Awarded Foreign PhD along with date of enrolment and name of University /Institute

BARI

SN	Name with detail address	Date of enrolment	Name of University/Institute
1.	Shimul Mondal, Scientific Officer (Soil Science and On-farm Research Division), RARS, BARI, Jashore E-mail: mondalbari@gmail.com	20/12/2018	University of Hohenheim, Germany
2.	Mamunur Rashid Sarker, Senior Scientific Officer, OFRD, BARI, Joydebpur, Gazipur. E-mail: barimamun@yahoo.com	01/10/2018	University of Leeds, UK
3.	Santosh Kumar Paul, Scientific Officer, Agronomy Division, BARI, Joydebpur, Gazipur. E-mail: santosh87dhaka@gmail.com	16/01/2019	The University of Newcastle, Australia
4.	H.M. Khairul Bashar, Senior Scientific Officer, OFRD, BARI, Sabujbag, Gopalganj. E-mail: basharlaboni@yahoo.com	07/09/2018	Universiti Putra Malaysia (UPM)
5.	Hafizur Rahman, Senior Scientific Officer, HRC, RARS, BARI, Jamalpur. E-mail: hafizbau@gmail.com	01/10/2018	The United Graduate School of Agricultural Sciences (UGAS-EU), Ehime, University, 3-5-7 Tarumi, Matsuyama, Ehime 790-8566, Japan
6.	K.A. Md. Mostafizar Rahman, Senior Scientific Officer (Biotechnology), TCRC, BARI, Joydebpur, Gazipur. E-mail: raselnipa02@yahoo.com	07/09/2018	Universiti Putra Malaysia (UPM)
7.	Md. Mosiur Rahman, Scientific Officer (Plant Breeding), Pulses Research Sub-station, BARI, Joydebpur, Gazipur. E-mail: mosiur1979@yahoo.com	12/09/2018	Crop Germplasm Resources, Institute of Crop Science, Chinese Academy of Agricultural Sciences(CAAS), Beijing, China
8.	Shahnewaz Begum, Scientific Officer, Plant Breeding Division, BARI, Joydebpur, Gazipur. E-mail: shahnewaz_ctg1952@yahoo.com	01/09/2018	Huazhong Agricultural University, China
9.	Md. Mahmudul Hasan Khan, Scientific Officer (Oilseed Breeding), RARS, Rahmatpur, Barishal. E-mail: mhasan.bari12@gmail.com	07/09/2018	Universiti Putra Malaysia (UPM)
10.	Mohammad Shariful Islam, Senior Scientific Officer, On-Farm Research Division, BARI, Kishoregonj. E-mail: sharifssd31@yahoo.com	07/09/2018	Universiti Putra Malaysia (UPM)
11.	Razu Ahmed, Scientific Officer (Soil Science), Soil& Water Management Section, HRC, BARI, Joydebpur, Gazipur. E-mail: razuahmed52@yahoo.com	07/09/2018	Universiti Putra Malaysia (UPM)
12.	Mohammad Amdadul Haque, Scientific Officer, Pomology Division, BARI, Joydebpur, Gazipur. E-mail: amdad80@gmail.com	07/09/2018	Universiti Putra Malaysia (UPM)
13.	Mostak Ahmed, Senior Scientific Officer, On-farm Research Division, BARI, Cox's Bazar. E-mail: mostakah_79@yahoo.com		Asian Institute of Technology (AIT), Thailand
14.	Remi Chakma, Senior Scientific Officer, Seed Technology Division, BARI, Joydebpur, Gazipur. E-mail: remichakma@yahoo.co.in	03/08/2018	Asian Institute of Technology (AIT), Thailand
15.	Sayla Khandoker, Scientific Officer, Agricultural Economics Division, BARI, Joydebpur, Gazipur. E-mail: skhandoker_86@yahoo.com	24/07/2018	IARI, New Delhi, India

