Annual Report
2016-17




KRISHI GOBESHONA FOUNDATION

A non-profit foundation for sustainable support to agricultural research & development

Annual Report

July 2016 - June 2017

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A non-profit foundation for sustainable support to agricultural research and development
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Message

I am delighted to know that the Annual Report 2016-17 of Krishi Gobeshona Foundation (KGF) is ready to be published. KGF has been documenting all of its activities performed during a year in its Annual Report since its commencement and this is the 8th edition that covers the activities completed during July 2016 to June 2017. This Report for the year 2016-17 is a self-explanatory one and wherever necessary stated the cumulative progress to make it more reader friendly and indeed a pride for its significant contribution is taking forward the agricultural research for development.

Bangladesh is considered to become self-sufficient in food especially in cereals production. Tangible achievements has been made in all sub-sectors of agriculture in recent days. All these have been made possible through the collective initiatives and efforts of research, extension and farming community as well as Government policies and steps taken for agricultural development of the country.

KGF, a Government sponsored autonomous grant making and non-profit organization has been addressing the recent challenges faced by agricultural sectors since its establishment in 2007. KGF has rightly emphasized on quality research by creating a competitive environment among the scientists working in the relevant fields with the invitation of research proposals on target-oriented and cross cutting issues. On-farm adaptive researches are being supported to develop demand-driven technologies to transform traditional agriculture to commercial enterprises and which is one of the present focuses of the foundation. KGF is supporting Technology Piloting Programs (TPP) by making partnership and strong linkages among research, extension, universities, NGOs and private sectors to disseminate the user friendly technologies being developed through successful projects. KGF starts supporting basic research projects being implemented by BARI and BRRI at different locations/research stations of the country since 2017. Indeed, KGF fosters a unique pluralistic approach to provide a common platform for people coming from private and public sectors having different strength and facilities but requiring cooperation to work together for common goals by sustainable support. It also fosters research works by removing the bottlenecks remaining in the existing systems.

Of the research approaches, CGP is one of the major components where 33 projects (1st call: 14 and 2nd call: 19) have been awarded under BKGET fund and 28 projects are awaiting to be awarded under 3rd call. Under the fourteen research projects taken under the 1st call have already been completed and most of the 2nd call projects completed more than two years of its duration in June 2017, while 28 other projects under 3rd call are ready to be awarded. Three mega projects, developed and designed by KGF for vulnerable areas of the country having national importance are being implemented during the period under CRP. Capacity enhancement program for the NARS and other stakeholders are being continued. International Collaborative research programs on conservation agriculture and identification of salt tolerant genotypes of rice, pulses and oilseeds are being undertaking with ACIAR in Southern region of the country. Eight basic research and 7 pilot projects having potentials for the development of Bangladesh are being implemented in different regions of the country.

These initiatives have really enhanced the height of the Foundation achieving its objectives and increased the visibility of the organization. The remarkable successes made during 2016-17 were the outcome of the sincere efforts and cooperation from all our associates/peer groups.

I believe that the strong initiatives and efforts of KGF experts under the leadership of its Executive Director will certainly enable positive impact in the field of sustainable agricultural research in Bangladesh.

Md. Kabir Ikramul Haque PhD
Chairman, Board of Directors, KGF
and
Executive Chairman, BARC

Preface

The Krishi Gobeshona Foundation (KGF) is an institutional innovation to sponsor agricultural research and development (R & D) in Bangladesh. The foundation was established in 2007 to provide a sustainable fund and guidance to foster and sustain a) a competitive environment for agricultural R&D initiatives by public and private institutions and enterprises or NGOs, and b) a common platform for interactions, cooperation and collaboration among them in the fields of agricultural technology generation, validation and uptake. c) Work in a pluralistic approach for agricultural R&D. The KGF mission is to facilitate capacity improvement, technology generation and adaptation for enhancing productivity and quality of crops, fisheries and livestock agriculture through effective management of R&D under a competitive and diversified research environment.

KGF operates with autonomy and transparency under the guidance of a Board of Directors and a General Body (GnB). It is governed by a fifteen-member General Body through a Board of Directors consisiting of seven members elected from among the members of GnB. The GnB members are eminent personalities from different disciplines of agriculture representing both public and private sectors of Bangladesh. The funding of KGF is maintained by the Bangladesh Krishi Gobeshona Endowment Trust (BKGET) with an endowment fund created by the Government of Bangladesh (GoB). KGF is closely linked with mainstream research through the Bangladesh Agricultural Research Council (BARC). KGF operates various programs covering crops, livestock, fisheries, natural resources, value chains, cross cutting issues, etc.

So far, KGF awarded 33 short term (3 years) CGP projects (1st call: 14 and 2nd call: 19) under BKGET funding of which 14 projects (1st call) completed their duration by June 2016 and most of the 2nd call projects completed more than 2 years. Processing of 3rd call projects almost completed and waiting for award. Funding for the first set of eight basic research programs on rice, wheat, potato and sesame was offered in early 2017. KGF designs and develops large projects under CRP (5 years) with a multi-institutional, multi-disciplinary approach to address agricultural production and management problems in the unfavorable ecosystems of the country, such as, the Hill Tracts, Coastal and Haor areas and the Drought prone North-Western region. The on-going CRP projects are: i) Harnessing the Potential of Hill Agriculture: Enhancing Crop Production through Sustainable Management of Natural Resources ii) Modeling Climate Change Impact on Agriculture and Developing Mitigation and Adoption Strategies for Sustaining Agricultural Production in Bangladesh iii) Strengthening Sugarcane Research and Development in the Hill Tracts iv) Hill Livestock Development v) Development of Upazila Land Suitability Assessment and Crop Zoning System of Bangladesh. KGF organizes short to medium term training programs in relevant areas for capacity enhancement of Scientists in NARS Institutions, Agricultural Universities and NGOs and so far, 20 training workshops and consultative meetings have been organized. The foundation explores avenues for undertaking short to medium term collaborative programs through co-financing with universities and organizations of developed countries like ACIAR/CSIRO (Australia), NRI (UK), NUFIC (Netherlands), Cornell University (USA), etc. KGF also undertakes piloting and up-scaling of potential technologies to facilitate adoption by the stakeholders.

This annual report 2016-17 elaborated On-going activities for fiscal year (July to June) including highlights of key technologies generated by different KGF supported projects. The previous KGF annual reports used to be published by calendar year (Jan to Dec) but from this report is prepared by fiscal year (July to June). I express my gratitude to all Honorable GB members, Board of Directors for their continued guidance, thoughtful decisions and directives.

I would like to thank and express my gratitude to the NARS scientists along with all KGF professionals whose contribution has made the foundation vibrant. I congratulate and thank those who worked hard to compile and edit this report, which will be useful to the scientists, extension workers, policy makers, teachers, students and other stakeholders.

KGF always appreciates receiving feedback, comments and suggestions from the users.

Wais Kabir PhD
Executive Director, KGF

Executive Summary

1. Preamble

Krishi Gobeshona Foundation (KGF) provides fund to short, medium and long term agricultural research projects to satisfy basic and adaptive research needs of crops, livestock, fisheries, agricultural engineering, farming systems and enterprise development etc. During the reporting year (2016-17) the foundation funded 33 CGP, 5 CRP, 4 CEP, one ICP and 7 pilot projects. Out of these projects, 14 CGP projects under 1st call have been completed their duration and the Principal Investigators (PIs) submitted all the PCRs, technology Bulletins, and Projukti Bartas in Bengali as per the requirements cited in the contract agreement. The relevant officials of the foundation started necessary steps to publish these Bulletins and Projukti Bartas for the end users. Of the rest 19 CGP projects under 2nd call, all except 3, completed more than 2 years of implementation by June 2017 and the foundation organized annual workshops where the PIs duly presented the updated progress of these projects. In addition, the foundation deployed an Independent Monitoring Team (external) for the field and desk monitoring of the project activities. None of the CRP and CEP projects completed their duration during the reporting period likewise, ICP project is being continued in collaboration with ACIAR. There was a major changes of the key manpower position of the foundation. A number of experts were recruited in the vacant positions due to retirement of the earlier experts. The foundation recruited Senior Program Specialist (Crops), Program Specialist (Field Crop), Program Specialist (Horticulture), Communication Specialist and Program Specialist (fisheries), in the year 2016-17. The new Executive Director of the Foundation also joined in the month of April 2017.

2. Project Implementation

The Implementation Status of the Projects Funded by KGF since Inception is Summarized in the following matrix.

Sl #	Project Type/Nature	# Project Proposal Submitted	# Proposal recomm-ended by TAC	# Project Funded by KGF	# Project on-going	# Project Completed
1	Competitive Grants Program (CGP)					
	NATP Phase I Funding (93)	353	97	93	0	84
a)	1st Call	128	71	14	1	13
b)	2nd Call	225		19	18	1
c)	3rd Call	109	60	00	00	00
d)	Basic Research	41	9	8	8	0
2	Commissioned Research Program (CRP)		5	5	5	0
3	Capacity Enhancement Program (CEP)			4	4	0
4	International collaboration			1	1	0
5	Pilot Project			21	7	15
Total		856	242	165	44	113

2.1 Distribution of Projects by Research Sectors

Till June 2017, 165 research projects have been funded by KGF, of which 63% were in the crop, 15% in livestock, 4% in fisheries, 2% in agricultural engineering and 12% in system based research sector. Among the crop sector projects 56% were covered by NATP phase I funding; 8% by BKGET 1st call, and 12% in 2nd call funding. To date, 8 basic research projects were awarded for knowledge or technology generation. Twenty-one pilot projects were implemented across the country to promote adoption of agricultural production technologies in order to make the production systems profitable.

2.2 Distribution of Projects by Implementing Organizations

A large number of research projects in different sectors have been funded by the KGF, and these projects have been implemented by several NARS institutions, universities, NGOs and private sector companies of the country. Out of the completed and ongoing projects, the universities' share was 42% followed by BARI (35%) and private enterprises (9%).

2.3 TPP Projects by Sectors

To date, 21 pilot projects have been offered of which 15 have been completed and 7 are ongoing. The crop sector had the largest share of these projects, (85%).

3. Physical and Financial Progress 2016-17

KGF started functioning in 2007-08 with financial support from NATP Phase I, but started for awarding projects with BKGET funding in 2012-13. By the end of 2016-17, KGF expenditure totaled a little over Tk 9000.00 lakh. In 2016-17, Tk 3190.59 lakh, or 35% of total expenditure, was spent. The year 2016-17 was marked by good progress as indicated by the expenditures under the various programs: 67% of the total expenditure made in ICP, 50% of that in CRP, 42% in basic research and 36% in CGP.The average spending against the target (3468.32) for the year 2016-17 was 92% and the physical progress achieved was almost 100%. The year 2016-17 saw good progress in establishing research projects under CRP, 35% of the total annual budget of KGF having been spent for the program (CRP). Progress achieved in CGP was also noteworthy; projects under this program accounted for 25% of the total expenditure.

4. Research Projects Awarded in 2016-17

Following establishment in 2007, KGF started awarding research projects under CGP through NATP Phase I funding, and by 2014 the foundation had funded 93 projects in two spells (54+39), out of which 7 were dropped (results not achieved) and 86 were completed successfully. Starting from fiscal year 2012-13, KGF began awarding research projects with BKGET funding, and awarded 33 projects by 2013. In addition, 8 projects were offered to different research organizations as basic research projects, and another 22 were awarded as pilot projects. The foundation almost finalized another 30 projects to be awarded under the 3rd call by 2016-17, and award process was expected to be completed by December 2017. During the reporting year KGF particularly awarded 15 projects to different institutions.

Research Projects Awarded in 2016-17

Sl #	Nature of Project	Title of project	Commencement	Implementing organization
1	CGP 2nd call	Design and development of two stage drying technique for drying high moisture grain	Mar 2017	HSTU, Dinajpur
2	CGP 2nd call	Market and value chain studies of selected fruits and vegetables with special references to post harvest losses and food safety in Bangladesh	Mar 2017	BARI, Gazipur
3	CGP 2nd call	Development and design of two stages dryers techniques for the drying of high moisture grain	Mar 2017	MSTU, Dinajpur
4	CRP IV	Hill livestock development	April 2017	CVASU Chittagong
5	CRP V	Development of upazila land suitability assessment and crop zoning system of Bangladesh	Mar 2017	BARC, Dhaka
6	Pilot Project	Improving the animal health and productivity through mobile veterinary services	May 2017	BAU, Mymensingh
7	Pilot Project	Scale up of community enterprise approach for intensification of floodplain fish production in Chalan beel	April 2017	SHISUK, Dhaka
8	Basic Research	Study of the physical mechanism related to water and heat stress tolerance in wheat genotypes	Mar 2017	BARI, Gazipur

Sl #	Nature of Project	Title of project	Commencement	Implementing organization
9	Basic Research	Linkage and QTL mapping of tungro resistance in rice	Mar 2017	BRRI, Gazipur
10	Basic Research	Exploring new source of blast resistance and pyramiding blast resistant genes into boro rice	Mar 2017	BRRI, Gazipur
11	Basic Research	Physiological mechanism of waterlogging tolerance in sesame	Mar 2017	BARI, Gazipur
12	Basic Research	Environmental stresses in wheat: Identification and expression of the influential genes at critical growth stages and analysis of their genetic architecture	Mar 2017	BARI, Gazipur
13	Basic Research	Physiological aspects of salinity tolerance of mungbean genotypes for southern region of Bangladesh	Mar 2017	BARI, Gazipur
14	Basic Research	Rice physiological development through trait discovery for boosting rice yield in changing climatic conditions	Mar 2017	BRRI, Gazipur
15	Basic Research	PCR based sequencing of salt and heat tolerant potato varieties using chloroplast DNA and QTL analysis	Mar 2017	BARI, Gazipur

5. Up-Scaling of Potential Technologies

Over the last twelve years since inception, KGF has financially and technically supported 93 CGP projects of which 84 was carried through to successful completion with NATP Phase I funding, and later, with BKGET funding, 33 projects under CGP, 8 under basic research, 5 under CRP and 21 under TPP are being supported to date (until June 2017). Through the sponsorship of these projects, KGF has been assisting in the up-scaling of promising agricultural production technologies, some of which are highlighted bellow:

Important Technologies having Potential of Extrapolation into the Farmers' Fields.

Sl #	Name of technology	Significance in Agriculture
1		Mite infestation reduced the yield and acreage of the commercial cultivation of coconut in the southern region. Mite management research showed that spraying omite @ 2 ml/l of water and incorporation of 250g of neem cake in the root zone produced 77 healthy coconuts/tree compared with infested untreated trees bearing no healthy fruits. This technology was considered a milestone in the control of mites to boost coconut production in Jessore, Khulna, Bagerhat, Gopalganj, Pirojpur and Jhalakati districts of southern Bangladesh.
2	BAU Bro chicken	Two broiler strains, BAU-Bro white and BAU-Bro color, developed from broiler sire and dam lines from locally available genetic resources were released by BAU. Findings of a previous study indicated that the two broiler strains had huge potentials and needed to be up-scaled for commercial production and popularized among poultry farmers. In this context, a marker assisted selection study was proposed for up-scaling, refinement, dissemination and popularization of the strains among the farmers. The overall growth of BAU-Bro white at 38 days of age was 1497g, whereas the BAU-Bro color at 51 days of age was 1110g. The overall profit in the farmer's level study was Tk. 6.29 per kg live weight with BAU-Bro white, while Tk. 24.80 with BAU-Bro color.
3	In vitro production of BARI kola-3 and BARI kola-4 plantlets in CHT	The project was undertaken to standardize the protocol for in vitro plantlet production of BARI kola-3 and BARI kola-4 to produce bunchy top disease free planting material in CHT. The tissue culture saplings produced about 10-15% higher yield. BARI kola-3 produced about 45 t/ha which was about 1 t/ha higher than BARI kola-4. BARI kola-4 matured about one month earlier than BARI kola-3. The technology offers good tissue culture business opportunities in the locality.
4	Up-scaling of cotton-rice intercropping technology in CHT	Hill farmers are subsistence farmers who produce traditional cotton cultivars under jhum cultivation with extremely low productivity and farm income. Improved cotton varieties with intercropped rice earned Tk 70000/- compared with only Tk 10000/- in the jhum method. The technology increased farm income by seven times and so, was piloted in CHT for extrapolation.
5	Community enterprise approach for intensification of floodplain fish production in Chalan *beel*	Chalan *beel* is one of the largest floodplain ecosystems in Bangladesh comprising parts of the Sirajgonj, Pabna and Natore districts. The project succeeded in bringing about 4.5- and 2.25-fold increases in the total fish production at the two project sites, Barmitola *beel* of Natore and Kasher*beel* of Sirajganj, respectively, over production at control sites. This indicated a very good prospect of enhanced fish production in the Chalan *beel* region.

Sl #	Name of technology	Significance in Agriculture
6	Aquaculture through innovative technologies in cage culture system in *Haor*	A new, low-cost feed for tilapia culture in cages was developed. The experimental results showed that complete replacement of fish meal by DL-methionine wa possible without risk production loss, but with a feed cost reduction by Tk. 4/kg. A few entrepreneurs were developed at Mithamoin, Austogram, Nikly and Tarakanda *haor* upazilas who were trained by the project personnel on 'haor cage culture and setting up of cages in the haor'. Several of these entrepreneurs set up new cages at different *Haor* sites and since then have been profitably practicing tilapia cage culture independently.
7	High-value fish species Shing (*Heteropneustes fossilis*) culture	Shing farming is largely confined to the Mymensingh region. A KGF funded project was undertaken to standardize the Shing culture techniques for wider adoption. Results from two consecutive years showed the feed conversion ratio (FCR) ranged between 2.99 and 3.17 with a net production of 3.93 to 5.43 t/ha. The average net return and BCR ranged in from Tk. 441738 to 872762/ha and 1.48 to 1.76, respectively.
8	Sugarcane research and development in CHT	Tobacco has been an invasive crop in the hill districts. Growing sugarcane intercropped with high value vegetables was reported to be more remunerative than tobacco. In the traditional sugar mill zones of the country, the average yield of sugarcane is 50 t/ha while the average yield of sugarcane in CHT hills was found to be >100 t/ha. This project seeks to strengthen the research capability of BSRI and generate improved technologies including high yielding varieties. BSRI identified the varieties BSRI Akh 41, BSRI Akh 42 and VMC 86-550 as suitable for *gur* production. On the other hand, the varieties BSRI Akh 41, BSRI Akh 42, Co 208 and China performed almost equally well as chewing cum juice types.
9	Management of canker disease of citrus fruits	The citrus canker disease was addressed by developing a technology package through a KGF funded project that re-opened the doors for the export of *jara* lemon, which was halted earlier due to the infestation. The project assisted in the development and adoption of clinico-pathological management methods that helped eradicate the canker disease in citrus growing areas of Moulavi Bazar, Habiganj and Sylhet.
10	Integrated crop-fish production system using ditch and dyke method	Converting a low land into a ditch and dyke landscape for raising vegetable crops on the dyke and fish culture in the ditch has been found more than three-folds profitable compared with the traditional single-crop culture (aman rice). Production of vegetables on dykes round the year and fish culture in the ditch/pond in the monsoon season substantially increased farmers' income in the southern district of Jhalakati.

6. Meetings of the Board of Director

As per provisions of the Memorandum and Articles of Association (MAA), KGF is governed by its General Body (GnB) and a seven-member Board of Directors (the Board). The Board takes the decisions for the successful operation of KGF programs/projects. Generally, the Board meets bi-monthly with the provision of additional meetings, as and when necessary, called by the Member Secretary (Executive Director of KGF). During the reported period six Board meetings were held one in each month of August, October, November, February, March and April.

7. Meetings of Technical Advisory Committee (TAC)

As per decision of the 31st Board Meeting of KGF in August 2012, a 14-member TAC was formed to provide strategic guidance ensuring the quality of research supported by KGF, to review BARC prioritized researchable areas, and to select issues appropriate for inviting proposals for KGF funding, and to identify areas where new initiatives may be required and to recommend resource allocation to CGP projects. In fact, TAC holds the responsibility of selecting research agenda to be supported by KGF funding and to accomplish this, several TAC meetings are arranged by KGF. The TAC meetings held in 2016-17 one in each month of July, August, October, January, March, April and May.

8. Progress of On-Going Projects

The progress of the on-going projects is discussed in chapter 4 of this annual report. The reports of the projects which discussed are: 19 projects of CGP 2nd call, 5 projects of CRP, 4 of CEP, 01 under ICP and 7 of technology piloting programs.

The existing manpower of the KGF, Audit Report 2016-17, and List of Projects being implemented has been shown as annexes.

Abbreviations and Acronyms

ACIAR	Australian Center for International Agricultural Research
ADP	Annual Development Program
AEZ	Agro-Ecological Zone
AIS	Agriculture Information Service
Aman	Rice grown in Monsoon season in BD
Aus	Rice grown in pre-monsoon season in BD
AWD	Alternate Wetting and Drying
BARC	Bangladesh Agricultural Research Council
BARI	Bangladesh Agricultural Research Institute
BAU	Bangladesh Agricultural University
BCR	Benefit Cost Ration
BD	Bangladesh
BINA	Bangladesh Institute of Nuclear Agriculture
BKGET	Bangladesh Krish Gobeshona Endowment Trust
BLRI	Bangladesh Livestock Research Institute
Boro	Rice grown in winter/dry season in BD
BR	Basic Research
BRRI	Bangladesh Rice Research Institute
BSFIC	Bangladesh Sugar and Food Industries Corporation
BSMRAU	Bangabandhu Sheikh Mujibur Rahman Agricultural University
BSRI	Bangladesh Sugarcrop Research Institute
CA	Conservation Agriculture
CDB	Cotton Development Board
CEB	Community Engagement Biosecurity
CEP	Capacity Enhancement Program
CGP	Competitive Grants Program
CGR	Crop Growth Rate
CHT	Chittagong Hill Tracts
CRP	Commissioned Research Program
CVASU	Chittagong Veterinary and Animal Science University
DAE	Department of Agricultural Extension
DLS	Department of Livestock Service
DoF	Department of Fisheries
ED	Executive Director
FAO	Food and Agriculture Organization of United Nations
FGD	Focus Group Discussion
FMD	Foot and Mouth Disease
GIS	Geographical Information System
GnB	General Body
GO	Government Organization
GoB	Government of Bangladesh
HARS	Hill Agricultural Research Station
HRC	Horticulture Research Center
HYG	High Yield Goal
HYV	High Yielding Variety
ICP	International Collaboration Program
KGF	Krishi Gobeshona Foundation
KSSL	Krishibid Somoboy Society Limited
LAI	Leaf Area Index
M & E	Monitoring and Evaluation
MAA	Memorandum and Articles of Association
MoA	Ministry of Agriculture
NAR	Net Assimilation Rate
NARS	National Agricultural Research System
NATP	National Agricultural Technology Project
NGO	Non-Government Organization
OFRD	On Farm Research Division
PCR	Project Completion Report
PGR	Plant Growth Regulator
PRTC	Poultry Research and Training Center
PSO	Principal Scientific Officer
R & D	Research and Development
RB	Repeat Breeder
RFV	Relative Feed Value
RGR	Relative Growth Rate
RS	Remote Sensing
SAU	Sylhet Agricultural University
SAU	Sher-e-Bangla Agricultural University
TAC	Technical Advisory Committee
TDN	Total Digestible Nutrient
TPP	Technology Piloting Program
UAO	Upazila Agriculture Officer
UNDP	United Nations Development Program

Krishi Gobeshona Foundation (KGF)

Annual Report 2016-17

1. Background of KGF

The Krishi Gobeshona Foundation (KGF) is an institutional innovation to sponsor agricultural research and development (R & D) in Bangladesh. The foundation was established in 2007 to provide funds and guidance to foster and sustain a) a competitive environment for agricultural R&D initiatives by public and private institutions and enterprises or NGOs, and b) a common platform for interactions, cooperation and collaboration among them in the fields of agricultural technology generation, validation and uptake) Work in a pluralistic approach for agricultural R&D. The mission of KGF is: To facilitate capacity improvement, technology generation and adaptation for enhancing productivity and quality of crops, fisheries and livestock agriculture through effective management of R&D under a competitive and diversified research environment.

KGF operates with autonomy and transparency under the guidance of a Board of Directors and a General Body (GnB). It is governed by a fifteen-member General Body through a Board of Directors consisting of seven members elected from among the members of GnB. The GnB members are eminent personalities from different disciplines of agriculture representing both public and private sectors of Bangladesh. The funding of KGF is maintained by the Bangladesh Krishi Gobeshona Endowment Trust (BKGET) with an endowment fund created by the Government of Bangladesh (GoB). KGF is closely linked with mainstream research through the Bangladesh Agricultural Research Council (BARC). The Executive Director, appointed by the Board, is the Chief Executive of KGF. KGF operates various programs covering crops, livestock, fisheries, natural resources, value chains, cross cutting issues, etc. as follows:

1.1 Competitive Grants Program (CGP)

KGF supports CGP to address location specific, demand driven, multi-disciplinary short to medium term research projects involving public and private sectors through open circulars inviting proposals with major focus on on-farm applied and adaptive research, including marketing, socio-economic and value adding aspects.

1.2 Basic Research (BR)

During the process of selection of CGP projects for KGF funding, it was felt that certain agricultural problems needed identification and understanding through basic research for the generation of sound technologies which could be adopted at the farmer field level. To address this issue, the Bangladesh Agricultural Research Institute (BARI) and the Bangladesh Rice Research Institute (BRRI) were asked to submit proposals to KGF for funding of basic research. The proposals were scrutinized by KGF and submitted to the Technical Advisory Committee (TAC) for final selection and approval by the Board of Directors. Funding for the first set of eight basic research programs on rice, wheat, potato and sesame was offered in early 2017. Work on these basic research programs started by June 2017.

1.3 Commissioned Research Program (CRP)

KGF designs and develops large projects under CRP with a multi-institutional, multi-disciplinary approach to address agricultural production and management problems in the unfavorable ecosystems of the country, such as, the Hill Tracts, Coastal and Haor areas and the Drought prone North-Western region. The CRP projects, presently being implemented are:

a) Harnessing the Potential of Hill Agriculture: Enhancing Crop Production through Sustainable Management of Natural Resources

b) Modeling Climate Change Impact on Agriculture and Developing Mitigation and Adoption Strategies for Sustaining Agricultural Production in Bangladesh

c) Strengthening Sugarcane Research and Development in the Hill Tracts
d) Hill Livestock Development
e) Development of Upazila Land Suitability Assessment and Crop Zoning System of Bangladesh

1.4 Capacity Enhancement Program (CEP)

KGF organizes short to medium term training programs in relevant areas for capacity enhancement of scientists in NARS institutions, agricultural universities and NGOs, so that they can design appropriate research projects to address agricultural problems and contribute to agricultural R&D. So far, a total of 20 training workshops and consultative meetings have been organized by KGF. Both national and international scientists participated as trainers in those training/workshops. Some of the important training courses are:

a) Climate Change Modeling
b) Scientific Writing Skill Improvement
c) Capacity Enhancement of NARS through Agricultural Research Management Information System (ARMIS)
d) Skill Enhancement of Field Level Service Providers in Livestock Service

1.5 International Collaboration Program (ICP)

KGF explores avenues for undertaking short to medium term collaborative programs through co-financing with universities and organizations of developed countries like ACIAR/CSIRO (Australia), NRI (UK), NUFIC (Netherlands), Cornell University (USA), etc. Collaboration with international agencies plays an important role in improving the quality of agricultural research and scientific capacity building in Bangladesh.

1.6 Technology Piloting Programs (TPP)

KGF undertakes piloting and up-scaling of potential technologies to facilitate adoption by the stakeholders. So far, eighteen pilot projects, seven of them in 2016-17, have been implemented.

2. Introduction

This Annual Report presents a brief account of the initiatives, activities and achievements of KGF under the various programs like CGP, CRP, ICP, CEP, etc. in fiscal year 2016-17. The report also includes a statement of financial progress during the same period. This report is the 8th in a series since the inception of KGF, highlighting outputs from on-going projects and key findings and a few success stories during the year 2016-17.

2.1 Research Priority Setting

A key step in KGF operational protocol is the identification and prioritization of research issues to be addressed and studied under CGP and other R&D programs for the best utilization of the research grants. Funding under CGP and other R&D programs is considered for location specific, pre-identified, high priority, multi-disciplinary, problem solving research and development. However, KGF also organizes consultative workshops/meetings for the identification and prioritization of local and regional level research issues. The thematic areas for research for each of the CGP calls are selected by TAC on the basis of recommendations set forth in BARC publications on research priority[1] resulting from extensive stakeholders' consultations and also in consideration of current demand driven issues like the `wheat blast

[1] Bangladesh Agricultural Research Council, Feb 2011: Agricultural Research Vision 2030 and beyond; and Research Priorities in Bangladesh Agriculture; Wais Kabir and Ghulam Hossain, SK 2012-13: Prioritization of Demand-driven Agricultural Research for Development in Bangladesh

disease affecting the agricultural landscape of the country. With the help of pre-designed formats KGF's desk officers preliminary scrutinize the proposals and submit those to TAC which selects the best proposals considering technical and financial feasibility. The proposals are then submitted to the Board of Directors for final approval. Following extensive evaluation criteria, research project funds offered to respective researchers of NARS institutes and universities.

Research projects under CRP are prioritized through consultation meetings with agricultural experts from both public and private sectors. KGF recruits one senior agricultural consultant. The consultant interacts with researchers working at NARS institutions to identify current agricultural production problem of regional or national dimensions which would need immediate attention to develop remedial measures for management and mitigation. A working paper is prepared and presented by the consultant at an expert meeting. The experts decide research theme (s), based on which TAC identifies the relevant research organization(s) and invites specific project proposals (PP). The KGF management evaluates and selects the PP and submits to TAC. The final approval of the PP is made by the KGF Board of Directors.

The pilot projects to be implemented under TPP are selected based on the past three years' results from relevant research projects and upon an evaluation of the adoption potential of the technology in extrapolation areas. Generally, based on the performance of tested technologies, the concerned Principal Investigators (PI) proposes to initiate pilot projects on the technology generated during the research phase. Following this, KGF experts visit the research technology field testing sites; interact with the expected beneficiaries through FGDs or KIIs. Their reports are evaluated by the KGF management, and if found appropriate, a process of approval of the proposed pilot projects is initiated which goes through the TAC-Board rounds before final approval as in the cases of CGP/CRP.

2.2 Project Implementation

Table 2.1. gives the numbers of projects proposed and those eventually implemented, since the inception of KGF, having gone through the rigorous screening process for selection and funding. The project proposals were submitted by scientists from national research institutes, universities, NGOs and private sectors following KGF advertisements in the national dailies. The initial screening was done by KGF's technical experts and submitted to TAC which had the proposals reviewed and evaluated by external experts of the relevant fields, recommended the suitable PPs for onward submission to the Board of Directors. The Board reviewed the PPs and gave final approval for award and funding.

Table 2.1: Research Projects Funded by KGF since Inception

Sl #	Project Type/Nature	# Project Proposal Submitted	# Proposal Selected by KGF	# Proposal recommended by TAC	Approved by Board of Director (#)	# Project Funded by KGF	# Project on-going	# Project Completed
1	Competitive Grants Program (CGP)							
	NATP Phase I Funding (93)	353	181	97	93	93	0	84
a)	1st Call	128	73	71	14	14	1	13
b)	2nd Call	225	110		22	19	18	1
c)	3rd Call	109	104	60	29	00	00	00
d)	Basic Research	41	41	9	8	8	8	0
2	Commissioned Research Program (CRP)			5	5	5	5	0
3	Capacity Enhancement Program (CEP)				4	4	4	0
4	International collaboration				1	1	1	0
5	Pilot Project				22	21	7	15
Total		856	509	242	198	165	44	113

2.2.1 Projects by Research Sectors

The areas of research sponsored by KGF since its establishment have been mainly crops, livestock, fisheries, agricultural engineering and system based programs like studies on specific issues, economic evaluation of various research entities, etc. So far,195 research projects have been funded by KGF, of which 63% (118) were in the crop sector,15% (28) in livestock,4% (15) in fisheries,2% (4) in agricultural engineering and 12% (22) in system based research (Fig. 2.1 and Table 2.2). Among the crop sector projects (118), 54 (46%) were covered by NATP phase I; 9 (7%) by BKGET in 1st call, 5 (4%) in 2nd call and 12 (10%) in 3rd call. To date, 8 basic research projects were awarded for knowledge or technology generation. Twenty-two pilot projects were implemented across the country to promote adoption of agricultural production technologies in order to make the production systems profitable.

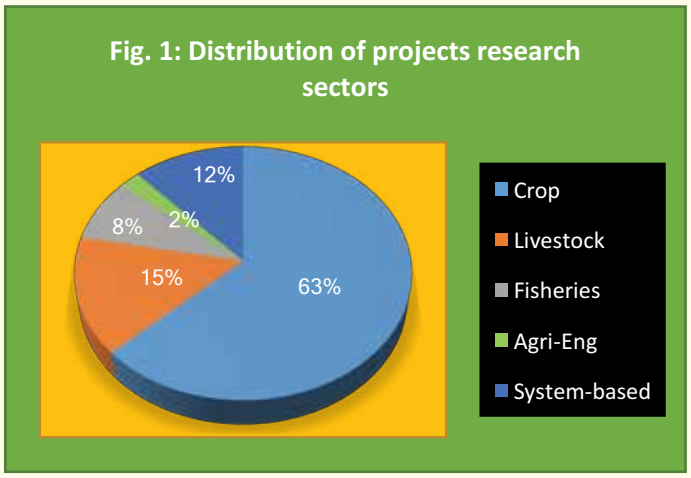


Table 2.1: Distribution of Research Projects by Research Sectors

Sl #	Type of project	Crop	Livestock	Fisheries	Agri-Engineering	System-based	Total
1	Competitive Grants Project (CGP)						
a)	NATP Phase I Funding (93)	54	11	4	4	20	93
b)	1st Call	9	1	2	--	2	14
c)	2nd Call	5	7	1	2	4	19
d)	3rd Call	12	7	4	2	4	29
e)	Basic Research	8	--	--	--	--	8
2	Commissioned Research Project (CRP)	--	--	--	--	--	5
3	Capacity Enhancement Program (CEP)	1	1			2	4
4	International Collaboration					1	1
5	Pilot Project	17	2	3			22
Total		118	28	15	4	22	195

2.2.2 Projects by Implementing Organizations

Large numbers of research projects in different sectors have been funded by the KGF, and these projects have been implemented by several NARS institutions, universities, NGOs and private sector companies of the country. Out of the completed and on-going projects, the universities' share was 42% followed by BARI (35%) and private enterprises (9% (Figure 2.2 and Table 2.3).

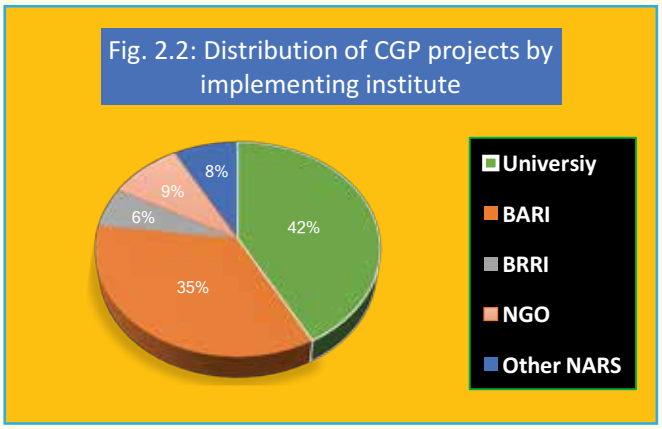
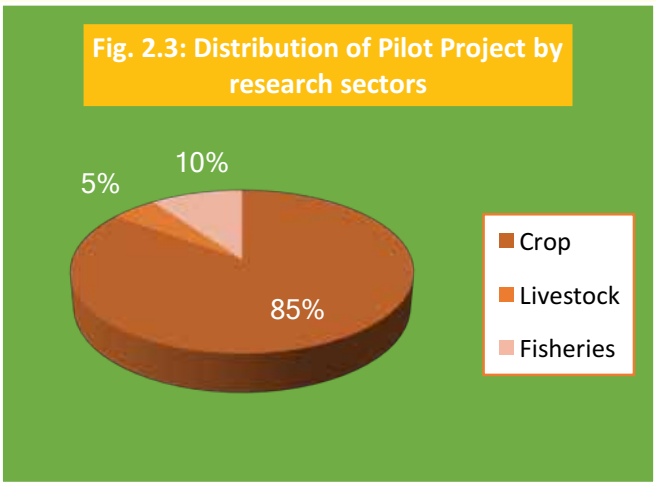


Table 2.3: Distribution of Projects by Implementing Organizations

Sl #	Type of project	BARI	BRRI	BINA	BJRI	BSRI	Other NARS	Unit	NGO	Total
1	Competitive Grants Project (CGP)									
a)	NATP Phase I Funding (93)	32	5	3			4	35	14	93
b)	1st Call	6	1		1			5	1	14
c)	2nd Call	4				1		14		19
d)	3rd Call	8				1	1	19		29
e)	Basic Research	5	3							8
2	Commissioned Research Project (CRP)	1	1			1	1	1		5
3	Capacity Enhancement Program (CEP)	1	1				1	1		3
4	International Collaboration (IC)	1								1
5	Pilot Project	9		1			4	6	2	22
Total		67	11	4	1	3	10	81	17	194

2.2.3 TPP Projects by Sectors

To date, 22 pilot projects have been offered of which 15 have been completed and 7 are on-going. The crop sector had the largest share of these projects, 85% (Figure 2.3)



3. Progress in 2016-17

This section presents a brief account of KGF's physical and financial progress in the year 2016-17 relative to the targets for the year. Progress achieved in the operation of programs like CGP, CRP, CEP, ICP and TPP implemented during the year is discussed in the following sub-sections.

3.1 Physical and Financial Progress 2016-17

KGF started functioning in 2007-08 with financial support from NATP Phase I, but started for awarding projects with BKGET funding in 2012-13. Table 3.1 shows the progress in KGF activities under BKGET funding. By the end of 2016-17, KGF expenditure totaled a little over Tk. 9000.00 lakh. In 2016-17, Tk. 3190.59 lakh, or 35%, was spent in 2016-17. The year 2016-17 was marked by good progress as indicated by the expenditures under the various programs: 67% of the total expenditure in ICP, 50% of that in CRP, 42% in basic research and 36% in CGP (Table 3.1).

The average spending against the target (3468.32) for the year 2016-17 was 92% and the physical progress achieved was almost 100%. The year 2016-17 saw good progress in establishing research projects under CRP, 35% of the total annual budget of KGF having been spent for the program. Progress achieved in CGP was also noteworthy; projects under this program accounted for 25% of the total expenditure (Table 3.1).

