Annual Report
2023-24






KRISHI GOBESHONA FOUNDATION

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

Annual Report 2023-24 (July 2023-June 2024)

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Contents

List of Contents	
Content	*Page*
Message	v
Preface	vi
Abbreviations and Acronyms	vii
1. Executive Summary	10
2. Introduction	13
3. Highlights of the Research Findings	20
4. Technical Progress	34
4.1 Crops and Natural Resources	34
4.1.1 Competitive Grants Program	34
4.1.1.A Completed Projects	34
4.1.1.B On-going Projects	34
4.1.2 Commissioned Research Program	34
4.1.2.A Completed Projects	34
4.1.2.B On-going Projects	74
4.1.3 Capacity Enhancement Program	134
4.1.3 A. Completed Projects	134
4.1.3.B On-going Projects	136
4.1.4 International Collaborative Program	143
4.1.4 A. Completed Projects	143
4.1.4.B On-going Projects	146
4.1.5 Lump Sum Grants	154
4.1.5 On-going Projects	154
4.2 Livestock	159
4.2.1 Competitive Grants Program	159
4.2.1.A Completed Projects	170
4.2.2.B On-going Projects	170
4.2.4 Technology Commercialization Program	201
4.2.4 A. On-going Projects	201
4.3 Fisheries	205
4.3.1 Competitive Grants Program	205
4.3.1.A Completed Projects	205
4.3.1.B On-going Projects	212
6. Other Inatitaves and Services	220
7. Financial Management	230
7.1 Statement of Expenditure (SoE)	
7.2 Budget for Fiscal Year	
7.3 Contributions of KGF to Scientific Events and Publications	
8. The KGF Organogram	226
9. The KGF Team	227
10. Annexure	241
Annex-1 List of BKGET funded CGP projects	

Annex-2 Statement of Expenditure (SoE) for July 2023 to June 2024	
Annex-3 KGF Work Plan and Implementation FY 2024-25(Tentative)	
Annex-4 Proposed Budget Fiscal Year 2024-25	
Annex-5 Members of Technical Advisory Committee(TAC), KGF	
Annex-5 Members of KGF Board and General Body	
Annex-6 Auditors' Report and Statements	

Message

Recently, the Agriculture Sector in Bangladesh has grown fast and is marked by spectacular achievements. We currently grow sufficient grains, vegetables, fruits, fish, and livestock to meet the needs of our population, and we are also able to export certain food products to international consumers. Bangladesh Bureau of Statistics (BBS) reports that the poverty situation in the country has improved significantly; the poverty head count, using the upper poverty line, has declined to 23.2% in 2016 from a high rate of 56.7% in 1991, and the target now is to further reduce it to 15% by the year 2030.

Agricultural researchers and extension personnel will have to address the challenges of achieving higher agricultural productivity and profitability by developing high-yielding, resilient crop varieties, as well as livestock and fish breeds. This includes implementing climate-smart production practices and sustainable, intensive integrated farming systems, among other strategies. To create a sustainable, safe, and profitable agricultural system, the Government of Bangladesh has highlighted agricultural development in key policy documents like Vision 2041, the 8th Five-Year Plan, and the Bangladesh Delta Plan (BDP) 2100. This initiative relies on the support of academicians, researchers, extension personnel, and other stakeholders, including food chain operators, processors, distributors, consumers, and most importantly, farmers. Together, they work to ensure sustainable agricultural production despite challenges such as population growth, decreasing arable land, land degradation, declining soil fertility, changing demand patterns, and climate change.

Krishi Gobeshona Foundation (KGF) has emphasized quality and pluralistic 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 in agriculture. On-farm adaptive research is being supported to develop demand-driven technologies to transform traditional agriculture into commercial enterprizes and which is one of the present focuses of the foundation. KGF is supporting CGP, CRP, ICP, CEP, Technology Piloting, Technology Commercialization, Lump Sum Grant Programs by making partnerships and strong linkages among research, extension, universities, NGOs and private sectors to disseminate the user-friendly technologies being developed through successful projects. Indeed, KGF fosters a unique diverse approach to provide a common platform for people coming from private and public sectors, having different strengths and facilities, but requiring cooperation to work together for common goals with sustainable support. It also fosters research work by removing the bottlenecks remaining in the existing systems. These initiatives have really enhanced the height of the Foundation, achieving its objectives and increasing the visibility of the organization. The remarkable successes made during 2023-24 were the outcome of the sincere efforts and cooperation from all KGF associates. I believe that the strong initiatives and efforts of KGF experts under the leadership of its Executive Director will certainly enable a positive impact in the field of sustainable agricultural R&D in Bangladesh.

The results and impacts of these agricultural research and development projects and programs, I understand, are regularly monitored, recorded and documented by KGF in assorted quarterly and annual publications, such as, Projukti barta, technical bulletins, annual reports, etc. I appreciate the efforts of KGF colleagues for the publication of the 15th Annual Report (2023-24), and hope that agricultural researchers and extension specialists, social workers and community leaders, government planners and strategists will find this publication useful as a resource and reference document related to agricultural research, technology generation and dissemination.

I am happy to know that the Annual Report 2023-24 of KGF is ready to be published. KGF is documenting its annual activities consistently in its Annual Report, and this is the 15th edition that covers the activities completed from July 2023 to June 2024.

Executive Chairman, BARC and
Chairman, Board of Directors, KGF

Preface

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 and development in Bangladesh. Its 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 Research and development (R&D) under a competitive and diversified research environment.

KGF is strongly connected to mainstream research and development via BARC. The development of the agriculture sector in Bangladesh has been supported by KGF over the last seventeen years as a part of a national effort to achieve food and nutrition security and improve farmers' livelihoods. Through successful collaboration among these essential partners on R&D projects backed by KGF, numerous promising technologies have been developed in the areas of crop, livestock and fisheries production in Bangladesh. Since its establishment, KGF has offered sustainable funding, encouraged competitive research, and nurtured collaboration among the public, private, and NGO sectors. Together, KGF utilizes scientific expertise to address critical challenges in agriculture and the environment through innovation and collaborative learning

KGF implements a wide range of programs focusing on crops, livestock, fisheries, natural resources, value chains, and cross cutting issues. To date, KGF has successfully completed around 100 CGP projects, 4 CRP projects, 5 CEP projects, 2 ICP projects, 8 BR projects, 24 pilot projects and 23 LSG projects. Furthermore, 65 projects are actively on-going across various regions of Bangladesh. The processing of the 6th call CGP projects is currently being overseen by the TAC. Technologies and scientific knowledge can only yield positive results when they are applied correctly and efficiently in agricultural practices, as well as through the supply chains and markets of entrepreneurs. In view of this, KGF has consistently released an annual report, which serves as an effective and valuable method for sharing information and knowledge. Moreover, this report offers insights into the governance, human resources, and finance and accounts of KGF. The Annual Report for the year 2023-24, the 15th in the series, provides a concise overview of the activities and accomplishments of KGF during fiscal year July 2023 to June 2024. The outcome of R&D activities concerning crops, fisheries, livestock, agricultural engineering, farming systems, socioeconomics, agroforestry and enterprise development throughout this time are recorded in the annual report. Apart from this, KGF has been publishing a scientific journal regularly to shares new research findings with the scientific community and the public. Additionally, this publication is crucial in enhancing KGF's profile as a unique centre for the sponsorship and support of agricultural research and development in Bangladesh.

This annual report 2023-24 outlines the ongoing activities for the year 2023-24 (July to June), showcasing the key technologies developed through various KG-supported projects. I want to express my sincere gratitude to all the esteemed members of the GB and the Board of Directors for their continuous guidance, insightful decisions, and invaluable advice. I also wish to thank and express my gratitude to the NARS scientists along with all KGF professionals whose contribution has made the foundation vibrant. I would like to congratulate and thank everyone who dedicated their efforts to compile and edit this report. It will be a significant resource for scientists, extension workers, policymakers, teachers, students, and other stakeholders. KGF appreciates feedback, comments, and suggestions from its readers.

Executive Director, KGF

Abbreviations and Acronyms

ACIAR	Australian Center for International Agricultural Research
ADP	Annual Development Program
AEZ	Agro-Ecological Zone
AIS	Agriculture Information Service
AWD	Alternate Wetting and Drying
BARC	Bangladesh Agricultural Research Council
BARI	Bangladesh Agricultural Research Institute
BAU	Bangladesh Agricultural University
BAURES	Bangladesh Agricultural University Research System
BCR	Benefit Cost Ratio
BINA	Bangladesh Institute of Nuclear Agriculture
BKGET	Bangladesh Krishi Gobeshona Endowment Trust
BLRI	Bangladesh Livestock Research Institute
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	Chattogram Hill Tracts
CRP	Commissioned Research Program
CSO	Chief Scientific Officer
CVASU	Chattogram Veterinary and Animal Sciences University
DAE	Department of Agricultural Extension
DLS	Department of Livestock Services
DoF	Department of Fisheries
ED	Executive Director
ETL	Economic Threshold Level
FAO	Food and Agriculture Organization of the United Nations
FGD	Focal Group Discussion
FMD	Foot and Mouth Disease
GHG	Green House Gas
GIS	Geographical Information System
GnB	General Body
GO	Government Organization
GoB	Government of Bangladesh
HARS	Hill Agricultural Research Station
HRC	Horticulture Research Centre
HYG	High Yield Goal
HYV	High Yielding Variety
ICP	International Collaborative Program
IRRI	International Rice Research Institute
KGF	Krishi Gobeshona Foundation
KII	Key Informant Interview
KSSL	Krishibid Somobay Samity Limited
LAI	Leaf Area Index

LSG	Lump Sum Grant
M&E	Monitoring and Evaluation
MAA	Memorandum and Articles of Association
MHAT	Moist and Hot Air Treatment
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
PKSF	Palli Karma-Sahayak Foundation
PRTC	Poultry Research and Training Centre
PSO	Principal Scientific Officer
R&D	Research and Development
RB	Repeat Breeder
RCT	Resource Conservation Technology
RFV	Relative Feed value
RGR	Relative Growth Rate
RS	Remote Sensing
SAU	Sher-e-Bangla Agricultural University
SyAU	Sylhet Agricultural University
SNPs	Single Nucleotide Polymorphisms
SO	Scientific Officer
SSO	Senior Scientific Officer
TAC	Technical Advisory Committee
TPP	Technology Piloting Program
T. Aman	Transplanted Aman
T. Aus	Transplanted Aus
TCP	Technology Commercialization Program
TDN	Total digestible nutrient
TPP	Technology Piloting Program
UAO	Upazila Agriculture Officer

Krishi Gobeshona Foundation (KGF)

Vision

Foster enabling environment for promoting quality agricultural R&D and capacity enhancement for sustaining agricultural productivity and nutritional security

Objectives

Improvement of research quality through creating a competitive environment for public and private entities to work together with pluralistic approach to address demand driven priority research to achieve higher productivity and nutritional security

Activities

KGF sponsors agricultural research for development (R&D) projects under seven major Categories viz., (a) Competitive Grants Program, (b) Commisioned Research Program, (c) Capacity Enhancement Program, (d) International Collaborative Program, (e) Technology Piloting Program to disseminate technologies (f) Technology Commercialization Program and (g) Lum Sum Grants. Recently, KGF has undertaken several innovative initiatives opening up new possibilities within Banglades's agricultural R&D sector. (i) Awareness Building and Technology Dissemination through Media Coverage and (ii) International Partnership for Information, Knowledge and Technology Exchange.

Krishi Gobeshona Foundation (KGF)
Annual Report 2023-24

Executive Summary

The Krishi Gobeshona Foundation (KGF) was established with the sponsorship of the government of Bangladesh in 2007 under the Companies Act 1994 to provide sustainable funding, create a competitive environment, and a common platform for the public, private, and NGOs to work for agricultural research and development. Initially funded by the World Bank through the National Agricultural Technology Project Phase-I (NATP-I), KGF facilitates public–private partnerships, promoting competitive, demand-led, and collaborative research. Its goal is to enhance agricultural productivity, food and nutrition security, and support innovation by linking with research institutes, universities and the private sector for sustainable agricultural development.
KGF began utilizing its endowment fund in 2012, which was allocated by the Krishi Gobeshona Endowment Trust (BKGET). The Secretary of the Ministry of Agriculture (MoA) is the Chairperson of BKGET. The Government of Bangladesh created the BKGET to maintain and enhance the initial **seed money** to ensure sustainable financing for agricultural research. This funding procedure enabled KGF to support demand-driven priority research and strengthen innovation systems in line with national priorities for agricultural transformation and productivity enhancement.
Since its establishment, KGF has offered sustainable funding, encouraged competitive research, and encouraged collaboration among the public, private, and NGO sectors. Together, KGF utilizes scientific expertise to address critical challenges in agriculture and the environment through innovation and collaborative learning.

KGF support agricultural R&D through seven distinct programs: (a) Competitive Grants Program (CGP), (b) Commissioned Research Program (CRP), (c) Capacity Enhancement Program (CEP), (d) International Collaborative Program (ICP), (e) Technology Piloting Program (TPP) and (f) Technology Commercialization Program (TCP) and g) Lump Sum Grant. The first five programs focuses on both existing and emerging issues related to agricultural development and the well-being and livelihoods of the farming community in the country. The last one is implemented to accelerate the dissemination, uptake and, where possible, commercialization of potentially useful technologies generated by the research projects. There have been six public announcements regarding the distribution of research funds through the CGP, supported by BKGET funding for the year 2013, 2015 and 2017-18, 2018-19, 2021-22, 2023-24.

KGF implements a wide range of programs focusing on crops, livestock, fisheries, natural resources, value chains, and cross cutting issues. To date, KGF has successfully completed around 100 CGP projects, 4 CRP projects, 5 CEP projects, 2 ICP projects, 8 BR projects, 24 pilot projects and 23 LSG projects. Furthermore, 65 projects are actively on-going across various regions of Bangladesh. The processing of the 6th call CGP projects is currently being overseen by the TAC.

CGP focuses on short to medium term location-specific, demand-driven, multidisciplinary agricultural research projects that engages both public and private sectors. This process includes an open call for project proposals, initial screening, peer evaluation by experts, and finally recommended by independent Technical Advisory Committee (TAC) to KGF Board consideration for final selection and approval.
KGF revisited the Thematic Area and Researchable Issues, considering location-specific regions for the 6th Call PPs under CGP. The updating Thematic Area and Researchable Issues were advertised.

Subsequently, TAC Members engaged in discussions regarding the various categories of sorted project proposals. They thoroughly examined each project by taking into account factors such as the national priority, project locations from PI, competitiveness, market value, fund availability, capital cost of the project, transferable output/technology, institutional representation, six hot spots, vertical agriculture, global agriculture & warming, supplementary feed and food, sustainability and more. TAC members expressed their opinion that in selecting the research proposal the national priority or need of the current researchable issues need to be considered.

Projects under the Commissioned Research Program (CRP) are designed and developed to address agricultural production issues in marginal and underutilized areas of the country which could otherwise be rendered productive with appropriate technologies and interventions. Five long-term CRP projects have been addressed, which included (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, (iii) Strengthening Sugarcane Research and Development in Chattogram Hill Tracts, (iv) Hill Livestock: Increasing Livestock Production in the Hills through Better Husbandry, Health Services and Improving Market Access through Value and Supply Chain Management, and (v) Development of Upazila Land Suitability Assessment and Crop Zoning System are being implemented. CRP-I, CRP-II, CRP-III and CRP-IV have been completed and CRP-V is currently on-going.

The capability of scientists in NARS institutions, agricultural universities, extension agencies, and NGOs plays a vital role in advancing quality research and agricultural development. To enhance skills and capacities, KGF undertakes short to medium-term training programs in key thematic areas, conducted by both national and international experts. Among the five initiatives in the Capacity Enhancement Program (CEP), three have been completed (a) Capacity Enhancement of NARS via the Agricultural Research Management Information System (ARMIS) (CEP-I), (b) Reducing Greenhouse Gas Emissions from Rice-Based Cropping Systems through Effective Fertilizer and Water Management (CEP-III), and (c) Skill Development Training for Scientists, Field Veterinarians, Livestock Workers, and Poultry/Dairy Farmers (CEP-IV). One project, titled "Adaptive Trials on Seaweed Cultivation in Coastal Areas (CEP-II)," is approaching its completion. Furthermore, two new CEP projects have been initiated: CEP-V, which is centered on building capacity for certain field-level extension workers from DAE, DoF, and DLS, along with progressive farmers in selected regions of Bangladesh, is also completed. Additionally, CEP-VI, which aims to improve the research capabilities of ARIs through external expert reviewing and evaluations, is currently in progress.

Collaboration with international research organizations has proven effective in research quality improvement and enhancing scientific capacity in agriculture. KGF actively explores opportunities for short- to medium-term collaborative research programs through co-financing arrangements with leading universities and organizations from developed countries. Notable partners include the Australian Centre for International Agricultural Research (ACIAR) and the Commonwealth Scientific and Industrial Research Organization (CSIRO) (Australia), NRI (UK), the Netherlands Organization for International Cooperation in Higher Education (NUFFIC) (Netherlands), IRRI, CIMMYT, Mardoch University (Australia), Saskatchewan University (Canada) and Cornell University (USA).
Currently, there are three ongoing ICP projects: (a) ICP-I focuses on intensifying cropping systems in the salt-affected coastal regions of Bangladesh and West Bengal, India; (b) ICP-II deals with nutrient management for diversified cropping in Bangladesh; and (c) ICP-III aims to integrate salt-tolerant wheat and pulses into smallholder farming systems in southern Bangladesh. These initiatives were initially supported by KGF and ACIAR (Australian Center for International Agricultural Research). The first phase of ICP-I, a joint effort by BARI, BRRI, and CSIRO (Commonwealth Scientific and Industrial Research Organization), has been completed and reported. The second phase of this project began in 2022-23 and is currently ongoing. ICP-II, which involved collaboration among BARI, BRRI, BAU, and Murdoch University of Australia, was concluded. ICP-III, conducted by BARI and the University of Western Australia, has also been completed. Additionally, two new ICP projects have been initiated: (i) ICP-IV, which aims to develop short-duration cold-tolerant rice varieties for the hoar areas of Bangladesh, is funded by BKGET-KGF and IRRI (International Rice Research Institute) and implemented by BRRI and IRRI; and (ii) ICP-VI, which seeks to manage wheat blast in Bangladesh by identifying and introducing wheat blast-resistant genes into varietal development and rapid dissemination, is funded by BKGET-KGF and ACIAR and executed by BWMRI and CIMMYT. These projects are currently underway.

Lump sum grants are given for in-depth studies on significant contemporary problems or emerging issues in Bangladesh's agriculture sector. The results and findings of these studies could aid in developing and designing of comprehensive research projects in the future. A total of twenty four lump sum grants (LSG) were awarded during the reporting period to investigate specific problems or emerging issues in Bangladesh agriculture. Twenty three LSG projects have been completed.

Technology commercialization aims to promote market-ready technologies from KGF-sponsored projects, generating returns on research investments through collaboration with inventors. The inventor will refund the project investment amount to KGF as per the agreement. It focuses on popularizing and branding agricultural products developed by researchers. The TCP was started in 2018-19 with a project called "BAU-Bro Chicken Conservation and Piloting Producer Group Farming" aimed at commercializing technology. The legal framework for this project is based on tripartite agreement between BAURES (on behalf of BAU), the technology inventors (two professors of BAU) and KGF. The organizations participating in this technology commercialization effort include BAU, Palli Karma-Sahayak Foundation (PKSF) and Protein Mart BD Ltd. (private enterprise). This marks the first attempt in Bangladesh to commercialize technology to generate returns from research investment through a legal frame work. KGF launched an innovative approach for technology dissemination, known as the Technology Commercialization Program (TCP). The TCP kicked off with a project focused on scaling up the production of two broiler chicken strains developed at BAU along with promoting dissemination and branding live and dressed chickens through a pilot project under the tripartite agreement involving BAU, the technology inventors and KGF. This TCP project is still in progress.

Research institutes, universities, various government organizations, NGOs and, private entrepreneurs including BARI, BRRI, BJRI, BAU, BSMRAU, HSTU, Rajshahi University, CVASU, PSTU, SAU, Dhaka, Sylhet Agricultural University, National Institute of Biotechnology (NIB), DoF, PUBSS and others are key stakeholders in the execution of these projects as recipients of KGF grants. The Project Coordinators/PIs prepare their respective project briefs and inception reports following prescribed formats and regularly submit technical and financial progress reports to KGF.

In addition to management of on-going projects, monitoring, reviewing (Desk and Field) and evaluation, KGF regularly organizes meetings of the Board of Directors and General Members, with Technical Advisory Committee and Independent Monitoring Team and organizes research review workshops through the year. During the year 2023-24, KGF organized seven Board meetings (85th, 86th, 87th, 88th, 89th, 90th, 91^{st,}) and two TAC meetings (42nd, 43rd). Additionally, the 17th Annual General Meetings (AGM) and the 9th extraordinary General Meeting (EGM) were also convened in this year.

This year, KGF held approximately 100 workshops focused on projects inception, coordination, review and completion report. These workshops were attended by scientists involved in KGF-sponsored projects along with relevant reviewers and experts invited by KGF, including KGF Specialists. The Executive Director and other KGF experts took part as invited experts in various meetings, seminars and workshops organized by both national and international organizations such as, BARC, NARS institutions, universities and NGOs. Numerous national and international delegates visited KGF, engaging in discussions, with the Executive Director and other KGF professionals. All these events and activities received support from BKGET funds. In addition, KGF addressed inqueries from various organizations including MoA, BARC, KGF Board through reports or presentations.

This annual report for 2023-24 provides a brief overview of the achievements and highlights from completed projects as well as the implementation progress of the ongoing projects. The KGF Board of Directors and General Body members are listed along with completed and on-going projects under CGP (1st, 2nd, 3rd, 4th and 5th Calls) and CRP, CEP, ICP and TCP. Additionally, the KGF statement of expenditure (SoE) for 20231-24, tentative work plan for 2025-26, the proposed budget for 2025-26 and the audit report for 2022-23 can be found in Annex-1, 2, 3, 4, 5 and 6, respectively.

Introduction

Background

KGF is an institutional innovation to foster and sustain a competitive environment for public and private institutions, enterprises and NGOs engaged in agricultural research and development (R&D) in Bangladesh. KGF creates a common stand, with a pluralistic approach, for interactions, cooperation and collaboration among the stakeholders in the fields of agricultural technology generation, validation and dissemination. The Foundation also facilitates capacity enhancement through human resources and infrastructure development. To proceed with its mandate of facilitating quality research, technology generation and dissemination in the agriculture sector, KGF cultivates and maintains close partnership and collaboration with national and international scientific communities. The Krishi Gobeshona Foundation (KGF) is a grant awarding organization established in 2007 under the Companies Act of 1994. Financial support for KGF is provided and sustained by the profits of an endowment fund maintained by the Bangladesh Krishi Gobeshona Endowment Trust (BKGET) created by the Government of Bangladesh (GoB) in 2008.

The Foundation operates independently and transparently, overseen by a Board of Directors (BoD) and a General Body (GnB). The General Body of KGF consists of fifteen members and the BoD consists of seven members elected from among the members of GnB. The GnB members are distinguished personalities from different disciplines of agriculture representing both public and private sectors of Bangladesh. KGF maintains a strong connection with mainstream agricultural research institutions and organizations in Bangladesh through BARC. The Executive Director, appointed by the BoD, is the Chief Executive of KGF. The Foundation supports a range of research and development initiatives that encompass crops, livestock, fisheries, management of natural resources, adaptation to climate change, challenging ecosystems, commercialization, marketing, value chains, and other interdisciplinary matters in agriculture.

Program Categories of KGF

Competitive Grants Program (CGP)

KGF provide funding and technical assistance to 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 thematic areas on on-farm applied and adaptive research, including marketing, agricultural commercialization, frontier research, safe and nutritious food, socio-economic and value adding aspects. At present KGF is supporting about 65 CGP projects during 2024-25. The processing for the 6th call is under way.

Commissioned Research Program (CRP)

KGF identifies current issues and then creates and implements large-scale projects under CRP, incorporating more consultations with esteemed experts to adopt a multi-institutional and multi-disciplinary approach. This approach aims to address agricultural issues related to production and management in challenging ecosystems of Bangladesh including the Hill Tracts, Coastal and Haor regions, as well as the drought-prone northwestern area. Recognizing the necessity to harness the production potential of these difficult ecosystems and enhancing their contributions to the national agricultural output, KGF held a series of consultation meetings with leaders from various research institutions and other key stakeholders. They pinpointed several crucial vulnerable areas of national significance, such as the Chattogram Hill Tracts (CHT), coastal ecosystems, drought-affected northern and northwestern regions, and the effects of climate change on agriculture. Concept notes on these agricultural research and development issues were prepared and placed before the TAC and, subsequently to the KGF Board for evaluation. The TAC made recommendation and the KGF Board approved the concept notes, advising the inclusion of the Haor areas in the CRP. The concept notes, upon further consultation with renowned agricultural experts, were expanded into comprehensive research proposals prioritizing the research topics and agenda. Finally, the TAC and the KGF Board approved the following five projects:

a. CRP-I. Harnessing the potential of hill agriculture: Enhancing crop production through sustainable management of natural resources (Total five components)
b. CRP-II. Modeling climate change impact on agriculture and developing mitigation and adaptation strategies for sustaining agricultural production in Bangladesh(Total three components)
c. CRP-III. Strengthening sugarcane research and development in the Chattogram Hill Tracts
d. CRP-IV. Hill livestock: Increasing livestock production in the hills through better husbandry, health service and improving market access through value and supply chain management
e. CRP-V. Development of upazila land suitability assessment and crop zoning system of Bangladesh.

The CRP-I, CRP-II, CRP-III, and CRP-IV projects have concluded, and their results were detailed in a prior Annual Report. The initial phase of CRP-II has ended with its outputs documented in the KGF annual report. The second phase, which integrated the livestock and fisheries sectors of CRP-II, commenced in 2020 and was completed in 2024. CRP-IV concluded in 2024, only CRP-V currently in progress.

Capacity Enhancement Program (CEP)

KGF also offers financial assistance for enhancing capacity in research infrastructure and facility development. Among the four initiatives under the Capacity Enhancement Program (CEP), three projects have concluded and were detailed in earlier annual reports: (a) Capacity Enhancement of NARS via the Agricultural Research Management Information System (ARMIS) (CEP-I), (b) Reducing Greenhouse Gas Emissions from Rice-Based Cropping Systems through Effective Fertilizer and Water Management (CEP-III), and (c) Skill Development Training for Scientists, Field Veterinarians, Livestock Workers, and Poultry/Dairy Farmers (CEP-IV). One project, titled "Adaptive Trials on Seaweed Cultivation in Coastal Areas (CEP-II)," is currently in progress. Additionally, two CEP projects have been launched: CEP-V, which focuses on capacity building for certain field-level extension workers from DAE, DoF, and DLS, as well as progressive farmers in selected regions of Bangladesh, and CEP-VI, aimed at enhancing the research quality of ARIs through external expert review and evaluation, both of which are ongoing.

International Collaborative Program (ICP)

KGF also explores avenues of undertaking collaborative research programs with universities and/or organizations of developed countries under the International Collaborative Program (ICP). Three ICP projects viz., (a) ICP-I: Cropping System Intensification in the Salt Affected Coastal Zones of Bangladesh and West Bengal, India is ongoing (b) ICP-II: Nutrient Management for Diversified Cropping in Bangladesh, and (c) ICP-III: Incorporating Salt Tolerant Wheat and Pulses into Small Holder Farming Systems in Southern Bangladesh were initiated earlier funded jointly by KGF and ACIAR (Australian Center for International Agricultural Research). The first phase of ICP-I, implemented jointly by BARI, BRRI and CSIRO (Commonwealth Scientific and Industrial Research Organization), was completed and reported out in the annual report, the second phase of this project began in 2022-23 is ongoing. ICP-II, implemented jointly by BARI, BRRI, BAU and Murdoch University of Australia, was completed in 2022-23 (reported in this annual report). ICP-III, implemented jointly by BARI and the University of Western Australia, was completed. Two ICP projects have been initiated and are currently underway: (i) ICP-IV, which focuses on the Development of Short-Duration Cold-Tolerant Rice Varieties for Hoar Areas of Bangladesh. This project is funded by BKGET-KGF and the International Rice Research Institute (IRRI), and is being implemented by BRRI and IRRI. (ii) ICP-VI, which aims to manage Wheat Blast in Bangladesh through the Identification and Introgression of Wheat Blast Resistant Gene(s) into Varietal Development and Rapid Varietal Dissemination. This project is also funded by BKGET-KGF, along with ACIAR, and is being carried out by BWMRI and CIMMYT.

Technology Piloting Program (TPP)

KGF has been executing pilot projects and scaling up potential or adapted technologies to encourage adoption by stakeholders in Bangladesh. To date, 24 pilot projects have been carried out.

Technology Commercialization Program (TCP)

The TCP initiative began in 2019-20 under the project titled, "BAU-Bro Chicken Conservation and Piloting Producer Group Farming," aimed at technology commercialization and is currently ongoing. The legal structure for this project is based on a tripartite agreement involving BAURES (representing BAU), the technology inventors (two professors from BAU), and KGF. The organizations participating in this technology commercialization effort include BAU, Palli Karma-Sahayak Foundation (PKSF), and Protein Mart BD Ltd. (a private enterprise). This marks the first effort in Bangladesh to commercialize technology in order to generate returns from research investments through a legal framework.

Lump Sum Grants (LSG)

LSG are granted for in-depth research on specific contemporary challenges or emerging issues of regional or national significance in Bangladesh's agriculture. The outcomes and insights from these studies could assist in formulating and structuring comprehensive research projects in the future. This initiative began in the 2020-21 period, and since then, 23 LSG projects have received approval from KGF. A total of twenty-three LSG were allocated to investigate particular problems or emerging issues within Bangladesh's agriculture. Out of these, twenty LSG projects have been completed, while three are currently ongoing.

Research Priority Setting

The primary focus of the KGF operational protocol is to identify and prioritize research issues based on needs that should be addressed and studied across various program categories to ensure optimal use of research grants. Funding through CGP and other R&D initiatives is allocated for location-specific, pre-identified, high-priority, multi-disciplinary, problem-solving research and development. Additionally, KGF conducts consultative workshops, meetings, and seminars in key areas to identify and prioritize research issues at local and regional levels. The TAC chooses the thematic areas for research in the CGP calls based on suggestions from BARC publications and NATP about research priorities, which arise from thorough consultations with stakeholders carried out by KGF. This selection also takes into account current demand-driven issues such as wheat blast disease, agricultural commercialization, safe food, marketing, and the adverse ecosystem impacts on the country's agricultural landscape. Utilizing pre-designed formats from KGF, desk officers conduct a preliminary review of the proposals and forward those to the TAC, which selects the most promising proposals based on technical and financial viability. These proposals are then presented to the Board of Directors for final approval. After a thorough evaluation process, research project grants are awarded to the respective researchers and faculty members of NARS institutes and universities.

The research issues under the CRP are prioritized through meetings and brainstorming sessions with agricultural experts from both the public and private sectors. KGF collaborates with researchers at NARS institutions and universities to pinpoint current agricultural production challenges that have regional or national significance and require immediate action to develop effective management and mitigation strategies. KGF prepares a concept note and presents it at a meeting with experts. The experts then determine the research themes, which leads TAC to identify the appropriate research organizations and invite specific project proposals. KGF management reviews and selects these proposals before submitting them to TAC. The KGF Board of Directors ultimately gives the final approval for the proposals. The pilot projects to be carried out under TPP are chosen based on the results from relevant research projects over the past three years and an assessment of the technology's adoption potential in extrapolated areas.

Generally based on the performance of the technologies that have been tested, the relevant Principal Investigators (PIs) suggest starting pilot projects using the technology developed during the research phase. After this, KGF experts travel to the field testing sites of the research technology; they engage with the anticipated beneficiaries through Focus Group Discussions (FGDs) or Key Informant Interviews (KIIs). The reports generated from these interactions are assessed by KGF management, and if deemed suitable, the approval process for the proposed pilot projects begins, which then undergoes rounds with the TAC Board before receiving final approval, similar to the procedures followed for CGP/CRP.

1.3 Technical Advisory Committee (TAC)

The TAC plays a key role in processing and recommending research proposals for various KGF programs. It is an independent entity formed by the Board of Directors, consisting of highly esteemed and experienced experts from diverse agricultural fields. Primary responsibilities of TAC include: i) offering strategic guidelines to ensure research quality and its alignment with the nation's goals and objectives, ii) assessing priority research areas and selecting relevant issues for KGF funding proposals, iii) advising on resource distribution for CGP projects/programs, iv) identifying areas for new initiatives, and v) reviewing proposals evaluated by peer reviewers and providing recommendations to the KGF Board.

Grant making process for CGP projects

KGF follows established protocols for distributing grants. The largest portion of project funding is designated for CGP. Figure 1 illustrates the flow chart of the competitive grant-making process.

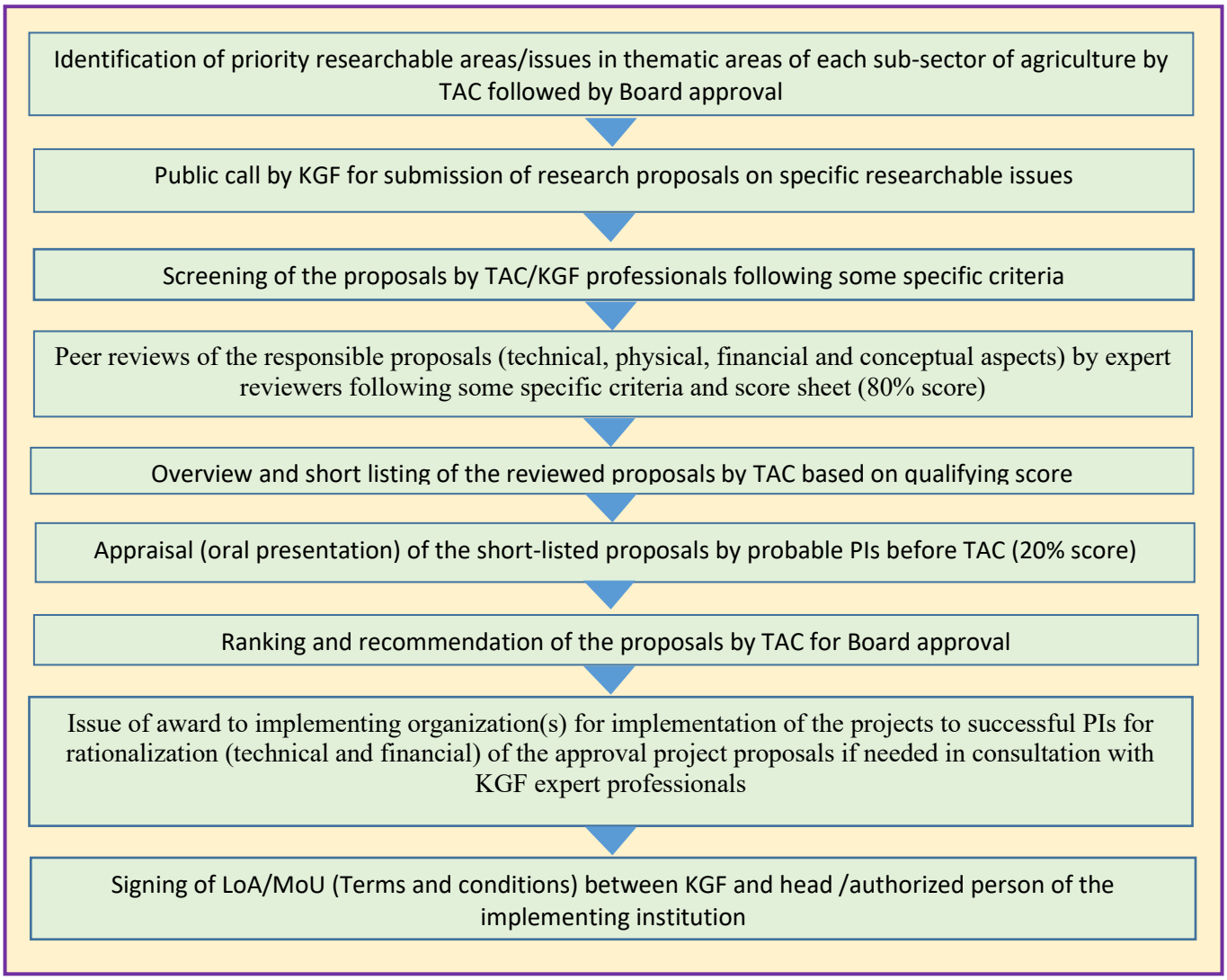


Figure 1. Followchart illustrating the competitive grant-making

Accomplishments during 2023-24

KGF has so far sponsored and funded a total about 231 for agricultural R&D projects in various fields such, natural resources management, system based research, agricultural machinery, farmers' livelihoods and socio-economic conditions and cross-cutting issues related to crops, livestock and fisheries. During 2023-24, around 100 projects were being executing by various institutions, of which 69 focused on the crop sector, 25 on livestock and 6 in fisheries. This 15th Annual Report of KGF covers activities carried out in the period July 2023 to June 2024 and focused on the crop, livestock and fisheries sub-sectors.

Financial progress

Total expenditure Tk. 3565.56 lac as of 30th June 2024 against a total fund of Tk. 3437.2453 lac from BKGET and Tk. 5.4541 lac from various closing project, Bank Interest, Vehicle rent. Financial Achievement 85% of Total Budget. 2023-24 approved annual budget: Tk. 4200.00 lac; Fund expenditure: Tk. 3565.56 lac. Progress on approved budget 85% and Progress on fund received 99.74%. The KGF statement of expenditure (SoE) for 2023-24 is shown in Annex, the activity plan for 2024-25 in Annex, the proposed budget for 2025-26 in Annex and the audit report for 2022-23 in Annex-6.

Table 1. Sector-wise distribution of Projects under different KGF programs

Program		Total Projects awarded (no.)	Sector-wise Projects (no.)			
			Crops	NRM/CC/AM/SBR /SoE	Livestock	Fisheries
CGP	1st Call	14	09	02	01	02
	2nd Call	19	09	03	06	01
	3rd Call	27	10	06	07	04
	Basic Research	08	08	-	-	-
	Interim-I	03	03	-	-	-
	4th Call	18	04	07	04	03
	Interim-II	17	07	06	02	02
	5th Call	60	34	03	13	03
CGP total		**159**	**84**	**27**	**33**	**15**
CRP		05	03	01	01	-
CEP		06	02	03	01	-
ICP		05	04	01	-	-
LSG		20	12	05	01	02
TPP		20	10	05	02	03
TCP		01	-	-	01	-
Grand total		**216**	**115**	**42**	**39**	**20**

NRM=Natural Resources Management (NRM), CC=Cross-cutting Issues, AM=Agricultural Machinery, SBR=System Based Research, SoE=Socio-Economic

Table 2. Sector-wise distribution of Projects under different programs in 2023-24

Program	Total proj. (no.)	Sector-wise Projects distribution (no.)*					
		Crops		Livestock		Fisheries	
		CP	OP	CP	OP	CP	OP
4th Call (Interim II and II Phase 2)	36	20	16	8	2	2	2
5th Call	60	1	38	0	18	0	3
CGP total	**96**	**23**	**38**	**10**	**18**	**4**	**3**
CRP	3		2	1			
CEP	3		3				
ICP	4	1	3				
LSG	6	5	1				
TPP	1	1					
TCP	1				1		
Grand total	**114**	**30**	**47**	**11**	**19**	**4**	**3**

*CP = completed projects; OP = ongoing projects

Other activities

In addition to management of on-going projects, monitoring, reviewing (Desk and Field) and evaluation, KGF organize the meetings of the Board of Directors and General Members, with Technical Advisory Committee and Independent Monitoring Team and held 100 research review workshops in the whole year. During the year 2023-24, KGF arranged six Board meetings (86th, 87th, 88th, 89th, 90th, 91st, two TAC meetings (42nd, 43rd). The 17th Annual General Meetings (AGM) and one (9th) Extraordinary General Meeting (EGM) were held in this year.

This year, KGF held approximately 100 workshops focused on the inception, coordination, review, and completion reports of projects. These workshops were attended by scientists involved in KGF-sponsored projects, as well as relevant reviewers and experts invited by KGF, including KGF specialists. The Executive Director, along with other KGF scientists, took part as invited experts in various meetings, seminars, and workshops organized by national and international organizations, including BARC, NARS institutions, universities, NGOs, and others. A number of national and international delegates visited KGF to share their insights with the Executive Director and other professionals at KGF. All these events and activities were funded by BKGET. Besides, KGF responded to queries from various organizations such as MoA, BARC, and the KGF Board through reports or presentations.

Research Highlights

- Competitive Grants Program (CGP)
- Commissioned Research Program (CRP)
- Capacity Enhancement Program (CEP)
- International Colaborative Program (ICP)
- Cross Cutting
- Technology Commercialization Program (TCP)
- Lump Sum Grants (LSG)



Crops



Livestock



Fisheries



Cross Cutting

2. Research Highlights

CROPS AND NATURAL RESOURCES

Competitive Grants Program (CGP)

Highlights of the Projects

TF-51- C/17

From remote sensing image processing, agro-environmental resources geo-databases were developed, including topsoil texture, soil reactivity, water body, soil consistency, land type, etc. which were used for dry season crop suitability assessment for the drought-prone Barind region of Bangladesh. Crop suitability assessment showed that wheat, lentil and maize would be the most suitable crops for this region. The results of this study provide information for researchers and decision-makers regarding cropping practices and suitability in the Barind region.

TF-65- C/19

Value-added jackfruit products such as, fresh cut jackfruit bulb (ripened), fresh cut tender jackfruit and jackfruit jam have been developed for local and foreign markets. This could minimize postharvest losses of jackfruit, improve the supply chain and create strong linkage among growers and local manufacturers, and introduction of newly developed value-added jackfruit products to the domestic as well as international markets may contribute to the GDP of the country

TF 68-C/20

In a survey program, as high as 47% bacterial wilt (BW) infection in eggplant and 20% infection in tomato were detected. A total of 400 isolates of Ralstonia solanacearum were collected and preserved. Sixty-three germplasm of eggplant and thirty germplasm of tomato showed resistance to BW. Among 5 integrated disease management (IDM) treatments for bacterial wilt, Stable Bleaching Powder @ 25 kg/ha + Burning of rice husk @ 10 t/ha + Bacillus cereus (seed and root soaking) was identified as the most effective IDM package for eggplant against BW. Meanwhile, Stable Bleaching Powder @ 25 kg/ha + Burning of rice husk @ 10 t/ha + Bacillus subtilis (seed and root soaking) was identified as the most effective IDM package for tomato against BW.

TF 69-C/20

The optimal dates for planting lilium bulbs were identified as November 15 and December 01, which demonstrated superior performance; however, these bulbs can still be planted until February 15 as part of a staggered planting approach to prolong the flower marketing period. Larger bulblets resulted in a higher yield of lilium and produced flowers of enhanced quality. Bulblets of larger size (27-30 mm) combined with a planting depth of 6 cm were determined to be the most effective combination for cultivating lilium bulbs. It requires three growing seasons to cultivate lilium bulbs of a commercially viable size. Lilium bulbs derived from large-sized bulblets are ready for flower production in the subsequent season, whereas bulbs produced from medium or small-sized bulblets require an additional season before they are suitable for commercial flower production.

TF 71-C/20

The development of four eco-friendly protocols for the biosynthesis of nanoparticles has demonstrated significant potential in agricultural disease management. Utilizing plant extracts, chitosan combinations, bacterial isolates, and microwave-assisted starch stabilization techniques, a variety of nanoparticles including AgNPs, CuONPs, ZnONPs, SiO2NPs, MgONPs, KNPs, CuChNPs, and ZnChNPs were synthesized. The morphological characterization confirmed their nanoscale size (1-100 nm). The green-synthesized AgNPs from Dholkolmi leaf extract showed remarkable inhibition of mycelial growth of *R. solani and M. oryzae,* major pathogens causing rice sheath blight and blast disease, respectively. Similarly, CuO, ZnO, and K nanoparticles effectively targeted *X. oryzae pv. oryzae*, the causal agent of bacterial blight in rice. Notably, ZnChNPs and CuChNPs exhibited strong microbial inhibition, with clear zones ranging from 22.37 mm to 32.9 mm. In practical applications, biosynthesized AgNPs and ZnONPs significantly reduced sheath blight disease, both independently and in combination with fungicides. The blend of Bismerthiazol with CuChNPs and ZnChNPs further

demonstrated substantial lesion length reduction in controlled net house conditions. Additionally, the combination of CuONPs and Bismerthiazol achieved a 90% reduction in bacterial blight disease. Field trials revealed that AgNPs and ZnONPs, when used with fungicides, significantly decreased sheath blight disease across different rice growing seasons, enhancing yield and showing favorable benefit-cost ratios. These findings underscore the potential of green-synthesized nanoparticles as effective, sustainable alternatives for managing agricultural diseases, promoting healthier crop production, and reducing reliance on chemical pesticides.

TF 72-C/20

Three profitable cropping patterns along with existing cropping pattern as check were evaluated at Rangpur and Bogura regions to select location specific cropping pattern. Among the patterns, Potato-Maize/Sesbania-T. Aman was selected for Rangpur, Mustard-Mungbean-T. Aus-T. Aman was selected for Bogura and Potato/Sweet Gourd-Jute-T. Aman pattern were found suitable for both Rangpur and Bogura. INM basis Soil Test Based (STB) fertilizer management with 5-ton ha^{-1} cowdung or with 3-ton ha^{-1} vermicompost found better for the productivity and maintaining soil quality but economically the use of cowdung manure is beneficial and readily available

Results/output of the project are offered in considering the research findings to increase cropping intensity while maintaining soil fertility in northern regions of Bangladeshas follows: Location-specific two potential four-crop-based cropping patterns at Rangpur and Bogura to achieve higher productivity and profitability- Potato/Sweet gourd-Jute-T. Aman and Potato-Maize/Sesbania-T. Aman and Potato/Sweet gourd-Jute-T. Aman and Mustard-Mungbean-T. Aus-T. Aman. The INM-based STB fertilizer (with 5 t/ha cow dung) could be recommended for maintaining soil fertility in the recommended four-crop-based cropping pattern.

TF 73-C/20

Climate-smart conservation technologies (CSCTS), such as raised beds and relay or zero tillage systems with residue retention, have demonstrated promise in the drought-prone and non-traditional regions of Rajshahi and Narail districts. These practices have been beneficial for the yields and economic returns of various crops, including lentil, mustard, wheat, maize, mungbean, sesame, cheena, and boro rice. This system has the potential to reduce production costs by 45-50% while increasing farmers' income by 5-7%.

TF 74-C/20

The study of the ASR system examined the function of the injectant, the hydro-geochemical quality of the infiltration water, and the reactions to rainfall and flooding across four trial locations: Naldanga, Paba, Mirzapur, and Dacope. Prior to the initiation of the project, farmers were unable to cultivate double or triple crops each year; however, the cropping patterns during the dry season have since evolved. The study also explored ASR's potential in coastal saline areas, conducting aquifer mapping, pumping tests, biweekly water table monitoring, and water quality assessments at the trial sites. Results showed the ASR chamber effectively eliminated coliform bacteria, indicating minimal health risks from contaminants in the aquifer. A proposal suggests using existing shallow tubewells for both recharging and irrigation to prevent clogging at the ASR sites. Climate-smart conservation technologies (CSCTS) like raised beds and zero tillage with residue retention have improved yields and economic returns in drought-prone areas of Rajshahi and Narail, particularly for crops such as lentil, mustard, wheat, maize, mungbean, sesame, cheena, and boro rice. This approach could cut production costs by 45-50% and boost farmers' incomes by 5-7%.

TF 79-SoE/20

The research project primarily focused on examining the nature, extent, driving forces, and challenges associated with the transition from conventional agriculture to high-value enterprises, along with its impacts on rural livelihoods. Additionally, the study offered policy recommendations aimed at addressing critical issues related to the development, promotion, and scaling of six selected high-value agricultural enterprises in Bangladesh with key findings from the study, highlighting their relevance and potential contribution to the broader context of agricultural development in Bangladesh

TF 80-C/20

Twelve types of functionalized biochars (such as those that are chemically, biologically, and mineral doped) have been created, which can be utilized by researchers in the relevant field to develop fertilizers tailored for specific functions. Biochar-enriched (coated) nitrogen fertilizers demonstrated a greater potential to enhance crop yield (for instance, up to 15% more maize yield) with improved nitrogen use efficiency (we observed approximately 22% higher NUE) compared to traditional prilled urea or common farming practices. This technology is directly applicable for maize farmers in Bangladesh, and its suitability for major agronomic and horticultural crops should be explored for widespread implementation in Bangladeshi agriculture. Biochar-based composite fertilizers have been developed, including six biochar-enriched composite fertilizers, and their dynamic protocol represents a novel area of scientific intervention aimed at creating composite fertilizers that are specific to soil/zone and crop needs, thereby increasing overall nutrient use efficiency and enhancing soil health for sustainable crop production.

In a trial conducted at Patuakhali, it was observed that rice grain yield decreased with delayed transplanting beyond the recommended date (January 15th). In Patuakhali Sadar, BRRI dhan67's highest yield was 6.93 t/ha with timely transplanting, but this dropped to 6.40 t/ha and 5.65 t/ha with 10 and 20-day delays, respectively. A 30-day delay resulted in a 1.93 t/ha yield reduction for BRRI dhan67. Similar reductions occurred for BRRI dhan74 and BRRI dhan89, with 30-day delays decreasing yields by 1.40 t/ha and 1.90 t/ha, respectively, emphasizing the importance of timely transplanting for optimal yields.

TF 84-SoE/20

A study on the adoption of climate resilient crop varieties in selected environmentally vulnerable areas of Bangladesh and its impact on farm productivity by Agricultural Economics Department of BAU, Mymensingh. The economic performance of large number of resilient and non-resilient rice and wheat varieties under farm level cultivation in the stress prone areas, opportunities and problems of climate-resilient varieties, the factors associated with the increase of the adoption level were studied with a view to support future policy formulation. The information generated here will also be helpful for farmers, extension workers, researchers, and other relevant stakeholders.

TF 86-C/21

A locally sourced IoT (internet of things) sensor package has been designed, developed and assembled utilizing components that are readily available to generate real-time field data. Field experiments aimed at the advancement of IoT-based precision agriculture have been established at BARI. Databases are currently being created to evaluate the data within the IoT-based machine learning (ML) program designed for a precision eggplant production system. The architecture of the IoT-based precision agriculture software system has been designed and is undergoing partial testing. Initial machine learning models concerning water and fertilizer needs, as well as the likelihood of pest attacks, have been developed and are currently being assessed for their performance. A mobile application that illustrates the potential interfaces and relevant features for the end user has been created and is undergoing enhancements.

TF 86-C/21

The activities related to sugarcane in the Chittagong Hill Tracts have resulted in the identification of a promising chewing clone (Black Ruby) and a gur-producing clone (Madhumala), which are anticipated to be introduced as new site-specific varieties. Moreover, 33 new genotypes that flowered at the Bandarban site contributed to the hybridization program, leading to the creation of several promising clones. The research also focused on the physico-chemical properties, nutrient composition, and effective storage methods for gur. Creating marketing connections between chewing cane farmers and middlemen guarantees safety and improved benefits for both sides. Intercropping high-value crops (French bean, Potato, Cabbage) with the BSRI Akh 42 sugarcane variety, along with newly suggested fertilizer doses and production packages, is expected to enhance farm productivity and profitability for sugarcane farmers in the Bandarban hill district.

TF 88-C/21

Out-scaling of modern premium quality rice (PQR) varieties and their management technologies was done in Bogura and Sirajganj districts through adaptive and pilot production trials. Farmers' preferences

of the varieties were; BRRI dhan90> BRRI dhan75> BRRI dhan80> BRRI dhan70>BRRI dhan34> Binadhan-13 in Aman 2022 while BRRI dhan102>Katari>Binadhan-25>Bangabandhu dhan100> BRRI dhan63>BRRI dhan81 in Boro 2023.

TF 89-AM/21

The study effectively validated and promoted three rice mechanization technologies developed by BRRI—namely, the rice transplanter cum fertilizer applicator, multi-row power weeder, and combine harvesters—through comprehensive trials in Habiganj and Sirajganj. Across several seasons, these machines demonstrated exceptional performance in terms of field efficiency, yield, and cost-effectiveness. Although there are challenges such as high investment costs, limited availability of spare parts, and a shortage of skilled operators, feedback from stakeholders has been predominantly positive. This model aims to enable the incorporation of mechanized solutions into various farming systems, while also tackling issues related to costs and services. Thus the initiatives collectively facilitate the broader adoption of mechanized rice farming, decreasing labor reliance and enhancing productivity for small and medium-sized farmers in Bangladesh.

TF 90-C/21

The study was conducted to improve the productivity and adoption of BARI-developed selected vegetable crops through integrated management approaches at char areas of Bogura and Rangpur districts (IPVC). All the crops (cabbage, cauliflower, tomato, garden pea, pumpkin, and brinjal) performed better with ICM, showing a higher BCA than those with non-ICM practices at all locations (Table 9). Before the start of project activities, garden pea was not familiar to the char farmers, but it is becoming popular due to its high market price. Crops (bottle gourd, bitter gourd, summer tomato, okra, Indian spinach, and kangkong) grown in crop cycle III of the year 2023 (summer) are in the field, and relevant data are being collected.