SN	Name with detail address	Date of enrolment	Name of University/Institute
16.	Kowshik Kumar Saha, Scientific Officer, Farm Machinery and Postharvest Process Engineering Division, BARI, Joydebpur, Gazipur. E-mail: kksaha.bari@gmail.com	8/11/2018	Leibniz Institute for Agricultural Engineering and Bioeconomy (ATB), Germany
17.	Muhammad Ziaur Rahman, Scientific Officer, Plant Pathology Division, RARS, BARI, Rahmatpur, Barishal.E-mail: ziapath@gmail.com	07/09/2018	Universiti Putra Malaysia (UPM)
18.	ATM Tanjimul Islam, Senior Scientific Officer (Plant Breeding), TCRC, BARI, Joydebpur, Gazipur. E-mail: tanjim022@gmail.com	04/01/2019	Asian Institute of Technology (AIT), Thailand
19.	Shiuli Ahmed, Scientific Officer (Plant Breeding), Biotechnology Division, BARI, Joydebpur, Gazipur. E-mail: dey_shiuli@yahoo.com	07/09/2018	Universiti Putra Malaysia (UPM)

BRRI

Sl #	Name with detail address	Date of enrolment	Name of University/Institute
20	Md. Abubakar Siddique, Senior Scientific Officer, Genetic Resources and Seed Division, BRRI, Gazipur. E-mail: mabs198401@yahoo.com	03/08/2018	University of the Philippines Los Banos (UPLB) and International Rice Research Institute (IRRI), Philippines
21	Md. Rejwan Bhuiyan, Senior Scientific Officer, Plant Pathology Division, BRRI, Gazipur. E-mail: rejwanbrri@gmail.com	01/08/2018	University of the Philippines Los Banos (UPLB) and International Rice Research Institute (IRRI), Philippines
22	Mohammad Abul Monsur, Senior Scientific Officer, Plant Pathology Division, BRRI, Gazipur. E-mail: monsurpath@gmail.com	01/08/2018	University of the Philippines Los Banos (UPLB) and International Rice Research Institute (IRRI), Philippines
23	Bidhan Chandra Nath, Senior Scientific Officer, Farm Machinery and Postharvest Technology Division, BRRI, Gazipur. E-mail: bidhanbrri@gmail.com	25/2/2019	University of Southern Queensland, Australia
24	Md. Iftekhar Mahmud Akhand, Senior Scientific Officer, BRRI Regional Station, Bhanga, Faridpur. E-mail: mimabrri@yahoo.com	03/08/2018	University of the Philippines Los Banos (UPLB) and International Rice Research Institute (IRRI), Philippines
25	Mst. Selima Zahan, Senior Scientific Officer, Agronomy Division, BRRI, Gazipur. E-mail: selimabrri11@gmail.com	03/082018	University of the Philippines Los Banos (UPLB) and International Rice Research Institute (IRRI), Philippines
26	Ripon Kumar Roy, Scientific Officer, Biotechnology Division, BRRI, Gazipur. E-mail: riponkumar1983@yahoo.com	21/01/2018	University of the Philippines Los Banos (UPLB) and International Rice Research Institute (IRRI), Philippines
28	Tapas Kumer Hore, Scientific Officer, Plant Breeding Division, BRRI, Gazipur. E-mail: tapas.hore@yahoo.com	03/08/2018	University of the Philippines Los Banos (UPLB) and International Rice Research Institute (IRRI), Philippines
28	Md. Adil, Scientific Officer, Plant Breeding Division, BRRI, Gazipur. E-mail: adil_gpb@yahoo.com	03/08/2018	University of the Philippines Los Banos (UPLB) and International Rice Research Institute (IRRI), Philippines
29	Md. Anisuzzaman, Senior Scientific Officer, Plant Breeding Division, BRRI, Gazipur. E-mail: zaman_brri94@yahoo.com	07/09/2018	Universiti Putra Malaysia (UPM)

BJRI

Sl #	Name with detail address	Date of enrolment	Name of University/Institute
30	Md. Al-Mamun, Senior Scientific Officer, Kenaf Mesta Department, Breeding Division, BJRI, Manik Mia Avenue, Dhaka. E-mail: almamunbjri@gmail.com	07/09/2018	Universiti Putra Malaysia (UPM)
31	Mohammad Munir Hossain, Senior Scientific Officer, BJRI, Jute Research Regional Station, Chandina, Cumilla. E-mail: munibjri@yahoo.com	07/09/2018	Universiti Malaysia Sabah
32	Sultan Ahmed, Scientific Officer, Pest Management Division, BJRI, Manik Mia Avenue, Dhaka. E-mail: sultanbjri1984@gmail.com	07/09/2018	Universiti Putra Malaysia (UPM)
33	Md. Tahzibul Haque, Scientific Officer, Machine Design & Development Section, Jute & Textile Product Development Section, BJRI, Manik Mia Avenue, Dhaka.	13/03/2019	Universiti Malaysia Sabah