Table 3.1: Physical and Financial Progress during 2016-17 (physical in no., financial in lakh taka)

Sl #	Budget item	Target in 2016-17		Progress in current year (2016-17)		Progress (%)		Cumulative progress till June 2017		Annual Cost sharing of item against total (%)	Annual Cost sharing against cumulative total by item (%)
		Phy	Fin	Phy	Fin	Phy	Fin	Phy	Fin	Fin	Fin
1	Manpower	39	222.52	39	217.17	100	98	39	875.92	7	25
	Allowance	LS	61.85	LS	40.79		66	LS	83.89	1	49
2	Projects										
i)	Competitive Grants Program	33	843.99	33	800.89	100	95	33	2206.66	25	36
ii)	Basic research	8	389.56	8	358.94	100	92	8	860.48	11	42
iii)	Commission Research Program	3	1246.28	3	1236.87	100	99	5	2451.782	39	50
iv)	Capacity Enhancement Program	3	159.01	3	116.49	100	73	3	554.34	4	21
v)	International collaboration Program	1	39.72	1	32.73	100	82	1	48.68	1	67
vi)	Technology Piloting program	21	246.77	18	196.17	86	79	19	848.64	6	23
3	Review and Monitoring	LS	88.29		83.39			LS	741.01	3	11
8	Publication	LS	45.11		31.38		70	LS	144.45	1	22
9	Contingency	LS	125.22	LS	75.77		61	LS	192.13	2	39
Total			3468.32		3190.59		92		9007.99	100	35

3.1.1 Progress in Competitive Grants Program (CGP)

In the current year (2016-17), KGF spent Tk. 1160 lakh to support 41 on-going CGP projects. A major portion of the spending was done in providing funds for PIs of the CGP projects awarded under the 2nd call. Details of the progress of operations of the CGP projects are shown in the following Table 3.2.

Table 3.2: Physical and Financial Progress of CGP during 2016-17

Sl #	Competitive Grants Program (CGP)	Target in 2016-17		Progress in current year (2016-17)		Progress (%)		Cumulative progress till June 2017	
		Phy	Fin	Phy	Fin	Phy	Fin	Phy	Fin
1	1st Call	14	100.00	14	90.38	100	90	14	974.72
2	2nd Call	19	714.99	19	710.51	100	99	19	1231.94
3	3rd Call	1	29.00	0	0.00	0	0	0	0.00
4	Basic Research	8	389.56	8	358.94	100	92	8	114.91
Total		52	1233.55	51	1159.83	100	94	51	2321.58

3.1.2 Progress in Commissioned Research Program (CRP)

Details of the progress of CRP projects during the year 2016-17 are shown in Table 3.3. Considering the targets and achievements of research projects, the progress in CRP in the year 2016-17 was commendable with almost 100% achievements relative to the physical and financial targets. Of the CRP projects initiated and on-going in the year, the expenditure for hill agriculture was Tk. 685 lakh or 55% of the total expenditure. The sugarcane development project in the hills accounted for 28% of the total Tk. 1237 expenditure.

Table 3.3: Physical and Financial Progress of CRP during 2016-17

Sl #	Commissioned Research Project (CRP)	Target in 2016-17		Progress in current year (2016-17)		Progress (%)		Cumulative progress till June 2017	
		Phy	Fin	Phy	Fin	Phy	Fin	Phy	Fin
1	Hill Agriculture: 5 Components	5	689.75		684.82	100	99	5	1305.34
2	Modeling Climate Change on Bangladesh Agriculture		42.00		42.00		100		434.30
3	Sugarcane R&D in CHT		305.53		350.17		115		552.26
4	R&D on Hill Livestock		93.01		43.88		47		43.88
5	Assessment of Land Suitability and Crop Zoning		116.00		116.00		100		116.00
Total		5	1246.28	0.00	1236.87	100	99	5	2451.78

3.2 Research Projects Awarded in 2016-17

Following establishment in 2007, KGF started awarding research projects under CGP through NATP Phase I funding, and by 2014 the foundation had funded 93 projects in two spells (54+39), out of which 7 were dropped (results not achieved) and 86 were completed successfully. Starting from fiscal year 2012-13, KGF began awarding research projects with BKGET funding, and awarded 33 projects by 2013. In addition, 8 projects were offered to different research organizations as basic research projects, and another 22 were awarded as pilot projects. The foundation almost finalized another 30 projects to be awarded under the 3rd call by 2016-17, and award process was expected to be completed by December 2017. During the reporting year KGF particularly awarded 15 projects to different institutions (Table 3.4).

Table 3.4: Research projects awarded in 2016-17.

Sl #	Nature of Project	Title of project	Commencement	Implementing organization
1	CGP 2nd call	Design and development of two stage drying technique for drying high moisture grain	Mar 2017	HSTU, Dinajpur
2	CGP 2nd call	Market and value chain studies of selected fruits and vegetables with special references to post harvest losses and food safety in Bangladesh	Mar 2017	BARI, Gazipur
3	CGP 2nd call	Development and design of two stages dryers techniques for the drying of high moisture grain	Mar 2017	MSTU, Dinajpur
4	CRP IV	Hill livestock development	April 2017	CVASU Chittagong
5	CRP V	Development of upazila land suitability assessment and crop zoning system of Bangladesh	Mar 2017	BARC, Dhaka
6	Pilot Project	Improving the animal health and productivity through mobile veterinary services	May 2017	BAU, Mymensingh
7	Pilot Project	Scale up of community enterprise approach for intensification of floodplain fish production in Chalan beel	April 2017	SHISUK, Dhaka
8	Basic Research	Study of the physical mechanism related to water and heat stress tolerance in wheat genotypes	Mar 2017	BARI, Gazipur
9	Basic Research	Linkage and QTL mapping of tungro resistance in rice	Mar 2017	BRRI, Gazipur
10	Basic Research	Exploring new source of blast resistance and pyramiding blast resistant genes into boro rice	Mar 2017	BRRI, Gazipur
11	Basic Research	Physiological mechanism of waterlogging tolerance in sesame	Mar 2017	BARI, Gazipur
12	Basic Research	Environmental stresses in wheat: Identification and expression of the influential genes at critical growth stages and analysis of their genetic architecture	Mar 2017	BARI, Gazipur
13	Basic Research	Physiological aspects of salinity tolerance of mungbean genotypes for southern region of Bangladesh	Mar 2017	BARI, Gazipur
14	Basic Research	Rice physiological development through trait discovery for boosting rice yield in changing climatic conditions	Mar 2017	BRRI, Gazipur
15	Basic Research	PCR based sequencing of salt and heat tolerant potato varieties using chloroplast DNA and QTL analysis	Mar 2017	BARI, Gazipur

3.2.1 CGP Projects

Of the 15 projects awarded in 2016-17, 3 were under CGP all of which commenced in March to May 2017 with expected completion in April to June 2020.One of the CGP projects is being implemented by BARI, Gazipur and another by Hazi Dansh Science and Technology University (HSTU), Dinajpur. One CGP project was planned as a study of the value chain of selected fruits and vegetable crops and another one would investigate the efficiency of seed dryers. The seed dryer projects have opportunities to transfer the generated knowledge for enterprise and business development by engaging entrepreneurs. Two pilot projects were offered in April and May 2017, to be implemented by the Bangladesh Agricultural University (BAU) and SHISUK.

3.2.2 CRP Projects

The Hill Livestock Development Project (CRP IV) is a unique on-going project for improvement of livestock resources of the country as the hill tracts have under-utilized natural grazing lands with great potential for livestock feeding. The upazila land suitability assessment and crop zoning project (CRP V) was awarded to BARC. It is important project that would explore the potential of crops in various zones of Bangladesh in respect of yield and quality. Due to some difficulties in staff recruitment, the project commenced later than expected, and the project inception workshop remains to be held.

3.3 Up-Scaling of Potential Technologies

Over the last twelve years since inception, KGF has financially and technically supported93 CGP projects of which 84 was carried through to successful completion with NATP Phase I funding, and later, with BKGET funding,33 projects under CGP, 8 under basic research, 5 under CRP and 22under TPP are being supported to date (until June 2017). Through the sponsorship of these projects, KGF has been assisting in the up-scaling promising agricultural production technologies, some of which are highlighted bellow:

3.3.1 Management and Control of Mite in Coconut through Farmers' Capacity Enhancement.

Coconut is an important cash crop of Bangladesh but its production has been found declining rapidly causing serious loss to the coconut palm/orchard owners. Widespread attack of mite has been identified as the major cause of such yield decline. The pest attacks on coconut fruits at the early stage results in deformed, small fruits. Mite being a very small insect remains unnoticed and effective control measures against this enemy was not known to the farmers.

A group of BARI scientists worked with the support of a CGP project funded by KGF, identified the mechanism of mite control and determined the extent of coconut damage due to mite attack. They also standardized an effective management option for controlling mite infestation in coconut. Application of management treatment successfully controlled mite infestation that helped increasing coconut productivity in the project areas.

The management practice of mite control includes several steps: i) harvesting of all the infested young nuts and burning ii) after harvesting the infested nuts, spraying Omit - 57 EC; 1.5 -2 ml per liter of water on the foliage and the trunk stem attaching the bunch of fruits iii) spraying for the second time when the young nuts attain 2 months old iv) spraying for the third time after harvesting young and mature nuts and v) repeating step three for the coconut bearing plants as well as neighboring non - bearing plants. Additionally incorporation of 250g of Neem Cake per plant at the root zone was suggested to apply as a

part of management practice which was found very effective. Application of the management treatment mentioned above successfully controlled mite and were found to produce nuts without any sign of mite infestation and increased coconut productivity in Jessore, Narail, Gopalgong, Bagerhat Sadar, Mollarhat and Fakirhat area.

3.3.2 Management of Canker Disease in Citrus

Citrus canker disease was addressed by developing package technology through KGF funded project that re-opened the door of export of jara lemon, which was halted earlier due to infestation. The project was implemented by BARI during 2010 to 2011 in Moulavi Bazar, Hobiganj and Sylhet districts. After two years field observations the project suggested the package as a) proper sanitation followed by eradication of infected plants, b) application of balanced chemical fertilizers and cow dung, c) pruning of older branches followed by application of Bordeaux paste, d) application of copper fungicide (Sunvit or Cupravit 50 WP at the rate of 7 gm/l water) with the initiation of disease at 15 days interval, and e) monthly application of Imidacloropid (Admire @ 0.5 ml/l water) for controlling leaf miner to reduce avenue for infection. In case of post-harvest treatment, healthy lemon soaked in the solution of Sodium Ortho Phenyl Phenate (SOPP) (@ 2.3%) for 1 minute reduced the bacteria from the skin surface of lemon. Development and adoption of clinico-pathological management methods helped to eradicate canker disease markedly in citrus growing areas in Moulavi Bazar, Hobiganj and Sylhet districts that reopened export market (U. K., Middle East countries) of citrus fruits again.

3.3.3 Rhizome Rot Disease of Ginger and its Management

Ginger is one of the essential spices in Bangladesh. The useful part of this crop is rhizome. It is an important ingredient of curry and also used in medicine. Bangladesh produces only 43,000 tons of ginger against the requirement of 96,000 tons per year. Average yield of this crop is only 5.54 t/ha. So in every year, a good quantity of ginger is imported in exchange of foreign currency. Among the diseases, rhizome rot is the most destructive and may cause yield loss to the extent of 50% or more. The causal pathogens are: *Ralstonia solanacearum, Pythium aphanidermatum and Fusarium* spp. and they are mostly soil borne. To address the issue, BARI

developed a promising technology package conducting a research program for three years (2012-2014) at four major ginger growing districts namely; Bogra, Nilphamari, Rangpur and Tangail with financial support of KGF. **The developed technology was : Seed treatment with Chlorox (10%) / Bordeaux mixture one day before sowing + Soil treatment with Stable Bleaching powder (20kg/ha) in furrow prior to sowing + Spraying of Cholrox (10%) and Ridomil Gold (0.2%) alternately for five times at plant base initiating from 60 days of seed sowing.** Later on for up scaling of this technology, Pilot project (2014-16) was executed also funded by KGF in aforesaid districts with collaboration with DAE (Department of Agriculture Extension). In addition validation of the technology was also

implemented in two new districts (Lalmonirhat and Mymensingh) for its expansion. The project was implemented in participatory approach with a sharing of the costs involved. Hands on training were imparted to 608 farmers and 96 field level officers of DAE. Six hundred eight demonstration plots (20 decimal each) were established in the farmers' fields for which the inputs (chemicals) were provided from the project. Crop condition of the trial plots was found much better compared to control plots. The technology reduced the rhizome rot disease incidence more than 75%. Farmers expressed their positive reaction and showed keen interest to use this technology in upcoming season.

3.3.4 Potato Storage under Natural Condition

Enormous loss of potato due to lack of adequate storage facility is a problem for expanding potato production in the country. In order to minimize storage losses, a low cost potato storage technology has been developed by BARI and BSMAU with KGF funding. A total of 39 store houses have been made in Bogra, Munshigonj and Rangpur. The model storage, increased storability of potato in natural storage and income generation through small scale processing of potato was observed.

The project successfully designed an improvised well ventilated thatch house, measuring 3.5m x 4m x 4m (length x width x height), having with several stairs, keeping space of 0.75m to 1.0m between stairs. An amount of 200 kg tubers can be stored under natural condition in each stair staking cm in layers of 20 - 25 for 4 months without significant storage loss. Cost of such structure around Tk. 20,000 (Twenty thousand) where about 8,000 kg can be stored per house in each season. The house can be maintained for at least three years without repair. Results indicated that storage loss can be reduced to the extent of 60% compared to farmers' usual practices. Several agronomic practices have been standardized to improve storage life of potato tubers. Halum pulling at around 80-85 days after planting helps prolong tuber storability. Potato requires irrigation for 2-3 times; but for the tubers to be stored under natural conditions, crop should not be irrigated beyond 60 DAE.

3.3.5 Rice-Cotton Intercropping in Bandarban and Khagrachari Districts

Bandarban, Rangamati and Khagrachari, the three hill districts of Bangladesh,covers about 10% of the geogarphical area of the country. Most of the area is covered with hills and hillocks and only 6% is plain found in the Valleys. Traditional Jhum system of crop production is practised in the hill slopes and that covers about 40000 ha of land. A number of crops including rice, cotton, melon, gourd, pumpkin, maize ctc are grown in the same hole (pit) in jhum cultivation and consequently, due to inter and intra specific competition, none of the crops shows its yield potential. At this situation, Cotton Development Board (CDB) conducted a number of trials on cotton-rice intercropping system, during 2013 and 2014 in different areas of Chittagong hill tracts under KGF funding and technical supervision, that made considerable benefit for farmers. The economic performance of rice (Shere, Cockro and Galon)- cotton (*Gossypium hirsutum*) intercropping over Jhum system was found encouraging. In case of Rice + Cotton Intercropping the net income per ha was Tk 41958against Tk 21228 in jhum cultivation. When rice intercropped with cotton the gross earnings from rice

was Tk 54260 and cotton Tk 63600 while for jhum cultivation the gross income from rice was Tk 39760 and other crops Tk. 15880. Noticeable yield advantages was also observed;in rice + cotton intercropping the rice yield was 2713 kg/ha against 1988 kg/ha in case of jhum cultivation. Due to high margine in income/ha an up-scaling program was taken to disseminate the technology among the Hill farmers. The program was executed in seven hundred farmers' fields of different hill districts in 2014-2015 and 2015-2016. The average benefit to cost ratio for traditional jhum cultivation was found 1.17 and that for rice – cotton intercropping was 1.95. The technology developed by CDB having fund from KGF appeared profitable for the hill farmers and might be disseminated among the farmers of the region for development of their livelihood.

3.3.6 Integrated Crop-Fish Production System using Ditch and Dyke Method

There are many low lying areas in the country, some of which become inundated in rainy season with opportunity of only irrigated boro cultivation and some are shallow with production possibility of aman rice. Year round crop production is neither feasible nor profitable in those areas. Productivity of the areas can considerably be increased by converting low land into ditch and dyke (sorjan production system) for raising vegetable crops in dyke and fish culture into the ditch has been found more than three-folds profitable compared with traditional single crop aman rice. KGF offered a two year project to BSMRAU in 2014 for development Indian spinach showed the highest yield (49.4t/ha). The yield of tilapia was 9.9 t/ha/120 days where as the monoculture of Shing and polyculture of carps and other fishes produced 2.0 and 7.4t/ha/120 days respectively. The monoculture of tilapia showed the highest gross income and BCR. Egg plants grown in 2nd year showed the highest yield and BCR, 55t/ha and Tk. 5.16 respectively. Results indicated that the Ditch-Dyke system would be profitable for the area and farmers' income could be increased by 10-12 times than that obtained by conventional production system. Production of vegetables in dykes round the year and fish culture in the ditch/pond during monsoon substantially increased farmers' income in the southern district of Jhalakati. So, the Ditch-Dyke system would be a profitable enterprise for the area and farmers' income could be increased manifolds than that obtained by conventional production system provided the capital costs to convert the land in to 'Ditch and Dyke' be managed by the farmer/land owner beforehand.

3.3.7 Adaptation of High Valued Fish Species Shing (*Heteropneustes fossilis*) Culture Technology

KGF completed the project with BSMRAU to broader the adoption of Shing fish (*Heteropneustes fossilis*) farming in wider environment of the country. Shing fish farming is largely confined in Mymensingh region due to the easy availability of hatchery bred seed and technological interventions. The success in developing captive breeding and pond culture indicates the potentiality of Shing farming throughout the country. The refinement and standardization of Shing farming in different agro climatic regions has been achieved through on-farm participatory adaptive trials. The trial conducted in two successive years to verify the Feed Conversion Ratio (FCR) and other parameters with same stocking density. The results indicated satisfactory FCR ranging in between 2.99-3.17 having a net production of 3.93-5.43 t/ha. The average net return and BCR ranged in between Tk. 441738-872762/ha and 1.48-1.76 respectively. This technology can be adopted in the different places of the country as a profitable aquaculture venture producing high valued live Shing fish.

3.3.8 Aquaculture through Innovative Technologies in Cage Culture System in Haor

To promote cage culture as business enterprise, a project was implemented by BAU in Haors of Kishoregonj during 2013 to 2016. Mono-sex tilapia production in *haor* water cages was found very profitable. Nursing and over-wintering of fries and fingerlings of tilapia, common carp, and Vietnamese Koi along with their cultures in cages under mono and poly-culture system were found profitable. An innovative fry nursing and over-wintering technique was developed where fish fries were nursed in hapas set inside the cages due to the scarcity of ponds in the *haor* areas. The growth of tilapia in cages in haor waters within a growing period of 4.5 months was found encouraging. The fish attained an average weight of 600g against the FCR of 1.1 in CP feed was the record of highest growth so far of tilapia in cage culture. These new ventures showed a wider avenue of improved aquaculture system to raise fish in low-lying flood plains. A new low-cost feed for tilapia culture in cages was developed. The result showed that complete replacement of fish meal by DL-methionine, an amino acid gave very satisfactory growth of fish and reduced feed cost by Tk. 4 per kg. A number of entrepreneurs were developed at Mithamoin, Austogram, Nikly, and Tarakanda haor upozilas having the training on 'haor cage culture and setting up of cages in the haor' from the project. Several private entrepreneurs set new cages at different sites of haor and now have been profitably operating tilapia cage culture independently.

3.3.9 Floodplain Fish Production in Chalan *Beel*

A project was implemented by SHISUK, an NGO in partnership with Department of Fisheries (DoF) and BSMRAU to increase fish production in floodplain through community enterprise initiatives. Chalan beel is one of the largest floodplain ecosystems in Bangladesh comprising parts of Sirajgonj, Pabna, and Natore districts. Aiming management of this vast water body and increase of fish production, a community based approach has been undertaken through this project. The key elements of this approach include mobilization of the surrounding community of the targeted floodplain, raising of collective capital for investment through share distribution, agreeing a work plan for aquaculture and enhancing community's capacity for management of the collective initiative. The trigger was raising a cumulative capital of Tk. 23.72 lac to run the aquaculture enterprise from 652 shareholders covering 230 households from the adjacent community.

Over three years of effort the project succeeded to bring about 4.5 and 2.25- fold increase in the total fish production of the two project sites Raninagar and new-Raninagar under Natore district. Against a baseline production of 265kg/ha, the community enterprise produce 222.94 t of fish from a 30 ha floodplain project of Raninagar, Natore. Income per share rose from Tk. 250 in first year, Tk. 860 for

second year and Tk. 1160 in 3rd year. Apart from benefits come from aquaculture, the other impact from the floodplain aquaculture include:(i) No cleaning costwater hyacinth/ weeds, the floodplain remain clean because of aquaculture activities like regular netting, feeding etc.(ii) No tillage, the system of timely draining the water when the seedlings are ready for plantation needs no tillage. On the other hand it helps to increase recharge the ground water table, increase use of the surface water and reduce drawing ground water for initial irrigation as the seedlings are planted using the soil moisture.(iii) Less fertilizer cost, the supplementary feed for fish and fish droppings contributes to improve soil fertility and micro nutrient, reduced chemical fertilizer use; and (iv) Less pest manifestation. Thus Community Enterprise approach helped to increase fish-production in floodplains with positive impacts on community members' incomes from share dividend, land rent, employment opportunities and protein intake by consuming fresh fish.

3.3.10 Least Cost Feed Formulation for Poultry through the Production of Fermented Yeast Product from Locally Available Feed Resources

In poultry production, feed cost is the largest single item that accounts for 70 to 80 percent of the total production cost and of the total feed cost about 95 percent is used to meet energy and protein requirements. Among all the feed ingredients protein is one of the costlier ingredients in poultry ration requiring 20-22% in broiler feed. Thus protein contributes for the higher price of poultry ration. Furthermore, protein is the most essential nutrient in feed which contributes in vital growth and development of the animal body as a sole nutrient. Baker's yeast (*Saccharomyces cerevisiae*) has been commercially exploited for production of single cell proteins that has been shown to provide around 53% proteins from molasses substrate. It is also rich in B-complex vitamins, amino acids, and minerals, particularly chromium. *Saccharomyces cerevisiae* boosts immune level resulting in a better protection against infections. Yeast also protects birds from the exposure to aflatoxin. Feeding birds with rations containing yeast help reducing plasma cholesterol and triglycerides concentration with increased level of high density lipoprotein (HDL) in plasma. Therefore, the study was undertaken to develop least cost fermented yeast based ration for poultry. Rubber seed, which is cheap and abundant in Chittagong containing around 17% protein, was also used as an alternate feed ingredient. The fungus, *Trichoderma sp* was also used to decrease crude fiber (CF) level in rice-polish, one of the main ingredients in poultry ration. The level of increase of crude protein (CP) after treatment with yeast was found to reach maximum by 13 days for maize, rice-polish, wheat and rubber seed samples with the rate from 9.0% to 12%, 11.0% to 13%, 11.0% to 14.5% and 17.0% to 20% respectively. Crude fibre (CF) level in rice-polish was found to decrease after treating with *Trichoderma sp* (from 18.0% to 12% maximum by 13 days).

Through this project two types of fermented yeast & fungus based feed formulae, one with rubber seeds and the other without rubber seeds, were developed. These feed formulae were used to compute starter and finisher rations for broiler. The cost of the fermented feed was 29.2 Tk. /kg which was around 1.8 Tk. /kg less compared to the control feed cost (31.0 Tk. /kg). The profit margin from the treatment group bird sale (161.15 Tk. /bird) when compared with control group bird sale (141.0 Tk. /bird) was 20.15 Tk. /bird. The feed formula with rubber seed may be used in the Chittagong region where rubber seed is abundant and the other formula with no rubber seed may be used at any region of the country. Using this least cost fermented yeast based broiler feed the cost of production of broiler will be reduced. Consequently, more farmers will be attracted to this broiler production industry thereby increasing the poultry meat production. And ultimately there will be an increase in the supply of animal origin protein in the diet of general mass.

3.4 Annual General Meeting

As per provisions of the Memorandum and Articles of Association (MAA), KGF is governed by its General Body (GnB) and a seven-member Board of Directors (the Board). The 10th Annual General Meeting (AGM) of KGF was held on 30 March 2017 at BRAC Inn, Dhaka. The Meeting addressed the six important agenda and the member of the meeting discussed on the agenda. Kbd. Dr. Mohammod Jalal Uddin, Executive Chairman of BARC and Chairman, General Body & Board of Directors, KGF presided the meeting. Respected Members of the General Body were attended in the meeting.

3.5 Meetings of the Board of Director

As per provisions of the Memorandum and Articles of Association (MAA), KGF is governed by its General Body (GnB) and a seven-member Board of Directors (the Board). The Board takes the decisions for the successful operation of KGF programs/projects. Generally, the Board meets bi-monthly with the provision of additional meetings, as and when necessary, called by the Member Secretary (Executive Director of KGF). Table 3.6gives an account of the Board meetings held in 2016-17 and the agenda.

Table 3.6: KGF Board of Directors' Meetings held during 2016-17

Sl #	Board Meeting	Month in 2016-17	Major Agenda (issues) discussed
1	50th	August	Approval of MoU between KGF and SAARC; approval of Expression of Interest (EoI) for the recruitment of ED of KGF; approval of ToR for recruiting 6 mid-level specialists of KGF; training proposal of Chittagong Veterinary and Animal Science University(CVASU)
2	51st	October	Approval of thematic area for CGP 3rd call projects; approval of basic research projects for BARI and BRRI; financial progress of KGF
3	52nd	November	Discussion and decision on recruitment of ED of KGF; evaluation of the progress of recruitment of mid-level specialists of KGF
4	53rd	February	Approval of 2 TAC recommended CRP projects; approval of 3 pilot projects from promising technologies generated through CGP
5	54th	March	Approval of program specialist (Livestock) as per organogram of KGF; Selection of chairman and co-chairman of TAC of KGF
6	55th	April	Approval of appointment of ED, KGF as per recommendation of search committee; approval of 'performance evaluation committee' for KGF funded research projects as per proposal of 10th AGM

3.6 Technical Advisory Committee (TAC)

As per decision of the 31st Board Meeting of KGF in August 2012, a 14-member TAC was formed to provide strategic guidance ensuring the quality of research supported by KGF, to review BARC prioritized researchable areas, and to select issues appropriate for inviting proposals for KGF funding, and to identify areas where new initiatives may be required and to recommend resource allocation to CGP projects. In fact, TAC holds the responsibility of selecting research agenda to be supported by KGF funding and to accomplish this, several TAC meetings are arranged by KGF. The TAC meetings held in 2016-17 and the agenda are shown in Table 3.7.

Table 3.7: KGF Technical Advisory Committee (TAC) Meetings held during 2016-17

Sl #	# TAC Meeting	Month in2016-17	Major Agenda (issues) discussed
1	11th	July	Review basic research proposals submitted by BRRI and BARI, researchable issues for 3rd call of CGP, CRP livestock in hills and CRP crop zoning
2	12th	August	Finalization of researchable issues in 3rd call of CGP, recommendations on basic research at BRRI and BARI
3	13th	October	Recommendation of project proposals under CEP and hill livestock programs
4	14th	January	Recommendation of CRP livestock in hills, recommendation of pending 5 CGP projects under BKGET 2nd call
5	15th	March	Recommendation of the project proposal from ACIAR `sustainable nutrient management for diversified cropping in Bangladesh'
6	16th	May	Presentation of findings of the project proposals under 3rd call of KGF BKGET
7	55th	April	Finalization of qualified proposals under 3rd call, policy issues for project monitoring and evaluation

4. Progress Reports of On-Going Projects

i) As stated earlier, KGF provides funds for both short, medium and long term projects in the following major programs: Competitive Grants Program (CGP) with short to medium term duration

ii) Commissioned Research Program (CRP) with medium to long term duration

iii) Capacity Enhancement Program (CEP) generally with short to medium term duration, and

iv) International Collaborative Program (ICP) with short to medium term duration

v) Technology Piloting Programs

4.1 Competitive Grants Program (CGP)

KGF offered 14 research projects under CGP from the 1st call in May 2013. Thirteen of these were completed by April 2016, but one project on `Fruit dropping of mango' continued until December 2017. Nineteen other projects were awarded from responses to the 2nd call in March 2015. All of these, except three, are expected to be completed by May 2018. The distribution of 2nd call projects by research sectors and by implementing institutes is shown in Figure 4.1 and 4.2 respectively. The list of total awarded CGP projects under 1st and 2nd call is available in earlier published annual report, so the list of 3rd call CGP projects is shown in the **Annex-1**.

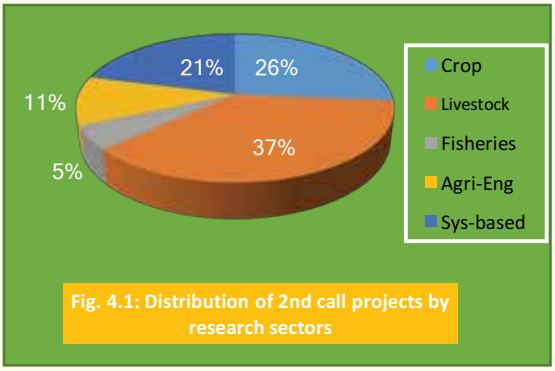
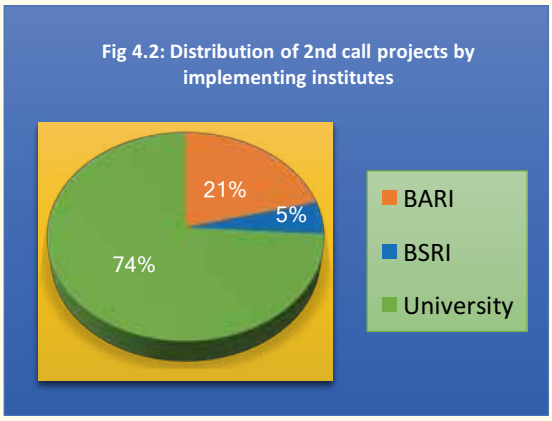


Fig. 4.1: Distribution of 2nd call projects by research sectors



Projects awarded under CGP 2nd call are discussed in the following section as they were on-going in the field during the period under report (2016-17).

4.1.1 Project code and title: TF 15-SF. Improvement of Soil Fertility and Crop Yield through Adoption of Conservation Agriculture in T. aman – mustard– boro Cropping Pattern

Implementing Organization: Bangladesh Agricultural University (BAU), Mymensingh

Principal Investigator: Dr. Md. Jahiruddin, Professor, Department of Soil Science, BAU; Cell phone: 01718813889, Email: m_jahiruddin@yahoo.com

Main objectives: To improve/maintain soil fertility status under intensive cropping system through nutrient management and conservation agriculture practice and to increase yield and system productivity of T.aman – wheat –mungbean and T.aman – mustard – boro cropping patterns.

Location: BAU Farm, Mymensingh; Muktagacha Upazilla, Mymensingh (three sites for three blocks); Dhanbari Upazilla, Tangail (three sites for three blocks)

Budget: BDT. 49.72 lakh

Background: Rice-rice, that is, two rice crops per year is the dominant cropping pattern (CP) in Bangladesh. There may be a scope to fit a mustard crop in between. Conservation agriculture (CA) is a new approach in Bangladesh. This practice has a yield advantage with reduced cost of production through labor and fuel savings and improvement of soil fertility. Also, CA reduces turn-around time between the establishments of two crops. Field trials with T. aman – mustard – boro pattern have been going on since 2015 following the principle of CA practice in farmers' fields of the Muktagacha and Dhanbari upazilas of the Mymensingh and Tangail districts, respectively. Another field trial with the t. aman – wheat –

mungbean pattern is in progress at the BAU farm, Mymensingh as a continuation of such trials since 2011.Two treatments were applied in the field trials – T_1: Conventional tillage (CT) + Farmers' practice (FP) based fertilizer use + 10% residue retention and T_2: Strip tillage (ST) + STB (soil test based) fertilizer use + 30% residue retention. The varieties used were BRRI dhan 28 in boro, BRRI dhan 49 in T. aman, BARI Sarisha 14 for mustadrd and BARI Mung 6 for mungbean.

Progress: Table 4.1.1 shows the yields of different crops in the two CP. Strip tillage (ST) as the CA method outperformed conventional tillage (CT) in terms of crop yielding all seasons. The magnitude of this yield increase with ST over CT varied from 7% in t. aman rice to 24% in mustard (Table 4.1.1).

Table 4.1.1: Yield of Crops under Tested CP by Conventional and Conservation Tillage during 2016-17

Treatment	Yield (kg/ha) of Cropping Pattern 1			Yield (kg/ha) of Cropping Pattern 2		
	T. aman	Mustard	Boro	T. aman	Mungbean	Wheat
CT-FP	4388	1240	5152	5238	1041	3045
ST-STB	5330	1535	5915	5580	1257	3456
Yield increase (%)	21	24	15	7	21	13

4.1.2 Project code and title: TF 16-WM. Collection, Evaluation and Introduction of White Maize for Human Consumption in Bangladesh

Implementing Organization: Sher-e-Bangla Agricultural University, Dhaka

Principal Investigator: Prof. Dr. Md. Jafarullah, Dept. of Agronomy, SAU, Dhaka; Cell phone: 01552331605, Email: jafarullahsau@gmail.com

Main objectives: To collect, evaluate, and select white maize variety/varieties for production in Bangladesh and to develop agronomic practices for growing white maize in the hills and plain land

Location: SAU (Dhaka), Barisal, Rangpur, Dinajpur, Nilphamari, Bandarban, Rangamati, and Khagrachari districts.

Budget: BDT. 198.1 lakh

Background: Maize is consumed by both humans and livestock worldwide, but in Bangladesh, maize is grown mainly to meet as poultry, fish and livestock feed requirements. Maize varieties grown for human consumption is white in color rather than yellow, the popular type grown in the country. The current project aims to introduce white maize in Bangladesh by adapting different exotic varieties with suitable production technologies. Six entries, Changnuo-1, Changnuo-6, PSC-121, Yangnuo-30, Yangnuo-3000, and Yangnuo-7 were primarily selected having seed yield ranging from 6.348 to 11.041 t/ha. The yield of control variety suvra was around 6.00 t/ha in last year, in current year no check variety included. Planting configuration of either 40x25cm or 50x25 cm or paired row showed higher seed yield (7.136 - 10.126 t/ha) than 60 x 25 cm spacing over locations and varieties.

Progress: The tested white maize hybrids showed higher seed yield with the higher than recommended doses of fertilizers (Table 4.1.2), V1 and V3 being the highest yielders, 13.06 t/ha and 12.10 t/ha, respectively with F3 at SAU (Dhaka) in the rabi 2016-17). At the other sites, i.e., Rangpur and Dhamai, the varieties responded similarly with additional fertilizer doses. Of the varieties taken into consideration (Yangnuo – 30, Yangnuo – 3000, Yangnuo – 7, Changnuo – 1, Changnuo – 6, Q-Xingnuo – 1 and India PSC – 12), PSC showed better seed yields irrespective of location. Of the planting configurations used (40 x 20 cm, 40 x 25 cm, 50 x 20 cm, 50 x 25 cm, 60 x 20 cm, 60 x 25 cm),40 x 20 or 25 cm gave thebest seed yield.

Table 4.1.2: Seed yield of White Maize Varieties with Varying Fertilizer Doses at SAU (Dhaka) in Rabi 2016-17

Variety	Yield of white maize (t/ha) by fertilizer dose over recommendation (%)				
	100 (F1)	50 (F2)	125 (F3)	75 (F4)	Average
Changnuo-1 (V1)	11.92	8.04	13.06	9.83	10.71
Q-Xiangnuo-1 (V2)	9.14	7.3	10.1	7.55	8.52
PSC (V3)	11.71	8.98	12.04	10.86	10.90
Changnuo-6 (V4)	9.98	8.36	10.9	9.59	9.71
Yungnuo-30 (V5)	11.64	8.73	12.1	10.08	10.64

4.1.3 Project code and title: TF 17- ARI. Refining and Validation of BAU-Bro Chickens

Implementing Organization: Bangladesh Agricultural University, Mymensingh

Principal Investigator: Professor Dr. Md.Ashraf Ali, Dept. of Poultry Science, BAU, Mymensingh; Cell: 01675145096, Email: md.mashraf@gmail.com

Main objectives: Molecular characterization of sire and dam lines of BAU-Bro strains with microsatellite markers and refinement of growth and reproductive traits of BAU-Bro sire and dam lines through marker assisted selection.

Location: BAU Poultry Farm and Poultry Biotechnology and Genomics Laboratory, Bangladesh Agricultural University, Mymensingh.

Budget: BDT. 161.0761 lakh.

Background: Two broiler strains, BAU-Bro white and BAU-Bro color, developed from broiler sire and dam lines from locally available genetic resources, were released. Findings of the previous study indicated that the two broiler strains had great potentials and needed to be up scaled for commercial production and popularization among farmers. In this context, a marker assisted selection study was proposed for up scaling, refinement, dissemination and popularization of the strains among the farmers.

Progress: Microsatellite DNA analysis of the parental lines of BAU-Bro chickens indicated that MLW birds are more homozygous (86. 67%) than other lines of chickens, while MLC birds are more heterozygous (33.33%). The qualitative characteristics of shank color, feather color and comb type indicated that the pure lines, MLW2, MLW and FLW have 100 percent white feather and single comb. While MLC, FLC (Br) and FLC have different shank color, feather color but have 100% single comb. While the white crossbred has also similar qualitative trait (100% white feather and single comb). In male lines, the body weight was significantly higher in MLW2 and MLW than MLC, while in female lines it was significantly higher for FLC (Br) than FLC and FLW. The weight gains per day at selection age were 25.99, 25.52 and 14.09g in male lines, respectively. The dressing meat yields on equal weight basis were almost similar, i.e., 68-72 % in male lines, 68-70 % in female lines. The livability during brooding period was 92-100 %, while during growing period it was 78-90% except in FLW2 and MLW2

and lying period was 91-100% in the genotypes. The reproductive study of the genotypes indicated that the evolved BAU-Bro color (FLC) parents gave the highest 65.49 ± 1.58 eggs followed by BAU-Bro white (FLW_2) i.e. (65.09 ± 1.14) eggs for up to 35 weeks laying. In the farmer's level study, the weight with BAU-Bro white was 1365-1600g at 38 days and with BAU-Bro color it was 1018-1175g at 51 days. This indicated variable performance of broilers depending on the farmer's experience and management. The overall growth performance of BAU-Bro white at 38 days of age was achievinga weight of 1497g, whereas for BAU-Bro color at 51 days of age it was 1110g. Likewise, FCR and profit were also affected by management, but not mortality. The BAU-Bro color chicken is more resistant to prevailing environment than the BAU-Bro white. The overall profit at farmer's level study was Tk. 6.29 per kg live weight with BAU-Bro white, while it was Tk. 24.80 for BAU-Bro color (Table 4.1.2a).