TF 91-C/21

Among different pesticides tested, Spiromesifen showed the highest effectiveness with a mortality rate 93.98% as well as MBCR value 4.16, significantly higher than the other biopesticides. The biopestocide Spiromesifen showed consistently the highest economic return in terms of highest MBCR values during the 3-year experimental period, so it may be the most cost effective treatments for red spider mite management in tea gardens.

TF 92-C/21

Five mutant lines (M4, gamma radiation induced, and M3, ion beam and X-Ray induced), 600 F2 populations generated from F1 of the crosses of BARI Gom-26 × S615 and BARI Gom-33× S615, and 3 new varieties from BWMRI and 10 lines from CAAS were collected and stored. Three hundred and thirty wheat lines resistant to blast were with superior agronomic characters were studied, and their DNA extracted. Genotypes numbering 250 were grown in the Boro season of 2022-23, and 5 leaf samples from each of them collected and stored for DNA extraction. After DNA extraction, the dry DNA pellets will be sent to GIFS, Canada for genotyping. Shoots were regenerated from the callus of all the varieties of lentil used in this study.

TF 93-C/21

The project will identify the barriers to and facilitators (including socio-economic and gender issues) of ensuring smooth adoption and diffusion of home-grown agricultural innovations in rural Bangladesh. The comprehensive model of adoption of agricultural innovation developed through this research project is unique. The collected field survey data and their analysis based on this adoption model is expected to unveil several important factors that would help develop appropriate policy and resource allocation strategies for research in agricultural technology development and dissemination in Bangladesh.

TF 94-C/21

With dedicated time, proper care, and attention in the fields, yields could match those obtained with the application of chemical fertilizers and pesticides. Importantly, farmers emphasized the safety of their produce for both human consumption and the environment. This increased awareness among local consumers, leading to a willingness to pay higher prices for these safe and sustainable products. However, challenges were observed in the upstream market, which struggled to fully embrace these alternative practices.

TF 95-C/21
Pre-harvest spray of Autostin (0.2%) + 10cm plant spacing + Cowdung @ 3 t/ha + Dipping bulbs in 10% H_2O_2 for 2 minutes + AC room showed the best performance in reducing black mold disease and increasing shelf life of onion in the validation trial. In the validation trial of soft rot disease, Pre-harvest spray of Cupravit (0.2%) + 10cm plant spacing + Cowdung @ 3 t/ha + Dipping bulbs in 10% H_2O_2 for 2 minutes + AC room showed the best performance in reducing soft rot disease and increasing shelf life of onion.

TF 96-C/21
Five irrigation schemes including the alternate wetting and drying (AWD) system of irrigation were evaluated for Boro rice production in two haor areas. Irrigation water saving by polythene pipe distribution system was 22.47% over the earthen canal. Satisfactory yield was obtained from the AWD plots with a saving of 1-2 irrigations compared with the local farmers' practice. Average yield loss due to water stress at the reproductive phase could be up to 43.2%.

TF 98-C/21
Promising advance lines (five lines) were selected form segregating generations of country bean needed to bring further individual plant selection to stabilize homozygosity with a view to develop OP variety for summer and winter season cultivation. During summer season mean pod yield performance of Sikribi Sheem-1 from the adaptive trials (n=46) made during extreme summer season (March onward) ranged 9.88 to 16.54 t/ha with an average of 13.01 t/ha) indication bright scope of country bean cultivation during summer season. BARI Sheem-1, Sikribi Sheem-1, BARI Jharsheem-1 and BARI Borboti-1 exhibited appreciable green pod yield at farm field in Sylhet region. Quality seed production of winter and summer country bean, French bean in Sylhet region was found noticeable under proper management practices.

TF 103-SBR/21
In the sorjan system of integrated farming, year round vegetables and fruits can be cultivated in Barishal, Pirojpur, Jhalakati districts of southern Bangladesh. Shade tolerant crops like pineapple, turmeric and ginger could be cultivated as intercrops with the existing guava and golden apple fruit orchards. Improved agronomic practices gave high yields of guava and golden apple and high vegetable yields in brinjal + cauliflower and spinach + cauliflower intercropping systems. Fodder crops (Packchong, German grass etc.) could also be cultivated on sorjan edges for livestock and also to reduce the erosion of soil from the sorjan bed.

Commissioned Research Program (CRP)

Highlights of the Projects

CRP- II
The models climate change predict that by 2050, precipitation will be the highest in the eastern part of Bangladesh while it will be the lowest in the north-western part. Minimum temperature is increasing more than maximum temperature which is likely to reduce agricultural production in future. Insect and diseases infestations will also be increased in future. As government policy is to reduce GHG emissions in Bangladesh, adoption of AWD, VC and non-rice cropping patterns will be helpful in this respect. However, a complete inventory of GHG from the agriculture sector is needed.

CRP-V
GIS based software Crop Zoning Information System (CZIS) has been developed and hosted into the government National Data Centre cloud. A mobile app named 'Khamari' has been developed as a handy tool to empower farmers and other agriculture stakeholders with much needed information relevant to agriculture productivity. The app/software can be downloaded and installed from the Google Play Store or from the website www.cropzoning.gov.bd. Users of CZIS/mobile app will get location based information on suitable crop, profitable cropping patterns, crop variety with their yield and duration, crop specific fertilizer recommendation, upazila-wise crop zoning information and upazila-wise cropping pattern information with gross margin and benefit cost ratios. Currently, crop zoning has been

completed for 355 upazilas. Once the crop zoning system is fully operational, it will serve as the much-needed decision support tool for sustainable agricultural production planning.

Capacity Enhancement Program (CEP)

Highlights of the Projects

CEP-V/21

The CEP project has been undertaken by Bangladesh Academy of Agriculture (BAAG) to enhance the capacity of Public Sector Extension Agency through technology transfer and strengthening the Research Extension linkages. More than 1400 participants were so far trained in different agro-ecological region as Training of Trainers (ToT) model. The crop sector (Fruits) includes Mango fruit and flower dropping problem. Citrus canker, Malta production tech and dragon fruit production technology. The crop sector (veg.) includes and safe vegetable production and summer tomato production technology. The crop sector (cereal crop) includes the Aromatic and Bio fortified and Hybrid Rice production technology, BINA developed short duration rice and modern techniques of Wheat and maize. The new and validated technologies, information and new knowledge were transferred to DAE officers, SAAO and progressive farmers. The technologies include new varieties, modern production packages, disease and insect management. The technologies also include post-harvest management and crop economics in same cases. The technology of fisheries sector includes the Koi, Shing, Pabda, Gulsha and Tilapiya fish. The technology of fisheries includes the fish breeding, hatchery and nursery preparation and management, water quality management, feed, health, disease management and Good Aquaculture Practice (GAP) etc. The technology of livestock sector includes the management of major diseases of ruminant. PPR, FMD etc., feed management, vaccination and Anti-microbial Resistant (AMR) etc. The livestock technology of BAU chicken and repeat breeding of sheep and cow.

CEP-VI/21

A ten-member External Panel of Experts (EPE) headed by a Chairman was formed for review and evaluation of 6 agricultural research instituted (ARI). Information regarding research capacity, quality and management are being collected from six ARIs (BARI, BJRI, BRRI, BINA, BSRI and BWMRI). With active collaboration of DAE five Regional Technology Uptake Workshops were held in Rangpur, Barishal, Cumilla, Rangamati and Rajshahi. Information on the extent of adoption of 6 ARI released varieties and technologies collected though district and regional DAE officers were presented and discussed in the workshop.

International Collaborative Program (ICP)

Highlights of the Projects

ICP- I

The project dealt with a wide range of activities including socio-economic studies, basic research, applied and adaptive research in the intensively cropped areas and coastal areas and on emerging cropping systems including conservation agriculture (CA), out-scaling of promising technologies, human resource development etc. Nutrient use gaps between current farmers' practice and scientific recommendations in Bangladesh are influenced mainly by category of farmer, crop residue retention, crop rotation, fertilizer use in previous crops, distance to input/output market, fertilizer price, level of extension contact, number of cattle owned, and study region. In depth research on N, P, K and S dynamics and balance in the ongoing long-term cropping pattern experiments is in progress. Introduction of a new crop, sunflower, into the existing single crop pattern appears to be a promising technology for increasing cropping intensity and land productivity in the coastal saline areas. Conservation agriculture practices like minimum soil disturbance (strip planting, non-puddled soil for transplanting of rice) and crop residue retention gave good results in terms crop yields and improvement of soil properties.

ICP- II

Field experiments under an international collaborative project (ICP) involving KGF, ACIAR, Bangladesh NARS organizations and Murdoch University, Australia, it was observed that with proper management, including mulching, dry season small scale supplemental irrigation with fresh water, use of salt tolerant crops/varieties and recommended fertilizers satisfactory yields of both wetland and upland crops could be obtained in the southern coastal saline areas of the country. The effect of appropriate fertilization in enhancing yields of various crops and build-up of soil fertility was obvious in the many fertilizer management trials in farmers' fields in the northern districts. Conservation agriculture practices like strip cropping and minimum tillage showed promise as a method of facilitating crop establishment at optimum times, resource conservation and maintenance of soil fertility without significant crop yield penalties.

ICP- IV

The BR11894-R-R-R-R-169 advanced breeding line exhibited significant cold tolerance at the reproductive stage across all sites. This line performed well even under 20°C cold stress at the most sensitive booting phase. This line has been recommended for advancement to variety release trials for cold tolerance in *haor* areas. In addition, promising advanced breeding lines will be studied further for cold tolerance at the reproductive stage to determine the best and most suited lines for the *Haor* environment. BRRI dhan67, a short-duration blast resistant Boro variety with moderate cold tolerance has already replaced BRRI dhan28 and 29 in the *haor* region.

ICP- VI

Wheat blast become a major threat to wheat production in Bangladesh. This disease is spreading to new areas each year. A series of activities have been performed to manage the devastating effect of wheat blast. The project is initiated to continue the major activities of a previously ACIAR/CIMMYT/BWMRI collaborative project. So far, two wheat blast resistant varieties have been developed. Collection of wheat germplasm are being evaluated to identify novel sources of resistance. Pathogenic variability is also being studied. Dissemination of newly developed resistant varieties is being continued.

Lump Sum Grants Program (LSG)

Highlights of the Projects

LSG 13

The cultivation of soybean in Bangladesh is still concentrated in the coastal region of the greater Noakhali District, where salinity hinders crop production. Four soybean genotypes, earlier found to be salt tolerant, AGS313, BD2330, G00028 and G00056, were grown in Kharif II season of 2022 at different locations of Lakshmipur district. Based on the results of multi-location trials and discussions with the farmers the following recommendations were made: (i) early planting (by 1st to 2nd week of January) of soybean seeds would lessen the effect of salinity, (ii) genotypes AGS313 and G00028 should be registered as varieties by the National Seed Board.

LSG 17

One LSG project has been undertaken and executed by BARC to formulate to formulate "National Seed Vision 2040" with a view to increase seed security, crop productivity and production, increase income, create employment opportunities, increase seed export, reduce seed import by implementation of the vision document. A draft of National Seed Vision 2040 has been prepared and presented in the stakeholders meeting and their feedback was aggregated. The technical committee meeting and workshops were arranged and the National Seed Vision 2040 has been finalized.

LSG 21

BRRI's Farm Machinery and Postharvest Technology (FMPHT) Division has developed a Mini Rice Mill suitable for household use with the philosophy of "rice conservation instead of over-polishing" under the lump-sum grand project "up scaling of the BRRI mini rice mill suitable for individual household "The BRRI Mini Rice Mill offers a promising solution to improve rice milling efficiency at the household level in Bangladesh by reducing nutritional loss through over polishing fabricated, field-tested, and easy to operate, this innovation aligns with the goals of sustainable mechanization. With ongoing user training, the mini mill is well-positioned for wider adoption and up scaling. Its successful

implementation can significantly contribute to food security and rural livelihoods across the country. So far, 12 mini mills have been fabricated, and 11 units have been distributed to farmers for field-level feedback

LIVESTOCK

Highlights of the CGP Projects

TF 77-L/20

Newcastle disease (ND) is one of the most economically important viral diseases of backyard chickens which causes huge financial loss to the small holder poultry farmers of Bangladesh. As currently used ND vaccines are thermo labile, our research was aimed to select possible candidate(s) to develop a thermos table ND vaccine. To accomplish this goal, the first task was to identify thermostable avirulent/ low virulent NDV strains and so far we have identified and characterized four (4) nonvirulent NDV strains which are thermostable at 37^{o}C for 28 days. It is expected that any or all of these four low virulent strains might be useful in developing a thermostable ND vaccine.

TF 78-L/20

The study was conducted to select crossbred dairy cattle using phenotypic and genomic information for efficient productivity and resilience in tropical environment of Bangladesh. Multi-trait selection index was constructed based on trait specific breeding values (EBV or gEBV) under three different models where all three indices manifested almost equal efficacy in selection process of sires and dams. About 70% similarity was observed among the top-ranked breeding bulls and cows when two different approaches were employed in construction of selection index. The rank order of every individual was performed on the basis of index value and top ranked 20% breeding bulls and cows were selected those could be utilized in future breeding for production of better progenies with known genetic merit.

TF 82-L/20

Layer manure contains lots of NH_4 and PO_4 that can be a good source of plant nutrients. Addition of $MgCl_2$ with the composting materials enhanced struvite precipitations in the compost. This struvite containing compost enhances the plant growth. The findings of the experiment showed that the struvite containing compost had a significant influence on maize fodder and grain yield. Struvite in the compost is a new innovation in field of waste utilization and it will be the only sustainable technology for food and animal production in near future when all rock P will be exhausted. Identification of application rate is very important because it's a new fertilizer for plant growth.

TF 83-L/20

To formulate a cost-effective ration, Napier packchongg was found as the best roughage considering the farm economic and year-round availability. Although the nutritional quality of straw is very poor, but the farmers consider it as animal feed due to its availability and shortage of year round green grass. The study also revealed that although silage is costly, it can be used as a sole roughage source and/or combination with rice straw as alternative roughage only in those places where, there is no opportunity to cultivate fodder.

TF 101-L/21

In case of Black Bengal Kids, the maternal dietary high energy and high protein (Hh) significantly ($p<0.05$) positively influenced the live weight changes before parturition, live weight changes during lactation, milk production, hormonal changes, blood metabolites of does and birth weight, live weight gain, weaning weight, carcass weight, dressing percentage (45.8%), muscle fiber diameter, myogenic regulatory factor 5 (*Myf5)*, heart fatty acid binding protein (*H-FABP)* gene expression of their kids. Kid mortality was also found lower in kids from high energy and high protein (Hh) consumed does. The density of muscle fiber and myostatin (*MSTN*) gene expression was significantly ($p<0.05$) higher in kids from low energy and low protein (Ll) consumed does. Thus, the results show that dietary energy and protein during pregnancy positively influence the performances of Black Bengal does and their kids. From these experiments, it can be concluded that the productivity

of the Black Bengal goat can be improved by manipulating the maternal dietary energy and protein during gestation.

TF 102-L/21

The fluke induces severe liver cirrhosis and cause very high condemnation of livers, resulting huge economic losses. Fascioliasis elicit very high level of IL-13, but not, INF γ production in affected livers. We found that none but only NTX and OCZ killed efficiently both sFg and asF. Our results suggest that control of fascioliasis is very essential for the profitable ruminant farming in Bangladesh, and the veterinarians and farmers should be careful about the treating of the ruminants affected with fascioliasis.

TF 120-L/23

There is an increased trend of two slaughter ages of broilers to the consumers. Because they have high conversion efficiency of feed to muscle and also return cash to a greater extent to the farmers. Interestingly, intermediate groups have more protein and others proximate nutrients than the counterpart. The present findings suggest that broilers could be reared either 25 days or 40 days above to get maximum economic returns.

TF 121-L/23

From this result it was concluded that average brix meter reading was higher in HF X breed colostrum than the other two breed. However, the deep yellow color colostrum shows highest brix reading than the light-yellow color colostrum at 1st day of calving.

TF 122-L/23

The potential decomposer bacteria were isolated and identified from shrimp waste samples collected from different shrimp processing areas of Satkhira, Bangladesh. The fermentation ability of the isolated decomposer bacteria was confirmed both aerobically and anaerobically at the bacteriology laboratory by measuring the change of pH (using pH meter) and turbidity (OD of UV Vis spectroscopy) of the culture broth. The chitosan powder was biogenically extracted by demineralization, deproteinization, and deacetylation by using isolated decomposer bacteria. The deproteinization and deacetylation of chitosan were confirmed with FTIR and X-Ray diffraction analysis. The confirmed chitosan powder was preserved for further use in green synthesis of Chitosan nanoparticles.

TF 123-L/23

To increase the production and reproductive success of Frizzle chickens, it is crucial to improve management procedures and prioritize genetic enhancements. In contrast, the Deshi Dwarf chickens exhibited positive performance results in demanding environments, indicating their potential for ongoing utilization and advancement in poultry farming. In summary, this thesis provides significant knowledge regarding the genetic and managerial techniques that can enhance the performance of Frizzle and Deshi Dwarf, Aseel chickens and pigeons. The study successfully extracted and quantified DNA from Aseel chicken blood samples, demonstrating the viability of molecular techniques in avian genetic research. The results highlighted considerable variations in DNA yield and purity, which could be attributed to differences in sample handling, storage conditions, and extraction efficiency. By advancing molecular research in poultry genetics, these efforts can support conservation strategies, sustainable breeding programs, and the long-term preservation of the experimental chickens and pigeon genotypes.

TF 124-L/23

A total of 110 samples from IBH-suspected broiler birds were collected, of which 98 (89.09%) tested positive for IBH virus by PCR targeting *Hexon* and *Polymerase* genes. Among these, 26 samples were successfully re-isolated in embryonated chicken eggs and reconfirmed by PCR. Partial gene sequencing identified FAdV Class E, serotype 8b in four samples from Mymensingh and Gazipur, and these isolates have been preserved at -80°C for inactivated vaccine development. Ongoing work includes WGS, detecting additional virulent serotypes (4 and 11) through continued molecular screening. Future goals include vaccine formulation, efficacy and safety testing, and field validation to protect poultry against IBH.

TF 125-L/23

Subclinical Mastitis (SCM) is a prevalent issue in dairy farming and poses a significant obstacle to the advancement of dairy industry in Bangladesh. Understanding and adopting identified risk factors could be crucial for developing effective control strategies for SCM. To combat the disease, SCM screenings regularly, good hygiene, improved milking practices and farmer awareness are recommended in the studied area even over the country

TF 126-L/23

Contagious ecthyma being a viral disease with no suitable antiviral therapeutic schedule, vaccination is the only option for effective control of this virus infection. To get a suitable vaccine candidate virus it is essential to collect as many as circulating viruses from the field. Based on their biological and molecular properties a strain then can be chosen to produce vaccine. The main aim of this research is isolation and identification of CE virus from the field samples with a target to develop an inactivated and/or live attenuated vaccine to control CE.

TF 128-L/23

Altogether, till to date, results of this study showed that 96.4% of the cattle in Bangladesh infected with piroplasms while 95.5% of the studied cattle were infected with *Babesia*. In 99.1% cases, *Babesia* was found co-infected with *Theileria* and *Anaplasma*. In this study, we established a self-designed genus and species-specific primer sets to amplify the 18S rRNA genes of *Babesia. Babesia bigemina, B. naoakii* and *B. bovis* were identified in cattle in Bangladesh. We optimized the *in vitro* culture protocol of *Babesia* in laboratory, made glycerin stock of infected RBC which preserved in cryovials in -80°C for further subculture.

TF 129-L/23

During the last one year, 300 blood samples were collected from three study areas. Alongside hundreds of tick vectors were collected and identified through morphotaxonomy. From blood samples the circulating *Anaplasma sp.* were characterized using conventional Giemsa staining and microscopy. In addition, PCR assay were performed for reliable molecular diagnosis of positive cases for future cell culture propagation. The sequence data will be crucial to explore molecular epidemiology. We have initiated infecting the cell line under culture in CVASU lab. The infective *Anaplasma* is now under careful purification steps which will ensure pure culture of *Anaplasma* in IDE-8 cells which will be used as a possible vaccine material. Over the next few months, we will establish *in vitro* cell culture with purified *Anaplasma sp*. and collect sufficient amount of vaccine seeds for subsequent challenge infection and WGS analysis.

TF 130-L/23

The project's structured approach to selection, training, and financial support demonstrates strong potential for scaling up and improving farmers assets and marketing facilities as well as livelihood develop of rural people in barind region of Bangladesh. The project also significantly boosted lamb production, increasing the total sheep population from 200 to 377 (88.5% growth). Training (100% completion) improved farmers' skills (housing 40 units) and moral ability in sheep keeping, marketing as well as uplifting their living standard that ensure sustainable sheep farming.

TF 131-L/23

The average body weights of growing chicken at 7th week of age were, ND male-655g & female-551g and NN male-630 & female-558g respectively and the difference was significant ($P<0.001$). These findings revealed that Naked Neck (NN) and Non-Descript Deshi (ND) compare to almost similar performance up to date. Data from laying hen is collecting for analysis. The 2nd and half year activities have completed successfully. Satisfactory result was obtained and for further activities project should be continued.

TF 134-L/23

The project aims at inventing and validating the processed cheese making technology for the dairy industry of Bangladesh toward technology transfer, entrepreneurship development and certification followed by patent application. The results so far obtained is highly promising as it shows that processed cheese can easily be made from low-fat acid curd. Hence a low break-even point can be achieved with

higher profitability of the manufacturers. Hence this technology is highly promising for the dairy industry in Bangladesh.

TF 153-L/23

The findings of this study indicate a significant presence of antibiotic residues in all analyzed samples, highlighting potential risks to public health and the need for stricter regulation and monitoring of antimicrobial use in food-producing animals. Although dexamethasone and prednisolone residues were within acceptable limits, the consistent detection warrants continued surveillance. The absence of estrogen and progesterone suggests that these hormones may not be commonly used or persist in the sampled products. Further analysis, including testosterone detection, is necessary to complete the hormonal residue profile. These results underscore the importance of enforcing withdrawal periods, promoting responsible drug use, and strengthening food safety monitoring systems within the broiler supply chain.

TF 160-L/23

Pasteurella multocida B: 2 causes bovine Haemorrhagic septicemia in cattle and buffaloes, primarily in Asia. Potential vaccines include porin protein, which is outer membrane protein H (OmpH). The OmpH of *P. multocida* serotype B: 2 has been identified and targeted for the development of a recombinant vaccine.

TF 161-L/23

Maize silage production has the potential for higher profit margins than maize grain production, but requires careful management in storage and ensiling. With appropriate training and support, smallholder farmers can adopt silage technology, reducing reliance on seasonal green fodder and enhancing climate resilience. The initiative also encouraged efficient use of crop residues like maize Stover and local grass (e.g. Chela grass). Further investment in infrastructure and farmer education is recommended for broader impact.

TF 162-L/23

The survey results clearly demonstrated that almost all the small- and medium-scale broiler farmers use drugs and additives without justifying the actual bird's health condition. The farmers usually do not follow the prescription/advise of registered veterinarians for treatment, rather they follow pre-listed drugs and additives on regular basis, mostly prescribed by the dealers. On-station research results showed that the broilers reared with injudicious drugs and additives did not yield significant differences in growth and meat quality. Thus, commercial broilers may be produced successfully without injudicious use of drugs and additives, even the final body weight of the birds reared drug free treatment was almost close to the other treatment groups fed commercial feed.

TF 164-L/23

An IoT-based biosensor system using machine learning for real-time estrus detection has been developed in the first year, in collaboration with different disciplines, aligning with project goals for cattle production.

Technology Commercialization Project (TCP)

TCP-1

Project timeline has been rescheduled and the required land for the construction work has been allocated by the university authority. The land development work is completed and proposed infrastructures has been started as per the new schedule and completed. Genotyping of parental lines has been started from the previously isolated DNA form generation 16 (G16). The multiplication of parental stocks was started and 6450 DOCs from different lines were hatched. As per the project plan, day-old BAU-Bro chicks were distributed among the farmers by the help of 34 NGOs in association of PKSF.

FISHERIES AND AQUATIC RESOURCES

Competitive Grants Program (CGP)

Highlights of the Projects

TF 76- F/20

Simple-designed, energy-saving, gravity-flow-based, locally-engineered RAS have been developed with locally available materials for culturing Tilapia, Catfish and Barbs. Two systems - a standard RAS (60 m^3) and a locally fabricated unit (60 m^3) were installed with similar layouts for performance comparison. Locally engineered RAS demonstrated high system efficiency, stability, and suitability for fish production under local conditions. Growth performance of fish in the locally engineered RAS was found to be statistically similar ($p > 0.05$) to that of those reared in the standard RAS. Tilapia (*Oreochromis niloticus*) reached an average weight of 300-350 g in 120 days, with a survival rate above 90%. Pabda (*Ompok bimaculatus*), Gulsha (*Mystus cavasius*) and Tengra (*Mystus tengara*) showed promising growth with good feed conversion ratios (FCR 1.4-1.6). Indigenous Shar Punti (*Puntius sarana*) also adapted well, showing uniform growth. The system was able to support a stocking density of 60-70 kg/m^3 without compromising water quality or fish health. The solar-powered components ensured 24-hour operation at minimal energy cost. Importantly, the locally fabricated RAS reduced setup costs by over 50%, and the production cost per kilogram of fish was significantly lower compared to standard or imported RAS.

TF 85- F/20

Quality brood stocks development and sustainable mass seed production technology of *Macrobrachium rosenbergii* by mitigating the problems encountered have been established in pond conditions. A total of nine species of bacteria including the genus *Vibrio*, *Aeromonas*, and *Bacillus* were found in the berried, larvae and water samples used in the hatchery. Nine bacterial isolates detected in the berried and larvae were tested for antibiotic susceptibility against 12 commonly used antibiotics. Out of the nine, five isolates were found to be resistant to all 12 antibiotics. Eight were sensitive to Norfloxacin; two were sensitive to Tetracycline, Oxytetracycline and Doxycycline; two isolates were resistant and seven were intermediate/sensitive to Ciprofloxacin. Tetracycline, Oxytetracycline and Doxycycline were found to show mixed results. PCR amplification of *tet*A and *aadA1* genes to detect Tetracycline and Streptomycin resistant species, *tet*B and *aac(3)-IV* genes to detect Tetracycline and Gentamicin resistant species, and *era*A gene to detect Erythromycin resistant species. All the isolates were found to contain Tetracycline resistant gene and Gentamycin resistant gene. Four microsatellite DNA markers were scored, and all were found to be polymorphic. The average number of allele in the three groups were almost the same (5.25-5.50), however the observed heterozygosities of 1:1 and 1:3 sex ratio was higher than that of 1:5 sex ratio.

TF 100- F/20

Technique of live feed culture for Aquaculture Industry has been developed by isolating and identifying indigenous microalgae from the south-eastern coastal region of Bangladesh. A total of 48 microalgae species have been isolated successfully from eight different sampling sites. Selected microalgal isolates were optimized for their maximum growth and proximate composition was analyzed based on nutrient (nitrogen, phosphorous stress) and environmental parameters. *Chlorella* sp., *Nannochloropsis* sp., *Tetraselmis* sp., and *Gonyostomum* sp. were found suitable for mass culture in rearing of zooplankton. Satisfactory growth and survival of Shrimp (*Penaeus monodon*) post-larvae were found with live microalgae.

TF 158- F/23

Tilapia farming in Bangladesh faces significant challenges due to the emergence of bacterial diseases, particularly those caused by *Streptococcus* sp. and *Aeromonas* sp. The study highlights the alarming mortality rates (60-80%) and the associated economic losses in infected farms. Comprehensive diagnostic analyses identified bacterial infections as the primary cause of these outbreaks, with *Streptococcus* sp. exhibiting alarming levels of antibiotic resistance. The findings underscore the urgent need for effective preventive measures, such as the development of vaccines and improved farm

management practices, to mitigate the impact of these diseases and sustain Tilapia productivity in Bangladesh.

TF 159- F/23

The main factor that may have attributed to the high survival was proper stocking of healthy sized fingerlings, freedom from predation, favorable ecological conditions and proper feeding. After completion of the culture period, the production of BFRI Suborno Rui was 1645 and 1570 kg/ha in P-1 and P-2, respectively. In comparison, the production of Local Rui was 1318kg/ha. Cost and return were performed to estimate the net profits of polyculture. While, estimating cost of production, variable costs towards lease value, labour, lime, fingerlings, feed and harvesting costs were taken into consideration. The net benefit of Tk. 352151, Tk. 325628 and Tk. 258920 were obtained from P-1, P-2 and P-3, respectively.

Technical Progress

CROPS





Crop agriculture in Bangladesh has grown fast, through t integrated efforts of researchers, extension exper policymakers and farmers. This growth of crop agricult has contributed greatly to the national endeavor to achie food security for the Bangladeshi populace. Development HYV crop varieties and suitable production technolog played an important role in bringing about dramatic cr production boosts in the country.

KGF, since its inception in 2007, has been a proud partner agricultural R&D in Bangladesh, through sponsoring a supporting agricultural research and technolo dissemination projects of NARS institutions, universiti DAE, NGOs and private enterprises. In the year 2022- with KGF sponsorship and involvement, 55 projects we ongoing, 76% (42) of which were related to crops. In the projects, some up-and-coming technologies for t production of cereals, legumes, vegetables and fruits n only in the favorable ecological systems but also in t marginal ecosystems like the coastal saline lan Chattogram Hill Tracts, *haor and char* areas and low-ly perpetually waterlogged basin areas have been tested. addition, the projects yielded useful scientific informati with potential to be developed into viable technologies the near future. A burning issue of the day, i.e., the effect climate on crop agriculture and development of clima smart production technologies has also been addresse This section provides an interesting and exciting throughp from the KGF sponsored projects.





Technical Progress

3. Technical Progress
3.1 CROPS AND NATURAL RESOURCES
3.1.1 Competitive Grants Program (CGP)
3.1.2 CGP 4th Call
3.1.2.A Completed Projects

Project Code and Title: TF 51-SBR/17: Assessment of cropping patterns for sustainable intensification in drought and saline-prone ecosystems using remote sensing and geospatial modeling

Implementing Organization: Bangladesh Agricultural Research Institute (BARI), Gazipur
Principal Investigator: Dr. Md. Golam Mahboob, SSO/Mr. Suman Biswas, Scientific Officer, Agricultural Statistics, Information and Communication Technology (ASICT) Division, BARI
Locations: Drought prone Barind Tract regions of Rajshahi, Chapai Nawabganj, Naogaon, Bogura, Natore, Sirajganj, Gaibandha, Jaipurhat, Dinajpur and Rangpur
Budget: Tk.122.901 lakh
Duration: April 2018 to March 2024 (With one year no cost extension)

Introduction: Bangladesh faces a great challenge to feed its increasing population with shrinking agricultural lands. Sustainable intensification has been proposed as an alternative to area expansion to ensure food security for such countries. Barind Tract, Bangladesh's driest part is largely dependent on rain-fed agriculture, but modern irrigation facilities make year-round multiple cropping possible instead single cropping. Nowadays, remote sensing and geospatial modeling can assess agricultural cropping patterns, resource availability, and sustainable intensification to allocate cropping patterns considering the best judicial use of resources. So, this project has been proposed to carry out in the drought-prone Barind region considering the dry season of Bangladesh.

Objective: To develop a geo-database of agro-environmental resources and constraints, dry season crop maps using remote sensing analysis to recommend suitable cropping patterns for sustainable intensification.

Materials and Methods: The approach has four parts: data collection, processing, and analysis; Rabi crop type's classification. Reference data and remote sensing data were field visit (Ground Truth Points) GTPs and Sentinel-2A images. Secondary data included elevation, soil, rainfall, etc. Fieldwork was conducted in Rajshahi's Godagari Upazila pilot study region from July 2022 to June 2023. Using the KoboCollect app, Garmin GPS and smartphones collected 857 GTPs and 1052 geotagged images. Google Earth Engine classified crop-type maps from 45 Sentinel-2A images. GEE computed the seasonal median (Oct.–Mar.) and NDVI and EVI from it. Five classification schemes were created using a 12-band composite. CART, Random Forest, and Support Vector Machine (SVM) classifiers were used to classify Rabi crops utilizing training data and composite images. Based on the validation findings, the best MLAs classified the crop type map, and a scientific visualization layout was created in ArcGIS 10.8. A land suitability evaluation was done using a geographical geo-database to suggest location specific crop suitability in the study area.

Results and Discussion: In the visible and red-edge spectrum, crop reflectance was similar, making differentiation challenging, particularly at Red-Edge 3. However, Red-Edge 4 and NIR showed comparable reflectance, with some overlap among crops. In SWIR-1 and SWIR-2, crops were more distinguishable, except for rice and maize. Wheat, potato, and maize had close NDVI values but were better differentiated using the EVI index. Table 1. Experimental schemes using different band combinations

Schemes	Sentinel-2A Bands	Description
Scheme 1	'B2', 'B3', 'B4', 'B8'	VIS. bands + NIR
Scheme 2	'B2', 'B3', 'B4', 'B8', 'B5', 'B6', 'B7', 'B8A'	VIS. bands + NIR + Red-Edge
Scheme 3	'B2', 'B3', 'B4', 'B8', 'B11', 'B12'	VIS. bands + NIR + SWIR
Scheme 4	'B2', 'B3', 'B4', 'B8', 'NDVI', 'EVI'	VIS. bands + NIR + Veg. Indices
Scheme 5	'B2', 'B3', 'B4', 'B8', 'B5', 'B6', 'B7', 'B8A', 'B11', 'B12', 'NDVI', 'EVI'	VIS. bands + NIR + Red-Edge + SWIR + Veg. Indices

Monthly median time-series images were utilized to create a seasonal composite for the study area, with all bands resampled to 10 meters using custom JavaScript in Google Earth Engine (GEE). Vegetation indices, specifically NDVI and EVI, were derived to enhance the classification process. Five distinct classification schemes were tested using Random Forest (RF), CART, and Support Vector Machine (SVM) algorithms. Scheme 5, which incorporated all ten spectral bands and two vegetation indices, yielded the highest overall accuracy. The RF algorithm overestimated area coverage, with the largest area attributed to other crops (34.93%), followed by mustard (29.16%) and rice (22.10%). Among the machine learning algorithms, RF achieved the highest accuracy (0.92), while CART and RBF followed with 0.87 and 0.55, respectively. The Kappa coefficients indicated that all algorithms performed best in scheme 5, with RF again leading at 0.90. This scheme was deemed the most effective for crop type classification. Additionally, remote sensing image processing facilitated the development of agro-environmental resource geo-databases, which were used for crop suitability assessments. The results indicated that wheat, lentil, and maize would be the most suitable crops for the region, with suitability percentages of 72.39%, 66.92%, and 63.24%, respectively.

Conclusion: The research demonstrates how advanced remote sensing and machine learning can classify crop types, focusing on the viability of wheat, lentil, and maize for sustainable intensification in the area, thus improving agro-environmental resource management. This knowledge not only deepens our understanding of crop reflectance patterns but also contributes to future research in agro-environmental resource management.

Project Code and Title: TF 65-C/19: Post-harvest management, processing and marketing of jackfruits for loss reduction and value addition

Implementing Organizations: Bangladesh Agricultural Research Institute (BARI), Gazipur and the NGO, New Vision Solutions Limited (NVSL), Dhaka
Principal Investigator: Dr. Md. Miaruddin/Dr. Md. Golam Ferdous Chowdhury, Post-Harvest Technology Division, BARI, Gazipur
Locations: BARI, Gazipur and 14 upazilas of 8 districts of Dhaka, Chattogram, Rajshahi and Mymensingh divisions
Total budget: Tk 248.68 lakh
Duration: May 2019 to July, 2023 (One year no cost extension)

Introduction: Jackfruit (*Artocarpus heterophyllus* Lam.), recognized as the national fruit, is among the most prevalent, significant, and tasty fruits in Bangladesh. The ripe fruit is highly nutritious, with its pulp and seeds being excellent sources of carbohydrates, vitamins, and minerals. Additionally, green jackfruit is favored in Bangladesh as a tasty vegetable. Cultivating and marketing jackfruit offers substantial livelihood opportunities for rural communities. However, due to inadequate post-harvest processing and management technologies, around 30-35% of jackfruit is lost, costing approximately Tk. 500 crore annually. By enhancing post-harvest management and processing methods to create canned fruit, dried fruit, pulp, jackfruit jam, and dehydrated chips, along with effective marketing, this national fruit can greatly enhance food security, generate employment, and boost export earnings for the country.

Objective: To develop improved methods of post-harvest management and processing technologies to produce assorted food items from jackfruit and devise strategies and develop a sustainable grower business model and strategic marketing plans for both fresh and processed jackfruit products.

Materials and Methods: A baseline survey was conducted to assess the current status of jackfruit production, postharvest management, and processing. Fresh BARI Khatal-2 jackfruits were used to create freeze-dried chips, while jackfruit seeds were processed into roasted seeds and flour. The study evaluated the impact of maltodextrin and sugar on chip quality and developed suitable packaging for long-term storage. Nutritional quality was analyzed through physicochemical assessments, including bioactive properties and antioxidant activities, alongside sensory evaluations. Consumer behavior was explored through surveys, and stakeholder engagement activities were held in various regions to enhance the jackfruit market and value chain.

Results and Discussion: Value-added jackfruit products, including chips, jams, and powders, were developed with good nutritional quality and bioactive compounds. Freeze-dried chips coated with 10% maltodextrin maintained quality for six months, while 40% sugar coating improved appearance. VMPET and LDPE packaging effectively preserved chips for two months under ambient conditions without compromising quality.

Roasted jackfruit seeds showed varying consumer preferences based on frying techniques, with vacuum frying receiving the highest acceptability score. Jackfruit seed flour is rich in protein, minerals, and bioactive compounds, and drying methods significantly impact its nutritional content and energy value. Surveys indicated a 40-45% loss of jackfruits post-harvest. Training for 320 small and medium processors focused on product preparation and marketing, highlighting health benefits. Sixteen entrepreneurs successfully sold processed jackfruit in various outlets. Information dissemination through media and workshops engaged stakeholders, fostering recommendations on farming, supply chain, and consumer preferences, enhancing market development for jackfruit products.

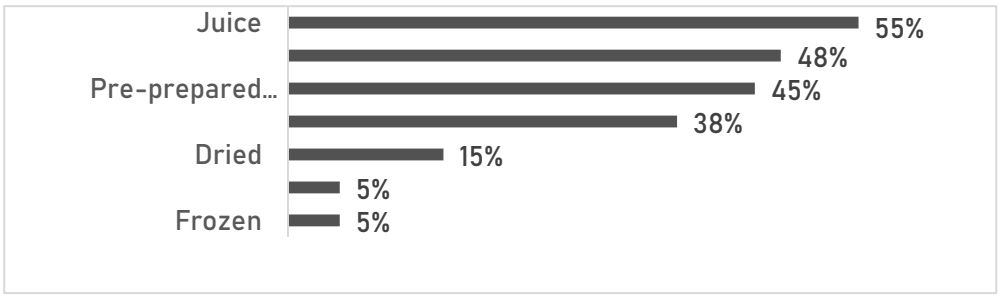


Fig. 1. Consumers' preferences for processed jackfruit products

Conclusions: In conclusion, by enhancing post-harvest management and fostering strong connections between growers and manufacturers, the jackfruit industry can significantly reduce losses, boost farmer incomes, and create valuable export opportunities, ultimately contributing to Bangladesh's economic growth and sustainability.



Fig. 2. Value added jackfruit products developed by BARI (left: rseed powder in a commercial packet, and

Project Code and Title: TF 68-C/20: Molecular characterization of biovars of *Ralstonia solanacearum*, the causal agent of bacterial wilt of solanaceous crops and integrated management of the disease.

Implementing Organization: Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur
Component Organization: None
Principal Investigator: Dr. Mafruha Afroz, Senior Scientific Officer (Plant Pathology), Horticulture Research Centre, BARI, Joydebpur, Gazipur
Location (s): i) Horticulture Research Centre, Joydebpur, Gazipur, ii) Tuber Crop Research Sub Centre, BARI, Seujgari, Bogura and iii) Agricultural Research Station, BARI, Thakurgaon
Budget: Tk. 80.00 (Eighty lakh taka only)
Duration: 13 December 2020 to 12 December 2023 (36 months)

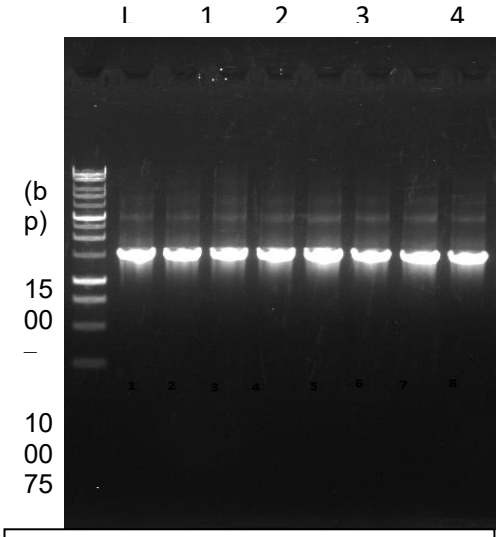


Figure 3. 16s rRNA profile of 27 F and 1492 R primer generated from 8 Bacterial Isolates, M: denotes 1 kb DNA ladder (Marker). General PCR with *Ralstonia solanacearum.* DNA from Eggplant-1 (Bog), Eggplant-2 (Bog), Eggplant-3 (Bog), Eggplant-4 (Bog), Chili-1 (Bog), Eggplant-5 (Bog), Potato-1(Bog), Tomato-2 (Bog) (lane 1, 2, 3, 4, 5, 6, 7 and 8) gave the positive band at 1465bp with

Introduction: Bacterial wilt, caused by Ralstonia solanacearum, poses a significant threat to tomato, eggplant, and other Solanaceous crops in South Asia, particularly in Bangladesh. The pathogen's variability and adaptability complicate disease management, leading to estimated yield losses exceeding 30% in eggplant, with potential for total crop failure in previously infected fields. Despite past recommendations for integrated disease management, these strategies have fallen out of favor. This project aims to explore new integrated approaches, including biological control, to combat bacterial wilt. Additionally, it seeks to enhance molecular understanding of Ralstonia solanacearum in tomato and eggplant, addressing the current knowledge gap and providing essential information for protecting these vital crops against bacterial wilt.

Objective: To assess the occurrence and severity of bacterial wilt of eggplant and tomato in Bangladesh, molecular characterization of biovars of *R. solanacearum* and to develop integrated package of the disease.

Materials and Methods: The study was conducted at Thakurgaon, Rangpur and Bogura etc. During the period, two upazillas (Thakurgaon Sadar and Baliadangi) were selected from Thakurgaon, one upazilla (Shahjahanpur) from Bogura and two upazillas (Pirganj and Mithapukur) from Rangpur. During the period, in three districts 72 farmer's field and trial sites were visited. Land area of eggplant was 6.69ha and that tomato was 1.86ha. In each field, 5-10 spots depending on the area of crop were selected randomly. Each spot was represented by $1m^2$ area and contained a number of plants. Data on area surveyed, variety grown, wilt incidence (%), etc. were recorded at the time of survey. It may be mentioned that in survey locations there were more eggplant fields than tomato fields.
Results and Discussion: A comprehensive survey conducted from July to December 2023 across three major eggplant and tomato growing districts—Thakurgaon, Rangpur, and Bogura—focused on the incidence of bacterial wilt. The survey covered 101 farmers' fields and trial sites, encompassing 6.69 hectares for eggplants and 1.86 hectares for tomatoes. The highest wilt incidence recorded was 26.6% in eggplants and 13.50% in tomatoes. A total of 400 isolates of R. *solanacearum* were preserved for future research. Screening of 125 eggplant and 36 tomato germplasms revealed that 63 eggplant and 30 tomato varieties exhibited resistance to the pathogen. Integrated disease management strategies significantly reduced wilt incidence, with the most effective treatment achieving a 74.51% reduction, highlighting the potential for improved fruit yields.

Table1. Effectiveness of IDM for bacterial wilt disease management of eggplant in Bogura

Treatment	Wilt (%)	Reduction of Wilt incidence over control %)	Yield (t/ha)	Yield increased over control (%)
T_1	17.80cd	56.80	45.20c	43.49
T_2	15.50d	62.38	47.59b	51.08
T_3	19.50c	52.67	42.90d	36.19
T_4	10.50e	74.51	53.90a	71.11
T_5	35.23b	14.49	35.30e	12.06
T_6	41.20a	-	31.50f	-
CV%	5.28		1.68	-

Means within the same column with a common letter(s) do not differ significantly (P=0.05)
T_1=Stable Bleaching Powder @ 25kg/ha+ Burning of rice husk @ 10 t/ha, T_2= Stable Bleaching Powder @ 25 kg/ha + *Bacillus cereus* (Seed and root soaking), T_3= Burning of rice husk @ 10 t/ha + *Bacillus cereus* (Seed and root soaking), T_4= Stable Bleaching Powder @ 25 kg/ha+ Burning of rice husk @ 10 t/ha + *Bacillus cereus* (Seed and root soaking), T_5=Farmer's practice, T_6= Susceptible check (BARI Begun-4)



Fig. 1 Survey of Bacterial wilt disease at Bogura



Fig.2 Visit of Experiment Field at TCRC, BARI, Bogura by KGF monitoring team

Confirmation of identification of *Ralstonia solanacearum* at genomic level: A comprehensive survey conducted from July to December 2023 in Thakurgaon, Rangpur, and Bogura assessed bacterial wilt in eggplant and tomato crops across 101 farmers' fields. The survey revealed a mean wilt incidence of 26.6% in eggplants and 13.50% in tomatoes. Notably, 63 eggplant and 30 tomato varieties showed resistance to the pathogen. Integrated disease management strategies effectively reduced wilt incidence by up to 74.51%, indicating significant potential for enhancing fruit yields in these crops.

Conclusion: This project highlights the effectiveness of integrated disease management (IDM) treatments in reducing wilt incidence in crops, achieving a maximum reduction of 74.51% with a specific combination of treatments. These findings promise enhanced agricultural resilience and improved food security.

Project Code and Title: TF 69-C/20. Adaption, validation, multiplication and maintenance of lilium genotypes in Bangladesh
Implementing Organization: Bangladesh Agricultural Research Institute (BARI), Gazipur
Principal Investigator: Dr. Farjana Nasrin Khan, Floriculture Division, Horticulture Research Center (HRC), BARI, Gazipur

Locations: Dhaka (Savar), Gazipur (Sadar), Rangpur (Sadar), Jashore (Jhikargacha)
Budget: Tk. 116 lakh

Duration: December 2020 to November 2023

Introduction: Lilium is a new exotic flower crop in Bangladesh which is recently being imported to meet user demand. Considering the local demand and profitability, farmers are much interested in cultivating this flower, but due to unavailability of lilium bulbs, commercial cultivation could not begin yet. On-farm validation, demonstration and dissemination of proven technologies of lilium flower production are necessary. Moreover, technologies need to be standardized for multiplication of lilium bulbs. Besides, bulb preservation and maintenance are important issues for the continuation of lilium cultivation. BARI has developed lilium technologies which require dissemination. Simultaneously, research should be carried out for standardizing the multiplication methods of lilium bulbs and facilities should be developed for flower production in the future.

Objective: To validate and disseminate developed technologies of lilium flower production and bulb preservation among growers**.**

Materials and Methods: In 2022-23, seven demonstration trials on BARI lilium-1 and BARI lilium- in Gazipur, Jashore and Bogura. Performance of 23 promising lines 3 newly collected genotypes were tested at BARI with BARI Lilium-1 and BARI Lilium-2 as checks. Production technologies such as influence of planting dates bulbs size and planting planting depth of bulb on the bulb production of BARI Lilium-1 were conducted at Floriculture Division of, HRC, BARI. Data were collected and summarized for analysis. Means were compared with DMRD.

Results and Discussion: We have established a multichamber cold storage facility at the Floriculture Division, HRC, BARI, intended for both short-term and long-term preservation of Lilium bulbs. A survey was conducted in key flower-growing regions throughout the country, and we collected 30 germplasms, which we have preserved in the cool chamber for future use in research. The demonstration trials of BARI Lilium-1 and BARI Lilium-2 showed highly satisfactory results across the locations. Farmers indicated their contentment with the profits garnered from selling their farm produce.



Fig. 1. Colorful lilium blooms in the field

Collected germplasms were evaluation and 26 genotypes ffound suitable as cut flowers, with two have double petals. The oriental lilium types produced strongly scented flowers, while Asiatic types lacked fragrance. Optimal planting dates for lilium bulbs were found November 15 and December 01, with a staggered schedule allowing planting until February 15 to extend marketing. Larger bulblets of 27-30mm at a 6 cm planting depth yielded high quality flowers.

Conclusions: The new lilium varieties, BARI Lilium-1 and BARI Lilium-2, showed promising results in demo fields, yielding profitable flower sticks. Optimal planting dates were identified, and larger bulblets produced higher yields. These findings have high potential for commercial lilium production in the country.

Project Code and Title: TF 71-C/20. Sustainable management of blast, sheath blight and bacterial blight diseases of rice through Nano-particles (NPs)

Implementing Organization: Bangladesh Rice Research Institute (BRRI)
Component Organization None
Principal Investigator: Dr. Md. Abdul Latif, Former Director (Administration and Common Services), BRRI, Joydebpur, Gazipur
Location: Plant Pathology Division, BRRI, Gazipur-1701
Budget: Tk. 397.30 Lac
Duration: 13 December 2020 to 12 June 2024 (with 6-months no-cost extension)

Introduction: Rice is the principal staple crop of Bangladesh, playing a vital role in national food security and rural livelihoods. However, its production is increasingly threatened by major diseases such as blast, sheath blight, and bacterial blight. Conventional chemical control methods pose environmental and health risks often lead to pathogen resistance. In response, nanotechnology offers a promising alternative. Their high surface area-to-volume ratio, controlled release properties, and ability to interact at the molecular level make them ideal candidates for targeted disease management. Recent studies have demonstrated the antimicrobial activity of various metal and metal oxide nanoparticles—such as silver (AgNPs), zinc oxide (ZnO NPs), and copper oxide (CuO NPs)—against plant pathogens. By investigating the application of nanoparticles for managing blast, sheath blight, and bacterial blight, this study seeks to contribute to the development of a sustainable plant protection framework that aligns with Bangladesh's agricultural development goals.

Objective: To bio-synthesize of nano-particles from available sources in Bangladesh, find out the effective nano-particles on fungal growth and to evaluate their efficacy for rice disease management

Materials and Methods:
Extracts from plants like neem, tulsi, dholkolmi, bishkatali, marigold, tomato, garlic, and ginger were used as reducing agents to synthesize nanoparticles. The plant extract preparation procedure involved boiling fresh, cleaned leaves in distilled water (1gm/15ml) and filtration and storage for further use. Plant extracts from neem, tulsi, dholkolmi, bishkatali, tomato, garlic, and ginger were used to synthesize nanoparticles. The color change from light orange to dark brown confirmed nanoparticle formation. Copper Oxide Nanoparticles (CuONPs) were synthesized from dholkolmi extracts mixed with copper sulfate solution and pH adjustment at 11, followed by incubation and precipitation. Zinc Oxide Nanoparticles (ZnONPs) were biosynthesized by reacting neem and dholkolmi leaf extracts with zinc sulfate and pH adjusted at 12 through sodium hydroxides, resulting in white precipitation. Silica (SiO2) Nanoparticles were synthesized using neem extract and sodium metasilicate. Potassium Nanoparticles (KNPs) were synthesized from marigold extract and potassium sulfate. Copper Chitosan (CuChNPs) and Zinc-Chitosan (ZnChNPs) Nanoparticles were synthesized using chitosan as a stabilizing agent. Moreover, AgNPs and ZnONPs biosynthesized from bacterial isolates. AgNPs, CuONPs, and ZnONPs also biosynthesized using microwave-assisted glucose-reducing starch stabilization technique. UV–vis spectroscopy, X-ray diffraction (XRD), Fourier Transform Infrared Spectroscopy (FTIR), particle size analyzer, zeta potential, Scanning Electron Microscopy (SEM), and Transmission Electron Microscopy (TEM) were employed to analyze the optical, morphological, and structural properties of the synthesized nanoparticles.

Green-synthesized AgNPs were tested at different ratios with varying pH levels (9, 10, 11) alongside other nanoparticles such as CuO, ZnO, SiO2, MgO, and K. The poisoned food method was employed using PDA media, and the mycelial growth inhibition rate was measured at 0, 24, 48, and 72 hours. To evaluate the effect of AgNPs, follicular-incorporated AgNPs, and ZnONPs on controlling sheath blight disease was evaluated in both T Aus and T Amon Season. Data was evaluated on a scale of 0 to 9 based on the percent of diseased leaf area (Standard Evaluation System of Rice, IRRI 2012) and data were collected at 14 days and 21 days after inoculation.