BSRI

SN	Name with detail address	Date of enrolment	Name of University/Institute
34	Asish Kumar Ghose, Scientific Officer, Biotechnology Division, BSRI, Ishurdi, Pabna. E-mail: asishbt@yahoo.com	07/09/2018	Universiti Putra Malaysia (UPM)
35	Md. Imam Hossain, Scientific Officer, Plant Pathology Division, BSRI, Ishurdi, Pabna. E-mail: imam4all@gmail.com	07/09/2018	Universiti Putra Malaysia (UPM)
36	KM Rezaul Karim, Senior Scientific Officer, Breeding Division, BSRI, Ishurdi, Pabna. E-mail: bsrirezaul@yahoo.com	07/09/2018	Universiti Putra Malaysia (UPM)
37	Saiful Islam, Scientific Officer, Soils and Nutrition Division, BSRI, Ishurdi, Pabna. E-mail: sislam.bsri@yahoo.com	07/09/2018	Universiti Putra Malaysia (UPM)

BINA

Sl #	Name with detail address	Date of enrolment	Name of University/Institute
38	Mohammad Nurun-Nabi Mazumder, Scientific Officer, Planning & Development Cell. BINA, Mymensingh. E-mail: mnnmbina@gmail.com	07/09/2018	Universiti Putra Malaysia (UPM)
39	Mohammad Asad Ullah, Scientific Officer, Plant Breeding Division, BINA, Mymensingh. E-mail: maullah09@gmail.com	13/11/2018	Universiti Kebangsaan Malaysia
40	Mohammad Ferdous Ikbal, Scientific Officer, Plant Breeding Division, BINA, Mymensingh. E-mail: binaikbal@gmail.com	07/09/2018	Universiti Putra Malaysia (UPM)
41	Ahmad Numery Ashfaqul Haque, Scientific Officer, Soil Science Division, BINA, Mymensingh. E-mail: numerybau@gmail.com	07/09/2018	Universiti Putra Malaysia (UPM)
42	Md. Kamruzzaman, Scientific Officer, Plant Breeding Division, BINA, Mymensingh. E-mail: kamruzzaman_bina2013@yahoo.com	24/10/2018	University of Bonn, Germany

SRDI

SN	Name with detail address	Date of enrolment	Name of University/Institute
43	Md. Motasim Ahmeed, Senior Scientific Officer, SRDI, District Office, Faridpur. E-mail: motasimsrdi@yahoo.com	07/09/2018	Universiti Putra Malaysia (UPM)
44	Md. Ekhlasur Rahman, Scientific Officer, SRDI Regional Laboratory, Dhaka. E-mail: ekhlasurrahman02@gmail.com	28/01/2019	Universiti Putra Malaysia (UPM)
45	Mehnaz Mosharrof, Scientific Officer, SRDI Central Laboratory, Dhaka.E-mail: mmd.mehnaz@gmail.com	03/09/2018	Universiti Putra Malaysia (UPM)

BLRI

SN	Name with detail address	Date of enrolment	Name of University/Institute
46	Dr. Mohammad Nuruzzaman Munsi, Senior Scientific Officer, Goat & Sheep Production Research Division, BLRI, Savar, Dhaka. E-mail: nzaman_blri@yahoo.com	03/12/2018	University of Reading, UK
47	Md. Shirajul Islam, Senior Scientific Officer & In-charge, BLRI Regional Station, Baghabari, Sirajgonj. E-mail: siraj_blri@yahoo.com	18/05/2018	Universiti Putra Malaysia (UPM)
48	Muhammad Khairul Bashar, Scientific Officer, Animal Production Research Division, BLRI, Savar, Dhaka. E-mail: kbashar20@yahoo.com	19/12/2018	University of Hohenheim, Germany
49	Dr. Md. Rezaul Karim, Scientific Officer, Animal Health Research Division, BLRI, Savar, Dhaka. E-mail: rezavetmicro@yahoo.com	30/01/2019	Universiti Putra Malaysia (UPM)