Table 4.1.2a: Performance of BAU-Bro White & BAU-Bro Color at Farmer's Level

Genotype	#Chicks	Age at marketing (d)	Body wt. at marketing (kg)	FCR	Mortality %	Selling price (Tk./kg)	Net profit (Tk.)	Profit/bird (Tk.)	Profit/kg LW(Tk.)
BAU-Bro white	7097	38	1.497	1.69	2.77	92	64,800	9.32	6.29
BAU-Bro color	4387	51	1.11	1.87	1.61	124	1,13,447	28.56	24.80

4.1.4 Project code and title: TF 18-EM. Exploring Epidemiology, Anthelmintic Resistance and Genetic Diversity of Some Common Gastrointestinal Nematodes of Small Ruminants in Bangladesh

Implementing Organization: Bangladesh Agricultural University (BAU), Mymensingh

Principal Investigator: Prof. Dr. Mohammad Zahangir Alam, Dept. of Parasitology, Faculty of Veterinary Science, BAU, Mymensingh; Cell phone: 01746611162, Email:mzislam74@yahoo.com

Main objectives: Investigation of common gastrointestinal (GI) nematodes of small ruminants targeting detailed epidemiological information of the parasites, anthelmintic resistance of GI nematodes of small ruminants and molecular characterization of the blood feeding GI nematode *Haemonchus contortus* to find out genetic variability, parasite transmission patterns and drug resistance genes.

Location: Department of Parasitology, Faculty of Veterinary Science, BAU, Mymensingh.

Budget: BDT. 66.80 lakh

Background: Infection caused by GI parasitic nematodes is a major constraint on efficient tending of small ruminants. Despite the impact of the diseases caused by the GI nematodes, there is a paucity of reports on epidemiological factors and anthelmintic resistance of parasites in small ruminants. A cross sectional epidemiological study was carried out from July 2015 to June 2016 to investigate the level of the GI nematode infection and the associated risk factors that make sheep and goats susceptible to the infection.

Progress: The present study provides risk factors and anthelmintic resistance status of GI nematodes in small ruminants. Body condition of the animals, farming system, housing, socio-economic status and the educational level of farmers were found to be associated with gastrointestinal nematode infection. A total of 2808

fecal samples were examined (using qualitative and quantitative techniques) to identify nematode eggs. The overall prevalence of GI nematodes in small ruminants was 62.0% (1742/2808) with an intensity of 225.11 EPG. *Haemonchus* spp. was the most prevalent parasite among the identified GI nematodes. The use of anthelmintics in animals was found to have no significant effect on the prevalence and intensity of GI nematodes. Multiple drug resistance was detected using the Faecal Egg Count Reduction Test (FECRT) against Albendazole, Levamisole and Ivermectin (Table 4.1.3).The results of faecal culture indicated that *Haemonchus* spp. and *Oesophagotomum* spp. are resistant to the anthelmintics Albendazole, Levamisole and Ivermectin.

Table 4.1.3: Prevalence of Anthelmintic Resistance in Govt. and Private Sheep/Goat Farms of Bangladesh

Name of farm	Anthelmintic used	Fecal egg count reduction (%FECR)	95% CI	Status
Govt. goat farm, Rajshahi	Albendazole	93	97-87	**Resistant**
	Levamisole	90	96-78	**Resistant**
	Ivermectine	86	92-74	**Resistant**
Govt. goat farm, Sylhet	Albendazole	99	100-95	Susceptible
	Levamisole	93	96-87	**Resistant**
	Ivermectine	96	98-91.62	Susceptible
Govt. sheep farm, Rajshahi	Albendazole	95	99-74	**Resistant**
	Levamisole	00	100-100	Susceptible
	Ivermectine	87	96-63	**Resistant**
Shambhugonj goat farm, Mymensingh	Albendazole	99	100-93	Susceptible
	Levamisole	99	100-93	Susceptible
	Ivermectine	74	92-17	**Resistant**

Resistance to a particular class of anthelmintic is considered to be present if the percentage reduction in egg count was less than 95 % and also the 95 % confidence level is less than 90 %. If only one of the two criteria is met out, the resistance is classed as suspected.

4.1.5 Project code and title: TF 19-EM. Community Engagement in Biosecurity (CEB) for the Prevention of Infectious Diseases of Poultry Based on Epidemiological Risk Analysis

Implementing Organization: Bangladesh Agricultural University (BAU), Mymensingh.

Principal Investigator: Dr. Rafiqul Islam, Professor, Dept. of Pathology, Faculty of Veterinary Science, BAU, Mymensingh; Cell phone: 01759674267, Email: mrislam_bau@yahoo.com

Main objectives: Identification of risk factors for poultry diseases and gaps in biosecurity practices, in the layer farms, designing community engagement in biosecurity (CEB) approach based on epidemiological risk analysis and fine tuning and finalization of CEB model through field trial.

Location: Department of Parasitology, Faculty of Veterinary Science, Bangladesh Agricultural University (BAU), Mymensingh.

Budget: BDT. 99.23 lakh

Background: Poultry is an important means of livelihood and a substantial contributor to food supply in Bangladesh. Development of commercial poultry farming has generated considerable employment. Outbreaks of different infectious diseases have been a major constraint to the growth of the poultry industry. Biosecurity is considered as the most important tool for the prevention of infectious poultry diseases. Biosecurity campaign is often a one-way, top-down communication. A shift from communication programs to participatory programs with the engagement of the community could make biosecurity more effective, long lasting, and self-sustaining. The present project is aimed at the development of a model for CEB based on epidemiological risk analysis. The study involved an epidemiological survey on the risk

factors, a KAP study on biosecurity, PRA workshops and expert consultations for mapping disease transmission risk pathways and development of the CEB approach and finally field trials and impact assessment.

Progress: Data from 226 layer farms of the Bhaluka upazila of Mymensingh and 196 layer farms of the Sakhipur upazila of Tangail were collected using a pre-designed questionnaire. The small and medium scale layer farmers of the Bhaluka and Sakhipur upazilas were selected as the immediate target groups, expecting all the layer farmers to be the final beneficiaries. The study involved participatory farmers' workshops, field surveys and expert consultation workshops for the development of a biosecurity model, followed by ToT for lead farmers, field level training by lead farmers, monitoring of adoption of biosecurity measures at farm levels and finally an assessment of the impact of the biosecurity campaign. The data were processed and analyzed using statistical methods. Farmers' knowledge, attitude and practices with regard to conceptual, structural and operational biosecurity were identified. The findings of this survey and the PRA workshops were presented and discussed at an expert workshop. A model biosecurity campaign, comprising 10 conceptual and structural and 10 operational interventions, was developed. A *modus operandi* for the engagement of farmers in the biosecurity campaign was also outlined. The model is now being implemented on a trial basis in 10 selected villages of the two upazilas, Bhaluka and Sakhipur.To begin with 5 lead farmers of each selected village (a total of 50 farmers from Bhaluka and 50 from Sakhipur) were trained on the 10+10 biosecurity concept.

4.1.6 Project code and title: TF 20-EM. Studies on Pigeon Diseases in Northern Bangladesh

Implementing Organization: Rajshahi University, Rajshahi.

Principal Investigator: Dr. Md. Jalal Uddin Sarder, Professor, Department of Animal Husbandry and Veterinary Science; Cell phone: 01556308564, Email: jalalnusa@yahoo.com

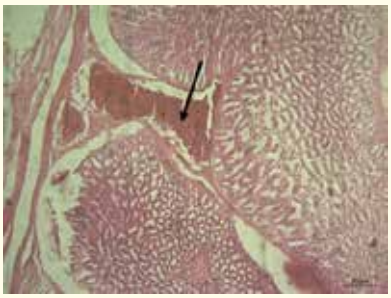
Main objectives: To determine the prevalence of pigeon diseases in relation to breed, age, sex, size, season, housing, feeding, breeding, farm type and to develop appropriate control strategies.

Location: Some upazilas of the Rajshahi, Natore and Pabna districts

Budget: BDT. 20.00 lakh

Background: The aim of the study was to evaluate the incidence and causes of pigeon diseases along with clinico-histopathological changes, and to determine effective drugs for treatment and vaccines for control of the diseases. The study was conducted on both commercial and backyard pigeon farms in the three districts of Rajshahi division (Rajshahi, Natore and Pabna). A total of 7489 pigeons were selected from the three districts involving a total of 45 pigeon farms (15 farms from each district). Selected pigeons were grouped on the basis of breed, age, sex, size, housing, feeding, breeding, biosecurity management, health care, farm type, etc. Relevant information was collected from the pigeon farmers using a structured questionnaire. Samples were collected from the diseased pigeons

and laboratory tests were carried out to identify the respective causal agents. The incidence of pigeon diseases was confirmed by the retrospective and cross sectional studies. The study was carried out from April 2015 to March 2017.



Progress: The overall morbidity and mortality rates of pigeon due to different diseases were recorded to be 21% (7489/1592) and 16% (7489/1176) respectively. A total of 1176 dead pigeons were collected from 45 pigeon farms for postmortem and other relevant studies (Bacteriological, virological, molecular biology, histopathology, etc.). The studies revealed highest incidence for viral diseases (599/51%), followed by bacterial (363/31%), miscellaneous (152/13%), parasitic (52/4%) and nutritional deficiency (10/0.85%) diseases (Table 4.1.4). Among the viral diseases Pigeon pox, Newcastle disease and Papillomatosis have been found to affect the pigeons at a rate of 31%, 19% and 0.5% respectively. Bacterial diseases that were identified to infect the pigeons include Salmonellosis (19%), *Escherichia coli* infection (4%) and Mycoplasmosis (8%).

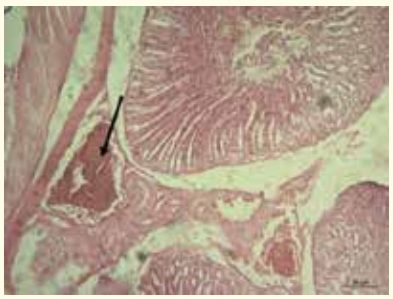


Table 4.1.4: Incidence of Different Diseases in Pigeon

Causes	Etiological agents		# Dead pigeon	Percentage
Bacterial	Salmonella		224	19.09
	Escherichiacoli		49	4.16
	Mycoplasma		90	7.65
	Overall =		**363**	**30.86[b]**
Viral	Pigeon pox		365	31.03
	Newcastle disease		228	19.38
	Papillomatosis		6	0.51
	Overall =		**599**	**50.93[a]**
Parasites	Protozoan	Canker	13	1.10
		Coccidia	28	2.38
	Endoparasites	Round worm	7	0.60
		Tape worm	4	0.34
	Overall=		**52**	**4.42[d]**
Nutritional deficiencies	Vitamin deficiency		6	0.51
	Mineral deficiency		4	0.34
	Overall=		**10**	**0.85[e]**
Miscellaneous	Arthritis		5	0.42
	Heat stroke		6	0.51
	Poisoning		122	10.37
	Accidental death		19	1.61
	Overall=		**152**	**12.92[c]**
Grand total			**1176**	**100.00**

Pigeons were less susceptible to diseases in the iron cages, a scientific housing system (14%) than in the traditional housing (35%). The case fatality rate was found to be higher in young (79%) than in adult (67%) pigeons. The prevalence of parasitic infestation in pigeon, determined through faces examination (direct

smear method) was 43% (263/114) for internal parasites (Ascariasis 23%, Capaliariasis 19% and Cestodes 2%). For external parasites the rate was found to be 20% (3677/722), where Lice were responsible for 18% and Fly for 2%. Adult pigeons were more susceptible to parasitic infestation than the young ones and the rate was 50% and 22% respectively. Salmonellosis and *E. coli* infection was successfully treated using Doxacycline with the recovery rate of 94%. In case of Mycoplasmosis the drug of choice was determined to be the Tiamutin 45% with 93% recovery rate. Toltazuril showed good performance (80% efficacy) for the treatment of Coccidiosis. The Piperazine citrate and Levamisole was found to be the effective anthelmintic against Ascarisis and Capillarisis with 80% and 79% efficacy respectively after 21 days of observation. In case of viral diseases, the response with Azithromycin was around 67% probably due to an effective control of secondary bacterial infection. Newcastle disease in pigeon was successfully controlled using vaccines both from private and government sources (Imposet, RDV & BCRDV, ND Clone 30 and Cevac New L)

4.1.7 Project code and title: CGP/TF 21-DL/15: Use of Probiotics to Improve Nutritional Value of Rice Straw and its Impact on Dairy Cow Production

Implementing Organization: Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur.

Principal Investigator: Dr. Abu Sadeque Md. Selim, Associate Professor, Dept. of Animal Science and Nutrition; Cell phone: 01718370722, Email: anima_l2002@yahoo.com

Main objectives: To improve the nutritional value of rice straw using probiotics and to evaluate the effect of treated rice straw on milk yield, milk composition and health status of cross bred dairy cows.

Location: Department of Animal Science and Nutrition, Faculty of Veterinary Medicine and Animal Science (FVMAS), Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur.

Budget: BDT. 80.00 lakh

Background: Better livestock production needs better and adequate supply of animal feed. Rice straw alone contributes 87% of the roughage feed of animals in Bangladesh. The value of rice straw is limited by low voluntary intake, slow rate of digestion and low content of available energy, protein, minerals and vitamins. Extensive research has been carried out for several decades to improve the nutritive value of cereal straws using physical, chemical and biological treatments with varying degrees of success. Treatment of rice straw with urea to increase the nitrogen content achieved success, but its acceptance at the field level is questionable. The use of probiotics (viable beneficial microbes) has been reported to increase the crude protein level of rice straw along with other benefits (improve fibre digestion, reduce the number of pathogenic microbes in the digestive tract, help balancing the microbial consortium by optimizing the fermentation process, etc.). In this context, the project was undertaken in April 2015 to investigate the quality and efficacy of commercially available probiotics in improving the nutritional value of rice straw and its impact on dairy cattle production in terms of milk yield, milk composition, and health status of dairy cows.

Progress: In the current study commercial probiotics and locally available microbes were investigated for their efficacy in improving the nutritional value of rice straw. Treated rice straw released more non-fiber carbohydrate with a higher relative feed value (RFV). The Probiotic, P4 with the composition bacteria of *Lactobacillus planatarum, Lactobacillus bulgaricus, Lactobacillus acidophilus, Lactobacillus rhamnosus, Bifidobacterium bifidum, Streptococcus*

thermophilus and Enterococcus faecium gave a higher total digestible nutrient (TDN) value with a higher degradation rate. Based on the chemical composition and *in vitro* results P4 has been selected for *in vivo* trial. Using the results of the study an article on assessment of the digestibility of probiotic-treated rice straw using the *in vitro* gas production technique has been published in the Indian Journal of Animal Nutritionin 2017.

Table 4.1.5: Relative Feed value (RFV) of Rice Straw after Treating with Probiotics in 2016-17

Treatment (probiotic)	0d (value in %)	2d (value in %)	4d (value in %)
Control	66		
P1	76	83	86
P2	84	89	93
P3	85	94	94
P4	71	72	90
P5	81	77	102
P6	83	82	88
P7	83	82	88
Aspergilus	67	74	65
Trichoderma	64	62	69
Urea	66	68	70

4.1.8 Project code and title: TF 22 – PS. Productivity Enhancement of *Gur*and Chewing Type Sugarcane through Management of Major Diseases in Non-mill Zones

Implementing Organization: Bangladesh Sugar Crops Research Institute (BSRI), Ishurdi, Pabna.

Principal Investigator: Dr. Md. Shamsur Rahman, PSO and Head, Pathology Division, BSRI, Ishurdi; Cell phone: 01716165669, Email: msrahmanbsri@gmail.com

Main objectives: Developing management practices against major diseases of sugarcane and increasing its productivity, especially in the *gur*and chewing cane zones.

Location: BSRI on-station Ishurdi, Pabna, Shibganj, Chapai Nawabganj (*gur*zone), Sadar- Sirajganj (*gur*zone), Bhawal Mirzapur, Gazipur (chewing zone), Khagrachari Sadar (chewing and *gur*zone), Bandarban Sadar (chewing zone).

Budget: BDT. 123.44 lakh

Background: The average production of sugarcane in Bangladesh is around 46.08 t/ha which is well below the average world production of 65.2 t/ha. In the country, sugarcane is grown in two separate zones, mill zone and non-mill zone or *goor zone* and chewing cane zone. In the mill zone, development work on sugarcane is done by the Bangladesh Sugar and Food Industries Corporation but in the non- mill zone, neither DAE nor BSFIC undertakes proper activities for cane development. About 60% of the sugarcane produced is used for *gra*nd juice preparation, and for chewing. The project was undertaken by BSRI in collaboration with Krishibid Somobay Society Limited (KSSL), a private enterprise, to increase the productivity of sugarcane in the non-mill zones through proper management of the major diseases of the crop. Four upazilas, namely, Singair of Manikganj, Sadar ofSirajganj, Shibganj of Chapai Nawabganj and Kalia of Narail, and the experimental farm of BSRI Headquarter, Ishurdi, Pabna were selected as the sites of the study. There were six farmers, each having one bigha (33 decimal) of land, at each of the off station sites. Two sugarcane varieties, of the chewing and *goor*-types, were used in the trials. There were four treatments, e.g., T_1 = Seed (sett) treatment by moist hot air (MHAT) at 54^o C and above 95% RH for four hours and sett dipping in 0.2% solution of the fungicide Carbendazim 50 WP for 10 minutes; T_2 = Rouging of disease infected clumps and removal of the older leaves; T_3= T_1 + T_2 and T_0 = Control (no sett treatment, no rouging, no removal of older leaves).

Progress: In the treated plots of Isd 37 at BSRI farm, smut disease incidence was 0.01 to 0.09 % against 2.13% in control plots. In treated plots of BSRI Akh 41(chewing cane variety) no disease was observed while in the untreated plot 0.12 % red rot disease was observed. In ratoon crops, control plots of Isd 37 showed 2.65 to 6.36 % incidence of smut disease at Shibgonj, Kalia and BSRI farm compared with 0.08 to 1.18 % in treated plots. In ratoon plots of BSRI Akh 41, 0.22 % red rot, 0.44 % grassy shoot disease (GSD) and 0.71 % smut were observed in the control plots at Singair and BSRI farm but no disease was observed in treated plots. A considerable increase in growth (tiller and millable cane) was found in the treated plots compared with non-treated plots in both the varieties. The treatments increased the yield (number of millable cane) of Isd 37 and BSRI Akh 41 by 31-54% and 27-47%, respectively, over that in the control plots. In the ratoon crop, the yield increases were 34-56% and 29-52%, respectively, for Isd 37and BSRI Akh 41, over the respective control plots (Table 4.1.6).

Table 4.1.6: Yield of Planted and Ratoon Crop of Two Sugarcane Varieties under Imposed Disease Management treatments in 2016-17

Treatment	Isd 37			BSRI Akh 41			
	Planted	Ratoon	Mean	Planted	Ratoon	Mean	Grand Mean
T0	100.06	86.93	93.49	72.51	61.52	67.02	80.25
T1	131.09	116.75	123.92	92.44	79.46	85.95	104.93
T2	112.95	92.84	102.89	78.53	67.47	73.00	87.95
T3	154.55	135.74	145.14	106.23	93.27	99.75	122.45
All	124.66	108.06	116.36	87.43	75.43	81.43	98.89

4.1.9 Project code and title: ID No-(CN/FRPP), TF 23-AM/15. Improvement and Validation of BARI Seeder for Grain Crops under Different Cropping Patterns and Soil Conditions

Implementing organization: Bangladesh Agricultural Research Institute (BARI)

Principal Investigator: Dr. Md. Ayub Hossain, FMPE Division, BARI

Main objectives: To standardize seeder for seeding of different grain crops and to evaluate the field performance of the seeder for different grain crops on different soil types

Location: Gazipur, Rajshahi and Patuakhali

Budget: BDT. 64.97 lakh

Background: Over 800,000 ha of crop land remains fallow in southern Bangladesh during the rabi season which can be brought under cultivation using improved agricultural machinery, irrigation and other technologies. In Barind areas, irrigated boro rice is the major crop, which is responsible for rapid ground water depletion. Instead, good stands of rabi crops can be established using residual soil moisture in the Barind and southern areas as well if the crops can be sown just after T.aman rice harvest. Timely tilling cum seed sowing can be done by using the BARI developed power tiller operated seeder. Optimum tilling, seed sowing and seed covering can be achieved simultaneously using this tiller cum seeder machine with only one single pass. **Progress:** Baseline information was collected with the collaboration of OFRD, BARI, Patuakhali and Rajshahi. Information on cropping patterns, types of crops grown, available crop varieties,

irrigation, crop management systems, etc. were collected from farmers of the project sites with the help of the respective Upazila Agriculture Officers. An inception workshop was held at BARI, Gazipur on 8 May 2017, where 50 participants attended. The improved seeder was designed to reduce its weight and enhance performance. The base plate, seed dropping funnel, hitching system, furrow opener and power transmission system were changed. Hands on training on manufacturing methods of the seeder were provided to the technical staff of R. K. Metal at Tepakhola, Faridpur. Manufacturing faults and some useful tricks shown to them practically. By now the partner workshop (R. K. Metal, Faridpur) has already fabricated an improved seeder.

4.1.10 Project code and title: TF 24EM/15. Epidemiological and Patho-biological Investigation of Repeat Breeding Syndrome and Development of Strategies for Improving the Fertility of Repeat Breeder Dairy Cattle

Implementing organization: Bangladesh Agricultural University (BAU), Mymensingh

Principal Investigator: Professor Dr. Nasrin Sultana Juyena, Dept. of Surgery and Obstetrics, Faculty of Veterinary Science, BAU, Mymensingh; Cell phone: 01759674267

Main objectives: To identify and determine the causes and associated factors of repeat breeding syndrome through epidemiological and patho-biological investigation, and to find its proper treatment and improvement of fertility by adopting ARTs.

Location: Munshigonj, Shajadpur, Sirajganj; Patiya, Chittagong; Commercial farms in Dhaka and Mymensingh.

Budget: BDT. 95.58 lakh

Background: Repeat breeder (RB) is defined as cow that has not conceived after third or more service, exhibits normal intervals between oestrus, has calved at least once, is <10 years of age, has no evidence of abnormalities of the genital organs detected by rectal palpation and has no abnormal genital discharges. RB is a - big problem in cattle breeding. During the last 50 years, RB has been repeatedly a subject of investigation in the dairy industry. Cost components associated with the RB syndrome include: extra inseminations, costs of delayed conception, extra veterinary service, losses due to culling. Most reports of RB in cows described blind treatment, e.g., administration of GnRH, antibiotics, multivitamin, etc. There is a lack of detailed characterization of the reproductive performance of repeat breeders and risk factors. In this context, the project was undertaken to find a sustainable solution of the problem.

VER Recording by Electronic Heat Detector

Progress: Overall, the prevalence of RB cows was20.71% (222/1072). RB prevalence was the highest in the Frisian (F x L) cross, in cows at 97 - 120 months of age, with a ≥5 parity and high milk yield and bred with AI. Microbiological, haemato-biochemical parameters and estrogen and progesterone profiles of the RB cows were studied for the first time in Bangladesh. The mean value of total erythrocyte count, hemoglobin (Hb), packed

cell (Pc) volume, monocyte, total cholesterol, triglycerides, high density lipoprotein (HDL), total protein, glucose, calcium and phosphorus of RB cows were lower than those in normal cows. Presence of microbes was very high (84.6%) in samples collected from deep vaginal swab and uterine fluid of RB cows having history of endometritis. RB cows without bacterial isolates in uterine sample had a history of sub-clinical mastitis (50.0%). The hormonal and VER profiles indicated disturbances in hormonal synchrony and also turbulence of synchrony between the ovarian structures and estrous cycle stages in RB cows. As shown in Table 4.1.7 well-timed double AI was effective in improving the fertility status of RB cows with a 54% increase of pregnancy rate; intrauterine application of antibiotics in the infected RB cows was more effective (51% pregnancy rate) than systemic application in improving fertility in RB cows; also, TAI after estrus synchronization was highly effective in this regard with 75% of pregnancy rate; RB cows could be conserved as recipients for embryo transfer, and it was effective in improving fertility with a pregnancy rate of 67%. Out of 173 RB cows, 99 (57%) got pregnant after the experimental treatments, and 65 calves were delivered from the pregnant cows. Following proper management, 91% RB cows became pregnant after the first post -partum AI, which were then considered normal cyclic cows.

Table 4.1.7: Pregnancy Rate Obtained after Different Measures Applied to RB Cows

Group	Experimental measures	Pregnancy rate (%)
EG-1	Improved management and proper time of AI	53.68
EG-2	Treatment with Antibiotic	51.28
EG-3	Timely AI after Estrous Synchronization	75.00
EG-4	Embryo transfer	66.67

4.1.11 Project code and title: TF 26 – ARI/15. Validation and Up-scaling of Bee Keeping Practices for Improving Yield and Quality of Bee Products

Implementing Organization: Sher-e-Bangla Agricultural University (SAU), Dhaka

Principal Investigator: Prof. Dr. Mohammed Sakhawat Hossain, Department of Entomology, Faculty of Agriculture, SAU, Dhaka; Cell phone: 01716092747, E-mail: sakhawat_sau@yahoo.com

Main objectives: Improving the yield and quality of bee products and enhancement of beekeepers' capacity.

Location: Gazipur, Sirajganj and Shatkhira districts.

Budget: BDT. 188.057 lakh

Background: Bee keeping is an important sub- sector of agriculture. Both domesticated and feral honey bees are the most crucial pollinators of agricultural crops, and more than 80% of agricultural crops are more or less dependent on bee pollination. At present, approximately 50,000 traditional modified Lang troth wooden bee hives are present in the country. However, bee-keeping practices in Bangladesh still remain by and large traditional. Although there are several kinds of bee products present in bee hives, i.e., honey, bee wax, pollen, propolis, royal jelly, bee venom, etc., bee-keepers harvest only honey and a very little amount of wax from bee hives in Bangladesh. Queen excluder and healthy queen utilization in the bee hives ensure ripe and quality honey production, and also increase honey and wax yields. On the other hand,

the use of pollen traps and propolis mesh help harvest pollen from the bee pollen basket and propolis collection, respectively. The use of polyhive boxes for bee-keeping can be a big boost for the bee-keeping sector, and this project was undertaken keeping this in mind. A total of 60domesticated bee stocks of *Apis mellifera,* collected from Manikganj, Gazipur, Narayanganj, Sirajganj, Shatkhira, and Tangail districts screened through hygienic behavior tests are being maintained at the apiary of SAU in the dearth period of bees. Sixty bee-keepers were selected from three different districts to undergo five training programs organized by the NGO associate, Sushilon. Twenty modern poly hive boxes, 20 traditional wooden hives (single box system) and twenty wooden hive super boxes (double box system) along with 120 modern pollen traps, 120 propolis traps, 120 queen excluders and other bee-keeping accessories were distributed among these 60 bee keepers to conduct the different field experiments. Different malfunctioned bee samples were collected from 60 selected bee boxes to identify different pests and diseases of honey bee in the laboratory.

Progress: The treatments: a) traditional bee hive and b) modern poly hive were tested at multiple sites in three districts, viz., Gazipur, Sirajganj and Satkhira. The treatments were laid out in mustard fields in Sirajganj, with Litchi plants in Gazipur and with multiflora in the Sundarbans, Satkhira during 2015-16 and 2016-17. The yields of bee products in 2016-17 are shown in Table 4.1.8.The highest amount of honey, 19 kg/hive/season, was obtained from mustard, while litchi was the highest pollen and propolis yielder, 299 and 89 g/box/season, respectively. Honey production was increased by about 35-36% with poly hive super over the traditional hive.

Table 4.1.8: Production of Bee Products in 2016-17 by Source Plant

Source	Honey production (kg/hive/season)				Pollen (g/box)/week	Propolis (g/box/season)
	Traditional hive	Poly hive super	Difference	Change (%)		
Mustard	14	19	5	35	244	29
Litchi	11	14	4	35	299	89
Multiflora	9	12	3	36	33	78

4.1.12 Project code and title: TF 27 – SF. Adoption of Improved Soil Fertility Management Practices for Arable Soil Conditions under Intensive Cropping Systems

Implementing Organization: Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU).

Principal Investigator: Dr. G K M Mustafizur Rahman, Professor, Dept. of Soil Science, BSMRAU, Gazipur. Cell phone: 01718186642, Email: mustafiz@bsmrau.edu.bd

Main objectives: Evaluation of soil and crop management options which are appropriate and available for farmers in selected study areas, and adoption of suitable and location specific technologies for conserving soil and improving its fertility.

Location: Sadar upazila of Faridpur; Trishal, Mymensingh; Khetlal, Joypurhat; Badarganj, Rangpur and Sonatala, Bogra.

Budget: BDT. 114.88 lakh

Background: Intensively rice cultivated soils, intensively cultivated acid soils and intensively cultivated arsenic affected soils might be rejuvenated by adopting proper and improved soil management practices using crop residues, biochar/peat soil, etc. for sustainable soil health and better crop production. Three soil types from intensively rice cropped (rice-rice-rice) areas, viz., acid, calcareous, and arsenic contaminated soils, were selected for this study after a proper survey. Two hundred (200) farmers' fields, each measuring one *bigha* (33 decimal), in 20 blocks of five upazilas (Faridpur Sadar, Trishal, Khetlal, Badarganj, and Sonatala), were selected. Inception workshops cum farmers' training were conducted with 50 participants at five selected sites to update farmers' knowledge about sustainable soil health management especially by using crop residues. A series of experiments were conducted in the above mentioned fields with the above mentioned soil types with three different treatments i.e., T_1: Fertilizer dose for HYG as per STB, T_2: T_1 + crop residues and T_3: Farmer's practice with four replications to evaluate sustainable crop production and soil health. Boro rice straw residues were used as organic matter sources except in Faridpur Sadar where lentil biomass was used as the organic matter source. In addition, biochar and peat soil were used as arsenic absorbers as well as organic matter sources in the next dry season experiment in Faridpur Sadar for graduate student research.

Progress: No significant effect of crop residues was found in the first year, which might have been due to slow decomposition of and nutrient mining from rice straw. However, an increasing rice yield trend was observed in all crops in the 2nd year with the use of rice straw residues. Significant grain and straw yield advantages were observed in the second year with recommended fertilizer treatment in both T. Aman and Aus rice. A 5-10% higher grain yield was obtained with rice straw application. Similarly, a higher jute fiber production was noticed with lentil residue application. Table 4.1.9 shows the yield of rice by fertilizer doses used. Lentil yield was found to be higher with biochar than peat (Fig 4.1.10).

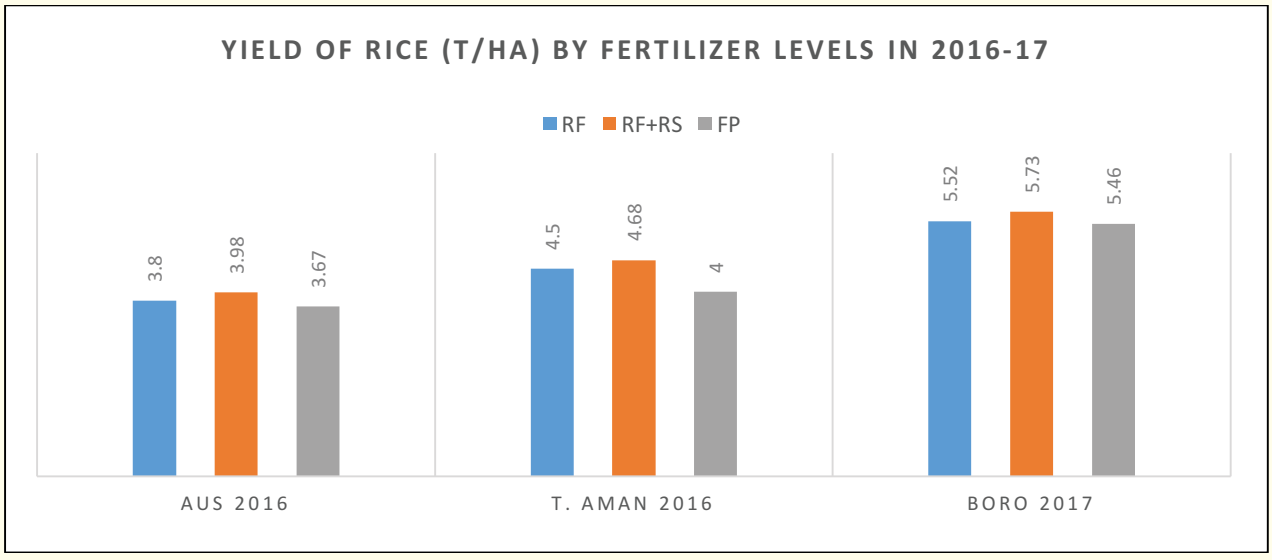


Fig: Yield of rice in varying levels of fertilizers in 2016-17

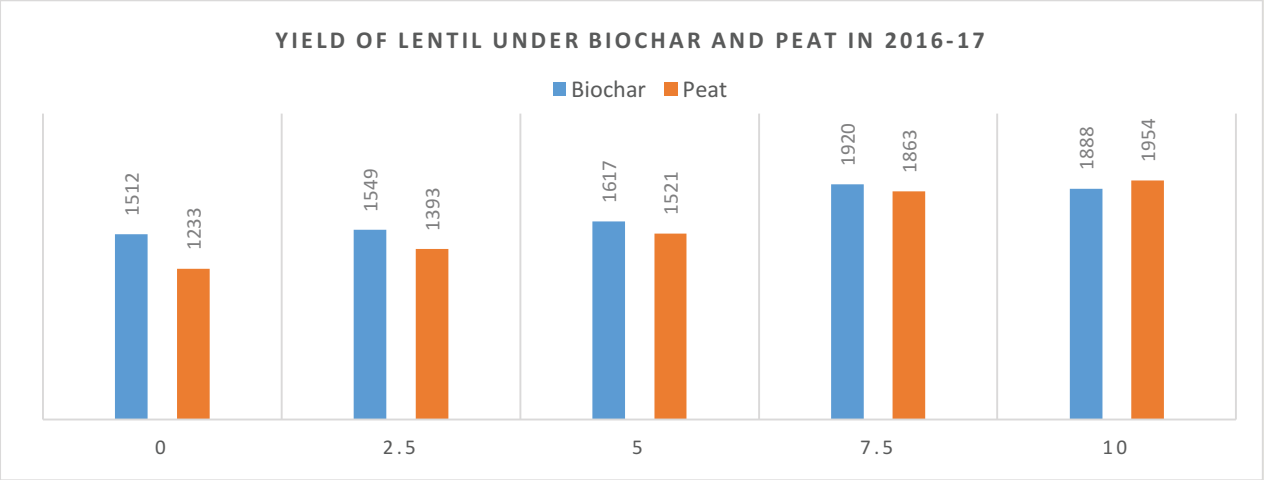


Fig: Yield of lentil under biochar and peat in 2016-17

4.1.13 Project code and title: TF 29-AM/15. Design and Development of Two-Stage Drying Technique for High-Moisture Grain

Implementing Organization: Haji Danesh University of Science and Technology (HDUST), Dinajpur

Principal Investigator: Prof. Md. Sazzat Hossain Sarker, Dept. of Food Engineering and Technology, HDUST; Cell phone: 01713163347; E-mail: mshsarker_hstu@yahoo.com

Main objectives: To develop an efficient two- stage drying technique for high- moisture paddy and maize and to evaluate its efficiency.

Location: HDUST, Dinajpur

Budget: BDT. 125.51 lakh

Background: At the industry level, only the LSU (Lousiana State University) type dryer is used for drying of parboiled and un-parboiled rice. For maize, sun drying is very common in spite of the possibility of grain quality deterioration, microbial infestation and wastage. During continuous and heavy rains, huge amounts of maize are wasted due to lack of proper drying techniques. Todate, the two- stage drying using the high temperature fluidized bed dryer followed drying by any low temperature dryer is not practiced in the commercial grain drying sector of Bangladesh. Besides single stage drying, two-stage paddy drying is being practiced at the industry level in many humid countries like Thailand, Philippines, Indonesia, Taiwan and Malaysia.

The overall drying time can be reduced by 65 to 75% and head rice yield (HRY) obtained after milling of the dried sample increased by at least by 5% through two- stage drying employed with the D fludized bed dryer (FBD), tempering and sun drying method. Drying of freshly harvested aromatic rice a total of 4.33 hr with two-stage drying in the FBD tempering- sun drying method. Milling recovery, whiteness and aroma of dried aromatic rice samples were not significantly affected ($p \leq 0.05$) by drying at three levels (65^oC, 85^oC and 100^oC) of air temperature in FBD. The total drying times required for high- moisture maize was found to be 4.57 and 2.57 hr in the two-stage drying with FBD, tempering and sun drying method and FBD, tempering and fixed bed drying method, respectively, while it was5.0 to 6.0 hr with the LSU dryer. This project aims to develop suitable two- stage drying techniques that will minimize post-harvest losses of grain and yield high quality dried products at reasonable costs.

Progress: The project was initiated in March, 2017. Within this period, baseline information has been collected with the help of the collaborator Uttar on Engineering Works. The inception workshop was completed at the HSTU premises. The design and fabrication works for the lab scale dryers have been finalized. Staff recruitment and procurement have been performed with the cooperation and approval of concerned authorities of HDUST.

4.1.14 Project code and title: TF 30 - AP/15: Sustainable Development of Aquaculture in the North-West Region of Bangladesh under Climate Changes Scenario.

Implementing Organization: Rajshahi University (RU), Rajshahi and Shuranjana Social Service Association (SSSA), national NGO, located at Bogra

Principal Investigator: Dr. Md. Istiaque Hossain, Professor, Department of Fisheries, RU; Cell phone: 01726514232, Email: bitanrubd@yahoo.com

Main objectives: Improvement of aquaculture in the seasonal ponds of north west Bangladesh, increasing their water holding capacity and improving farmers' knowledge and skills infish polyculture technology.

Location: Paba, Charghat-Bhagha upazila of Rajshahi and Sadar upazila of Bogra.

Budget: BDT. 167.93 lakh

Background: Bangladesh is highly vulnerable to the effects of climate change and other adversities. The fresh-water culture fisheries are also affected. Among the open ponds in Bangladesh, 55% are seasonal and 45% perennial ponds, 0.09 hectares in size on an average. The analysis of rainfall data from 1960 to 2010 showed a decreasing trend of annual average rainfall at the rate of 3.0698 mm/year in the NW region of Bangladesh, indicating a deteriorating situation for aquaculture in this region of the country. The water retention capacity of soils is another factor in the north-west region, where 55% of the seasonal ponds become totally unsuitable for fish culture during December to May due to low water retention capacities of the bottom soil. Lack of technological knowledge is also a constraint to fish culture in the country. In this context, this project was initiated to foster fish production in the NW region of the country.

Progress: Activities like benchmark surveys, selection of beneficiaries, skills training (both for field staff and beneficiaries), group exchange visits, inception workshop, training programs, contacts with potential pond owners, group meetings for information dissemination, and site selection were completed during the 1st year. Three research sites i.e., Paba, Charght-Bhagha in Rajshahi and Sadar of Bogra were selected. Based on the surveys, 27 seasonal ponds and 90 farmers (30 from each site) were selected for the project activities. In the study area, 87% of the ponds were found having single ownership, and the rest (13%) had multiple ownership. The average pond size in the study area is 18.4, 33.1, and 24.4 decimal in Paba, Charghat-Bagha, and Bogra Sadar, respectively. Project activities in three upazila sites over the reporting period progressed well. The 27 selected seasonal ponds were stocked with carp fingerlings and supplementary feeds were applied at certain rates. Monitoring of fish growth, water quality parameters and water depth from the study ponds is being carried out on regularly. Initial results from the farmers' ponds are indicative of better fish growth along with higher water retention compared with the baseline situation. Final fish harvests from the first-year stocks during February-March next year may reveal fish production and corresponding variations in pond water retention capacities to have changed in the positive direction across the three sites.