Results and Discussion: Four eco-friendly protocols have been developed for the biosynthesis of nanoparticles from silver, copper oxide, zinc oxide, silica, magnesium oxide, and potassium combining chitosan with plant extracts. The products were copper chitosan (CuChNPs), zinc chitosan (ZnChNPs); silver (AgNPs); zinc oxide (ZnONPs) nanoparticles, AgNPs, ZnONPs, and CuONPs. Morphological characterization confirmed the nanoscale size (1-100 nm) of eight nanoparticles. The results, in Table 1, reveal significant differences in disease severity and control efficacy among treatments. The untreated disease control group exhibited the highest disease severity score (8.33) and percent disease severity index (52%), establishing the baseline for comparison. Among all treatments, the commercial fungicide Nativo 75 WG demonstrated the highest efficacy, reducing disease severity to a score of 2.00 and achieving a 75% **.**

In summary, the study highlights the significant potential of green-synthesized nanoparticles, particularly AgNPs, CuO, and ZnO, in effectively managing rice diseases such as sheath blight and bacterial blight. The results demonstrate that these nanoparticles not only inhibit mycelial growth and reduce lesion lengths but also enhance crop yields when combined with traditional fungicides like Bismerthiazol and Folicur. Notably, AgNPs and ZnONPs showed remarkable efficacy in both controlled and field conditions, achieving reductions in disease severity of up to 90% and yield increases exceeding 54% over control. This research underscores the promise of utilizing environmentally friendly nanotechnology as a sustainable approach to combat rice diseases, ultimately contributing to improved agricultural productivity and food security.

Table 1: Disease severity score and percent disease severity index of different biosynthesized nano agents at controlled condition

Sl. No.	Treatments	Disease severity score	% disease severity index	% Disease Control
1	AgNPs (30%)	4.33	33	37
2	AgNPs (40%)	3	25	52
3	AgNPs (50%)	3	25	52
4	AgNO3	3.66	37	29
5	ZnONPs (30%)	4.33	35	33
6	ZnONPs (40%)	3	32	38
7	ZnONPs (50%)	3	29	44
8	ZnSO4	3.66	35	33
9	Bacterial suspension	4.33	41	22
10	Nativo 75 WG	2	13	75
11	Disease control	8.33	52	-

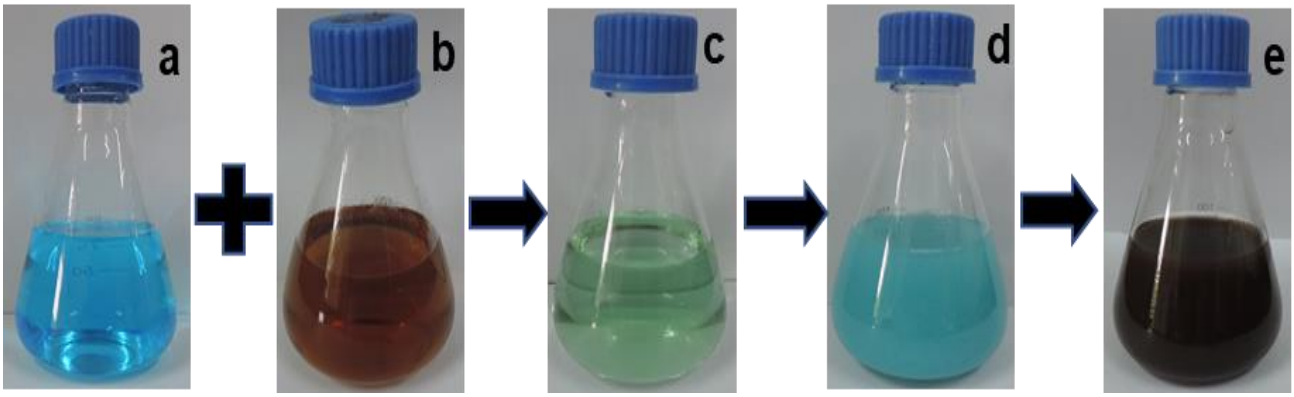
Conclusion: In conclusion, the innovative use of green-synthesized nanoparticles, particularly AgNPs, CuO, ZnO, and K nanoparticles, has shown remarkable efficacy in managing rice diseases such as sheath blight and bacterial blight. These eco-friendly solutions not only significantly inhibit the growth of key pathogens but also enhance crop yields and offer a sustainable alternative to chemical pesticides. The promising results from both laboratory and field trials highlight the potential of these biosynthesized nanoparticles to revolutionize agricultural practices, ensuring healthier crops while promoting environmental sustainability.

Project code and title: TF 72-NRM/20: Evaluation of profitable and agro-ecologically suitable cropping patterns considering soil fertility for increasing cropping intensity in the northern region of Bangladesh

Implementing Organizations: Bangladesh Agricultural University (BAU), Mymensingh and OFRD, Rangpur, Bangladesh Agricultural Research Institute (BARI)
Locations: Rangpur Sadar, Rangpur and Gabtali, Bogura
Coordinator: Dr. A K. M. Zakir Hossain, Professor, BAU
Budget: Tk. 89.00 lakh

Duration: December 2020 to November 2023 (One year no cost extension)

Introduction: Climate change is considerably affecting food security in Bangladesh. Some parts of the northern region are experiencing moderate to severe drought during the Kharif season due to climate change. The most common cropping pattern in northern Bangladesh is Boro-fallow-T. Aman. A vast land area remains fallow between T. Aman and Boro rice, the fallow period being 75-80 days during November to February.



There is room for increasing cropping intensity by incorporating short-duration crops like mustard, mungbean, potato, maize or Aus rice in the rice based cropping pattern. Soil degradation is also emerging as a problem. Farmers need to gradually reduce their dependence on the use of chemical fertilizers to maintain soil fertility. Organic fertilizers need to be combined with inorganic fertilizers for increasing the availability of nutrients and

crop yields. This project attempts to introduce new crops by adjusting the planting times and other management options.

Objective: To evaluate cropping patterns using agro-ecologically suitable and profitable crop varieties for increasing cropping intensity and maintaining soil fertility in the northern region of Bangladesh.

Materials and Methods: Four cropping patterns (CP) viz. (i) Boro-fallow-T. Aman (existing and control) and new patterns, (ii) mustard-mungbean-T. Aus-T. Aman, (iii) potato-maize-*dhaincha*- T. Aman, (iv) potato/sweet gourd (relay)-jute-T. Aman were tested at two locations, Rangpur Sadar (Rangpur) and Gabtali (Bogura) in year 1 (2020-21). In year 2 (2021-22) combinations of organic and inorganic fertilizers were tested for three selected CP from year 1: (i) recommended doses, i.e., 100% chemical fertilizers (CF) according to the BARC Fertilizer Recommendation Guide (FRG 2018), (ii) IPNS (integrated plant nutrition) with STB (soil test based) chemical fertilizers + 5 t/ha cowdung, (iii) IPNS-STB fertilizers + 3 t/ha vermicompost), (iv) INM (integrated nutrient management) based STB fertilizers + 5 t/ha cowdung, (v) INM with STB fertilizers + 3 t/ha vermicompost and (vi) farmers' practice (control). The three cropping patterns selected from Yr 1 trials were: (a) Boro-fallow-T. Aman, (b) mustard-mungbean-T. Aus-T. Aman and (c) potato/sweet gourd (relay)-jute-T. Aman which were tested with six different fertilizer management practices uch as, (i) T1= recommended doses of inorganic fertlizers as per the BARC Fertlizer Recommendation Guide 2018 (FRG 2018); (ii) T2= IPNS with soil test based (STB) fertilizers + 5 t/ha cowdung; (iii) T3= IPNS-STB + 3 t/ha vermicompost, (iv) T4= INM-STB + t/ha cowdung, (v) T5= INM-STB + 3 t/ha vermicompost, and (vi) T6= farmers' practice (control). In year 3, validation trials of selected cropping patterns (CP) with suitable packages of organic and inorganic fertilizers were set up which were ongoing.

Results and Discussion:

Boro-Fallow-T. Aman pattern

Grain yield and straw yields, panicle number, grain number, panicle length and plant height were significantly influenced by fertilizer management. The treatment T5 (INM-STB + 3 t/ha vermicompost) gave the highest grain yield of 5.74 t/ha of T. Aman rice followed by T4 (5.40 t ha^{-1}); farmers' practice (FP) (5.17 t/ha) while T1 (chemical fertilizers only as per FRG 2018) gave the lowest grain yield of 5.00 t/ha. T_5 **(**INM-STB + 3 t/ha vermicompost also fetched the highest whole pattern gross return of Tk. 3,21,481/ha/year, but the whole pattern highest gross margin of Tk. 1,77,105/ha came from T_4 (INM- STB + cowdung 5 t/ha). The highest MBCR (7.37) was found observed for T1 due to the low cost of chemical fertilizers; MBCR with the costlier treatments including organic manure was lower 0.18 to 3.43).

Mustard-mungbean-T. Aus-T. Aman pattern

The growth parameters and economic yields of crops in this CP were markedly affected the different fertilizer management treatments. . The whole pattern highest gross return and margin were found to be Tk. 4,39,880 and 2,40,774/ha from T5. The highest MBCR (6.72) was found for T4 followed by 2.93 for T5 while MBCR for T2 was the lowest, 1.28.

Potato/sweet gourd (relay)-jute-T. Aman pattern

In this CP, too, treatments that included organic manure gave better results in terms of crop growth parameters and yields, and also economic benefits, than the "chemical fertilizer only" treatment. T5, again, fetched the highest whole pattern gross return of Tk. 7,38,510/ha with a margin of Tk. 4,42,856/ha The highest MBCR (12.61), however, was for T4 followed by 3.72 for T5 t and the lowest (0.27) for T3.

Soil nutrient balance sheets

A significant effect of Nutrient management treatments significantly influenced the uptake of N, P, K and S by crops of the various CPs and left the soil depleted of these nutrients in varying magnitudes. For example, mustard-mungbean-T. Aus-T.Aman rice cropping system crop removal of nutrients was the highest, 337.2 kg N, 60.3 kg P, 344.1kg and 64.20 kg S/ha/yr with T5 while the lowest nutrient

uptake values, i.e., 290.33, 53.73, 305.04 and 53.68 kg/ha/yr of N, P, K and S, respectively, were recorded for T1.

As expected, the nutrient depletion was relatively high in the four-crop CP, potato/sweet gourd (relay)-jute-T. Aman (Fig. 9). In this CP, the N balance was negative with T2 (-16.58 kg N/ha/yr) and T3 (-16.31 kg N/ha/yr) while with the other treatments the N balance remained positive (26.9 to 43.0 kg/ha/yr). The P balance sheet indicated depletion with any treatment, the P balance in soil after the CP ranging from -111.98 to -61.91 kg P/ha/yr. The balance of K was also negative ranging from -185.10 to -96.44 kg K/ha/yr. The S balance was also negative across the treatments.

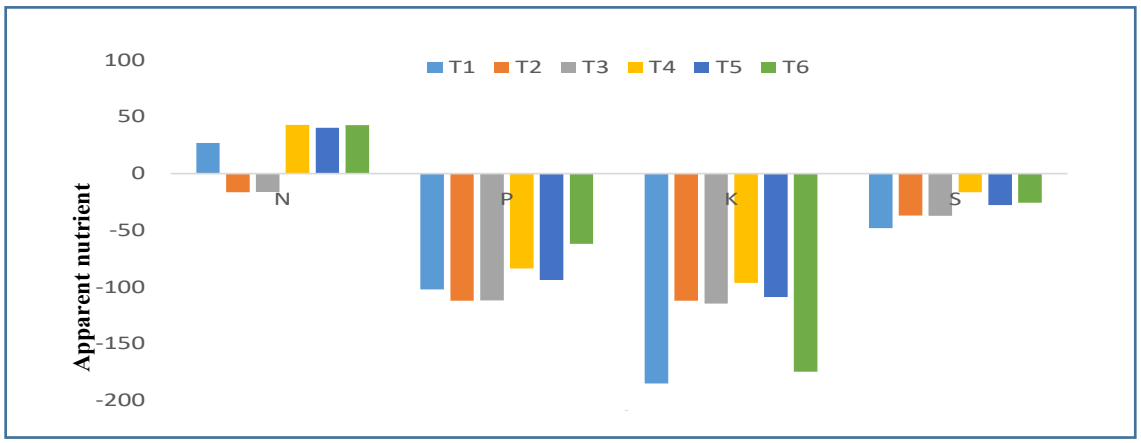


Fig. 1. Effect of different organic and inorganic fertilizer management packages on apparent balances of N, P, K and S in soil in a potato/sweet gourd (relay)-jute-T. Aman cropping pattern

Conclusions: Depending on the 2nd year's trials two profitable cropping patterns, i.e., potato/sweet Gourd-Jute-T. Aman) and potato-maize-*Sesbania*-T. Aman (Rangpur)/mustard-mungbean-T. Aus-T. Aman (Bogura)) and two fertilizer packages (one cowdung based and one vermicompost based) have been selected for trials in year 3 of the project.

Project Code and Title: TF 73-NRM/20. Increasing crops and soil productivity through climate smart conservation technologies (CSCT) in drought and non-traditional areas of Bangladesh

Implementing Organization: Bangladesh Wheat and Maize Research Institute (BWMRI), Dinajpur
Principal Investigator: Dr. Md. Ilias Hossain, Principal Scientific Officer and Head, Regional Station, BWMRI, Shyampur, Rajshahi
Location(s): Paba and Godagari, Rajshahi and Narail Sadar and Lohagora upazilas of Narail
Budget: Tk. 68.0 lakh
Duration: December 2020 to November 2023 (36 months)

Introduction: Climatic variations have a profound effect on agriculture and livelihoods of the rural communities of Bangladesh. This effect is more pronounced in the drought prone areas of the country. The north-west parts of Rajshahi and Narail districts are different from other parts of the country due to their undulating topography having compact and low-fertility soils. Crop production in this region is challenging and productivity and cropping intensity have been low compared with other parts of Bangladesh. It may be possible to mitigate the adverse effect of climatic variation and increase productivity and cropping intensity by climate smart conservation technologies (CSCT) which can reduce irrigation water requirement by about 25-30% and production costs by about 60%. This can also increase farmers' incomes.

Objective: Increasing cropping intensity and system productivity and preserving natural resources like soil and water, saving energy, fuel, labor, biodiversity in drought prone and non-traditional areas.

Materials and Methods: The project work consists of (1) establishment of lentil (Zn and Fe enriched lentil variety like BARI Moshur 7 or BARI Moshur 8) and mustard (BARI Sarisha 14 and 15) using

residual soil moisture by zero or relay planting and raised bed systems in Godagari and Paba upazilas of Rajshahi and Sadar and Lohagora upazilas of Narail, (2) validation and upscaling of heat, drought and blast resistant wheat (BARI Gom 30, BARI Gom 32, BARI Gom 33 and WMRI Gom 3) and maize varieties after T. Aman rice (BRRI dhan71) in the bed planting system using minimum irrigation water (6 validation trials in Godagari, Paba, Narail Sadar and Lohagora upazilas in each year), (3) establishment of drought tolerant mungbean, sesame, *cheena* and maize varieties through bed planting and power tiller operated seeder (PTOS) system using residual soil moisture in Kharif 1 season, (4) establishment of drought tolerant T. Aman rice varieties through the bed planting system. In 2022-23, field trials were conducted in farmers' fields of four upazilas such as, Godagai and Paba of Rajshahi and Sadar and Lohagora of Narail. Three tillage options viz. raised bed; zero/relay and conventional tillage were tested. The unit plot size was one bigha (33 decimals). Soil moisture regimes (0-15 cm depth) of the experimental plots were recorded at 15-day intervals at all experimental sites. Yield and yield component data were recorded. The data were analyzed statistically. Economic analysis was done on the basis of existing market prices of inputs and outputs, and marginal benefit cost ratios (MBCR) for the various treatments were calculated.

Results and Discussion:

Seeding cost

The wheat crop was considered in a seeding cost comparison. Seeding cost by raised bed was much less than that for the conventional planting method, the cost of planting wheat being Tk. 1410/bigha in the CSCTs system compared with Tk. 2500 in farmers' practices. As a results 8175 taka per hectare that means seeding cost save about 45-50% through CSCTs technology.

Irrigation water requirement

The amounts of irrigation water required at different growth stages of rice, wheat and mungbean varied markedly between the conventional method and beds in both the years. The conventional method required a higher amount of water at each irrigation time (Fig. 1). The total amounts of irrigation water required for the conventional method were 320, 350, 155 liters for wheat, rice and mungbean, ut in the bed planting system, the total amounts of irrigation water needed were 240, 270 and 110 liters for wheat, rice and mungbean, respectively. The total water savings by the bed system from the conventional method were 25 %, 23% and 29%, respectively. In the bed planting system, irrigation water was applied only in furrows, whereas flood irrigation was given in the conventional method.

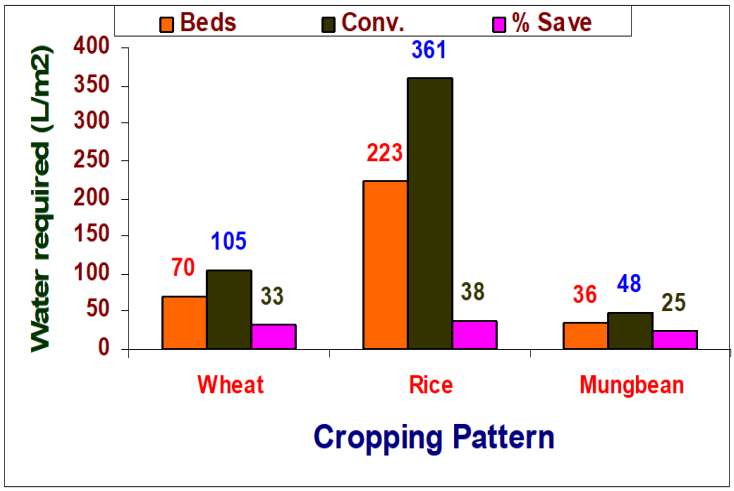


Fig. 1. Amounts of irrigation water needed and water savings for wheat, mungbean and rice on raised beds and in the conventional system

Labor requirement

Labor requirements for growing crops were significantly influenced by the cultivation method. For example, to grow wheat, the labor cost for strip tillage was much less than that in the conventional planting method. The labor cost savings were the highest with the raised bed system followed by zero tillage and strip till methods. Overall, CSCT saved 26-50% labor cost.

Crop productivity and economic benefits

The CSCT system consistently improved yield components, yields and economic benefits of different crops like lentil, mustard, wheat, maize, mungbean sesame, cheena and Boro rice over traditional practices (Fig. 2). The yields T. Aman-Boro rice increased by 5-10%, by 10-15% of wheat, chickpea and maize and by 15-20% of the mungbean, cheena, sesame and lentil crops. The average cropping intensity increased by 10-12% through included of mungbean, cheena, maize and sesame in drought

prone and non-traditional areas. About 7-10 tons of good quality seeds of different crops were produced which were in farmers' possession. Farmers achieved significantly higher gross margins from relay lentil with T. Aman rice than relay mustard with T. Aman rice. CSTC increased farmers' income by 5-7% and improved livelihood through introduction of climate smart conservation technology. Farmers used heat tolerant, blast resistant, Zn enriched high-yielding varieties in drought prone and non-traditional areas of Bangladesh. They were very much impressed with the higher total grain yields as well as total gross margin from relay lentil with T. Aman rice compare with relay mustard with T. Aman rice. The results indicated that relay lentil with T. Aman rice would be economically viable and profitable over the relay mustard with T. Aman rice system.

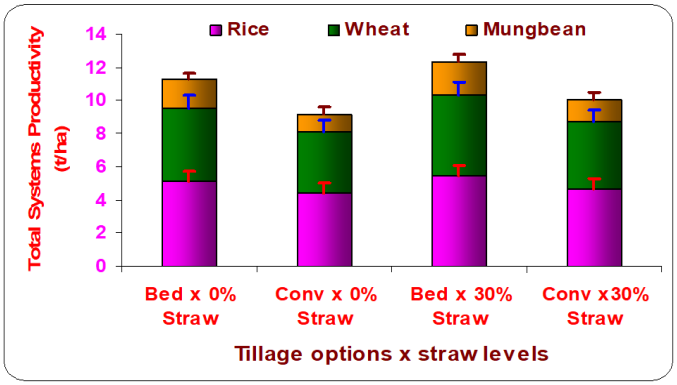


Fig. 2. Total system productivity under different tillage options and residue retention in rice-wheat-mungbean cropping pattern in drought prone areas

Conclusions: This project deals with climate smart conservation technologies (CSTC) for drought prone, less favorable ecosystems of Bangladesh which are essential for increasing cropping intensity, system productivity and saving natural resources. There are good opportunities of increasing cropping intensity, saving water, reducing production costs and enhancing land productivity and farmers' incomes in drought prone and non-traditional areas of the country. Farmers are adopting alternative cropping patterns like rice-wheat-mungbean and rice-wheat-sesame as better alternatives to the existing cropping patterns, rice-fallow-fallow and rice-wheat-fallow in the study areas in the CSTC system. Also, using residue retention in the alternative cropping pattern may improve soil quality. The CSCT system shows promise for improving crop and soil productivity in drought prone areas of Bangladesh.

Project Code and Title: TF74-NRM/20. Field based applied research on "Aquifer Storage and Recovery (ASR)" technology for increasing cropping intensity of Bangladesh

Implementing Organizations: Bangladesh University of Engineering and Technology (BUET) and Bangladesh Agricultural Development Corporation (BADC)
Principal Investigator: Dr. Sara Nowreen, Assistant Professor, Institute of Water and Flood Management (IWFM), BUET
Location: (i) Paba, Rajshahi; (ii) Naldanga, Natore; (iii) Mirzapur, Tangail; (iv) Dacope, Khulna.
Budget: Tk. 87, 57,000
Duration: December 2020 to November 2023

Introduction: Aquifer Storage and Recovery (ASR) is a concept of artificial recharge and has recently been encouraged in the Bangladesh Delta Plan 2100. India has many success stories of implementing ASR for increasing cropping intensity. However, no field-based application has yet been attempted in Bangladesh for agricultural purposes. Bore well aquifer type ASR is expected to be a useful innovative water management solution for farmers facing drought, water-logged and salinity situations and increase cropping intensity in these regions of Bangladesh. ASR may help farmers get rid of water logging in their lands in the peak monsoon and post-monsoon periods and access good quality irrigation water. ASR may be an added benefit along with a solution for mitigating salinity in the coastal region.

Objective: To explore the viability of using ASR speed up drainage of excess water and supply post-monsoon irrigation in drought and saline prone areas of Bangladesh

Materials and Methods: As part of the aquifer testing, lithology tests were performed in 40 boreholes (10 at each site) in the presence of a geologist to assess aquifer conditions. BADC conducted one aquifer test, a pumping test, in the same unions of Naldanga and Mirzapur upazilas to ascertain the general aquifer geometry and study aquifer properties such as, vertical and horizontal hydraulic conductivity, transmissivity, storage coefficient, and specific yield. Secondary baseline data on land use, cropping patterns, existing filtration chamber design etc. were collected. Groundwater (GW) flow directions and recharge variations over the last decade were determined from water table measurements of the neighboring tubewells and BWDB data,
respectively. Hydrometric observations of the recharge facility, at a 0 m distance and 50 m away from the recharge facility at the ASR trial sites were made through a regular intensive monitoring of GW levels and rainfall with automated data loggers (i.e., groundwater-level loggers installed with a tipping bucket rain gauge). Forty-three field visits to the four sites were during 2022-23 to (i) conduct a back wash of the ASR well and repair filter materials of the recharge pit to resolve the well clogging problem, (ii) estimate the infiltration rate (Fig. 1), (iii) monitor GW level of surrounding wells, and (iv) collect water samples for quality tests. The field assistants manually monitored GW levels and water EC at 15-day intervals. An average infiltration rate was manually measured at each field site. Water quality tests were done four times, i.e., in the pre-monsoon, monsoon, post-monsoon, and dry seasons of the year at 3-month intervals. Water samples from 0 m and 50 m depths (down to the GW flow direction) were tested for standard drinking water quality parameters such as, color, turbidity, pH, alkalinity, hardness, EC, total dissolved solids (TDS), Cl, Fe, Mn and phosphate concentrations, and coliform bacterial populations (faecal and total).



Fig. 1. Infiltration rate measurement at ASR trial setup, Paba, Rajshahi

Results and Discussion: Slow and delayed drainage kept the study fields at Paba, Naldanga, Mirzapur, and Dacope inundated in January, November, October, and November, respectively, but the lithological models and groundwater level positions indicated that the aquifer underneath the impermeable topsoil has the capacity to store more water. The groundwater level (GWL) rose up responding to pre-monsoon rainfall in May-July (Table 1). The ASR system's efficacy as a recharge mechanism was most evident in the early monsoon, but after July, GWL remained unchanged despite increased rainfall intensity. Farmers used to drain water forcefully underground during the pre-project time without a filtration system, but which carried with it the risk of GW contamination. The presence of coliform bacteria in the GW samples collected in the post-project periods during monsoon and post-monsoon before washout or clogging removal confirmed such pollution. However, in the post-project periods, water samples collected after washout through pumping had no coliform bacteria.

Table 1. Pre- and post-project groundwater recharge at the project sites

Project site	Annual groundwater recharge (million cubic meter)	
	Pre- project period (2018)	Post-project period (2019)
Paba, Rajshahi	51.4	64.79
Naldanga, Natore	26.4	62.49
Mirzapur, Tangail	52.53	92.48
Dacope, Khulna	7.79	8.18

Infiltrated monsoon water under the ASR setup at Khulna diluted the salts to a tolerable limit during the stages of sowing seeds and transplanting of rice. Following the cessation of waterlogging, the water EC of the Khulna ASR well increased, albeit at a smaller magnitude in comparison with the neighbouring observation wells. Farmers were expected to continue producing Boro rice as in 2021 and 2022, but after 367 m^3 irrigation water were pumped in February, 2023 the water EC reverted to a high value of 6.220 µS/cm, which similar as the EC of ambient GW. The EC value and the volume of pumping indicated that the mixing of fresh water into the saline aquifer by a single ASR system was limited.

Conclusions: Given the concerns over the undesirable water quality changes due to implementation of the ASR system, this study closely monitored the contributions of the injectant, hydro-geochemical quality of the infiltration water, response to rainfall events and flooding, etc. at the four ASR trial sites (i.e., Naldanga, Paba, Mirzapur and Dacope). Before the project started, farmers could not grow double/triple crops in a year. But now the cropping patterns here have changed in the dry season. There is a plan to assess the possibility of using existing shallow tubewell structures in both recharging and discharging (i.e., irrigation pumping) to minimize the risk of well clogging at the current experimental ASR sites. The opportunity of using the ASR setup in the coastal saline areas was also explored. In this regard, so far, aquifer mapping, pumping test, fortnightly water table observations and water quality tests have been conducted at the said ASR trial sites. The water quality test data showed that the ASR chamber effectively eliminated coliform bacteria, suggesting that ASR poses little or no health risk in terms of the transportation of contaminants or pollutants in the aquifer.

Project Code and Title: TF 79-So-E/20. Shifting of conventional agriculture towards high-value enterprise for better livelihood of the rural people

Implementing Organizations: Bangladesh Agricultural University (BAU), Mymensingh, Bangladesh Agricultural Research Council (BARC), Dhaka, Seba Sangstha (NGO)

Principal Investigator: Dr. M. Zulfikar Rahman, Professor, Department of Agricultural Extension Education, BAU, Mymensingh

Locations: *Haor* areas of Itna (Kishoreganj), Trishal (Mymensingh), Kapasia (Gazipur), *char* lands of Gaibandha, Bandarban of Chattogram Hill Tracts (CHT), Satkhira Sadar

Budget: Tk. 198 lakh
Duration: December 2020 to November 2023 (One year no cost extension)

Introduction: Development of technologies and innovations has resulted in gradual shifts of the traditional rice monoculture system to diversified and modern technology oriented specialised farming systems greatly impacting livelihoods of the farming communities in rural Bangladesh. However, constraints like sub-optimal use of agricultural land, improper use of technologies, labour price fluctuations, rural emigration, conversion of agricultural land to non-farm establishments like brick kilns, gas stations, industries and rural settlements, riverbank erosion, water logging, natural hazards and disasters etc. have been restraining rural economic growth in the country. This project assesses the impacts of the shifts of conventional farming towards high-value crops and enterprises focusing on shifts from traditional rice varieties to short-duration varieties, rice and other crop lands to pond aquaculture and shrimp/*gher* culture, homestead space to poultry rearing, *char* land to sandbar farming and natural vegetation in hill areas to fruit orchards.
Objective: To assess the extent and nature of livelihood changes among rural people due to shifts of conventional agriculture to modern technology oriented, high-value farming systems, identify the drivers of such shifts and evaluate the emerging opportunities and challenges in shifts towards high-value enterprises

Materials and Methods: The study is being conducted in the following six areas: (i) *Haor* (Itna upazila) of Kishoregonj district (traditional rice varieties shift to short duration varieties), (ii) Trishal upazila of Mymensingh district (field crops shift into aquaculture), (iii) Kapasia upazila of Gazipur district (homestead shift to poultry rearing), (iv) *char* land (Kaunia upazila of Rangpur (barren *chars* shift to sandbar farming), (v) Sadar upazlia of Bandarban, Chattogram Hill Tracts (natural vegetation to fruit orchard), and (vi) Sadar upazila of Satkhira (field crops shift to *gher* culture). In 2022-23, data collection through a number of qualitative methods and questionnaire surveys was done. The final sample for the questionnaire survey included 600 farmers (100 from each study area). Apart from the key variable (effect of shifting of traditional practices on livelihoods of the farming communities), a number of explanatory variables were included. The project work comprised visits to the study areas for preliminary assessment of the locations and meetings and discussions with concerned officials of the Department of Agricultural Extension (DAE), Department of Fisheries (DoF) and Department of Livestock Services (DLS), focal group discussions (FGD) and questionnaire preparation for key

informant interviews (KII). Farmers and related stakeholders were the target populations for data collection. The samples of the study consisted of selected farmers, researchers, extension officials (UAO/AAO/AEO, UFO and ULO) and field workers, local political leaders/civil society personnel, NGO agents, traders and market actors. The variables of the study are: extent of transformation of enterprises; effect of shift of cultivation on farming practices; reasons for shifting from conventional farming; effect of shifting of farming in terms of household food security, poverty alleviation, wellness, livelihoods and food consumption behavior of the households and farmers' problems in high-value enterprises. Appropriate scaling techniques were used for measuring the variables. Appropriate statistical tests were employed for data analysis by using the SPSS software.

Results and Discussion: Shifts from traditional cropping practices to diversified and specialized farming systems driven by modern technologies and innovations in agriculture are greatly impacting livelihoods of the farming communities in the agro ecosystems across Bangladesh. Table 1 summarizes the findings of the project so far in respect of the impact of shifting of traditional farming to high value crops on different livelihoods indicators of the farmers.

Table 1. Effect of shifting of traditional farming to high value enterprise on different livelihoods indicators of farmers in six project areas

Indicator	Changes observed in the study areas					
	Char (Kaunia)	Hill (Bandarban)	Haor (Itna)	Poultry (Kapasia)	Shrimp (Satkhira)	Pond fish (Trishal)
Household income	Increased	Increased	Increased	Unstable	Increased	Increased
Ability to buy food	Increased	Increased	Increased	Increased	Increased	Increased
Household food consumption	Increased	Increased	Increased	Increased	Increased	Increased
Consumption of nutritional foods	Increased	Increased	Increased	Increased	Increased	Increased
Social status and inclusiveness	Improved	Unchanged	Unchanged	Improved	Improved	Improved
Housing, sanitation and drinking water	Improved	Improved	Improved	Unchanged	Improved	Improved
Employment opportunity	Increased	Increased	Increased	Increased	Increased	Increased
Women involvement in farming	Increased	Increased	Increased	Increased	Unchanged	Increased
Women decision making	Increased	Unchanged	Unchanged	Increased	Unchanged	Unchanged
Migration of local labor force	Decreased	Unchanged	Unchanged	Unchanged	Unchanged	Decreased

Sandbar farming in chars
The major crops after transformation of the barren chars are pumpkin, water melon, *bangi* and squashes. The major effects of transformation are: increased income from new crops; improvement in household food security and nutritional status; improvement in housing, sanitation and drinking water supply; increase in women participation/employment in farming enterprises; decrease in household level violence; better labour utilization and decrease in seasonal migration.

Fruit cultivation in hills
Previous crops (before 1990) were *jhum* crops and banana, a shift towards fruits occurred the key effects of transformation included high profits from different fruit crops, huge land erosion with increased landslide, increase in household food security and nutritional status, livelihood improvement due to good market price, increased women participation in farming, and better household labor utilization.

Short-duration rice varieties in haor areas

Previous crops in *haor* were local boro rice which gave way to short duration modern varieties. Better income and livelihoods opportunity have been the key impacts.

Crop land to aquaculture
Before transformation to pond aquaculture, the fields were extensively used for rice cultivation. The shifting of the practices has had a huge impact on the local economy and an improved in the supply of protein nationally for the population.

Poultry farming
Although the key impact of household poultry farming is homestead nutrition security, increased income, involvement of women in farming for smallholders, poultry farming is not always profitable for them due to unstable market prices and increasing input costs.
Shrimp cultivation in coastal areas
Mostly *bagda* shrimp is under cultivation and it played a huge role in improving the socio-economic conditons of the farmers. Recent shifts comprised inclusion of other fish species besides shrimp and cultivation of vegetables in the *gher*.

Conclusions: Significant transformations in agricultural enterprises have occurred in different areas of the country. Profitability, improvement in household food security and nutritional status, encouragement from advisory organizations were the major drivers towards a shift from traditional farming to high-value enterprises. These shifts in farming, however, were not free from some challenges. Farmers expect further technological interventions, stronger logistics support from the Government and better advisory services from the concerned organizations. Thus, tangible interventions by the relevant organizations (like DAE, DLS, DoF etc.) are deemed necessary to boost production and improve rural livelihoods.

Project Code and Title: TF 80-NRM/20: Development of Biochar Enriched Fertilizer for Enhancing Nutrient Use Efficiency in Agriculture

Implementing Organization: Department of Agronomy, Patuakhali Science and Technology University, Patuakhali, Bangladesh
Component Organization: Bangladesh Agricultural Research Institute, Joydebpur, Gazipur
Name of Coordinator cum Principal Investigator: Professor Gopal Saha, PhD, Department of Agronomy, Patuakhali Science and Technology University, Bangladesh
Location (s): PSTU, Patuakhali, Rajshahi, BARI, Joydebpur, Gazipur
Budget: Tk. 50.0 lakh
Duration: 2nd of March 2021 to 1st June 2024 (39 months)

Introduction: Fertilizer use efficiency in agricultural systems of Bangladesh is often quite low due to low reactive surfaces of our soil. An increment in soil reactive surfaces can increase nutrient use efficiency while nutrient binding directly to reactive surfaces could further enhance it. Biochar, a pyrolyzed biomass, can be used for developing such reactive surface blended fertilizer. In this project, biochar enriched fertilizers have been tailored blending function specific biochars with nutrients (nitrogen, phosphorus and micronutrients). Physico-chemical properties of these fertilizers have been investigated with advanced spectroscopic chemical and molecular techniques including FTIR and potentiometric charge. Both laboratory and field trials have been conducted for examining the use efficiency of these fertilizers. These high-performance fertilizers would provide a sustainable mean for increasing fertilizer use efficiency for agricultural crops.

Objective(s): To develop technologies for functionalized biochar production, formulate biochar-enriched nitrogen and composite fertilizer and evaluate the performance of different biochar enriched fertilizers.

Materials and Method: The project activities have been executed at Biochar Research Centre, Patuakhali Science and Technology University (PSTU) in collaboration with BARI. The overall project activities cover: development of functional biochar and their characterization (PSTU), development of biochar enriched nitrogen fertilizers (PSTU), performance evaluation of biochar enriched nitrogen fertilizers using maize (PSTU & BARI), development of composite fertilizers (BARI, Gazipur) and

performance evaluation of biochar enriched composite fertilizers using different soil types. The biochar was functionalized using mineral doping before after pyrolysis following standard protocol. Ten selected niochar having both negatively and positively functionalized biochars were blended with ammonium from urea and nitrate from potassium nitrate. A total of 13 combinations of pellets were made by mixing with biochar and 2 additives-bentonite and clay-2 in composite fertilizer formulation. The performance of 8 different biochar enriched nitrogen fertilizers along with 4 commercially available N fertilizers including control were tested at PSTU campus, Rajshahi and Gazipur with maize hybrid crop following RCB design with 3 replications. Six biochar enriched-composite fertilizers were developed through physical mixing of the elements following 3 stoichiometric ratios of nutrient elements. Specifically, N, K and Zn were mixed with chemically (H_2O_2) oxidized biochar and P, S, B and Mo were mixed with FeAlMg-doped biochar. Finally 2 groups of formulations were mixed simultaneously. Performance of the composite fertilizers were evaluated using rice crop at different soil types in pot culture at the soil science lab. Of BARI, Gazipur.

Results and Discussion:

The following achievements were obtained under 03 years of project period:

- **Twelve (12) functionalized biochar** (e.g., chemically, biologically and mineral doped) were produced that can be used by the researchers of relevant field for developing function specific fertilizers (Fig. 1).



Fig 1. Showing (A) production of 12 functionalized biochars, (B) fresh biochar, and (C) oxidized biochar.

- **Biochar enriched nitrogen fertilizers with greater nitrogen use efficiency (NUE) were developed.** Biochar enriched (coated) nitrogen fertilizers showed higher potentialities to increase crop yield (e.g., up to 15% more maize yield) with greater N use efficiency (we found ~22% more NUE) over traditional prilled urea /farmers' practice (Fig. 2). This technology can be directly recommend for the maize farmers of Bangladesh, as well as
further performance trials using major agronomic and horticultural crops are certainly be beneficial for recommending these fertilizers in a larger scale in Bangladesh agriculture.



Fig 2. Showing (A) biochar coated nitrogen fertilizer, (B) & (C) comparative cob growth obtained from biochar coated (biologically activate) nitrogen fertilizer, and urea (farmers' practice) applied maize field, respectively.

- **Biochar based composite fertilizers were developed**
  Six (06) biochar-enriched composite fertilizers and their dynamic protocol would be a new arena of scientific interventions for developing soil/zone-, as well as crop-specific composite fertilizers to increase overall nutrient use efficiency and improving soil health for sustainable crop production (Fig. 3).

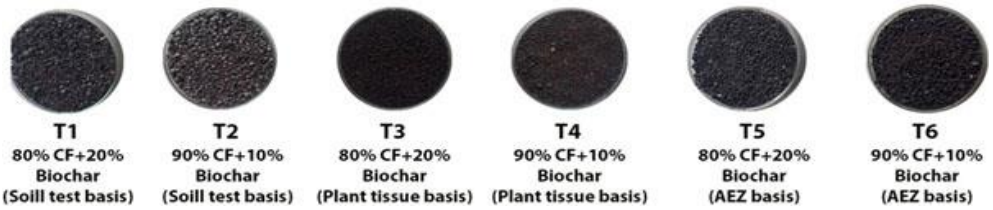


Fig 3. Showing six (6) different biochar based composite fertilizers

Conclusion: The formula and technology of producing biochar enriched fertilizers including both nitrogen and composite variants have been developed in this project. These fertilizers were rigorously evaluated through multiple laboratory and field trials. Twelve biochar-enriched blended and –coated nitrogen fertilizers using two N sources: Urea and KNO3 which were formulated with eco-friendly and sustainable formulations. The performance of these fertilizers were test on the performance of maize through field trials in 3 locations of Bangladesh. It was estimated an increase of 15% more maize yield through using biochar-coated urea fertilizers along with ~22% more NUE as compared to applying only urea (prilled)/farmers' practice. Besides six biochar-enriched composite fertilizers have been developed through a dynamic protocol.

Project Code and Title: TF81-NRM/20: Intervention in surface water utilization through integrated minor irrigation schemes for escalating water and land productivity in coastal region (ISIMISC))

Implementing Organization: Bangladesh Rice Research Institute
Component Organization: None
Principal Investigator: Dr. Mir Nurul Hasan Mahmud, BRRI
Co-Investigator: Dr. Debjit Roy, Md. Belal Hossain, BRRI
Location(s): Patuakhali Sadar Upazilla, and Taltoli Upazilla of Barguna District
Budget: Tk. 115.00 Lakh
Duration: 3 Years 3 Months (March 03, 2021 to June 02, 2024)

Introduction: The salinity-affected regions in Patuakhali and Barguna districts covers roughly 50% of the area, while the remaining 50% predominantly consists of non-saline areas. The cropping intensity in these districts is lower (177%) compared to the national average (191%). The primary cropping pattern is single T. Aman, and during the dry season, a significant portion of the lands remains fallow, despite the abundance of canals and rivers carrying freshwater throughout the area. Most rivers and canals exhibit water salinity levels below 1.0 dS/m, presenting a significant opportunity to cultivate Boro rice using these freshwater resources in the project locations.

Objective: Cropping system intensification, land and water productivity improvement by expansion of Boro rice cultivation in selected area utilizing less saline surface water.

Materials and Methods: The project involves five experiments in Patuakhali and Barguna districts. Experiment 1 monitors water and soil salinity biweekly from November to May. Experiment 2 assesses freshwater storage in canal networks. In Experiment 3, 500 Bighas of fallow land were brought under Boro cultivation with efficient water management (Fig. 3). Experiment 4 compares six cropping patterns, T. Aman-Fallow-Fallow, T. Aman-Boro-Fallow, T. Aman-Fallow-T.Aus, T.Aman-Sunflower-T.Aus, T.Aman-Mungbean-T.Aus, and T.Aman-Watermelon-T.Aus, for best water use efficiency. Lastly, Experiment 5 evaluates the transplanting window for BRRI dhan67, BRRI dhan74, and BRRI dhan89, with all varieties transplanted on January 15, January 25, February 5, and February 15, to identify the best transplanting time.

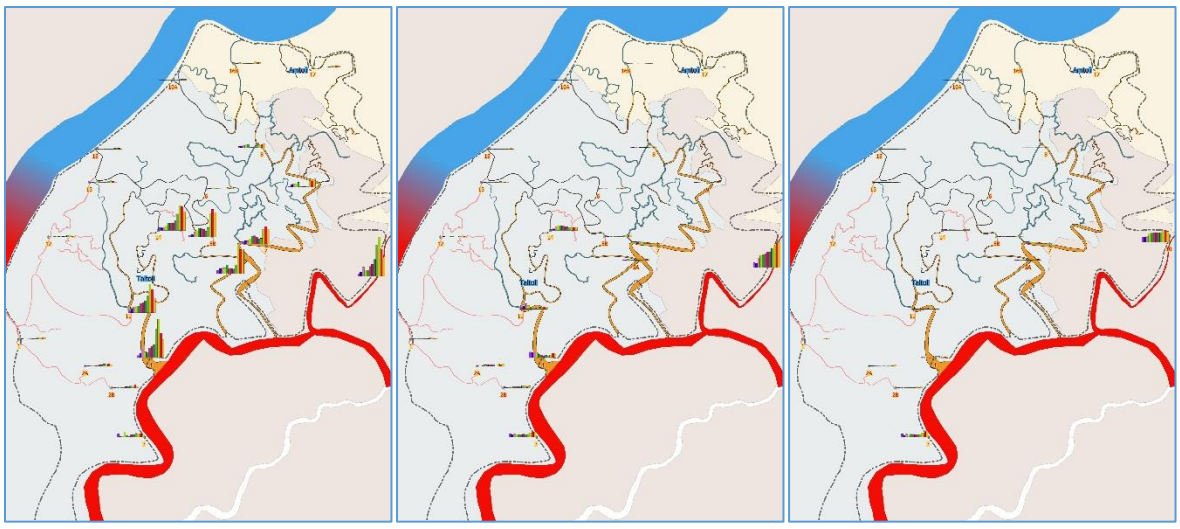
Results and Discussion: Salinity data from three maps, created during the first, second, and third year of project duration, revealed significant differences in water salinity. In the first year (Fig. 1a), most of the canal water in polder 44 exhibited high salinity levels. However, by the second and third years (Fig.s 1b and 1c), when two sluice gates were kept closed, salinity levels in most canal locations dropped below 4 dS/m, indicating a notable decrease in water salinity.

In Patuakhali Sadar Upazila of Patuakhali district, around 27 hectares (200 Bighas) of fallow land were brought under Boro cultivation with modern high-yielding BRRI rice varieties, including BRRI dhan67, BRRI dhan74, and BRRI dhan89. Similarly, in Taltoli Upazila of Barguna district, approximately 41 hectares (300 Bighas) of fallow land were brought under Boro cultivation with the same BRRI rice varieties.

Yields in Patuakhali Sadar for BRRI dhan67, BRRI dhan74, and BRRI dhan89 were 6.3, 7.3, and 8.2 tons per hectare (t/ha), respectively (Fig. 2). In Taltoli Upazila, yields were 6.6, 7.2, and 8.4 t/ha, respectively. Irrigation water savings using surface-laid PVC distribution pipes reduced time, water, and fuel consumption by about 33%.

Farmers were directly involved in seed production and marketing throughout the project, fostering entrepreneurship in seed marketing, with one farmer registering as a seed dealer.

In both locations, rice grain yield decreased when transplanting was delayed beyond the recommended January 15th date. In Patuakhali Sadar, BRRI dhan67's highest yield was 6.93 t/ha with timely transplanting, but this dropped to 6.40 t/ha and 5.65 t/ha with 10 and 20-day delays, respectively. A 30-day delay resulted in a 1.93 t/ha yield reduction for BRRI dhan67. Similar reductions occurred for BRRI dhan74 and BRRI dhan89, with 30-day delays decreasing yields by 1.40 t/ha and 1.90 t/ha, respectively, emphasizing the importance of timely transplanting for optimal yields.



Year 1 Year 2 Year 3

Fig. 1. Canal water salinity in 20 locations taken 15 days interval from November to May during the project 1st year, 2nd year, and 3rd year. Each histogram presents salinity of 12 different dates of a location.

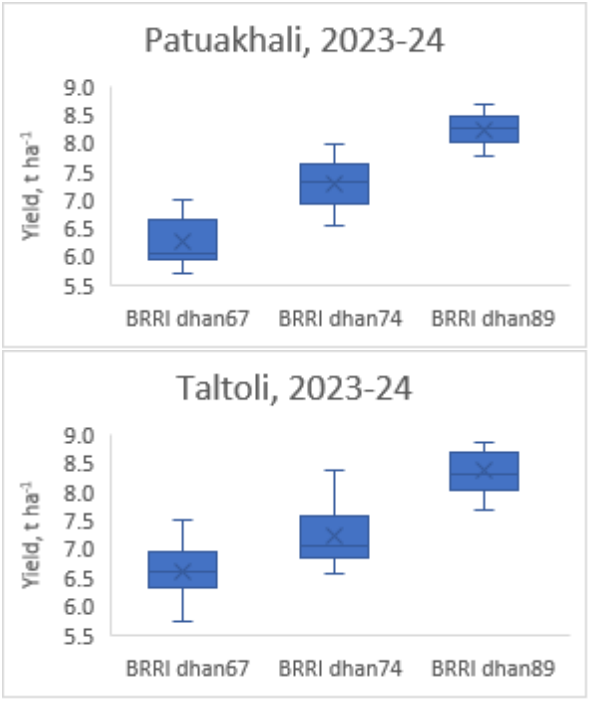


Fig. 2: Yield of three rice varieties cultivated at Patuakhali sadar and Talitoli upazilla under 20 block demonstratons in Boro 2023-24 season.



Fig. 3. Boro rice establishment under integrated minor irrigation scheme at Patuakhali sadar and Taltoli upazila.

Conclusion: Through demonstrations and training, farmers learned to cultivate Boro rice by building earthen embankments across canals and managing sluice gates to store fresh or less saline water. This innovative approach enabled the cultivation of fallow lands within the project and additional lands as more farmers adopted the method, leading to increased national crop production. The project also raised awareness about irrigation facilities and the potential for Boro cultivation using surface water. It directly engaged 300 farmers and indirectly benefited 500 more, promoting the latest BRRI varieties and water-saving techniques. Additionally, an entrepreneurship for seed marketing emerged, with one farmer registering as a seed dealer, further supporting local Boro cultivation.

Project Code and Title: TF 84-SoE/20. Adoption of climate resilient crop varieties in selected environmentally vulnerable areas of Bangladesh and its impact on farm productivity

Implementing Organization: Bangladesh Agricultural University (BAU), Mymensingh
Principal Investigator: Dr. Hasneen Jahan, Professor, Department of Agricultural Economics, BAU, Mymensingh
Locations: Satkhira (salinity affected), Jamalpur (flood affected), Chapainawabganj (drought affected), Sunamganj (*haor*), Thakurgaon (drought and high temperature), Meherpur (high temperature and blast affected)
Budget: Tk. 70 lakh
Duration: March 2021 to February 2024 (One year no cost extension)

Introduction: Bangladesh is one of the countries in the world worst affected by climate change. Adoption of agricultural technologies that can withstand climatic stress is crucial for maintaining food security in the country. Development of nutrient-rich stress tolerant crop varieties is a good option to achieve and maintain food security in the face of threats from climate change. It is, therefore, essential to study factors influencing farmers' decisions to adopt climate resilient crop varieties, constraints and opportunities that exist in this adoption process, impact of adoption on farm profitability and productivity, etc.

Objective: To study climate resilient crop adoption trends among farmers and related economic performances.

Material and Methods: The project is designed to survey 1,200 farmers comprising 800 rice farmers and 400 wheat farmers and 600 technology adopters and 600 non-adopter farmers. In total 18 (6 locations x 3) focal group discussions (FGDs) and key informant interviews (KII) are planned to be conducted. For assessing the socioeconomic status of farmers, relevant data on socioeconomic and demographic variables were collected from the sample farmers. Besides rice and wheat, these farmers are also cultivating some stress tolerant crops (e.g. pulses, spices, vegetables, fruits, etc.,) and 90 additional data regarding those farmers' practices were collected. For assessing the socioeconomic characteristics of farmers, relevant data on socioeconomic and demographic variables were analysed. In addition, a comparison of the pertinent socioeconomic and demographic characteristics were done between farmers who adopted and who did not adopt by applying the t-test technique. In order to assess the factors underlying the farmers' decisions to adopt, discrete choice model strategy will be applied. The list of predictor variables included farmers' age, education, gender, farm size, experience, access to financial resources, availability of technology in the area, costs of adoption of the technology, and availability of support/extension services, and so on. To explore the constraints and opportunities of adoption faced by the farmers, a Problem Confrontation Index (PCI) was constructed. In order to analyse profitability of the crops, gross margin, net return, and Benefit-Cost Ratio (BCR) were computed. The Cobb-Douglas production function was used to estimate the elasticity of production with respect to the input being considered. The Chow test was also performed to see if there was statistically significant difference in the parameters of the production functions across adopters and non-adopters.



Fig. 1. An FGD session at Shyamnagar, Satkhira

Results and Discussion: Farmers in in Thakurgaon and Meherpur districts cultivated BARIgom-30, BARIgom-32, BARIgom-33, China-3, etc. wheat varieties. . Rice varieties like Binadhan-11, Binadhan-12, Binadhan-17, BRRI dhan49, BRRI dhan51, BRRI dhan52, Haridhan, etc. were found to be major rice varieties in Jamalpur and Sunamganj districts, Binadhan-19, Binadhan-17, BRRI dhan85, Jirashail, etc. in Chapainawabganj district, and BRRI dhan67, Binadhan-10, Binadhan-23 in Satkhira district. Other crops observed were maize, pulse, peanuts, vegetables, jute, and spices. The study found that the main occupation of the respondents was farming: 99.42% in Sunamganj distrct, 97.55% in Satkhira district, 99.53% in Chapainawabganj district, 97.30% Jamalpur district, 99.08 % in Thakurgaon and 99.03% in Meherpur district. Among the farmers 34.92% had a secondary occupation whereas 65.08% had no secondary occupation. respondent farmers were found to be aware of the advantages of climate resilient rice varieties (Fig. 2), which, among other things, were perceived as high yield (21.83%), disease and pest resistance (21.06%), good taste (19.44%), abiotic stress tolerance (11.97%), but only very few farmers (0.28%) saw an advantage in respect of labor requirement. In case of wheat, farmers' considerations regarding the advantage of growing resilient wheat varieties were stress-tolerance, 24.76%, high yield, 22.62%, disease and pest resistance, 22.38%, and least advantage was taste, 0.48%. Talking about disadvantages in wheat cultivation, the respondent farmers mentioned lack of demand (29.13%), inadequate training (21.96 %), high input cost (17.61 %) and lack of information (11.74%). The per ha average net returns for climate resilient rice varieties were Tk. 62,882, 92,867, 40,825, 1,10,176, 72,799, and 61,832 with BCR 1.47-2.45 indicating that growing resilient varieties was profitable (Table 1).