BFRI (Fisheries)

Sl #	Name with detail address	Date of enrolment	Name of University/Institute
50	Arun Chandra Barman, Senior Scientific Officer, BFRI, Mymensingh.E-mail: aruncbt@yahoo.com	18/05/2018	Universiti Putra Malaysia (UPM)
51	Md. Shiraum Monir, Senior Scientific Officer, BFRI, Freshwater Station, Mymensingh. E-mail: monir_bau22@yahoo.com	18/05/2018	Universiti Putra Malaysia (UPM)
52	Md. Moshiur Rahman, Scientific Officer, BFRI, Freshwater Station, Mymensingh. E-mail: riad242@gmail.com	30/8/2018	Asian Institute of Technology, (AIT), Thailand
53	Md. Shahzad Kuli Khan, Scientific Officer, Marine Fisheries & Technology Station, BFRI, Cox's Bazar. E-mail: khanbfri@gmail.com	30/8/2018	Asian Institute of Technology, (AIT), Thailand
54	Md. Ariful Islam, Scientific Officer, Shrimp Research Station, BFRI, Bagerhat. E-mail: arifulbau@gmail.com	12/06/2018	Universiti Putra Malaysia (UPM)

BTRI

SN	Name with detail address	Date of enrolment	Name of University/Institute
55	Shovon Kumar Paul, Scientific Officer, Entomology Division, BTRI, Sreemangal, Moulvibazar. E-mail: shovonbtri@gmail.com	07/09/2018	Universiti Putra Malaysia (UPM)

BFRI (Forest)

SN	Name with detail address	Date of enrolment	Name of University/Institute
56	Sheikh Mohammad Rabiul Alam, Senior Research Officer, Wildlife Section, BFRI, Chittagong. E-mail: rabiwild@gmail.com	04/10/2018	Universiti Malaysia Terengganu
57	Md. Rowson Ali, Senior Research Officer, Seasoning & Timber Physics Division, BFRI, Chittagong. E-mail: rowson_ali@yahoo.com	07/09/2018	Universiti Putra Malaysia (UPM)

CDB

SN	Name with detail address	Date of enrolment	Name of University/Institute
58	Khalequzzaman, Scientific Officer, Cotton Research, Training and Seed Multiplication Farm, Sreepur, Gazipur. E-mail: khalequzzaman30@gmail.com	Awarded	Asian Institute of Technology (AIT), Thailand

MoA

SN	Name with detail address	Date of enrolment	Name of University/Institute
59	Farhana Iris, Deputy Secretary, Ministry of Agriculture, E-mail: farhanairis@yahoo.com	05/3/2018	Universiti Putra Malaysia (UPM)
60	Mosammat Mustari Khanaum, Senior Assistant Secretary, Ministry of Agriculture. E-mail: mustari_khanaum@hotmail.com	15/08/2018	North Dakota State University, USA