4.1.15 Project code and title: TF 31-VC/15: Market and Value Chain Studies of Selected Fruits and Vegetables with Special Reference to Post-Harvest Losses and Food Safety in Bangladesh

Implementing Organization: Bangladesh Agriculture Research Institute (BARI), Gazipur-1701

Principal Investigator: Dr. M. Abdul Matin, Agril Economics, BARI, Cell: 01725694481

Location: Bogra, Rajshahi, Jhenaidah and Jessore

Budget: BDT. 24,500,000

Main objectives: The main objectives of the project are: a) to develop awareness among fruit producers and traders about safe fruit and vegetables preservation practices, b)introduction of some efficient value chains with improved post-harvest (PH)technologies in fruits and vegetables marketing for reducing post-harvest losses, c) improving food safety for the consumers, d) developing a safe food business model and e)crafting and implementing a piloting scheme to provide incubation support to some selected agro-MSMEs.

Background: Large amounts of fruits and vegetables are damaged and contaminated in Bangladesh every year due to their perishability, seasonality, bulkiness, poor infrastructure and poor post-harvest (PH) handling and processing. In addition, unscrupulous use of hazardous chemicals and preservatives in fruits and vegetables adversely affects food safety for the consumers. This situation needs to be improved through PH technology, value chain management, awareness building and innovative business incubation schemes that would promote market-responsive agro-MSMEs.

Progress: The inception workshop was held at BARI on the 4th May 2017. A series of sensitization workshops was organized at Rajshahi, Jessore and Bogra, where the project team deliberated on the needs for fair practices at all levels, starting from planting through harvest and post-harvest processing to marketing. A MoU was signed with the Dhaka University Teachers' Club to supply safe agro produce through Farmers End network members (CDCS® G4G farmers/traders**).** CDCS is designing an inclusive market development business model involving agro-SME farmers (or agro-MSMEs). Through crafting, piloting and validating inclusive business model(s) for production and marketing of safe fruits and vegetables, CDCS plans to provide incubation support to agro entrepreneurs through an online e-commerce platform.

4.1.16 Project code and title: TF 32-SF/15. Integrated Nutrient Management for Intensive Cropping in the Coastal Charland Areas of the Bhola District

Implementing Organization: On-Farm Research Division (OFRD), BARI, Bhola

Principal Investigator: Md. Shahidul Islam, Senior Scientific Officer, OFRD, BARI; Cell phone: 01718638771, Email: shahid75bari@gmail.com

Main objectives: To develop and recommend an improved soil fertility management package for intensive cropping systems in the coastal and charland areas of the Bhola district for increasing crop yields and system productivity.

Location: Sadar and Daulatkhan upazilas, Bhola

Budget: BDT. 46.67 lakh

Background: To meet the growing food demands of Bangladesh, farmers need to grow modern high yielding varieties (HYV) and hybrids of different crops. The cultivation of multiple crops in the same field in a year allows accelerates nutrient mining from the soil fast resulting in fast and serious nutrient depletion. Moreover, high humidity and high temperature cause rapid breakdown of the soil organic matter which is the natural reservoir of plant nutrients, and soil fertility- productivity status deteriorates with time. Farmers use chemical fertilizers but very few of them are aware of or care for the need to preserve and enhance soil organic matter. Moreover, the chemical fertilizers are mostly used in doses that would be proper and balanced for the specific field or crop. Soil test based integrated nutrient management practices can save the soil from nutrient depletion and keep it healthy and productive for the long run.

Progress: Experiments were conducted in a participatory approach in farmers' fields in two upazilas (Sadar and Daulatkhan) of Bhola (AEZ-18) between September 2015 and June 2017. Four sub-blocks (8-10 bigha each) in each upazila were selected with 68 farmer cooperators in 9.07 ha of landwith two cropping patterns: (i) wheat-t.aus – t. aman (CP-1) and (ii)mungbean - t.aus-t.aman (CP-2).

In i 2016-17 CP-1,grain yields of wheat, T. aus rice and Taman rice were, 3.74, 4.78 and 5.11t/ha, respectively, and in CP-2, these were 0.96, 4.92 and 5.26 t/ha for mungbean, T. aus rice and T.aman rice, respectively (Table 4.1.11). Research plots produced yields that were higher by 41% (mungbean), 19% (wheat), 31-36% (T. aus rice) and 11-14% (T. aman rice) than those in the farmers' plots. The higher yields in the researcher's plots might have been due to the use of STB fertilizers, incorporation of mungbean and T. aus biomasses following the INM approach and improved management practices. The gross return of CP wheat – T. aus – T. aman was Tk. 243880/ha, total variable cost Tk. 138250/ha and gross margin was Tk. 105630/ha. The marginal benefit cost ratio (MBCR) over farmers' practice was 2.18. STB fertilizer application along with INM approach reduced the need for chemical fertilizers.

Table 4.1.11: Change in Grain Yield of Crops under Two Cropping Patterns in the District in 2016-17

Cropping pattern (CP)	Crops in CP	Grain yield (t/ha)		Yield advantage in RP over FP (%)
		Research plot (RP)	Farmer plot (FP)	
Wheat –T. as –T.aman	Wheat	3.74	3.15	19
	T. aus	4.78	3.66	31
	T. aman	5.11	4.62	11
Moonbeam –T.aus – T.aman	Mungbean	0.96	0.68	41
	T. aus	4.92	3.62	36
	T. aman	5.26	4.60	14

4.1.17 Project code andtitle: TF-33-ARI/15. Farm Productivity Improvement in Haor Areas through Integrated Farming Systems Approach

Implementing Organization: Sylhet Agricultural University (SAU), Sylhet.

Principal Investigator: Professor Dr. Md. Abul Kashem, Dept. of Soil Science, Faculty of Agriculture, SAU**;** Cell phone: 01712213707, Email: makashem.agri@gmail.com

Location: Haor areas of the Sunamganj district (one site and three sub-sites selected through PRA)

Budget: BDT. 370.48 lakh

Main objectives: a) To develop location-specific system-based appropriate technologies through farmers' participatory research, b)To increase household productivity with integrated use of field crops, vegetables, livestock, fish, agricultural mechanization, etc. technologies, c) To diversify and intensify farming and non-farming activities for *in situ* employment generation as well as develop value chain and market linkage.

Background: Seven north-eastern districts of Bangladesh, namely, Sylhet, Sunamganj, Moulvibazar, Habiganj, Brahmanbaria, Kishoreganj and Netrokona have a total of about 373 *haors*, both large and small, existing in 57 upazilas.These very special ecosystems are home to about 20 million people. The *haor* people mainly depend on agriculture, but crop damage by flash floods in most years is a regular

phenomenon that affects the lives and livelihoods of these people. With a view to addressing the problems of the *haor* areas, this project was taken up as an interdisciplinary approach with a multi-disciplinary team to work together so that location-specific system based appropriate technologies can be developed through farmers' participatory research in the Dekar *haor* that covering an area of 252 square km, which is characterized by the occurrence of early floods and flash floods.

Progress: More than 31 experiments were completed during the first year and about 35 experiments conducted during the 2nd year to verify the adoption of several technologies related to crops, livestock and fisheries. Some of the results are highlighted: BARI sorisha15 when cultivated in farmers' fields gave an average yield of 1.59 t/ha. Cabbage responded well to micronutrients and the highest yield (44.13 t/ha) followed by 41.73 t/ha was obtained with Zn + B and Zn alone, respectively. Use of vermi-compost (120:55:120 kg/ha of N-P-K + 2.47 t/ha vermi) had a positive impact on the yield of cauliflower (33.93 t/ha). Creeper vegetables, such as, bottle gourd, sweet gourd, country bean, cucumber, bitter gourd, cultivated in homestead areas in the Noagaon village, resulted in extra incomes of Tk. 364, 476, 480, 110 and 114 per household, respectively. During the winter season, red amaranth, stem amaranth, radish and spinach were cultivated which earned extra incomes of Tk. 168, 112, 611 and 1636 per farm, respectively. Creepers like snake gourd, ridge gourd and yard long bean were cultivated at the homestead, which generated incomes of Tk. 116, 160 and 168 per farm, respectively. Saplings of coconut, jambolan, orange, jujube, jackfruit, olive, pomelo, litchi, hogplum, betel nuts, shatkora and hijal were distributed among the homesteads of the south Sunamganj upazila. No mortality of saplings was reported except in papaya (58%).fertilizer trials on HYVs of fine rice in the boro season were conducted for a student's PhD program. The results of the experiments are shown in Table 4.1.11. BRRI dhan 63, which matured about 10 days earlier, gave a yield advantage of 6-17% over BRRI dhan 50. The best yield advantages were obtained with IPNS including poultry litter (17%) and IPNS including cowdung (13%). Besides crops, trials were also conducted to improve livestock and fisheries resources of the community.

Table 4.1.12: Yield of Two Boro Rice Varieties in Sunamganj during 20116-17

Treatment	Yield of rice (t/ha)		Difference	Difference (%)
	BRRI dhan 50	BRRI dhan 63		
RFD	3.51	3.79	0.28	8
RFD+20 kg N	3.62	3.91	0.29	8
RFD-20 kg N	3.41	3.72	0.31	9
RFD-40 kg N	3.21	3.02	-0.19	-6
IPNS (CD 5 t/ha)	3.91	4.4	0.49	13
IPNS (PL 5 t/ha)	3.42	3.99	0.57	17
Farmer practice	3.01	3.18	0.17	6

4.1.18 Project code and title: TF-35. Integrated Nutrient Management for Sustaining Soil Fertility and Productivity under Intensive Cropping Systems.

Implementing Organization: OFRD, BARI, Gazipur

Principal Investigator: Dr. A S M Mahbubur Rahman Khan, Chief Scientific Officer, OFRD, BARI, Gazipur.

Location: Sherpur Sadar, Melandah of Jamalpur, Gabtali of Bogra, Lahirirhat of Rangpur, Mohanpur and Godagari of Rajshahi.

Budget: BDT. 138.51 lakh

Main objectives: a) To develop and recommend an improved soil fertility management package for location specific three/four crop based cropping pattern b) To increase crop yield and system productivity under intensive crop production system

Background: Low organic matter content, higher cropping intensity, improper cropping sequence and faulty management practices are the major causes of depletion of soil fertility. Intensive use of high yielding varieties has led to a sharp increase in the removal of plant nutrients. Farmers usually apply fertilizers on single crop basis instead of considering the cropping pattern, and, also, there is hardly any organic matter use. Recently, four crop based cropping patterns are being followed in different parts of the country to meet the increasing food demands. This project aims at improving system productivity and sustaining soil fertility by increasing yields of all four crops of the cropping patterns with integrated nutrient management in selected areas of six upazilas of five districts of Bangladesh.

Progress: Focus group discussions (FGD) were conducted to identify major cropping patterns and suitable crop varieties (short duration HYV) to be accommodated in three or four crop based existing patterns at the locations. Each FGD was carried out with 10-15 small and marginal farmers per location. Based on the results of FGD and review of literature, on-farm trials were established at the locations. Forty farmers (4 groups, each group consisting of 10 farmers) having one bigha (33 decimal) of land each from each upazila were selected for field trials. The experiment consisted of two management packages--trial plots receiving IPNS fertilizer dose for high yield goal (HYG) and farmers' practice (FP). Initial soil samples were collected and analyzed before setting up the trials.

Rice equivalent yield (REY) in the IPNS plots was found to be higher than that in the FP plots at all locations. The average yield increase with IPNS over FP was 28% while the gross return increased by 26% (Table 4.1.13).

Table 4.1.13: Rice Equivalent Yield and Gross Return as Affected by IPNS Based Treatments during 2016-17

Location	IPNS treatment		Farmers' practice		Change (%)	
	REY (t/ha	GR (Tk./ha)	REY (t/ha	GR (Tk./ha)	REY (t/ha	GR (Tk./ha)
Bogra	16.49	412270.00	10.18	254420.00	62	62
Rangpur	28.36	610023.00	22.19	532338.00	28	15
Rajshahi	22.21	485125.00	18.99	401240.00	17	21
Jamalpur	13.01	312240.00	9.20	220800.00	41	41
Serpur	12.10	290400.00	11.27	270480.00	7	7
All	18.43	422011.60	14.37	335855.60	28	26

4.1.19 Project code and title: TF-36. Maximizing Forage Production in Saline Prone Areas of South-West Coastal Belt through Improved Management Practices

Implementing Organization: Khulna University (KU), Khulna.

Principal Investigator: Dr. Md. Shafiqul Islam, Professor of Agro-technology Discipline, KU, Khulna.

Location: KU campus, Khulna and three field sites (to be decided) in the districts of Khulna, Bagerhat and Satkhira in the southwestern coastal zone of Bangladesh.

Budget: BDT. 40.72 lakh

Background: Arable land in Bangladesh is mainly occupied by crops for cereals, vegetables legumes and other foodstuff, fiber, etc. for human consumption and use. Farmers hardly grow any crop exclusively as fodder since they do not have enough land for this. Fodder shortage, therefore, is aggravating in the country with the passage of time. Recently the problem has heightened to such a level that rearing of livestock has become difficult. In this scenario, and realizing the importance of forages for livestock feeding, the Department of Livestock Services (DLS) of Bangladesh introduced some improved varieties of forage, such as, napier, para, german, guinea and tree forage, i.e., ipilipil (*Leucaena*) in the early 1990s, in several districts. From a recent study on the availability of feeds and forage, it is evident that the availability of nutrients is 73% DM, 18% DCP, and 25% ME with deficits of 27% DM, 82% DCP, and 75% ME, respectively. Since there is a scarcity of land for growing forage crops in the traditional arable areas of the country, it is imperative to explore areas which still lie unutilized or underutilized which could be used for forage production. The coastal saline zone of Bangladesh offers a possibility in this regard. This project was undertaken to evaluate forage species for salt tolerance and the possibility of growing these in the coastal saline areas with high soil salinity.

Progress: The project inception workshop was completed and report submitted. Necessary equipment and appliances have been purchased to facilitate soil and water salinity testing in the laboratory and field trials on the growth of forage species in saline soils. One pot experiment was in the greenhouse of the Agro-technology Discipline, KU campus in the last week of December 2016. The growth of 20 local fodder varieties in pots containing salt-spiked soils (ECe 4 – 6, 8 – 10 and 10+ dS/m) was evaluated in this greenhouse experiment. Suitable sites for the field trials in the Khulna, Bagerhat and Satkhira districts are being looked for.

4.2 Basic Research

KGF awarded basic research projects to the national research institutes to address specific issues like finding a solution to the problem of the blast disease in wheat, development of salt tolerant wheat/rice varieties for the coastal region, to look for and introduce resistant genes in sesame for tolerance to water logging. Eight basic research projects were awarded to BARI, BRRI, and universities in Mar 2017.These projects are at initial stages of operation

4.2.1 Project code and title: BR 1- C/17. Physiological Mechanism Related to Water and Heat Stress Tolerance in Wheat Genotypes

Principal Investigator: Dr Imrul Mosaddek Ahmed, SSO, Plant Physiology Division, BARI

Implementing Organization: BARI, Gazipur

Locations: BARI, Gazipur and Barind, Rajshahi (Screening experiment)

Budget: BDT. 97.92 lakh

Main objectives: To identify drought and high temperature tolerant wheat genotypes for future climate change situations and to study the physiological, biochemical and molecular changes in wheat in water and temperature heat stress conditions.

Background: Impacts of abiotic stress factors on crop plants have been mostly studied by applying a single stress factor like drought or high temperature in controlled experiments. However, field crops often encounter multiple stresses such as drought and elevated temperature simultaneously at certain stages of growth. In fact, the combination of drought and high temperature comprises a major abiotic stress factor that restricts wheat growth and yield in many regions of the world including Bangladesh. Earlier studies have demonstrated that drought or air heating significantly decreased crop growth and yield, whereas the effect of combined drought and high temperature stresses on crop growth yield is largely unknown. In this study, plant water status and yield responses of BARI wheat varieties/lines to heat, drought and both at anthesis will be investigated.

Progress: The inception workshop of the project is expected to be held in 1st of Aug 2017. The field and pot experiment is planned to be set in Nov 2017.

4.2.2 Project code and title: BR 2 - C/17: Linkage and QTL Mapping of Tungro Resistance in Rice

Principal Investigator: Dr. Md. Abdul Latif, PSO and Head, Plant Pathology Division, BRRI, Gazipur-1701; Cell phone: 01715034094, E-mail: alatif1965@yahoo.com

Implementing Organization: Bangladesh Rice Research Institute (BRRI), Gazipur

Location: BRRI, Gazipur

Budget: BDT. 69 lakh

Main objective: To identify the Quantitative Trait Loci (QTL) with linked marker for tungro resistance in the land race of rice, Kumragoir

Background: In Bangladesh, rice is known to suffer from a number of fungal, bacterial, viral and nemic diseases. So far, 10 major rice diseases have been identified. Of these, the rice tungro virus disease is a major constraint to rice production, particularly in the aus and rainfed ecosystems. In Bangladesh, yield losses due to tungro was reported to be as high as 100% under severe conditions (BRRI 1983).High yielding varieties (HYV) of rice developed so far in Bangladesh for the rainfed aus and aman ecosystems are highly susceptible to rice tungro virus.

A preliminary step to develop tungro resistant varieties is to identify the chromosomal locations containing the QTL associated with tungro resistance in a resistant landrace, such as, Kumragoir. Chromosomal linkage maps (also known as QTL map or genetic maps) are a powerful tool which can detect such QTL. The QTL detection approach has already been employed to map major and minor genes involved in resistance to other rice diseases, as well as in estimating the number, the location and the effect of the genomic region of these genes. DNA marker technologies, such as SSRs, SNPs, RFLP,

RAPD, and AFLP, facilitate the study of genetic diversity, the identification and characterization of stress resistance related genes and the construction of a high-resolution genetic map for isolating genes associated with important traits. SSR (Simple Sequence Repeat) or SNPs (Single Nucleotide Polymorphism) markers have been used extensively to identify markers linked to disease resistance genes and to locate these genes and QTLs in rice chromosomes.

The QTL for tungro resistance might be distributed in different chromosomes of Kumragoir. In this project, SSR or SNPs markers linked to tungro resistance in Kumragoir will be investigated thoroughly in whole genome. Finally, the project will come up with the first SSR or SNPs-based QTL map for tungro resistance in Bangladesh. Resources, such as, well equipped molecular study laboratory, technical manpower and most of the other required facilities, are available at the Plant Pathology Division, BRRI to construct such QTL maps for tungro resistance in the local land race. SSR marker genotyping facilities are available at BRRI, but SNPs markers genotyping could be outsourced from India or UK if necessary.

Progress: Three sets of parents (Kumragoir and BRRI dhan 48) were planted at 7 days intervals to synchronize flowering. A cross between two parents was made to find out F_1 generation. F_1 seeds were harvested from the successful crosses between Kumragoir and BRRI dhan 48. In addition, tungro sources were collected from different parts of Comilla and the virus source is being maintained through the insect acquisition method. Presence of the rice tungro bacilliform virus (RTBV) was confirmed through molecular marker.

4.2.3 Project code and title: BR 3-C/17. Exploring New Source of Blast Resistance and Pyramiding Blast Resistant Genes into Boro Rice

Principal Investigator: Dr. Tahmid Hossain Ansari, PSO, Plant Pathology, BRRI, Gazipur; Cell phone: 01716839404; Email: tahmidhossain@yahoo.com

Implementing Organization: BRRI, Gazipur

Location: BRRI, Gazipur

Budget: BDT. 99.1 lakh

Main objectives: To find out new source of major resistant gene against blast disease and introgression of known resistant genes and/or gene pyramiding to develop durable blast resistant rice variety

Background: Among the biotic stresses, rice diseases, especially rice blast, have appeared as a major threat to rice production. In low and medium infestations, the disease causes 11% and 46.4% yield losses, respectively, in Bangladesh. Outbreak of this disease in BRRI dhan 28 and BRRI dhan 29 during the boro season of 2014-15 was the highest with some 90% neck infection in some rice fields of the Rangpur region where the crop yield dipped to even zero. So far, boro has been the safest rice crop season in Bangladesh, contributing more than 56% of the total rice production, but the recent widespread outbreak of the blast disease showed up as a very serious threat to boro rice. This disease has historically prevailed as a chronic problem in the southern coastal and northern regions in both the wet and dry seasons. Farmers hardly can recognize the disease early on in the crop growth cycle to take control measures against neck blast resulting, sometimes, in total crop failure. On-farm management practices of the disease rely solely on chemical control which increases not only the cost of production but also causes environmental pollution. Pest resurgence

results in further crop vulnerability or higher disease susceptibility. Contamination of the food chain, improper fungicides use, etc. cause serious deterioration of farmers' health. In this context, the development of blast resistant rice variety(s) deserves urgent attention. Host resistance with multiple genes could be a potential option for rice blast management.

Progress: Project work started in April, 2017 with the successful completion of the inception workshop. Recruitment of one Research Fellow/Associate is under process. Isolation and pure culture of blast isolates for screening rice germplasm is continually done and inoculated in the rice germplasm as per protocol. Initially 40 germplasms have been selected from 100 germplasms against two mixture isolates and will be tested further. BRRI dhan28 and BRRI dhan29 have been selected as recipient parents and the above mentioned genes have been selected as donor genes. Some physical facilities have also been developed like the blast pure culture laboratory, SS-tray for laboratory screening, emasculator and tri-cycle van.

4.2.4 Project code and title: BR 4 - C/17. Physiological Mechanism of Waterlogging Tolerance in Sesame

Principal Investigator: A. F. M. Shamim Ahsan, Scientific Officer, Plant Physiology Division, BARI; Cell Phone: 01713376569; E-mail: shamim.agro@yahoo.com

Implementing Organization: BARI, Gazipur

Budget: BDT.66.7619 Lakh

Main objectives: To examine the dynamics and mechanisms of action of anaerobic proteins and antioxidant enzymes together with the morpho-anatomic adaptations in waterlogged sesame with a view to developing waterlogging tolerant sesame genotype

Background: Sesame (*Sesamum indicum L.*) is an ancient oil crop widely cultivated in many parts of the world, and it meets a high-end need for high quality oil with an abundance of oleic acid and linoleic acid and a good balance in their concentrations. However, the sesame crop is very sensitive to waterlogging. In Bangladesh, sesame is mainly grown in the kharif- I season which is the dry- wet transition period due to the start of monsoon and it is often affected by waterlogging due to heavy monsoon rains. Genetic variation in sesame in terms of waterlogging tolerance has been documented. The present study was planned to investigate the anti-oxidative and glyoxalase mediated waterlogging tolerance mechanism in sesame. The responses of sesame genotypes to waterlogging at both the morpho-anatomical and physiological levels will be studied for a better understanding of the underlying waterlogging tolerance mechanisms in sesame, with the ultimate objective of developing sesame cultivars tolerant to waterlogging.

About 100 sesame genotypes were collected from different sources like ORC, PGRC, BINA, and farmers, etc. to identify the desired waterlogging stress tolerant genotype(s). In the 1st experiment, 30 genotypes were grown in petri-dishes under laboratory conditions. In the 2nd experiment, 87 genotypes including 3 checks (BARI Til-3, BARI Til- 4 and BD-6980) were planted in the field (Joydebpur) on 15 Mar 2017 with the following treatments: T_1= no waterlogging (control) and T_2= waterlogging at flowering stage (48 DAS). To impose waterlogging, water was applied to submerge the soil to 5 cm above the surface and water was kept standing for 2 days (48h) in each block. After 2 d, the standing water was drained out. Plant data on wilting rate, plant death%, yellowed top leaves, diminishing of biomass, yield and yield contributing characters, different waterlogging tolerance and susceptibility indices, etc. were recorded.

Progress: Data on root length (RL) shoot length (SL), total length (TL), total fresh and dry weight and plant mortality rate in control and waterlogged conditions were measured. Detailed data to be provided in the next report.

4.2.5 Project code and title: BR 5 - C/17. Environmental Stresses in Wheat: Identification and Expression of the genes at Critical Growth Stages and Analysis of their Genetic Architecture

Principal Investigator: Dr. Golam Faruq, Principal Scientific Officer and in-charge, Regional Wheat Research Center (RWRC), BARI, Gazipur

Implementing Organization: RWRC, BARI, Gazipur

Location: Gazipur, Dinajpur, Jessore, Rajshahi and Khagrachari

Main objectives: Identifying of major heat tolerant genes and their expression analysis at reproductive stages in wheat and to generate prolific breeding information (inheritance pattern of the identified genes, genetic architecture) and development of base line populations/early generation breeding materials for relevant basic studies

Budget: BDT 199.98 lakhs

Project Background: High temperature stress at reproductive growth stages such as flowering and grain filling substantially reduces wheat grain yield through an adverse effect on both yield components, grain number per panicle and grain weight. This abiotic stress is common across much of the Bangladesh wheat belt. Many studies have shown that high temperatures during pollen development and grain filling adversely affects a number of morpho-physiological processes within wheat plants, resulting in substantial yield losses. During pollen formation, from as early as Zadoks growth stage 45 (booting), viability is affected by high ambient temperature, reducing grain number. During grain filling, fill duration is reduced, leading to reduced grain size and increased screen out levels. The wheat crop in most production zones of Bangladesh frequently experiences temperatures that inhibit optimal plant growth. This study aims to develop a detailed understanding of the genetic basis of high temperature stress tolerance in wheat genotypes to help develop varieties that are better able to handle the adverse high temperature growing conditions encountered by wheat in Bangladesh.

Progress: Inception workshop of the project is expected to be held in 1st week of July 2017. The field and laboratory experiment is planned to be set in Nov 2017.

4.2.6 Project code and title: BR 6 - C/17. Physiological Aspects of Salinity Tolerance of Mungbean Genotypes for the Southern Region of Bangladesh

Principal Investigator: Dr. Babu Lal Nag, CSO (in-charge), BARI, Madaripur, Cell: 01712750358, E-mail: blnag.bari@yahoo.com

Implementing Organization: Regional Pulses Research Station, BARI, Madaripur

Main objective: To measure the growth parameters (CGR, RGR, NAR, LAI), dry matter partitioning, root growth dynamics, root-zone cation concentrations and yield loss of different mungbean genotypes under variable soil salinity levels.

Budget: BDT. 46.30 lakh

Background: Out of the 2.85 million M ha of coastal and off shore lands of Bangladesh, the area affected by soil salinity is estimated to be about 0.83 million ha of which more than 0.38 million ha occurs in Khulna, 0.22in Patuakhali, 0.11 in Chittagong, 0.06 in Barisal, 0.05 in Noakhali districts and the remaining 0.01 million ha exist in Laximipur, Feni and Chandpur districts. Soil salinity is the major yield limiting factor for mungbean in these coastal saline areas. Mungbean is relatively resistant to salinity at the early vegetative stage compared with the late vegetative and reproductive stages. A decrease in root and shoot growth is one of the major causes of reduced mungbean plant growth salinity stress. Salinity also reduces chlorophyll and carotenoid contents in mungbean which in turn causes pronounced chlorosis and necrosis in the leaves, causes swelling of membranes in the chloroplasts. These adverse changes in mungbean under salinity stress may be due to an accumulation of Na^+ and Cl^-ions at toxic leaves in the roots and shoots ultimately hampering plant growth and drastically

reducing yield. This project work is designed to study the root and shoot growth dynamics in mungbean as affected by soil salinity and identify salt tolerant mungbean varieties/genotypes for different levels of soil salinity.

Progress: The project the inception workshop was completed in January 2017 with some necessary modifications as suggested by the workshop participants. In 1st year 20 mungbean genopypes were planted in pots under 3 salinity levels as control (normal soil condition without imposing any salinity), DS 4, DS 6 and DS 8. The 1st mungbean crop was planted in pots in later part of February 2017. The seeds germinated well and the seedlings grew normally until the salinity was imposed, while the crop damage by heavy rainfall and happened possibly due to late sowing.

4.2.7 Project code and title: BR 7 - C/17. Rice Physiological Development through Trait Discovery for Boosting Rice yield in Changing Climatic Conditions.

Coordinator: Dr. Md. Ansar Ali, Director Research, Bangladesh Rice Research Institute (BRRI), Gazipur 1701, Cell Phone: +88-01925053582; Tel: +88-02-49272045-46; E-mail: maalibrri@yahoo.com

Implementing Organization: BRRI, Gazipur

Location: BRRI, Gazipur

Budget: BDT. 110.00 lakh

Main objective: Characterization of rice germplasm with *indica/indica* and *indica/japonica* combinations for higher total biomass yield and a reasonable grain to straw ratio through the manipulation of the current HYV-ideotype with the aim to enhance the total biomass to 20-22 t/ha.

Background: Rice plants can transform 5% of the solar radiation they receive into organic matter. However, even with a conservative 2.5% usage of the solar radiation received, the rice biomass yield in a single season may reach 22.50 t/ha. Thus, achieving yields >15.0 t/ha is the oretically possible. So, solar radiation *per se*may not be the limiting factor in an endeavor to enhance the current yield level unless adverse conditions exist. Among the climatic factors, the atmospheric CO_2 concentration may be limiting for rice yield. However, the CO_2 concentration is increasing day by day due to burning of fossil fuels and the concentration is now approaching~400 ppm, greatly increased from the level of 250 ppm during the 1950s. There is a possibility of harnessing this enhanced atmospheric $CO_2$for increasing the yields of C3crops like rice through "CO2-fertilization effect". Growing CO_2 responsive cultivars that would benefit from the increasing of CO_2level in the atmosphere would be one powerful option contributing to crop productivity enhancement and sustaining the yield increase in the future climate change scenario. Thus, identification of CO_2 responsive genotypes should be a major target for enhancing rice productivity in the global elevated atmospheric CO_2 boost scenarios projected for the future. In this context, this project was designed to identify the trait(s) for improving the total biomass of rice while maintaining a reasonable grain: straw ratio, and improve the available elite lines/varieties by combining the identified trait(s) with them.

Progress: A large number of local varieties (227) was been selected for their specific characters like disease and insect resistance, tolerance of abiotic stress like drought/salinity/submergence, etc. BRRI dhan 47 possesses almost all of the targeted traits while BRRI dhan 28 and BRRI dhan 29 are the most popular

and widely used MV rices in Bangladesh. Backcrossing is planned to be done among these varieties. The first experimental crop (boro rice) was established in boro 2017 after initiation of the project. The crop was harvested in May 2017 but report not provided by the PI by June 2017.

4.2.8 Project code and title: BR 8-C/17: Molecular Characterization, Chloroplast genome Sequencing and QTL Analysis of Salt Tolerant, Heat Tolerant and Late Blight Resistant Potato Varieties.

Principal Investigator: Dr. Md. Mosharraf Hossain, PSO, Tuber Crop Research Center (TCRC), Bangladesh Agricultural Research Institute (BARI), Gazipur; Cell phone: 01552403728; E-mail: mhmolla@hotmail.com

Implementing organization: BARI, Gazipur

Budget: BDT. 147.48 lakh

Main objectives: To study the genetic variation and phylogenetic relationship among potato varieties, to locate the stress tolerant gene and genetic linkage QTL map, and to improve the capacity of scientists on DNA technology for QTL mapping.

Background: In Bangladesh, potato comprises about 53% of the total edible vegetables, and it plays a vital role during the lean period. It has a great demand throughout the year, but production is concentrated during the January- March period. Biotic and abiotic stresses are major constraints to potato production. Late blight is a devastating disease responsible for 30-40% yield losses in potato. Recently, TCRC, BARI has developed few potato HYVs with resistance to biotic and abiotic stresses, e.g., BARI Alu-46 and BARI Alu-53 for late blight resistance, BARI Alu-73 for heat and salt tolerance, BARI Alu-73 for heat tolerance. So far, genomic analysis has not been done of these varieties. The nuclear genomes are generally inherited in a bi-parental manner where changes frequently occur through mutation, recombination, translation, transcription, replication, and so on while chloroplast and mitochondrial genomes are generally maternally inherited. Due to maternal inheritance, analyses of variation in chloroplast DNA (cpDNA) are effective for investigating relationships between the genotypes. Sequence comparison of cpDNA provides basic information which supports comparative levels. Chloroplast genome is a circular molecule of double stranded DNA. The genome has a size of 120 -180 kb and its coding capacity is approximately 120 genes. Chloroplast genome is smaller in size, does not change rapidly, changes are stable compared with nuclear DNA, and very few changes come through mutation only. So, genomics studies using the chloroplast gene is very important. Moreover, use of molecular markers is fundamentally important for the efficient exploration of a plant genome and for dissecting quantitative traits.

Progress: The project was initiated in April, 2017. By this time, inception workshop has been successfully completed. Recruitment of one Research Associate is under process. Procurement of research chemicals is also under process following BARI rules (PPR 2008). In relation to the project work, some references on chloroplast genome sequencing, diplod and tetraploid map QTL and genome studio have been collected.

4.3 Commissioned Research Program (CRP)

As stated earlier, CRP projects are designed and developed through series of consultation meetings of stakeholders including scientists from research institutions, university academics, experts from local and international NGOs and representatives of private entrepreneurs. These are generally designed to study

agricultural production problems and prospects in marginal areas like the hills, coastal saline land, chars and drought stressed land (such as, Barind), haors, etc.Three of the CRP projects, initiated between 2013 and 2015 are: a) Hill agriculture, which have 5 components (Jul 2013), b) Strengthening sugarcane research and development in the Chittagong Hill Tracts (CHT) (May 2015), and c) Climate change (Jul 2015, and, Later on, two more projects were initiated in early 2017: a) Research on development of hill livestock (Apr 2017),and b) Assessment of land suitability and crop zoning (Jun 2017).The status of these five on-going CRP projects is briefly described in the following section.

4.3.1 Project code and title: CRP-1. Harnessing the Potential of Hill Agriculture: Enhancing Crop Production through Sustainable Management of Natural Resources.

The main objectives of CRP-1are to explore the potential of and give a boost to agricultural production in the CHT region. The project has five components: i) Watershed management, ii) Sustainable land management, iii) Technology development and delivery, iv) Entrepreneurship & value chain development, and v) Coordination and management support

The components of CRP-1 are discussed in the following sections.

4.3.1.1. Component I: Watershed Management for Sustainable Agricultural Production

Implementing Organization: Hill Agriculture Research Station (HARS), Bangladesh Agricultural Research Institute (BARI), Khagrachari

Coordinator: Dr. Muhammad Nurul Alam, Cell phone: 01711822586, Email: coordinator-ha@kgf.org.bd

Component Leader: Dr. Munshi Rashid Ahmed, Chief Scientific Officer, HARS, BARI, Khagrachari;

Cell phone: 01748717603

Main objectives: Infrastructure development and management of watersheds for augmenting surface water supply for irrigation and domestic use.

Location: Selected watersheds in Sadar, Rwangchari and Thanchi upazilas of the Bandarban district, Sadar, Dighinala, Mahalchari, Ramgarh and Manikchari upazilas of the Khagrachari district, and Sadar, Longodu and Kaukhali upazilas of the Rangamati district.

Budget: BDT. 707.00 lakh

Background: The Chittagong hill tracts (CHT) region consisting of three hill districts, namely Rangamati, Bandarban and Khagrachari, covers about 10% of the total land area of Bangladesh. The landform of this region is mainly composed of hills and valleys. Most of the vallys are flat and broad where small streams, virgin forests and swams can be found. The vallys and low hills are suitable for farming. Many streams in this region are silted up or dried /disappeared as their watersheds areas were improperly used in the past. The agricultural production system in this region is severely limited due to water scarcity and severe soil erosion due to wrong farming practices. Apart from problem of flash flooding during monsoon, non availability of water for irrigation and drinking in the dry season has become the most critical problem of this region. Under these circumstances, there is an urgent need to make study on the watershed conditions of the region in order to identify the feasible options of conservation of surface water and rainwater harvest to facilitate irrigated agriculture and improve the situation of supplying drinking and domestic water supplies, especially in dry season. Under the component I of the project main aim was to explore the possibility of using different sources of water including rain water through appropriate water management technologies in order to increase cropping intensity, water and land productivity in some selected areas of three hill districts. To materialize this aim, delineation of watershed area and construction of hydraulic structures like dams, weirs, gates etc in the selected watersheds for conserving water for irrigation and domestic uses was undertaken. Training on watershed management was also done for awareness and knowledge building.

Progress: Collection of year round metrological data (temperature, rainfall, humidity and evaporation) at HARS, Khagrachari and water flow (discharge) data of two rivers (Chengi and Myni) and 14 creeks (*chhara*) is being continued. Also, hydrological data of three selected watersheds at Khagrabil (Ramghar), Ramripara (Bandarban) and Rasiknagor (Dhiginala) are being collected regularly. The design and cost estimate of rooftop rainwater collection systems have been completed. Twenty-seven items of irrigation equipment (tank, pipe and fittings/pump set) have been distributed to the hill farmers for developing irrigation facilities. The design, layout and cost estimate of four weirs and five dams at selected locations have been completed. Till June 2017, three rainwater harvesting devices (earthen dam) have been constructed at Noymail, Golakanapar and ComillaTilla. Two safe drinking water provisions at Aladon Para and Noy Mile of Khagrachari Sadar have been completed by installing artificial filters beside rainwater harvesting reservoirs. The first and second year irrigation scheduling experiments on sweet orange (*malta*) and cauliflower have been completed. It has been observed that two irrigations are enough to achieve commercially profitable production of sweet orange. So far, in 2016-17, three training programs have been organized for the scientists on: a) watershed management issues, b) use of remote sensing, and c) GIS for watershed delineation and characterization.

4.3.1.2. Component II: Sustainable Land Management

Implementing organization: Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur.

Main objectives: Development and delivery of land management technologies for sustainable crop production in the hills and to restore/maintain and enhance soil fertility for sustainable agriculture in hill areas.

Background: Productivity of hill soils is constrained by erosion, fertility depletion, strong acidity, inappropriate cropping and lack of proper management practices. *Jhum* cultivation is an age-old, rain-fed cultivation method, practiced by the indigenous people in the hills and slopes of the Chittagong Hill Tracts (CHT). The jhum or shifting cultivation system involves a "slash and burn" practice—chopping off vegetation and clearing large areas of the hillside by setting fire. About 40,000 households are engaged in *jhum* cultivation in CHT. Traditionally j*hum* has been practiced as a multi-crop production system where seeds of several crops, such as, rice, sesame, cotton, sweet gourd, marpha, etc. are simultaneously sown as seed mixtures in the same field. However, presently rice makes up 90-95% of the seeds in the jhum seed mixture leaving room for very few other crops. Diminishing soil fertility is a major constraint to sustained high yields in j*hum*cultivation in CHT. So, to restore the soil fertility and to increase the productivity of jhum, a judicious application of fertilizer is a must.