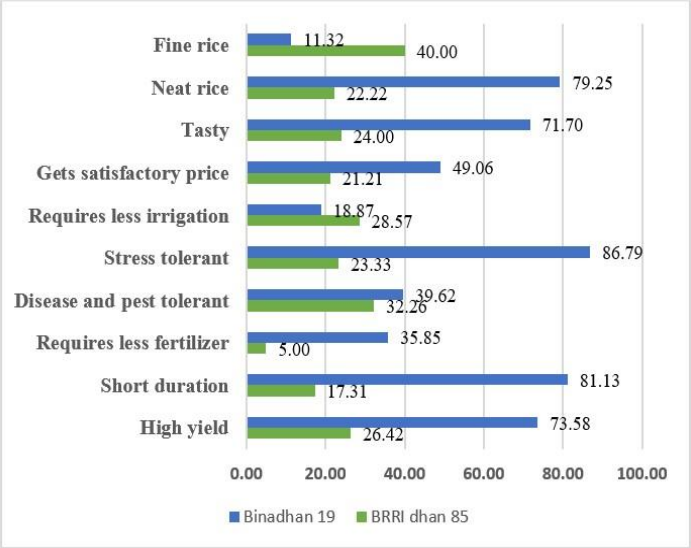


Fig. 2. Advantages of climate resilient rice varieties in Chapainawabgani district

Conclusions: The data and information generated by this project will help researchers, extension workers and other relevant stakeholders understand the socioeconomic implications of adoption of climate resilient crop varieties. This information is also expected to help the government in policy formulation.

Table 1. Profitability of major climate resilient rice varieties in Sunamganj district

Particulars	Climate resilient rice varieties (salt tolerant)			Avg
	BRRI dhan51	BRRI dhan52	Binadhan-11	
Fig.s except BCR are in Tk				
Seed cost	3060	3600	3300	3320
Seedling cost	6473	5980	7245	6566
Costs of tillage and transplanting	18893	17743	22210	19615
Cost of intercultural operations	7600	9200	10000	8933
Fertilizer and manure costs (total)	9907	12278	11005	11063
Costs of post-harvest operations	9500	11500	18000	13000
Irrigation cost	1276	1603	2650	1843
Insecticides cost	5503	2266	3401	3723.33
Total Cost	**62275**	**64170**	**77811**	**68085.33**
Return from paddy	117000	113000	127000	119000
Return from By-product	10328	12910	12664	11967.33
Total Revenue	127328	125910	139664	130967.3
Net Return	65053	61740	61853	62882
BCR (undiscounted)	**2.04**	**1.97**	**1.81**	**1.94**

Project Code and Title: TF 86-C/21: Feasibility study of the IoT based precision agriculture for sustainable crop production in Bangladesh

Implementing Organizations: Bangladesh Agricultural Research Council (BARC), Farmgate, Dhaka, Bangladesh Agricultural Research Institute (BARI), Gazipur and Nodes Digital Limited (NDL), Banani, Dhaka
Coordinator: Dr. Nazmun Nahar Karim, Member-Director (Livestock), BARC
Principal Investigators: Dr. Khokan Kumer Sarker, BARI and Dr. Saad Hasan, NDL
Location: BARI, Gazipur
Budget: Tk 99,54,680.00
Duration: October 2021 to October 2023

Introduction: Sensor-based precision agriculture is not in general practice in Bangladesh and its potential is yet to be adequately investigated in field conditions. The common agricultural practices are traditional surface-broadcast fertilizers, flood irrigation for wetland rice and frequent pesticide application. These traditional practices encourage the use of excess fertilizers, water, pesticides which ultimately lower input use efficiency and crop productivity. This study was designed to create a database for eggplant and test the feasibility of the Internet of Things (IoT) based machine learning software model for predicting water and fertilizer use for eggplant production under farmers' field conditions for improving crop productivity.

Objective: To develop and test IoT-based machine learning precision agriculture systems for improving crop productivity in Bangladesh
Materials and methods: Integration of IoT devices in farming activities is being tried for decision making predictions regarding the use of inputs like water, fertilizers and pesticides (Fig. 20). Data from installed sensors are fed into the machine learning (ML) system to analyze and compare with reference data of crops. Reference values of input requirements throughout different crop growth stages are prerequisite for more accurate ML modeling and decision predictions. The conceptual algorithm development technique was used to correlate the data acquired. Necessary techniques were used for data transformation and augmentation for ML research. The models used for ML included Linear, Ridge, Elastic Net, KNN (K-Nearest Neighbors), SVM and DT (Decision Tree) regression, RF (Random Forest), SVM (Support Vector Machine), Naïve Bayes classifier and extreme gradient

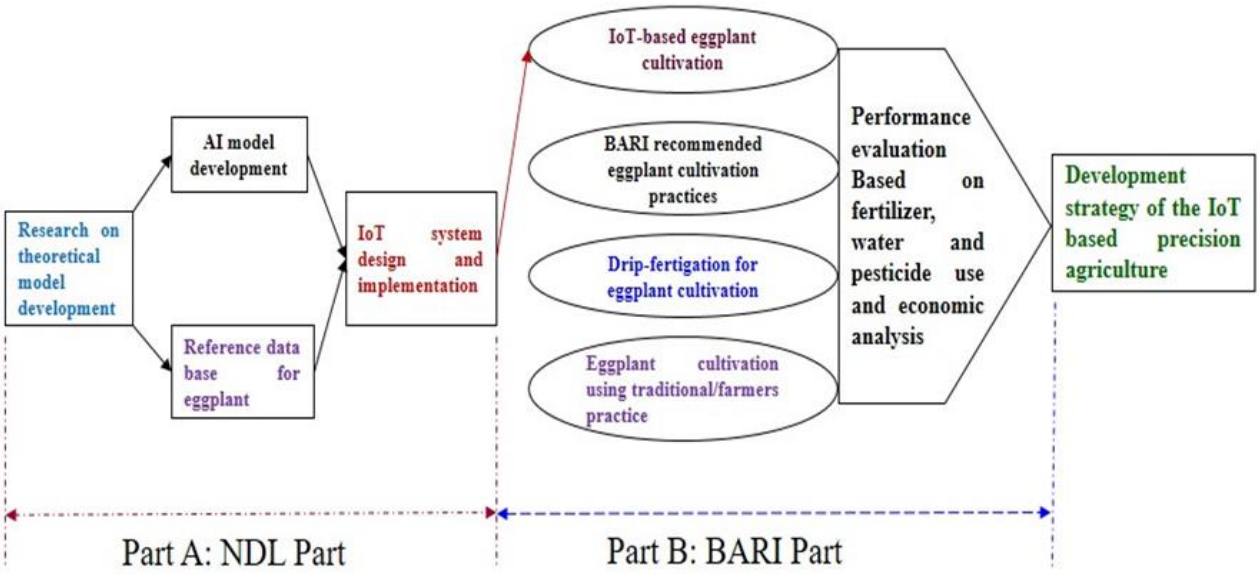


Fig. 1. Schematic diagram of the research/activity flow

boosting. Various programming languages were used for software development activities e.g., Python for ML models; Mysql for database; Google Firbase for notifications service; and Java for Mobile app.

The performance of the IoT-based precision agriculture practice (IAP) (T_1) is being evaluated by comparing with BARI recommended practices for eggplant production (T_2), drip fertilizer and irrigation (fertigation) (T_3) and farmers' practice (T_4). The IoT-based physical and networking system (T_1) was

in the process of being set up during the first crop cycle. Two focus group discussions (FGD) were done for setting up treatment T_4. A reference data framework for eggplants was developed based on a literature review and available data so far and data collected from experimental fields at BARI. To test this system an experiment was set up at BARI, Gazipur with four treatments (T_1, T_2, T_3, T_4) for eggplant (BARI Begun 10) production during October 2021-April 2022. In the reporting year, the experiment was continued at BARI, Gazipur with the four previous treatments (T_1, T_2, T_3, T_4) for eggplant (BARI Begun 10) production during November 2022-April 2023.

Results and Discussion: Eggplant fruit yield with T_1 (IAP) was similar as with other practices although T_1 required 40% less urea and 30% less potash than any of the traditional practices. The farmers' practice (T_4) needed greater amounts of fertilizer, water and pesticides to produce yield contributing attributes and yield similar as those with T_1, T_2 or T_3. Fourteen variables for the development of initial ML models for irrigation, fertilizer requirement and pest attack predictions were considered. Initial ML models- irrigation and fertilizer requirements and pest attack likelihood have been developed and are being tested for performance. The models used for ML includes Linear, Ridge, Elastic Net, KNN, SVM and DT regression, RF, SVM, Naïve Bayes classifier and extreme gradient boosting. The data were generated from reference data, lab tests conducted at BARI, and field sensor data. The NDL component of the project designed and developed IoT sensor systems, which included integration of hardware component (e.g. sensors for EC and moisture), micro-processors, cooling and power management system, custom PCB (printed cicuit board) design, Electronic Data Interchange (EDI) and data compatibility, fabrication of node/sensor system casing, wiring system etc. A database has been developed in two crop cycles of eggplant to train the IoT based precision model. The accuracy of decision prediction needs to be assessed for further improvement.

Conclusions: For sensor-based precision agriculture, an indigenous IoT sensor package has been designed, developed and assembled using locally available components to generate real-time field data. A mobile app representing the possible interfaces and relative features for the end user has been developed and is being improved. An experimental field has been set up and a reference database is being created from the experiment and other sources for testing IoT-based precision crop production. Initial ML models for water and fertilizer requirements, and pest attack likelihood have been developed and are being tested for performance. Information and technology that are expected to be generated by this project will pave the way for future research on precision agriculture with the help of sensors and related gadgets.

Project Code and Title: TF 87–SC/21. Strengthening sugarcane research and development in Chattogram Hill Tracts (CHT)

Implementing Organization: Bangladesh Sugarcrops Research Institute (BSRI), Ishwardi-6620, Pabna
Principal Investigator: Dr. Md. Anisur Rahman, CSO and Head, Breeding Division, BSRI
Location: Bandarban district of CHT: Bandarban Sadar, Rowangchari and Lama upazilas
Budget: Tk13.48 lakh

Duration: October 2021 to October 2023

Introduction: In most places in Bangladesh, sugarcane fails to flower, which limits the development of new varieties at the BARI germplasm bank. However, flowering occurs in southwestern Bandarban and Kawkhali in Rangamati. Average yields in sugarcane mill zones are 50 t/ha, while in CHT, they exceed 100 t/ha, with fewer disease and pest issues. A previous KGF project showed that sugarcane can be profitably grown alongside vegetables or legumes in CHT, potentially replacing tobacco. A breeding station in Bandarban aims to create high-yield, disease-resistant sugarcane varieties for CHT. This project builds on the KGF-BSRI initiative to improve sugarcane production for poor hill farmers, focusing on varietal enhancement, production technology, quality goor production, marketing, and farmer training.

Objective: The project focuses on developing high-yield, disease-resistant sugarcane clones, enhancing production technologies for hilly areas, creating market channels for sugarcane products, and promoting improved agricultural practices with intercrops.

Materials and Methods: Sparse and non-flowering genotypes of sugarcane numbering 162 (local clones-12, foreign clones-103, BSRI bred varieties-23 and clones-24) were grown at BSRI Sub-Station, Bandarban during 2022-23 season. Based on the results of pollen viability tests the targeted flowering varieties/clones were set for 33 field crosses, 8 marcott crosses and 9 selfing. From those 50 crosses, 692 g true seed (fuzz) was harvested and preserved in the seed storage facility of the Breeding Division of BSRI, Ishwardi, Pabna. All scheduled field experimentations focusing genotypic screening for *goor* and chewing cane together with newly recommended fertilizer doses and intercropping were performed properly. Necessary field data were collected. Fifteen field demonstrations were conducted during the present reporting period (2022-23). Three demonstrations on intercropping, three demonstrations on newly recommended fertilizer doses and nine on latest sugarcane varieties with improved production packages were set up to disseminate appropriate technologies in the hilly areas of Bangladesh. Conducted farmers training on improved sugarcane production with intercrops in hilly areas, on the production, processing and storing of *goor.* Conducted a field survey was carried out among randomly selected sugarcane growers and business middlemen with a pre-tested interview questionnaire. Data were collected on inputs, input costs, output, output price, yield and constraints of sugarcane cultivation. In addition, data on the sale price of farmer-produced sugarcane to different market intermediaries were collected.

Table 1. Field performance of chewing cane varieties/clones in three upazilas of Bandarban, CHT

Variety/clone	Sadar		Rowangchari		Lama	
	Cane yield (t/ha)	Brix (%)	Cane yield (t/ha)	Brix (%)	Cane yield (t/ha)	Brix (%)
BSRI Akh 42	212.33 a	13.00 ab	119.30 bc	14.33 a	105.63 ab	13.33
Senegal	160.17 b	13.33 ab	154.52 a	13.67 b	122.42 a	12.67
Black Ruby	216.56 a	14.83 a	138.74 b	14.67 a	132.17 a	13.50
I 100-16	137.49 c	12.67 b	101.78 c	13.67 b	88.98 b	13.33
CV (%)	13.58	6.34	7.80	2.31	13.58	6.34

Results and Discussion: A total 162 (sparse flowering-20 and non-flowering142) genotypes of sugarcane (local clone-12, foreign clone-103, BSRI bred variety-23 and clone-24) were grown and utilized for hybridization at the Bandarban Sub-Station (CHT) of BSRI. From 50 crosses performed (33 field crosses, 8 marcott crosses and 9 selfing), a total of 692 g true seed (fuzz) was harvested and handed over to the Breeding Division of BSRI HQ, Ishwardi. From these stored fuzz, around 20,000 true seedlings were produced. Several new flowering parents such as, the popular sugarcane variety Isd 34, Isd 38, Isd 37 and Isd 20 together with some promising exotic clones such as, CP 52-68, CP 44-155, CP 71-1086, Cok 31, Cok 37, Co 285, Co 775, Q 102 and HoCP 95-988 were subjected to hybridization by exploiting the flowering advantage in the Bandarban. One chewing clone Black Ruby and one *goor* producing clone Madhumala were selected primarily for trials in the future. In the field performance trial in three upazias of Bandarban, CHT, Black Ruby out yielded the other test materials with a cane yield of 132-217 t/ha compared with 89-212 t/ha of the other cane varieties/clones (Table 1). The *goor* cane Madhumala produced $76x10^3$/ha millable canes and gave a cane yield of 141 t/ha (averaged over 3 upazilas) compared with $75\text{-}93x10^3$/ha and 86-119 t/ha, respectively, produced by the other varieties/clones (Table 2). The *goor* product was analyzed for physico-chemical properties and nutrient composition. Special *goor* packets were prepared labelled with information regarding the nutrient composition of the *goor*.

Table 2. Field performance of *goor* varieties/clones pooled over three locations in Sadar, Rowangchari and Lama upazilas of Bandarban, CHT

Variety/clone	Millable cane ($x10^3$/ha)	Cane yield (t/ha)	Brix (%)
BSRI Akh 41	80.05 b	119.18 b	14.02
Madhumala	76.20 c	140.95 a	15.14
I 61-90	74.96 c	86.37 cd	16.55
BSRI Akh 46	93.84 a	97.27 c	16.96
CV (%)	6.41	8.25	3.95

Cabbage, French bean and potato became very popular as intercrops with the chewing sugarcane BSRI Akh 42 being a profitable practice (Fig. 1) in sugarcane production with a BCR of 2 to 3. Five possible marketing channels were identified in Bandarban district. The major problems of sugarcane growers have been identified as tolls of various kinds, firm hold of marketing middlemen on pricing, inadequate irrigation facilities, scarcity of labor, lack of funds, lack of transport facilities, high production cost, etc. Farmer training was successful in that the farmers were strongly motivated by first hand field observations of the sugarcane crop and and hearing success stories from local chewing cane growers.



Fig. 1. Intercropping French bean with sugarcane

Conclusions: This project demonstrates the viability of cultivating sugarcane alongside various intercrops in the Chattogram Hill Tracts, offering a sustainable alternative to tobacco that can boost local economies and create employment opportunities. The findings underscore the need for enhanced research and infrastructure to support the growth of the sugarcane industry, ultimately benefiting farmers and consumers alike.

Project Code and Title: TF 88-C/21. Scaling-up premium quality rice in northern region of Bangladesh

Implementing Organization: Bangladesh Rice Research Institute (BRRI), Agro-based Socio Economic Development Services (ASEDS), Brahmagacha Bazar, Raiganj, Sirajganj
Principal Investigator: Dr. Biswajit Karmakar, Principal Scientific Officer and Head, BRRI Regional Station, Sonagazi, Feni

Locations: Tarash and Raiganj upazilas of Sirajganj (AEZ 25); Sherpur upazila (AEZ 25) and Dhunat upazila (AEZ 25, 26) of Bogura
Budget: Tk 74.997 lakh
Duration (months): October 2021 to October 2024

Introduction: The production of premium quality rice (PQR) is becoming a key income opportunity for Bangladeshi rice farmers, alongside standard coarse rice. PQR farming offers significantly higher profitability due to its higher market price. The demand for aromatic fine rice is increasing nationally and has strong export potential, especially among non-Asian consumers like Europeans, Americans, and affluent Africans. With proper marketing and support, Bangladeshi fine-quality rice can access substantial domestic and international markets. Bangladesh has a competitive advantage in producing aromatic rice, particularly for export and import substitution based on Domestic Resource Cost (DRC) ratios. This initiative aims to expand the acreage for premium-quality rice in northern Bangladesh by promoting diverse strains and production methods.

Objective: Strengthening quality seed production, storage and availability of location-specific premium quality rice (PQR) varieties at the farmers' in the northern region of Bangladesh

Material and Methods: The project activities were conducted using a participatory approach in the fields of farmers across four upazilas located in two districts: Raiganj and Tarash in Sirajganj, as well as Sherpur and Dhunat in Bogura. At each project site there were about 50 participatory farmers, each possessing between 1 to 3 bighas of land. The project was executed in partnership with DAE and farmers across selected sites. Between July 2022 and June 2023, there were 24 adaptive trials (AT) on PQR varieties, 120 pilot production (PP) projects, 8 training sessions for farmers, and 12 field days conducted. The AT trials for the T. Aman season featured BRRI dhan34, 70, 75, 80, 90, 103, and Binadhan-13, while the Boro 2023 season trials included BRRI dhan63, BRRI dhan81, Bangabandhu dhan100, BRRI dhan102, and Binadhan-25.

Results and Discussion: Followings are the results of growing seaon 2023-24.

The study compares six rice varieties based on grain yield (t/ha), farmer preference, and growth_duration (days). Among them, BRRI dhan102 (V4) exhibited the highest yield (~8.5 t/ha) and longest growth duration (~155 days), though it scored lowest in preference. In contrast, BRRI_dhan63 (V1) showed a favorable balance with moderate yield (~6.5 t/ha), short duration (~115 days), and highest preference. The local variety Katari (V6) had low yield and short duration, but moderate preference. These findings highlight the trade-offs between productivity and acceptability in varietal_selection.

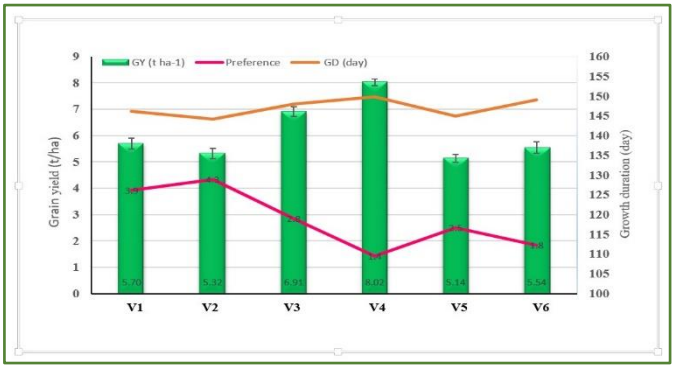


Figure 23. Comparison of grain yield, preference, and growth duration among six rice varieties including BRRI and local check (Katari).

(V1=BRRI dhan63, V2= BRRI dhan81, V3= BRRI dhan100, V4= BRRI dhan102, V5= BINAdhan-25, V6= Katari, local check)

Pilot production of the rice varieties BRRI dhan102 and Bangabandhu dhan100 yielded a total of 52.74 tons from 60 bighas of land. Farmers retained 2,750 kg, or 5% of the total output, as seeds for the upcoming season's cultivation. The average seed retention of the varieties was low, it was even lower for varieties like BRRI dhan50, 63 and 81 as they were relatively low yielders.
Conducted twelve field days that drew approximately 1,500 farmers. Eight training programs in Sirajganj and Bogura on PQR technologies involved 240 farmers and some DAE officials, and NGO workers.

Conclusions: In conclusion, this project successfully identified premium-quality rice varieties that balance yield and farmer preference, while also enhancing seed production and training. Future activities will focus on further disseminating these findings and expanding farmer engagement to optimize rice cultivation in northern Bangladesh.

15. Project code and title: TF 89–AM/21: Validation and up-scaling of rice transplanting and harvesting technology in the selected sites of Bangladesh (VRTHB)

Implementation Organization: Farm Machinery and Post-harvest Technology Division, Bangladesh Rice Research Institute (BRRI), Gazipur
Component Organization: None
Name of Principal Investigator: Dr. Md. Anwar Hossen, Principal Scientific Officer Technology (FMPHT) Division, Bangladesh Rice Research Institute (BRRI) Gazipur-1710
Location(s): Habiganj and Sirajganj (Two villages from each district)
Budget: TK: 90.37 Lakh
Duration: 36 Months (04/11/2021 to 03/05/2025 (42 months with 6 months no-cost extension)

Introduction: In order to increase production and cropping intensity, it has become necessary to mechanize certain farm operations like transplanting, weeding, fertilizer application, harvesting, etc.

Under the present labor crisis situation, crop production sustainability mostly depends on mechanization sustainability. Manual transplanting, harvesting, and weeding operations are very tedious and labor-intensive, and every operation is time-consuming and cost-intensive. Under the current situation, BRRI has developed a mechanical power weeder, which has been successfully demonstrated in the research stations and farmers' fields. The proposed program has been undertaken to validate and disseminate the rice transplanter-cum-mixed fertilizer applicator, mechanical power weeder, and combine harvester in the farmers' fields in Habiganj and Sirajganj districts, capacity building of the manufacturers, service providers, and promoting mechanization.

Objectives: The initiative aims to validate mechanical rice transplanting, fertilizer deep placement, weeding, and harvesting technologies to reduce paddy production costs, enhance profitability, and build capacity among researchers, extension workers, and rural youth.

Materials and Methods: We conducted multi-season extensive field trials during 2021 to 2024 in Habiganj and Sirajganj. Five treatment combinations were tested, involving various levels of urea fertilizer and machine transplanting. The BRRI multi-row power weeder was tested in 16 trials from 2021 to 2024 against manual weeding, herbicide application, and no weeding. Combine harvesters were evaluated across 22 trials over five rice seasons between 2021 and 2024. Both head-feed (HFCH) and whole-feed (WFCH) models, including the Yanmar AG600A, Kubota PRO588i-G, and Zoomlion FH-100, were tested to assess the performance of the machineries at farm level. Training sessions and field demos were conducted to enhance farmers' skills and confidence.

Results and Discussion: The transplanter machine outperformed manual transplanting in field efficiency (42.5%–91%) and yield, especially with 100% and 80% urea application. The BCR reached 1.95-1.97 for 80-100% urea treatments. The BRRI multi-row power weeder achieved a weeding efficiency of 89.22%, resulting in an average yield increase of 40.4% over unweeded plots. Its field efficiency was between 80.31% and 83.57%, with low fuel consumption (0.28–0.384 l/hp-h), saving up to Tk. 11,500 per hectare. Enhanced plant height and tiller numbers demonstrated the power weeder's adaptability across various soil types. Among combine harvesters, head-feed types had lower grain loss, with the Yanmar AG600A at just 0.73%, while whole-feed types operated at higher speeds and greater capacity. Optimal performance occurred at speeds under 4–5 km/h and plant densities below 300 plants/m². Field length was crucial, with 50–60 m being ideal for efficiency. Combine harvesters cut labor and operational costs by 60%–65% compared to manual methods. Sixteen hands-on training sessions were held, training 480 participants, including 18 women, on machine operation, maintenance, and seedling production. Thirty field demonstrations highlighted the advantages of BRRI-developed machines. A business model was created to integrate customized machinery, flexible financing, localized maintenance, and operator training to promote sustainable adoption.

Conclusion: The project successfully validated and promoted innovative rice mechanization technologies, demonstrating their potential to enhance productivity and reduce labor reliance for small and medium-scale farmers in Bangladesh. By addressing challenges and offering training, it creates a robust basis for sustainable agriculture and the wider implementation of mechanized rice farming.

Project code and title: TF 90–TF/21: Improving Productivity and Adoption of BARI Developed Selected Vegetable Crops through Integrated Management Approaches at Char-Areas of Bogura and Rangpur Districts (IPVC)

Implementing Organization: Bangladesh Agricultural Research Institute, Gazipur

Component Organization: Society for Sustainable Development for the Rural and Urban Area (SSURDA), H- 215/217, Block-B, Eastern-Housing, Mirpur, Dhaka

Principal Investigator: Dr. M. A. Goffar, PSO, BARI

Location(s): BARI, Gazipur, Shariakandi Char of Bogura and Kaunia Char of Rangpur district

Budget: Tk 50.00 lac (Fifty lac) only

Duration: November 2021 to October 2024 (36 months)

Introduction: In Bangladesh, the availability of land for food production is diminishing, with little opportunity to cultivate new agricultural areas. The riverine chars, often deemed unsuitable for vegetable cultivation, present a unique opportunity for agricultural development. However, the residents of these char regions lack knowledge about modern vegetable varieties and the associated production techniques. This gap in awareness highlights the potential for introducing BARI-developed vegetable crops and advanced farming methods tailored to the favorable conditions of the char areas. By doing so, it is possible to enhance the livelihoods and nutritional well-being of the char dwellers, ultimately contributing to food security and economic improvement in these communities.

Objective: To adopt BARI developed vegetable varieties and introducing integrated management practices for increasing productivity at char land for improving livelihood and nutritional status of char dwellers.

Materials and Methods: Thirteen field trials were conducted on sixteen selected vegetables using integrated and non-integrated crop management practices across six farmers' fields and one on-station. Each crop was allocated 12.0 decimals of land in a compact block, with two decimals per crop—one managed under the Integrated Management Approach (IMA) and the other under Non-IMA. Farmers cultivated three crop cycles annually: Cycle-I included radish, red amaranth, spinach, stem amaranth, and Sabuj danta shak; Cycle-II featured cabbage, cauliflower, tomato, garden pea, pumpkin, and brinjal; Cycle-III comprised summer tomato, summer bottle gourd, bitter gourd, okra, Indian spinach, and Kangkong. The trials lasted two years, focusing on agronomically and economically viable practices. In the third year, selected crops were tested in six new farmers' fields to validate results.

Results and Discussion: Farmers have learned techniques for healthy seedling cultivation. MBCR analysis showed the highest rates under IMA practices compared to non-IMA for the same cropping patterns (Table 1). They are familiar with BARI varieties, particularly radish, garden pea, red amaranth, tomato, okra, and summer bottle gourd for year-round farming. Based on productivity, consumer preference, and profitability, the suggested patterns for IMA practices in northern char areas are: i) radish – tomato - bottle gourd; and ii) red amaranth - garden pea - okra. Farmers have adopted IPM techniques for safe vegetable production, using pheromone and yellow sticky traps for brinjal and cucurbits. They have gained knowledge in modern vegetable production and management techniques, including bed system cultivation, artificial pollination, and pruning of tomato and bottle gourd. Women's participation in vegetable production has risen to 30%. Self-seed savings of OP varieties and technology dissemination through farmer-to-farmer seed exchange have been implemented. Vegetable consumption has increased by 34%, leading to a 60% rise in income from vegetable sales. Social and family ties have strengthened by 5-6% through vegetable exchanges among neighbors and relatives.

Table 1. Comparative scenario of productivity and profitability under IMA and Non-IMA practices over locations (rabi season during 2023-24)

A. Productivity (t/ha)

Crops	Location and yield (t/ha)							
	IMA				Non-IMA			
	Shariakandi	Kaunia	Gazipur	Ave.	Shariakandi	Kaunia	Gazipur	Ave.
Tomato	65.46	60.52	67.93	62.99	62.99	59.53	65.46	62.66
Garden pea	10.13	9.63	8.89	9.55	9.39	9.88	8.15	9.14

B. Profitability (cost benefit ratio)

Crops	Locations and BCR							
	IMA				Non-IMA			
	Shariakandi	Kaunia	Gazipur	Ave.	Shariakandi	Kaunia	Gazipur	Ave.
Tomato	3.51	3.53	3.90	3.65	3.36	3.44	3.80	3.53
Garden pea	3.18	2.79	3.36	3.11	3.29	3.13	3.26	3.23




Fig 1. Field views of Bogura & Rangpur displaying contented farmers experiencing significant productivity.

Conclusion: In conclusion, Integrated Management Approaches (IMA) have significantly boosted crop yields and diversified local vegetable markets, improving income for char dwellers. By focusing on sustainable practices and consumer preferences, the project recommends targeted vegetable patterns to enhance productivity and profitability in northern districts.

Project Code and Title: TF 91-Tea/21. Selection of drought and red spider mite tolerant tea clones for sustainable tea production

Implementing Organization: Sylhet Agricultural University, Sylhet
Component Organization None
Principal Investigator: Prof. Dr. A F M Saiful Islam, Department of Crop Botany and Tea Production Technology, Faculty of Agriculture, Sylhet Agricultural University, Sylhet
Location(s): 1) Sylhet Agricultural University, 2) Chandpore Tea Estate, Chunarughat, Habiganj and 3) Nalua Tea Estate, Chunarughat, Habiganj
Budget: Tk. 50.00 (Fifty Lac) only
Duration: From 26 October, 2021 to 25 October, 2024 (36 months)

Introduction: Tea, derived from *Camellia sinensis* leaves, is a fragrant drink. Bangladesh ranks as the 10th largest tea producer, contributing 2% to global production. Tea is cultivated in a rain-fed mono-cropping system. Climate change threatens yields, with drought potentially reducing them by up to 40% due to leaf wilting. Climate models predict more frequent droughts from global warming. Additionally, 15% of crops may be lost to pests like the red spider mite, which has affected 31.29% of tea crops in Bangladesh, causing a 9.57% yield loss. This pest could result in a loss of 340–511 kg of tea per hectare. The project aims to create drought and red spider mite-resistant tea clones that yield well and improve aroma and liquor quality.

Objective: Selection of tea clones against drought and pest tolerance having reasonable yield potential with better growth habits.

Materials and Methods:

In October 2023, eight tea clones were selected from 30 and transplanted for evaluation under two watering regimes: normal (FC 100%) and supplementary (FC 50-70%). The study assessed pest tolerance from the sapling stage, measuring growth parameters like plant height, leaf number, and root characteristics. Survival rates and growth metrics were recorded in a screen-house, with chlorophyll content measured monthly using a SPAD Meter. Biochemical analyses of phenolic compounds were conducted at BCSIR, and organoleptic tests evaluated aroma and liquor quality against control varieties BT2 and BT19. Additionally, the relative water content of leaves was calculated, and bush and leaf characteristics were assessed for pest and disease tolerance, noting damage from pests such as the tea mosquito bug and red spider mite.

Results and Discussion: Eight clones were screened out primarily depending on the infestation rate,

liquor quality, drought tolerance and growth. Clones C7 (ML7Y1), C5 (ML5Y1) and C11 (SAU1Y1) were found better with respect to liquor quality. Four clones C5 (ML5Y1), C7 (ML7Y1), C37 (LC7Y2) and C69 (DD3Y2) showed promising characteristics for drought tolerance and high productivity. The clones C5 (ML5Y1) and C4 (ML4Y1) possessed enhanced tolerance to red spider mite and diseases (Table 1). Among the various pesticides evaluated, Spiromesifen demonstrated the greatest effectiveness, achieving a mortality rate of 93.98% and an MBCR value of 4.16, which is significantly superior to the other biopesticides. Throughout the 3-year experimental period, the biopesticide Spiromesifen consistently yielded the highest economic return, reflected in its superior MBCR values, indicating that it may represent the most cost-effective solution for managing red spider mites in tea gardens.

Conclusion: In conclusion, conducting field evaluations of drought and pest tolerant tea clones alongside eco-friendly pest management techniques across various tea estates in the Sylhet region is essential for optimizing yields and ensuring sustainable practices.

Table 1: Bush and leaf characteristics of eight selected tea clones with two check variety at field condition (Year 2 from June 2022 to May 2023)

Clone name	Photographs of clone	Bush habit	Leaf characters
C1 (Assam agrotype)		densely branched, fairly dense plucking points.	Dark green, semi broad, serrated, semi- horizontal pose.
C4 (China agrotype)		Erect and dense branching habit, compact plucking points	Light green, smaller size, serrated, semi-erect leaf pose.
C 5 (Assam agrotype)		Profuse branching, compact bush, dense plucking points.	Light green, semi broad, prominent apex, semi-erect leaf pose, serrated margin.
C 7 (China Monipuri agrotype)		Dense leaf, erect bush type, profuse plucking points	Light green, semi broad, semi-erect in pose, serrated margin.
C 11(Assam agrotype)		Dense bush, heavy branching, medium sized shoots,	Light green, medium to broad in size, semi- horizontal leaf pose, serrated margin.
C 16 (China agrotype)		Dense plucking points, profuse branching, uniform flushing behavior	Light green, semi broad in size, semi-erect pose, pointed apex, serrated margin.
C 19 (China agrotype)		Dense branching, spread with profuse plucking point	Light to semi dark green, semi broad, semi erect pose, pointed apex, uniform serration.
C 21(Assam agrotype)		Good branching behavior, fairly dense plucking points	Light green, medium to broad size, semi- horizontal pose, pointed apex, serrated margin.

Clone name	Photographs of clone	Bush habit	Leaf characters
C l1 (China Monipuri)		Profuse branching, dense plucking points	Light to dark green, semi broad, semi- erect pose, pointed apex, uniform serration.
C l2(Assam agrotype)		Uneven spreading type, fairly dense plucking points, medium shoots sized.	Light green leaves, semi broad size, semi-erect leaf pose, less pointed apex, uniform serration.

Project Code and Title: TF 93-SoE/21. Assessing Adoption and Diffusion of Agricultural Innovations in Bangladesh.

Implementing Organization: North South University, Dhaka
Component Organization: Bangladesh Agricultural University, Mymensingh
Principal Investigator: Professor Dr. Nazrul Islam, NSU
Location(s): Bangladesh
Budget: Total cost: Tk. **199.96** lakh
Duration: 32 months, from: 26 October 2021 to 25 June 2024 (As per approved revised proposal).

Introduction: The adoption and diffusion of agricultural innovations are critical to enhancing productivity, sustainability, and resilience in Bangladesh's agrarian economy. Despite significant advancements in agricultural technologies—ranging from high-yielding crop varieties to climate-smart practices—their uptake remains uneven across regions and farming communities. This report examines the socio-economic, institutional, and environmental factors influencing the adoption and spread of agricultural innovations in Bangladesh. Understanding these dynamics is essential for designing inclusive policies and interventions that bridge the gap between research and practice, ensuring that innovations contribute meaningfully to promote sustainable agricultural development for year to come.

Objective: The Key objectives of the project are to identify the adoption characteristics of agricultural technology users in the agricultural value chain of Bangladesh and to explicate the attitudes and values of the users with specific reference towards adopting local versus foreign agricultural technologies.

Materials and Methods: The research was conducted in three phases:

- The **First phase** (is exploratory in nature) involved identification of various adoption characteristics of agricultural technologies and innovations of Bangladesh's and of their sources.
- The **Second phase** included identification of attitudes of agricultural technology users in the agricultural value chain towards various technology characteristics/factors identified in the First phase of the project.
- The **Third phase** will disseminate the results of the **Second phage** to respective Government and non-Government agencies of Bangladesh
- A generic conceptual frame work was developed and applied to identify key berier to technology adoption (Fig 1)
- The Quality Function Deployment (QFD) model analysis was applied to formulate and prioritized input support policy strategy to addresses the needs of those intended to support
- A diagram of Sample Distribution of Farm and Non-farm Stakeholders in Agri-food Supply Chain was developed for policy makers aiming to bust agricultural productivity and sustainability (Fig 2)

The First and Second phases of the project is nearly completed and about to step into Third phase of its progress.

Results and Discussion: This report covers the activities of the period 25 June 2024. Agricultural technologies developed by public organizations are presented in Table 1 while Table 2 showing the number of agricultural technologies developed by public organization. The data in Table 3 summarizes

the regional distribution of rice variety adoption among surveyed farmers across five agro ecological zones in Bangladesh. To visualize the primary drivers of agricultural technology adoption, a model was constructed highlighting the core influencing components. This model provides key influencing factors for adoption (a**) perceived simplicity**, where technologies that are easy to use are more likely to be adopted; (b) **farmer capabilities**, which significantly impact on their ability to adopt and effectively utilize new technologies; trust in the technology itself and the institutions promoting it; and (c) **organizational support**, which can greatly influence adoption rates by providing necessary resources and training. While key barriers to adoption are (a) **market conditions** that limit access to new technologies, (b) **insufficient government support** that hamper the dissemination and implementation of innovations, and (c) **environmental factors** such as climate conditions and soil quality that affect the performance of new technologies (Fig not shown).

The Quality Function Deployment (QFD) model analysis suggests that among the identified 14 groups of policy strategies input support policy strategy for technology adoption. The results of the Multivariate Probit Model of joint adoption of multiple agricultural technologies among rice farmers indicate that (a) agricultural training**,** (b) access to extension services, and (c) strong social networks significantly affects farmers' adoption of BRRI rice varieties simultaneously with fertilizer and irrigation technologies. The study reveals that farmers are more likely to adopt complementary technologies when they recognize the synergistic benefits they offer, especially in contexts where targeted training and localized support are available. A diagram of sample distribution of farm and nonfarm stakeholders in agri-food supply chain was developed to ellustrate in supply chain. The framework indicates that organizational support can greatly influence adoption and market profit by providing key resources and training.

Conclusion: In conclusion, this research not only identifies critical barriers to technology adoption among farmers but also provides actionable policy strategies through a QFD model, making it an essential resource for enhancing agricultural productivity and sustainability in Bangladesh. Its insights pave the way for effective solutions in the face of budget constraints.

Table 1: Number of agricultural technologies (by types and industries) developed by public organizations in Bangladesh

Technology	Chemical	Genetic	Mechanical	Farming Practice	Total
Crop	41	1002	67	338	1,448
Fisheries	6	31	13	76	126
Livestock	3	34	6	65	108
Total	**50**	**1,067**	**86**	**479**	**1,682**

Table 2: Number of agricultural technologies (seeds) developed/supplied by private organisations in Bangladesh.

Private sector	Crop	Fruits	Vegetable	Total
Total	1,535	16	559	2,110

Table 3: Regional distribution of survey farmers adopting different rice varieties in the sample study area of Bangladesh in 2022-24.

Biological Technologies	Zone					
	Central	North-East	North-West	South-East	South-West	All Regions
	Number of farm respondents					
BINA Varieties						
BINA-7	18	5	2	0	0	25
BINA-17	4	0	0	6	0	10
Other BINA Varieties	11	3	1	3	0	18
BRRI Varieties						
BRRI dhan29	169	102	27	4	12	314
BRRI dhan28	132	103	21	16	22	294
BRRI dhan49	38	31	28	2	21	120
BRRI dhan51	0	0	11	0	19	30
BRRI dhan74	3	0	0	6	12	21
BRRI dhan48	0	13	2	0	5	20
Other BRRI Varieties[b]	*55*	*16*	*42*	*10*	*16*	*139*
Other Rice varieties						
Rice-Guti Sonna	7	1	47	2	34	91
Rice-Hira	2	32	10	13	0	57
Rice-Miniket	0	0	27	0	20	47
Rice-Subollota	0	0	14	0	24	38
Rice-Katari Vog	0	0	34	0	3	37
More Rice Varieties[c]	28	23	26	92	64	233
All Rice Varieties	**467**	**329**	**292**	**154**	**252**	**1494**

Notes: [a] (BINA-11, BINA-25, BINA-12, BINA-21)

Project ID and Title: TF 94/21. Upscaling of agro ecological farming technologies through participatory action research

Implementing Organization: Bangladesh Agricultural Research Institute (BARI), Gazipur, CARD Mohila Samity (CARDMS), Kaliganj, Jhenaidah, Sheha Organic, Bangladesh
Principal Investigator: Dr. M Nazim Uddin, BARI
Locations: Gazipur, Jhenaidah and Mymensingh
Budget: Tk. 72.95 lakh
Duration: October 2021 to October 2024

Introduction: Agroecology provides a comprehensive approach to agriculture by merging ecological principles, traditional wisdom, and practices that require minimal external inputs. However, despite its promise, the widespread implementation of agroecology is hindered by socio-institutional and technical challenges. By involving farmers and stakeholders in collaborative creation and continuous learning, the project promotes solutions tailored to local conditions that rejuvenate soil fertility, boost biodiversity, and mitigate environmental harm. The initiative seeks to enhance resilient food systems and shape policies that facilitate ecologically sustainable agricultural transitions. PRA is designed to empower farmers to spearhead this change, in alignment with agroecological principles, knowledge exchange, community participation, and ecological balance.

Objectives: To promote good agroecological practices in vegetables-based farming

Materials and Methods: CARDMS in Jhenaidah and Sheha Organic Bangladesh in Muktagacha are the collaborative NGOs of the project. A baseline survey was conducted at the onset of the project. We adopted PRA tools such as focus group discussion (FGD), structured questionnaires to collect data on baseline information of socio-economic and environmental information and farming practices following the communities. Farmers belonging to local collaborative prepared their manures and fertilizers such as biologically active organic fertilizer (BAOFER), household waste compost, water hyacinth/straw based municipal waste compost, microbial consortium BARI IMO 1, BARI IMO 2 (liquid), vermi-

wash, liquid fertilizers, bio slurry based co-composted fertilizers are in progress. Farmers participated with the research team in the experiment setup and technology demonstration activities. Treatments of the experiments/demonstrations application of organic fertilizers and other traditional but innovative agronomic practices. Centres for selling farm products in local markets were established in each location to popularise the farm products. Argo-ecological and agro-economic data were collected. The collected data were summarized and analyzed for interpretation.

Results and Discussion:

The use of agroecological farming methods, such as bio fertilizers, vermicompost, and microbial inoculants, has proven effective in increasing farm yields while reducing reliance on chemicals. Organic amendments have improved soil health, enhancing moisture retention, nutrient availability, and pest resistance, which boosts crop performance amid climate change. Agroforestry practices for fruit and vegetable production focus on high yields and revenue. Using bamboo supports has maximized country bean pod yields in eco-friendly conditions. Sustainable practices have led to low pod infestation and virus infection, positively impacting yield and product quality. Research shows that the microbiome significantly affects root systems, with diverse microbes in the rhizosphere influencing crop growth and yield. Initiatives like the Model Organic Agricultural Village (MOAV) and BARI Seed Village (BASVI) in Jhenaidah and Muktagacha aim to empower farmers through agroecological methods and ensure a steady supply of quality seeds, promoting sustainable farming. An organic vegetable sales center has been set up to improve marketing channels. Fig 1 and Fig 2 illustrate project activities and key outputs from three years of work.

Table 1. Yield of crops in the agroforestry system

Name of the farmer	Crops	Yield total (kg)	total amount(Tk)
Abu Taleb	guava	796	19900
	lemon	319	1595
	Jujube	13	1040
	Turmeric	60	1800
	ginger	32	5760
Abu Jafer	guava	50	2500
	lemon	30	150
	Jujube	8	560
	Onion	30	3200
	garlic	65	7800

The results reflect promising early outcome from vegetable based agroforestry.



a) Premarketing processing centre at the project iste



b) Organic vegetable sales center in local market of the project site

Table 1 displays aggregated yield data for vegetable production derived from demonstration plots situated in Jhenaidah and Muktagacha, where bitter gourd reached a yield of up to 13.34 t/ha. This yield data suggests that the use of organic fertilizers has significantly enhanced soil health and overall

productivity. Encouraged by positive market returns, farmers have shown a strong interest in continuing organic vegetable cultivation to ensure sustainable income and foster environmental benefits.



a) Preparation of BAOFER at project sites



b) Community vermicompost plant at the project site



d) Agroforestry-based fruit and vegetables production

The project started seeling system and to boost local entrepreneurship.

Conclusions: The successful implementation of agroecological practices has not only improved crop yields and soil health but also fostered sustainable farming methods. Continued funding is essential to expand these initiatives, ensuring long-term benefits for farmers and the environment in the face of climate change.

20. Project Code and Title: TF 95-C/21. Prevalence of major pre and post-harvest diseases of onion and their management.

Implementing organization: Bangladesh Agricultural Research Institute, Gazipur-1701.
Component organization: None

Principal Investigator: Dr. M. Monirul Islam, PSO, Plant Pathology Division, BARI, Gazipur.

Locations (S): Experimentation location: Faridpur, Bogura and Gazipur. Survey location: Faridpur, Rajbari, Magura, Bogura, Pabna, Lalmonirat and Gazipur districts
Budget: Tk. 30, 00000/-

Duration: 36 months; from 18 November, 2021 to 17 November, 2024

Introduction: The management of major pre and post-harvest diseases in onion (*Allium cepa* L.) is a critical area of concern that remains underexplored. Despite the significant impact these diseases have on onion yield and quality, there is a notable lack of comprehensive studies addressing their prevalence and effective management strategies. Understanding the specific pathogens that affect onions during both pre-harvest and post-harvest stages is essential for developing targeted interventions. This knowledge gap hinders the ability of farmers and agricultural professionals to implement effective disease control measures, ultimately affecting food security and economic stability in onion production.

Objective: To determine the present status of important pre and post-harvest diseases of onion and to develop their sustainable management technologies.

Materials and Methods:

Activities during the reporting period 2022-23
A base line survey was on purple blotch, black mould and soft rot diseases of onion in Faridpur, Rajbari, Magura, Bogura, Pabna, Lalmonirhat and Gazipur during reporting period. A screening trial of germplasm against purple blotch disease was conducted. Germplasm were collected from SRC- Bogura, RSRS-Gazipur and SRSS- Faridpur for the experiment. Six bio-fungicide viz. Decoprima, Paenamaxi, Biosida, Dynamic, Lycomax and Clybion were tested against purple blotch disease of onion. Conducted three validation trial of Integrated Diseeased Management (IDM) practices in Faridpur, Bogura and Gazipur: Followings are IDM treatments.

i. Integrated management of purple blotch disease of Onion: $N_{150}P_{200}K_{100}S_{20}Zn_4B_1$ kg/ha + Luna sensation (0.1%) + 10cm plant spacing + Cowdung @ 3 t/ha

ii. Integrated management of black mold disease of Onion: Pre-harvest spray of Autostin (0.2%) + 10cm plant spacing + Cowdung @ 3 t/ha + Dipping bulbs in 10% H_2O_2 for 2 minutes + AC room and
iii. Integrated management of soft rot disease of Onion: Pre-harvest spray of Cupravit (0.2%) + 10cm plant spacing + Cowdung @ 3 t/ha + Dipping bulbs in 10% $H_2O_2$for 2 minutes + AC room

b) Four farmers training were conducted at Gazipur, Rangpur, Bogura and Lalmonirhat.

Results and Discussion: The baseline survey shows that purple blotch is the most common and severe onion disease, with Rajbari having the highest incidence (78%) and severity (4.23). Significant infections were also found in Faridpur and Gazipur. Lalmonirhat had the worst black mould (29%, 3.34) and soft rot (26%, 3.13), indicating poor post-harvest conditions. Conversely, Magura reported the lowest incidence and severity of all diseases. These differences reflect the impact of regional agro-climatic conditions and management practices on disease prevalence, highlighting the need for targeted control strategies (Table 1). In varietal trials, purple blotch incidence ranged from 5% to 73%, with onion line AB8 showing the highest severity (4.0) and lines AC-GAZ-384, AC-GAZ-380, and AB4 the lowest (1.0) (data not shown).

The control treatment exhibited the highest incidence (72%) and severity (4.67) of purple blotch disease in onions, while Lycomax showed the lowest incidence (25%) and severity (2.00). The most effective control method involved Luna sensation combined with specific nutrient applications and cow dung.

Table 1. Incidence and severity of purple blotch, black mould and soft rot diseases of onion at seven districts of Bangladesh.

Sl. No.	Location(S)	Purple blotch disease		Back mould disease		Soft rot disease	
		Incidence (%)	Severity (0-5 scale)	Incidence (%)	Severity (0-5 scale)	Incidence (%)	Severity (0-5 scale)
01	Bogura	65.00	3.70	20.00	2.78	18.00	2.57
02	Pabna	67.00	3.68	21.00	2.86	20.00	2.65
03	Faridpur	72.00	3.79	23.00	2.94	19.00	2.73
04	Rajbari	78.00	4.23	23.00	2.90	16.00	2.69
05	Magura	56.00	3.53	19.00	2.66	15.00	2.35
06	Lalmonirhat	58.00	3.66	29.00	3.34	26.00	3.13
07	Gazipur	76.00	3.93	24.00	2.97	22.00	2.91

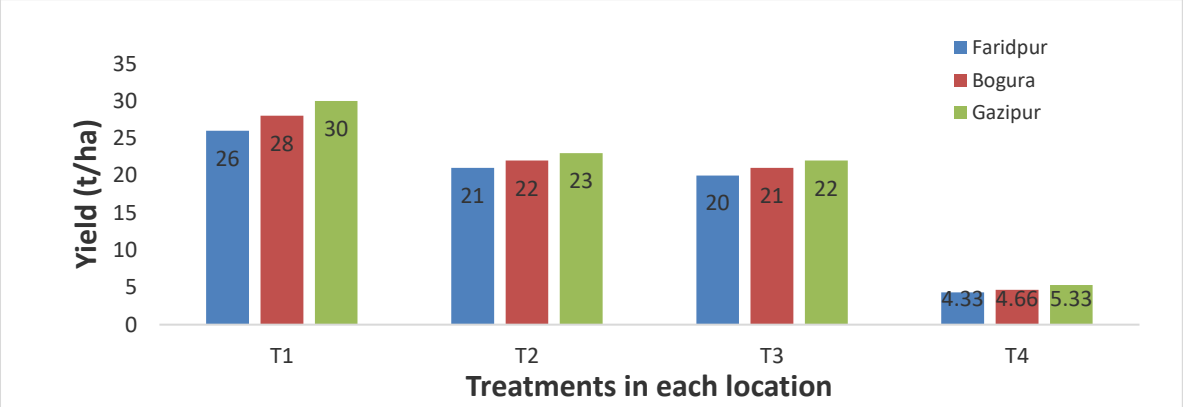


Fig 1. Effect of IDM approach on yield (t/ha) of onion (BARI Piaz-4) at Faridpur, Bogura and Gazipur

T1 = $N_{150}P_{200}K_{100}S_{20}Zn_4B_1$ kg/ha + Luna sensation (0.1%) + 10cm plant spacing + Cowdung @3t/ha, T2 = $N_{150}P_{200}K_{100}S_{20}Zn_4B_1$ kg/ha + Amister Top (0.1%) + 10cm plant spacing + Cowdung @3t/ha, T3 = $N_{150}P_{200}K_{100}S_{20}Zn_4B_1$ kg/ha + Royral (0.2%) + 10cm plant spacing + Cowdung @3t/ha, T4 = Control

To address black mold disease, a pre-harvest spray of Autostin (0.2%), combined with 10cm plant spacing, 3 t/ha of cow dung, 2-minute bulb dipping in 10% H2O2, and using an AC room, yielded the best results for shelf life. A validation trial for soft rot disease using a similar Cupravit (0.2%) spray

under the same conditions also improved onion shelf life. Fig 1. shows that integrated disease management (IDM) significantly enhances the yield of BARI Piaz-4 onions across different regions. The consistent success of T1 highlights the importance of comprehensive IDM practices in minimizing yield loss and boosting onion farming productivity.



a b

Fig 2. Integrated disease management (a) Treatment 1 (T_1)and Treatment 4 (T_4)

Conclusion

In conclusion, the prevalence of onion diseases such as purple blotch, black mold, and soft rot highlights the need for effective management strategies. The promising lines and integrated management technologies developed in this study pave the way for future research and implementation to enhance onion crop resilience and yield.

21. Project Code and Title: TF 98-C/21. Productivity enhancement of beans through on-station and on-farm research approaches in Sylhet region

Implementing Organization: Department of Horticulture, Sylhet Agricultural University, Sylhet
Component Organization: None
Principal Investigator: Professor Dr. Md. Shahidul Islam, SAU
Location: SAU campus, Sylhet; Horticulture Centre of DAE; ten upazila's from Sylhet, Moulavibazar, Sunamganj and Habiganj districts.
Budget: 45.91 lakh Taka
Duration: 39 months (18 November 2021 to 17 February 2025)

Introduction:

Beans, including country bean, yard long bean, and French bean, are important winter crops in Bangladesh, belonging to the Leguminosae family. They provide essential protein, vitamins, and minerals for health. While some country bean varieties are also grown in the summer, there is a need to enhance their pod production and quality. The Sylhet region has much more potential to boost vegetable output, as much of the arable land remains unutilized during both the Rabi and Kharif seasons. There exists significant potential for cultivating bean crops in the Sylhet region through the introduction of appropriate varieties and the innovation of production technologies; therefore, this study was conducted to improve the productivity of bean crops in the Sylhet region.

Objective of the Project

To improve bean crops productivity in Sylhet region through identifying appropriate varieties and innovating production technologies.