Annex- IV

Table: Detailed Training Activities of PIU-BARC

National Training 2018-19

SL#	Name of Training	Participant No.	Organized by	Duration (days)
1	Research Methodology	30	GTI	13
2	Research Methodology	30	GTI	13
3	Research Methodology	30	GTI	13
4	Administrative and Financial Management	29	BARD	13
5	Administrative and Financial Management	30	BARD	13
6	Project Development and Management	30	BIM	5
7	Project Development and Management	30	BIM	5
8	Financial Development	30	BIM	6
9	Financial Development	30	BIM	6
10	P. Procurement Management	30	BIM	6
11	P. Procurement Management	30	BIM	6
12	Advanced Laboratory technologies	30	SRDI	5
13	Advanced Laboratory technologies	30	SRDI	5
14	Technologies created by BARI	30	BARI	30
15	Quality flower production and Management	30	BARI	1
16	Quality flower production and Management	30	BARI	1
17	Quality flower production and Management	30	BARI	1
18	Agronomic Research and Development of Major Crops	30	BARI	5
19	Soil Fertility and Nutrient Management of Major Crops	30	BARI	6
20	Production technologies, storage and processing of tuber crops	30	BARI	5
21	Farm Mechanization and Conservation Agriculture	30	BARI	5
22	Field Monitoring Format and Data Generation for PBRG	35	PIU-BARC	1
23	Financial Management	30	PIU-BARC	1
24	Financial Management	30	PIU-BARC	1
25	Financial Management	30	PIU-BARC	1
26	Financial Management	30	PIU-BARC	1
27	ToT Training on BLRI Developed Technology	30	BLRI	4
28	Improve Fish culture and Management	30	BFRI	3
29	Endangered Fish conservation and spawning	30	BFRI	3
30	Balance Diet for young children, pregnant women and lactating mother	30	BARC	5
31	Balance Diet for young children, pregnant women and lactating mother	30	BARC (N)	5
32	Role of food based nutrition reducing stunting and under weight	30	BARC(N)	5
33	Role of food based nutrition reducing stunting and under weight	30	BARC(N)	5
34	Food Adulteration and contamination	170	BARC(N)	1
35	Training on Nagorik Sheba	86	BARC	1
36	Awareness Building on Act and Policies of Bangladesh Agriculture	30	BARC	3
37	Climate Change, Carbon Sequestration and Adaption Strategies	40	BARC (Soil)	3
38	Global Plan of Action of ITPGRFA	40	BARC (Cro)	2
39	Mutation breeding of Field and Horticultural crops	30	BARC	2

SL#	Name of Training	Participant No.	Organized by	Duration (days)
			(Cro)	
40	Solar Pump Irrigation System	35	BARC (Eng)	3
41	Bioinformatics for sustainable development in agriculture	20	BARC (Liv)	3
Total		1445		

National Workshop for 2018-19

SL#	Name of Workshop/Seminar/Meeting	Participant No.	Organized by	Duration (days)
1	CRG Annual Progress-Crops	304	PIU-BARC	1
2	CRG Annual Progress-AERS	61	PIU-BARC	1
3	CRG Annual Progress-P&E	67	PIU-BARC	1
4	CRG Annual Progress-NRM	220	PIU-BARC	1
5	CRG Annual Progress-Livestock	60	PIU-BARC	1
6	CRG Annual Progress-Fisheries	80	PIU-BARC	1
7	NATP- Research Linkage to SDG	44	PIU-BARC	1
8	Victory Day	300	BARC	1
9	AIC Media Workshop	70	BARC	1
10	Fall Armyworm Outbreak Management	360	BWMRI	3
11	Awareness Workshop on Fall Armyworm Outbreak Management	450	BWMRI	3
12	Progress Review Workshop On Biotechnology Research	35	BARC	1
13	Awareness Building of Environmental and Social Safeguard Management	70	BARC	1
14	Workshop on Asia Open Access	140	BARC	1
15	National workshop on research, development and production on quality seed in Bangladesh	230	BARC	1
16	Bioinformatics for sustainable development	20	BARC	1
17	Aquaculture and Fisheries for Achieving SDG	400	BARC	1
Total		2911		

International Training for 2018-19

SN	Name of Training	Participant No.	Organized by	Duration (days)
1	Advance Contact Management (Public Procurement Management)	6	Turin, Italy	9
2	Modern breeding and Cultivation Technology of vegetables	2	China	20
Total		8		

Self-Initiative Conference/Workshop/Seminar for 2018-19 in foreign countries

SN	Name of Conference/Workshop/Seminar	Participant No.	Organized by	Duration (days)
1	International Conference on Earth Science	1	Netherlands	3
2	International Conference on Biological Control	1	Bengalaru, India	2
3	International Rice Congress	1	Singapore	4
4	International Congress on Plant Pathology and Plant Biotechnology	1	USA	2
5	International Congress on Plant Pathology and Plant Biotechnology	1	USA	2

SN	Name of Conference/Workshop/Seminar	Participant No.	Organized by	Duration (days)
6	3rd Organic Asia Congress	1	Philippines	3
7	International Rice Congress (IRC)	1	Singapore	3
8	International Rice Congress (IRC)	2	Singapore	4
9	International Rice Congress (IRC)	3	Singapore	5
Total		12		