Progress: Last year (2015-16) results of the field trials indicated that soil loss was higher in well tilled soil + no crop (145.25 t/ha in a 19-20% slope) at the Khagrachari site. A soil loss of 20 t/ha (tillage + no crop) compared with 56.44 t/ha (well tilled soil+no crop) was observed at the Bandarban site. A soil loss of 50.04

t/ha was observed for a slope measuring 30 m in length. Soil loss decreased with decreased slope length. Besides, experiments on *jhum*, intercropping, rice+ cotton and their fertilizer management, etc. were conducted. A rice yield of 3.0 to3.5 t/ha rice with fertilizer doses of 60 kg N+20 kg P+30 kg K/ was obtained. While continuous *jhum* cultivation during the last 4years on the same piece of land with the same fertilizer doses gave almost the similar results. Information generated by these experiments has generated keen interest among the *jhumia* people, and has a good potential of contributing food security for the indigenous people of CHT.

4.3.1.3. Component III: Development and Delivery of Intensive Crop Production Technologies for Hill Agriculture

Implementing Organization: Bangladesh Agricultural Research Institute (BARI), RARS, Hathazari, Chittagong

Main objectives: To improve the *jhum* system for enhancing production and reducing environmental degradation and to conduct strategic and applied research for developing appropriate crop production technologies suitable for uplands and valleys.

Background: The Chittagong Hill Tracts (CHT) has good prospects of becoming an agriculturally productive region of the country. This region comprises about one tenth of the total agricultural land area of the country. *Jhum* cultivation is the indigenous practice in the hills, but the productivity is low. With a view to improving the local production systems the present study was designed to assess the existing *jhum* cultivation system and develop an improved *jhum* system, by i) identifying location specific alternative cropping systems for the hill slopes, ii) developing appropriate management practices for quick growing fruits as well as perennial ones on the hill slopes, iii) developing suitable production packages for vegetable on the hill slopes and valleys, iv) suggesting appropriate production packages for maize and other cereals in the hilly areas, v) developing sustainable techniques for enhancement of hill soil fertility, vi) identifying suitable varieties and appropriate techniques for cotton production in the farming system, vii) assessing socio-economic impacts of generated the technologies and innovations generated. The project was launched in October 2013 in three hill districts of Bangladesh.

Progress: During 2016-17, 12 black pepper orchards were in the Bandarban district. Other activities included the establishment of 83 homestead gardens, 205 mango orchards, 35 litchi orchards, 24 Banana Orchards, 15 *malta* orchards, 15 Papaya orchards, 19 maize plots, 6 summer tomato plots (BARIhybrid tomato-4), 8 *panikochu*plots, 24 BARI Lau-4, 30 BARI jharsheem-3 and 14 BARImishtikumra-1 were planted. Also, vegetable production through homestead gardening was initiated following the Khagrachari Model and the Modified Khagrachari Model. The Modified Khagrachari Model became popular as many vegetables were introduced and consumed. The Modified Khagrachari Model increased vegetable consumption by about 171% over the existing model. In the homestead, 32 BARI released vegetables and other varieties released by other NARS institutes and

relevant production technologies were introduced which had distinct marketable production advantages over the existing practices. Eight experiments on weed control were conducted successfully. Hand weeding was found to be effective in obtaining a higher yield from *jhum* crops. Major insect pests were identified and their behavior studied *jhum* rice-cotton intercropping. Seven experiments were being conducted to develop insect pest management technology. Experiments on time of sowing, fertilizer management, varietal screening and up scaling of cotton were also conducted.

4.3.1.4. Component IV: Entrepreneurship and Value Chain Development for Linking Farmers with Market

Implementing organization: Regional Agricultural Research Station (RARS), Bangladesh Agricultural Research Institute (BARI), Hathazari, Chittagong

Main objectives: To promote and develop entrepreneurship in agri-business for generating income and reduction of poverty in CHT.

Background: Agriculture in Chittagong Hill Tracts can benefit from the emerging market opportunities. Development of viable and sustainable value chain requires new relationships, networks, skills, and coordination mechanisms to manage the flow of products among intermediaries and end users and ensure that quality specifications are met. This project was planned to achieve the specific objectives (i) to assess, develop and upgrade existing supply/value chains of selected vegetables and fruits and linking hill farmers with markets (ii) to develop value added products applying post-harvest technologies and measure the business performance and (iii) to promote and develop entrepreneurship in agri-business for generating income and reducing poverty in CHT, and (iv) follow-up actions for entrepreneurs and value chain actors in CHT.

Progress: As per the revised project inception report, out of 5 identified activities, 4 have been completed. To ensure safe fruit production and marketing, the fruit bagging technology was demonstrated among the project farmers in three hill districts, i.e., Bandarban, Khagrachari and Rangamati adopted the technology. Fruit protection paper bags were supplied to the farmers associated with the fruit growers' organization. Before disseminating the technology to the farmers, a hand on training on fruit bagging was organized in Khagrachari. In total, 4000 pc sof the fruit protection paper bag were supplied for mango, 1000 for litchi and 300 for banana. Farmers got higher prices (32% to 67%) for bagged compared with non-bagged mangoes. The price benefits were 56% for banana and 48% for litchi. A survey was completed covering 180 sample farmers at the 6 selected locations of Khagrachari and Rangamati. Three leaflets were published on (i) fruit bagging technology of mango and marketing strategy in hill, (ii) fruit bagging technology of banana and marketing strategy in hill, and (iii) commercial nursery management and marketing for entrepreneurship development in hill. A total of 9 sales centers/outlets were established of which 5 were in Khagrachari, and one each at Korerhat, Mirer Sarai, Hathazari, Rangamati and Dhaka (National Fruit Fair). A marketed opportunity survey selected fruits (banana, sweet orange etc.) was conducted covering 120 sample farmers in selected areas of Khagracahri (90) and Rangamati (30). Another survey was done covering 240 sample farmers in selected areas of Khagracahri (120), Bandarban (90) and Rangamati (30).

4.3.1.5. Component V: Coordination and Management Support Unit

The Coordination and Management Support Unit (Component V) of CRP-1 (Hill Agriculture) is headed by a Coordinator recruited directly by KGF and posted at RHAR Station, Harhazari, and Chittagong. Monitoring and coordination of different CRP projects and components of CRP-1 is the prime function of the Coordinator. During the year 2016-17, the Coordinator performed the following major responsibilities:

- Regular monitoring/field visits of different components Facilitated the organization of required numbers of training and field days as per project plan and attended many of them to ensure quality training
- Organized the 5th coordination meeting in September 2016 with PIs and other project officials. Altogether 20 participants attended the meeting where the KGF HQ was represented
- Out of a total 8 planned training programs, 6 were completed in earlier years and the remaining two were organized by the current Coordinator in Nov 2016. Twenty participants attended each of the training courses
- The Coordinator compiled 3 half yearly and the 3rd annual report of CRP operating in CHT

4.3.2 Project code and title: CRP -2. Modeling Climate Change Impact on Agriculture and Developing Mitigation and Adaptation Strategies for Sustainable Agricultural Production in Bangladesh

Principal Investigator: Dr. Jatish C Biswas, Chief Scientific Officer, Soil Science Division, Bangladesh Rice Research Institute (BRRI), Gazipur 1701

Implementing Organizations: BRRI, Gazipur; BARI, Gazipur; BSMRAU, Gazipur and KGF, Farmgate, Dhaka

Location: BARI, BRRI, BSMRAU, with locations at Gazipur, Dinajpur, Rajshahi, Jessore and Barishal

Project Duration: July 2015- June 2018

Budget: BDT. 1997.07 lakh

Background: Modeling has been a powerful tool to i) predict climate change, its impact on economic sectors, simulate ii) scenarios of vulnerability, iii) make projections regarding the impact of climatic variability and climate change on agricultural productivity and livelihoods. To be adequately prepared for coping with climate change scenarios and assisting farmers with climate resilient agricultural production technologies, KGF felt it necessary to equip NARS scientists and institutions with modern tools and techniques that empower them to deliver the goods and services. In 2012-13, KGF organized training on climate change impact on agriculture in three sessions where 54 scientists from 14 NARS institutions and two agricultural universities participated. The participants received hands on training on modeling climate change. Most trainees are at their mid-career stages of different disciplines.KGF also constituted a National Committee on Climate Change on Agriculture involving all the trainees and participating institutions. In turn, the trainees prepared a project proposal, "Modelling climate change impact on agriculture and developing mitigation and adaptation strategies for sustaining agricultural production in Bangladesh" and submitted it to KGF for funding under CRP.

Main objectives: To develop the capacity of risk assessment in relation to climatic variability and climate change on agricultural production and developing the best management practices for adapting Bangladesh agriculture to climate change scenarios.

Progress: Climate change is a major concern for future agriculture in Bangladesh. A group of scientists from BARI, BRRI, and BSMRAU together with KGF is involved in implementing the different plans and programs of the project. Historical weather data, secondary and primary data on crop, soil, water, analysis of seasonal maximum and minimum temperatures along with annual rainfall trends for selected districts and statistical tools, ArcGIS, DSSAT and Idrisi software's have been utilized in developing the models. The group studied and analyzed responses of mainly rice, wheat, maize, potato, mustard and mungbean to climate change and their adaptation and mitigation strategies, and developed a model. The model has been successfully calibrated and validated for the Gazipur environment and can now be used for climate change impact studies for similar environments in Bangladesh. Vulnerability of crops to climate change in Bangladesh can become a real threat to agricultural production in Bangladesh. The impact of seasonal climatic variability on rainfed lowland rice (wet season T. amen rice). Yields in north-west Bangladesh were analyzed based on historic weather data (1971-2010). Wet season maximum and minimum temperatures increased by 0.0174 and 0.0083°C/yr, respectively. Sunshine hours decreased by 0.0259-0.027 hr/yr. The RCPs based projection showed that the maximum and minimum temperatures would increase by 0.42-1.51 and 0.79-1.34^{o}C, respectively, in 2050. T. aman rice yield could be reduced by 0.17-0.37 t/ha if temperature rises by 1^{o}C.Ifsunshine hour decreases by 1 hr, yield reduction could be 0.20 t/ha. The combined effect of increased temperature and decreased sunshine hours will dictate T. aman rice yield in future. Temperature tolerant and solar radiation use-efficient rice varieties need to be bred and developed for adaptation to climate change impacts in north-west Bangladesh. The projected rice yields by location are shown in Table 4.3.2.1.

Table 4.3.2.1.: Descriptive Statistics of Historic T. aman Rice Yields and Weather Data (1971-2010), North-West region of Bangladesh

Statistics	Yield (t/ha)				
	Rajshahi	Dinajpur	Rangpur	Bogra	All
Mean	2.41	2.39	2.57	2.64	2.50
Std. dev.	0.74	0.50	0.43	0.53	0.55
Maximum	3.78	3.73	3.37	3.76	3.66
Minimum	1.35	1.63	1.80	1.59	1.59
Skewness	0.34	0.88	0.17	0.01	0.35
Kurtosis	-1.17	0.49	-1.04	-1.06	-0.70

4.3.3. Project code and title: CRP- 3. Strengthening Sugarcane Research and Development in the Chittagong Hill Tracts

Principal Investigator: Dr. A mzad Hossain, Director General, Bangladesh Sugarcrop Research Institute (BSRI); Cell phone: 01718426200; E-mail: dg-bsri@bsri.gov.bd

Implementing Organization: BSRI, Ishwardi, Pabna

Location: Khagrachari, Rangamati, Bandarban

Budget: BDT. 1026.86 lakh

Main objectives: Development of high yielding, disease resistant chewing and *gu*ru type sugarcane varieties suitable for growing in the Chittagong Hill Tracts (CHT).

Background: Agro-climatic conditions of some parts of CHT present an excellent opportunity for sugarcane breeding. Sugarcane does not flower in larger parts of Bangladesh where sugarcane is usually grown. Sugarcane breeders of BSRI conduct breeding research which is largely constrained by the non-flowering nature of the sugarcane gramplasm maintained at the gramplasm bank of the institute. Of a total of 1100 clones in the BSRI germplasm bank, only 325 (30%) flower while the rest (70%) are non-

flowering types. For years, BSRI hybridization work has continued routinely practicing around 700-800 cross combinations annually utilizing only 100-150 available male and female clones, resulting in the generation of the same types of clones year after year, obviously due tithe non-availability of new or diverse genome in cross combinations. Thus, no significant varietal improvement or break-through has been achieved so far. However, there are encouraging observations that some hitherto known non-flowering varieties flower at Bandarban and Noakhali because of the proximity of these two locations to the sea. Also, many. *spontaneum* land races flower profusely in the CHT natural environment. It is reasonably expected that incorporation of *spontaneum* traits in future cane hybrids will add to stress tolerance, particularly against pests and diseases. The ambient temperature and photoperiodic conditions favor sugarcane flowering in the south-western part of Bandarban (Lama, Ali Kadom, and Naikhongchari) and in Kowkhali of Rangamati. The establishment of a sugarcane breeding research station in Bandarban and one crossing shed at Kowkhali will help enhance sugarcane breeding for CHT and as well as other regions of Bangaldesh.

Tobacco has been an invasive crop in the hill districts. It competes with most winter crops. Being allured by potential cash returns and buy-back guarantees from the tobacco companies, farmers are increasingly adopting tobacco cultivation. Growing sugarcane intercropped with high value crops is reported to be more remunerative than tobacco. In the mill zones, the average yield of sugarcane is 50 t/ha. On the other hand, the average yield of sugarcane in hill district is over 100 t/ha. It is observed that disease and pest infestation is negligible in comparison with that in the sugar mill areas.

This project seeks to strengthen the research capability of BSRI and generate improved technologies including high yielding varieties suitable for chewing and *goor* making for growing in the hill districts. It also aims at improving incomes and livelihoods of hill farmers through production of sugarcane with assorted high-value intercrops and *goor* making. Enhanced production and utilization of *goor* may bring in required cash for household level processing of locally produced surplus and easily perishable fruits and vegetable like pineapple, guava, tomato, etc.

Progress: Tillage with 9'' deep trenches with a row-to-row distance of100 was found to be superior to conventional tillage. In CHT, October planting gave better results with 125% of RFD of intercropping systems with sugarcane in Bandarban with the trend: Tomato>chili> radish> potato> sweet potato> peanut>French bean with profit levels ranging from Tk. 37,000 to81,500/ha. While in Rangamati the trend was**:** Radish>tomato> carrot>French bean> onion> garlic where profits achieved were between Tk. 14,225- and 75,000/ha, in Khagrachari the trend was peanut>tomato> chili> cabbage> carrot> potato> radish> French bean with profits ranging from Tk. 26,550to 92,000/ha. The BSRI identified varieties BSRI Akh 42, BSRI Akh 41 and VMC 86-550 are suitable for *goor* making. On the other hand, the varieties BSRI Akh 42, BSRI Akh 41, Co 208 and China performed almost equally well as chewing cum juice canes. The varieties BSRI Akh 42 and VMC 86-550 were found to have better ratooning potential.

Sugarcane hybridization. Forty clones that are of non-flowering nature at Iswardi, flowered at Bandarban. Twenty bi-parental field crosses were made in addition to 11 varieties salted. The 20 field cross yielded 262 g fuzz and 11 selfing-clones yielded 138 g fuzz which are currently being preserved in deep freezer (-20^{o}C) at Bandarban.

Training and technology transfer. Training sessions on technologies for sugarcane and intercrops, *goor* production, value addition, entrepreneurship, etc. and field demonstrations of varieties and relevant production technologies were conducted for farmers, agriculture extension officials and entrepreneurs were conducted in the CHT districts of Bandarban, Khagrachari and Rangamati. A total of 1260 stake holders attended these training sessions and field days (Table 4.3.2.1).

Table 4.3.2.1: Training and Technology Transfer Activities

Activities	Number of participant			
	Bandarban	Rangamati	Khagrachari	Total
Training of Farmers on production of sugarcane and Intercrops	360	240	480	1080
Training of Farmers on Goor production technology	200	200	200	600
Training of Farmers/Entrepreneurs on Value addition of Intercrops	120	200	200	520
Training of Sub Assistant Agriculture Officers (SAAOs) of DAE	150	120	180	450
Training of Upazila Agriculture Officers/ Agriculture Extension Officers (UAOs/AEOs) of DAE	30	-	30	60
Field Days (FDs) organized to demonstrate improved varieties, cultural practices and intercropping etc.	420	280	560	1260

4.3.4. Project code and title: CRP- 4. Increasing Livestock Production in the Hills through Better Husbandry, Health Service and Improving Market Access through Value and Supply Chain Management

Coordinator: Prof. Dr. Md. Kabirul Islam Khan, Chittagong Veterinary and Animal Sciences University (CVASU); Phone: +88 031 659224; **Email:** kik1775@yahoo.co.uk/vccvasu@gmail.com

Implementing Organization: CVASU, Chittagong

Location: Animal Nutrition Laboratory and Poultry Research and Training Centre (PRTC) under CVASU; different upazillas of the Chittagong Hill Tracts (CHT) districts of Bandarban (Sadar and Naikhongchari upazilla) and Khagrachari (Sadar and Panchari upazilla).

Budget: BDT. 549.50 Lakh

Main objectives: Understanding the problems and prospects of livestock production in the hill districts of Bangladesh and enhancing livestock production through improved health and nutrition management services and livestock product value chain development in the hills.

Background: Farmers in the CHT districts rear cattle, goats, pig, *gayal* and poultry for their livelihood. Increased livestock and poultry productivity through introduction of balanced feeding system, fodder cultivation, good husbandry practices, improved veterinary health care services, validation and up-scaling of improved technologies, development of marketing facilities, introduction of community livestock workers, providing training and motivation on livestock rearing and creation of job opportunities, etc. would help improve the livelihood of hill people. Value addition to the livestock and poultry products (meat, eggs, milk, etc.) is needed through adequate training on processing, packaging and marketing. This project was initiated in April 2017 to address these issues in the CHT districts.

This is a coordinated project. Four organizations/institutes, CVASU, PRTC, Bangladesh Livestock Research Institute (BLRI) and Integrated Development Foundation, IDF (NGO) are involved with the project activities. Project activities include a baseline survey to assess the problems and prospects of livestock production in the CHT districts. Based on the results of this survey and on field observations, 200 farmers are planned to be selected as beneficiaries and 20 community livestock workers are to be developed through hands on training. The major livestock diseases including zoonotic diseases would be identified and regular disease control measures introduced. Different perennial grasses and seasonal fodders, including fodder trees, will be cultivated, and, in addition, fodder processing and preservation methods will be researched and developed. For enhancing livestock production system, validation and up-

scaling of improved technologies developed by BLRI for local variety livestock species (Red Chittagong cattle (RCC), sheep, black Bengal goat, hilly chicken, etc.) will be done and their production potentials and adaptability evaluated. Development of marketing channels for value addition products (meat, milk, eggs, etc.) from these species will be attempted. This will enable access of CHT branded products to the city markets ensuring a boost to the primary producers' incomes.

Progress: The project is at the initial stages of implementation. Inception workshop of the project was held in May 2017. The questionnaire for bench mark survey has been developed. Recruitment of project staff has been started.

4.3.5 Project code and title: CRP-5: Development of Upazila Land Suitability Assessment and Crop Zoning Systems of Bangladesh

Coordinator: Dr. Md. Aziz Zilani Chowdhury, Member-Director, Crops Division, Bangladesh Agricultural Research Council (BARC), Dhaka; Cell phone: 01552355393, Email: ec-barc@barc.gov.bd

Implementing Organization: BARC, Dhaka

Main objectives: To provide crop suitability information to different stakeholders including farmers on the choice of rotation of their crops that would ensure increases in food production and farmers' incomes. The specific objectives are creating, updating and validation of land/crops suitability data bases as drivers of appropriate farming practices and sustainable socio-economic development in Bangladesh, and development of online GIS based software for crop land suitability assessment.

Budget: BDT. 1634.55 lakh

Background: Crop zoning is the art of choosing the right crop for the right environment in the in the context of the need for optimizing crop production through judicious use of land and water resources. The purpose of crop zoning is to make the best and sustainable use of scarce land and water resources for crop production. But, even in the agro-ecologically best suitable areas, the success or failure of a crop depends on economic and social factors related to the crop growers. FAO introduced a concept for assessing the crop production potential, where length of the growing period zones is very useful as it describes an area within which rainfall and temperature conditions are suitable for crop growth for a given number of days in the year. Realizing the importance of proper utilization of agricultural land, the Govt. of Bangladesh (GoB) undertook a study on Land Resources Appraisal with the assistance of FAO/UNDP which continued through the period 1984-1988 and successfully ended with a database of land resources inventory of Bangladesh popularly known as AEZ database which is composed of reconnaissance soil survey data (surveys conducted during the period 1963-75). In the year 2010, BARC initiated crop zoning activity according to the decision taken in the annual development program meeting of the Ministry of Agriculture. Land suitability assessment and crop zoning of 17 major crops were done using this national level (1:250,000 scale) land resources inventory database. There are some shortcomings which are (i) the AEZ database with 1:250,000 scales is suitable for national level planning not for local level considering the low resolution of the database; (ii) the AEZ database has not been updated since 1988, so updated soil data (soil pH, drainage, flooding depth, soil moisture, etc.) were not used for crop zoning, and (iii) crop zoning for single crops was done but cropping pattern suitability was not considered.

This project is very important and constitutes a timely endeavor considering the increasing demand for food production by means of optimum land use and its conservation. It is also aligned with the Gob 7thFYP policies and strategies for the crop sub-sector where emphasis has been given on crop zoning and land use planning. Once implemented, the project will provide upazila wise necessary information in the context of agriculture production planning, inputs availability and requirements, etc. among different stakeholders, especially farmers' communities. In addition, online accessibility to the crop suitability assessment software will provide users with the options to select the right crops/cropping patterns. These will ensure an increase in food production and enhancement of farmers' incomes.

Progress: The project was initiated in June 2017. So far, the 1st installment of funds, amounting to 20% of the 1st year's budget has been released. The project inception workshop has not yet been held. Manpower recruitment is in progress.

4.4 Capacity Enhancement Program (CEP)

4.4.1 Project code and title: CEP-1. Capacity Enhancement of NARS through Agricultural Research Management Information System (ARMIS)

Implementing Organization: Bangladesh Agricultural Research Council (BARC), Dhaka.

Principal Investigator: H. M. Hamidur Rahman, Senior System Analyst, Computer and System Analyst, BARC, Dhaka

Location: BARC, Dhaka.

Budget: BDT**.** 40.327 lakh

Background: In Bangladesh, the NARS institutes under the leadership of BARC, the universities and a number of other agencies are engaged in agricultural research and development activities. Through their work, they have by now, generated a significant number of problem solving technologies, which have notably contributed towards enhancement of agricultural productivity and self-sufficiency in food, especially cereals. Besides, much useful research information has also been made available, which is acting as an input for further investigation and in making research more responsive to the field level complexities and demands. Unfortunately though, in many cases, information on these technologies/innovations is scattered and not maintained in an organized manner as a central database system. As a result, valuable information is either lost or is not readily available to plan and initiate new research programs/projects.

In this context, for effective management of agricultural research, BARC as a part of its mandated responsibilities undertook the ICT- based research management information system-ARMIS project.

Progress: The ARMIS project started in July 2013 and completed the activities in two phases by 31 August 2016 with the submission of the Project Completion Report (PCR) to KGF. Data were collected by consulting 102 reputed journals belonging from 150 organizations/agencies. Altogether, 25000 research entries from 250 sources have been covered in the final report. The ARMIS project was designed and implemented as an integrated online centric system in which information on research title, abstract, institution, researcher information, objectives, methodology, duration, major findings, keywords, and so on are archived and can be made available as per client needs.

4.4.2 Project code and title: CEP-2. Capacity Building for Conducting Adaptive Trials on Seaweed Cultivation in Coastal Areas

Co-coordinator: Dr. Md. Aziz Zilani Chowdhury, Member Director (Crops), Bangladesh Agricultural Research Council (BARC), Dhaka; Cell phone: 01552355393, Email: ec-barc@barc.gov.bd

Implementing Organizations: BARC, Dhaka,

Bangladesh Agricultural Research Institute (BARI), Gazipur and University of Dhaka (DU)

Location: Cox's Bazar, Chittagong

Budget: BDT. 2, 67.02 lakh

Main objectives: Situation analysis and mapping of seaweed farming along the Teknaf/Cox's Bazarcoast for year-round seaweed production, screening of potential species, laboratory study of the biology of 'multi-step' seed production of some delicate seaweed species.

Background: Bangladesh is the country most vulnerable to global climate change. Introduction of massive 'seaweed culture 'may contribute toCO_2 sequestration, it could be a mechanism of adaptation to environmental changes in the wake of salinity increase in crop fields, and also act as a new source of revenue that would enhance the economic value of the Bangladesh's coastal waters. The goal of the project was to introduce cultivation of seaweeds of commercial importance along the Bangladesh coast.

Progress: Adaptive trials for the cultivation of 8seaweed species, such as, *Hypnea, Asparagopsis,* and *Chrysymenia* (among reds), *Caulerpa* and *Ulva* (among greens), and *Dictyota, spatoglossum,* and *Sargassum* (among browns) were carried out in a nursery (land-based system) connected with the Naf river estuary at Noapara, Teknaf, Cox's Bazar as well as in open sea at Nuniachara, Cox's Bazar.

In the Teknaf situation, growth of different seaweed species was very good until 30 days after transplanting (DT) on April 8, 2016. After 30 DT, growth was stunted due to high water turbidity. Two species, *Hypnea* and *Caulerpa,* survived until 70 DT on May 5, 2016, but their growth beyond 30 DT was not satisfactory. The remaining five species did not survive due to high temperature and high water turbidity. Seaweed culture in the rainy season may not be possible in Teknaf as water salinity decreases with increased rainfall. As the Naf river bank was highly clayey, water wave carries turbid water into the nursery which was harmful for seaweed culture. Considering the changed situation, a new site at Nuniarchara, Cox's Bazar was selected. About4 ha area of the sea beach was used to set up experiments in November, 2016. In the open sea culture, the performance of *Hypnea* species in single rows was better than that in the double row system (Table 4.4.2.1). Another experiment was set up to study the effect of harvest interval on the yield of *Hypnea*. The highest yield was obtained from a harvest interval of 40 days while the 10-day harvest interval gave the lowest yield (Table 4.4.2.2). The experiment on the effect of spacing on the yield of *Hypnea* showed the highest yield with 20 cm spacing while 40 cm spacing gave the lowest yield (Table 4.4.2.2). An experiment on the performance of seaweed species in the open sea was set up with different seaweed species. After 30 days, only two species, *Sargassum*and *Hypnea*, survived. Other seaweed species did not survive due to high turbidity and high waves. The species *Hypnea musciformis*, gave a lower yield in the experiments conducted in the 2nd year (October 2017) than that obtained in the previous year (November 2016) mainly due to lower salinity, higher rainfall and higher water turbidity in the latter year. Turbidity was higher in 2017 because of dredging of the Moheshkhali Channel, Cox's Bazar.

Table 4.4.2.1: Performance of *Hypnea* Species in Single and Double Row Planting in Open Sea Culture in Nov 2016

Parameter	Single row	Double weight	Weight (Kg/m2)	
			Single row	Double weight
Fresh weight (g)	16.88	34.25	6.17	5.09
Dry weight (g)	6.24	7.21	0.98	0.78
Length (cm)	6.67	14.31		

Table4.4.2.2: Seaweed Yield as Affected by Spacing and Harvest Interval, at Nuniarchar, Nov/Dec 2016

Harvest interval (day)	Fresh weight (g)	Dry weight (g)	Spacing (cm)	Fresh weight (g)	Dry weight (g)
10	38.82	4.76	10.00	126.86	16.58
20	136.62	17.18	20.00	357.20	44.29
30	322.44	38.87	30.00	421.54	47.67
40	460.57	57.93	40.00	432.53	52.43
50	356.89	40.56			
Mean	263.07	31.86		334.53	40.24

4.4.3 Project code and title: CEP-3. Mitigating Greenhouse Gas (GHG) Emissions from Rice-Based Cropping Systems through Efficient Fertilizer and Water Management

Principal Investigator: Dr. Rafiqul Islam, CSO, BRRI, Gazipur, And Cell: --- & Dr. M. Rafiqul Islam, Prof, Dept of Soil Science, BAU, Mymensingh, and Cell: 01711985414

Location: BRRI Research Stations and BAU Farm, Mymensingh

Main objectives: To quantify GHG (methane, nitrous oxide and nitric oxide) emissions from rice-based cropping systems under different water and fertilizer management practices and to find out efficient nitrogen and water management technologies that increase crop productivity and mitigate GHG emissions.

Budget: BDT. 88.00 lakh and 79.99 lakh for BRRI and BAU, respectively.

Background: In Bangladesh, 80% of agricultural land is devoted to rice cultivation. The wetland rice fields which emit methane and nitrous oxide, two major greenhouse gases (GHG). It is estimated that rice farming alone contributes 7.2% of the total GHG emission in Bangladesh. This estimate was made using default emission factors due to a lack of measured data. Quantification of GHG emissions is necessary to develop proper mitigation strategies, but there have so far been no direct measurement of methane emission from rice fields in Bangladesh. Moreover, there is a lack of trained manpower to conduct climate change mitigation research in the country.

Fertilizer deep placement (FDP) is recognized as one of the best fertilizer management practices that can reduce nitrogen fertilizer use by 30% and increase rice yield by 15-20%.FDP is increasingly used in Bangladesh. The alternate wetting and drying (AWD) technology is being promoted because it saves irrigation water by up to 38% and reduces irrigation costs. Although the government encourages the use of both FDP and AWD technologies, their capability to mitigate GHG emission has not yet been fully measured. Research on GHG emission mitigation options while increasing rice productivity, is crucial in the context of climate change. The first phase of the GHG project quantified the nitrous oxide and nitric oxide emissions under continuous flooded conditions. However, benefits of FDP and AWD technologies on rice in terms of emission of methane, a major GHG, have not yet been measured.

Progress:

i) BRRI

Yield and N efficiency

Eight fertilizer treatments with different N rates, sources and IPNS based organic amendments were tested in t. amen 2016, boro 2017 and t.aus 2017. In the aus and aman seasons, deep placement of urea briquettes (UBD) significantly increased grain yield compared with broadcast prilled urea (PU) at 52 kg N/haunder both AWD and continuous standing water (CSW)regimes. In the boro season, UBD also increased rice yield than that of PU with both water management options. IPNS organic amendments, particularly

UB+IPNS with poultry litter (PL) significantly increased rice yield compared with broadcast PU with both water regimes (Table 4.4.3.1). Nitrogen use efficiency was the highest (75-76%) with UBD.

Table 4.4.3.1: Grain Yield, total N Uptake and N Recovery Efficiency (NRE) of Rice (BRRI dhan28) in AWD and CSW Conditions as Affected by N Sources and Management, BRRI-Gazipur, boro 2017

Treatment	N-rate (kg/ha)	AWD			CSW		
		Grain yield (t/ha)	N-uptake (kg N/ha)	NRE (%)	Grain yield (t/ha)	N-uptake (kg N/ha)	NRE (%)
Control	0	2.7e	32.4d	–	3.2d	38.3e	–
UBD	78	6.1a	90.7a	75a	6.2a	97.2a	76a
PU by applicator	78	5.1bcd	64.2c	41b	5.9ab	74.6cd	47c
PU	78	4.9cd	63.1c	39b	5.5bc	74.0cd	46c
PU	104	5.5abc	79.6b	45b	5.7ab	85.1abc	45c
PU+ IPNS with VC	78 (39+39)	4.5d	65.7c	43b	4.9c	66.6d	36c
UB+ IPNS with PL	78 (39+39)	5.8ab	81.0ab	64a	6.1a	89.7ab	66ab
PU+ IPNS with PL	78(39+39)	4.9cd	67.8c	45b	5.6ab	77.4bcd	50bc

*In t. aman 2016, PU was applied as broadcast @ 104 kg N ha^{-1}. PL and VC indicate poultry litter and vermicompost, respectively. Emissions measured from T1, T2, T4 and T8 treatments. NH_3 volatilization measured from T1, T2, T4, T5 and T8 treatments. All other nutrients used as recommended by BRRI

Floodwater NH_4-N and NH_3 volatilization

The concentration of NH_4-N in floodwater was consistently higher in broadcast PU plots and reached peaks after 2-3 days of fertilizer application, but it was almost negligible in UBD plots, irrespective of season (Fig.4.4.3.1). In contrast, PU+IPNS with PL and VC showed slightly higher floodwater NH_4-N, while almost negligible floodwater NH_4-N was observed in UB+IPNS with PL treatment.UBD and PU and IPNS based organic amendments significantly reduced NH_3volatilization compared to PU treatment.

Cumulative N_2O-N and NO-N emissions

Cumulative N_2O-N fluxes were measured from control, UBD, PU and PU+IPNS with PL treatments in AWD water regime. In the boro season, no significant variation in total N_2O fluxes between UBD and PU was observed in (Fig. 4.4.3.2). However, IPNS based organic fertilizer, i.e., PU + IPNS with PL and control treatment produced less cumulative N_2O fluxes than PU or UB. Higher N_2O emission from UBD might be associated with greater non-exchangeable NH_4^+ substrate. Moreover, frequent nitrification and de-nitrification in the season may lead to more emission. Cumulative emissions of N_2O and NO (November 2016–January 2017) from mustard field (2016) are presented in Fig. 4.4.3.3. Broadcast PU significantly increased seasonal cumulative N_2O and NO fluxes compared with N control and RN (residual N of previous crop from PU+IPNS with PL) treatments. The control treatment showed similar seasonal cumulative fluxes as the RN treatment. It might indicate that RN of the previous crop from organic and inorganic fertilizer was negligible.

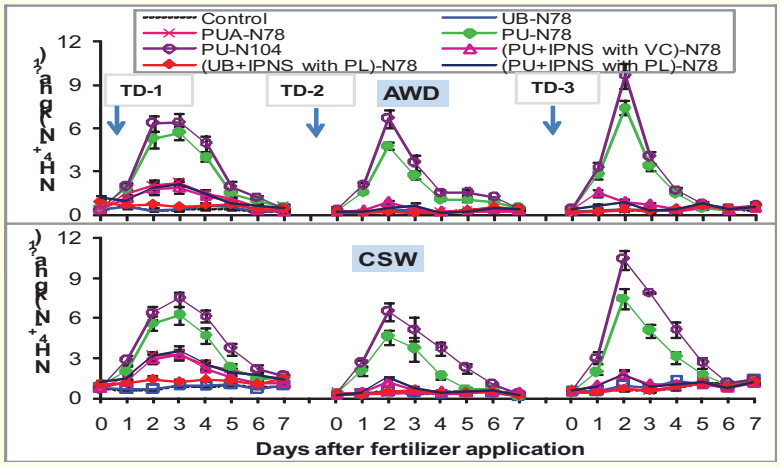


Figure 4.4.3.1 Floodwater NH_4^+-N in AWD and CSW conditions in rice field at different times after fertilizer application, BRRI farm, Gazipur, boro 2017

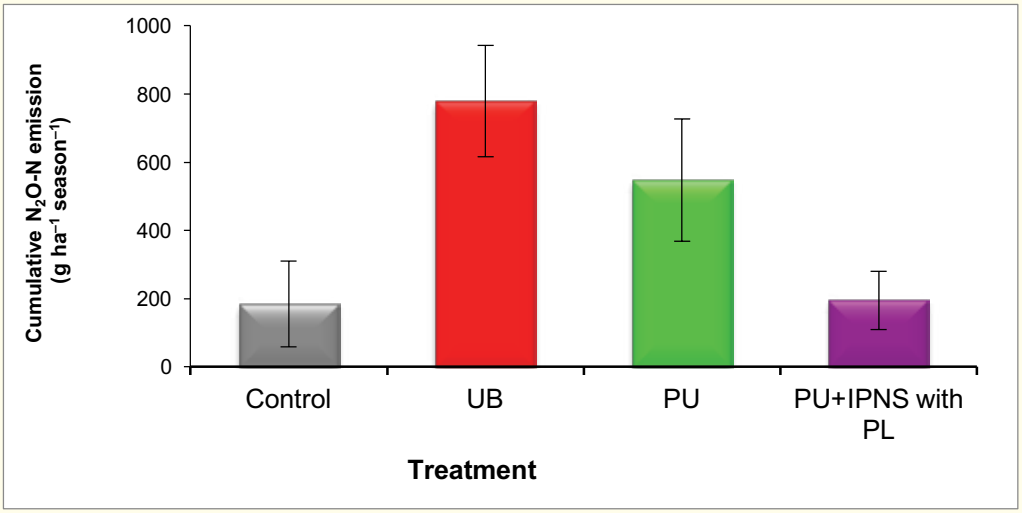


Figure 4.4.3.2: Effect of N source and method placement on cumulative N_2O and NO-N emissions from rice field under AWD condition, BRRI farm, Gazipur, boro 2017. Vertical bars indicate SE of mean (n=3).

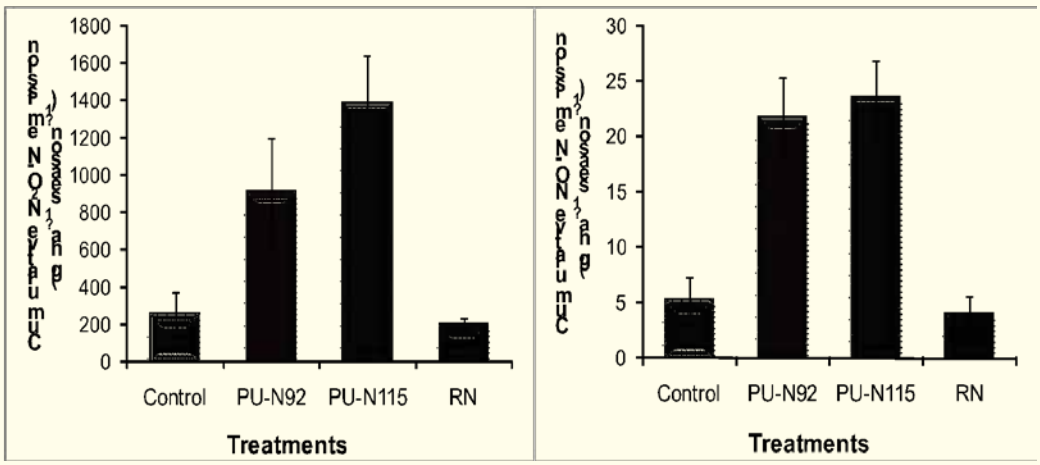


Figure **4.4.3.3**: Effect of N source and method of placement on cumulative N_2O and NO-N emissions from a mustard field (2016), BRRI farm, Gazipur. PU = prilled urea and RN = residual N from previous crop. Vertical bars indicate SE of mean (n=3).