Materials and Methods

The study was conducted at the Sylhet Agricultural University research file and in the farmers' fields. The experiments included under the following heads (s):

(i) heterosis and combining ability of country bean
(ii) on-farm adaptive trials of beans during summer and winter
(iii) on farm adaptability of French beans
(iv) seed production of promising varieties of country beans and French bens
(v) on-farm adaptability of country beans during summer at farmers 'field
(vi) on farm adaptability of yard long beans during summer at farmers 'field

(vii) influence of support system on country beans and
(viii) performance of advanced lines of country beans.

Results and Discussion

Four cross combinations were selected based on significant positive heterosis on the basis of yield and earliness. The hybrid combinations P1 × P4, P1 × P2, P2 × P4, and P1 × P5 are potential candidates for further assessment to be developed as hybrid varieties of country bean. An assessment was conducted on 23 lines of country bean, focusing on the number of pods per plant, the weight of individual pods, and their antioxidant content. Farmers were trained on production technologies of Country beans, Jhar Sheem and Borboti.

Based on the adaptive trials both BARI Sheem-1 and Goalgadda performed comparably across agronomic traits. However, statistical analysis (paired t-test) revealed no significant difference in yield or maturity ($p > 0.05$), suggesting both genotypes are equally suited for Sylhet conditions under the tested management practices. Hence, farmers may choose either genotype based on additional criteria such as market preference, taste, or resistance traits not covered in this study (Table 1).

Table 1: Performance of two country bean genotypes at farmer's field in Sylhet and Habiganj regions

Trial No.	Sylhet (n=9)				Habiganj (n=7)			
	Days to harvest		Pod yield (kg/decimal)		Days to harvest		Pod yield (kg/decimal)	
	BARI Sheem-1	Goalgadda	BARI Sheem-1	Goalgadda	BARI Sheem-1	Goalgadda	BARI Sheem-1	Goalgadda
1	83	88	70	74	87	88	52	73
2	92	87	66	78	90	88	50	73
3	90	90	64	54	85	86	48	63
4	85	90	54	58	94	96	52	54
5	85	94	55	58	90	90	46	48
6	90	90	52	63	86	85	60	44
7	84	88	65	62	88	86	43	43
8	87	87	50	52	-	-	-	-
9	88	84	49	60	-	-	-	-
Mean	87.11	88.67	58.33	62.11	88.57	88.43	50.14	56.86
Variance	9.61	7.75	62.25	75.11	9.28	13.95	29.47	167.14
CV (%)	3.56	3.14	13.53	13.95	3.44	4.22	10.83	22.74
P(T.=t) two tail	0.27		0.93				0.93	0.22
T critical two tail	2.11		2.17				2.17	2.17

No statistically significant difference in harvest duration ($p > 0.05$), indicating similar maturation behavior of BARI Jharsheem-1 in both districts (Tavle 2). Pod yield is significantly higher in Sylhet ($p < 0.01$). This implies better environmental conditions or agronomic practices contributing to higher productivity (Table 2). Further investigation into soil type, irrigation, fertilizer use, and microclimatic conditions between the districts may provide insights into why Sylhet outperforms Sunamganj in yield.

Table 2: Days to harvest, pods per plant and pod yield of BARI Jharsheem-1 Sylhet and Sunamganj district

Trial No	Days to harvest		No. of pods/plant		Pod yield (kg/decimal)	
	Sylhet (n=8)	Sunamganj (n=6)	Sylhet (n=8)	Sunamganj (n=6)	Sylhet (n=8)	Sunamganj (n=6)
1	59	61	33	25	81	55
2	62	65	33	17	64	46
3	64	64	26	21	63	49
4	61	60	21	18	64	47
5	62	63	23	22	70	58
6	66	64	27	33	61	63
7	63	-	30	-	60	-
8	61	-	23	-	65	-
Mean	62.25	62.83	27.0	22.67	66.0	53.0
CV (%)	3.41	3.09	17.14	25.67	10.24	12.80
P(T<=t) two-tail	0.60		0.16		0.0045	
t Critical two-tail	2.20		2.26		2.20	

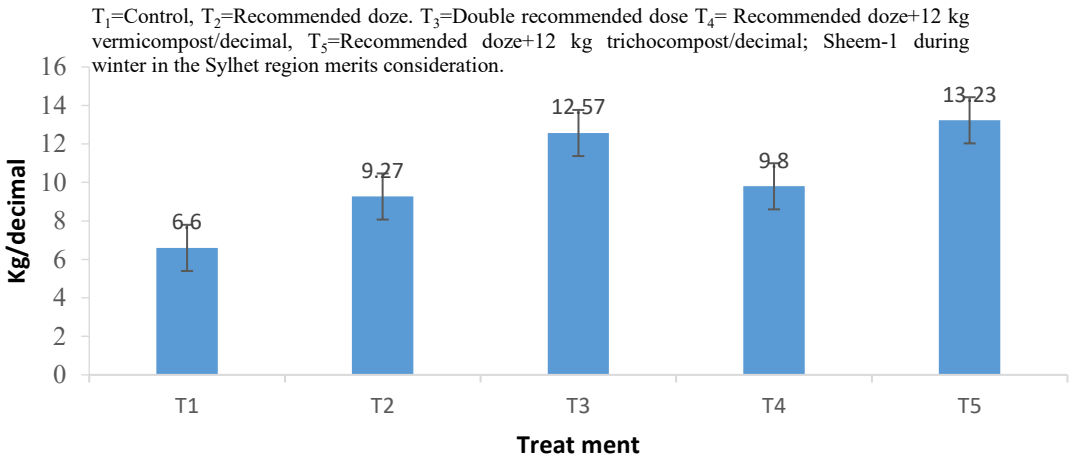


Figure1. Seed yield (kg/decimal) of country bean at different fertilizer management kg/decimal

Increased yields of T5 and T3 suggest additional advantages of using vermicompost and tricho-compost compared to the recommended fertilizer doses alone (Figure 1).



Figure 2. Sikribi Sheem-1, BARI Sheem-1 and Goalgadda sheen at Farmer's field

Conclusion

The findings of the research highlights the successful adaptation and performance of various bean cultivars in the Sylhet region, particularly BARI Sheem-1 and BARI Borboti-1, which showed promising yields. Future programs should focus on enhancing production technologies and quality seed management to further optimize these cultivars for local farmers.

CGP 4th Call

On-going Projects

Project Code & Title: TF 96/SBR/21/585: Upscaling of Improved Water Management Practices for Sustainable Productivity in the Haor areas

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

Component Organization: None

Principal Investigator: Dr. Md. Mahbubul Alam, PSO & Head, IWM Division, BRRI

Location: Tahirpur upazila and adjacent areas in Sunamganj
Budget: Tk. 58,25 Lac

Duration: 17th Nov. 2021 to May 2025 (42 Months)

Introduction: Haor areas are natural depressions along the rivers. Boro is the main and only crop for the haor area. The cultivation of Boro in haor areas are unique and different from other parts of the country. The cultivation and harvest of the Boro crop is earlier than the other areas of the country. The whole areas remain deeply inundated during the monsoon whether severe water scarcity observed during the pre-monsoon time. The yields of Boro in the haor areas are much lower than the potential due to water stress in the reproductive phase. Enhancing water availability in the later stages of growth through the development of infrastructure and the implementation of efficient management practices for irrigation is essential to unlock the full potential of Boro rice.

Objective: Improvement of rice productivity in the haor areas through suitable water management interventions

Materials and methods:
Materials used: HYV (BRRI dhan 67, 89 and 92) and hybrid varieties (BRRI hybriddhan 5 & 8, Syngenta1203, BRAC Hybrid2, BRAC Hybrid777, Chokka, Tejgold, and Babylon-2). The study was conducted in haors of Shanir and Matian in Tahirpur upazila, Sunamgonj district. Twenty-five plots were monitored for drought-related yield loss. STWs were established, and farmers received polythene pipes for river water transport. Twelve demonstrations on AWD irrigation were held using HYV and hybrid rice. Key trials included polythene pipe systems (4), STW check valves (3), and drum seeding for Boro. A survey assessed existing buried pipe water distribution systems in the haor areas, and satellite images were analyzed using remote sensing to enhance irrigation coverage.

Results & Discussion: The yield loss due to less, moderate, severe and very severe water stress plots were 11.3%, 20.1%, 29.4% and 39.6%, respectively (Fig. 1). The curve of yield reduction follows a steep upward trend, emphasizing nonlinear losses. A total of 12 demonstrations were set up on AWD irrigation practice. Yield obtained in the demonstrations were ranges from 7.28 to 10.76 t/ha. Average yield was 8.17 t/ha (Table 1). The yield of the AWD plots were better compared to the adjacent farmers practice (FP) plots. The average irrigation water saving in AWD plots were 16 percent compared to FP plots. Polythene pipe distribution systems saved both irrigation water 32% and irrigation time 21%. Surface-laid PVC pipe distribution system saved both irrigation water 30% and irrigation time 26% (Fig. 2). Installation of check valve in STW offers quick and easier starting without reduction in discharge. Farmers were found not interested in drum seeding method. Surface water body area decreased sharply with the progress of dry season. To ensure supplementary irrigation location specific water management plan is necessary.

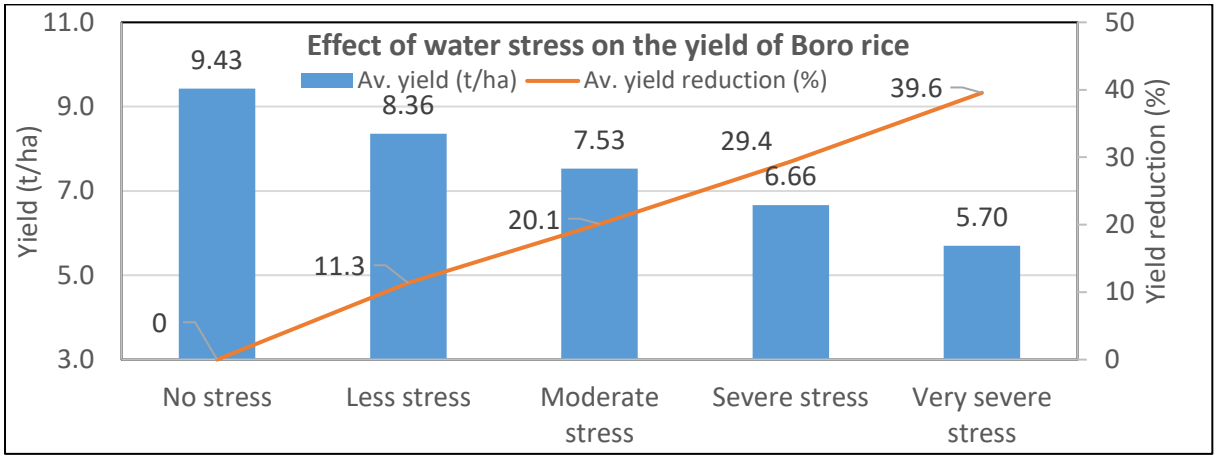


Fig. 1: Mean yield of rice under different categories of water stress with relative yield reduction at Tahirpur, Sunamgonj during Boro season 2023-24.



Fig. 2: Surface-laid PVC pipe irrigation water distribution system (a) Stand tank (b) Outlet

Table 1: Number and depth of irrigations, cumulative rainfall location, and grain yield both in AWD demonstrations and farmers' practice plots during Boro season 2023-24.

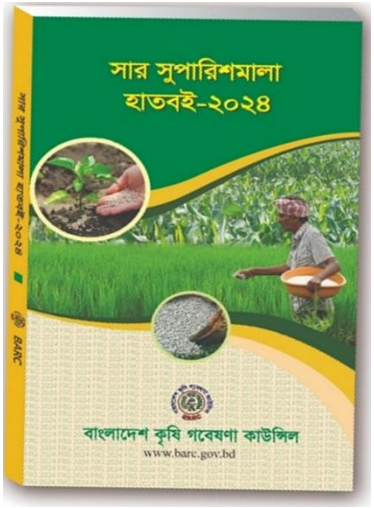
Practice	Farmers' name	Variety	Number of irrigation	irrigation depth (mm)	Rainfall (mm)	Mean yield (Kg/ha)
AWD-1	Abdullah Mamun	BRRI dhan67	5	400	270.4	7932.2
AWD-2	Hazi Rafiqul Islam	BRAC Hybrid2	6	450	271.8	7907.2
AWD-3	Ziaul Haque	Tejgold	6	460	274.4	7283.3
AWD-4	Afroz Ali	Chokka	6	460	274.4	10293.3
AWD-5	Towhid	BRRI Hybrid dhan8	6	460	274.4	10573.9
AWD-6	Morom Ali	BRRI Hybrid dhan8	6	470	274.4	9742.2
AWD-7	Md. Abdullah	BRRI Hybrid dhan5	6	470	274.4	10348.3
AWD-8	Maldar Mia	BRRI dhan92	7	520	274.4	9207.2
AWD-9	Abdul Hakim	BRRI dhan89	7	520	315.9	8078.9
AWD-10	Ashraful Alam	BRRI dhan92	7	520	336.3	10757.8
AWD-11	Bulbul Mia	BRRI dhan92	7	525	271.8	7912.8
AWD-12	Abdul Matlib	BRRI dhan67	6	470	271.8	8920.0
FP-1	Borhanuddin	BRRI dhan67	7	510	271.8	6815.6
FP-2	Mujibor Rahman	BRAC Hybrid777	7	510	271.8	7117.8
FP-3	Nizam Uddin	BRRI dhan92	9	620	274.4	7400.0
FP-4	Babul Chowdhury	BRRI Hybrid dhan8	9	620	274.4	8947.8
FP- 5	Abdul Ali	Babylon-2	8	580	271.8	9082.2
		Average AWD	**6.3**	**477.1**	**282.0**	**9079.8**
		Average FP	**8.0**	**568.0**	**272.8**	**7872.7**
		Water saving (%)		**16.0**		

Conclusion: To address irrigation water scarcity in the Haor area, implementing supplementary irrigation from alternative sources and adopting AWD practices are crucial. Future efforts should focus on enhancing water distribution systems, such as polythene and PVC pipes, to optimize water use and improve agricultural productivity sustainably Check valve makes STW starting quick and easier.

CGP 5th Call

Completed Project

Project Code & Title: TF 104-C/2023. Updating and publication of Fertilizer Recommendation Guide-2023



Implementing Organization: Bangladesh Agricultural Research Council (BARC)

Component Organization: None

Principal Investigator: Dr. Md. Baktear Hossain, Member Director (NRM) (RC) and Director (M&T), BARC, Dhaka.

Location: Dhaka.

Budget: Tk. 60:00 Lakh

Duration: 29 March 2023 to 30 September 2024 (18 months with 8 months no-cost extension)

Introduction: Fertilizer recommendation is a dynamic process in view of the generation of new knowledge, changes in soil fertility, changes in crops/varieties and cropping patterns, etc. along with the associated crop management practices. Soil fertility and fertilizer management research is a regular activity of the crop-based NARS institutes. Fertilizer recommendations for different crops and cropping patterns are being updated regularly under the changing situation. Changes in soil fertilitystatus of the country over time are also being monitored on regular basis. The soils units of Natural Resources Management Division of BARC is mandated to update and publish Fertilizer Recommendation Guide (FRG) at a certain interval. The next FRG will be published under this project fund both in English as "Fertilizer Recommendation Guides-2024" and in Bengali as " সার সুপারিশমালা হাতবই-২০২৪" .

Objective (s): Publishing and disseminate updated fertilizer recommendations guid in english and Bangla ((mvi mycvwikgvjv nvZeB-2024) for diverse cropping patterns across agro-ecological zones in Bangladesh via a user-friendly mobile app of fertilizer recommendations guid (mvi mycvwikgvjv nvZeB-2024) to enhance accessibility, efficiency, and widespread adoption.

Methodologies: Fertilizer recommendations for various crops and cropping patterns across Bangladesh's agro-ecological zones (AEZs) have been updated based on research conducted over the past five years. This includes contributions from NARS institutes and universities since the release of the previous guide in 2018, now compiled into the revised Fertilizer Recommendation Guide (FRG-2024). A team of scientists and expert professionals led the data compilation process, which was subsequently reviewed and refined by a panel under the Editorial Board to ensure scientific rigor and policy relevance.

Results and Discussion: An updated version of the Fertilizer Recommendation Guides in English (FRG-2023) and Bengali: ***mvi mycvwikgvjv nvZeB-2023***) has been published. A mobile app based on the online version ***mvi mycvwikgvjv nvZeB-2023*** has been developed to promote wider access and user-friendly engagement. As part of the dissemination strategy, 2,000 printed copies of the English edition and 25,000 copies of the Bengali version have been published for national outreach.

Conclusion: This initiative strengthens national outreach, ensuring inclusive access to updated fertilizer guidelines through print and mobile platforms, supporting informed decision-making across diverse agricultural stakeholders.

On-going Projects
Project Code and Title: TF-92-FNS/21: Omics Food and Nutritional Security – Platform Technologies to Enhance Crop Genetic Resources and Food Value Chains in Bangladesh (OFANS)

Implementing Organization: Planning and Evaluation Division, Bangladesh Agricultural Research Council (BARC), Farmgate, Dhaka
Component Organization: BARC, BARI, BRRI, BSMRAU, BWMRI, Hortex Foundation, GIFS (Canada).
Principal Investigator (Coordinator): Dr. Md. Abdus Salam, Member Director, Crops Division, BARC.
Location: Farmgate, Dhaka.
Budget: TK 506.025 lakh
Duration: From November 2021 to November 2024 (Proposed for 8 months no-cost extension)

Introduction: Omics technologies are instrumental in enhancing food and nutritional security, with the term 'omics' reflecting a comprehensive approach to biological analysis. Unlike traditional methods that focus on specific biomolecules, omics methods facilitate a broader understanding of biological systems (Prasad 2020). The integration of omics tools in the food sector, aimed at improving consumer trust and promoting health, is termed foodomics (Herrero et al., 2012; Lee Nen That et al., 2022). Recent advancements in omics have led to the development of high-throughput tools that profile various biological samples, pivotal for better insights into crop performance, environmental quality, and human health.

Objective (s):
(i) Genotyping and sequencing a targeted diversity panel of 1000 wheat lines from diverse global germplasm that are enriched for potential wheat blast resistance complemented by existing sequence/genetic resources.
(ii) Collection of seeds of screened wheat blast resistant germplasms (natural and mutagenized) from the IBGE of BSMRAU, CIMMYT, and BWMRI for identifying single seed homozygous blast resistant lines

Materials and Method: The project focuses on two thematic areas through eight components, utilizing diverse materials and methods. It involves genotyping and sequencing of wheat blast resistant germplasms sourced from IBGE of BSMRAU, CIMMYT, and BWMRI. Homozygous blast resistant lines will be selected and grown to extract genomic DNA from wheat seedlings. Additionally, 192 rice germplasm accessions from the Bangladesh rice genebank will be cultivated as part of the research. The project aims to screen approximately 250 germplasm accessions from Bangladesh and Canada for resistance to stem borer (SB) under natural and controlled conditions. Postharvest technologies and human resource development are also key components, enhancing the skills of agricultural scientists. Sequencing will be conducted using Illumina NextSeq 550 at BSMRAU and Illumina NovaSeq and PacBio. GIFS will train graduate students and postdoctoral researchers in research design and execution.

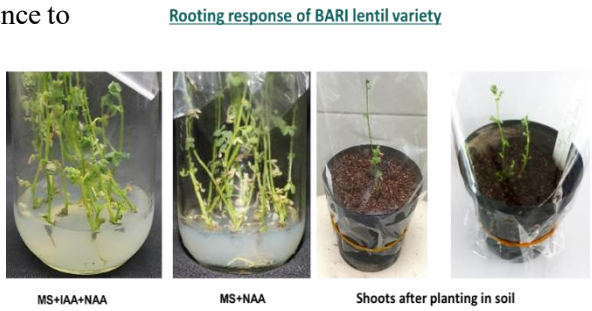
Results and Discussion: Sixteen mutant lines (M6 for gamma ray and M5 for ion beam & X-ray) and 20 F3/F4/Backcrossed populations generated from F1 of the crosses of BARI Gom-26 × S615 and BARI Gom-33 × S615 obtained as highly resistant to wheat blast. Three Chinese lines showed immunity against wheat blast. DNA from 120 selected blast-resistant lines were extracted for genotyping by sequencing and GRAS-Di analysis.Twenty lentil germplasms demonstrated moderate resistance to stemphylium blight (SB), with ongoing evaluations of approximately 300 Canadian germplasms for SB resistance and heat tolerance. In the 2023-24 reporting year, 3-5 germplasms exhibited SB resistance. Usask has flowered



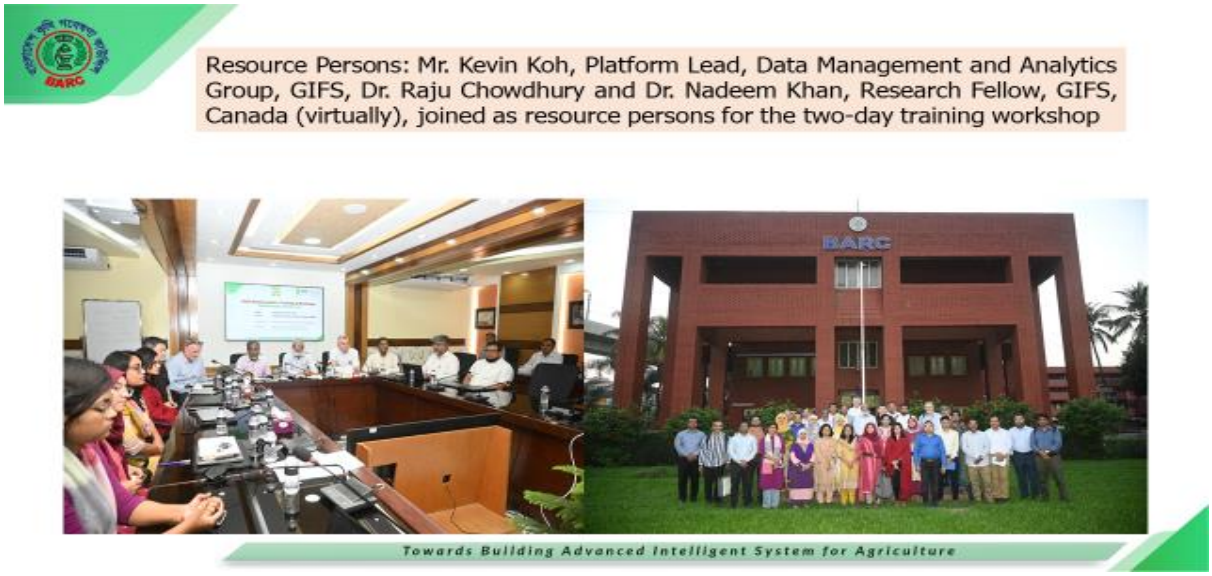
Blast resistant M6 mutant line (right photo) of BARI Gom 27

around 250 germplasms, collecting seeds from about 50. In vitro studies on BARI Masur-4 yielded numerous shoots, with successful grafting. Additionally, BRRI received GBS results for two batches, and 236 germplasm accessions were grown in the Boro 2023-24 season for DNA analysis.

Twenty lentil germplasms exhibited moderate resistance to stemphylium blight (SB). Approximately 300 Canadian germplasms are under evaluation for SB resistance and heat tolerance, with a total of 800 germplasms being screened (400 for each trait). Of the Usask germplasms, around 250 have flowered, and seeds from about 50 have been collected. In the 2023-24 reporting year, 3-5 germplasms showed SB resistance. *In vitro* studies on BARI Masur-4 resulted in many shoots, with successful grafting and seed collection from the grafted plants.



Three sessions on Introduction to Linux and three on Introduction to R were conducted, with 33 participants each. A two-day Bioinformatics Training Workshop attracted 35 researchers from various institutions.



Conclusion: Recent breakthroughs in resistance breeding, genotyping, and institutional training have positioned Bangladesh's research ecosystem for climate-resilient crop innovation. To build on this progress, sustained funding is essential for expanding trait discovery, technical capacity, and genetic resource utilization—ensuring long-term agricultural resilience and food security.

Project Code and Title: TF 103-SBR/21: Sorjan Based Eco-Friendly Farming Systems Research for Agricultural Intensification in Southern Bangladesh

Implementing Organization: Bangladesh Agricultural Research Institute, Regional Horticulture Research Station, Lebukhali, Dumki, Patuakhali.
Component Organization: None
Principal Investigator: Dr. Md. Alimur Rahman, PSO, BARI, RHRS, Lebukhali, Dumki, Patuakhali.
Location(s): Barishal (Babuganj and Banaripara), Bhola (Charfashion), Jhalakati (Sadar) and Pirojpur (Nesarabad upazila)
Budget (Total): Tk. 59.98 lakh

Duration: 18/11/2021 to 17/07/2025 (44 months with no cost extension)

Introduction: In the Barishal region, about 21% of land is used for a single crop under the T.aman/Boro rice/Winter crop-Fallow-Fallow pattern, mainly due to salinity, waterlogging, poor irrigation, and tidal

flooding. Farmers have relied on the traditional sorjan system, which features alternating raised beds and sinks, for nearly 200 years to grow local vegetables and fruits. However, productivity is low due to a lack of modern sorjan technologies and poor resource management. By optimizing sorjan spaces, farmers could grow vegetables, fruits, spices, and fish year-round. Additionally, shade-tolerant crops like pineapple, turmeric, and ginger could be added to fruit orchards on sorjan beds. Implementing sorjan-based farming could greatly improve agricultural productivity and profitability in the region.

Objective: To develop location specific sorjan based cropping patterns and improve management practices and to integrate crops (vegetables, fruits and spices), fisheries.

Materials and Methods: To achieve the objectives, the following experiments were conducted in Barisahal and Pirojpur districts:

a) Performances of turmeric varieties under existing guava and golden apple orchards
b) Intercropping of vegetables with newly planted BARI Peyara-2 orchard
c) Effects of USG and NPK briquette on the yield of sweet gourd and bottle gourd
d) Performances of fish species in sorjan canals
e) Improvement of agronomic practices for guava and golden apple
f) Intercropping brinjal with other vegetables
g) Intercropping of cauliflower and leafy vegetables
h) Intercropping pineapple under existing guava and golden apple orchards, and
i) Design and development of a power - operated rotary tiller for sorjan farming systems.

Results and Discussion: Among the cropping patterns on sorjan beds, treatment Chili – Brinjal + Chili – Brinjal) achieved the highest cumulative economic yield (CEY) of 35.36 t/ha, followed by Chili – Chili – Brinjal with a yield of 30.80 t/ha. The treatment with Ridge gourd, Ash gourd, and Bottle gourd yielded the highest bottle gourd equivalent yield (BEY) of 126.57 t/ha on sorjan trellises. The Guava inter-cropping system with Ridge and Bottle gourd achieved a maximum guava equivalent yield of 54.33 t/ha. The yield of guava was notably higher in intercropped areas, reaching 73.29 t/ha with pineapple and 72.41 t/ha with golden apple, compared to 28.13 and 28.17 t/ha in sole crops.

Improved management techniques of Earthing up, RDF fertiliser, removal of dead branches, pesticide application led to the highest guava yield (37.30 t/ha) and total soluble solids (15.10%). The combination of earthing up, pesticide use, and suggested fertilizer amounts resulted in a peak yield of golden apple fruit at 23.97 t/ha, a 43.36% rise compared to the control (farmers' method). Furthermore, this approach yielded the longest shelf life of 9.25 days.
Cultivating BARI Halud-4 and BARI Halud-5 in the golden apple orchard on sorjan beds is beneficial, yielding 31.24 and 28.16 t/ha, with economic returns of Tk. 1077727 and 923615/ha, respectively. The guava orchard in the Pilot production program produced 36.26 t/ha. Planting Napier and Pakchong grasses on the sorjan slope may be advantageous. Rearing Tilapia and sorputi fish in the canal can increase farmers' income. The IPM pest management approach using 'Bio-clean (D-Limonene 5% SL)' at 1 ml/L for sucking pests, along with sex pheromones for fruit flies, effectively reduced infestations and improved yields.

Growth performance of different treatment of stududies in Sorjan Based Farming Systems **(**SBFS) are illustrated in picture 1-5.

Conclusion: The study highlights the significant benefits of diverse cropping patterns and improved management techniques on sorjan beds, leading to enhanced yields and economic returns. Rearing of Tilapia and sorputi fishes in sorjan canal are suitable for increasing farmers’ income. Future plans should focus on promoting sustainable practices and integrating aquaculture to further boost farmers' income and environmental health.





Field trial of Intercropping of turmeric in golden apple orchard on SBSF (Bermahal, Sadar, Jhalakati)





Off-season production of BARI Peyara-2 orchard in SBSF (Banaripara, Barishal)

Project Code and Title: TF 105-C/23. Smart detection of rice disease and insects through 4IR technologies.

Implementing Organizations: Bangladesh Rice Research Institute (BRRI)
Component Organization: None
Principal Investigator: Md. Mahfuz Bin Wahab Programmer, ICT Cell, BRRI
Locations: BRRI head quarter (HQ) and all regional stations (R/S)
Budget: TK 3500.00 Thousands
Duration: From 24 May 2023 to 23 May 2026

Introduction: Bangladesh is advancing its smart agriculture initiatives by utilizing Fourth Industrial Revolution (4IR) technologies, such as Artificial Intelligence (AI), the Internet of Things (IoT), and machine vision to enhance the monitoring of pests and diseases. By extracting texture, color, and shape features from crop images, real-time decision-making becomes faster and more targeted. This shift is critical for boosting yields and mitigating climate-induced risks. Initiatives like BRRI's 'Rice Solution' app offer scalable solutions aligned with the National ICT Policy-2018 and the AI Strategy (2019–2024), promoting data-driven, efficient interventions. These technologies ensure precision farming and integrated advisory support, fulfilling the nation's goal of digitizing agriculture for food security and resilience.

Objective: To develop AI-based image analysis for rice disease and insect detection, create a real-time monitoring system, generate spatio-temporal reports, and integrate these with a centralized digital dashboard.

Materials and Methods: The system has following the standard code convention, code level documentations, header of each file, algorithms, interfaces, code compression. Image sensors used through 'Rice Solution' mobile app for timely capturing accurate, precise and high resolution images of insect and disease of rice from different locations of the country. When any insect and disease is detected, this real time data has sent to the cloud server for further processing through an artificial neural network (ANN).

Results and Discussion:
Developed and uploaded a platform as mobile into Google Play Store and Apple App Stored (iPhone) named as 'Rice Solution. Image analysis sensor has been developed through AI and Machine Learning Method (MLM). Approximately 56000 images of several disease and insect have been stored and

trained through AI and MLM technology. Image have been stored in government cloud server (eGovCloud). BRRI has paid cloud server and data center service charges every month. Leveraging existing cloud infrastructure and operational funding, the application is primed for sustainable delivery, national integration, and long-term impact on crop health and farmer resilience. Mobile app is available in for Google play store:
https://play.google.com/store/apps/details?id=com.brriapps.
Mobile app is available in for Apple App (iPhone) store:
https://apps.apple.com/us/app/rice-solution/id1663661762

Overall Benefits:
Recent advancements in resistance breeding, genotyping, and training have enhanced Bangladesh's research capabilities for climate-resilient crops. Continued funding is crucial for expanding trait discovery and genetic resource use, ensuring long-term agricultural resilience and food security.

Project Sustainability
BRRI utilizes a paid subscription for cloud services, covering hosting, maintenance, and security. It aims to enhance agricultural extension services by fostering partnerships with NARS institutions and ICT agencies to improve data infrastructure and support continuous capacity-building for field officers and farmers.

Conclusion
Bangladesh's agricultural systems are facing growing threats from climate change, pest resurgence, and disease proliferation. This app not only supports rice crop protection but can be tailored for the protection of other crops. Thus the initiative aligns with national priorities on smart agriculture, food system resilience, and digital agricultural transformation.

Home page of 'Rice Solution' Mobile app



Collection of different types of images of disease and insects affected rice plant from several areas



Project Code and Tittle: TF 106- C/23. Processing and preservation of fruits (pineapple, banana, papaya) in Madhupur Region

Implementing Organization: Bangladesh Agricultural University, Mymensingh
Principal Investigator: Prof. Dr. Poly Karmoker, BAU
Location: Bangladesh Agricultural University and Madhupur
Budget: Tk. 50.00 Lack
Duration: 24 May 2023 to 23 May 2026 (36 months)
Introduction: Bangladesh produces huge amounts of fruit and vegetable annually. Madhupur region is well known for Pineapple production as well as other fruits like banana, papaya etc. Most fruits and vegetables are highly perishable, spoilage after harvest is also a significant issue; in Bangladesh, losses could range from 24 to 44%, according to Hassan (2010). If these perishables are processed in to shelf stable products, like dried item, flakes, chips etc. the financial return will be expected by the growers as well as post-harvest loss of the commodities will be reduced to a greater extent.

Objective: The objectives of the project are to process pineapple, banana and papaya to dried and fried form and provide training to ethnic farmer and entrepreneurs on the processing techniques.

Materials and Methods: Pineapple, papaya, and bananas were sourced from Madhupur, Bangladesh, and processed into dehydrated products. Pineapple and bananas were transformed into self-stable osmotically dehydrated air-fried chips, while green papaya was made into osmotically dehydrated flakes. The fruits were peeled, washed, and cut into various thicknesses: 2mm, 4mm, and 6mm for pineapple and bananas, and 4mm, 6mm, and 8mm for papaya. Osmotic dehydration involved sugar solutions of varying concentrations (20%, 30%, and 40% for pineapple and bananas; 30%, 40%, and 50% for papaya). The study assessed heat and mass transfer kinetics, along with nutritional and sensory evaluations.

Results and Discussions: The study focused on preparing osmotic dehydrated air-fried pineapple chips, identifying a 30% sugar solution as optimal for sensory attributes. Pineapple slices of varying thicknesses (2mm, 4mm, 6mm) were treated with the sugar solution, dried, and air-fried at temperatures of 100°C, 110°C, and 120°C. Results indicated that frying time significantly influenced color change (Fig 1), while increasing temperature led to a decrease in protein content, vitamin C, and pH levels, alongside an increase in ash, fat, and crude fiber. The frying rate was affected by both air temperature and slice thickness, with thicker samples requiring longer frying times (Fig 2). The activation energy was highest for the 2mm thickness at 9.015 kcal/mole. Two packaging materials, HDPE and PET, were tested for their impact on the physicochemical properties of the chips. Vitamin C and pH levels decreased more in PET than in HDPE, which also provided better stability for color parameters during a 21-day storage period. The study concluded that osmotic solution concentration and slice thickness significantly affect the properties of dehydrated products, with HDPE packaging yielding the best quality for both pineapple and papaya flakes.

Conclusion: In conclusion, the study highlights the critical role of osmotic solution concentration and slice thickness in enhancing the quality of air-fried pineapple chips, with HDPE packaging proving superior for maintaining sensory attributes. These findings pave the way for further advancements in dehydrated fruit products in the 2nd year activities.

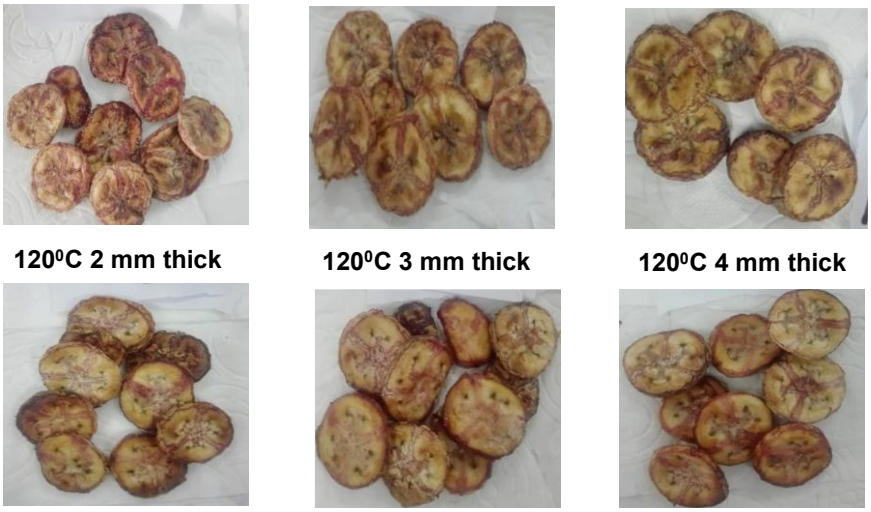


Fig.1 Air fried Banana chips

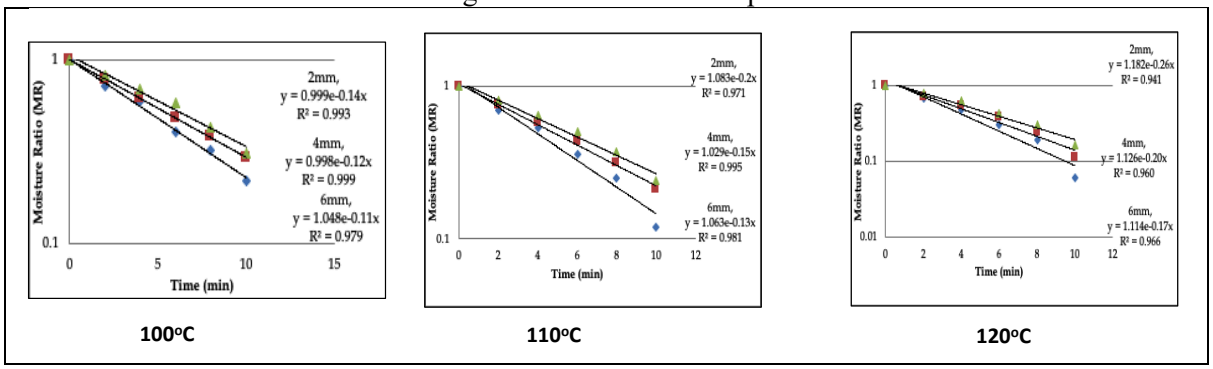


Fig 2. Kinetic behavior of the air fried pineapple chips prepared with 30% osmotic sugar solution

Project Code and Title: TF 107-C/23: Insecticide Resistance and Resurgence Management of Tungro Disseminating Green Leafhopper, *Nephotettix virescens* (Distant)

Implementing Organization: Bangladesh Rice Research Institute
Component Organization: None
Principal Investigator: Dr. Md. Nazmul Bari, BRRI
Location(s): BRRI, Gazipur, Cumilla and Rangpur region
Budget: 35.00 (lakh)
Duration: 24 May 2023 to 23 May 2026 (36 months

Introduction: The green leafhopper (GLH), *Nephotettix virescens* (Distant) (Homoptera: Cicadellidae), is a major insect vector responsible for transmitting rice tungro disease. Since the mid-1960s, GLH has been considered a significant pest in Bangladesh (Islam and Catling, 2012). Regions such as Cumilla, Rangpur, Sylhet, Mymensingh, Chattogram, and Barishal are particularly vulnerable due to frequent infestations and substantial yield losses. Tungro outbreaks occur every two to three years, severely impacting rice production (BBC, 2021). The disease is especially problematic in the Aus, T. Aman, and Boro seasons. Farmers rely heavily on pesticides, but increasing resistance has led to reduced effectiveness and higher control costs (Yu et al., 2012; Bao et al., 2016; Matsumura et al., 2018).

Objective: Investigate GLH insecticide resistance, assess natural enemies in management, verify hand net control effectiveness, and evaluate GLH and natural enemy populations in hotspots.

Materials and Methods: Surveys were conducted in Cumilla and Rangpur regions during Aus, T. Aman 2023, and Boro 2023-24 to monitor GLH and natural enemies in rice seedbeds and fields. Data were collected using rectangular and round sweep nets at five locations in each region. GLH populations were mass-reared for over 15 generations in BRRI net houses using potted BR3 plants, maintained under controlled conditions. Eggs were laid by gravid females and nymphs were reared to adulthood to supply consistent test populations. Six insecticide groups (Carbamate, Organophosphate, Neonicotinoids, Nereistoxin analogue, IGR, and Organophosphate + Pyrethroids) were tested following IRAC method 005. Treated seedlings were exposed to GLH nymphs, and mortality was recorded at 24-72 hours post-treatment.

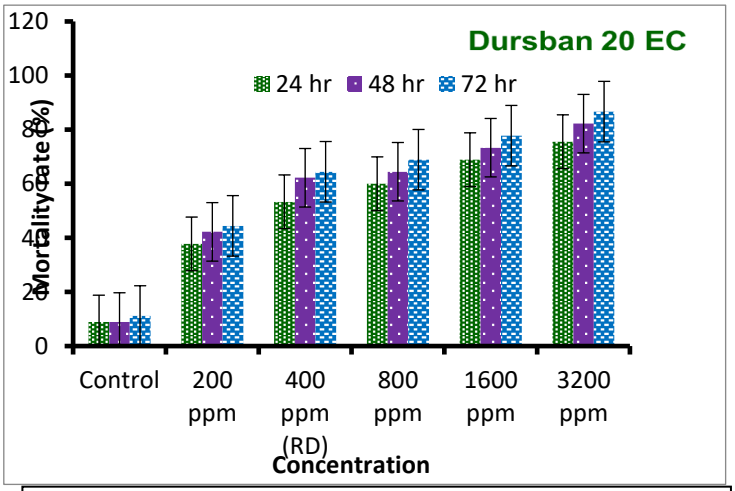


Fig. 1: Mortality rate of GLH in a greenhouse population after the application of Dursban 20EC,

Results and Discussion: Field surveys conducted in Cumilla and Rangpur across the Aus, T. Aman, and Boro seasons revealed distinct patterns in GLH and natural enemy populations. Approximately 1,400 GLH populations were collected and used for rearing and further experiments. Cumilla exhibited lower abundance and diversity of natural enemies compared to Rangpur, where various predatory species including ladybird beetles, spiders, long-horned grasshoppers, damsel flies, and dragonflies-were frequently observed. This variation suggests that ecological factors and cropping practices influence predator presence and pest resurgence. Insecticide susceptibility tests using six chemical groups showed varied efficacy (data not shown). Dursban 20 EC shows effectiveness against GLH, even at higher doses, suggesting potential insecticide resistance. Mortality rates increase with concentration and exposure time, peaking at 3200 ppm after 72 hours (Fig 1). Environmental impacts necessitate adherence to recommended doses for safety.

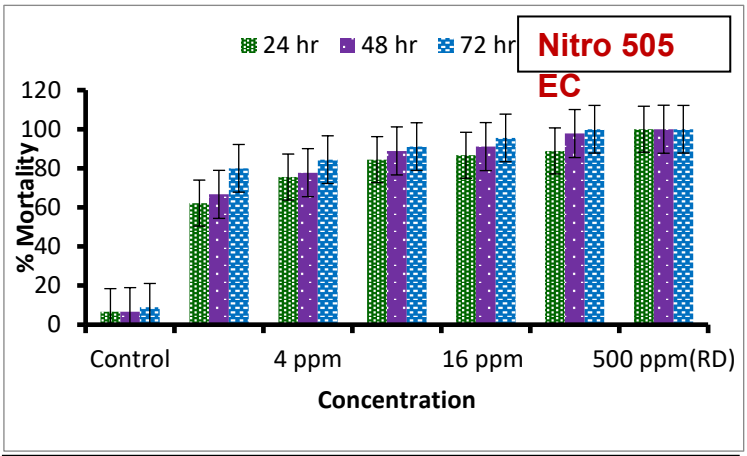


Fig. 2: Mortality rate (%) of GLH in a greenhouse population after the application of Nitro 505 EC

In contrast, Nitro 505 EC demonstrates high efficacy against GLH, achieving over 90% mortality at 32 ppm and 500 ppm within 72 hours, indicating a strong dose- and time-dependent response for rapid pest control. Other insecticides like Cartap 50 SP, Confidor 70 WG, and Award 40 SC also proved effective at standard doses, making them viable options for GLH management.





Photo 1: IRAC Susceptible Test Method, Photo 2: Sweep netting method of collecting GLH

Conclusion: These findings highlight the urgent need for integrated pest management strategies that consider ecological balance, minimize resistance development, and incorporate biological control agents for sustainable GLH suppression.

Project code and Title: TF 108-C/23. Integrated Management of Arthropod Pests of Malta and Dragon Fruit Crops in Madhupur Tract of Bangladesh

Implementing organization: Gazipur Agricultural University, Gazipur, Bangladesh
Principal Investigator: Prof. Dr. Md. Ruhul Amin, Department of Entomology, GAU
Location(s): Madhupur, Dhanbari and Ghatail Upazila of Tangail district, Bangladesh
Budget: TK 29.904 Lakh
Duration: From 24 May 2023 to 23 May 2026 (36 months)

Introduction: Farmers of the Madhupur tract are not well updated with the modern production technologies, and arthropod pest management of Malta and Dragon fruits, because due attention has not been paid in this region. Due to lack of information and knowledge on insect and mite pests, Malta and Dragon fruit growers of Madhupur tract are solely relied on highly toxic pesticides to overcome the pest problems. Now-a-days, consciousness among the consumers have arisen for getting safe and nutritious food. As a result, cultivation of fruit crops with judicious use of pesticides is highly encouraged.

Objective: To increase productivity of Malta and Dragon fruits by enhancing the knowledge of the farmers and giving reasonable supports to them.

Materials and Methods: The current project is implementing through periodic survey and monitoring, and consultation with scientists, extension workers and farmers. Training program has been arranged at the beginning of the project year at Madhupur upazila, Tangail. The selected farmers (30 persons) participated in the training program for acquiring knowledge on identification of arthropod pests (insects and mites), natural enemies of the pests (predators and parasitoids), pollinator insects and integrated pest management. The farmers who attended the training program realized modern production and protection technologies, and appropriate use of agrochemicals, are directly contributing to the safe fruits production substantially.

Results and Discussion: Thirty selected farmers were trained on the identification of arthropod pests (insects and mites), natural enemies of the pests (predators and parasitoids), pollinator insects, and integrated pest management. A total of 33 species of arthropods were identified within the Malta ecosystem. Of these, 6 species were classified as major pests, 7 species as minor pests, 6 species as predators, 2 species as pollinators, and 12 species as casual visitors. Scale insect, mealy bug, Asian psyllid, lemon butterfly, leaf miner and citrus mite were found as major arthropod pests in the Malta ecosystem (Table 1). The rank abundance of the harboured arthropods showed that the major pest,

namely the scale insect, occupied the highest rank with 25.1% abundance. The other major arthropods viz, citrus mite, Asian psyllid, mealy bug, leaf miner and lemon butterfly showed 11.6%, 11.4%, 9.4%, 3.7% and 0.2% abundances, respectively (Fig. 1). Citrus bark borer, root weevil, lace wing, carpenter bee, cabbage butterfly and hog-palm beetle depicted the lowest rank with 0.2% abundance individually.

Table1. Encountered insect and mite species and their harbored categories in Malta fruit crops in Madhupur tract of Bangladesh

Category	Species
Major pests	Scale insect *Anoidiella aurantia (*Hemiptera: Coccidae) Mealy bugs *Planococcus citri (*Hemiptera: Pseudococcidae) Asian psyllid *Diaphornia citri (*Hemiptera: Psyllidae) Leaf miner *Phyllocnistis citrella (*Lepidoptera: Gracillariidae) Lemmon butterfly *Papilio demoleus (*Lepidoptera: Papilionidae) Citrus mite *Phyllocoptruta oleivora (*Acarina: Eriophyidae)
Minor pests	Aphid *Toxoptera citricida (*Hemiptera: Aphidoidae) Citrus bark borer *Prays endocarpa (*Coleoptera: Cerambycidae) Root weevils *Diaprepes abbreviates (*Coleoptera: Curculionidare) White fly *Dialeurodes citri (*Hemiptera: Aleyrodidae) Fruit flies *Bactrocera dorsalis (*Diptera: Tephritidae) Epilachna beetle *Epilachna* 12-punctata (Coleoptera: Coccinellidae) Squash bug *Anasa tristis* (Hemiptera: Coreidae)
Predators	Ladybird beetle *Coccinella septempunctata (*Coleoptera: Coccinellidae) Syrphid fly *Spaerophoria philanthus (*Diptera: Syrphidae) Lacewing *Crysoperla carnea (*Neuroptera: Crysopidae) Ground beetle *Promecognathus laevissimus (*Coleoptera: Carabidae) Mirid bug *Helopeltis* sp. (Hemiptera: Miridae) Leaf-footed bug *Leptoglossus phyllopus (*Hemiptera: Coreidae)
Pollinators	Honey bees *Apis spp.* (Hymenoptera: Apidae) Carpenter bee *Halictus sp* (Hymenoptera: Apidae)
Casual visitors	Green leaf hopper *Cicadella viridis (*Homoptera: Cicadellidae) Green stink bug *Nezara viridula* (Hemiptera: Pentatomidae) Flea beetle *Phyllotreta Cruciferae* (Coleoptera: Chrysomelidae) Ant *Camoponotus compressus* (Hymenoptera: Formicidae) House fly *Musca domestica* (Diptera: Muscidae) Cabbage butterfly *pieris brassicae* (Lepidoptera: Pieridae) Sulphur butterfly *Phoebis sennae* (Lepidoptera: Pieridae) Black ant *Lasius niger* (Hymenoptera: Formicidae) Red ant *Myrmica rubra* (Hymenoptera: Formicidae) Mosquitoes *Anopheles* spp. (Diptera: Culicidae) Grasshopper *Schistocerca Americana (*Orthoptera: Acrididae) Hog-palm beetle *Podontia quatuordecimpunctata* **(**Coleoptera: Chrysomelidae)

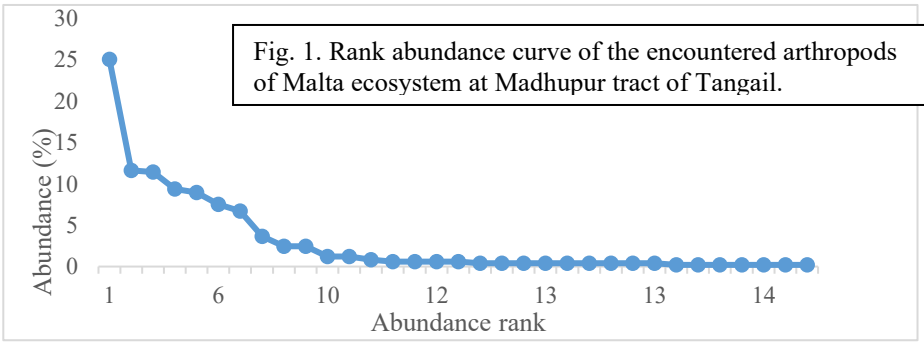


Fig. 1. Rank abundance curve of the encountered arthropods of Malta ecosystem at Madhupur tract of Tangail.

Conclusion: Identifying 33 arthropod species in Malta is vital for improving integrated pest management. Training farmers to recognize pests and beneficial insects supports agroecosystem stability and aligns with climate-resilient agriculture principles. Additional funding for training and research on arthropod species could further enhance sustainable agricultural practices.

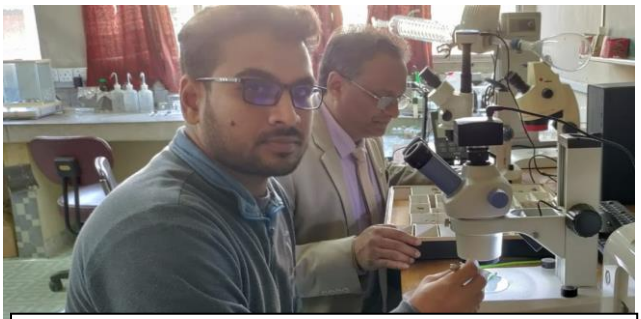


Photo 1: Collection, identification and preservation of arthropod species.

Project Code and Title: TF 109-C/23: Title: Development of processing, preservation and marketing techniques for value addition of major spices crops

Implementing Organization: Spices Research Centre (SRC), BARI, Shibgonj, Bogura
Component Organization: None
Principal Investigator: Dr. Md. Masud Alam, Principal Scientific Officer, SRC, BARI, Shibgonj, Bogura
Location: SRC, Shibgonj, Bogura, BARI, Gazipur, Bandarban
Budget: Tk. 30.11 lakh
Duration: From 24 May, 2023 to 23 May, 2026 (36 Months)

Introduction: Onion, garlic, ginger, and chili are essential spices in Bangladesh, often leading to surplus during harvest seasons, which subsequently drives down market prices and negatively impacts farmers. Inadequate storage facilities contribute to significant post-harvest losses, estimated between 20-40% according to the BARI Annual Report of 2020, primarily due to respiration, transpiration, and microbial activity. Notably, BARI summer onion, ginger, and green chili can only be stored for up to 15 days at ambient temperatures. With annual import costs exceeding a thousand crore taka for these spices, developing efficient processing methods for surplus crops could significantly reduce waste, ensure fair prices for farmers, and encourage increased production of spice crops.

Objective: The project aims to enhance major spice crops by value-addition, ensuring their quality and stability, and promoting effective packaging and training for successful market integration.