Annex -V

List of Management Staff in PIU-BARC, NATP-2 as on 30 June, 2019

Sl	Name and Position	Address
1.	Dr. Mian Sayeed Hassan Director	Address: Address Sami, House#202, Road#07, Flat#A3, Mohammadpur Housing Society, Dhaka-1207, Mobile No: 01911-740390, E-mail: directornatpbarc@gmail.com
2.	Dr. Md. Abdul Jalil Bhuyan Research Management Specialist	Address: House # 61, Road # 16, Sector# 11, Uttara, Dhaka-1230, Mobile No: 01552-491457 E-mail: maj.bhuyan54@yahoo.com
3.	Dr. Nowsher Ali Sarder Monitoring and Evaluation Specialist	Address: Flat # A1, Building: Janani, 35 Indira Road, Tejgaon, Dhaka. Email: nsarder@gmail.com
4.	Md. Mokhlesur Rahman Training & Communication Specialist	Address: 58, 1/b, West Rajabazar, Farmgate, Dhaka Mobile No: 01710-807313, E-mail: mokhles12@yahoo.com
5.	Mohammad Assaduzzaman Manager (Financial Management)	Address: 84/23, Vasantac, Dhaka Cantonment, Dhaka, Mobile No: 01912-241-929 E-mail: natp.barc.fin@gmail.com
6.	Dr. Md. Serajul Islam Environmental and Social Safe Guard Specilialist	Flat-1/A, House-44, Road-18, Sector-7, Uttara Model Town, Dhaka-1230, Mobile no: 01552387178, E-mail: msislam52@yahoo.com
7.	Mohammad Abdullah Al-Faroque Assistant Manager (Administration)	Address: 1/21/5, East Bashabo, Kadamtola Road, Shabujbag, Dhaka-1214, Mobile No: 01711-061147 E-mail: faroquekbd@gmail.com
8.	Md. Ashequr Rahman Assistant Manager (Accounts)	Address: C/O- Md. Abdul Malek, BUTEX R/A-1, Dalia Building, C/13, South Begunbari, Tejgaon, Dhaka Mobile No: 01912-575317, E-mail: asik0852@yahoo.com
9.	Munshi Mamunur Rahman Documentation Associate	Address: House # 42, Road # 4, Monsurabad, Adabor, Dhaka, Mobile No: 01978-387610 E-mail: mamun71t@yahoo.com
10.	Md. Abdur Rahman Monitoring Associate	Address: 24, Monipuripara, Sangsod Avenue, Tejgaon, Dhaka-1215, Mobile No: 01711-233030 E-mail: agriltechnology@gmail.com
11.	Mr. Dipok Kumar Monitoring Associate	Address: 101, Niribili (7th Floor), West Raja Bazar, Dhaka.Mobile No:01716-210375 E-mail: dipokbarc@gmail.com
12.	Mr. Md. Hasan Mahmud Capacity Development Associate	Address: 146, Bochila (South) 2nd Floor, Mohammadpur, Dhaka-1207.Mobile No: 01819-187798, E-mail: cdanatp2@gmail.com
13.	Nadia Rahnuma Accountant	Address: 40/2, Zigatola, Dhaka Mobile No: 01670-017531E-mail: rahnuma13@gmail.com
14.	Monir Ahamed Khondaker Accountant	Address: H # 3/C, R # 1, Block # kha, Pisiculture Housing Society, Mohammadpur,Dhaka,Mobile No: 01916-045587 E-mail: ripon782002@yahoo.com
15.	Mr. Md. Anowarul Islam Computer Operator	Address: 56 (Middle building), West Rajabazar, Dhaka, Mobile No: 01630-277172 E-mail: maislam.nijhum@gmail.com
16.	Ms. Asma Akhter Computer Operator	Address: 279, Zafrabad, Shonkor, Dhaka Mobile No: 01911-283203, E-mail: asla9@yahoo.com
17.	Md. Shahinur Islam Photocopy, Multimedia, PA System Operator	Address: College Road, Bank Colony, Block #H, 60/1, Savar, Dhaka, Mobile No: 01818-280849

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