Methane emission

We estimated CH_4mission from rice fields by using the Cool Farm Tool Beta 3 device. The gas chromatography GC) system has been calibrated and will be used in the coming season for CH_4 measurement. Estimated CH_4 emissions from t. as, t. amen and boro rice fields are shown in Table 4.4.3.2. Methane emissions varied from 297-445 kg/ha/season depending on season. These results will be verified through GC in the coming seasons.

Table 4.4.3.2: Methane emission from rice fields in different seasons, BRRI farm, Gazipur

CH_4 emission (kg/ha/season)		
T. aman 2016	Boro2017	T. aus 2017
393	445	297

ii) BAU

The magnitude of ammonia (NH_3) volatilization loss from PU plots increased with increasing N rate, butNH_3volatilization from urea deep placement (UDP) plots was negligible irrespective of N rate (Fig. 4.4.3.4).

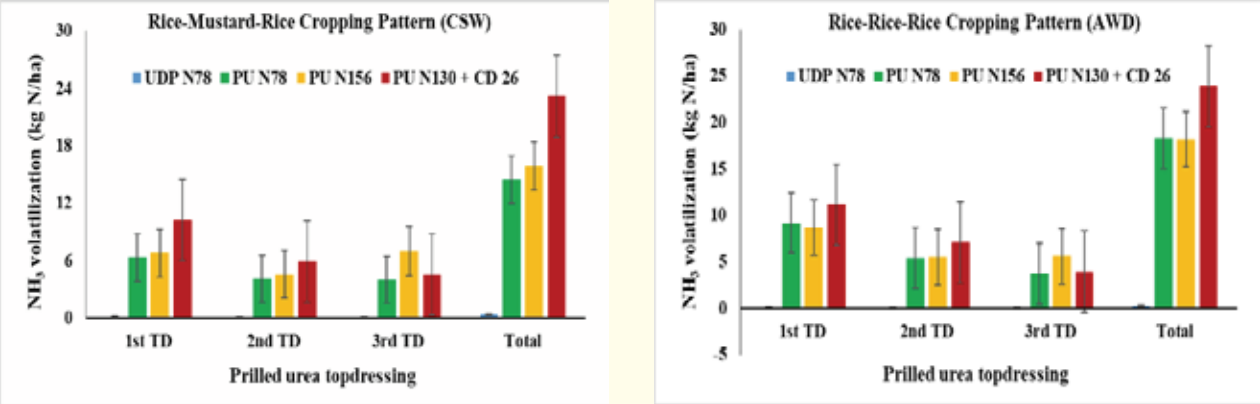


Figure 4.4.3.4: Ammonia (NH_3) volatilization from crop fields treated with different sources, methods and rates of N in two cropping patterns under two water regimes (AWD and CSW).

Deep placement of either urea or UDP briquettes irrespective of N rate significantly increased grain yield of t.aus rice compared with broadcast PU (Table 4.4.3.3). The highest grain yield was observed with 78 kg N/ha as combined application of PU and poultry manure (PM) (52 kg from PU and 26 kg from PM). Increasing N rates decreased nitrogen use efficiency (NUE). The highest NUE was observed in UDP plots at 78 kg N/ha (boro) and 52 kg N/ha (T. as/T.aman) which was significantly higher than that achieved with broadcast PU.

Table 4.4.3.3: Effect of prilled urea (PU), urea briquette (UB) and manure on grain and straw yields and N use efficiency (NUE, kg grain/kg N and N recovery, NR %)) int. aus rice (BRRI dhan48) in rice-rice-rice cropping pattern

Treatment			Yield (t/ha)		NUE	
No.	Description	N rate (kg/ha)	Grain	Straw	kg grain/kg N	NR (%)
Rice-rice-rice cropping pattern						
1	Control	0	2.09c	2.48c	-	-
2	UB	52	3.90a	4.28b	34.71a	75.38a
3	PU (broadcast)	52	3.64b	4.08b	29.75b	42.9c
4	PU deep placement (BRRI applicator)	52	3.84ab	4.21b	33.66ab	71.00a
5	PUbroadcast	78	3.98a	4.75a	24.16c	58.08b
6	PU + poultry manure(PM) (IPNS basis)	52 kg from PU and 26 kg from PM	3.98a	4.75a	24.19c	51.62bc
7	PU +vermicompost (IPNS basis)	52 kg from PU and 26 kg from vermicompost	4.01a	4.82a	24.62c	50.60bc
8	PU +cowdung(CD) (IPNS basis)	52 kg from PU and 26 kg from CD	4.02a	4.82a	24.72c	53.15b
CV (%)			3.78	5.92	9.36	13.14

Within a column, numbers followed by the same letters are not significantly different at the 5 percent level of significance, CV (%) = Coefficient of variation.

Deep placement of urea (UDP) significantly reduced N_2O emission from rice plots compared with broadcast PU (BPU). Emission from BPU plots was two times higher than that from UDP plots (Fig. 4.4.3.5). Application of N fertilizer increased methane emission from rice fields compared with that from plots receiving no N fertilizer. Application of PU or PU in combination with manure resulted in a higher methane emission than that with UDP (Fig. 4.4.3.6).

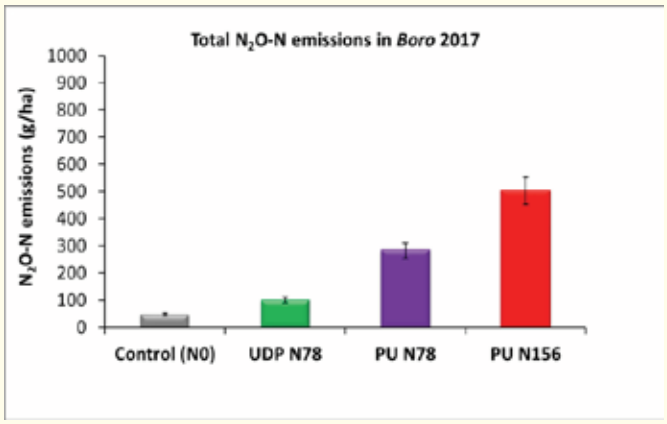


Figure4.4.3.5: Cumulative N_2O emission from rice fields (t. aman 2016, a rice-rice-cropping pattern) treated with different N sources, rates and methods of application.

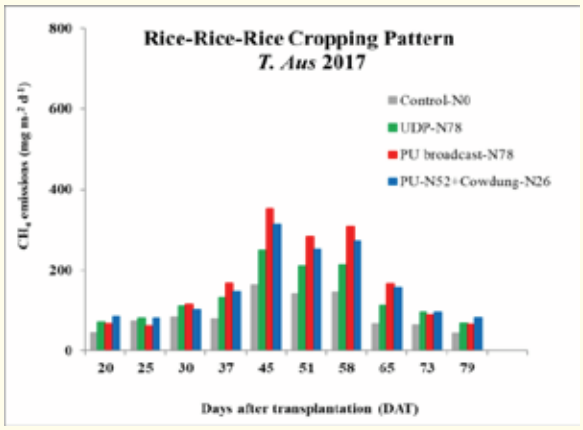


Figure 4.4.3.6: Methane emission from rice fields (t. aman 2016 in rice-rice-rice cropping pattern) treated with different sources of N, sources and methods of application.

4.4.4 Project code and title: CEP-4: Skill Development Trainings for the Scientists, Field Veterinarians, Livestock Workers and Poultry/Dairy Farmers

Coordinator: Dr. Paritosh Kumar Biswas, Director, PRTC, CVASU; Cell phone 01718318926; Email: biswaspk2000@yahoo.com

Implementing Organization: Poultry Research and Training Centre (PRTC), CVASU, Chittagong

Location: CVASU, Chittagong

Main objectives: Capacity development of selected scientists and veterinary surgeons working in the field of livestock research & development for better research output and poultry and dairy farmers for running commercial farms in a bio-secured, environment friendly way with advanced techniques, and creating and sustaining linkages with service providers to address current and emerging issues.

Budget: BDT. 68.1635 lakh

Background: Research in microbiology, virology, biotechnology and biomedical/veterinary sciences nowadays need thorough understanding of the basic principles and techniques used in molecular biology and biotechnology. Saving life of a domestic animal through surgical intervention is meant a great economic benefit for its owner. To correctly perform surgical operations veterinarians have to go through clinical training. Properly done anesthesia using available anesthetics at field level is prerequisite to conduct a surgical operation. Further, use of correct surgical techniques and making decision for doing surgery is dependent on proper diagnosis of a case by modern imaging techniques including radiography and ultrasonography. For research purpose and to provide quality veterinary services to the farmers in the country it is necessary to train the relevant veterinarians by providing hands-on exposure on surgery. Poultry and dairy farming has a great potential for self-employment and income generation in Bangladesh. There is already a good section of people involved in commercial poultry and dairy farming, and most of whom started farming without any technical training or with just a little basics/technical advice from local officials of the Department of Livestock Services (DLS)/NGOs. This has been a handicap for the small poultry/dairy farmers in terms of the profitability of their enterprises. Profits of such farms are dependent

on two things: low-cost good management and increase in quality yield. Advanced management practices for disease control, bio-security and feeds can only be introduced to the conventional farming if the farmers are well-trained on the holistic issues of farming within applicable/available local resources. Good training would contribute substantially to increasing the production of livestock-based, highly nutritious foodstuff like meat, eggs and milk in the country. The PRTC at CVASU has access to both experienced human resources and state-of-the-art equipment facilities to provide necessary hands-on training to the concerned farmers, scientists and technical personnel. This program was designed to provide skill development and capacity building training to the technical staff and scientists from BLRI/DLS involved in R&D activities and the beneficiaries farmers involved in commercial poultry and livestock production.

Progress: The project started functioning in March 2017, and just completed the 1st quarter. So far, three training programs have been conducted in seven batches on a) Broiler and layer farming, 2 batches; b) Training on dairy farming, 2 batches; and c) Community based livestock worker training, 3 batches. A total of 135 farm entrepreneurs and livestock workers participated in the training programs and developed their skills using project facilities. In most of the cases the duration of the training program was 3 days. Three training manuals have been published for the three completed training programs that include all the details of the training.

4.5 International Collaborative Program (ICP)

4.5.1 Project code and title: Cropping System Intensification in the Salt Affected Coastal Zones of Bangladesh and India

Principal Investigator: Dr. Md. Ansar Ali, Director (Research), Bangladesh Rice Research Institute (BRRI), Gazipur; Cell phone: 01925053582; and Dr. Md. Abdur Razzaque, Chief Scientific Officer and & Head, Irrigation and Water Management Division, Bangladesh Agricultural research Institute (BARI), Gazipur; Cell phone: 01711570461

Implementing Organizations: BRRI and BARI

Location: Dacope, Khulna and Amtali, Barguna

Budget: BDT. 312.00 lakh

Main objectives: The project aims to: (1) develop a sub- regional scale understanding of the surface and ground water resources, recharge/discharge mechanisms and trends in coastal polders of Bangladesh,(2)to study the salt and water dynamics in soils in selected polder areas, (3)explore the opportunities for pre-monsoon and post-monsoon ground water obstruction regimes that may improve ground water quality and availability during the dry season, (4) develop detailed understanding of crop production, water balance and salinity responses to various improved polder level water management strategies and cropping system and management options; and to test suitable cropping system x management options and water and salt management strategies through field evaluation and co-learning with farmers.

Background: A collaborative research program with financial support from KGF and the Australian Center for International Agricultural Research (ACIAR) was initiated in the latter half of 2016. Several meetings were organized with TEEAL of Cornell University, USA for collaboration with Bangladesh in the field of agricultural research. The project started formally in April 2016. Fund was released by May 2016. Experimental sites were selected at Amtali and Dacope of Barguna and Khulna, respectively. Experiments were planned forT. aman 2016 and Rabi 2016-17. Data have been collected for modeling work (APSIM, polder level water and salt balances and ground water modeling). However, they were not fully calibrated and ready for analysis of the crop experiments or for the wider water and salt management at the polder level.

Progress:

i) BARI

Thirteen field experiments were conducted in 2016-2017 at farmers' fields in the village of Pankhali and Sikandorkhali in polder 31 in Dacope, Khulna and polder 43/1 in Amtali, Barguna situated in the coastal region of Bangladesh. In these experiments, dates of transplanting several modern short- duration varieties of T. aman rice, dates of sowing of rabi crops, such as, maize, sunflower, wheat, mustard, watermelon, using different conservation agriculture (CA) practices (zero, strip tillage), relaying grass pea, irrigating the crops with mixtures of fresh and slightly saline water, conjunctive use of fresh and saline water in irrigation for maize, sunflower and cropping pattern (CP) - based water management for different crops were tested.

The first year (2016-2017) results indicate that farmers can increase their farm income by growing selected short duration verities of T. aman rice in the Kharif-II season and then cultivating a range of Rabicrops. The farmers were not interested in cultivating BRRIdhan 62 in the next T. aman season as the variety expected not to be sustained due to lack extensive use by local farmers as it was damaged by rates, birds and yielded poorly compared with local varieties grown by farmers outside the project site. As observed, the cropping pattern maize-t. aus-T. aman and sunflower-T. aus-T. aman would be more profitable than the CP fallow-fallow-T.aman in the coastal saline areas (Table 4.5.1.1).Different rabi crops grew successfully up to maturity and harvest. The local farmers liked the yield levels of wheat, gardenpea, mustard and spinach. The optimum sowing times for the sunflower varieties, Hisun-33 and BARI Surjomukhi-2 and the maize varieties, BARI hybrid maize 9 and NK 40, were found to be between 25 November and 15 December. BARI hybrid maize 9 yielded better than NK-40, and the sunflower variety of Hisun-33 out yielded BARI Surjomukhi-2. The seed yield of sunflower ranged from 2.33 to 2.53 t/ha at Dacope and 1.65 to 1.93 t/ha at Amtali, and maize yield ranged from 6.46 to 7.8 t/ha. The grasspea variety, BARI Khesari-2, when sown on 25 November gave a satisfactory yield. Cultivation of some selected vegetable crops on dykes surrounding shrimp *ghers* throughout the year in the coastal areas of Dacope, Khulna was found to be profitable for the farmers. There is a good scope to develop better gher designs, management and crop cultivation techniques, which will integrate more farmers including women into better livelihood activities in coastal saline areas of Bangladesh.

Table 4.4.5.1.1: Yields of Different Individual Crops in Various Cropping Patterns and the Rice Equivalent Yields (REY) of the Patterns., 2016-17

Cropping pattern	T. aman	Wheat	Mustard	Garden pea	Spinach	REY (t/ha)
CP_1 = T.aman – wheat – mungbean –t. aus	4.99	3.07	-	-	-	7.78
CP_2 = T.aman – mustard – mungbean –t. aus	4.99	-	0.77	-	-	7.04
CP_3 = T.aman – gardenpea – mungbean –t. aus	4.99	-	-	4.79	-	10.31
CP_4 = T.aman – spinach– mungbean–t. aus	4.99	-	-	-	27.5	17.21
CP_5 = T. aman – fallow –fallow (farmers' practice)	4.99	-	-	-	-	4.99

Price: Rice TK 22.5/kg, Wheat TK 20/kg, Mustard TK 60/kg, Gardenpea TK 25/kg, Spinach TK 10/kg

The soil water contents ranged from 22.2 to 32.3%, on an average, from the month of January to March 2017.Soil pH values vertically down in soil profiles up to a depth of 60 cm at 15 cm intervals ranged from 6.5 to 7.5 at Amtali and 7.8 to 8.2 at Dacope. Soil salinity (ECe) ranged from 7 to 17 dS/m from January to March 2017 in 60 cm soil profiles with 15 cm increments. The average pond, canal and river water EC values at Dacope were 1.21, 2.2 and 16.81 dS/m, respectively, and 0.47, 4.40 and 12.65 dS/m, respectively, at Amtali at 10 day intervals during the crop growing season.

The seasonal crop water use for sunflower was, on an average, 223 mm at Dacope and 248 mm at Amtali. Water productivity of sunflower was 1.12 kg/m^3 at Dacope and 0.75 kg/m^3 at Amtali (Table 4.4.5.2). Seasonal crop water use of maize was 244 mm at Dacope and 274 mm at Amtali. Water productivity of

maize was 2.97 kg/m^3 at Dacope and 2.83 kg/m^3. Farmers are being encouraged to practice the conjunctive use of fresh water (FW) and saline water (SW) for irrigation in the future of agriculture in the coastal saline areas of Bangladesh constrained by the scarcity of sweet water. The technique of conjunctive use of fresh water (EC≤0.5dS/m) at early crop growth stages and saline water (EC ≥1.5to ≤5dS/m) at later growth stages of sunflower and maize in the coastal saline areas of Bangladesh could be a good alternative irrigation method without the risk of unacceptable yield loss.

Table4.4.5.2: Seed yield and water productivity of maize and sunflower in 2016-17

Treatment	Dacope				Amtali			
	Maize		Sunflower		Maize		Sunflower	
	Seed yield (t/ha)	WP (kg/m3)	Seed yield (t/ha)	WP (kg/m3)	Seed yield (t/ha)	WP (kg/m3)	Seed yield (t/ha)	WP (kg/m3)
T1	7.30	3.27	2.47	1.27	6.82	2.83	1.87	0.85
T2	6.55	2.96	2.39	1.23	6.43	2.61	1.76	0.80
T3	6.69	3.29	2.47	1.24	6.46	2.49	1.74	0.75
T4	7.70	2.83	2.33	0.94	7.24	2.41	2.07	0.79
T5	7.23	2.67	2.52	1.01	6.89	2.31	1.65	0.63
T6	7.67	2.80	2.53	1.02	7.57	2.52	1.93	0.73
All	7.19	2.97	2.45	1.12	6.90	2.53	1.84	0.76

*IR indicates irrigation. T_1: 2 IR at vegetative and flowering stages with FW, T_2: 2 IR given at vegetative stage with FW and at flowering stage with SW, T_3: 2 IR given at vegetative with FW and at grain filling stage with SW, T_4: 3 IR at vegetative, flowering and grain filling stage with FW, T_5: 3 IR at vegetative with FW and at flowering and grain filling stages with SW, T_6:3 IR at vegetative and flowering stages with FW and at grain filling stage with SW.

ii) BRRI

A bench mark survey for identifying the constraints to cropping system intensification in the coastal saline areas indicated, among other things, inadequate access to freshwater for irrigation, high soil salinity, and excess soil moisture at sowing time for dry season crops, lack of suitable technologies at local levels, inadequate stress tolerant varieties and price volatility of farm products. The use of low yielding rice varieties is another constraint to be addressed. BRRI set up trials with modern rice varieties (MV) in the wet season and compared the yields with local varieties (LV) and found a yield advantage of 3-28% with MV over LV (Table 4.4.5.3)

Table4.4.5.3: Grain yield of different rice varieties in Dacope and Amtali

Variety	Location		Variety	Location			Change %	
	Dacope	Amtali		Dacope	Variety	Amtali	Dacope	Amtali
BR 23	4.2	4.56	BR23	3.85	Swarna-mushare	3.6	9	27
BRRI dhan53	4.2	4.57	BR11	4.07	Tapu	3.56	3	28
BRRI dhan54	3.5	4.13	Boran	4.03	Vogon	3.88	-13	6
BRRI dhan66/62	4.3	3.82	BRRI dhan34	3.78			14	
BRRI dhan73/62	4.5	4.21						

BRRI conducted experiments on growing vegetables with rice in wet season in the bag/ridge method and found this to be promising. At both the locations, farmers were able to grow vegetables without a significant loss in rice yield.

Fresh water resources development is one of the crucial issues for sustainable crop and soil salinity management in coastal areas. Soil and water salinity levels (ECe/EC) were monitored at both the locations, river water became strongly saline (EC > 4.0 dS/m) after December and salinity reached a very high peak of EC 20-25 dS/m in April. At Dacope, the depth to groundwater varied from 0.75 to0.95 m from the soil surface and its salinity varied from EC 2.3 to3.52 dS/m, which could be within the permissible limit for irrigation. At Amtali, the depth to groundwater varied from 1.02 to1.40 m and its salinity varied from EC 3.25 to11.7 dS/m, which was beyond the permissible limit for irrigation. Soils are slightly alkaline at all tested locations.

At bothDacope and Amtali, the salt tolerant boro rice varieties, BRRI dhan67 and BINA dhan10, gave the highest yield (about 6 t/ha) when planted in November. Irrespective of location, irrigation water productivity varied from 0.54 to 1.08 kg/m^3 and total water productivity varied from 0.42 to 0.80 kg/m^3 for all the tested varieties. This indicated that boro rice can be grown successfully in the coastal region. Rabi crops were established using the seed dibbling, mulching and pit methods. The dibbling method performed well for sunflower and maize at both the locations. Sweet gourd established in the pit method showed an advantage over the other methods in terms of growth and yield.

4.6 Technology Piloting Program (TPP)

The TPP projects of KGF facilitate the process of technology transfer adoption at the end user level. Important and promising technologies generated by the CGP and other projects including NARS institutions having potentials to substantially enhance productivity and production in the various sub-sectors of agriculture in the country are first selected. The extrapolation domains of the technologies are thoroughly evaluated by a team of experts including desk officers of KGF through FGDs, KIIs, personal consultations and field visits. T Then pilot projects are taken up by KGF to promote and foster large scale farmer adoption of these technologies. Piloting of technology transfer is done in the specific areas with a view to facilitating a greater extrapolation of the technology with the help of officials of the Department of Agricultural Extension (DAE) officials at the field levels. In 2016-17, KGF executed seven pilot projects. A list of pilot projects in operation during the period under report with the relevant thematic area is given in Table 4.6.1.

Table 4.6.1: List of On-going pilot Project Supported by KGF during 2016-17

Sl #	Name of projects	Lead organization	Sector	Running year	Partner organization
1	Validation and piloting of improved production technologies in the Gopalganj Basin	BARI	Crop	3rd	None
2	Up-scaling and validation of rhizome rot disease management	BARI	Crop	2nd	
3	Validation and scaling up of T. aman - potato/mustard - mungbean -t.aus cropping system in northern districts of Bangladesh	BSMRAU	Crop	2nd	
4	Adaptation of the Community Enterprise Approach (CEA) in tidal floodplains for crop-fish culture - Jhalkathi Model	SHISUK	Fisheries	2nd	Dhaka University and DoF
5	Up-scaling of high-value shing fish culture technology in homestead/household ponds	BSMRAU	Fisheries	1st	CDMS
6	Improving the animal health and productivity through mobile veterinary services	BAU	Livestock	1st	SEEDS(NGO)
7	Scale up of CEA for intensification of floodplain fish production in Chalan Beel	SHISUK	Fisheries	1st	BSMRAU

4.6.1 Project code and title: P-8. Validation and Piloting of Improved Production Technologies in the Gopalgonj Basin

Implementing Organization: Bangladesh Agricultural Research Institute (BARI), Gazipur

The Gopalganj Basin covers extensive low- lying areas of the Gopalganj, Madaripur and Barisal districts where lands remain under water for a prolonged period (5-6 months). The basin is composed of high (5%), medium high (15%), medium low (41%), and low to very low lands (39%). Cropping intensity in the Gopalganj and Madaripur districts is low (176%).Newly developed charlands as well as old established chars cover a vast area of the basin. Jute is the predominant crop followed by broadcast aman and boro rice. Grass pea, lentil, and chickpea are widely cultivated in the dry season. In these areas, coconut mite is reported to have caused extensive damage to coconut orchards. BARI recommended appropriate technologies developed from KGF supported CGP projects appeared to be suitable for the Gopalganj Basin. This pilot project was undertaken for validation and large scale adoption of the technologies involving a large number of farmers.

The project activities started in November 2014 with lentil (325 bigha; 1 bigha equals 33 decimals), mustard (225 bigha), and chickpea (125 bigha) as the first crops of three existing cropping patterns, viz., lentil- mungbean- T. aman/mustard- mungbean-t. aman, and chickpea - T. aman, respectively. Recently developed high yielding varieties of these crops were used and seed availability was ensured. The recorded average yields of lentil, mustard and chickpea were 1.68, 1.81 and 1.94 t/ha in the project areas compared with 0.99, 0.98 and 1.09 t/ha, respectively, in farmers' fields outside. Thus, yield increases by 69.70, 84.70, and 81.65% of lentil, mustard and chickpea, respectively, over the farmers' yield levels were obtained with improved technologies. In the kharif-1 season, BARI Mung 6 was cultivated as a new crop in 82.44 ha (611 bigha) of land. The average yield of BARI Mung 6 was 1.30 t/ha in the project area compared with only 0.98 t/ha in non-project farmers' fields. As the 3rd crop of the sequence T. aman rice was planted in 94.47 ha (700 bigha) of land with short duration and high yielding varieties (BRRI dhan39, BRRI dhan57, and BRRI dhan62); yields achieved were 4.19, 3.90, and 3.85 (t/ha), respectively.

Four hundred and eighty farmers from Gopalganj (Sadar), Kalkini (Madaripur) and Agailjhara (Barisal) were trained on management of coconut mite. Introduction of a new crop (mungbean), replacement of traditionally grown varieties with better and modern varieties, improvement of knowledge and skills of the participating farmers contributed to increases in the cropping intensity, crop productivity and farmers' incomes.

Improved production technologies for mustard, lentil, chickpea, mungbean, jute, and T.aman rice were demonstrated to 4,552 farmers during the Rabi, kharif-I and kharif-II seasons of 2014-15 and 2015-16.Six hundred farmers were trained on mite control technology. T.aman demonstrations were established in 1000 farmers' fields each measuring one bigha in size in 2016-17.Areas covered by participatory block demonstrations with mustard, lentil, chickpea, mungbean, jute, and T.aman were 887, 1048, 526, 1071, 420, and 600 bigha, respectively, in two years of piloting. Demonstrations of production technologies included introduction of a new crop like mungbean, replacement of low yielding verities by high yielding modern varieties like BARI Sarisha 14, BARI Sarisha 15 for mustard, BARI Musur 6, BARI Musur 7 for lentil, BARI Chola 5, BARI Chola 9 for chickpea, BARI Mung 6 for mungbean and BRRI dhan57, BRRI dhan49, and BRRI dhan62 for T.aman.Training and inputs like seeds, fertilizers, pesticides, etc. were provided to the enlisted farmers. Field days, 35 in total, were organized at maturity stages of the crops (lentil-6, mustard-11, mungbean-7, t.aman-9 and Jute- 2) at different project sites attended by4920 farmers. Moreover, high officials from BARI and DAE, field level officers of concerned research and extension departments and political dignitaries were present in the field days. A total of 4660 farmers were trained on production technologies for the listed crops in 110 batches. Field day events were telecast in electronic and published in print media. It is reported that after the project intervention, cropping intensity in the project area increased from 176% to 185%. Single and double cropped areas were being converted into triple cropped areas. Crop productivity, farmers' incomes and land valuation increased and dependence on irrigation reduced.

4.6.2 Project code and title: P-10. Up-scaling and Validation of Rhizome Rot Disease Management Technology

Implementing Organization: Bangladesh Agricultural Research Institute (BARI), Gazipur

Ginger is one of the essential spices in Bangladesh. It is an important ingredient of curry and is also used as medicinal herb. The useful part of this crop is the rhizome. Bangladesh produces only 43,000 tons of ginger against the requirement of 96,000 tons per year. The average yield of this crop is only 5.54 t/ha. So, every year, a large quantity of ginger is imported in exchange of foreign currency. Several diseases are responsible for the poor yield, of which rhizome rot is the most harmful. Yield loss due to this disease may be as high as 50% or more. To address the issue, BARI developed a promising technology package conducting through a three-year research project completed earlier with the financial support of KGF. In order to promote the recommended technology package to the ginger growers of Nilphamari, Rangpur, Bogra and Tangail districts and validate the technology package to new ginger growing areas (Lalmonirhat and Mymensingh), this pilot project (P-10) was taken up by BARI with the financial and technical support of KGF. The project I being implemented in participatory approach with farmers on a production cost sharing basis. Hands on training were imparted to 608 farmers and 96 field level officers of DAE. Six hundred and eight demonstration plots (20decimals each) were established in farmers' fields for which the inputs (chemicals) were provided by the project. Crop condition in the trial plots was found better than that in the control plots. The disease infestation levels in both the trial and farmers' plots were monitored regularly. The highest and lowest levels of infestation, 29.51 and 5.22% and 46.50 and 11.26% in trial and farmers' plots were observed in Nilphamari and Bogra, respectively. About 50-70% of the ginger in control plots planted with untreated seeds was damaged by the disease at Shibganj. Considering the success of the project, its duration was extended for 10 more months which benefited 688 more farmers of 14 more upazilas. Five field days were arranged at crop maturity stage where more than 1000 farmers including the project farmers attended. Besides, senior officers of KGF, DAE, scientists from BARI, SRDI, etc. participated in the programs.

4.6.3 Project code and title: P-11. Validation and Scaling up of the T.aman - potato/mustard - mungbean -T.aus cropping System in Northern Districts of Bangladesh.

Implementing Organization: Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur.

To increase system productivity and water use efficiency, a new cropping pattern, T. aman rice (early maturing) - potato/mustard- mungbean (early maturing) -aus rice (early maturing) in place of the age old Swarnalata (long duration T. aman rice)-potato-boro rice was found to be a promising pattern for northern Bangladesh in a research carried out earlier by BSMRAU with the financial and technical support of KGF. For a further validation and up-scaling of this new cropping pattern, this pilot project was undertaken to conduct on farm trials in large areas involving a large number of farmers. Another important objective of this pilot project was to study the soil nutrient balance for ascertaining the future sustainability of soil fertility, which was not considered in the previous project. The project started in November 2014 with mustard/potato depending upon the land suitability and choice of the farmers. The number of farmers involved in the project was 1000 (400 in Dinajpur, 300 in Gaibandha and 300 in Nilphamari districts). After the winter crops (mustard and potato), mungbean (BARI Mung 6), T. aus (Pariza) and T. aman (BRRI dhan49 and BU dhan1) were planted and harvested timely.

The yield of mustard was found encouraging in all the three districts. Two years' average yield of mustard (BARI Sarisha 14), potato, mungbean (BARI Mung 6), T. aus (Pariza) and T.aman (BRRI dhan56 and `BU dhan1) were 1.48, 21.22, 0.77, 3.21 and 3.70 t/ha, respectively. Yield of mungbean was not satisfactory in Dinajpur where it was only 0.17- 0.62 t/ha. Aus rice (Pariza) performed well at most of the sites, the average yield across project sites of three districts being 3.21 t/ha, whereas T. aman (BRRI dhan56 and BU dhan1) yielded of 3.70 t/ha. Soil samples were collected and tested before and after the project trials.

Results revealed that the amount of carbon, nitrogen, phosphorus, potassium, sulphur, and zinc did not change significantly in two years. Growing of four crops in the same land in a year did not create any adverse effect on soil quality. It is expected that the new cropping pattern will be expanded in other districts of northern Bangladesh. In the meantime, about 2500 farmers have already adopted the new cropping pattern. RDRS Bangladesh (NGO) has included this cropping pattern in its core program with the financial support of PKSF, IFAD and Syngenta.

4.6.4 Project code and title: P-13. Adaptation of Community Enterprise Approach (CEA) in Tidal Floodplains for Crop-Fish Culture - Jhalokathi Model

Implementing Organization: SHISUK, Dept. of Fisheries DoF) and Dhaka University (DU)

The CEA projects have been under implementation at 3 sites: Jhanjhania of Pirojpur, Uttampur and Bishnudia of Jhalokati. The pilot project was designed to adapt the community based approach to convert tidal floodplains into CEA crop-fish culture model lands. Comparative results from 3 floodplain sites in the last year show that Jhanjhania was better in terms of productivity (340Kg/ha) than either Bishnudia (205kg/ha) or Uttampur (49 kg/ha). Rice and vegetable production was also higher at this site (Jhanjhania). A total of 516 farm households have been engaged as shareholders at these three sites of the project. A total of Tk. 21, 17,000 was collected as share money to run production activities across a total area of 75 ha. Construction of a 2000 ft. long embankment at Bishnudia helped protect the settlement area and crop land from flood and facilitated aquaculture inside along with vegetable cultivation on the embankment. On top of that, the cropping intensity increased gradually across the traditionally mono cropped tidal floodplain land, and household incomes, fish and vegetable consumption were found to increase from the baseline positions. It is expected that information from pilot project will spread to other parts of the area bringing seasonally fallow land under the crop-fish culture system. The CEA encourages communities to bring potential land and water resources under the crop-fish culture system through local funds raised as share subscriptions from the stakeholders.

4.6.5 Project code and title: P-14.Up-scaling and Campaigning of Rice-Cotton Intercropping in Bandarban and Khagrachari Districts

Implementing Organization: Cotton Development Board (CDB), Khamarbari, Farmgate, Dhaka

Most hill farmers of the Chittagong Hill Tracts (CHT) are dependent on traditional *jhum* cultivation for their livelihood. The farmers sow seeds of several crops like rice, cotton, marpha, sesame, pumpkin, maize, chili, etc. in the same pit on the hill slopes and harvest them one after another. Traditional *jhum* farming is in fact a form subsistence farming with marginal returns. In j*hum* farming, component crop productivity is low and the system causes soil degradation. With the objective of improving the *jhum* cropping system in the hill districts, scientists of CDB implemented a project in 2012-2014 with the financial and technical support of KGF, the results showing a substantial advantage of intercropping of rice with cotton over traditional *jhum* cultivation bringing about a 40% higher profit.

In order to disseminate the technology among a large number of farmers an up-scaling program involving 700 hill farmers from four upazilas of Bandarban (Sadar, Thanchi, Ruma, and Rowangchari), Sadar upazila of Rangamati and two upazilas of Khagrachari (Sadar and Matiranga)was implemented in 2014-15 and 2015-2016.Despite a number of problems associated with working in hilly areas, a little success could be achieved in 2014-15 through yields1500 and 900 kg/ha of rice and cotton, which were are 50 and 66% higher, respectively, than that obtained from *jhum* cultivation. However, the achievements in 2015-16 were remarkable. The average yields of rice and cotton in intercropping were 3.03 and 1.59 t/ha compared with 1.72 and 0.405 t/ha, respectively, in *jhum* cultivation. This yield increase of rice and cotton was 76% and 292% higher, respectively. The net average income from rice- cotton intercropping was Tk. 2,85,765/ha while from the indigenous *jhum* practice it was only Tk. 56,386/ha. Thus, the net income from rice- cotton intercropping was 406% higher than that achieved with the traditional *jhum* practice.

As the rice-cotton intercropping technology was found highly agro-economically remunerative, CDB has already taken measures for further extension of the technology through a project in collaboration with the Chittagong Hill Tracts Development Board having financial support from the Chittagong Hill Tracts Affairs Ministry.

4.6.6 Project code and title: P-15. Up-scaling of High Valued Shing Fish Culture Technology in Homestead/Household Ponds

Implementing Organizations: Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur and Chinishpur Dipshikha Mohila Samity (CDMS), Narsingdi.

Promotion of high value shing fish or stinging catfish (*Heteropneustesfossilis*) culture in small homestead ponds (10-25 decimal) was undertaken in six upazilas (Sadar, Palash, Shibpur, Raipura, Belabo and Monohardi) of the Narsingdi district. Under direct supervision of the Department of Fisheries (DoF),

BSMRAU and a local CDMS, a local NGO, the pilot project was carried out across 50 selected homestead ponds, usually left fallow, in these upazilas. Pond preparation, stocking of fingerlings, feeding and fertilization were done with the help of local DoF officials during *insitu* practical training. A total of 100 farmers including 13 women were trained using a technical training manual of shing aquaculture. The training manual and a leaflet were prepared as part of the project implementation following the technology package developed from a previous KGF project on shing fish aquaculture. The average yield of shing fish was 4.0 t/ha. In a culture period of 7 months after stocking, the fish growth ranged from 55.9 g to 69.5 g with a mean of 63.32 g of individual weight. The survival rate at harvest varied from 38.7 % to 62.1% with a mean survival of 53.4% of the stocked fingerlings. Apart from four batches of farmers' group training, two 'Farmers Days' were organized to communicate the technology demonstration results publicly.

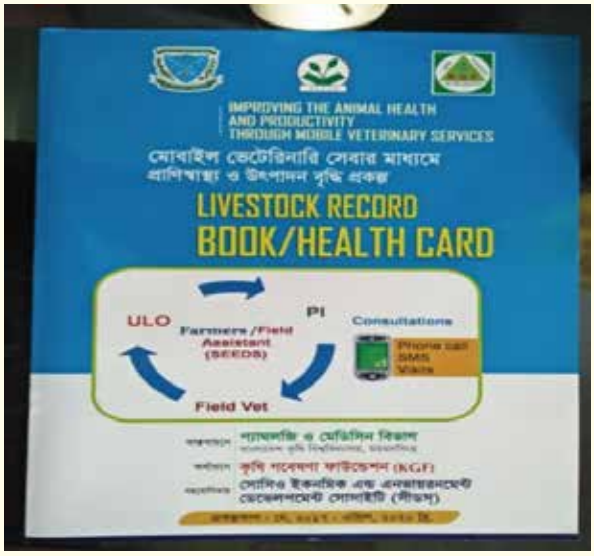
As an initiative to promote large scale adoption of shing culture in homestead ponds, this up scaling program was participated in by researchers, local GO-NGO extension workers and a large number of farmers from different upazilas of the Narsingdi district. The District Fisheries Officer, Narsinghdi and his colleagues extended valuable support in implementing this project.

4.6.7 Project code and title: P-16. Improving Animal Health and Productivity through Mobile Veterinary Services

Implementing Organization: Bangladesh Agricultural University (BAU), Mymensingh

Outbreaks of different infectious diseases and low productivity of local genetic resources are the most important constraints to livestock development in Bangladesh. The impacts of diseases are multifaceted: loss to the farmers through mortality, loss of productivity, cost for disease management including treatment and sanitation, poor quality of livestock products, disruption in the production cycle, market effects, culling, etc. These seriously affect the livelihood of the poor farmers. The climatic condition of Bangladesh is conducive to animal diseases. High density of animals and their seasonal aggregation particularly in the monsoon period aggravate infections and disease propagation. The predicted annual direct losses stand at Tk. 819 million for FMD, Tk. 1,842 million for PPR and Tk. 1,105 million for HS. A study of BLRI estimated a total loss of Tk. 38,583 million due to HPAI outbreaks in the first two years. The estimate included direct loss of Tk. 86 million, indirect loss of Tk. 2,497 million and the loss due to production downtime affects Tk. 36,000 million. If the figure is adjusted for the outbreak data of five years, 2007 – 2011, the total loss would stand at Tk. 51,720 million. Research conducted in a previous KGF funded project "Calf mortality in large and small holder crossbred dairy cattle: Epidemiological and pathological investigation and mitigation" proved that door step veterinary services provided by mobile veterinary teams reduced calf mortality from 13% to 2% and improved the fertility of cows in the project area. The project output received from the above mentioned project will be validated in two more upazilas. If similar results are obtained, the concept will be ready for implementation nationwide.