Materials and Methods: The research works were conducted at the laboratory of Spices Research Center (SRC) under Bangladesh Agricultural Research Institute (BARI), Bogura. Location of the study were SRC, Bogura, Gazipur and Bandarbon.
Methodologies followed:

1st experiment
1. Optimization of processing parameters for onion and garlic paste separately
2. Standardization of packaging and storage temperature on quality and shelf life of onion paste
The onion and garlic pastes was prepared by blending sliced onion in a blender/crusher using 100 ml water per kg of sliced onion and garlic.
Treatments:

a) T_1- spice paste with 10% salt + 1% citric acid + 1000ppm sodium benzoate
b) T_2- Spice paste with 10% salt + 1% citric acid + 1000ppm potassium metabisulphite
c) T_3- Spice paste with 1% citric acid and
d) T_4- Spice paste was collected from local market.

Data were recorded on pH, TSS, colour, flavor, texture, overall acceptability, shelf life, composition analysis and microbiological study.

2nd experiment
Onion and garlic pastes were treated separately in three ways:

a) T_1- Glass container at room temperature (25-30^0 C)

b) T_2- Glass container at refrigerated temperature (10^0 C)
c) T_3- Plastic container (Food grade)/Foil packet at room temperature (25-30^0 C) and
d) T_4- Plastic container (Food grade)/Foil packet at refrigerated temperature (10^0 C).

Data were collected on Paste pH, acidity, TSS, sensory evaluation, shelf life, composition analysis and microbiological study. The acceptability of developed onion and garlic products was evaluated by taste-testing panel using 1-9 hedonic scale (Pawar*et al*., 2011). CDR design with 15 replications of the experiment was followed.

Results and Discussion:
The shelf life of onion and garlic pastes was assessed under room/ambient (25–30°C) and refrigerated (7–10°C) conditions using various preservation treatments and packaging materials. The results are summarized in Table 1.

Onion Paste
Preservative Effectiveness: Treatments incorporating preservatives (T_1 and T_2) significantly extended shelf life. T_2 (10% NaCl + 1% citric acid + 1000 ppm potassium metabisulfite) achieved the longest shelf life of 270 days in glass bottles under ambient conditions, outperforming T_1 (with sodium metabisulfite) which reached 180 days.

Packaging Influence: Glass bottles consistently provided better preservation than plastic pots, particularly under ambient conditions. For instance, T_2 showed a 120-day increase in shelf life in glass compared to plastic.

Refrigeration Benefit: Refrigerated storage enhanced shelf life across all treatments. T_3 (1% citric acid only) improved from 75 days (glass, ambient) to 150 days (glass, refrigerated).

Commercial Comparison: The purchased onion paste (T_4) exhibited lower shelf life (60 days in plastic at room temperature and 90 days under refrigeration), indicating inferior preservation compared to T_1 and T_2.

Garlic Paste
Preservation Trends: Similar to onion paste, T1 and T2 yielded the highest shelf life. T2 reached 210 days at room temperature in glass bottles, while both T1 and T2 maintained 270 days under refrigeration.

Table 1: Shelf life (days) of onion and garlic pastes under room/ambient and refrigerated Temperature

Onion paste	Room/Ambient temperature (25-30^0C)		Refrigerated temperature (7-10^0C)	
	Glass Bottle	Plastic Pot	Glass Bottle	Plastic Pot
T_1-10% NaCl + 1% CA+1000 ppm $Na_2S_2O_5$	180	180	270	270
T_2-10% NaCl + 1% CA+1000 ppm KMS	270	150	270	270
T_3-1% CA	75	60	150	120
T_4- Purchased onion paste (From Dhaka Super Shop)	-	60	-	90
Garlic Paste				
T_1-10% NaCl + 1% CA+1000 ppm $Na_2S_2O_5$	180	180	270	270
T_2-10% NaCl + 1% CA+1000 ppm KMS	210	150	270	270
T_3-1% CA	60	60	120	120
T_4- Purchased onion paste (From Dhaka Super Shop)	-	60	-	90

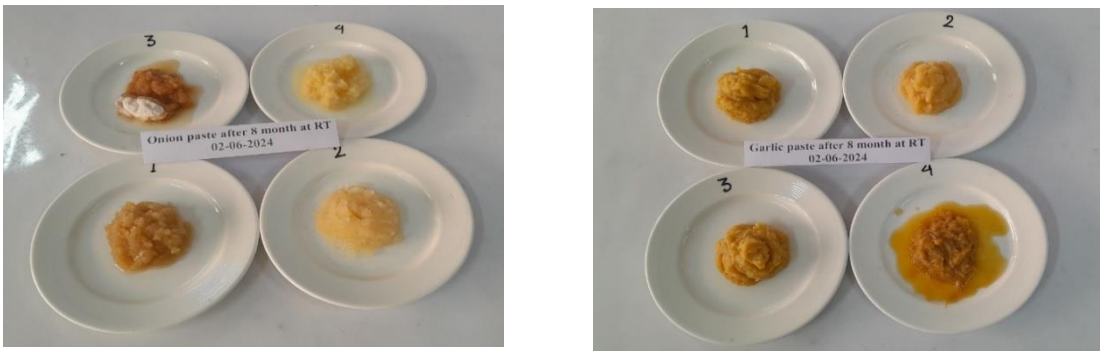


Fig. 1: Onion and garlic pastes after 08 month (240 days) at room temperature



Fig. 2: Onion and garlic pastes after 08 month (240 days) at Refrigerated temperature (RMT)

Conclusion: Onion and garlic pastes treated with salt, citric acid, and preservatives ($Na_2S_2O_5$ or KMS) showed significantly extended shelf life, especially in glass bottles and under refrigeration. T2 was most effective. Commercial samples had shorter shelf life, highlighting the need for improved preservation methods and packaging to enhance product stability.

Project Code and Title: TF 111-C/23. Integrated management of rugose spiralling whitefly in coconut.

Implementing organization: Bangladesh Agricultural Research Institute (BARI), Gazipur
Component organization:
Principal Investigator: Dr. Nirmal Kumar Dutta, Chief Scientific Officer & Head
Entomology Division, BARI, Gazipur
Location(s): Barishal, Jashore & Gazipur (Natural enemy survey and collection to be done across the country)
Budget: Tk. 30.00 Lakh
Duration: May 2023 to April 2026 (36 months)

Introduction: Bangladesh, characterized by its tropical climate and high humidity, facilitates free trade and the movement of agricultural goods. However, this environment also makes the country susceptible to invasive pests. One such pest, the rugose spiralling whitefly (RSW), was first identified in May 2019 on coconut plants in the Jashore region. This pest has been found on 61 different host plants, with coconut being the most severely affected. In light of these challenges, a project was initiated to develop and promote sustainable management strategies for controlling the rugose spiralling whitefly in coconut cultivation.

Objective: To develop and promote a sustainable integrated management package to combat the rugose spiralling whitefly affecting coconut.

Materials and Methods: A field survey was carried out across the districts of Gazipur, Barishal, Patuakhali, Jashore, Satkhira, Bogura, Rangpur, and Noakhali from September 2023 to March 2024 to evaluate the prevalence of natural enemies of pests. Concurrently, field experiments were conducted at RARS in Jashore and Barishal to assess the effectiveness of various bio-pesticides against the rugose spiraling whitefly infesting coconuts. Heavily infested coconut leaves were collected and analyzed in the IPM lab at BARI in Gazipur, where the rates of parasitism and adult emergence of nymphal parasitoids were recorded. Additionally, research focused on reduced-risk insecticides, insect growth regulators, and microbial biopesticides targeting the same pest.

Results and Discussion: Two types of parasitoids were discovered attacking RSW nymphs in the examined regions, identified as Encarsia guadeloupae Viggiani and Encarsia dispersa Polaszek. Field surveillance across eight agricultural zones in Bangladesh revealed significant variation in parasitization rates of target pests. The highest mean parasitization (26.47 ± 1.64%) and adult emergence (20.05 ± 0.43%) was recorded in Barishal closely followed by Jashore (21.73 ± 1.23%; 17.83 ± 0.88%). In contrast, Rangpur exhibited the lowest parasitization (9.8 ± 0.9%) and emergence (7.87 ± 0.76%), suggesting reduced parasitoid establishment or host density. Moderate to high emergence rates in Bogura (13.99%) and Noakhali (13.37%) suggest favorable ecological compatibility despite slightly lower parasitization, indicating potential for scaling targeted biocontrol. Lower standard error of each mean vale indicating relatively tight confidence around this estimate due to consistent sampling. Coefficients of variation remained below 10% for both indicators, ensuring consistency and reliability in sampling. Field experiments identified bioclean 5% SL (D-limonene) as a promising biopesticide against rugose spiralling whitefly in coconut. Insecticides Imunit 15 SC and Gladius 10 SC also showed effectiveness. Microbial biopesticides demonstrated moderate efficacy (52-61%) (data not shown). These findings will inform the development of an Integrated Pest Management (IPM) package in the project's second year.



Fig. 01: Collection of rugose spiralling whitefly samples from coconut plants



Fig. 02: Field view of evaluation trial of reduced risk insecticides against rugose spiralling whitefly

Table1. Location wise parasitization (%) and adult emergence (%) of nymphal parasitoids of rugose spiraling whitefly during September 2023 to March 2024

Location	Percent Parasitization (Mean ±SE)	Percent Parasitiod adult emergence (Mean ±SE)
Gazipur	14.64 ± 1.65d	9.02 ± 1.01de
Noakhali	20.02 ± 1.49bc	13.37 ± 1.04bc
Rangpur	9.8 ± 0.9e	7.87 ± 0.76e
Satkhira	13.94 ± 2.01d	10.98 ± 0.82cd
Bogura	17.33 ± 1.57b-d	13.99 ± 0.99b
Jashore	21.73 ± 1.23ab	17.83 ± 0.88a
Barishal	26.47 ± 1.64a	20.05 ± 0.43a
Patuakhali	16.69 ± 1.40cd	11.44 ± 0.74cd
CV (%)	9.78	8.09

NB: Means having same letter(s) in a column did not differ significantly by LSD ($P < 0.05$). Data were transformed "square root" prior to ANOVA; non-transformed means are presented.

Conclusion: The study highlights significant regional variations in parasitoid effectiveness against RSW nymphs, emphasizing the potential for targeted biocontrol strategies and the development of an Integrated Pest Management package in Bangladesh. The result also emphasizes the necessity for additional funding to improve pest control initiatives in Bangladesh.

Project Code and Title: TF 112-C/23. Bio-ecology and morpho-molecular characterization of rugose spiralling whitefly and evaluation of some new generation insecticides against this insect under laboratory condition.

Implementing Organization: Department of Entomology, Bangladesh Agricultural University, Mymensingh

Component organization: None

Principal Investigator: Professor Dr. Gopal Das, BAU

Location (s): Bio-ecology study: BAU Mymensingh, Population incidence and relationship with weather parameters: Mymensingh, Natore and Sreemangal
Budget: TK. 25.0 Lakh.
Project duration: 24 May, 2023 to 23 May, 2026 (36 months)
Introduction: The rugose spiralling whitefly (RSW), *Aleurodicus rugioperculatus* is an invasive insect pest that was first identified in Bangladesh in 2019 in Jashore. In 2020, we conducted a baseline survey study across the country and identified 61 host plants of the insect. Despite the increasing prevalence of this insect, there remains a significant knowledge gap regarding its ecological interactions and management strategies. The study examines the bio-ecology and morpho-molecular traits of the RSW and evaluates the effectiveness of new-generation insecticides against this pest in a lab settings. Understanding the rugose spiraling whitefly's biological traits and resistance mechanisms is vital for improving insecticide applications, enhancing pest control, and minimizing agricultural losses, necessitating further research.

Objective: To study the host preference of RSW, bio-ecology and relationship between weather parameters and prevalence of RSW populations.

Materials and methods: Host preference study was conducted on four coconut varieties viz: DJ Sompurna, Siam Blue, Siam Green, Bangladesh Tall as well as on Banana and Guava. A 3 m x 3 m x 3 sized net house was used to conduct this study. To know the most preferred host plant, number of adult whiteflies/5 cm^2 leaf area, number of spirals/10 cm^2 leaf area and mean numbers of eggs/spiral were counted. Fecundity, incubation period, different nymphal instars duration and total life cycle duration was counted on host plants. Morphometric measures of eggs, nymphs and adults of RSW on six different host plants were also done. Effect of high temperature (e.g. >35°C) on the growth and development and total life-cycle duration of RSW was also studied under controlled temperature (incubator) condition.

Results and Discussion:
The study identified DJ Sompurna as the most preferred host for RSW, with a life cycle completion time of 37.6 days. Guava was the least preferred, taking 45.4 days. Banana ranked second after coconut, with a life cycle duration of 41.8 days. DJ Sompurna also supported the highest growth and development of RSW stages compared to other host plants. Smaller SEM indicates more confidence that the sample mean is close to the true population mean. As shown in Fig 1, the Maximum temperature and relative humidity showed a significant positive correlation with RSW population flare-ups. In contrast, egg spiral formation and whitefly abundance declined sharply when temperatures reached or exceeded 40°C. Rainfall, meanwhile, exhibited a negative correlation with RSW incidence. These trends are clearly illustrated in Fig. 2, which visually reinforces the climatic thresholds influencing pest dynamics.

Table-1: Life cycle of rugose spiralling whitefly on host plants under room temperature condition (Temperature: 28.5 ± 0.21°C, Relative Humidity: 78.3 ± 1.4%)

Parameters	Duration: Days (Mean ± SEM)					
	Coconut Native	Coconut Siam Blue	Coconut Siam Green	Coconut DJ Sompurna	Banana	Guava
Egg laying period	2.60 ± 0.24	2.40 ± 0.24	2.20 ± 0.37	2.20 ± 0.37	2.20 ± 0.32	2.40 ± 0.21
Incubation period	7.40 ± 0.24	7.00 ± 0.31	7.00 ± 0.31	7.60 ± 0.24	8.00 ± 0.31	8.60 ± 0.24
1st nymphal instar	5.40 ± 0.24	5.20 ± 0.20	5.40 ± 0.24	5.40 ± 0.24	5.60 ± 0.21	6.60 ± 0.22
2nd nymphal instar	5.20 ± 0.20	6.00 ± 0.31	5.40 ± 0.24	5.60 ± 0.24	6.40 ± 0.24	7.20 ± 0.37
3rd nymphal instar	5.80 ± 0.20	6.20 ± 0.48	6.00 ± 0.31	5.60 ± 0.24	7.20 ± 0.20	7.80 ± 0.20
4th nymphal instar	6.80 ± 0.37	7.00 ± 0.31	7.20 ± 0.37	6.80 ± 0.20	7.80 ± 0.37	8.60 ± 0.24
Egg-Nymph duration	30.6 ± 0.40	31.4 ± 0.24	31.0 ± 0.63	31.0 ± 0.70	35.2 ± 0.63	38.8 ± 0.37
Male longevity	4.80 ± 0.37	4.00 ± 0.31	4.00 ± 0.31	4.00 ± 0.31	3.60 ± 0.24	4.00 ± 0.31
Female longevity	7.80 ± 0.37	6.80 ± 0.37	7.30 ± 0.24	6.60 ± 0.40	6.60 ± 0.20	6.60 ± 0.24
Life cycle (Female)	38.4 ± 0.67	38.2 ± 0.48	38.3 ± 0.50	37.6 ± 0.92	41.8 ± 0.80	45.4 ± 0.60

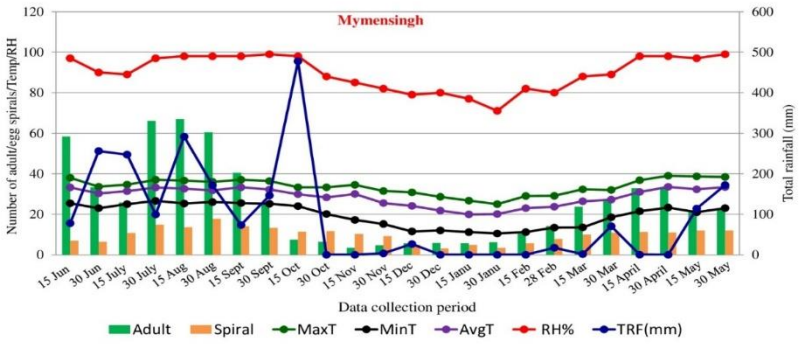


Fig.1: Number of adult and egg of spiral roggos white fly per leaflet of coconut (June/2023 to May/2024).

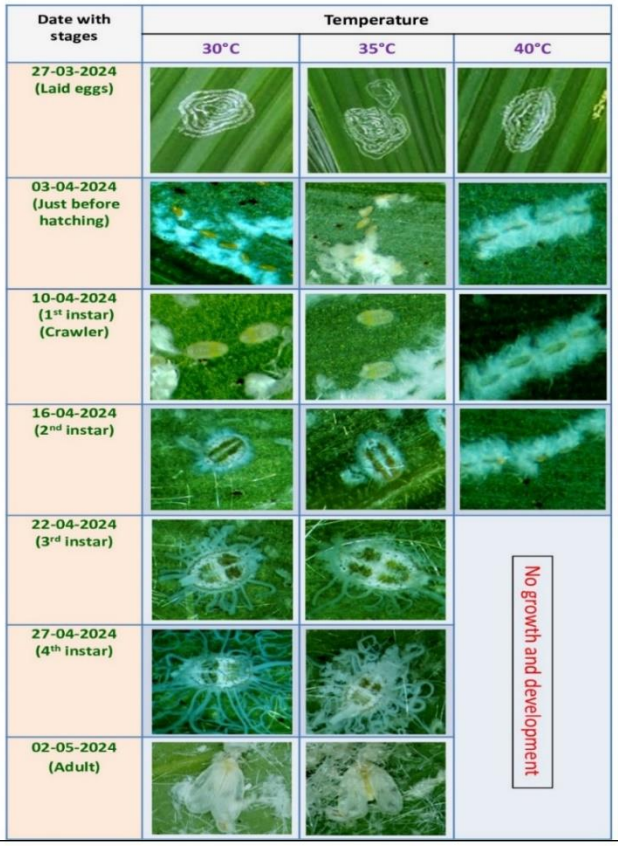


Fig.1: Survivability of eggs and growth & development of rugose spiralling whitefly under different

Fig 2. Temperature-dependent growth patterns of RSW, including complete development at 30°C and 35°C and arrested progression at 40°C

Conclusion: Understanding the host-dependent variation in the life cycle of rugose spiralling whitefly highlights the importance of selecting suitable host plants for effective management strategies. Future research should focus on integrating these findings with weather data to optimize control measures across diverse agroecological zones.

Project Code and Title: TF-114 C/23: Enhancement of Crop Productivity in the Char lands Through Climate Resilient Farming

Implementing Organization: On-Farm Research Division, BARI, Gazipur
Component Organization: Regional Agricultural Research Station, BARI, Jamalpur.
Coordinator: Dr. Md. Mazharul Anwar, Chief Scientific Officer, On-Farm Research Division, BARI, Gazipur.
Principal Investigator (OFRD, BARI part): Dr. Md. Robiul Alam, Principal Scientific Officer, On-Farm Research Division, BARI, Gazipur.
Principal Investigator RARS, BARI, Jamalpur part): Dr. Md. Monjurul Kadir, Chief Scientific Officer, RARS, BARI, Jamalpur.

Location(s): Fulchari Char of Gaibandha, Khatiamari Char, Bogura; Char Belgachha, Jamalpur; Char Basalia, Tangail, Char Thetrai, Kurigram; Naobhangar Char and Char Belgachha, Jamalpur; Char Sadipur, Pabna and Naduar char/Moukurir char, Rajbari.
Budget: Tk. 79.992 lakh
Duration: May 24, 2023 to May 23, 2026 (36 months)

Introduction: Char is characterized by a unique social and hydro-environmental situation. The char regions of the Brahmaputra, Jamuna, and Padma basins each provide slightly different prospects for

agriculture. The regions exhibit a notable lack of crop diversity, primarily characterized by the prevalence of traditional varieties. This limited diversity, along with an unplanned production system, contributes to poor crop productivity. In addition, farmers have lacked knowledge regarding the production and preservation of seeds, leading to a prevalent issue of seed adulteration when purchasing from the local markets. Addressing these issues through training and improved farming techniques could lead to more sustainable agricultural practices, ultimately boosting productivity and resilience in the face of climate change.

Objective: To improve crop yield by introducing high-value crops via a farmer-led quality seed system.

Materials and Methods: The project was executed by the On-Farm Research Division (OFRD), Bangladesh Agricultural Research Institute (BARI), and the Regional Agricultural Research Station (RARS), BARI, Jamalpur. OFRD, BARI, carried out activities in Rangpur, Bogura, Gaibandha, Pabna, Tangail, and Rajbari, while RARS executed activities in the Jamalpur region. A total of 13 crops, including pulses, oilseeds, vegetables, tuber crops, spices, and minor cereals, were selected for this study. Suitable BARI-developed crop varieties were selected for the trial. Five cooperative farmers were chosen for every crop in each location. Farmers were actively involved in the selection of land, crops, and inputs such as seeds, fertilizers, and pesticides. The OFRD and RARS teams conducted regular visits to the participating farmers to provide support and gather data for the study.

Results and Discussion: Among the tested pulse crops BARI Masur-8 exhibited significantly higher seed yield (ranged from 1.36 to 1.95 t ha^{-1}) which was remarkably higher (11, 51 and 64% higher) over local cultivars of Pabna, Bogura and Gaibandha char, respectively. BARI Khesari-2 showed higher seed yield of 1.33 and 1.65 t ha^{-1} which was 5 and 19% higher as compared to local variety at Kurigram and Tangail char. BARI Khesari-3 showed significantly higher seed yield 1.80 and 1.72 t ha^{-1} which was 21 and 15% higher over local variety of Tangail and Rajbari char while BARI Khesari-5 exhibited 16% higher seed yield over local variety of Rajbari char. Regarding the productivity of oilseed crops, significantly higher seed yield of 1.85 and 1.53 t ha^{-1} of BARI Sarisha-17 showed 74 and 54% higher over Tori-7 at Pabna and Kurigram char. BARI Sarisha-14 also showed higher seed yield of 1.80 and 1.25 t ha^{-1} which exhibited 62% and 44% higher over Tori-7 at the same char locations. In char of Rajbari, the seed yield of BARI Sarisha-19 (1.79 t ha^{-1}) and BARI Sarisha-20 (1.64 t ha^{-1}) demonstrated 29 and 27% higher over locally adapted variety. Significantly higher seed yield of BARI Chinabadam-8 (1.73, 2.06 and 2.46 t ha^{-1}) and BARI Chinabadam-9 (1.86, 2.11 and 2.38 t ha^{-1}) demonstrated 25-31% and 21-39% higher nut yield over local variety at Gaibandha, Tangail and Bogura char, respectively while BARI Chinabadam-9 showed 20% higher yield over local variety at Rajbari char. Binachinabadam-10 also performed better with 23% higher nut yield over local variety at Rajbari char. Among the spices crops BARI Piaz-4 showed better performance with higher bulb yield (25.20, 16.09, 17.43 and 14.37 t ha^{-1}) which resulted in 21, 26, 30 and 51% higher bulb yield over locally adapted variety at Rajbari, Bogura, Kurigram and Gaibandha char. BARI Piaz-6 exhibited 20% higher yield over local variety at Gaibandha char and BARI Kalozira-1 showed 10% higher yield as compared to local variety at Pabna char. Among the vegetables, the higher yield of BARI Hybrid Mistikumra-1 (28.05 t ha^{-1}) and BARI Hybrid Mistikumra-2 (25.88 t ha^{-1}) showed 31-51% and 68% higher yield over local variety at Bogura and Gaibandha char. In char of Bogura commercial hybrid mistikumra Bankok-1 was also performed better with 30.39 t ha^{-1} fruit yield contributed 42% higher yield over local variety. The higher root yield of BARI Mistialu-12 (29.90 t ha^{-1}), BARI Mistialu-14 (23.78 t ha^{-1}) and BARI Mistialu-17 (28.87 t ha^{-1}) contributed 65, 73 and 40-89% higher yield over local variety was recorded at Bogura and Rajbari char. BARI Alu-75 exhibited significantly higher tuber yield (34.47 t ha^{-1}) which was 26% higher over local variety at Kurigram char. Among the minor cereals, significantly higher grain yield of BARI BArley-6 (ranged from 1.94 to 1.76 t ha^{-1}) and BARI Barley-7 (2.10 t ha^{-1}) was 72-77% and 59% higher as compared to local variety at Gaibandha and Tangail char. BARI Gom-32 also performed better with 77% higher grain yield over control at char location of Tangail. In Jamalpur char locations, BARI Mash-3, BARI Chinabadam-9, BARI Piaz-4, BARI Mistialu-12 and BARI Sarisha-20 performed better with the yield of 1.25-1.47, 1.36-2.46, 15.22-17.39, 19.99-24.18 and 1.45 t ha^{-1}, respectively which was 52, 30, 49, 84 and 59% higher over existing local cultivar/variety.
Higher gross return and gross margin were obtained from the improved varieties of pulse, oilseed, spices, vegetables and minor cereals due to higher yield. Farmers were happy and expressed their

satisfaction with improved varieties across the selected char locations of both components under this project.

Table 1.Yield and yield contributing characters of Sweet potato variety at Paturia char of Kalukhali upazilla, Rajbari during 2023-24.

Variety	Plant height (cm)	Plant pop. m^{-2}	Root $plant^{-1}$	No of root m^{-2}	Weight $root^{-1}$ (g)	Root yield (t ha^{-1})
BARI Misti Alu-14	66.16a	5.25a	4.68ab	24 a	68.35a	23.78 b
BARI Misti Alu-17	82.51a	5.25a	6.57a	33.5a	71.08a	28.87a
Local	78.15a	5.0a	3.72b	19.67a	65.10	15.25 c
CV (%)	28.32	55.70	29.79	50.78	66.59	6.11

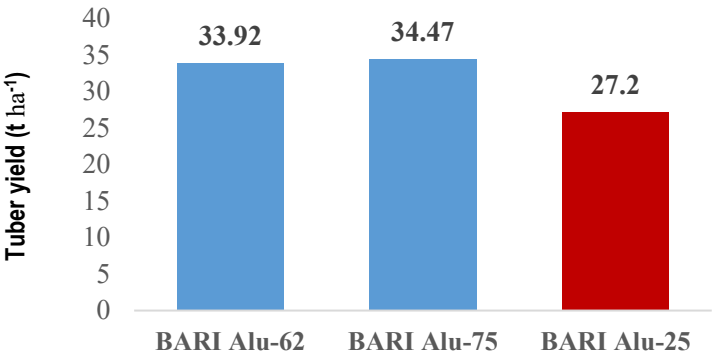


Fig. 1. Performance of Potato varieties at Kurigram char



Fig. 2. Field Performance of onion varieties at Raipur char, Bogura

Conclusion: The study indicated that the productivity of improved varieties of pulse, oilseed, spices, vegetables and minor cereal crops performed better regarding productivity and economic return as compared to locally adapted cultivars/varieties. The productivity of pulse, oilseed, spices, vegetables and minor cereal crops increased by 5 to 64%, 20 to 74%, 10 to 51%, 26 to 89% and 59 to 77% over locally cultivated varieties due to inclusion of improved varieties irrespective of char areas. Regarding the economic benefit, higher gross return and gross margin was obtained from the improved varieties of pulse, oilseed, spices, vegetables and minor cereals due to higher yield. Farmers were happy and expressed their satisfaction with improved varieties across the char locations under this project.

Project Code and Title: TF 116-C/23. Establishment of Disease-free Citrus Sapling Production System in Bangladesh

Implementing Organization: Bangladesh Agricultural Research Institute, Citrus Research Station, Jaintapur, Sylhet
Component Organization: None
Principal Investigator: Dr. MHM Borhannuddin Bhuyan, Scientific Officer, Citrus Research Station, BARI, Jaintapur, Sylhet
Location(s): Citrus Research Station, BARI, Jaintapur, Sylhet
Budget: TK 34.99 Lakhs
Duration: 36 months; from 24/05/2023 to 23/05/2026
Introduction: Citrus fruits stand second after grapes and are cultivated in more than 140 countries. The production of citrus fruit is increasing in Bangladesh at 5.21% annually. However, fungal, bacterial, and viral diseases are the major problems that have led to the decline of the plants. Besides, the tropical climate favors a high prevalence of disease vectors. Therefore, producing disease-free, healthy citrus saplings in - vitro by micro-grafting for growing mother plants, as well as foundation blocks under controlled screen houses and routine monitoring of diseases, is necessary.
Objective: Adapting the shoot tip micro-grafting (STG), standardizing the protocol for disease indexing and conserving the disease free mother plants under controlled screen house condition.

Materials and Methods: Rootstocks were gathered from CRS Jaintapur and RHRS, Akbarpur, and established as mother plants in the net house at Jaintapur. Budstick scions were collected and cultured in vitro in the lab to produce microshoots, which served as microbuds. Furthermore, seeds from the rootstocks were sown in the lab for multiplication. Micro-grafting was performed using stereo-microscopes. Data on successful grafts and subsequent scion growth were documented for each treatment. Rootstocks were cultivated under three temperature gradients: 20, 25, and 30°C, and three dark/light cycles: 0/24h, 12/12h, and 8/16h. Two scion cultivars, BARI Komola-1 and BARI Malta-1, were utilized for in vitro micro-bud formation. Micro-grafts of BARI Komola-1 and BARI Malta-1 were created through in vitro grafting on rootstocks of varying ages.

Results and Discussion: Optimum growth of pummelo seedlings at 25-30°C in complete darkness (0/24h D/L) for micro-grafting. The finding is consistent with the previous reports of 21 °C to 27 °C temperature was effective in vitro morphogenesis. According to the previous reports light directly involves in photosynthesis that support growth and development of plants. We prepared some micro-grafts of BARI Komola-1 and BARI Malta-1 using in vitro grown root stocks of different ages; however, none were successful. This was likely attributed to a lack of precision. Conversely, the survival rate for citrus micro-grafting is quite low, ranging from approximately 5% to 10%; thus, numerous grafts must be conducted to achieve the necessary quantity of successful micro-grafts.



Fig 3. *In vitro* micro-graft

the optimum temperature range of 25-30°C in complete darkness promote[illegible] seedlings, the low survival rate of citrus micro-grafting highlights the need[illegible] grafting techniques. Future research should focus on refining these method[illegible] and ultimately increase the viability of micro-grafted citrus varieties.

Project Code with Title: TF117-C/23. Development of simplified hydroponic technology and validation for commercial cultivation

Implementing Organization: Olericulture Division, Horticulture Research Centre (HRC)
Bangladesh Agricultural Research Institute (BARI), Gazipur
Component Organization: None

Principal Investigator: Dr. Bahauddin Ahmed, Senior Scientific Officer, Olericulture Division, HRC, BARI, Gazipur
Locations: a) Olericulture Division, HRC, BARI, Gazipur
b) Regional Agriculture Research Station (RARS), Jashore, c) Rangpur (Farmers Field)
Budget: TK. 40.0 Lakh
Duration: May 2023 to April 2026 (36 months)

Introduction: At the Horticulture Research Centre (HRC) of the Bangladesh Agricultural Research Institute (BARI), simplified hydroponic systems have been developed using locally available materials for cultivating vegetables in solution culture during winter and in coco-coir based soilless culture in summer. Hydroponics, as a managed cultivation method, presents a viable alternative for producing high-value vegetables and ensuring safe food amidst climate change. Consequently, the Bangladesh Government has recognized hydroponics as a specialized agricultural practice to boost national agricultural productivity. This study aims to develop simplified hydroponic technologies utilizing

affordable local materials to grow safe and high-value vegetables with excellent yield and quality year-round.

Objective: The goal of the proposed project is to develop simplified hydroponic systems for growing high value, safe and nutrient rich fruits and vegetables throughout the year
Materials and Methods: A polyhouse designed for natural ventilation (NVPH) has been constructed with materials sourced locally. This greenhouse type maintains temperatures below 30°C in the pre-summer and late winter months, facilitating an extended growing season and enabling vegetable production throughout the year.

Results and Discussion: Commercial grade fertilizer produced greater performance compared to standard solution BARI Hydroponic solution-1. Among the three strength of commercial grade solution, ¾ and ½ strength solution produced greater fresh fruit weight compared to full strength solution. Therefore, ¾ and ½ strength commercial grade solution (under trial) can be standardized through further experiments. BARI hydroponic solution-1 produced greater fresh fruit weight in Deep Water Culture (DWC) of hydroponic system. In case leafy vegetables in nutrient film techniques (NFT) BARI hydroponic solution-1 also produced greater fresh weight but in coco dust based soilless culture Japanese nutrient solution (Enshi- shoo) showed better performance.

- Repair and maintenance of the existing greenhouse of the Olericulture Division, HRC, BARI, and RARS Jashore were completed for facilitating the experiments.
- Construct a naturally ventilated poly house (NVPH) at Progressive Farmers Field, Rangpur and RARS, Jashore for validation trials.

Conclusion: In the coming year, further experiments will standardize the effective ¾ and ½ strength commercial grade solutions, while ongoing infrastructure improvements will support validation trials in the newly constructed poly house.

Project Code and Title: TF 118-C/23.: Production and Scaling-up Jute Seed Production Technology at Farmers' Level

Implementing Organization: Bangladesh Jute Research Institute, Dhaka
Component Organization: None
Principal Investigator: Dr. Md. Babul Hossain, Principal Scientific Officer, Jute Farming Systems Division (JFSD), BJRI, Dhaka.
Location(s): BJRI, Dhaka; Regional/Sub-stations of BJRI viz: Manikganj; Rangpur, Faridpur, Kishoreganj; Monirampur, Jashore, and Dinajpur.

Budget: Total: 50.00 Lakh
Duration: May, 2023 to June, 2026 (36 months)

Introduction: Jute cultivation in Bangladesh covers an area of 7.44 lakh hectares, producing 15.02 lakh metric tons. The nation requires between 5,500 and 6,000 metric tons of jute and allied fiber seeds each year. However, only 20 to 25% of this demand is met through local sources, including BADC and farmers. To lessen dependence on imports and inferior seeds, BJRI has created high-yielding varieties along with seed production technologies. This initiative suggests intercropping, top cutting, and seedling techniques to improve seed production while accommodating winter crops. The project aims to validate these technologies by conducting field trials and providing training to promote BJRI's high-yielding jute seed production technologies.

Objective: Validating jute seed production technologies, promoting seed production, fostering farmer networks, and developing a digital platform.

Materials and Methods: Top Cutting, seedling transplanting, seeding techniques with vegetables and aman rice were adopted to optimize the seed production technologies. Farmer co-operation sought for field trials and motivation activities (training and field day). There were six planting methods viz:

a) P_1: One line of Jute/kenaf along the border- winter vegetables or T. aman field
b) P_2: Two lines of Jute/kenaf, at closer spacing along the border winter vegetables or T. Aman field

c) P_3: One row (1.5 m wide) with five lines of Jute/kenaf (length depending on the land) in vegetables or T. Aman field.

Field trials, training, workshop, field day fact sheets distribution, etc. were conducted in the farmers' field to motivating farmers to grow tossa and kenaf seeds. Fallow lands were urilized for seed crops. Building a local seed networks to produce their own jute seeds, reducing reliance on external sources, and improving the overall quality and availability of seeds for local needs

Results and Discussion

The P1 and P3 methods offered intermediate benefits, balancing jute and T. Aman rice or vegetables yields but not reaching the economic efficiency of P2. The study suggests that intercropping jute with T. Aman or vegetables with a strategic planting method, like the two-line spacing approach of P2, can enhance both crop yields and economic returns. Fig. 1 and Fig 2, visually reinforce the intercropping jute with T. Aman or vegetables can enhance yields and economic returns. .

This version improves readability, tightens the phrasing, and adds a bit of narrative flow while keeping the scientific rigor intact. Would you like a version tailored for extension materials or donor communications as well?

Thirty-five field trials on three planting methods P_1, P_2 and P_3 were conducted in farmers field. The yield performance of the trial highly motivated farmers about the seed production technologies of tossa and kenaf. Two training sessions for farmers were conducted, and three field day days were organized, successfully reaching a total of 180 farmers to share knowledge about the technology of jute and kenaf seed production within the T. Aman rice and vegetable ecosystems.

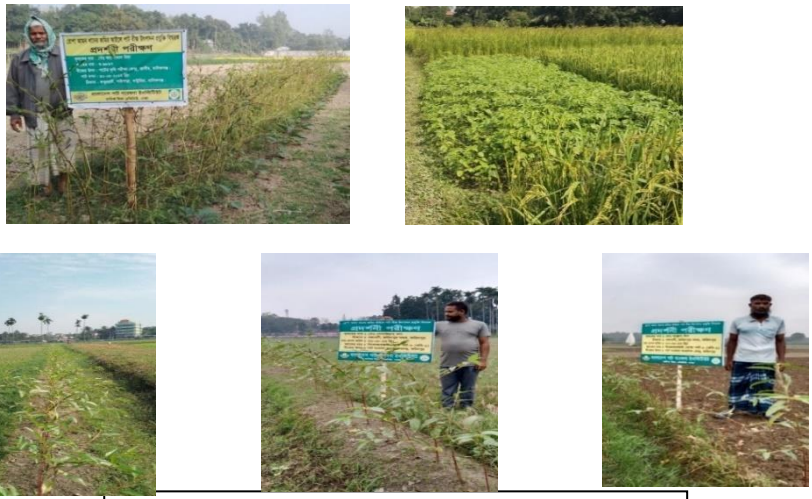


Fig. 2: One line tossa seed along the border of T.

Conclusion: In conclusion, while the P2 method demonstrated superior yields, further studies need for optimizing intercropping strategies to enhance seed production and economic viability for farmers in diverse ecosystems.

Project Code and Title: TF-133-SoE/23: Impact Assessment of Salt-tolerant Crop Varieties developed by NARS Institutes

Implementing Organization: Bangladesh Institute of Nuclear Agriculture (BINA), BAU Campus, Mymensingh
Component Organization: None
Principal Investigator: Dr. Md. Habibur Rahman, CSO & Head, Agricultural Economics Division, BINA
Location(s): Satkhira, Khulna, Bagherhat, Barguna, Patuakhali, Noakhali, Chattogram and Cox's Bazar districts of Bangladesh.
Budget: TK. 40.00 Lakh
Duration: 24 May 2023 to 23 May 2026 (36 months)

Introduction: Impact assessment of salt-tolerant crop varieties developed by NARS institutes is crucial for understanding their effectiveness in enhancing agricultural resilience. These varieties are designed to thrive in saline conditions, which are increasingly prevalent due to climate change and poor land management. Evaluating their performance involves analyzing yield improvements, economic benefits for farmers, and environmental sustainability. By assessing these factors, stakeholders can make informed decisions about the adoption and promotion of these crops, ultimately contributing to food security and sustainable agricultural practices in affected regions. Therefore, a research initiative was launched to assess the economic benefits for livelihoods.

Objective (s): The study aims to assess economic benefits of salt-tolerant crops, farmer livelihoods, crop productivity, profitability, and policy recommendations.

Materials and Method: The baseline survey on 1000 households was conducted in Noakhali, Chattogram, Cox's Bazar, Patuakhali, Barguna, Satkhira, Khulna and Bagerhat districts. 375 Farmers data collection, FGD and KII conducted in Noakhali, Chattogram, Cox's Bazar and data entry and data analysis is in progress. Collected secondary data from different sources. The study used primary and secondary data, and statistical analysis was conducted to evaluate the economic benefits and impact on livelihood of salt-tolerant crop varieties.

Results and Discussion: Salt-tolerant varieties demonstrated strong return on investment across multiple crop groups, with BCRs ranging from 1.30 to 2.96. BARI sunflower-2 (2.96), Sohag (PB1) (1.99), and BARI sarisha-16 (1.86) were the most economically rewarding. Enhanced profitability for farmers in saline-prone zones supports livelihood diversification and local market resilience. The majority of adopters reside in tin-shade dwellings and report average annual incomes near Tk. 1.52 lac, indicating accessibility to low-income households. Adoption by these demographics highlights the social equity dimension of salt-tolerant varietal dissemination. Twelve cropping patterns were identified, with Aus-Aman-Boro ranking highest in adoption, reflecting robust seasonal fit. Salt-tolerant varieties are now embedded within traditional rotations, offering both agroecological resilience and cropping system flexibility. Persistent constraints in production practices signal the need for targeted extension services, farmer training, and improved technology transfer mechanisms. Strategic engagement by NARS and national extension agencies will be pivotal to sustaining impact and scaling adoption.

Conclusion: These innovations directly contribute to climate change adaptation in saline-affected zones; food and income security for marginal farming communities and alignment with national digital and agricultural transformation agendas.

Project Code and Title: TF 135-C/23. Nitrogen Use Efficiency of Neem Coated Urea and Its Effect on Productivity of Rice

Implementing organization: Bangladesh Agricultural University (BAU), Mymensingh
Component Organization: Bangladesh Rice Research Institute (BRRI), Gazipur
Principal Investigator: Prof. Dr. Md. Rashedur Rahman, BAU Mymensingh
Locations: BAU, Mymensingh and Cumilla regional station, BRRI
Budget: BDT 45.00 Lack
Duration: 26 Dec. 2023 to 25 Dec. 2026 (36 months)

Introduction: Bangladesh relies heavily on urea imports, with around 1.66 million tons brought in during the 2021-22 period to support rice, wheat, and maize cultivation, costing approximately 3607 crore taka. Farmers often apply excessive urea to enhance crop yields, but a considerable amount is lost each season through nitrification, volatilization, and leaching. Coating urea granules with neem oil can significantly mitigate these losses, as the compounds in neem oil, like epinimbin and azadirachtin, slow nutrient release and enhance nitrogen use efficiency. This approach not only optimizes nitrogen absorption for rice plants but also helps reduce greenhouse gas emissions associated with traditional urea use, addressing both agricultural productivity and environmental concerns.Therefore, the project was undertaken.
Objective: The main Objective is to assess the efficacy and economics of neem coated urea as well as to quantify the greenhouse gas emission from the rice field of Bangladesh.

Materials and Methods: Only one experiment in each location (BRRI, Cumilla and BAU, Mymensingh) has been completed in boro season with a view to find out the optimum amount of neem oil to be coated with urea. In this experiment only BRRI dhan102 was used as test variety. The treatments and design of the experiment is presented below-

(i) No urea (control)
(ii) 0 ml neem oil/kg urea
(iii) 3 ml neem oil/kg urea
(iv) 5 ml neem oil/kg urea
(v) 7 ml neem oil/kg urea
(vi) 10 ml neem oil/kg urea

Randomized complete block design (RCBD) was used with three replications. Area of each plot was 15 m^2. The data on plant characters were collected from both the location but partial statistical analysis was done for the data collected from BRRI, Cumilla. The input and analysis is going on for the data from BAU, Mymensingh.

Results and Discussion: In the second season of boro, experiments were conducted at BRRI in Cumilla and BAU in Mymensingh. The analysis of crop characteristics for BRRI, Cumilla is complete and will be included in the upcoming progress report. Preliminary data shows that applying 3 ml of neem oil per kg of urea resulted in the highest number of tillers and panicles per square meter, with significant yield differences among treatments. The lowest grain yield occurred in plots without urea, while the highest was with 3 ml of neem oil per kg of urea, a trend also seen in straw yield. Data on nitrogen uptake efficiency and greenhouse gas emissions is still being analyzed.

Conclusion: The findings of the current study indicated that urea coated with neem oil has a notable impact on the grain yield of rice compared to prilled urea. Although this conclusion is based solely on data from a single location and one season of the year, a definitive conclusion can be reached upon the project's completion after conducting several additional experiments.

Project Code and Title: TF 137-C/23: Development of Nano and Microbial Technologies for Heavy Metal Remediation in Soil-Plant System

Implementing Organization: Department of Soil Science, Gazipur Agricultural University (GAU), Gazipur
Principal Investigator: Prof. Dr. GKM Mustafizur Rahman, GAU Gazipur
Location (s): Department of Soil Science, Gazipur Agricultural University (GAU), Salna, Gazipur 1706.
Budget: TK. 49.982 Lakh
Duration: 24-05-2023 to 23-05-2026 (36 months)

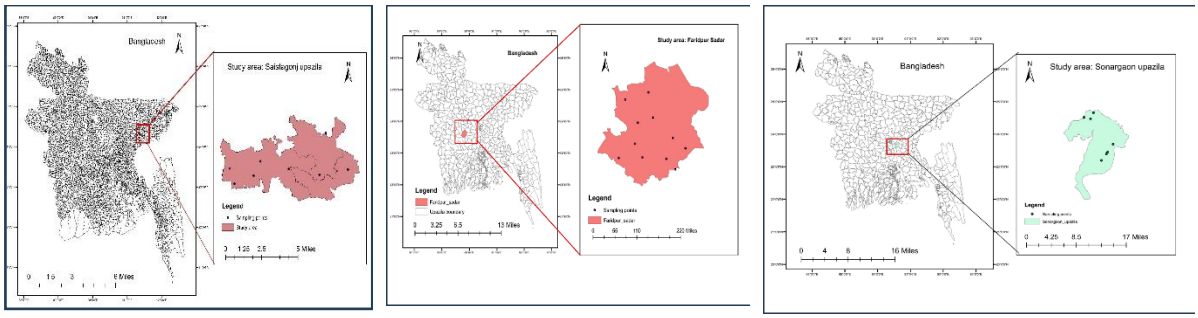
Introduction: The rapid industrial growth has led to increased wastewater and environmental damage worldwide, including in Bangladesh. Initial studies at Gazipur Agricultural University's Soil Science department assessed heavy metal accumulation and distribution in polluted soils of Gazipur, along with arsenic contamination in Faridpur. Other industrial regions like Narayangonj and Sylhet may face similar heavy metal challenges, but lack thorough research. Nano-biochar and silicon offer significant benefits for sustainable agriculture and environmental remediation due to their enhanced surface area, adsorption capacity, and soil mobility compared to traditional materials. Furthermore, bacteria are essential for soil diversity and play a key role in pollution reduction. Therefore, it is crucial to develop soil and plant management strategies to mitigate heavy metal and arsenic risks in contaminated areas of Bangladesh.

Objective (s):
The study evaluates the effects of silicon and biochar on contaminated soils in Bangladesh, focusing on physicochemical properties, heavy metal levels, and microbial diversity to improve soil health and crop yield.

Materials amd methods
Development of nanoparticles: Preparation and characterization of nano particles of Si and biochar

Soil sample collection: Soil sample collection from Shaistaganj, Faridpur (sadar), and Sonargaon, Collected samples were analyzed in the laboratory to identify tolerant bacteria and detecting heavy metals. Laboratory analysis of sample water carried out to identify potential nanoadsorbents. We used GIS tools for sample collection. GIS mapping was used to identify spatial variability of tolerant bacteria. Grid basis soil sample collection from the selected three contaminated sites.

Determination of tolerant Bacteria of contaminated soil: The enumeration of bacterial population, isolation and biochemical characterization in selected soils to identify the dominant and tolerant bacteria in the contaminated soils

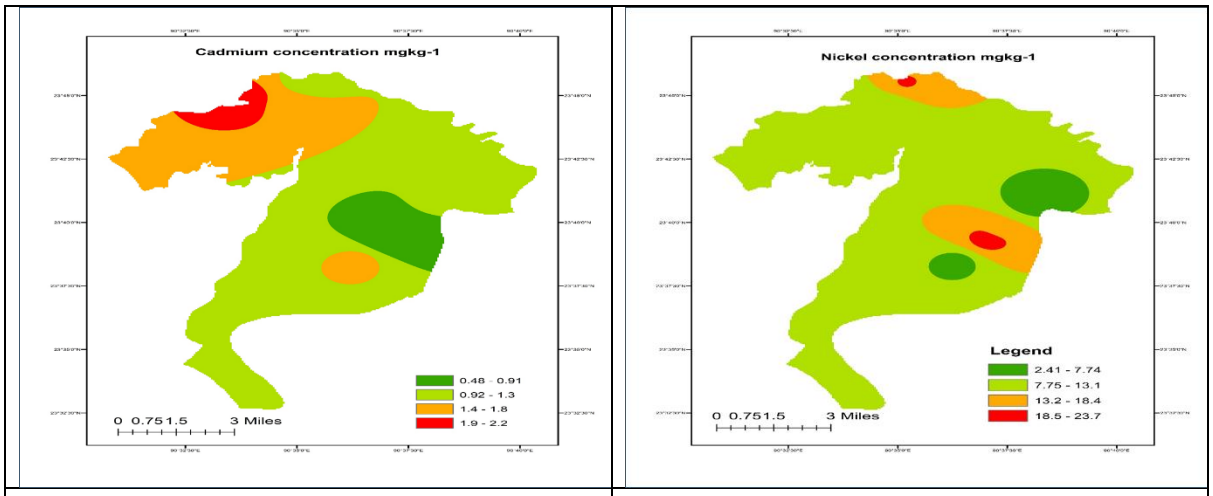


(a) Shaistaganj (b) Faridpur Sadar (c) Sonargaon

Fig: 1 Soil sample collection from the selected three contaminated sites (a) Shaistaganj, (b) Faridpur Sadar, and (c) Sonargaon to identify the tolerant bacteria and spatial variably of contamination by GIS Mapping.

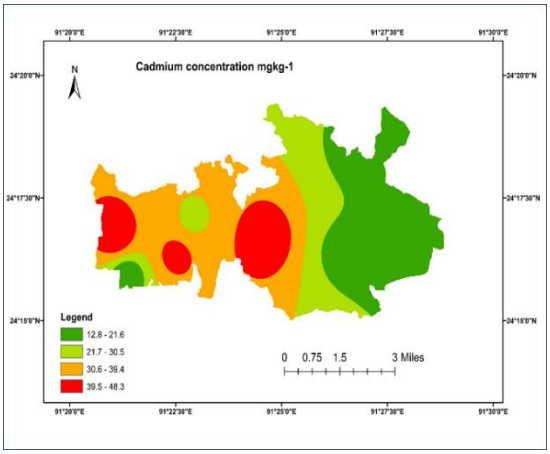
Results and discussions

Soil analysis from Shaistaganj, Faridpur Sadar, and Sonargaon revealed notable variation in pH, texture, nutrient levels, and heavy metal concentrations. In particular, Cadmium and Nickel levels exceeded permissible thresholds in several locations, indicating potential soil contamination and associated environmental risks (Fig. 2)

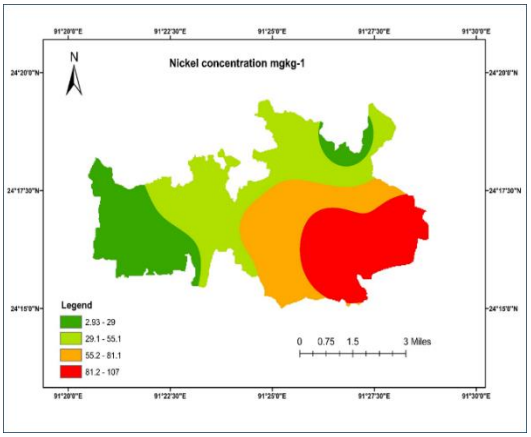


a b

Fig 2: Spatial Distribution of (a) Cadmium and (b) Nickel concentration at Sonargaon

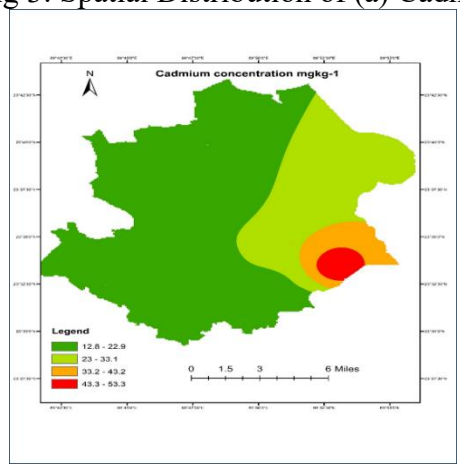


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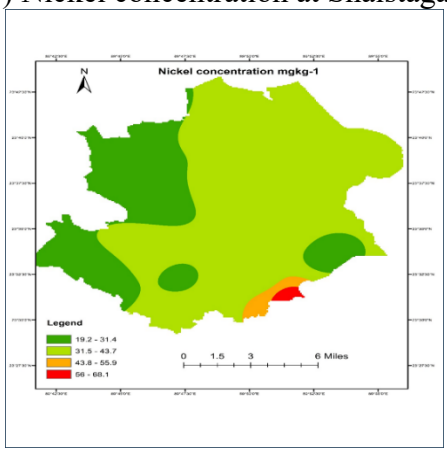


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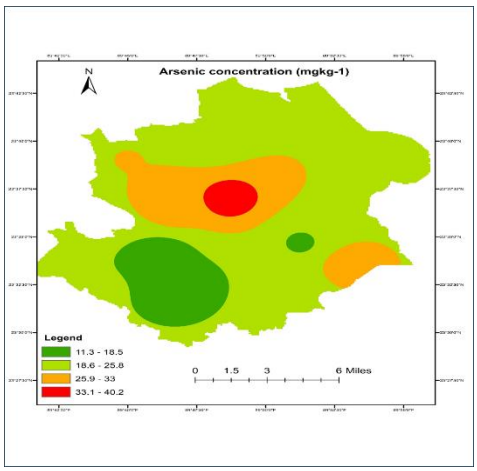
Fig 3: Spatial Distribution of (a) Cadmium and (b) Nickel concentration at Shaistaganj



(a)



(b)



(c)

Fig 3: Spatial Distribution of (a) Cadmium, (b) Nickel and (c) arsenic Concentration at Faridpur Sadar

The GIS-based spatial distribution maps of heavy metals—Cadmium, Nickel, and Arsenic—reveal marked variability across Shaistaganj, Faridpur Sadar, and Sonargoa (Figs. 2 and 3). These visualizations highlight distinct concentration patterns, underscoring localized contamination risks within the study areas. These spatial patterns suggest localized contamination sources and emphasize the need for targeted soil management and remediation strategies to ensure environmental and agricultural sustainability.