Training of field assistants has been completed and they have been posted to their respective areas. Project inception workshop was held with participants from universities, DLS, SEEDS and KGF. The project completed selection of 500 farmer cooperators from the two targeted upazilas. The baseline survey has been completed, 10 farmers' club has been formed and interactions among the farmers are continuing. A livestock health card (LHC) has been designed, printed and distributed among the beneficiary farmers. So far, farmers from 3 of the 10 farmers' clubs have received training. Mobile veterinary services are being provided to the farmers every day. Services including door step treatment of sick animals, door step artificial insemination services, fodder cultivation in homestead, preventive veterinary care, i.e., de-worming and vaccination, are being provided. De-worming of cattle is almost complete, and vaccinations in progress. Protocols for the diagnosis of the disease have been completed.



4.6.8 Project code and title: P-18. Scale up of Community Enterprise Approach (CEA) for Intensification of Floodplain Fish Production in Chalan beel

Implementing Organization: Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur and SHISUK (NGO)

Work to prepare feasibility maps for floodplain aquaculture using remote sensing (RS) and geographical information system (GIS) is in progress through SHISUK and BSMRAU. Out of 2.8 million ha floodplain areas of the country, the RS-GIS study has already identified 586 suitable floodplain sites with detailed contour maps. Such maps can be used as reference materials to boost floodplain aquaculture in the country. As a follow-up activity from a previous project in the Chalan beel areas, at least 20 floodplain areas where aquaculture intervention seems to be feasible will be brought under CEA for intensified aquaculture. This will facilitate additional fish production without competing with existing crop production.

5. Training and Workshop

5.1 Skill Development Training

KGF organizes short to medium term activities including training programs for capacity building of professionals engaged in agricultural research and extension work at NARS institutions, universities and other organizations. Training programs on important agricultural R&D issues, such as, climate change impacts assessment, modeling and mitigation, stress physiology, genetic engineering, marker assisted selection for breeding, crop simulation modeling, brood stock management, fish breeding and fish migration, marine fisheries, modern poultry farming (broiler and layer) techniques, etc. were organized in the past.

Several training courses on climate change issues were organized for the NARS scientists during the current fiscal year (2016-17). In each of the training courses, one participant from KGF also attended.

5.2 Internal Workshops

KGF organized internal workshops mostly in relation to monitoring of on-going projects, national workshops to strengthen coordination and support for work on national agricultural development issues. The Foundation also

assists in organizing international workshops to establish linkages and collaboration between national and International agricultural research organizations and universities. A number of meetings, review and planning workshops, coordination meetings, etc. were organized by KGF at different places of the country considering their necessity, relevance and realities. In total, 13 internal workshops were held in 2016-17. A list of the workshops with dates is furnished in table 5.2.1.

Table 5.2.1: Workshops Organized by KGF during 2016-17

Sl. No.	Workshop	Date
1.	Review Workshop on Pilot Project	14 July 2016
2.	1st Annual Review Workshop on BKGET CRP 2nd Call (7)	20 July 2016
3.	Co-ordination Workshop on Hill Project Khagrachari	05. September 2016
4.	Workshop on Crop Zoning	24. September 2016
5.	Annual Review Workshop on BKGET CGP 2nd Call (7) Projects	15 October 2016
6.	1st Annual Review Workshop on MCCA	24 October 2016
7.	Completion and Half Yearly Workshop of Pilot Projects	15 November 2016
8.	Co-ordination Workshop on MCCA	17-19 November 2016
9.	Workshop on Climate Change	14 December 2016
10.	Workshop on Basic Research	08 April 2017
11.	Workshop on Pilot Projects	02 May 2017
12.	The 2nd Half Yearly Progress Report Coordination Workshop on Five Projects	9 May 2017
13.	Project Completion Workshop on Three Pilot Projects	08 June 2017

5.3 National Workshop

A day long national workshop on `Loss of Boro Rice due to Early Flash Floods in Haor Areas' was held at the Hortex Foundation, Manik Mia Avenue on 24 May 2017. Dr. Abdus Satter Mandal chaired the workshop. Two expert pool members of the Ministry of Agriculture attended the workshop. Participants included scientists of NARS institutes, university professors, officials of DAE, DLS, etc. Dr. Wais Kabir, Executive Director, KGF moderated the presentations and discussions.

5.4 International Workshop

No international workshop was sponsored by KGF was held in fiscal 2016-17.

6. Monitoring and Evaluation

The Monitoring and Evaluation (M&E) program is meant for assessing and reviewing the implementation activities and outputs of projects sponsored and funded by KGF and providing, where and when necessary, required advice and suggestions on the relevant technical, administrative and financial issues. This helps project investigators/coordinators carry out smoothly and efficiently their activities towards successful completion of the projects. As a sponsoring and funding organization for strengthening agricultural research and development of the country, it is a key responsibility of KGF to ensure desired returns from its investments by way of successful completion of the financially supported and sponsored projects generating useful technologies and scientific information. The M&E program is a very important and potent tool in the hands of KGF to ensure that all goes well with the projects it is funding and sponsoring. At present, KGF employs two types of M&E discussed below.

6.1 Internal Monitoring

Internal project monitoring is done by assigned desk officers (program specialists) through a) desk monitoring to ensure timely submission of reports on activities and documents like related to i) inception workshop ii) annual workshop iii) timely submission of bi-ennial and annual project report, etc., and b)

field monitoring for physical verification of trials at the planned sites. Each of the desk officers () who are comparatively new and joined in Mar/Apr 2017 visited twice or at least once the project sites under their supervision. During the year under report, the KGF Executive Director visited a number of project sites and attended inception or other workshops arranged by the concerned PIs.

6.2 External Monitoring

External project monitoring is done by hiring competent expert teams comprising senior officials from the national research institutes and professors of agricultural universities of the country. The monitoring teams independently visit the project sites and extensively interact with implementing scientist(s) at the concerned research station and field levels for two to three weeks and furnish detailed monitoring and evaluation reports to KGF. Based on these reports, the KGF management revises the project funding and management work strategies.

In fiscal 2016-17, two external monitoring teams headed by Dr. Sk. Md. Abdus Sattar and Dr. Md. Fazlul Haque monitored the CGP and the pilot projects. These two external M&E teams visited 27 CGP 2nd call projects during April-May2017. According to their reports, all the projects were rated satisfactory except one. The team also reported the farmers' reaction as very good, and in some areas, farmers showed interest in adopting the technologies generated and demonstrated by the relevant projects and started to practice in their own fields. Another 8-memberteam headed by Dr. Hamizuddin Ahmed, Former Director (Research), BARI reviewed theCRP-1 (Hill Agriculture) project. The team reorganized the implementation plans for the component activities of the project. It was decided that activities for the remaining three years of the project would run according to the recommendations of the review team.

6.2.1 Reviewer Panel

The reviewer panel of KGF has been reformed/revised by adding eminent agricultural experts of the country immediately after joining of the new Executive Director. The list contains names of the reviewers, from Bangladesh and abroad, with full contact details including office and residential addresses, phone numbers, e-mail addresses, etc. and their fields of specialization, such as, crops, livestock, fisheries, forestry, agricultural engineering, agricultural economics and rural sociology, etc. Considering its volume (large numbers of experts) the list is not annexed with the report, however available with KGF office.

7. Publications

7.1 KGF Annual Report

The annual report is a key document detailing major KGF activities and implementation status and progress statements related to projects sponsored and funded by KGF is a key yearly regular publication of the Foundation. This publication endeavor has been continued and maintained through the years following the inception of KGF in 2007.This annual report is the 8thin the annual report of its series.

7.2 MS and PhD Thesis

At present KGF has no scope to support directly any post graduate program. However, KGF indirectly supports MS and PhD degree programs at agricultural universities through the research projects by allowing recruitment of promising graduate students as project research fellows for MS/PhD degree pursuits at agricultural universities of the country. In fiscal 2016-17, this indirect support for in country MS/PhD programs was continued.KGF indirect support for the graduate programs would mean support for the ultimate outcomes, i.e., the MS/PhD theses, of these programs.

7.3 Newsletters

KGF has been publishing half-yearly newsletters since March 2016.During 2016-17, one issue has been distributed to the concerned officials including NARS scientists. The half-yearly newsletter contains information on technologies related to crops, fisheries, forestry, livestock, etc. in Bangladesh and abroad. By this time, two issues (Issue 1 and 2) of the first volume (Vol. 1) have been published.

7.4 Manual

Publication of manuals is a common activity related to the project operations, and each of the funded projects prepared training manuals/ technology manuals as when necessary. In 2016-17, a number of manuals published by the project. The KGF manual, `Operation Manual for KGF Research and Development (R & D) Programs in Agricultural Science', has been revised recently.

7.5 Booklet/Leaflet

PIs of the KGF supported projects are supposed to prepare and publish booklets and leaflets in easily comprehensible language and terms detailing important aspects of the technologies generated and validated, and distribute these to the end users, so that they can apply and practice the new technologies/systems independently.KGF also has been periodically preparing booklets and leaflets on important technologies and distributing these to the stakeholders. Several booklets/leaflets have been prepared and distributed during the period under report.

7.6 Brochure

The KGF brochure has been improved further with additional information and in a new design during 2016-17, following the joining of the new ED.

8. International Visit/Delegation

8.1 International visit

Dr. Wais Kabir, ED, KGF visited IRRI, Los Banos, Philippines along with Begum Matia Chowdhury, Honourable Minister, Ministry of Agriculture, Government of Bangladesh and her team in Sep 2017.

8.2 International Delegation

FAO delegation: A FAO delegation on SDG, headed by Mr. Ewald Rametsteiner, Program Coordinator, Sustainable Agricultural Program, FAO, visited KGF on 28 May 2017 and discussed transformational strategies with KGF's officials towards achieving the targets of the universal Sustainable Development Goals (SDG).

ACIAR Team: The ACIAR (Australian Center for International Agricultural Research) team visited KGF several times in relation to the formulation of a joint KGF-ACIAR project on conservation agriculture during April-June 2017.

9. Financial Management

9.1 Financial progress

The annual revised budget for the year 2016-2017 of KGF, approved by the Board was Tk. 3468.00 lakh and expenditure 3190.59 lakh (92%). The budget for the year 2016-17 was received in two installments (on July 17 and September 9, 2016). The details of expenditure during fiscal 2016-17 are shown in the **Annex-3**.

9.2 Annual Work Plan Budget (AWPB) 2017-18

The Foundation has prepared the annual work plan and budget for the year 2017-18. The budget proposed for the fiscal year 2018-19 for approval of the Board of Directors and General Body of KGF is 5169.46 lakh. The detailed budget (table) and Plan (gang chart) by items is given in the **Annex-5**.

9.3 Audit

The accounts and audit functions of the Foundation are regulated in accordance with Clause 78-89 of the Memorandum and Articles of Association of KGF. The General Body approved the balance sheet for the fiscal year 2015-16 and was audited by Rahman Mostofa Alam & Co. The detailed audit report is given in **Annex- 9.**

9.4 Financial Contribution to Professional Bodies

KGF receives request from different professional societies/associations including NGOs and daily/weekly/monthly magazines to subscribe for their events. Respecting the requests, KGF supports in celebrating different events of different professional societies related to agriculture. The beneficiaries used the KGF logo in their banners and placards, souvenirs/proceedings/books, advertisements, etc. So far, KGF has sponsored a good number of national and international conferences, workshops held in Bangladesh through financial contributions.

10. Governance

A 15-member General Body (GB) and a 7-member Board of Directors (BD) govern KGF. The GB members, having vast experience and knowledge in the field of agriculture hailed from both public and private sectors. The BD members are elected from among the members of GB and have the authority of taking decisions and developing policies for the successful operation and management of KGF, although GB provides overall guidance and oversees the KGF activities. The list of GB and BD members is given in **Annexes-7.**

10.1 Team at KGF

A new set of technical manpower including the Executive Director (ED) joined KGF in April 2017. Two Program Directors, one for Crops and the other for Livestock and Fisheries, from the earlier set of technical manpower are continuing. Four Program Specialists, each one for Crops, Horticulture, Comunication and Fisheries, and one Senior Program Specialist joined in March 2017.The list of manpower is given in **Annex-8**. One Assistant Manager (Audit and Accounts) joined the KGF financial team in March 2017.

10.2 New Executive Director joined at KGF

Dr. Wais Kabir, an Agricultural Research Management Professional joined at Krishi Gobeshona Foundation (KGF) as Executive Director on 13 April, 2017. He served Bangladesh Agricultural Research Council as Executive Chairman during 2009 to 2013. During this period, he successfully coordinated research and development of the twelve National Research Institutes of Bangladesh.

Dr. Kabir also served as the Chairman of the General Body & Board of Directors of KGF during his tenure at BARC as CEO. He made a major reorganization of the SAARC Agriculture Centre as the Director of the international Centre. Also Dr. Wais Kabir worked with Food and Agricultural Organization of United Nations for three years and was responsible for mapping exercise of water logging with South-West part of Bangladesh. During his stay at FAO, he performed as a member of international panel of experts with the Netherland Government project.

Dr. Kabir obtained his Bachelor of Science Degree in Agricultural Engineering from Bangladesh Agricultural University in 1978, Master of Engineering from Asian Institute of Technology, Thailand and PhD from Central Luzon State University, Philippines in 1994. He also completed Post Doctoral Research at Kansas State University, USA. Dr. Kabir has a good number of publications national and international journals.

10.3 Five Professionals joined at KGF

Dr. Tapan Kumar Dey joined at KGF on 15 March 2017 as Senior Program Specialist (Crops). He started his career as Scientific Officer at Bangladesh Agricultural Research Institutes and retired as Director (PRC and RARS) from the same institute. Before joining at KGF Dr. Dey served as Consultant in USAID, Supreme Seed Ltd. and Ispahani Agro Ltd. His specialization in Plant Pathological Research and Seed Production. Director of BARI. Dr. Dey has a good linkage with educational institutes and he supervised 12 MS and 9 Ph D (4

awarded and 5 under process) and maintained pleasurable linkage with CGIAR Institutes. In his service tenure, Dr. Tapan published 16 International and 61 National papers in Journal. Dr. Dey honored as Expert Member of Board of Studies, BAU, Mymensingh and Member of TAC (Technical Advisory Committee), KGF. He has lot of experience on Project Review and Monitoring of NARS Institutes, Universities, BAS USDA, UGC and ACIAR.

Md. Hazrat Ali, PhD joined as Program Specialist (Field Crops) at KGF on 15 March 2017. Prior joining to KGF, he worked more than 34 years under National/International research organizations, Public & NGO sectors. He was responsible for to define local needs and opportunities for intervention of faster sustainable and profitable management technologies for the key crops and cropping systems through participatory approaches. At BRRI, he served for more than 30 years under different positions in the Rice Farming Systems Division and he also performed the responsibilities of Program Leader of the Rice Farming Systems Research Program area where he was involved in planning and designing of different Research program for the division. Dr. Ali also was involved in dissemination of Rice based Cropping Systems technologies across the country. Furthermore, he prepared and executed several projects on Resource poor–farm households to improve farm productivity and livelihood pattern in Favorable, Coastal saline and none saline tidal ecosystems. A book and more 40 forty scientific papers published in National and International Journal in his credit.

Shahabuddin Ahmad, Ph.D. joined at KGF at 15 March 2017 as Program Specialist (Horticulture) Prior to the new position Mr. Ahmad served as a Director, Horticulture Research Centre, BARI. Also he served as a sector leader vegetable, at The World Vegetable Center under USAID Horticulture Project. Total 33 years of experience in vegetable variety development, production technology, seed production, research farm management, project management and extensive technology dissemination through training and demonstration and international experience with diverse stakeholders, he published more than 100 research and extension publications. He was Awarded Gold medal by The Bangladesh Academy of Agriculture in recognition of contribution to the Science of Agriculture in 2006. Also was awarded crest by the Seed Wing, Ministry of Agriculture, in recognition of special contribution to Seed Management sector in 2008. He obtained Ph.D. in Horticulture and M Sc Ag in Horticulture.

Ms. Nasrin Akter joined at KGF on 14 March 2017 as Communication Specialist. Before joining KGF, she worked at SAARC Agriculture Centre (SAC), Dhaka, an inter-governmental body since 1994 in different capacities. She has specialization in crops production, improvement and management as well as knowledge management and networking. Her diversified professional career of almost 25 years made her known to the scientific society at home and abroad. While at SAC, she served as the Senior Program Specialist for Horticulture as the regional recruited professional. Also she was Senior Program Officer (Crops) and Technical Editor at SAC and worked for program development, management, maintaining linkages with the different stakeholders including regional and international bodies for the development of the Centre. Ms. Nasrin engaged herself in developing strategy, improvement in program implementation of the Centre and involved in transformation process of SAIC to present SAC including institutional development. She Conducted International/regional adaptive trials/research of the selected crops in SAARC member countries and Preparation and Coordination of the regional programs/projects of SAC in SAARC member countries. She also work as Scientific Officer at International Rice Research Institute (IRRI) after completion of her academic career.

Mohammad Nuruzzaman joined at KGF on 14 March 2017 as Program Specialist (Fisheries). Before this current position in KGF, Mohammad Nuruzzaman has over 30 years of experience working for Bangladesh government and different donors/development agencies including UN organizations like UNIDO and ILO. He had been working for Department of Fisheries. Mr. Nuruzzaman worked for ICLARM (currently WorldFish),

DFID, World Bank and different NGOs. He worked long for the United Nations Industrial Development Organization (UNIDO) as Gender Specialist for its Shrimp and Livestock Sector development projects in Bangladesh. He took his B Sc. Fisheries and M Sc. in Aquaculture degrees from Bangladesh Agricultural University, Mymensingh. Later he obtained M Sc. in Coastal Zone Management from Department of Marine Science, University of Newcastle, UK. He also earned another degree on Master of Development Studies (MDS) from BRAC University.

10.4 Farewell

Dr. Md. Abdur Razzaque, Program Director (Crops) of KGF completed his tenure on 30 June 2017. He joined KGF in 2009 and contributed to KGF for achieving its goal to pluralistic research environment in Bangladesh. Executive Director and Staff of KGF remembered his achievements in a farewell program organized by KGF.

Annexes

Annex- 1

CGP Projects Awarded under 3rd call

Sl #	Project code #	Title of the Project	Principal Investigators (PIs)
	TF-37-F/17	Development of Health Management Strategy against Bacterial Diseases in the Aqua-farms of Bangladesh	Dr. Gias Uddin Ahmed, Prof, Aquaculture, BAU, Mymensingh, Mobile:01712564528
	TF-38-F/17	Post-harvest loss reduction through improved methods and value-addition of fresh fish through better handling, processing, distribution and marketing in haor areas of Kishoreganj	Prof. Dr. A. K. M. Nowsad Alam, Faculty of Fisheries, Fisheries Technology, BAU, Mymensingh; Mobile: 01711446315
	TF-39-F/17	Adaptation of Disease Management Strategy in the Existing Culture Practices of Shrimp through Aquamimicry System	Dr. S. M. Rafiquzzaman, Department of Fisheries Biology & Aquatic Environment, BSMRAU, Gazipur; Mobile: 01754041311
	TF-40-F/17	Effects of dietary polyunsaturated fatty acid and beta glucan on broodfish (Labeo rohita, Mystus cavasius and Ompok pabda) immunity and fry quality	Dr. Zakir Hossain, Prof, Dept. of Fisheries Biology and Genetics, BAU, Mymensingh; Cell # 01711150059
	TF-41-F/17	Development and Adoption of Cotton-Based Cropping System for Drought-prone Highland of Chittagong Hill Tracts	Dr. Md. Farid Uddin, ED, CDB, 6th Floor, Rear Building, Khamarbari, Farmgate, Dhaka-1215 Mobile: 01711020798
	TF-42-F/17	Development and adoption of low cost small potato planter and harvester for profitable potato production	Dr. Md. Israil Hossain, CSO, Farm Machinery & Postharvest Division, BARI, Gazipur, M: 01713363630
	TF-43-F/17	Livelihood improvement through farming system research and development in floating agriculture system.	Dr. ASM Mahbubur Rahman Khan, CSO, OFRD, BARI, Gazipur. Cell: 01712598035, Email: mahbubur.bio@bari.gov.bd
	TF-44-F/17	Livestock and Human Brucellosis: Molecular diagnosis, treatment and control	Dr. Md. SiddiqurRahman, Prof, Department of Medicine, BAU, Mym; Mobile: 01918181550
	TF-45-F/17	Epidemiological investigation on tuberculosis and campylobacteriosis associated with dairy farming practices in the selected districts of Bangladesh	Dr. S.M. Lutful Kabir, Prof, Microbiology and Hygiene, BAU, Mym; Mobile: 01754987218
	TF-46-F/17	Study on zoonotic diseases of pets and assessment of risk factors of commonly occurred zoonoses for better management	Dr. Jahangir Alam, CSO, Animal Biotechnology Division, National Institute of Biotechnology, Ganakbari, Ashulia, Savar, Dhaka-1349; Mobile: 01712819098
	TF-47-F/17	Value addition to feeds and fodder through bioactive component-rice herbs for safe livestock production	Mohammad Al-Mamun, Prof, Animal Nutrition, BAU, Mym; Mobile: 01715051093
	TF-48-F/17	Improving Lamb Production Potentiality of Native Sheep through Selection and Genetic Enhancement	Dr. Md. Munir Hossain, Prof, Animal Breeding and Genetics, BAU, Mym; Mobile: 01716540609
	TF-49-F/17	Value addition through pelleting and densifying of feed using crop residues for ruminants	Dr. Mohammad Mohi Uddin, Assistant Prof, Animal Nutirtion, BAU, Mymensingh; Mobile: 01818429023
1	TF-50-F/17	Management of wheat blast caused by Magnaporthe oryzae pathotype Triticum introduction	PI 1: Dr. Paritosh Kumar Malaker, CSO, WRC, BARI, Nashipur, Dinajpur. Cell: 01716456674; PI 2: Dr. M Bahadur Meah, Prof, Plant Pathology, BAU, Mym. PI 3: Md. Tofazzal Islam, PhD, Prof, Biotechnology, BSMRAU, Gazipur-1706; Mobile: 01714001414
	TF-51-F/17	Assessment of cropping patterns for sustainable intensification in drought and saline-prone ecosystems using remote sensing and geospatial modeling.	Dr. Md. Golam Mahboob, SSO, ASICT Division, BARI, Gazipur, Cell: 01819194986
	TF-52-F/17	Adaptation of BARI released hyacinth bean varieties and up-scaling the farmer's innovation for productivity enhancement in Narsingdi region.	Dr. Md. Moshiur Rahman, SSO, RHRS, BARI, Sibpur, Narsingdi; Mobile: 01716838586
	TF-53-F/17	Production and dissemination of BARI released year round jackfruit variety and its management packages.	Dr. Md. Jillur Rahman, SSO, Pomology Division, HRC, BARI, Gazipur.; 01715082555
	TF-54-F/17	Improvement of cropping systems applying different agronomic management practices in salinity affected coastal zone of south-western part of Bangladesh for attaining food security and sustainability.	Dr. Md. Sirajul Islam, CSO, Regional Agricultural Research Station, BARI, Jessore-7400, Cell: 01712142042

Sl #	Project code #	Title of the Project	Principal Investigators (PIs)
	TF-55-F/17	Development and adoption of a solar cabinet dryer for vegetable seeds	Dr. Md Nurul Amin, SSO, Farm Machinery and Post Harvest Process Engineering Division, BARI
	TF-56-F/17	Collection characterization of potential germplasm of rape seed-mustard and participatory salt tolerant short duration variety development for increasing cropping intensity in southern coastal Bangladesh	Dr. Lutful Hassan, Professor, Dept. of Genetics & Plant Breeding, BAU, Mymensingh; Mobile: 01715091096
	TF-57-F/17	Identification of Resistant Sources against Gallmidge and Development of Tolerant Advanced Breeding Lines	Dr. Md. Mofazzel Hossain, PSO, Entomology Division, BRRI, Gazipur-1701, Cell: 01731386113
	TF-58-F/17	Sustainable management of maize insect pests with special emphasis on the com borer, the emerging species through innovative, participatory and collaborative research.	Professor Dr. Khandakar Shariful Islam, Dept. of Entomology, BAU, Mymensingh 2202, Cell: 01716370731
2	TF-59-F/17	Promoting production of beans (bushbean, mungbean and soybean) for increased income of rural people in the south central coastal region of Bangladesh.	Dr. Md. Ashraf Hossain, PSO and Head, Pulses Research Sub-Station, BARI, Joydebpur, Gazipur; Mobile: 01712948871
3	TF-60-F/17	Improvement of agroforestry practices for better livelihood and environment in Charland area of Tista River Basin.	Dr. Md. Shafiqul Bari, Prof, Agroforestry and Environment, HMDSTU. Cell: 01713163399
4	TF-61-F/17	Up-scaling of Rice-Bean cropping system for increased yield, Nutrients and soil productivity.	Dr. Md. Solaiman Ali Fakir, Professor, Dept. of Crop Botany, BAU, Mymensingh-2202, Cell: 01715523202
5	TF-62-F/17	Validation of good practices of on-farm lamb production systems	Coordinator: Dr. M. A. Hashem, Prof, Animal Science, BAU, Mym; Mobile: 01721310621

Annex- 2

List of Awarded Pilot Projects

Sl #	Project code #	Title of the Project	Principal Investigators (PIs)
1	C-HF-103	Validation of improved agricultural technologies at farmer's field in hill farming system. Implemented by BARI	Dr. Md. Mohabbat Ullah, Principal Scientific Officer, Hill Agril. Research Station, Bangladesh Agricultural Research Institute, Khagrachhari, Cell: 01550605727
2	C-PHT-179	Increasing storability of potato in natural storage and income generation through small scale processing of potato. BARI	Dr. Md Azizul Haque, Former in charge, Tuber Crops Research Sub-center, BARI Munshiganj-1500. Currently Professor, BSMRAU. Cell: 01711488619
3	C-CA-113	Adaptation of improved Sesame varieties in Khulna District optimizing sowing time and Nitrogenous fertilizer management. Khulna University	Dr. Md. Sarwar Jahan, Professor, Agrotechnology Discipline, Khulna University, Khulna-9208. Cell: 01712813106
4	C-S-161	Water management practices for increasing cropping intensity in Chapai Nawabganj District of Bangladesh. BINA	Dr. Md. Asgar Ali Sarker, CSO (cc), Agriculture Engineering Division, BINA, P.O. Box-04, Mymensingh-2202. Cell: 01715998145
5	P-1	Crop intensification in Barind area through effective drought management. BSMRAU	Dr. Md. Abdus Salam, Senior Scientific Officer On-Farm Research Division, Bangladesh Agricultural Research Institute, Rajshahi. Cell: 01712092122
6	P-2	Management and control of mites in coconut through farmers' capacity enhancement. BARI	Dr. Md. Nazirul Islam, Principal Scientific Officer Regional Horticultural Research Station, Shibpur, Narshingdi. Cell: 01715855239
7	P-3	Increasing rice production adopting improved production technologies in the tidal floodplain. BARI	Professor Dr. Md. Jafar Ullah, Department of Agronomy, Sher-E-Bangla Agricultural University, Dhaka. Cell: 01552331605

Sl #	Project code #	Title of the Project	Principal Investigators (PIs)
8	P-4	Upscaling of mubgbean-rice pattern in the Charlands of Kurigram. BARI	Professor Dr. Md. Abdul Karim, Department of Agronomy Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur-1706. 01716752414
9	P-5	Upscaling improved jhum cultivation introducing intercropping rice with cotton.	Prof. Dr. Md. Farid Uddin, Additional Director Cotton Development Board Khamarbari. Cell: 01711020798
10	P-6	Integrating crops and fish culture through land conversion into-ditch-dyke system	Professor Dr. Md. Mofazzal Hossain, Department of Horticulture, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur-1706. Cell: 01819433225
11	P-7	Up-scaling and Validation of a proven technology on management of the major diseases of Brinjal and Tomato. BARI	Dr. Biresh Kumar Goswami, CSO, TCRC, BARI, Gazipur-1701. Cell: 01716519187
12	P-8	Validation and piloting of improved production technologies in Gopalgonj Basin. BARI	Dr. Ashraf Hossain, Principal Scientific Officer, Pulses Research Sub-station, BARI, Gazipur. Cell: 01712948871
13	P-9	Validation of up-scaling of Improved Rice Based Cropping Systems incorporating Mustard and Potato in Northern Districts BARI	Bangladesh Agricultural Research Institute (BARI), Gazipur
14	P-10	Up-Scaling and validation of Rhizome Rot Disease Management BARI	Dr. Atika Ayub, Chief Scientific Officer, Plant Pathology Division, Bangladesh Agricultural Research Institute (BARI); Cell:01716549366
15	P-11	Validation and scaling up of T.Aman - Potato/Mustard - Mungbean -T.Aus Cropping System in Northern districts of Bangladesh. BSMRAU	Prof. Dr. Md. Moynul Haque, Dept. of Agronomy; Cell: 01711908640
16	P-12	Up-scaling of cost effective formula feeds and improved management practices for increasing milk and meat production from buffaloes. BAU	Prof. Dr. Emdadul Haque Chowdhury, Department of Pathology, BAU, Mymensingh, Mobile no. 01712 017381
17	P-13	Adaptation of Community Enterprise Approach in Tidal Floodplains for crop-fish culture - Jhalokathi Model. SHISUK	Mr. Zillur Rahman, Program Director, SHISUK, Dept. of Fisheries and Dhaka University
18	P-14	Pilot Project on "Up-scaling and Campaigning of Rice-Cotton intercropping in Bandarban and Khagrachari districts". CDP	Dr. Md. Farid Uddin, Executive Director, CDB, Dhaka
19	P-15	Upscaling of high value shing fish culture technology in homestead household ponds	Dr. Md. Jahangir Alam, Prof., Dept. of Fisheries Biology and Aquatic Environment, Bangabandhu Sheikh Mujibur Rahman Agricultural University(BSMRAU), Gazipur;Cell: 01715143521
20	P-16	Improving the animal health and productivity through mobile veterinary services	Prof. Dr. Emdadul Haque Chowdhury, Department of Pathology, BAU, Mymensingh, Mobile no. 01712 017381
21	P-17	Upscaling of tricho-compost and tricho-leachate production for disease management in vegetable and spices (rhizome and bulb crops)	Dr. Shamsunnahar, PSO, HRC, BARI, Gazipur
22	P-18	Scale up of Community Enterprise Approach (CEA) for Intensification of floodplain fish production in Chalan beel	SHISUK, Dept. of Genetics and Fish Breeding, BSMRAU, Gazipur

Annex- 3

KRISHI GOBESHONA FOUNDATION
Statement of Expenditure (SoE) for the Period from July 2016 to June, 29, 2017

Fig. in Crore Tk.

Sources of Fund / Head of Income:		Approved budget	1st Revised approved budget 2016-17	2nd Revised approved budget 2016-17	Quarterly expenditure	Fund Received yet to date	Receiving Date	Remarks
Opening Balance 01/07/2016			2.7900	2.79000		2.79000	Unspent Balance as of	
Grants from BKGET Trust Fund		65.3800	31.6900	31.69000		1st inst. (1st Portion) 1683.51195	17/07/2016	
						1st inst. (2nd Portion) 1485.48804	10/09/2016	
Interest Received on KGF account Balance as of 29 June, 17				0.20320				
Total Fund for the period July 2016 to June, 2017		65.3800	34.4800	34.48000				
Sl. No.	**Line Items / Head of Expenditures**	**Approved budget**	**1st revised approved budget 2016-17**	**2nd revised approved budget 2016-17**	**April-June 2017**	**Expenditure July 2016 to 29 June 2017**	**Rest of Budget Amount (Tk.)**	**Achivement %**
1	Program Cost:							
1.1	Research Grants Program (on-going):							
	(a) Competitive Grants Program (CGP)							
	(i) CGP (1st Call)	1.760	1.2994769	1.00000	0.00000	0.90380	0.09620	90%
	(ii) CGP (2nd Call)	9.000	7.449867	7.14987	2.07550	7.10512	0.04475	99%
	Sub- total	10.760	8.7493437	8.14987	2.07550	8.00892	0.14095	98%
	(b) Commissioned Resrch Program (CRP):							
	(i) CRP-1: Hill Agriculture	10.00)	6.1980600	6.89754	3.63019	6.84822	0.04932	99%
	(ii) CRP-2: Modeling Climate Change on Bangladesh Agriculture	6.000	0.4200000	0.42000	0.42000	0.42000	0.00000	100%
	(iii) CRP- 3: Sugarcane R&D in CHT	1.000	3.1152757	3.50528	0.83641	3.50169	0.00359	100%
	(c) Technology Piloting Program (TPP)	1.800	2.9577000	2.46770	1.00400	1.96167	0.50603	79%
	(d) International Collaborative Prog (ICP)	0.00	0.0000000	0.00000	0.00000	0.00000	0.00000	0
	(i) Cropping System Intensification in the Salt Affected Coastal Zone of Bangladesh & West Bangal, India. (ACIAR)	1.5000	0.4972500	0.39725	0.08250	0.32725	0.07000	82%
	Sub- total	20.300	13.1882857	13.68776	5.97310	13.05883	0.62894	95%
	(e) Other Program:							
	(i) Mitigation of Greenhouse Gas (GHG)	1.500	0.5130420	0.51304	0.17464	0.33768	0.17536	66%
	(ii) R&D of Seaweed cultivation	1.740	1.8137800	1.81380	0.00000	1.81380	0.00000	100%
	(iii) ICT-ARMIS Project	0.700	0.2887909	0.28880	0.00000	0.28880	0.00000	100%
	(ii) Preparation of plan & other documents, management review & M&E cost (TA/DA), TAC Related Expenses, Honorarium (CGP/CRP/Pilot Projects), Expert Reviewer Honorarium etc.	2.000	1.1829460	0.88292	0.30972	0.83387	0.04905	94%
	Sub- total	5.940	3.7985589	3.49856	0.48436	3.27415	0.22441	94%
	Research Grants Program (Up-coming):							
	(i) CGP 3rd Call (50 projects)	6.000	0.2900000	0.29000	0.00000	0.00000	0.2900	0%
	(ii) CRP (R&D in Drought prone Agriculture, R&D in Charland Agriculture, R&D in Hill Livestock, assessment of land suitability & crop zoning)	1.500	1.2400000	1.64000	1.59880	1.59880	0.0412	97%
	(iii) Basic Research	10.00	1.2800000	1.28000	1.14914	1.14914	0.1309	90%
	(iv) ICP: Soil nutrition ACIAR/Murdoch university, Pulse	2.000	0.0000000	-	0.00000	0.00000	0.0000	0%
	Sub- total	19.500	2.8100000	3.21000	2.74794	2.74794	0.46206	85.61%

1.2	Capacity Enhancement Program (CEP):							
	(a) Human Resource Development (HRD) Program: Higher studies, Skill enhancement of scientists and R&D partners; National/International training / visits, etc.; International resource person/ consultant/ expert (remuneration, perdiem, fees, airfare, lodging and others cost); National/International linkage development program with KGF and R&D partners	2.000	1.0886756	1.08868	0.23767	0.82523	0.2634	76%
	(b) Institutional capacity enhancement: i) Strengthening/ creation of research facilities/renovation, etc. for NARS institute; ii) KGF capacity improvement: Office rent, procurement of KGF equipment, computer, goods and logistics support and services, hiring of services and facilities, etc. for KGF.	2.000	0.5013722	0.50137	0.14142	0.33969	0.1617	68%
	(c) Preparation of plan & other documents: Fees for different studies/ publications / books, etc.; including logistics support and printing, publication, documents & video production cost, etc and hiring of National/Intenational experts/consultants/resource persons	1.000	0.4511000	0.45110	0.06601	0.31380	0.1373	70%
	Sub- total	5.000	2.0411478	2.04115	0.44510	1.47872	0.56243	72%
	Total Programm Cost:	61.500	30.587336	30.58734	11.72600	28.56855	2.01879	93%
2	Operational Support Cost:							
2.1	(a) Salaries: i) Salaries of KGF Technical/Admin & Finance/Office and General Support Service Management Staff and support service Worker fees (ii) Remuneration of contractual services & other staff, etc	2.3648	2.225150	2.22515	0.75877	2.17170	0.05345	98%
	(b) Allowances: Allowances, service benefits, TAX/VAT, payments, etc. of KGF Technical/Admin & Finance/Office and General Support Service Management Staff and support service Worker	0.6025	0.618499	0.61850	0.17600	0.40794	0.21056	66%
2.2	(a)General Operating Cost: Utilities, hiring of vehicles, repair & maintenance/ renovation, supply & services, TA/DA, Audit fees/ financial/ technical services, AGM/EGM/Board Meeting and other costs, etc.	0.8984	1.044015	1.04402	0.21629	0.75522	0.28879	72%
	(b) Contingency/ Any other misc. cost (as per need)	0.0143	0.005000	0.20820	0.00000	0.002500	0.20570	1%
	Sub-total of Operational Support Cost	3.880	3.892664	4.09586	1.15105	3.33737	0.75850	81%
	Grant total Budget for 2016 and 2017	65.380	34.480000	34.68320	12.87705	31.90592	2.7772847	92%
Progress, 29 June, 2017 against received Tk. 34.48 Crore Plus Interest received on Bank Account of KGF BDT 0.2032.						92%		

Annex- 4

KRISHI GOBESHONA FOUNDATION
Annual Budget for the Year 2018-19 (Tentative)

Fig. in Lakh Tk.