Table 1: Types of Bacteria from Shaistaganj Upazila, Habiganj

Types	Colony Shape	Elevation	Surface	Color	Source (Soil)	Catalase Activity Test
SGS T-1	Round	Flat	Smooth Sticky	Watery White	Contaminated	Positive (+)
SGS T-2	Round	Raised	Rough Non Sticky	Creamy	Contaminated & Uncontaminated	Negative (-)
SGS T-3	Round	Flat	Smooth Sticky	Yellow	Contaminated & Uncontaminated	Positive (+)
SGS T-4	Round	Flat	Smooth Sticky	Light Orange	Uncontaminated	Negative (-)
SGS T-5	Irregular	Raised	Rough Non Sticky	White	Contaminated	Positive (+)



Fig 4: Types of Bacterial isolates (5 types) from Shaistaganj Upazila, Habiganj

Table 1 compares five bacterial isolates (SGS T-1 to T-5) from Shaistaganj soils, highlighting morphology and catalase activity. Catalase-positive traits suggest microbial adaptation to oxidative stress, offering insights into soil health and bioremediation potential. This microbial profiling can inform further exploration into soil health, microbial ecology, and bioremediation potential.

Conclusion: The analysis reveals significant heavy metal contamination in soil across Shaistaganj, Faridpur, and Sonargaon, highlighting urgent environmental risks and the necessity for targeted remediation strategies to safeguard soil health and sustainability.

Project Code and Title: TF 138-C/23. Effect of Vermicompost and Biochar on Some Selected Vegetables under Soil-based and Soilless Media in Rooftop Garden

Implementing Organization: Department of Agricultural Botany, Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka

Component Organization: None

Principal Investigator: Prof. Mohammad Mahbub Islam, *PhD, SAU, Dhaka*

Location(s): Rooftop Garden, Department of Agricultural Botany, Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka

Budget: Tk. 24.90 Lakh

Duration: 3rd October 2023 to 2nd October 2026 (36 months)

Introduction: Urban gardeners face a major challenge in selecting appropriate soil-based and soilless growing media for sustainable rooftop farming (Uddin *et al.,* 2016). Many authors reported that vermicompost and biochar positively influenced physical, chemical and biological properties of soil-based and soilless growing media and increased crop growth and yield (Canellas *et al.,* 2015, Metwally 2016, Ding *et al.,* 2016, Piya *et al.,* 2018, Demir 2019, Wang *et al.,* 2021). To support the development of urban agriculture, it is essential to identify suitable soil-based media using soil, vermicompost, and biochar, as well as coir-based soilless media made using cocodust, vermicompost, and biochar for cultivating cherry tomatoes, brinjal, and country beans in rooftop garden.

Objective: To investigate the primary and residual effects of vermicompost and biochar addition to soil-based and coir-based soilless media on different fruit vegetables grown in the rooftop garden.

Materials and Methods: There are four out of eight pot experiments completed in the 1st year to assess the primary effects of vermicompost and biochar in soil-based and coir-based soilless media on cherry tomato and brinjal. Two of the four experiments are ongoing this year as 2nd year activities to find the primary effects of vermicompost and biochar in soil-based and coir-based media on country bean. The last two experiments are ongoing to find the residual effects of vermicompost and biochar in soil-based and coir-based media on cherry tomato grown in the rooftop garden. Data on growth, physiology, and yield were collected. The quality attributes, including BRIX, EC, pH, vitamin C, P, and K, were taken from the fruits of cherry tomato.



Photo 1: Exp. Soil-based



Photo 3: Exp. Soilless

Results and Discussion: The study found that the growth parameters of cherry tomato and brinjal, including plant height, number of leaves and branches, and stem diameter, improved with the application of vermicompost and biochar, either separately or in combination. The best results for physiological traits, such as leaf water loss and relative water content, were observed with the combined application. Maximum fruit yields were recorded at 1293.5 g for cherry tomatoes and 1620.3 g for brinjal with a specific combination of vermicompost and biochar, while fruit quality attributes also enhanced with this treatment.

The study demonstrated that the growth parameters of cherry tomato and brinjal, such as plant height, leaf and branch count, and stem diameter, improved with the application of vermicompost and biochar, either alone or in combination. The most significant enhancements in physiological traits, including leaf water loss and relative water content, were achieved with the combined treatment. Notably, maximum fruit yields reached 1293.5 g for cherry tomatoes and 1620.3 g for brinjal, alongside improved fruit quality attributes, when using the specific combination of vermicompost and biochar.



Photo 2: Exp. Soil-based

Conclusion In conclusion, incorporating vermicompost and biochar significantly enhances the growth and yield of cherry tomatoes and brinjals, particularly in soilless coir-based media, suggesting further exploration of these combinations for urban gardening.



Photo 4: Exp. Soilless brinial

Project Code and Title: TF-139-C/23, Resistance screening for Alternaria blight disease of mustard-rapeseed and it's bio-control using plant growth promoting rhizobacteria

Implementing Organization: Plant Pathology Division, Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh
Component Organization: Department of Plant Pathology, Bangladesh Agricultural University (BAU), Mymensingh
Principal Investigator/Coordinator: Dr. Md. Ibrahim Khalil, Chief Scientific officer, Plant Pathology Division, BINA, Mymensingh
Location(s): Mymensingh
Budget: Tk. 30.00 Lakh
Duration: 17 October 2023 to 16 October 2026 (36 months)
Introduction: Alternaria leaf spot is considered one of the major diseases due to its wide distribution and yield losses to Brassica crops worldwide. This disease causes an average yield loss of 30-60% in Bangladesh. Unfortunately, no comprehensive research work has been performed in Bangladesh on the genetic diversity of Alternaria spp. causing Alternaria blight of mustard-rape seed and its resistance evaluation using conventional as well as molecular means. In addition, biological control of plant

diseases using plant growth-promoting rhizobacteria (PGPR) has emerged as an effective strategy during the last two decades and will play an important role in ecological agriculture.

Objective: Objective: To characterize *Alternaria* pathogens, screen mustard-rapeseed genotypes for resistance, and evaluate plant growth-promoting rhizobacteria for their antagonistic and growth-enhancing properties to control *Alternaria* leaf blight effectively.

Material and Methods:

Performed molecular analysis of Alternaria fungi responsible for Alternaria blight in mustard. Resistance testing was carried out in natural field settings. Identification of plant growth-promoting rhizobacteria was also conducted. One hundred mustard genotypes collected from BINA, BARI and BAU were screened under natural field conditions and also by detached leaf method. The isolation, identification and development of pure culture were done according standard protocol.

Result and Discussion:

I. Morpho-molecular detection of *Alternaria* spp. causing Alternaria blight of mustard

Eighteen pure isolates of *Alternaria brassicicola* were developed and morphologically characterized on PDA plates based on colony color, shape, growth rate, margin patterns, conidial variation revealing significant variations among isolates (Fig. 1). A total of 200 bacterial isolates were collected from the mustard rhizosphere.

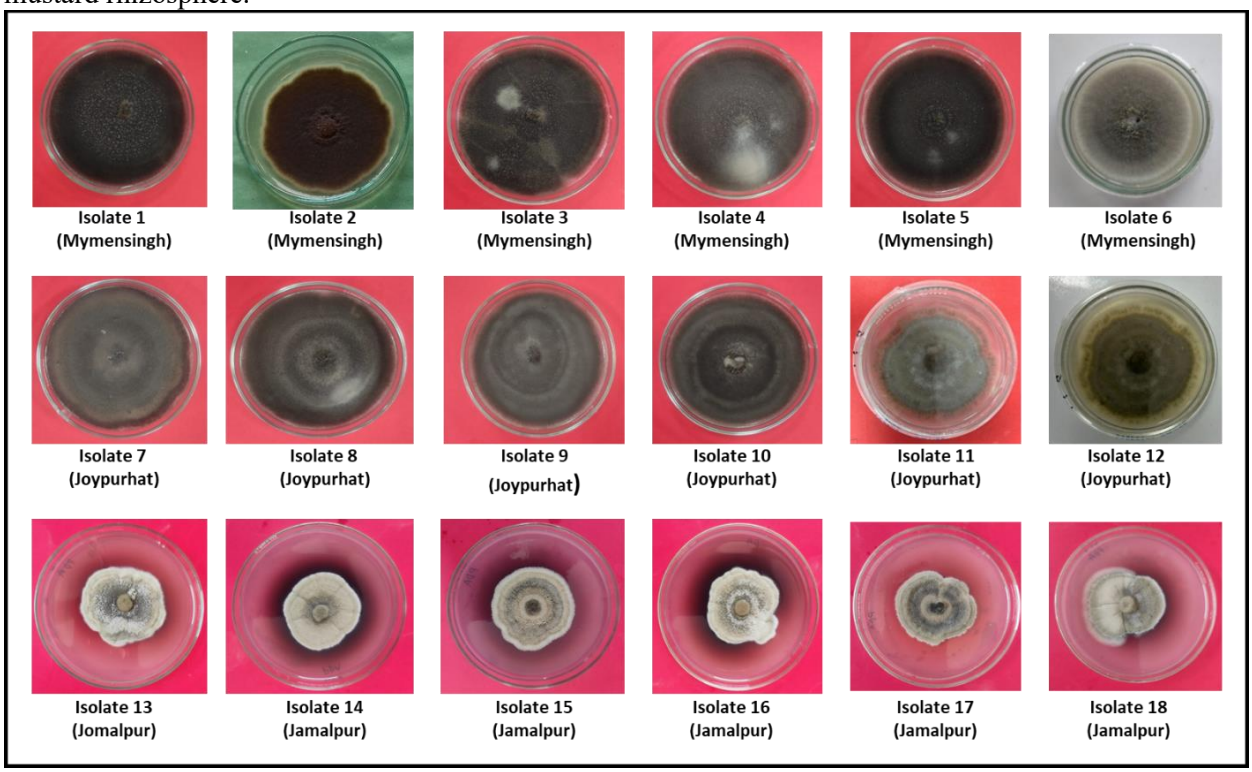


Fig. 1: Growth status and conidial variation of different Alternaria isolates on PDA plates

Only 4 mustard genotypes (*Brassica napus* muant lines) exhibited resistant reaction, 10 mustard genotypes showed moderately resistant reaction, 36 genotypes showed moderately susceptible reaction, 31 genotypes showed susceptible reaction and 19 genotypes showed highly susceptible reaction against Alternaria leaf blight disease under natural field condition. The collected germplasm was grouped under five categories Viz: resistant (4), Moderately resistant (10) Moderately susceptible (36) Susceptible (31) and Highly Susceptible (19). From 200 bacterial isolates collected from the mustard rhizosphere, *Bacillus spp.* were identified by their tiny, layered colonies with irregular edges on nutrient agar, while *Pseudomonas spp.* displayed smooth, glistening colonies with green pigmentation under UV light on King's B plates (Fig 2a and 2b).



Fig. 2a: Presumably identified Bacillus and other bacterial isolated from mustard rhizosphere



Fig. 2b: Presumably identified Pseudomonas bacterial isolated from mustard rhizosphere

Conclusion: In its first year, the project identified resistant mustard genotypes, advancing sustainable farming and market potential. Moving forward, scaling these findings through breeding, partnerships, and policy support can strengthen resilience and reduce chemical reliance in mustard cultivation.

Project code and Title: TF 140-C/23: Application of Intermittent Irrigation for Efficient Water Management and Its Impact on Heavy Metal Accumulation in Boro Rice

Implementing organization: Department of Soil Science, BAU Mymensingh
Principle investigator: Dr. Md. Rafiqul Islam, BAU Mymensingh
Location: a) Chougacha Upazila, Jashore, b) Bhaluka Upazila, Mymensingh, c) Soil Science laboratory, BAU, Mymensingh
Budget: Tk. 30 Lakh
Duration: 3 October 2023 to 2 October 2026 (36 months)

Introduction: The use of intermittent irrigation presents a promising strategy for optimizing water management in agriculture, particularly in the cultivation of Boro rice. This method is especially crucial in areas where soil and water are contaminated with heavy metals, such as arsenic (As) and cadmium (Cd). When Boro rice is grown in such environments, it tends to absorb these harmful metals, leading to their accumulation in the grains. By implementing intermittent irrigation, it may be possible to mitigate the uptake of these heavy metals, thereby enhancing both the safety and quality of the rice produced while promoting sustainable agricultural practices.
Objectives: To assess the effectiveness of intermittent irrigation compared to AWD and traditional methods for Boro rice in contaminated regions of Bangladesh, evaluating water cost-benefit of T. Aman-Mustard-Boro, crop quality concerning heavy metal levels.
Materials and Methods:
(Tis report cover the activities of 1st year)
Locations: Chougacha upazila, Jashore and Bhaluka upazila, Mymensingh
Designe followed: Randomized complete block design (RCBD) with three replications.

Treatments (Boro rice)

Treatment	Treatment description
T1	Farmers' practice (flooding throughout the growth period) (CF)
T2	Alternate wetting and drying (AWD)
T3	Int-3F4D (Intermittent irrigation every 7 days with 3-day flooding followed by 4-day drainage
T4	AWD + Int-3F4D

Crop varieties used: Three boro - BRRI dhan88, BRRI dhan100, BINA dhan25

Crop management: Fertilizers and manures were applied as per doses and application methods.
Treatments: CF, AWD, and intermittent irrigation were applied from transplanting, 15 days after transplanting (DAT), and three weeks before heading, respectively. The evapotranspiration was

calculated as the reduction in water height and water was supplied in each treatment considering the evaporation loss and period to dry the plot.

Data collection: Soil soil texture, bulk density, organic C, Total N, pH, redox potential, available P and S, exchangeable K, etc. were measured following standard protocol. Pore water was collected from the field by Rhizon sampler at different growth stages for heavy metal analysis, soil pH, Eh and gravimetric water. 1m^2 area was harvested for measuring grain and straw yield. Average of 10 plants considered for sample plants a treatment. Required chemical analysises were done and data were recorded.

Result and Discussion:

Grain yield

In Bhaluka, BRRI dhan88 and BRRI dhan100 showed no significant yield differences across water management practices, while BINA dhan25 did. BINA dhan25 peaked at 7.16 t ha^{-1} under continuous flooding but dropped to 4.55 t ha^{-1} under AWD. In Jashore, yields were statistically non-significant, with BRRI dhan88 achieving 6 t ha^{-1} under 3F4D+AWD and BINA dhan25's highest yield at 4.96 t ha^{-1} under 3F4D.

Heavy metal concentrations

In Bhaluka, significant differences in heavy metal concentrations (As, Cd) were observed across water management treatments, with 3F4D+AWD exhibiting the lowest As levels (Fig 1.). In contrast, Jashore showed no significant differences in heavy metals across treatments, although a slight reduction in As was noted under the 3F4D treatment. Overall, Fe and Zn remained high and unaffected by treatments (Data not shown).

Table 1: Effect of Water Management on Grain, Straw yield and heavy metal concentration

Water Management	Variety	Grain Yield (t ha^{-1})		Straw Yield (t ha^{-1})		As concentration(ppm)	
		Bhaluka	Jashore	Bhaluka	Jashore	Bhaluka	Jashore
CF	BRRI dhan88	6.75	5.93	5.03	7.61	0.37a	0.365a
AWD		6.65	5.3	5.79	7.18	0.26b	0.286b
3F4D		7.11	5.29	5.66	5.95	0.29b	0.261b
3F4D+AWD		6.82	6	5.78	6.29	0.29b	0.289b
SE		0.11	0.23	0.19	0.27	0.004	0.004
%CV		7.26	17.72	15.08	16.98	4.37	4.36
LS		NS	NS	NS	NS	***	***
CF	BRRI dhan100	7.38	6.44	5.81	7.07	0.13a	0.40
AWD		7.55	6.12	6.94	7.32	0.10ab	0.343
3F4D		7.51	6.46	6.19	7.25	0.10ab	0.346
3F4D+AWD		7.30	6.25	6.67	6.96	0.08b	0.273
SE		0.08	0.219	0.17	0.28	0.002	0.011
%CV		4.79	15.08	9.75	17.04	7.17	10.32
LS		NS	NS	NS	NS	**	NS
CF	BINA dhan 25	7.16a	4.5	6.67	14.12	0.13a	0.34
AWD		4.55b	4.88	7.93	10.35	0.125a	0.29
3F4D		5.80ab	4.96	7.63	9.72	0.095ab	0.28
3F4D+AWD		4.55b	4.89	7.32	10.65	0.085b	0.25
SE		0.20	0.185	0.25	0.49	0.003	0.015
%CV		15.51	16.44	14.74	20.03	8.07	16.37
LS		***	NS	NS	NS	*	NS

Heavy metal concentration in boro rice grain

In Bhaluka, significant differences in As, Cd, Cu, and Ni were observed across treatments, with the lowest As in rice grain under 3F4D+AWD and the highest Cd in the same treatment. In Jashore, As was lowest under AWD, while other elements showed no significant differences.

Economic analysis: BCR was calculated by using this formula of Shively and Gerald (2012). CR = Gross Income / Gross Cost of Production.

Table 1: Economic analysis of boro rice

Water Management	BCR (Bhaluka)	BCR (Jashore)
CF	1.81	1.5
AWD	1.82	1.63
3F4D	2.05	1.66
3F4D+AWD	1.88	1.71

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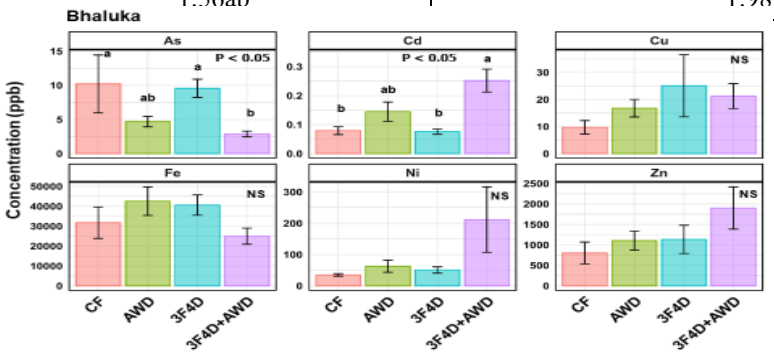
Table 2: Grain and straw yield of T. Aman in Bhaluka and Jashore location:

	Bhaluka		Jashore	
Treatment	**Grain Yield(t/ha)**	**Straw Yield(t/ha)**	**Grain Yield(t/ha)**	**Straw Yield(t/ha)**
CF	7.20	7.61	6.00	8.07
AWD	6.84	7.36	6.32	8.83
3F4D	7.23	7.50	6.06	8.51
3F4D+AWD	7.14	8.64	6.12	8.99

In Bhaluka, the highest grain yield was from the 3F4D treatment at 7.23 t/ha, while Jashore saw the highest yield from AWD at 6.32 t/ha. Straw yields were generally higher in Jashore, with AWD producing 8.83 t/ha, compared to Bhaluka's maximum of 8.64 t/ha from 3F4D+AWD (Table 2).

Table 3: Seed yield of mustard in Bhaluka and Jashore

	Bhaluka	Jashore
Treatment	**Yield(t/ha)**	**Yield(t/ha)**
CF	1.87a	1.87
AWD	1.49ab	1.90
3F4D	1.33b	1.93
3F4D+AWD	1.56ab	1.98



The seed yield of mustard varied across treatments in Bhaluka and Jashore, with the highest yield in Bhaluka for CF at 1.87 t/ha and in Jashore for 3F4D+AWD at 1.98 t/ha (Table 3).

Fig. 1. Heavy metal concentrations in soil under different water management practices in Bhaluka

Conclusion: As a first-year study, it lays a strong foundation—demonstrating that 3F4D and 3F4D+AWD improve yield, water efficiency, and reduce arsenic. In the second year, expanded trials and farmer engagement will validate scalability, driving sustainable transformation in rice cultivation across Bangladesh.

Project Code and Title: TF141-C/23. Developing mushroom variety through conventional and/or advanced fungal breeding techniques.
Implementing Organization: Independent University Bangladesh (IUB), Dhaka
Component Organization: None
Principal Investigator: Dr. Jebunnahar Khandakar, Associate Professor, Department of Life Sciences, School of Environment and Life Sciences, Independent University Bangladesh (IUB

Location(s): Laboratory of Department of Life Sciences and Mushroom Development Institute, Savar, Dhaka.
Budget: Tk. 24.99 Lakh
Duration: July 2023 to June 2026 (36 months)
Introduction: The high-protein mushroom presents significant opportunities for Bangladesh, contributing to food security, increased crop diversity, and poverty alleviation. However, several challenges hinder its widespread cultivation, including a lack of diverse varieties, limited access to quality spawn, and poorly developed market channels. A major issue is the insufficient varietal diversity, especially for summer mushrooms. Consequently, farmers struggle to cultivate mushrooms during the summer months, despite the growing demand in the country. Addressing these challenges and enhancing genetic diversity is crucial for realizing the full potential of mushroom farming in Bangladesh. Wild mushroom samples have been collected from the Satchori Forest and are currently being preserved through tissue culture at the DLS laboratory, Independent University Bangladesh (IUB).

Objective: To develop a novel mushroom variety through conventional and/or advanced fungal breeding methods.

Materials and Methods:
Materials used: Wild mushroom collection conserved the DLS laboratory, Independent University Bangladesh (IUB). We use a sucrose solution (pH 6.0) which served as the osmotic stabilizer and Lysing enzymes including Driselase and Cellulase to digest the cell walls. Potato Dextrose Agar (PDA) were collected and used for protoplast isolation.

Protoplast Isolation from Mycelium:

Seven-day-old mushroom mycelia grown on Potato Dextrose Agar (PDA) were collected for protoplast isolation. The enzyme mixture was added to the mycelial suspension in a flask, which was incubated for 24 hours. Following incubation, the mixture was centrifuged at 3,000 rpm for 10 minutes. The resulting protoplasts were purified and resuspended in 10 mL of 1 M sucrose solution. Protoplast concentration was determined using a hemocytometer under bright-field microscopy at 400× magnification.

Results and Discussion: Among the osmotic stabilizers tested, sucrose outperformed sodium chloride in generating the highest number of protoplasts after incubating with the enzymes. Chemical digestion is a more effective and debris free method. Uses cellulase laminarinase and xylanase activities. These enzymes, when supplemented with 15 mg of cellulase, resulted in clear solutions of protoplasts with minimal cellular debris or damage (Fig 1). Hemocytometer-mediated observations revealed a high protoplast yield for all the mushroom species, reaching up to 6.13×10^6 cells/ml.

The next phase of the study focused on the fusion process between *Pleurotus ostreatus* and *Pleurotus florida*, facilitated by 30% PEG (MW-4000). The establishing protoplast isolation method is a simple and easy-to-replicate which is efficiently isolates protoplast from various mushroom species, including *Pleurotus ostreatus, Pleurotus djamor, Pleurotus florida, Calocybe indica,* and a wild species (*Pleurotus giganticus*). The enzymatic digestion method was pretreated with osmotic stabilizer of 1M sucrose solution. A high protoplast yield of 6.13×10^6 cells/ml was achieved. The fusion technique then was performed using 30% Polyethylene glycol (PEG, MW-4000) and successfully facilitated the intragenic hybridization between *Pleurotus ostreatus* and *Pleurotus Florida*. The established method demonstrates the potential for developing improved fungal strains and addressing challenges like heat resistance or improving the nutritional value and shelf life of these products, which is critical to the advancement of mushroom cultivation in Bangladesh.



Fig. 1: Protoplast Isolation of Different Strains of Mushroom.

Conclusion: Sucrose-enhanced enzymatic digestion yielded high protoplast counts with minimal debris; PEG-mediated fusion successfully generated Pleurotus hybrids. Future work should validate hybrid stability and assess agronomic traits for commercial cultivation and strain improvement.

Project Code and Title: TF143-C/23: Improving N-use efficiency and reducing GHG emissions through fungal assisted root modulation of rice
Implementing organization: Gazipur Agricultural University (GAU), Gazipur
Component Organization: BAU Mymensingh and BRRI, Gazipur
Principal Investigator cum coordinator: Prof. Dr. Shah Mohammad Naimul Islam, GAU
Location(s): Gazipur Agricultural University (GAU), Gazipur; Bangladesh Agricultural University (BAU), Mymensingh
Budget: Tk. 45 lack
Duration: 3 years

Introduction: Plants adapt their root anatomy and architecture to optimize nutrient uptake from the soil. They also modify the rhizosphere, influencing microbial communities and root development. Endophytic fungi play a crucial role, providing ecosystem services like insect control and nutrient recycling. In rice, low nitrogen use efficiency is a challenge due to fertilizer losses. Researchers are investigating how *Metarhizium anisopliae* and *Beauveria bassiana* fungi affect rice root traits, nitrogen use efficiency, carbon sequestration in soil and greenhouse gas emissions (GHG). These findings could help mitigate global warming while maintaining crop performance.

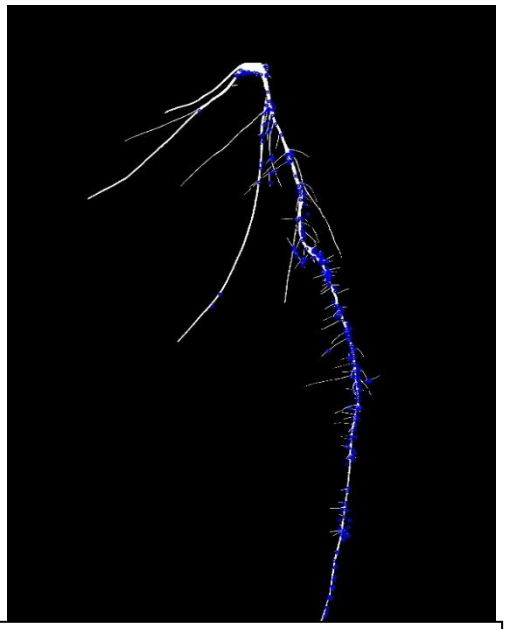
Objective: To investigate how rice roots and the endophytic fungi *Metarhizium anisopliae* and *Beauveria bassiana* (Order: Hypocreales) influences nitrogen use efficiency, soil carbon sequestration, and greenhouse gas emissions (GHG)

Materials and Methods:

1. Fungal Culture and Spore Production:
    - Hypocrealean fungal isolate (*Metarhizium anisopliae*) were cultured on SDAY medium for spore production.
    - A spore suspension (1 × 10^6 spores/ml) was prepared using Tween 80 (0.05%) for rice seed inoculation.
2. Seed Inoculation:
    - Sterilized germinated rice seeds were soaked in the spore suspension for 24 hours.
3. Plant Culture and Root Phenotyping:
    - Fungal-inoculated germinating rice seeds were planted in rhizoboxes containing quarter-strength MS basic salt solution.
    - After 10 days of growth, root images were captured using a digital camera.
    - ImageJ software was used to analyze root characteristics.

Results and Discussion: Nineteen 19 rice varieties were collected for root traits study. Among the studied varieties, the *M. anisopliae* primed BRRI dhan88 rice varieties showed the highest root length followed by BRRI dhan89 and BRRI dhan74. Within each variety, primed seedling significantly increased the root length. However, the highest percent increase of root length induced by endophyte was observed in BRRI dhan74 (454%) compare to control seedling. BRRI dhan88 and BRRI dhan89 primed seedling showed 64% and 52% increase of length respectively compare to their corresponding control.

The study on rice varieties primed with M. anisopliae revealed that BRRI dhan88 exhibited the highest root vector growth, followed by BRRI dhan89 and BRRI dhan74. Primed seedlings significantly enhanced root vector length, with BRRI dhan74 showing the greatest increase at 479% compared to control seedlings. In terms of surface area, BRRI dhan88 again led, with BRRI dhan89 and BRRI dhan74 following. The highest percent increase in root surface area was also seen in BRRI dhan74 at 131%, while BRRI dhan88 and BRRI dhan89 showed increases of 127% and 42%, respectively, compared to their controls.



Photograph: BRRI 89 Treated with *Metarhizium anisopliae*

Conclusion: the study highlights the beneficial effects of *Metarhizium anisopliae* on rice root development, revealing significant genotypic variation in response to the treatment. These findings pave the way for further research on root characteristics across multiple rice genotypes in relation to endophytic fungi, enhancing our understanding of plant-fungal interactions.

Project Code and Title: TF 144-C/23. A study of heavy metal hyper-accumulating plant species in Bangladesh and phytoremediation of contaminated soils

Implementing Organization: Dept. of Environmental Science, BAU, Mymensingh
Component Organization: None
Principal Investigator: Dr. Md. Azharul Islam
Location(s): Gazipur, Mymensingh, Narayanganj and Narshingdi
Budget: TK. 40.00 Lakh
Duration: 22 October 2023 to 21 October 2026 (36 months)
Introduction: The natural phytoremediation process was reported more than 300 years ago, and following that, humans began using these plants to remove pollutants from contaminated sites. For phytoremediation purposes, it is essential to use plants with strong resistance to heavy metal toxicity, greater translocation of contaminants from the roots to above-ground parts (shoots), therefore so at the end, the metal- contaminated plant biomass could be harvested, treated and disposed of properly. Based on the history of rich plant biodiversity in Bangladesh; hence, it has good potential to provide suitable species for phytoremediation. Research activities involve both survey on available and efficient heavy metal hyper-accumulating ant species, laboratory analysis of soil and plant samples and on-farm experiments on the management of heavy metals from soils.

Objective: To explore the availability of hyperaccumulating plant species and evaluate their metal uptake capability and storing ability within the parts of the species.
Materials and Methods: Conducted survey on available heavy metal hyper-accumulating species in major regions of Bangladesh. Soil samples of each field were collected before planting/sowing the test species (Mustard, Dhaincha, Bean) in experimental fields and prepared for metal analysis in the laboratory**.** The test species Mustard, Alpine, Dhaincha, Bean, Soybean were grown accordingly in farmers' fields. Plant shoots and roots were harvested after maturation and prepared for analysis in laboratory. Collected data were analyzed statistically and were compared by DMRT.
Results and Discussion: A total 5 species viz: Mustard, Alpine, Dhaincha, Bean, Soybean were identified (Table-1). In the first year trials, 3 test plants (Mustard, Dhaincha, Bean) were grown. In upcoming 2nd year, remaining 4 test plants will be grown accordingly.

Table 1: The list of the species identified as hyperaccumulators along with their common and botanical names and locations.

Common Name	Botanical Name	Location
Mustard	*Brassica napus*	G, M, N, Nj
Jute	*Corchorus capsularis*	G, M, N, Nj
Mesta	*Hibiscus cannabinus*	G, M, N, Nj
Marigold	*Tagetes patula*	G, M, N,
Cotton	Gossypium hirsutum	G, M, N, Nj
Water hyacinth	*Eichhornia crassipes*	G, M, N, Nj
Barnyard grass	*Echinochloa spp.*	G, M, N, Nj
Water Taro	*Colocasia esculenta*	M, N, Nj
Horse Bean	*Vicia faba*	G, M, N, Nj
Soyabean	*Glycine max*	G, M, N, Nj
Sunflower	*Helianthus annuus*	G, M, N, Nj
Alpine	*Thlaspi caerulescens*	M, N, Nj
Red Clover	*Trifolium pratense*	G, M, N, Nj
Dhaincha	*Sesbania bispinosa*	G, M, N, Nj

Note: G denotes Gazipur, M denotes Mymensingh, Nj Narayanganj, N denotes Narsingdi

Soil samples collected from Narayanganj, Gazipur, Mymensingh, and Narsingdi were analyzed for heavy metal concentrations before and after harvest (Table 3). Results were benchmarked against WHO's MPLs to assess environmental safety and crop health risks. Soil samples from Narayanganj, Gazipur, Mymensingh, and Norsingdi revealed elevated concentrations of nickel, chromium, and iron, with all sites exceeding WHO's maximum permissible limits. While post-harvest reductions suggest partial uptake by crops or leaching, the consistently high levels point to chronic contamination likely linked to industrial runoff, agrochemical inputs, or irrigation sources. Arsenic levels in Norsingdi also approached critical thresholds. These findings underscore the urgent need for targeted soil remediation, stricter regulation of agricultural inputs, and enhanced monitoring systems to mitigate environmental

risks, protect crop safety, and support long-term sustainability in Bangladesh's agricultural landscapes. The following pictorial views explain lab and field activites (Fig 1).

Table 3: Metal concentrations (in ppm) estimated in soil samples (pre and post harvest) of different experimental fields.

Metal	Narayanganj		Gazipur		Mymensigh		Narsinghdi		MPL*
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	
As	4.49	4.42	3.00	2.88	8.15	7.900	19.275	17.640	20
Cd	0.0255	0.0252	0.1788	0.096	0.1585	0.162	0.1935	0.1508	3
Cu	18.25	16.72	9.125	8.52	24.025	22.440	14.85	11.74	30
Cr	156.75	134.80	54.25	47.62	64.75	60.260	152.25	137.82	100
Ni	110.25	90.16	144.50	98.80	91.50	86.902	62.75	53.04	50
Mn	470.00	424.84	71.00	66.86	357.5	346.840	282.50	213.52	740
Co	10.90	9.80	4.975	3.980	14.55	11.66	7.975	7.562	50
Fe	21925	20750	8775	8560	28250	25840	18675	16580	5000

*MPL= Maximum Permissible Limits

Source: Permissible limit for heavy metals in soil (WHO, 2019)

Fig 1. Pictorial activities include land preparation, soil sample collection, plant sample processing and laboratory activities



Land preparation



Soil sampling



Visited experimental field
(PI, UAO, SAAO, PhD student)

Laboratory work



Preparing Dhaincha sample in laboratory



Preparing bean sample in laboratory



Conclusion: The study presents compelling evidence of widespread heavy metal contamination across key agricultural zones, with persistent exceedances of WHO safety limits for nickel, chromium, iron, and arsenic. First year trials have demonstrated the potential of selected plant species for metal uptake, but a comprehensive evaluation of phytoremediation efficacy across diverse crops and contamination profiles remains essential. The second year of the project will focus on evaluating the metal uptake and accumulation potential of four additional test species viz: Alpine, Dhaincha, Bean, and Soybean—under similar agro-ecological conditions. Comparative assessments will inform species-specific phytoremediation efficacy and guide future interventions.

Project Code and Title: TF 145- C/23. Development of watermelon variety and quality seed production

Implementing Organization: Bangladesh Agricultural Research Institute (BARI), Gazipur
Component Organization: None
Principal Investigator: Dr. AKM Quamruzzaman, CSO, HRC, BARI

Location(s): Olericulture Division, HRC, BARI, Gazipur. RHRS, Patuakhali, ARS, Benorpota, Satkhira

Budget: 40.00 lakh. (36 months)

Duration: 36 months; From 23 November 2023 to 22 November 2026

Introduction: Watermelon (Citrullus lanatus) is a popular fruit in Bangladesh, especially in the southern regions, with a primary growing season in the dry summer months. The national yield is low at 20.91 t/ha, lagging behind other tropical countries. To address this, BARI has introduced two open-pollinated varieties that can be cultivated year-round with proper techniques. The study emphasizes the importance of establishing a robust system for disseminating these cultivation methods to farmers, aiming to enhance watermelon production and tackle existing agricultural challenges.

Objective: To develop promising OP, hybrid variety and innovate production technology and also produce sufficient watermelon seed for year-round production

Materials and Methods: During the reporting period November 2023 to November 2026) four experiments were conducted to achieve the goals. A seed production program also was under taken during this reporting period

1. Collection, characterization and evaluation of watermelon germplasm
2. Diallel crossing of the inbreds
3. Advance yield trial of watermelon
4. Regional yield trial of watermelon (OP)

The studies were conducted with 10 germplasm along with check variety (BARI Tarmuj-1 and BARI Tarmuj-1) in the research field of Olericulture Division, HRC, BARI, Gazipur. The seeds were sown on 1st February and transplanted on 20th February 2024. The experiment was laid out in a Randomized Complete Block design with two replications. The unit plot size was 10.0 x 2.0m maintaining 1.5 x 2.3m spacing and 0.3m drain. Recommended doses and method of application of fertilizers was fertilized used.

Results and Discussion:

Collection, Characterization and Evaluation of Watermelon Germplasm

The highest yield per hectare was recorded from the lines CL 009D (49.97 t/ha), followed by CL 009B (49.61 t/ha), CL 12B (49.22 t/ha), CL 009C (48.88 t/ha), and CL 009A (46.70 t/ha), with CL 008 at 46.47 t/ha. Fusarium wilt infection rates ranged from 0 to 20%, while mite infestations varied from 0 to 10% under field conditions (Table 1). Therefore, we can select lines with zero percent infestation.

Advance Yield Trial (AYT) of Watermelon

CL 009A emerged as the most productive watermelon variety, yielding 27.97 kg per plant and 55.93 t/ha, attributed to favorable genetic traits and effective hybrid selection. BARI Tarmuj-1 excelled in fruit quality, featuring the thickest flesh (31.0 cm), largest diameter (33.0 cm), and highest Brix percentage (12.9%), indicating superior sweetness and market value. In terms of disease resistance, CL 009D stood out as the only variety resistant to Fusarium wilt and mite infestation, while CL 006 showed susceptibility to both, limiting its viability in disease-prone areas (Table 2). Each variety offers distinct advantages for breeding and production goals.

Table1. Quantitative characteristics of 10 watermelon germplasm/varieties

Lines/ varieties	Vine length (m)	Number of fruit /plant	Single fruit weight (kg)	Fruit length (cm)	Fruit diameter (cm)	Flesh thickness (cm)	Rind thickness (cm)	TSS (%)	Yield/ plant (kg)	Fusarium wilt (%)	Mite (%)
CL 001	5.10	3.40	5.80	37.50	19.40	18.00	1.70	11.30	12.52	20	10
CL 006	4.20	4.40	5.50	34.00	20.10	17.50	2.30	11.50	16.30	10	5
CL 005A	4.30	3.30	7.10	44.20	19.80	18.00	1.90	12.20	15.03	10	5
CL 008	4.50	3.80	6.80	45.50	21.30	18.50	2.40	12.00	17.24	5	5
CL 009A	4.60	4.40	5.80	39.00	19.80	16.80	2.50	10.50	17.32	5	0
CL 009B	5.10	4.10	6.60	40.50	21.20	19.00	2.10	13.60	18.36	0	0
CL 009C	4.80	6.70	4.00	35.80	15.20	13.00	2.10	11.30	18.10	0	0
CL 009D	4.00	4.30	6.30	38.00	22.60	21.00	1.80	11.40	18.49	0	0
BARI Tarmuj-1	4.10	5.10	4.90	35.60	33.40	31.00	2.20	12.80	16.99	5	0
BARI Tarmuj-2	4.20	4.10	4.50	25.50	17.00	15.00	2.00	12.10	11.85	0	0
Mean	3.48	3.26	4.58	36.67	19.08	16.72	1.18	10.45	14.47		
St Dev	0.37	0.78	0.89	6.80	3.83	3.83	0.26	0.79	2.40		
CV (%)	0.11	0.24	0.19	0.19	0.20	0.23	0.22	0.08	0.17		

Table 2. Quantitative characteristics of 5 advanced watermelon lines/varieties

Germplasm/ varieties	No. of fruit /plant	Single fruit weight (kg)	Vine length (m)	Yield/ plant (kg)	Flesh thickness (cm)	Rind thickness (mm)	Brix (%)	Fruit yield (t/ha)	Fruit length (cm)	Fruit diameter (cm)	Fusarium wilt infestation (%)	Mite infestation (%)
CL 006	4.3	6.35	4.5	27.31	17.5	17.2	11.7	54.61	35.0	21.0	5	5
CL 005A	4.3	6.47	4.6	27.82	18.0	17.5	12.4	55.64	44.0	21.5	5	0
CL 009A	4.7	5.95	4.9	27.97	16.8	17.5	10.8	55.93	38.0	21.5	5	0
CL 009D	4.3	6.25	4.3	26.88	21.0	19.2	11.5	53.75	39.0	22.8	0	0
BARI Tarmuj-1	4.6	5.45	4.1	25.07	31.0	29.6	12.9	50.14	36.0	33.0	5	0
Mean	4.44	6.094	4.48	27.01	20.86	20.20	11.86	54.01	38.40	23.96	4.00	1.00
Std. Dev	0.195	0.408	0.303	1.167	5.891	5.314	0.814	2.332	3.507	5.097	2.236	2.236
CV (%)	4.39	6.70	6.77	4.32	28.24	26.31	6.87	4.32	9.13	21.27	55.90	223.6

LSD $_{(0.05\%)}$	0.242	0.507	0.377	1.449	7.314	6.598	1.011	2.895	4.355	6.329	2.776	2.776

Diallel Crossing of the Inbreds

By forming 10 cross combinations from inbreds CL 001, CL 005A, CL 006, CL 009A, and CL 009D, the research aimed to simplify the experimental design while gaining insights into genetic interactions. Key parameters, general combining ability (GCA) and specific combining ability (SCA), were analyzed to understand the genetic effects on traits like yield and stress resistance. The findings will aid in selecting superior hybrids, enhancing crop productivity, adaptability, and sustainability in agriculture.



Figure 1. (a) Field view of regional yield trial (RYT) of OP watermelon (b) seed crop of BARI Tarmuj 1

Conclusion: In conclusion, the evaluation of watermelon germplasm reveals promising lines with high yield and quality, emphasizing the need for strategic variety selection. Future breeding efforts will focus on enhancing disease resistance and market value, ultimately fostering sustainable and resilient watermelon production systems.

Project Code and Title: TF 147-C/23: Title: Evaluation and expansion of salt tolerant wheat genotypes in the coastal areas of Bangladesh

Implementing Organization: Bangladesh Wheat and Maize Research Institute, Regional Station (RS), Gazipur
Component Organization: None
Principal Investigator: Dr. Md. Mustafa Khan, Senior Scientific Officer, BWMRI, Regional Station (RS), Gazipur
Location: Regional station (RS), BWMRI, Gazipur, Barishal, Patuakhali, Barguna and Satkhira
Budget: 30 lakh
Duration: From 3 October, 2023 to 2 October, 2026 (36 Months)

Introduction: Wheat is the second most important cereal crop in Bangladesh, with a current demand of 7.5 million MT and a production of only 1.085 million MT. Expanding wheat cultivation in traditional northern regions faces challenges due to crop competition. To bridge the production-demand gap, the project aims to cultivate wheat in 1.056 million hectares of salt-affected fallow lands in coastal areas. It emphasizes the development and promotion of salt-tolerant wheat varieties, addressing past research funding issues. The goal is to evaluate and disseminate high-yielding salinity-resistant wheat lines to enhance production among coastal farmers.

Objective: to identify salinity tolerant wheat lines/genotypes and to disseminate and popularize the existing salt tolerant wheat varieties in the southern Bangladesh

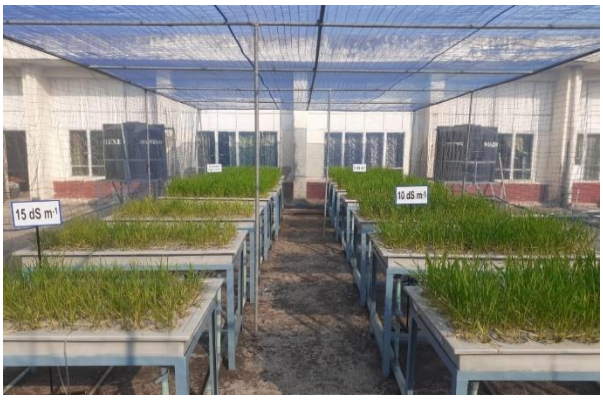
Materials and Methods: A total of 100 wheat genotypes were evaluated in a hydroponic system with 0 (control), 5, 10, and 15 dS m^{-1} salinity levels of solution at RS, BWMRI, Gazipur. Two sets of field trials were conducted with 16 advanced lines at Sekandarkhali, Amtoli, in the Barguna district and Monohorpur, Kolapara in the Patuakhali district. Another two trials were set up with 16 high vigor - high biomass genotypes collected from CSIRO, Australia, in the same locations.
Soil salinity levels were measured 4 times from all the experimental plots at regular intervals. We set up fifty variety demonstrations and two wheat block demonstrations. A training program on wheat cultivation and seed preservation was conducted for the beneficiary farmers.

Results and Discussion: A total of 100 wheat genotypes were assessed, and 50 of these genotypes were chosen due to their favorable dry matter production during the early vegetative stage. The evaluation trial is scheduled to be repeated next year to verify the consistency of the results.
In the second activity, the heat map illustrated the variability of soil salinity across the experimental sites. This map also indicated a rising trend in salinity over time, starting from the date of seed sowing. The average salinity at the Amtoli location varied from 4.1 to 9.8 dS m-1, while at the Kolapara location, it ranged from 5.4 to 14.4 dS m-1 throughout the cropping season. Cluster analysis indicated that the genotypes BAW 1425, BAW 1430, and BAW 1435 exhibited greater salt tolerance, as evidenced by their higher grain yield, increased 1000-grain weight, and spike density per square meter in both locations. The genotypic response to salinity, assessed through regression analysis, largely corroborated the findings of the cluster analysis for BAW 1425 and BAW 1435. Nevertheless, these trials are scheduled to be conducted next year for further validation.

In the third activity, the genotype CSVig-2020-B11 was prevalent among the highest-yielding groups in both locations. As a result of the seed dissemination activities conducted in the first year, approximately two metric tons of seeds have been retained by the farmers for sale and for their utilization in the following year.
Conclusion: The results of the first year activities are highly encouraging. It is expected that few high yielding salinity tolerant wheat genotypes will be selected from such research activities. We also hope that quality seed of the existing salinity tolerant varieties will become available among the wheat farmers of this region. Continued research and validation in the upcoming trials are essential to attain the rest of the objectives.

Table 1: Comparison among wheat genotypes clustered by the agglomerative Ward's linkage method based on mean trait values

Location	Group	No. of member	Spike m^{-2}	Grain $spike^{-1}$	TGW (g)	Grain yield (t ha^{-1})	BY (t ha^{-1})	NDVI
Amtoli, Barguna	I	4: BARI Gom 25, BWMRI Gom 4, BAW 1436, BAW 1438	198	28	49	2.54	5.36	0.56
	II	7: BARI Gom 33, Bio 6, BAW 1286, BAW 1422, BAW 1433, BAW 1434, BAW 1439	175	32	52	3.10	5.79	0.60
	III	5: Bio 12, BAW 1340, BAW 1425, BAW 1430, BAW 1435	215	30	48	3.51	6.93	0.63
Kolapara, Patuakhali	I	6: BARI Gom 25, BARI Gom 33, Bio 6, Bio 12, BAW 1422, BAW 1436	143	27	47	1.76	3.00	0.26
	II	5: BWMRI Gom 4, BAW 1425, BAW 1430, BAW 1435, BAW 1439	154	26	50	2.39	3.51	0.34
	III	5: BAW 1286, BAW 1340, BAW 1433, BAW 1434, BAW 1438	119	27	49	1.68	2.56	0.26



Photograph: Screening wheat germplasm against

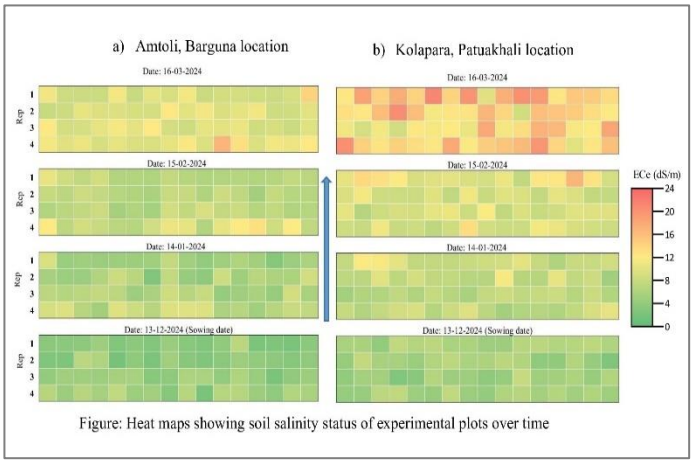


Figure: Heat maps showing soil salinity status of experimental plots over time

Project Code and Title: TF 148-C/23. Serological and molecular diagnosis and management of the yellowing disease complex of sweet orange
Implementing Organization: Plant Pathology Division, BARI, Gazipur
Component Organization: None
Principal Investigator: Dr. Md. Shamim Akhter, BARI
Location(s): Plant Virology Laboratory, Green house of Plant Pathology Division; ChapaiNowabgonj; Rangpur; Citrus Research Staion, Jaintiapur, Sylhet
Budget: Tk. 35.00 Lakh

Duration: October 2024 to October 2026 (36 months)

Introduction: The yellowing disease complex followed by decline is a severe constrained to citrus cultivation especially of sweet orange in Bangladesh. Three species of fastidious bacteria ie *Candidatus, Liberibacter* and *Asiaticus* (CLas), transmitted by two species of psyllid, *Citrus tristeza virus* (CTV) which are vectored by aphid and Citrus sudden death associated virus (CSDaV) causing yellowing complex followed by tree decline. Moreover, 16Sr group of phytoplasma also been reported from yellowing symptoms of citrus. Therefore, it is crucial to identify the causal agents and insect vectors of the yellowing disease complex in citrus, including sweet orange, to create effective management solutions and reduce the yellowing decline threat in Bangladesh.

Objective: Diagnosis and studies of the genetic variability among causal agent/s and its insects vector, epidemiology, field diagnostics and management are the major Objective.

Materials and Methods: An extensive survey program has been started at different citrus orchards including sweet orange to know the existing disease status. Immuno-nucleobased diagnosis (DAC-ELISA) , molecular technique (PCR and/or RT-PCR) and biological indexing using different grafting techniques (cleft, bark and leaf grafting along with insect transmission) on to different citrus species (pathogenicity test) has been carried out to diagnosis for the yellowing disease complex of citrus. For field diagnosis using immunoassay later flow in house polyclonal antibody (Pab) against Bangladeshi isolates will be developed. The insect vector/s will be identified by sequencing of mitochondrial cytochrome oxidase I (mtCOI) gene. For management of the disease, cross protection and vector control will be carried out.

Results and Discussion: A total of 780 samples were collected from different locations in different citrus species and characterized through considering phenotypic, serological, molecular diagnosis and biological indexing using cleft grafting and insect transmission. The characteristics symptoms induced by CTV in *Citrus reticulata*, *Citrus sinensis, Citrus aurantifolia* are leaf yellowing, stem pitting and vein clearing observed. *Citrus assamensis*; *Citrus macroptera; Citrus lemon* confirmed by DAC-ELISA followed by RT-PCR . This description of yellowing symptoms aligns well with the visual representation in Fig 1. Type I to Type III are typical symptoms of CCTC and Tyoe IV to X are associated symptoms of greening disease (Fig 2). Among the 780 samples tested by DAC-

ELISA, 176 samples found positive against in-house antibody raised against CTV.
The molecular characterization based on the partial CP gene sequencing and genotype specific RT-PCR of the Bangladeshi CTV isolates revealed that the resistance Breaking (RB) genotypes prevailing in Bangladesh. Symptomatic 190 samples of *Citrus Sinensis* tested by PCR and found positive citrus greening causing bacteria (CLas) in 87 samples (Table 1). Our immune-nuclobased diagnosis revealed that HLB in more frequent in sweet orange than CTV. The biological indexing of CTV-maxican lime isolates on to Rangpur lime root stock by cleft grafting produced identical yellowing filed symptoms. Citrus greening (HLB) - Sweet orange isolates in Rangpur lime; Trifoliate orange and Pamelo has been confirmed by cleft grafting. The results of the biological indexing revealed that Pamelo is the more tolerant root stock than Rangpur lime and Trifoliate orange. The Asian citrus psyllid (ACP) has been identified by amplification of species specific primer and insect transmission test of HLB in trifoliate orange. Our pathogenicity test suggested that natural mild genotypes of CTV might be a suitable option for cross protection against virulent strain of CTV as well as HLB.

Conclusion: We developed sensitive protocol for diagnosis of CTV and CLas and their insect vector that are responsible for yellowing disease complex of sweet orange in Bangladesh. For field diagnosis using immunoassay later flow for large number of samples an in-house polyclonal antibody production is in progress. For management of yellowing disease complex of sweet orange, the searching of resistant or tolerant root stock, mild CTV strain and vector control are in progress.