Sources of Fund / Head of Income:		**Annual budget for the year 2018-19**	
Grants from BKGET Trust Fund			
Sl. No.	**Line Items / Head of Expenditures**	**Itemwise program cost**	**% of total budget**
1	**Programs Cost:**		
1.1	**Research Grants Program (on-going):**		
	(a) Competitive Grants Program (CGP)		
	(i) CGP (2nd Call)	189.6460	0.04
	(ii) CGP (3rd Call)	1,481.5071	0.29
	(iii) Basic Research	219.5380	0.04
	Sub- total	1,890.6911	0.37
	(b) Commissioned Research Program (CRP) :		
	(i) CRP-1: Hill Agriculture	100.0000	0.02
	(ii) CRP-2: Modeling Climate Change on Bangladesh Agriculture	674.0000	0.13
	(iii) CRP- 3: Sugarcane R&D in CHT	152.0000	0.03
	(iv) CRP- 4: R&D on Hill Livestock	127.8800	0.02
	(v) CRP -5: Assessment of land suitability & crop zoning	500.0000	0.10
	© Technology Piloting Program (TPP)	142.3900	0.03
	(d) International Collaborative Program (ICP)	-	
	(i) Cropping System Intensification in the Salt Affected Coastal Zone of Bangladesh& West Bangal, India. (ACIAR)	185.0000	0.04
	Sub- total	1,881.2700	0.36
	(e) Other Program:		
	(i) Mitigation of Greenhouse Gas (GHG)	-	
	(ii) R & D Seaweed Cultivation	60.0000	0.01
	(iii) Numan	140.0000	0.03
	(iv) Preparation of plan & other documents, management review & M&E cost (TA/DA), TAC Related Expenses, Honorarium (CGP/CRP/Pilot Projects), Expert Reviewer Honorarium etc.	250.000	0.05
	Sub- total	**450.000**	**0.09**
	Total (Research Grants Program)	**4,221.961**	**0.82**
1.2	**Capacity Enhancement Program (CEP):**		
	(a) Human capacity (HRD Program): Skill enhancement of scientists and R&D partners; National/International training / workshops/ meetings/ visits, etc.; National/International resource person/ consultant/ experts perdiem, remuneration, fees, airfare, lodging and others cost; National/International linkage development program with KGF and R&D partners	165.0000	0.03
	(b) Institutional capacity enhancement: i) Strengthening/ creation of research facilities/renovation, etc. for NARS institute; ii) KGF capacity improvement: Office rent, procurement of KGF equipment, computer, vehicles, goods and logistics support and services, hiring of services and facilities, etc. for KGF.	150.0000	0.03
	© Preparation of plan & other documents: National/ International experts/ consultants/resource persons fees for different studies / publications / books, etc.; including logistics support and printing, publication, documents & video production cost, etc.	50.0000	0.01
	Sub- total	**365.000**	0.07
	1. Sub-total of Program Cost	**4,586.961**	

2	**Operational Support Cost:**		
2.1	**(a) Salaries:** i) Salaries of KGF Technical/Admin & Finance/Office and General Support Service Management Staff and support service Worker fees (ii) Remuneration of contractual services & other staff, etc	365.0000	0.07
	(b)Allowances: Allowances, service benefits, TAX/VAT, payments, etc. of KGF Technical/Admin & Finance/Office and General Support Service Management Staff and support service Worker	85.0000	0.02
2.2	**(a) General Operating Cost:** Utilities, hiring of vehicles, repair & maintenance/ renovation, supply & services, TA/DA, Audit fees/ financial/ technical services, AGM/EGM/Board Meeting and other costs, etc.	130.0000	0.03
	(b) Contingency/ Any other misc. cost (as per need)	2.5000	0.00
	2. Sub-total of Operational Support Cost	**582.500**	**0.11**
	Total Budget for the Financial Year 2018-19	**5,169.461**	**1.00**
In word : Taka 5169.461 (Fifty One Crore Sixty Nine Lakh Forty Six Thousand One Hundred) only			
(As per need, line-item costs may be adjusted by the ED, KGF within the Total)			
Trust fund grants (Tk 5169.461lakh) will be utilized as per objectives of the BKGET Clause iv no.7 (page-10) and the provisions of the Memorandum of KGF.			

Annex- 5

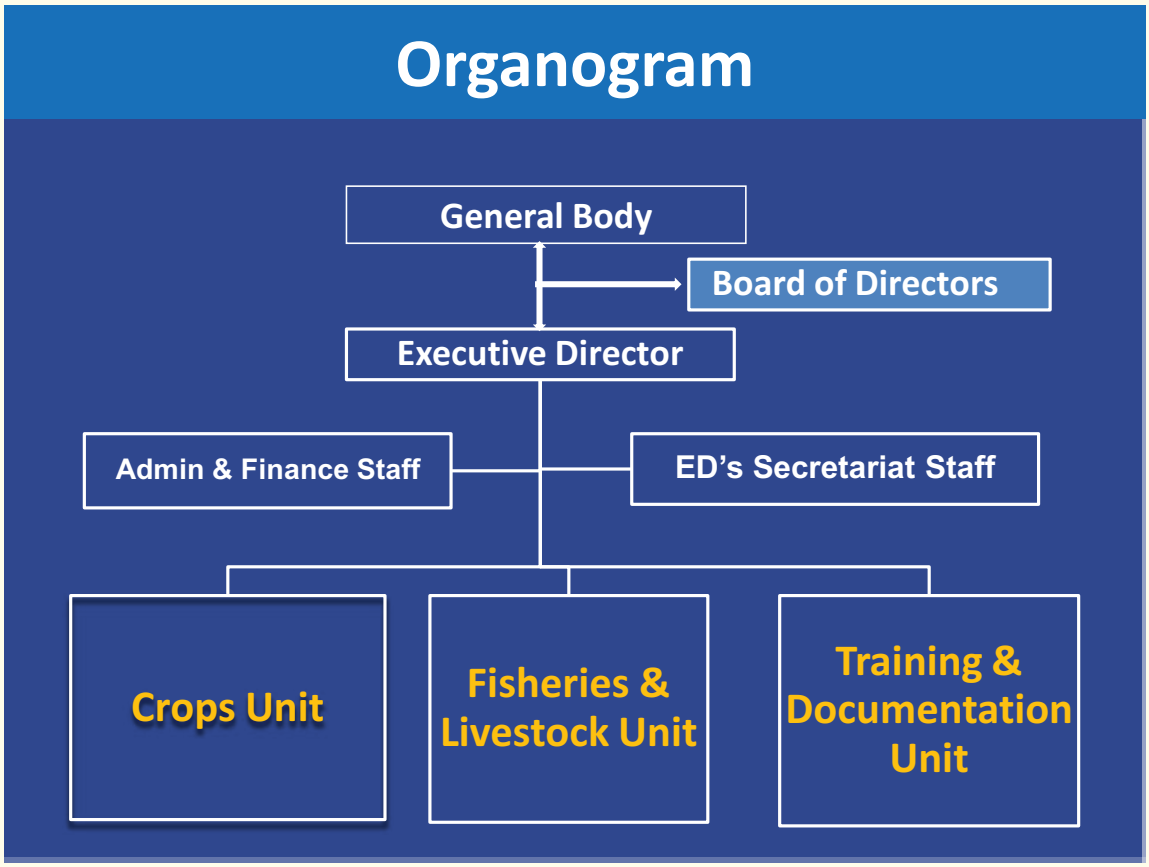
KGF Work Plan and Implementation FY: 2018-19 (Tentative)

Sl. No.	List of Activities/Programs to be performed	Performance Schedule of the each Activity (Tentative)											
		J	A	S	O	N	D	J	F	M	A	M	J
A.	**Competitive Grants Program**												
1.	Selection of research areas, call for research proposals for 4th call, TAC evaluation and Budget rationalization												
2	Board Approval, MoU signing and awarding grant of BKGET 4th Call of CGP projects												
3	Coordination, Implementation and Management of KGF funded on-going CGP and Basic research projects												
B.	**Commissioned Research Program**												
1.	Coordination, Implementation and Management of CRP I-Harnessing the potentials of Hill Agriculture CRPII-Modeling Climate Change Impact on Agriculture CRPIII-Strengthening Sugarcane Research and Development in the Chittagong Hill Tracts CRPIV- Implementation of Livestock R&D project in CHT CRPV- Assessment of land suitability and crop zoning												
2.	Formulation of new CRP projects based on national demand : Biotic / Abiotic stress (Drought Prone Environment, Haor Agriculture and in Char lands)												
C.	**Capacity Enhancement Program**												
1.	Coordination and Implementation of KGF BKGET funded Capacity Enhancement program of Sea Weed production, GHG projects and ARMIS												
2.	Coordination, Implementation and Management of KGF funded on-going Training Program (Livestock & D) and Foundation Training etc.												
3.	Development and Implementation of Training on Statistical/Advanced Breeding/Disease Forecasting/ Crop Modeling/IPM/Crop Management/IPR etc.												
4.	Holding need based Consultative Meeting, Seminar, Workshops, policy dialogue etc.												
5.	Providing assistance to develop/improve physical facilities of NARS institutes.												
6.	Developing International Linkage & collaboration with CGIAR institutes, reputed universities and R&D organizations												
D.	**International Collaborative Program**												
	Coordination, Implementation and Management of ICP 1 (Intensification…Coastal area), ICP II (NUMAN) and ICP III (Salt tolerant Wheat and Pulses) and other upcoming projects												
1.	Continue Implementation of the upcoming and on- going pilot projects initiated through BKGET												

Sl. No.	List of Activities/Programs to be performed	Performance Schedule of the each Activity (Tentative)											
		J	A	S	O	N	D	J	F	M	A	M	J
	funding. Impact assessment studies of the completed pilot projects.												
E.	**Monitoring and Evaluation**												
1.	Conducting concurrent M & E of KGF funded ongoing CGP, Basic research, CRP, CEP, ICP and Pilot projects												
2.	Organizing Half yearly, Annual progress review and planning workshops												
F.	**Other Activities**												
1.	Annual General Meeting												
2.	**Board meetings, Project Management meetings etc.**												
3.	Preparation and Printing of Annual report												
4.	Preparation and Printing of project briefs/ Need based Fact Sheet, other reports, compilation of technical and scientific booklets/publications etc.												
5.	Miscellaneous activities												

Annex- 6

KGF Organogram



Annex- 7

List of Board of Directors & Members of General Body of KGF

(As per provisions in the KGF Memorandum and Articles of Association)

List of the Board of Directors	List of the General Body Members
Dr. Mohammad Jalal Uddin Chairman, Board of Directors of KGF and Executive Chairman, BARC, Farmgate, Dhaka-1215	**Dr. Mohammad Jalal Uddin** Chairman, General Body of KGF, and Executive Chairman, BARC, Farmgate, Dhaka-1215
Prof. Dr. M. A. Sattar Mandal Emeritus Professor, BAU, House- B-6, Arambagh Main road (Gate No. 5), Mirpur-7 (Nearest to Milk Vita), Dhaka.	**Prof. Dr. M. A. Sattar Mandal** Emeritus Professor, BAU, House- B-6, Arambagh Main road (Gate No. 5), Mirpur-7 (Nearest to Milk Vita), Dhaka.
Dr. Abul Kalam Azad Director General, BARI, Joydebpur, Gazipur-1701	**Dr. Abul Kalam Azad** Director General, BARI, Joydebpur, Gazipur-1701
Dr. Bhagya Rani Banik Director General, BRRI, Joydebpur, Gazipur-1701	**Dr. Bhagya Rani Banik** Director General, BRRI, Joydebpur, Gazipur-1701
Prof. Dr. Md. Hazrat Ali, Treasurer, and former Dean and Professor, Department of Agronomy Sher-e-Bangla Agricultural University(SAU), Sher-e-Bangla Nagar, Dhaka-1207	**Prof. Dr. Md. Hazrat Ali** Treasurer, and former Dean and Professor, Department of Agronomy, Sher-e-Bangla Agricultural University(SAU),Sher-e-Bangla Nagar, Dhaka-1207
Dr. Md. Rafiqul Islam Molla Former DD, DAE, and Director, Social Upliftment Society (SUS), 76/A, Uttarpara, Savar, Dhaka-1340	**Dr. Md. Rafiqul Islam Molla** Former DD, DAE, and Director, Social Upliftment Society (SUS), 76/A, Uttarpara, Saver, Dhaka-1340
Dr. Shaikh Abdul Quader Managing Director, Agriconcern Ltd. 67, Purana Paltan Line, Dhaka-1000	**Dr. Shaikh Abdul Quader** Managing Director, Agriconcern Ltd. 67, Purana Paltan Line, Dhaka-1000
	Kbd. Md. Manzurul Hannan Director General DAE, Khamarbari, Farmgate, Dhaka-1215
	Prof. Dr. Shah-e-Alam Former VC, Sher-e-Bangla Agricultural University, and Professor of Plant Breeding and Genetics Department, BAU, Mymenshingh-2202
	Dr. Nowsad Alam Professor of Post-harvest, Fisheris and Quality Control, Department of Fisheries Technology, BAU, Mymenshingh-2202
	Dr. Md. Abdur Razzaque Former DG, BARI and Executive Director Lalteer, Anchor Tower, Uttam C.R. Road, Dhaka
	Dr. Md. Aynul Haque DG and Director (in-charge) Annimal Health andAdministration, DLS, Khamarbari, Dhaka-2015
	Dr. Kshirode Chandra Roy Former DG, BARI House-247 (2nd Floor) Block-K, West Joydebpur, Gazipur-1700
	Dr. Craig A. Meisner Country Director, WorldFIsh Centre Bangaldesh and South Asia Bangladesh Office, House-22B, Road-7, Block-F, Banani, Dhaka-1213

Team at KGF

Dr. Wais Kabir, Executive Director, KGF

Dr. Kazi M. Kamaruddin, Program Director (Livestock & Fisheries)

Dr. Md. Abdur Razzaque, Program Director (Crops), In-charge

Dr. Tapan Kumar Dey, Senior Program Specialist (Crops)

Dr. Md. Hazrat Ali, Program Specialist (Field Crops)

Dr. Shahabuddin Ahmad, Program Specialist (Horticulture)

Dr. Mohibul Hasan, Technical Editor

Mohammad Nuruzzaman, Program Specialist (Fisheries)

Ms. Nasrin Akter, Communication Specialist

Ms. Shahrina Akhtar, Technical Officer

Mr. Mehedi Hasan, Manager (Admin & SS)

Mr. Md. Salat Ahmed, Manager (Finance & Accounts)

A.T.M. Jashim Uddin, IT Manager

Ms. Tahsina Naznin, Graphic Design Manager/Audio Visual Associate

Md. Delowar Hossain, Assistant Manager (Audit & Accounts)

Ms. Mahmuda Begum, Audit & Accounts Supervisor

Mr. Md. Rafiqul Islam Akanda, Office Supervisor

Ms. Noormahal Begum, Logistic and Common Service Supervisor

Mohammed Abul Khair, Office Assistant cum Computer Operator

Mr. Kabel Hossain, Office Assistant cum Computer Operator

Ms. Jarin Tasmim, Cashier/Account Assistant

Mr. Aminul Islam Khan, Store Keeper

Audit Report 2016

Krishi Gobeshona Foundation (KGF)

For

Bangladesh Krishi Gobeshona Endowment Trust (BKGET) Fund
For the year ended December 31, 2016

Auditors' Report
of
Bangladesh Krishi Gobeshona Endowment Trust (BKGET) Fund of
Krishi Gobeshona Foundation

We have audited the accompanying financial statements of Bangladesh Krishi Gobeshona Endowment Trust (BKGET) Fund of **Krishi Gobeshona Foundation**. ("the company") which comprise the statement of financial position as at December 31, 2016, the statement of income and expenditure and statement of receipts and payments for the year then ended and a summary of significant accounting policies and other explanatory information disclosed in notes 1 to 19 and Annexure-A .

Management's responsibility for the financial statements

Management of the company is responsible for the preparation and fair presentation of these financial statements in accordance with Bangladesh Financial Reporting Standards (BFRSs), Companies Act 1994, other applicable laws and regulations and for such internal control as management determines is necessary to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error.

Auditors' responsibility

Our responsibility is to express an opinion on these financial statements based on our audit. We conducted our audit in accordance with Bangladesh Standards on Auditing (BSA). Those standards require that we comply with relevant ethical requirements and plan and perform the audit to obtain reasonable assurance whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditor's judgment, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, we consider internal control relevant to the entity's preparation and fair presentation of the financial statements in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the entity's internal control. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our qualified audit opinion.

Dhaka Office : Paramount Heights (7th Floor, D2, C1 & A), 65/2/1 Box Culvert Road, Purana Paltan, Dhaka- 1000. Phone : +88-02-9553449, 9551128, E-mail : rmadhaka@gmail.com, Web : www.rmaandco.com
Chittagong Office : Taher Chamber (2nd Floor), 10 Agrabad C/A, Chittagong, Bangladesh. Phone : +88-031-725314, E-mail : rmactg@gmail.com, Web : www.rmaandco.com

Basis of qualification:

1. KGF did not charge any depreciation on fixed assets. It is the non-compliance of Bangladesh Accounting Standards BAS-16.

2. KGF has been maintained cash basis accounting. It is non-compliance of BAS-1, para-27.

3. KGF did not maintain provision for gratuity fund amount of Tk.13, 250,000, as per BAS-19.

Opinion

In our opinion, except for the effect on the financial statements of the matters described the basis for qualified opinion paragraph, the financial position of Bangladesh Krishi Gobeshona Endowment Trust (BKGET) Fund of **Krishi Gobeshona Foundation** as at December 31, 2016 and its financial performance for the year then ended in accordance with Bangladesh Financial Reporting Standards (BFRSs) and comply with the applicable section of the Companies Act 1994 and other applicable laws and regulations.

We also report that:

a) we have obtained all the information and explanations which to the best of our knowledge and believe were necessary for the purposes of our audit and made due verification thereof;

b) in our opinion, proper books of account as required by law have been kept by the company so far as it appeared from our examination of these books; and

c) the statement of financial position and statement of profit or loss and other comprehensive income dealt with by the report are in agreement with the books of account and returns;

Dated: Dhaka
December 21, 2017

Rahman Mostafa Alam & Co.
Chartered Accountants

Dhaka Office : Paramount Heights (7th Floor, D2, C1 & A), 65/2/1 Box Culvert Road, Purana Paltan, Dhaka- 1000. Phone : +88-02-9553449, 9551128, E-mail : rmadhaka@gmail.com, Web : www.rmaandco.com
Chittagong Office : Taher Chamber (2nd Floor), 10 Agrabad C/A, Chittagong, Bangladesh. Phone : +88-031-725314, E-mail : rmactg@gmail.com, Web : www.rmaandco.com

Krishi Gobeshona Foundation (KGF)
Bangladesh Krishi Gobeshona Endowment Trust (BKGET) Fund
Statement of Financial Position
As at December 31, 2016

Particulars	Notes	Amount in Taka	
		Dec 31, 2016	Dec 31, 2015
Assets:			
Non-current assets:			
Property, Plant and Equipments	4.00	13,730,979	13,257,818
Current assets:			
Loans & advances	5.00	1,024,800	6,105,186
Security deposits	6.00	1,080,000	1,080,000
Cash & Cash Equivalents	7.00	215,387,106	26,094,782
Total current assets		**217,491,906**	**33,279,968**
Total assets		**231,222,885**	**46,537,786**
Fund and Liabilities:			
Fund Account (BKGET Fund)	8.00	231,222,885	46,380,690
Other Liabilities	9.00	-	157,096
Total Fund and Liabilities		**231,222,885**	**46,537,786**

The annexed notes 1 to 19 and Annexure -A form an integral part of these financial statements.

Manager (Finance & Accounts)

Executive Director

Signed in terms of our separate report of even date.

Dated: Dhaka
December 21, 2017

Rahman Mostafa Alam & Co.
Chartered Accountants

Krishi Gobeshona Foundation (KGF)
Bangladesh Krishi Gobeshona Endowment Trust (BKGET) Fund
Statement of Income & Expenditure
For the year ended December 31, 2016

Particulars	Notes	Amount in Taka	
		2016	2015
Income:			
Grant	8.02	282,470,258	242,483,888
Interest Received	19.01	2,486,371	3,381,862
Revenue from sale of tender documents		-	3,900
Total Income:		**284,956,629**	**245,869,651**
Less : Expenditure			
Salaries and Allowances	10.00	22,083,827	28,352,453
Training, Workshop & CGP Related Expenses	11.00	15,777,209	15,904,572
Operational Cost	12.00	17,702,569	19,838,219
Competitive Grant Program CGP	13.00	71,460,768	59,110,370
Commissioned Research Project CRP-1	14.00	104,944,614	64,265,327
Pilot Project	15.00	19,399,697	51,456,794
Committed Expenditure CGP Grant	16.00	-	3,185,377
Project Expense	17.00	-	3,756,539
Other Projects	18.00	33,587,945	-
Total Expenditure:		**284,956,629**	**245,869,651**
Excess of Income over Expenditure (Transferred to Fund Account)		-	-

The annexed notes 1 to 19 and Annexure -A form an integral part of these financial statements.

Manager (Finance & Accounts)

Executive Director

Signed in terms of our separate report of even date.

Dated: Dhaka
December 21, 2017

Rahman Mostafa Alam & Co.
Chartered Accountants

Krishi Gobeshona Foundation (KGF)
Bangladesh Krishi Gobeshona Endowment Trust (BKGET) Fund
Statement of Receipts and Payments
For the year ended December 31, 2016

Particulars	Notes	Amount in Taka	
		2016	2015
A. Receipts:			
Opening balance:			
Cash at Bank		26,094,782	17,390,274
Cash in Hand		-	-
Fund Received	8.01	466,900,000	250,000,000
Other Received	19.00	4,184,850	3,542,858
Total		**497,179,632**	**270,933,132**
B. Payments:			
Salaries and Allowances	10.00	22,083,827	28,352,453
Acquisition of property plant and equipments		473,161	3,135,074
Training, Workshop & CGP related expenses		11,326,048	10,561,721
Operational Cost		17,334,570	14,909,509
Other Paid		157,096	-
Loans & advances	5.00	1,024,800	6,105,186
Competitive Grant Program CGP	13.00	71,460,768	59,110,370
Commissioned Research Project CRP-1	14.00	104,944,614	64,265,327
Pilot Project	15.00	19,399,697	51,456,794
Committed Expenditure CGP Grant		-	3,185,377
Project Expense		-	3,756,539
Other Projects	18.00	33,587,945	-
Total Payments		**281,792,526**	**244,838,350**
Closing balance:			
Cash at Bank	7.00	215,387,106	26,094,782
Cash in Hand		-	-
Total		**497,179,632**	**270,933,132**

Manager (Finance & Accounts)

Executive Director

Krishi Gobeshona Foundation (KGF)
Bangladesh Krishi Gobeshona Endowment Trust (BKGET) Fund
Notes to the Financial Statements
For the year ended December 31, 2016

1.0 Reporting Entity

i) Organizations Profile:

The Krishi Gobeshona Foundation (KGF) was established by the Govt. of the People's Republic of Bangladesh in 2007 under the Companies Act 1994 having Reg. No. E-684(05)07 dated September 19, 2007. The Foundation is an Association not for profit within the meaning of the section 28 of the said act.

The Foundation is set with its own General Body to manage the Competitive Grants Program CGP under the Bangladesh Krishi Gobeshona Endowment Trust (BKGET) with independence, objectivity and transparency. The General Body and the board of Directors have representative members from Government, Bangladesh Agricultural Research Council (BARC), eminent persons of Agricultural Research and Development under National Agricultural Research System (NARS), Consultative Group on International Agricultural Research (CGIAR), Agricultural Extension Service and Agricultural University/ Academic Institutes, NGO's Relevant Foundations/ Financial Institutions, Economists/ Rural Development Practitioners, Agribusiness Entrepreneurs and Private Sectors of Individuals.

ii) Objective and Activities:

KGF is responsible for management and implementation of the Competitive Grants Program (CGP) with objectivity and transparency. CGP is a sub-component of the research Component of the Bangladesh Krishi Gobeshona Endowment Trust (BKGET), Phase- 1 finance by the World Bank and IFAD. KGF through its CGP seeks to develop a more Pluralistic research system by opening the CGP to the NARS institutes, Universities, other research institutes, NGO's and privet sectors organizations. Agricultural research and development projects funded under CGP require having location-specific, pre-identified high priority area, multi-disciplinary approach short or medium term duration, demand driven, immediate benefit and problem-solving criteria. KGF funds the CGP projects that are crucial to bridge the yield gaps, respond to pre-identified problems and address other demand-based issues for improving productivity and farm income. Major focus is on-farm applied and adaptive research, including marketing, socio-economic aspects and value addition.

2.00 Basis of Presentation of Financial Statements

i) Basis of Accounting:

The financial statements have been prepared on the cash basis.

ii) Basis of Measurement:

The financial statements have been prepared on the historical cost convention and therefore do not take into consideration the effect of inflation.

iii) Accounting records:
Income has been recognized at the time when it was received and an expense has been recognized when it was paid.

iii) Fixed assets and Depreciation:

No depreciation has been charged on fixed assets continuously.

iv) Reporting Currency :

Reporting currency is Bangladeshi Taka .

3.00 Additional information on financial statements:

i) Components of the Financial Statements:

(a) Statement of financial position .

(b) Statement of income and expenditure.

(c) Statement of receipts and payments.

(d) Notes to the financial statements.

ii) Comparative:

Comparative information have been disclosed in respect of the previous year for all numerical information in the financial statements and also the narrative and descriptive information when it is relevant for understanding of the current year financial statements.

Previous year's figure has been restated and re-arranged wherever necessary, to confirm to the current year's presentation as per BAS-8 "Accounting Policies, Changes in Accounting Estimates and Errors".

iii) Reporting Period:

Financial statements of the company cover one year from January 01, 2016 to December 31, 2016.

iv) General:

Figures appearing in the Financial Statements have been rounded off to the nearest Taka.

		Amount in Taka	
		2016	2015
4.0	**Property, Plant and Equipments**		
	A. Cost:		
	As on 01.01.2016	13,257,818	10,122,744
	Add: Addition during the year	473,161	3,135,074
	Less: Adjustment during the year	-	-
	As on 31.12.2016	**13,730,979**	**13,257,818**
	Less:		
	B. Accumulated Depreciation:		
	As on 01.01.2016	-	-
	Add: Depreciation charged during the year	-	-
	Less: Adjustment during the year	-	-
	As on 31.12.2016	**-**	**-**
	Written Down Value (WDV) (A-B) as on 31.12.2016	**13,730,979**	**13,257,818**
	(Details have been shown in Annexure-A)		
5.00	**Loans & advances**		
	Nurmohol Begum	-	255,325
	Dr. Abdul Aziz	-	4,505,938
	Abdur Razzak	-	771,100
	DG BARI Gajipur	300,000	289,000
	Executive Director (CDB)	-	60,650
	Mia Sayed Hasan	491,400	-
	Samsul Alam	-	212,000
	Iqbal hossain	85,000	-
	Sajol Kumar kor	59,200	-
	Rafiqul Islam	89,200	11,173
	Total	**1,024,800**	**6,105,186**
6.00	**Security deposits**		
	Deposit against office rent	**1,080,000**	**1,080,000**
7.00	**Cash & Cash Equivalents**		
	Bank		
	Pubali Bank Ltd. Farmgate Br. A/C# 0522	209,797,538	20,585,977
	Agrani Bank Ltd. Farmgate Br. A/C# 1367	1,443,561	1,396,417
	Agrani Bank Ltd. Farmgate Br. A/C# 7701	4,146,007	4,112,388
	Total	**215,387,106**	**26,094,782**

		Amount in Taka	
		2016	2015
8.00	**Fund Account (BKGET Fund)**		
	Opening Balance	46,380,690	38,808,228
	Add: Fund Received during the year **(Note - 8.01)**	466,900,000	250,000,000
	Add: Adjustment in advance amount (Fund refund)	412,453	56,350
		513,693,143	**288,864,578**
	Less: Transferred to grant income **(Note-8.02)**	282,470,258	242,483,888
	Add : Excess of Income over Expenditure	-	-
	Total	**231,222,885**	**46,380,690**
8.01	**Fund Received during the year:**		
	Fund received from Agriculture Ministry	**466,900,000**	**250,000,000**
8.02	**Transferred to grant income**	**282,470,258**	**242,483,888**
9.00	**Other Liabilities**		
	Other Liabilities	**-**	**157,096**
10.00	**Salaries and Allowances**		
	Expert salary	9,253,387	14,093,986
	Allowance/ Bonus	2,264,000	856,533
	Officer & Staff salary	10,116,000	10,523,022
	Contractual Service salary	-	778,912
	Gratuity	450,440	2,100,000
	Total	**22,083,827**	**28,352,453**
11.00	**Training, Workshop & CGP Related Expenses**		
	CGP meeting, training fees & other	-	41,356
	Hiring of vehicle CGP monitoring	453,206	-
	Hiring individual monitoring exp.	734,000	-
	CGP TA/DA (review and M & E cost)	1,203,173	434,285
	Technical advisory committee fees	50,104	725,000
	Travel & Tour	-	8,690
	Honorioum	7,420,165	10,074,462
	CGP Training Workshop	-	530,032
	Resource person honorioum (International)	1,465,400	3,588,724
	Pre proposal activities of modeling climate change	4,451,161	-
	Workshop/Seminar/ Meeting expense paid	-	502,023
	Total	**15,777,209**	**15,904,572**

		Amount in Taka	
		2016	2015
12.00	**Operational Cost**		
	Conveyance TA/DA	-	2,139,672
	Sitting Allowance	24,000	45,000
	Entertainment	454,876	229,168
	Hiring of Vehicles	-	599,922
	Security Bill	332,255	724,330
	Board Meeting Expense	410,321	701,455
	Office Repair & Maintenance	58,236	181,368
	Car Repair & Maintenance	1,142,425	1,139,230
	Other Repair & Maintenance	236,165	223,430
	Travel & Tour	-	27,566
	Overtime Bill	731,181	727,106
	Bank Charge	41,302	63,297
	Electricity Bill	-	2,799,824
	AGM expenses	263,081	117,235
	Audit fee	200,000	148,800
	Printing and Publication/documents, video	672,900	410,378
	Books & Periodicals	7,077	490
	Miscellaneous Expenses	806,262	1,895,686
	Office Rent	2,530,836	2,410,982
	Gas, Fuel & Oil etc.	1,241,484	1,018,567
	Promotional advertisement	1,000,534	284,150
	Car Insurance Premium	395,312	357,937
	Telephone/ Mobile Bill, Courier, Internet & Website	83,014	382,032
	Office Supply & Stationary	456,519	89,173
	Technical advisory committee related expenses	177,045	53,708
	Training workshop (National/International)	3,554,351	2,424,822
	National/ local Exerts/consultants	1,723,346	-
	Workshop/ Seminar/ Training	367,999	22,962
	Retention Fee	468,000	497,000
	Postage bill	25,640	-
	Internet bill	298,408	-
	Miscellaneous VAT	-	122,930
	Total	**17,702,569**	**19,838,219**
13.00	**Competitive Grant Program CGP**		
	1st Call:		
	TF 01-C	500,000	1,345,700
	TF 02-C	815,400	2,591,590
	TF 03-C	154,224	103,700
	TF 04-C	550,000	1,601,200
	TF 05-C	678,600	2,035,800
	TF 06-C	432,800	791,000
	TF 07-C	644,175	1,079,800
	TF 08-NR	336,826	1,303,640
	TF 09-NR	1,226,830	954,730
	TF 10-F	1,918,112	2,175,234
	TF 11-C	1,052,168	2,311,744
	TF 12-L	1,767,839	1,565,970
	TF 13-F	2,764,500	3,748,000
	TF 14-C	6,401,100	10,373,500
	Total 1st Call	**19,242,574**	**31,981,608**

		Amount in Taka	
		2016	2015
	2nd Call:		
	TF 15-SF	1,853,750	1,113,000
	TF 16-WM	6,579,500	3,022,000
	TF 17-ARI	5,420,754	4,335,400
	TF 18-ARI	2,537,800	1,418,500
	TF 19-EM	2,817,889	389,422
	TF 20- EM	958,300	273,800
	TF 21-DL	2,831,770	2,831,770
	TF 22- PS	4,252,838	2,204,862
	TF 24-EM	2,796,800	699,200
	TF 26-ARI	7,711,120	1,927,780
	TF 27-SF	3,367,317	2,222,140
	TF 30-AP	3,099,900	2,066,600
	TF 32-SF	1,611,640	327,672
	TF 33-ARI	2,650,400	3,313,000
	TF 35-SF	3,442,656	983,616
	TF 36-FP	285,760	-
	Total 2nd Call	**52,218,194**	**27,128,762**
	Total	**71,460,768**	**59,110,370**
14.00	**Commissioned Research Project CRP-1**		
	Components- I	10,010,700	1,500,000
	Components- II	10,648,500	5,044,200
	Components- III	14,426,000	8,786,350
	Components- IV	3,525,100	2,549,200
	Components- V	4,520,000	2,000,000
	CRP-2: Modeling Climate Change	33,623,700	5,606,450
	CRP-3: Sugarcane	13,318,533	20,209,892
	ARMIS (ICT)	12,301,681	17,712,435
	CGP Mitigation Green-House Gas (GHG) BRRI Component	2,570,400	-
	GHG-BRRI-IFDC	-	856,800
	Total	**104,944,614**	**64,265,327**
15.00	**Pilot Project**		
	Pilot Project-3	-	510,000
	Pilot Project-4	-	170,000
	Pilot Project-5	-	225,000
	Pilot Project-7	250,000	750,000
	Pilot Project-8	3,701,075	8,500,000
	Pilot Project-9	378,394	5,543,000
	Pilot Project-10	2,300,000	4,625,000
	Pilot Project-11	1,812,300	8,954,400
	Pilot Project-12	-	2,850,000
	Pilot Project-13	4,775,928	6,661,532
	Pilot Project-14	980,000	8,109,362
	Pilot Project-15	2,430,000	2,700,000
	Pilot Project Honorioum (Abdul Baten)	1,518,000	1,644,500
	Pilot Project Honorioum (Sochindra)	1,104,000	184,000
	Pilot Project Honorioum (Liza Begum)	150,000	30,000
	Total	**19,399,697**	**51,456,794**

	Amount in Taka	
	2016	2015

16.00 Committed Expenditure CGP Grant

Project C-3.1	-	369,340
Project C-1.26	-	311,974
Project C-2.11	-	294,413
Project F-21.20	-	201,620
Project NR-16.15	-	49,988
Project C-1.27	-	278,200
Project C-71.2	-	87,000
Project C-4.1	-	236,419
Project C-2.20	-	235,970
Project CPHT-179	-	82,365
Project C-6.9	-	131,400
Project C-1.12	-	188,127
Project L-17.1	-	18,530
Project 19.7	-	407,849
Project C-6.8	-	292,182
Total	**-**	**3,185,377**

17.00 Project Expense

CGP Grants L-17.1	-	200,000
CGP Grants C-1.11	-	725,018
CGP Grants CHF-103	-	231,540
CGP Grants C-5.2	-	114,000
Pilot Project- (P-06)	-	500,000
Management Review & M&E Cost	-	76,830
Festival Allowance	-	288,812
Office & Staff salary	-	422,826
Retention fee	-	34,000
Misc. Operational cost (Salary)	-	40,000
Internet & Telephone bill	-	9,300
Training Workshop	-	213,524
Fuel & CNG	-	85,214
Security Service Salary	-	28,635
International workshop	-	756,600
Misc. Cost	-	1,108
Car repair & maintenance	-	4,210
Repair & Maintenance office	-	21,422
Overtime allowance	-	3,500
Total	**-**	**3,756,539**

18.00 Other Projects

Seaweed project	26,702,000	-
CGP Mitigation Greenhouse Gas (GHG) BAU Component	3,668,445	-
KGF ACAIR Grants	3,217,500	-
Total	**33,587,945**	**-**

		Amount in Taka	
		2016	2015
19.00	**Other Received**		
	Revenue from sale of tender documents	-	3,900
	Fund Refund	412,453	-
	Receipt against loans and advances	1,286,026	-
	Interest Received **(Note-19.01)**	2,486,371	3,381,862
	Other Received	-	157,096
	Total	**4,184,850**	**3,542,858**
19.01	**Interest Received**	**2,486,371**	**3,381,862**

Rahman Mostafa Alam & Co.
Chartered Accountants

Krishi Gobeshona Foundation (KGF)
Bangladesh Krishi Gobeshona Endowment Trust (BKGET) Fund
Schedule of Property, Plant and Equipments
As at December 31, 2016

Annexure-A
Figures in Taka

Particulars	Cost				Rate %	Depreciation				Written down value as on 31.12.2016
	As on 01.01.2016	Addition during the year	Adjustment during the year	As on 31.12.16		As on 01.01.2016	Charged during the year	Adjustment during the year	As on 31.12.2016	
Vehicles (Micro Bus-2)	7,764,565	-	-	7,764,565	0%	-	-	-	-	7,764,565
Misc Equipment & Materials	-	47,670	-	47,670	0%			-	-	47,670
CGP Equipment	17,034	-	-	17,034	0%	-	-	-	-	17,034
Computer Accessories	1,140,851		-	1,140,851	0%	-	-	-	-	1,140,851
Multimedia Projector	95,680	-	-	95,680	0%	-	-	-	-	95,680
Office Equipment	3,013,596	234,990	-	3,248,586	0%	-	-	-	-	3,248,586
Furniture & Fixtures	634,123	90,471	-	724,594	0%	-	-	-	-	724,594
Electric Equipments	591,969	100,030	-	691,999	0%	-	-	-	-	691,999
Total	**13,257,818**	**473,161**	**-**	**13,730,979**		**-**	**-**	**-**	**-**	**13,730,979**

Note: Depreciation has not been charged on fixed assets during the year and previous years.

KRISHI GOBESHONA FOUNDATION

Krishi Gobeshona Foundation (KGF) is a Government sponsored autonomous grant making and non-profit organization established in 2007 considering the dire need for sustainable funding and operational flexibility of agricultural research for development. It has the overall objective to facilitate and contribute towards integration of a pluralistic agricultural research system by involving public sector (NARS institutes, universities), private sector and non-government organizations in agricultural R & D.

KGF operates with transparency under its Board of Directors and policy guidance of the General Body. The functions of KGF are governed by its Memorandum and Articles of Association. The sustainable funding of KGF comes from the profits of an endowment fund created by the Government of Bangladesh (GoB). KGF is very closely linked to mainstream research through Bangladesh Agricultural Research Council (BARC) and its Executive Chairman represents Governing Board of Bangladesh Agricultural Research Council (BARC).

On the other hand, Executive Director represents the Executive Council of BARC. As per provisions in the Memorandum, KGF is governed by its General Body (GnB) and a 7-member Board of Directors (the Board). General Body of KGF is consisting of not exceeding 15 members taken from public and private sectors having eminence in the different disciplines of agriculture for recommending overall policy directions and approval of the budgetary allocations.

The KGF Board having diversified technical professionals as Directors has the authority for taking any decision needed for the successful operation of KGF programs/projects. The Board of Directors, comprising of 7 elected members from the GnB, pursues and carries out the objectives of KGF.

Technical Advisory Committee (TAC) is formed by the Board of Directors drawing members of highly reputed and representing diversified categories. It provides strategic guidance ensuring the quality of the research supported by KGF- BKGET fund and its relevance to the country's goals and objectives and recommends resource allocations to the CGP projects/programs in the context of priority thematic areas as well as overview the proposals reviewed by peer reviewers for making recommendation to the KGF Board.

Research Grant Making

- Full Research Proposals (FRPs) are screened on specific template by a screening committee formed by the TAC
- Responsive proposals acceptable to the TAC are then forwarded to the designated expert reviewers (peer review) for grading
- The graded proposals are then overviewed by the TAC members and forwarded with recommendations to the Board of Directors
- The Board of Directors approves the projects for KGF funding that received higher grades showing promise of success

KGF undertakes effective measures through external/independent and internal monitoring teams to guide monitor and evaluate the implementation progress of all types of project/programs as a routine function and continuous process. External/independent monitoring is done at an interval of 5-6 months by the team of external members having expertise in the specific fields. External monitoring teams usually conduct field monitoring of each of the projects to give necessary suggestions to Coordinator/PI/CI to keep the activities of the project in line with the work plan and objectives. KGF's technical professionals usually conduct desk and field monitoring as and when required.

KGF is involved with different categories of programs are as follows:

1. Competitive Grants Program (CGP) - Short-Medium
   i. Applied Research
   ii. Basic Research
2. Commissioned Research Program (CRP) - Medium-Long
3. Capacity Enhancement Program (CEP) - Short-Medium
4. International Collaborative Program (ICP)-Short-Medium
5. Technology Piloting Program (TPP) - Short

KRISHI GOBESHONA FOUNDATION

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