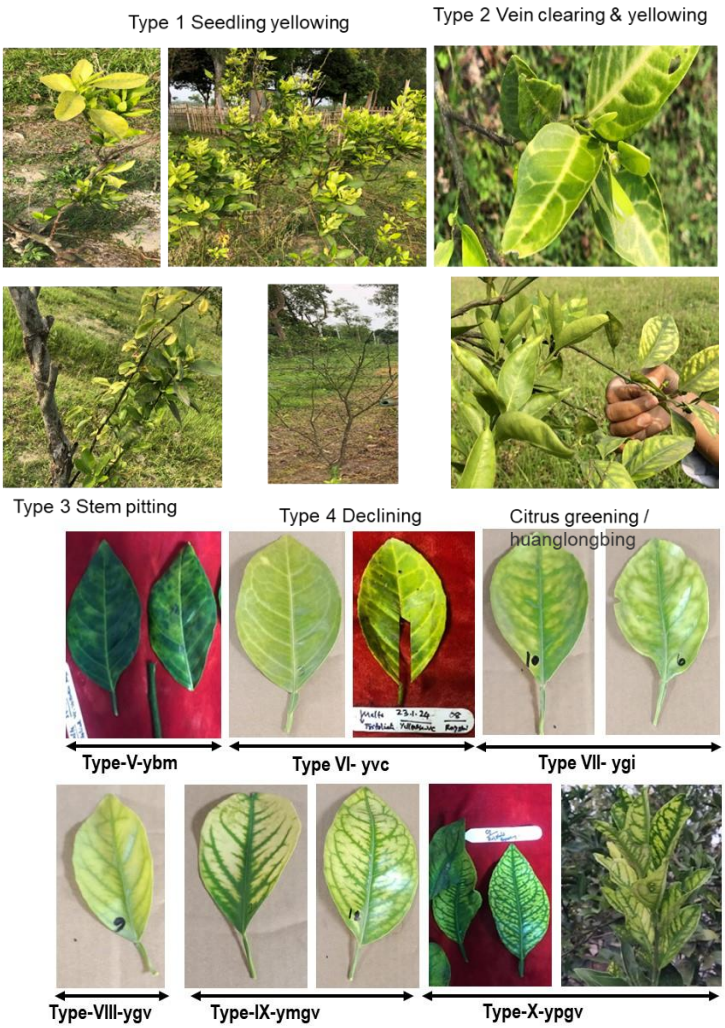


Fig1. Types of yellowing symptoms in citrus sp in Bangladesh.

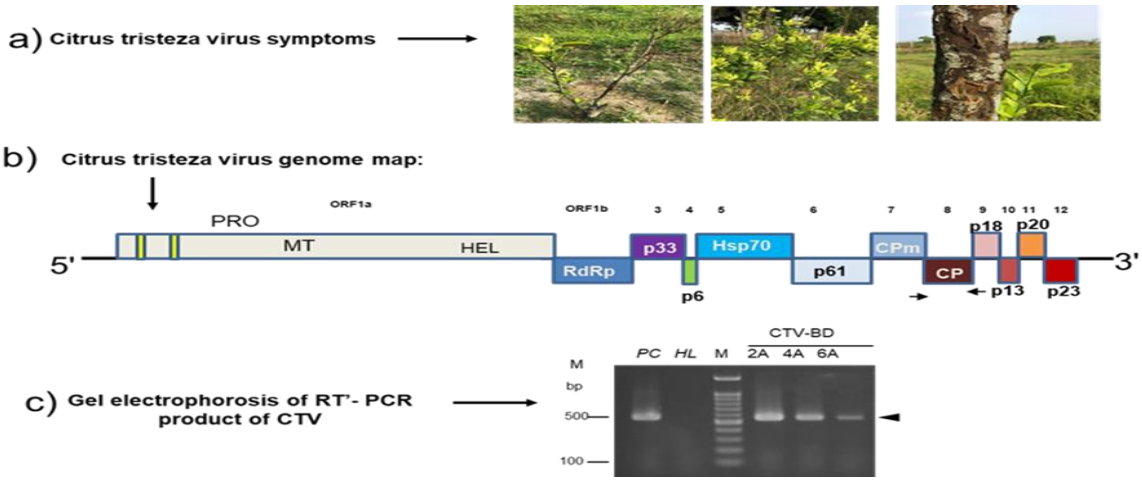
Table 1: Molecular diagnosis of *Candidatus Liberibacter* casuing greening disease (HLB) in different citrus species from different locations in Bangladesh.

Sl no	Sample collection location	Citrus species	Total number of leaf samples tested by PCR	Number of leaf samples positive by PCR	PDI (%)
1	Puthia, Rajshahi	Sweet orange (*Citrus sinensis*)	10	06	60
2	Durgapur, Rajshahi	Sweet orange (*Citrus sinensis*)	10	07	70
3	Godagari, Rajshahi	Sweet orange (*Citrus sinensis*)	10	05	50
4	Tanore, Rajshahi	Sweet orange (*Citrus sinensis*)	10	05	40
5	Nachol, Chapai	Sweet orange (*Citrus sinensis*)	10	8	80
6	RARS, Jamaplpur	Jara lebu (Citrus medica)	10	00	00
7	RARS, Jamalpur	Sweet orange (*Citrus sinensis*)	10	02	20
8	Gangachara, Moulvibazar	Zinger lime (*Citrus assamensis*)	10	08	30
9	Gangachara, Moulvibazar	shatkora (*Citrus macroptera*)	10	NT	--
10	Gangachara, Moulvibazar	Sweet orange (*Citrus sinensis*)	10	05	80
11	Kamalgonj, Moulvibazar	Sweet orange (*Citrus sinensis*)	10	04	50
12	Kamalganj, Moulvibazar	Mandarin (*Citrus reticulata*)	10	04	40
13	Dumki, Patuakhali	Seedless Lemon (*Citrus limon*)	`10	NT	--
14	Dumki, Patuakhali	China komola (*Citrus reticulata*)	10	08	30
15	Dumki, Patuakhali	Sweet orange (*Citrus sinensis*)	10	03	70
16	Gangachara, Rangpur	Sweet orange (*Citrus sinensis*)	10	08	30
17	Horticulture Centre, Burirhat, Rangpur	Sweet orange (*Citrus sinensis*)	10	05	70
18	Horticulture Centre, Burirhat, Rangpur	Mandarin (*Citrus reticulata*)	10	04	60
19	Betgari, Rangpur	*Seedless lemon (Citrus limon)*	10	NT	--
20	Burimari, Nilphamari	Sweet orange (*Citrus sinensis*)	10	05	50
			190	87	44.21

Fig 2. Molecular diagnosis of *Citrus tristeza virus* (CTV) causing yellowing and sudden decline disease. Different types of yellowing disease symptoms a. Genome map of *Citrus tristeza virus* (CTV) b. Gel electropherosis of CTV amplified by coat protein gene primers.

Project Code and Title: TF 149- C/23. Validating and Refining Sprinkler and Subsurface Drip Irrigation Systems for Sustainable Crop Production in Different Char Areas of Bangladesh

Implementing organization: Bangladesh Agricultural Research Institute (BARI), Gazipur
Component Organization: None
Principal Investigator: Dr. Md Anower Hossain, CSO & Head, Irrigation and Water Management Division, BARI, Gazipur



Location(s): Char areas of Manikganj, Rajbari and Tangail
Budget: TK 49.3185 Lakh
Duration: 03 October 2023 to 02 October 2026 (36 months)

Introduction: In the char areas of Bangladesh, agriculture faces critical challenges due to poor soil quality and water scarcity. Traditional irrigation practices are often inefficient, leading to water wastage and reduced crop productivity. The potential of sprinkler and subsurface drip irrigation systems to address these issues remains underexplored in the diverse char environments. Research is needed to validate and refine these systems to optimize water use efficiency, ensure sustainable crop production, and support farmers' livelihoods. Therefore, this project aims to bridge the knowledge gap by evaluating the performance of these irrigation systems to the specific needs of char agriculture.

Objective: To validate and enhance sprinkler and subsurface drip irrigation systems for crop cultivation in various char regions of Bangladesh.

Materials and Methods: Validation trials were carried out at the farmers' fields of Harirampur, Manikganj; Kalukhali, Rajbari and Bhuapur, Tangail during *Rabi* season of 2023-2024. Treatments of the xperiments wer:

a) Farmer's practice (T_1)
b) Sprinkler and surface drip irrigation (T_2)
c) Subsurface drip irrigation (T_3).

The performance of these irrigation systems was tested and compared with farmers' practices. Materials used:

a) Onion, garlic and ground nut for T_2
b) brinjal, chilli and sweetgourd for T_3

Data on crop yield and water use were collected and analyzed.

Results and Discussion:
T2 consistently outperforms T1 suggesting a superior irrigation method leading to higher productivity. Garlic, groundnut, and green chili show the most significant yield improvements, indicating strong responsiveness to irrigation upgrades. Sweet gourd and brinjal display moderate gains, though multiple trials suggest variability depending on treatment and location. In some cases, T3 performed nearly as well or even slightly better than T2, underscoring the potential efficiency of alternative methods. All four locations demonstrated yield improvements under enhanced irrigation practices, with the greatest relative gains seen in Garlic (Harirampur) and Groundnut (Bhuapur). Kalukhali and Bhuapur showed slightly more moderate but consistent responses, especially in brinjal (Table 1).

The vegetables tested—onion, garlic, chili, brinjal, groundnut, and sweet gourd—are recognized for their strong market demand and attractive farmgate prices, especially when productivity is boosted through efficient irrigation.
Trials showed yield gains ranging from 4.7% to 29.8%, depending on crop and irrigation treatment.
This means farmers can harvest more from the same field, increasing their gross return without expanding land use (Table 1).

Onion and brinjal in Kalukhali, sweet gourd in Harirampur, and chili and brinjal in Bhuapur showed the highest water savings (ranging from 13.4% to 43.6%) and increased productivity—sometimes nearly doubling compared to conventional practices. These results demonstrate the potential of optimized irrigation scheduling in enhancing yield per unit of water, thereby contributing to both water conservation and agricultural profitability in diverse agro-ecological contexts (Table 2).

Table 1: Average crop yields under various irrigation technologies across different locations in 2023–2024

Location	Crops	Treatment	Yield, t/ha	Yield increase, %
Kalukhali, Rajbari	Onion	T_1	17.2	-
		T_2	20.7	20.1
	Brinjal	T_1	22.0	-
		T_2	23.0	4.7
		T_3	22.6	2.6
Harirampur, Manikganj	Garlic	T_1	6.1	-
		T_2	7.8	29.1
	Sweet Gourd	T_1	30.6	-
		T_2	37.4	18.1
		T_3	36.8	20.0
Bhuapur, Tangail	Groundnut	T_1	1.6	-
		T_2	2.1	29.8
	Chili (green)	T_1	9.6	-
		T_2	11.9	23.7
		T_3	10.7	11.3
	Brinjal	T_1	15.6	-
		T_2	16.7	7.3
		T_3	16.0	2.8

Table 2: Total water use and water productivity of crops under different locations in 2023-24

Location	Name of crops	Treatment	No. of irrigation	Total water use (mm)	Yield (t/ha)	Water productivity, kg/m^3	Water Saving (%)
Kalukhali, Rajbari	Onion	T_1	4	215	17.2	8.0	-
		T_2	7	186	20.7	11.1	13.4
	Brinjal	T_1	6	305	22.02	7.2	-
		T_2	15	187	23.0	12.3	38.6
		T_3	9	172	22.6	13.1	43.6
Harirampur, Manikgonj	Garlic	T_1	4	226	6.1	2.7	-
		T_2	6	202	7.8	3.9	10.6
	Sweet Gourd	T_1	4	245	30.6	12.5	-
		T_2	12	194	37.4	19.3	20.8
		T_3	7	163	36.8	22.5	33.4
Bhuapur, Tangail	Groundnut	T_1	6	298	1.6	0.55	-
		T_2	6	246	2.1	0.87	17.4
	Chili	T_1	5	250	9.6	3.8	-
		T_2	16	183	11.9	6.5	26.8
		T_3	10	164	10.7	6.5	34.4
	Brinjal	T_1	5	262	15.6	5.9	-
		T_2	13	174	16.7	9.6	33.5
		T_3	8	156	16.0	10.3	40.4

* For groundnut, onion & garlic: T_1: Farmer's practice; T_2: Sprinkler irrigation system; For chili, sweet gourd & brinjal: T_1: Farmer's practice, T_2: Surface drip irrigation system T_3: Sub-surface drip irrigation system



Fig. 1. Photographic views of sprinkler irrigation for groundnut production at the char areas of Tangail



Fig. 2. Photographic views of solar-powered sub-surface and surface drip irrigation system for chili production at char area of Bhuapur, Tangail

Conclusion: The first year result has demonstrated the potential of sprinkler and subsurface drip irrigation to enhance crop yield and water productivity in the char lands. In the 2nd year, efforts will focus on further optimizing irrigation practices to maximize crop yields and water efficiency across diverse regions in Bangladesh, building on the promising results observed in garlic, groundnut, and other high-demand vegetables.

Project Code and Title: TF 150- C/23. Development of N-fixing and P-solubilizing Bio-Fertilizers with Plant Growth Promoting Bacteria for Enhancing Nutrient Use Efficiency of Sugarcane

Implementing Organization: Bangladesh Sugarcrop Research Institute, Ishurdi, Pabna
Principal Investigator: Dr. Gazi Md. Akram Hossain, BSRI
Location(s): 15 (Thakurgoan (AEZ-1), Panchaghar (AEZ-1), Joypurhat (AEZ-3), Jamalpur (AEZ-8), Gazipur (AEZ-28), Ishurdi (AEZ-11), Rajshahi (AEZ 11), Chapai Nawabgonj (AEZ 26), Chuadanga (AEZ-11), Faridpur (AEZ-12), Barisal (AEZ-13), Subarnachar (AEZ-19), Bandarban (AEZ-29), Kishoregonj (AEZ-9) and Gaibandha (AEZ-27)
Budget: Tk. 47.00 lakh
Duration: June 2023 to May 2026 (36 months)

Introduction: Various plant growth-promoting bacteria (PGPB) associated with sugarcane rhizosphere, roots, stems, and leaves enhance growth by improving nitrogen fixation, phosphorus solubilization, disease resistance, and nutrient efficiency. BSRI has gathered 200 soil samples and 200 each of sugarcane root and stem samples from 10 agroecological zones (AEZs) nationwide. From these, 14 nitrogen-fixing bacteria and 14 phosphate-solubilizing bacteria were isolated. Developing bio-fertilizers from PGPB presents a promising method to boost nutrient efficiency in sugarcane farming. Current agricultural practices often do not maximize nutrient availability, resulting in lower yields and increased environmental impact. This research seeks to leverage beneficial microorganisms to improve nutrient uptake, supporting sustainable sugarcane production and reducing chemical fertilizer dependence, thus fostering eco-friendly agriculture.

Objective: To isolate, identify, characterize of N_2-fixing and P-solubilizing bacteria; and develop N-fixing and P-solubilizing biofertilizer for sugarcane.

Materials and Methods: The soil and plant samples collected from 10 AEZs viz. Thakurgoan (AEZ-1), Panchaghar (AEZ-1), Joypurhat (AEZ-3), Ishurdi (AEZ-11), Rajshahi (AEZ 11), Chapai Nawabgonj (AEZ 26), Gaibandha (AEZ-27), Jamalpur (AEZ 8), Gazipur (AEZ 28) and Kishoregonj (AEZ 9). From those ten locations, soil samples of 200, sugarcane root samples of 200 and sugarcane stem samples 200 were collected using global positioning system. The capacity of N_2-fixation and P-solubilization tested in the laboratory. The field and pot experiments were conducted to find out the efficacy of bacteria entitled. Pot experiment has been conducted at BSRI and field experiment with promising N_2-fixing

bacteria and P-solubilizing bacteria has been conducted at BSRI Farm, Ishurdi; RSRS Farm, Thakurgoan; RSRS Farm, Gazipur and BSRI Sub-station, Jamalpur.

Results and Discussion: Soil and plant samples have been collected from 10 out of 15 location. Locations are Thakurgoan (AEZ-1), Panchaghar (AEZ-1), Joypurhat (AEZ-3), Ishurdi (AEZ-11), Rajshahi (AEZ 11), Chapai Nawabgonj (AEZ 26), Gaibandha (AEZ-27), Jamalpur (AEZ 8), Gazipur (AEZ 28) and Kishoregonj (AEZ 9). A total of 600 samples were collected, 200 each from soil, root and stem at each location.



Fig 1. Soil and plant sample collection

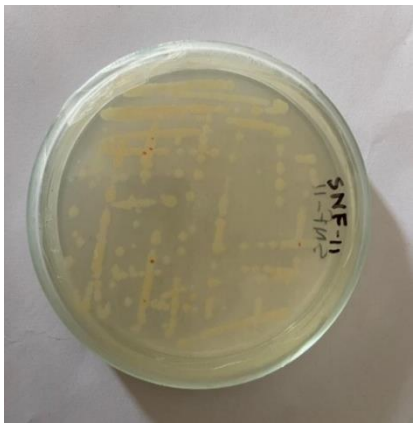


Fig. 2. Colonies of N_2-fixing bacteria

Fourteen promising nitrogen-fixing bacteria were isolated from sugarcane root, stem and leaf (Table 1).

Table 1. Nitrogen fixation potentiality of isolates obtained from sugarcane root, leaf and stem

Sl. No.	Isolates ID	Source	**Nitrogen Fixation** (µg of N/mg of C)
1.	SNF 1	Leaf (Isd 37)	53.37
2.	SNF 2	Root (Isd 37)	96.75
3.	SNF 3	Leaf (BSRI Akh 46)	93.39
4.	SNF 4	Leaf (Isd 37)	143.42
5.	SNF 5	Root (B 34)	73.38
6.	SNF 6	Root (Isd 37)	63.37
7.	SNF 7	Root (Isd 37)	61.88
8.	SNF 8	Leaf (Isd 37	73.38
9.	SNF 9	Leaf (Isd 37)	106.74
10.	SNF 10	Root (Isd 37)	83.39
11.	SNF 11	Leaf (Isd 37)	190.12
12.	SNF 12	Root (Isd 37)	103.40
13.	SNF 13	Stem (BSRI Akh 46)	180.38
14.	SNF 14	Stem (BSRI Akh 46)	143.38

The highest nitrogen fixation capacity of 190.12 µg of N/mg of C was found in SNF 11 which was isolated from leaf of Isd 37 and second highest of 180.38 µg of N/mg of C was found in SNF 13 which was isolated from stem of BSRI Akh 46. Fourteen promising phosphate solubilizing bacteria (PSB) were isolated from sugarcane rhizosphere soil (Table 2).

Table 2. Phosphate solubilizing potentiality of isolates obtained from sugarcane rhizosphere soil

Sl. No.	Isolates ID	Source	**Phosphorus Solubilization** (µg/ml)
1.	SPS 1	Rhizosphere Soil (Clone Pl -2)	300.00
2.	SPS 2	Rhizosphere Soil (Clone I 75 -18)	353.00
3.	SPS 3	Rhizosphere Soil (Clone I 49 -17)	133.00
4.	SPS 4	Rhizosphere Soil (Var. BSRI Akh 43)	88.00
5.	SPS 5	Rhizosphere Soil (Clone I 78 – 17)	283.00
6.	SPS 6	Rhizosphere Soil (Clone I 74 – 13)	266.00
7.	SPS 7	Rhizosphere Soil (Clone I 198 – 18)	36.00
8.	SPS 8	Rhizosphere Soil (Clone I 198 – 16)	96.00
9.	SPS 9	Rhizosphere Soil (Clone I 141 – 18)	96.00
10.	SPS 10	Rhizosphere Soil (Clone I 182 – 18)	180.00
11.	SPS 11	Rhizosphere Soil (Clone I 141 – 18)	230.00
12.	SPS 12	Rhizosphere Soil (Var. Isd 40)	336.00
13.	SPS 13	Rhizosphere Soil (Clone I 78 – 17)	188.00
14.	SPS 14	Rhizosphere Soil (Clone I 27 – 16)	180.00

The highest phosphate solubilizing capacity of 353 µg/ml was found in SPS 2 which was isolated from clone I 75-18 and second highest of 336 µg/ml was found in SPS 12 which was isolated from Isd 40

Conclusion: The isolation of fourteen promising nitrogen-fixing and phosphate-solubilizing bacteria from sugarcane samples highlights their potential for biofertilizer development, underscoring the need for further research to optimize their application in sustainable agriculture.

Project Code and Title: TF 152-C/23: Effect of legume residue incorporation on greenhouse gas emission, soil health and system productivity

Implementing Organization: Bangladesh Institute of Nuclear Agriculture (BINA)
Component Organization: None
Principal Investigator: Dr. Mahbubur Rahman Khan, BINA

Location(s): Mymensingh and Ishurdi, Pabna

Budget: Tk. 44.72 Lakh

Duration: Three years

Introduction: Climate change is brought about by increasing atmospheric content of a range of gases viz. carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), ozone (O_3), and chlorofluorocarbons (CFCs) etc. in the atmosphere, due to anthropogenic activities. Per global estimates, agriculture contributes 12% to the GHG emissions. Legume integration into the cropping pattern is one of the ways to diversify and intensify cropping systems. Legume cropping can also be used to add biologically fixed nitrogen to soils, build soil carbon and improve soil quality. To reduce GHG emission as well as to produce sustainable yield this project are executing to develop suitable technique as climate smart agricultural practices.

Objective: To estimate the effect of legume residue incorporation on GHG emissions (CH_4 and N_2O) in different cropping system; evaluate the effect of legume residue incorporation on soil health in

different cropping system on system productivity and investigate the effect of legume residue incorporation in different cropping system on system productivity.

Materials and Methods: The filed experiments are executing at BINA headquarters research farm Mymensingh and BINA sub-station Ishwardi. All the laboratory studies and laboratory analyses are ongoing. The details data analysis and final report will be prepared in the last year (2025-26) of the project. In these study 5 different treatments has been assigned in a RCBD with 3 replications.

Results and Discussion: Three cropping pattern has been selected for the project viz: i) Mustard-boro-T.Aman ii) Wheat-mungbean-T.Aman iii) Lentil T.Aus-T.Aman. The first year crops of the three cropping pattern has been conducted in both the locations. The crop residue of the first crop has been incorporated in the field according to the treatments
The treatments are:

T_1: Legume residue incorporation + PKS (100%) and N_0 (No nitrogen fertilizer)
T_2: Legume residue incorporation + NPKS (Recommended N fertilizer)
T_3: Legume residue incorporation + PKS + 75% N
T_4: No residue + NPKS 100% (recommended rate of Fertilizer)
T_5: Absolute control (No residue + N_0)

Yield and yield contributing characters data has been recorded. The analysis of the recorded data is under process. The soil samples were collected from both the location. Samples were also were collected from the three cropping patterns. Analysis of soil samples is on progress. Chemical analysis for soil pH, organic matter, nitrogen, phosphorus, potassium, sulphur, zinc and boron will be done. The greenhouse gas (GHGs) collection has been taking according to the standard protocol of the crop of the both locations in different treatments.
The procurement approval has been found from KGF authority. There are three items like gas collection vials, gas collection box, water distillation units and an electrode for pH meter is under process with RFQ tendering method. The remaining fund will not cover all the expenses of the procurement of the goods. There will be immediate fund is necessary to fulfill all cost thereby.



Fig 1: Field experiments of Boro rice 2025 for greenhouse gas emission collections

Conclusion: The project is running according to the approach and methodology with the plan of activities with performance schedule. First year experiments has been completed and second year experiments are undergoing and yet to complete in both the locations (Mymensingh and Ishurdi, Pabna). The first year experiments results are found good and greenhouse gas samples are undergoing in analysis.

Project Code and Title: TF- 153-C/23.: Generation Advancement and Evaluation of Bio-fortified and Late Blight Resistant Potato Hybrid Clones
Implementing Organization: Bangladesh Agricultural Research Institute, BARI
Component Organization: None
Principal Investigator: Md Shafiqul Islam, SSO, TCRC, BARI, Gazipur
Location(s): Tuber Crops Research Centre, BARI, Gazipur, Breeder Seed Production Centre (BSPC), Debigonj, Panchagarh, On Farm Research Division and farmers' field
Budget: TK 40.00 Lakh
Duration: October 03, 2023, to October 02, 2026 (36 months)

Introduction: Potato is one of the main food crops in Bangladesh after rice and wheat. The country is producing on average 10 million MT potatoes over the last few years. TCRC has successfully developed 104 potato varieties, none of these have been bio-fortified to enhance their nutritional value. Late blight caused by the fungus *Phytophthora infestans* is the most important disease of potato that can result into crop failures in a short period if appropriate control measures are not adopted. The primary objective of the project is to develop advanced breeding lines that integrate biofortification with late blight resistance and seed production of the anthocyanin-rich variety, BARI Alu-101.

Objective: To characterization potato breeding lines to screening clones of Fe and Zn-rich and evaluation them against late blight resistance and seed production of BARI Alu-10

Materials and Methods: The study was conducted at TCRC, BARI Gazipur and BSPC, Debiganj, Panchagarh during 2023-24 cropping season in TCRC Gzipur. We characterized 414 breeding lines of potato obtained from CIP, Peru, in 2021-22, resistant to late blight disease and enriched in Fe, Zn, Cu, Mn. Samples were analyzed to determine Fe and Zn content in Soil Science Laboratory, BARI. Hazel-Smith Index was used for multi-trait genotype selection for lines advancement. For seed production, mini-tubers of BARI Alu-101 collected from TCRC.

Results and Discussion: A first-year yield trial was conducted at BSPC, Debiganj, to evaluate 414 late blight-resistant (LBR) biofortified potato hybrid clones. The evaluation revealed considerable variation among genotypes in terms of yield, micronutrient content, and tuber quality. The potatoes germplasm exhibits normal to moderately squewed distribution across the evaluated rates. High genetic diversity is observed particularly in iron content, while yield , Zn and Mn show more concentrated distributions, This variability provides useful scope for selective breeding and nutritional improvement of potato varieties (Fig 1).

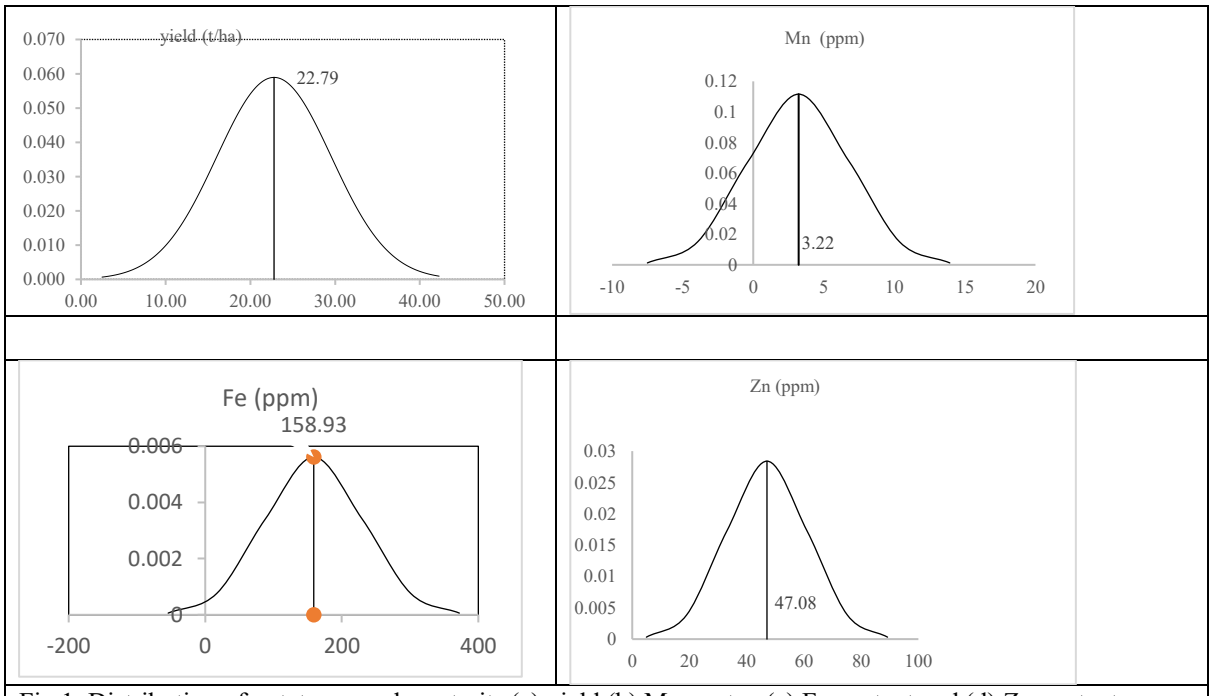


Fig 1. Distribution of potato germplasm traits (a) yield (b) Mn conten (c) Fe content and (d) Zn content

Twenty-eight lines yielded more than 35 tons/ha, though BARI Alu-7 also met this yield level but its micronutrient content was inadequate. Tuber choice showed significant variation, with 73 lines receiving the highest preference rating, indicating strong market potential.

In vitro production of BARI Alu-101, a deep purple, anthocyanin-rich variety, was successfully conducted, producing 2,550 plantlets and 250 kg of minitubers at TCRC and BSPC. Breeder seed production was carried out using mini tubers from 2022–23, with 1,000 kg produced across three locations. Lastly, 450 kg of seed potatoes were produced from the 2023–24 yield trial.

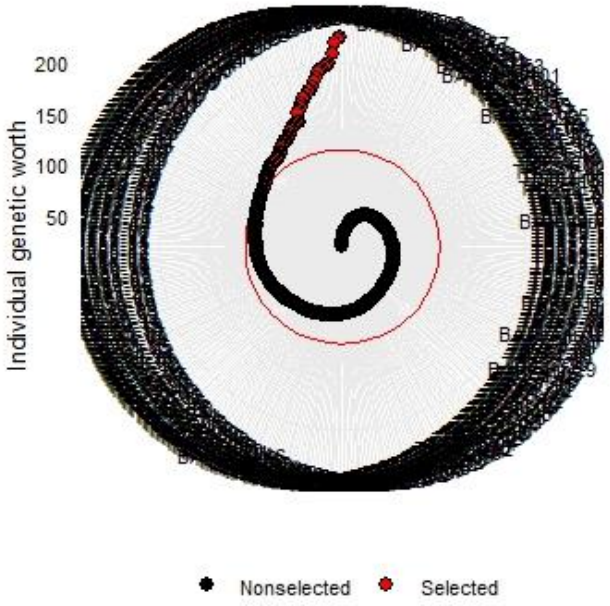


Fig. 2: Hazel-Smith index for LBR biofortified hybrid segregating clones

The Hazel-Smith Index integrates nutritional, agronomic, and consumer preference traits into a single value to evaluate and select high-performing genotypes in plant breeding. A higher index reflects better performance, and 64 outstanding lines out of 414 lines and identified for advancement to next year's yield trials. In this context, red marks signify that the genotype has undergone selection. Non-selection genotypes are indicated by black dots.



Picture 1. Field view of biofortified potato hybrid clones at BSPC, Debiganj during 2023-24



Picture 1. Field view of biofortified potato hybrid clones at TCRC, Gazipur during 2023-24

Project ID and Title: TF 155-C/23. Rapid development of aromatic rice mutants through induced mutation employing advanced breeding techniques

Implementing Organization: Bangladesh Institute of Nuclear Agriculture (BINA), BAU campus, Mymensingh

Principal Investigator: Dr. Shamsun Nahar Begum, CSO and Head, Plant Breeding Division, BINA, BAU Campus, Mymensingh.
Location(s): BINA Headquarters, Mymensingh; BINA sub-stations at Nalitabari, Rangpur, Ishwardi, Sunamganj, Cumilla and farmers' field at Dinajpur
Budget: Tk. 45.00 Lakh
Duration: 11 October 2023 to 10 October 2026 (36 months)
Introduction: Bangladesh is known for its high-quality short-grain aromatic rice, particularly Kalizira and Kataribhog, which are often underrated despite their GI status. Aromatic rice accounts for 12.5% of the country's transplant Aman rice cultivation, producing over 1.5 million tons each year. Induced mutation presents a viable solution for developing high-yield aromatic rice varieties that enhance both quality and production. Consequently, we applied gamma and X-ray irradiation to 10 local landraces and improved varieties to stimulate variability and foster the development of superior rice cultivars.

Objective: To create genetic variability in the background of aromatic rice landraces/varieties to select mutant high-yielding lodging and disease-resistant aromatic rice mutants.

Materials and Methods: Ten rice germplasm viz. BRRI dhan34, BRRI dhan90, Chinigura, Kataribhog, Basmati-370, Bansful, Tepiboro, Kalizira, Tulshimala, and Rataborowere subjected to X-ray irradiation from the International Atomic Energy Agency and their seeds were harvested. Four M_2 population have been grown during Aman 2024 to select semi-dwarf, aromatic mutants. Four M_3 were grown to validate semi-dwarfness and aroma and they are currently in maturity stage. Multienvironment trial with four aromatic mutants have been conducted during Aman 2024 and Boro 2024-25 season to assess yield performance over locations. Semi-dwarf phenotypes (90-120 cm) were seleted for further evaluation. Experimental plots are shown in Fig. 1

Results and Discussion: X-ray irradiation with 100, 200, and 300 Gy for ten rice germplasm has been grown during the Aman 2024 season. Seeds (a single panicle) were collected separately from each plant and preserved treatment wise. A total of 42 putative mutant plants have been selected from Bansful population based on semi-dwarf plant height, aroma, and number of filled grains per panicle. Based on semi-dwarf plant height, aroma, and number of filled grains per panicle, a total of 47 putative mutants from Tepi boro have been selected. Based on semi-dwarf plant height, aroma, and number of filled grains per panicle, a total of 137 putative mutants from BRRI dhan90 have been selected. Based on semi-dwarf plant height, aroma, and number of filled grains per panicle, a total of 34 putative mutants from BRRI dhan34 have been selected.

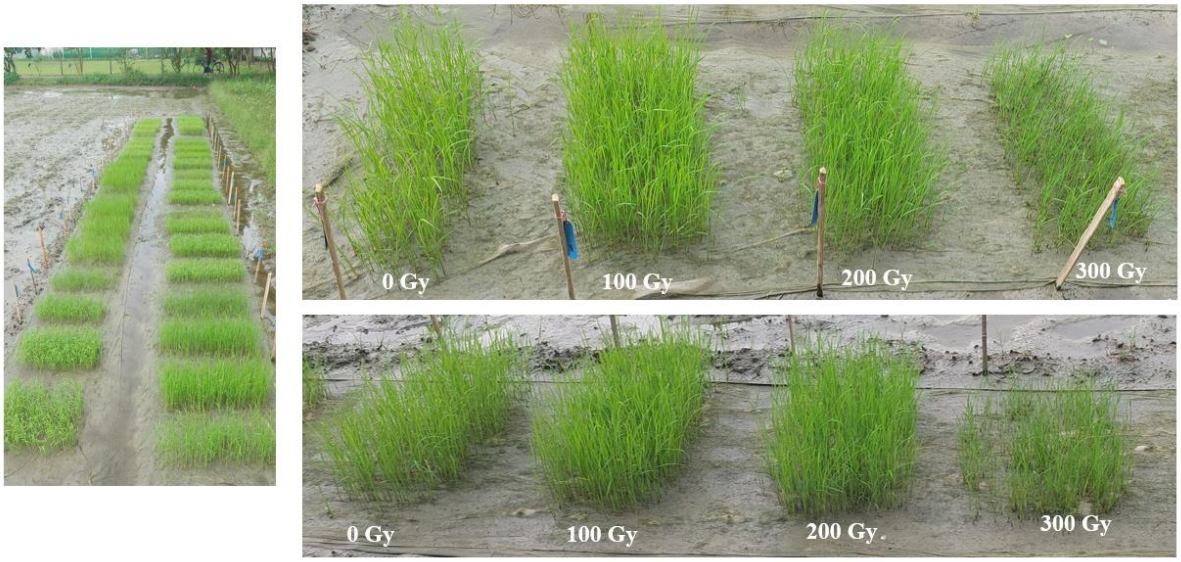


Fig. 1: M_1 generation of different germplasm induced through X-ray irradiation (seedling stage)

Four M_3 populations of Bansful, Tepiboro, BRRI dhan34, and BRRI dhan90 were grown during the Boro season of 2024 to evaluate the yield and yield attributing characters and grain quality parameters of aromatic mutants, a trial has been set up in four locations: BINA HQ, Mymensingh; BINA substation farms at Nalitabari, Rangpur, and Magura during Aman season 2024. Among the genotypes, BN-R-

250-7-1-R2, BN-R-250-7-1-3, and BN-R-250-7-1 showed the highest grain yield (3.5 t/ha), while BN-R-250-7-1-1 had the shortest growth duration (137 days) (Table 1). The same experiment has been set up in the Boro 2024-25 season which is currently in maturity stage.

Table 1. Performance of aromatic rice mutants during Aman/2024

Genotype	GY*	GD*	PH*
BN-R-250-7-1-R2	3.5	140	147
BN-R-250-7-1-1	2.9	137	150
BN-R-250-7-1-3	3.5	143	152
BN-R-250-7-1	3.5	143	158
BRRI dhan34	3.2	146	157
H^2	0.65	0.82	0.8

*Mean over three locations. GY = Grain yield (t/ha), GD = Growth duration (days), PH = Plant height (cm), H^2 = Heritability in broad sense

Conclusion: A total of 260 putative mutant lines were selected from 4 M_3 populations of Bansful (42), Tepiboro (47), BRRI dhan34 (34) and BRRI dhan90 to validate putative mutants with desirable plant height, aroma, and disease tolerance, etc. during next season.

Project Code & Title: TF 156-C/23. Determination of pesticide residues, pre-harvest interval (PHI) and their decontamination in some selected fruits and vegetables.
Implementing Organization: Entomology Division, Bangladesh Agricultural Research Institute, Gazipur
Component Organization: None
Principal Investigator: Dr. Mohammad Dalower Hossain Prodhan, BARI
Location (s): Dhaka, Jamalpur, Cumilla, Gazipur, Chattogram and Bogura
Budget: TK. 30.00 Lack
Duration: October 11, 2023 to October 10, 2026 (36 Months)

Introduction. In Bangladesh, the cultivation of fruits and vegetables is on the rise as awareness of nutritious diets grows. However, farmers encounter significant challenges, particularly from insect pest infestations. In response, many resort to the indiscriminate use of pesticides, which can harm both human health and the environment. To promote safe food production, it is essential to adhere to Good Agricultural Practices (GAP) and monitor pesticide residues in produces. Additionally, implementing Pre-Harvest Intervals (PHI) is crucial for ensuring food safety. PHI intervals vary depending on the pesticide types and crops. So, the study was undertaken with the following objectives.

Objective: To determine crop wise preharvest interval of some commonly used pestdicides and ensuring safe fruits and vegetables for the consumers and quantifying residue reduction through household processes.

Materials and Methods: The experiment was conducted in the experimental field of Entomology Division, BARI, Gazipur for the determination of Pre Harvest Intervals (PHI). The selected vegetable was sprayed with the recommended dose of the selected pesticides, and the samples were collected at 0, 1, 3, 5, 7, 9, 11, 13, 15, 17, 19 and 21 days after spray (DAS). Samples were extracted and cleaned up using QuEChERS (Quick, Easy, Cheap, Effective, Rugged and Safe) extraction technique. The concentrated extracts of the selected fruits and vegetables were analyzed by GC-2010 (Shimadzu) coupled with Electron Capture Detector (ECD) and Flame Thermionic Detector (FTD).

Results & Discussion: A total of 288 vegetable samples (broccoli, cucumber, chili, summer tomato and okra) were analyzed. Out of 288 analyzed samples of vegetables, 52 sample (18.0 % of the total number of samples) had pesticide residues, and among the contaminated samples, 9.4% samples had residues at a level above EU-MRLs. Among 5 analyzed vegetables, broccoli had higher pesticide residues load (20.8%) followed by chili (19.4%). Among 72 analyzed samples of ber/Jujube, 7 sample (9.7 % of the total number of samples) contained pesticide residues, of which only 3 samples (4.2% of the total number of samples) had residues of lambda-cyhalothrin and chlorpyrifos which were above EU-MRLs. Moreover, in this study,

the PHI was determined at 13 DAS for lambda-cyhalothrin, 15 DAS for chlorpyrifos+ cypermethrin and acephate in broccoli, but in case of dimethoate, it was at 17 DAS in broccoli.

Conclusion: The firstyear findings are encourasing and adherence to food safy issues and Good Agricultural Practices in Bangladesh. The 2024-25 initiatives aim to empower farmers through training in safe food cultivation and healthier agricultural practices.

Project code and Title: TF 157-SoE/23. Adoption and Impact of some Climate Resilient Crop Technologies for Boosting Production in Haor Areas of Sunamganj

Implementing Organization: Sylhet Agricultural University, Sylhet
Component Organization: None
Principal Investigator: Dr. Mohammad Ashraful Islam, SAU, Sylhet
Location: Tahirpur and Biswamvorpur of Sunamganj district
Budget: TK. 30.00 Lack
Duration: 15 October, 2023 to 14 October, 2026 (36 Month)
Introduction: Climate-resilient crop technologies include a range of methods and practices designed to help agriculture endure and adapt to the effects of climate change. This study examines the implementation of farming practices that can withstand the consequences of climate change in the haor regions of Sunamganj, where increased climatic threats jeopardize rice production and the livelihoods of farmers. Through a participatory approach, researchers, extension service providers, and farmers worked together to assess various modern technologies for the cultivation of Boro and T-Aman rice, as well as French beans, with the goal of improving productivity and enhancing the resilience properties of haor farmers in the face of climatic challenges.

Objective (s): To identify climate-resilient crop varieties, enhance farmer skills, evaluate performance, encourage adoption, and assess factors influencing the use of these varieties in flood-prone Haor areas.

Materials and Methods: The study was conducted in a specific haor region using a participatory approach. Initial meetings were held to form groups and select cooperating farmers, followed by Key Informant Interviews (KII) and a baseline survey. Farmers were trained in technologies that are resilient to climate change Field experiments were conducted, and data was gathered, analyzed, and recorded for the purposes of reporting and evaluation

Results & Discussion: Firstly, there was a substantial improvement in the knowledge and skills of farmers regarding the climate-resilient crop varieties. The Boro rice varieties showcased in the experiment produced strong yields, ranging from 7.0 t/ha to 8.5 t/ha in two boro season, in the absence of climatic stresses. Withstanding 7–10 days of submergence and still yielding 4–4.2 t/ha signifies strong **genetic resilience**, showing how certain traits can maintain productivity under acute climate stress like flash floods. T-Aman rice shows macro-scale robustness, offering scalable solutions for climate-stressed regions. Out of six plots of French bean, two yielded satisfactorily, two were partial damaged, and the remaining two were completely damaged. The variable performance across six plots implies potential learning zones for adaptive planning such as adjusting sowing time, drainage design, or varietal selection to enhance future resilience.



Fig 1. Farmers are participating in training programs focused on building climate resilience

Conclusion: The variable outcomes of field experiments underscore the necessity for adaptive planning in agriculture, emphasizing the need for ongoing research to enhance resilience against climate challenges through strategic adjustments in sowing and crop selection.

Project Code and Title: TF 163-C/24. Bio-rational management of litchi fruit borer, *Conopomorpha sinensis*

Implementing Organization: Department of Entomology, Hajee Mohammad Danesh Science and Technology University, Dinajpur
Component Organization: None
Principal Investigator: Professor Dr. Md. Abdul Alim, HDSTU
Location(s): HSTU campus and Dinajpur Sadar Upazila
Budget: Tk. 30.00 Lakh
Duration: 14/01/2024 to 13/01/2027 (36 months)

Introduction: A major litchi pest, the litchi fruit borer (*Conopomorpha sinensis*) (Lepidoptera: Gracillariidae) damages fruit, new shoots and leaves, and inflorescences, which in turn affects the value of litchi exports. It is tough to keep an eye on and manage with pesticides since the larva dwells inside the fruit. Concerns about the potential negative impacts of chemical pesticides on human health have prompted an uptick in research into non-chemical methods of pest control. Because of this, it would be preferable to employ bio-pesticides, insect growth regulators (IGRs), and pre-harvest panicle bagging in order to reduce pollution and maintain natural control.

Objective: Development of bio-rational management techniques of litchi fruit borer in litchi orchards.

Materials and Methods: A comprehensive survey was conducted at Dinajpur Sadar. Madraji, Bombai, Bedana, and China 3 were evaluated for their comparative resistance / susceptibility to litchi fruit borer. Experiment were laid out in 2 factor RCBD design to evaluate the efficacy of various bio-pesticides, insect growth regulators and pre harvest panicle bagging to manage litchi fruit borer and assess the fruit quality. First spray was given at clove size fruit, second spray at after fifteen days of first spray while third spray was given at 10 days after second spray. The panicles bagging were started from 7 and 17 days after fruit set.

Results and Discussion: As stated by Fig. 2, the litchi fruit borer, first noticed in April, causes fruit damage of 25.64% to 27.77%. The Madrajie variety had the highest infestation at 33.46%, while Bedana had the lowest at 20.08%. Bio-pesticides and insect growth regulators (IGRs) were more effective over the control in protecting against damage. Effective treatments included Spinosad (0.40 ml/L and 0.3 ml/L), Bio-Btk (3.0 gm/L and 2.0 gm/L), Buprofezin (2.0 ml/L and 1.0 ml/L), and Novaluron with Emamectin benzoate (2.0 ml/L and 1.5 ml/L) (Table 1). The highest percentages of healthy fruit, 95.73% and 94.30%, were obtained when bagged with cellophane and non-woven yellow fabric bags, compared to 59.65% in the control (Table 1). Buprofezin (2.0 ml/L), Indoxacarb (1.0 ml/L), and Novaluron with Emamectin benzoate (2.0 ml/L), along with bagging methods, maintained fruit quality. Thus, Spinosad, Bio-Btk, Buprofezin, and Novaluron with Emamectin benzoate, along with bagging techniques, are effective for the management.

Fig. 1 (a-c) illustrates the data collection, spraying insecticides, and bagging operations against the litchi fruit borer **(***Conopomorpha sinensis*).



Fig. 1: (a) Collecting infestation data (b) bagging treatment (c) treating fruits with insecticides as per treatments.

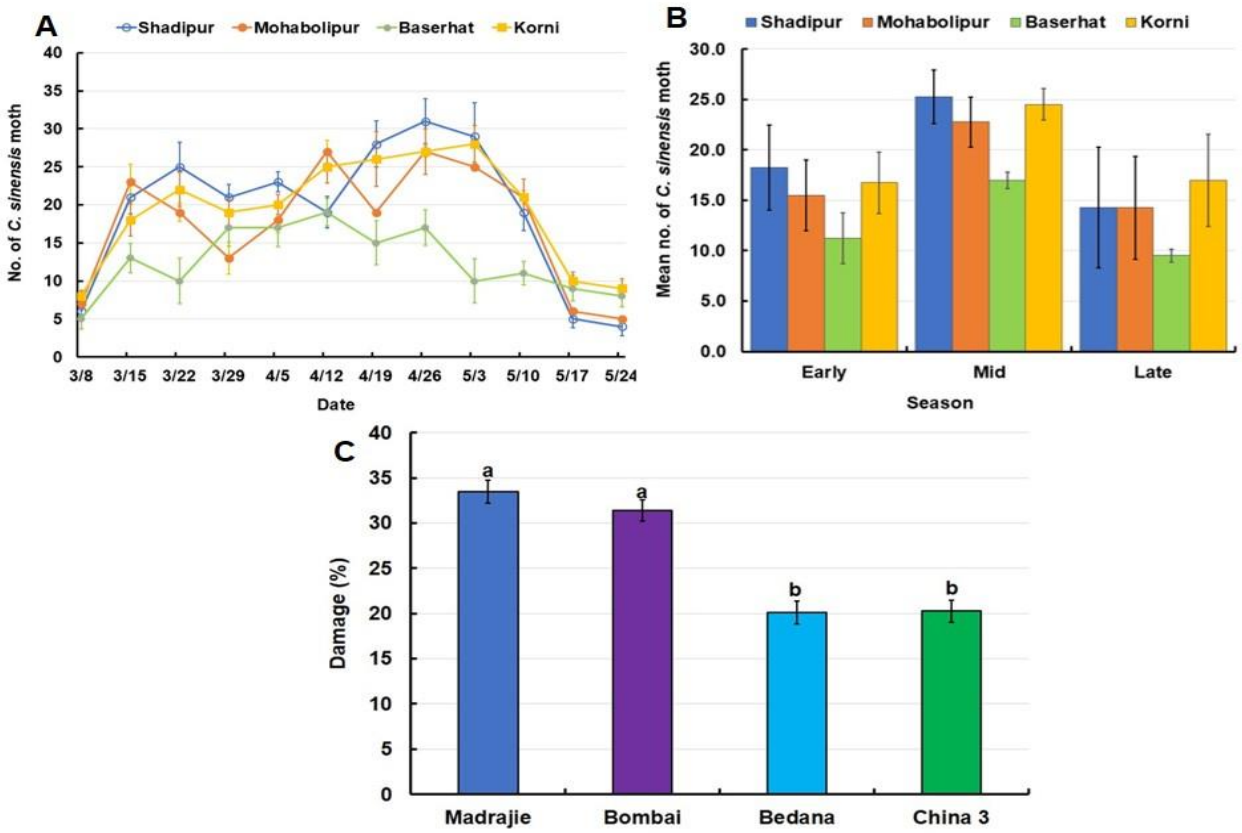


Fig. 2: Seasonal abundance of Litchi fruit borer (A); Season wise distribution (B) on light traps installed and (c) seasonal damage by litchi fruit borer in different litchi orchards.

Conclusion: The study highlights the significant impact of the litchi fruit borer on fruit quality, demonstrating that specific bio-pesticides and bagging methods can effectively mitigate damage. Further research is essential to optimize these treatments for broader application and sustainability.

Commissioned Research Program (CRP)
Completed Projects

Project code and title: **CRP-II (Modeling climate change impact on agriculture and developing mitigation and adaptation strategies for sustaining agricultural production in Bangladesh, 2nd phase)**
Implementing organizations: BARI, BAU, BRRI, BSMRAU and KGF
Principal Investigator: Coordinated project
Coordinator
Dr. Md. Maniruzzaman, PSO, IWM, BRRI, Gazipur

Deputy Coordinators
Dr. M. Mazharul Anwar, CSO and Head, OFRD, BARI, Gazipur
Dr. Md. Mizanur Rahman, Professor, Department of Soil Science, BSMRAU, Gazipur

Location: All over Bangladesh
Budget: TK 10, 68, 19,000/-
Duration: December 2020- November 2023 (36 months)
Introduction: The global mean surface temperature during 2006-2015 was 0.87°C higher than that averaged over the period 1850-1900. Increases in temperature and atmospheric CO_2 level adversely affected natural resources. The yields of crops, fish and livestock are likely to decrease in the future. There is an urgent need to study and monitor the adverse effects of climate change (CC) on crop, fish and livestock production in Bangaldesh which is dubbed as the country most vulnerable to CC. In the first phase of this project, the effect of climate change on crops, mostly rice, wheat and maize, was evaluated. To assess the impact of climate change on agriculture as a whole, it was felt that the scope of the project needed to be expanded to include, in addition to crops, livestock and fisheries and identify the vulnerable regions of the country. Accordingly, work under the second phase of the project was designed to generate information that can be used to develop strategies to reduce greenhouse gas (GHG) emissions from crop, livestock and fish production sites and fine tune climate smart crop, livestock, fisheries and resource management options for sustainable agricultural enterprises in the future.

Objective: Assessment and characterization of climatic variability, vulnerability and extreme events and their impacts on soil and plant processes, livestock, fisheries and socioeconomic conditions of farmers

Materials and Methods: The project is being implemented by BARI, BRRI, BSMRAU, BAU and KGF. Field and laboratory experiments (growth chambers, incubators, static closed chamber technique) were conducted. Socio-economic data were collected through field surveys and from secondary literature. Greenhouse gas (GHG) emissions were estimated based on measured data (static closed chamber technique), drones, data from DSSAT (Decision Support System for Agrotechnology Transfer), APSIM (Agricultural Production Systems Simulator), DNDC (Denitrification-Decomposition), AI (Artificial Intelligence), CMIP6 (Coupled Model Intercomparison Project), GCMs (General Circulation Models) etc. were used for obtaining different kinds of data.

Results and Discussion: In the distant future (2075-2100) in Bangladesh, the average annual precipitation is likely to be increased by 9.48%, 13.63%, 21.07%, and 30.90%, while the average Tmax (Tmin) are likely to increase by 1.09 (1.17), 1.60 (1.91), 2.12 (2.80), and 2.99 (3.69)°C for shared socioeconomic pathways (SSP)1-2.6, SSP2-4.5, SSP3-7.0, and SSP5-8.5, respectively, compared with those during 1985

2014 (Fig. 39). Increase in minimum temperature will be responsible for a shift in the comfort zone of agricultural production.

An increase in temperature will favor aphid and wilt disease incidences in the future. Besides, a temperature increase in by 2 and 3°C could reduce the grain yield of BARI Mung-6. Grain yield reduction in rice due to a temperature rise by 1, 2 or 3°C varied among the project locations.

Greenhouse gas (GHG) emissions from crop fields and livestock farms varied with management practices. Irrigating rice fields in the alternate wetting and drying (AWD) system in straed of the conventional flood irrigation system reduced GHG emissions without any significant yield penalty. Recommended practices (RP) lowered the total GHG flux and GWP than the farmer's practice (FP) (Table 1). In general, vermicompost (VC) increased about 6% grain yield by about 6% in T. Aman and 4% in Boro than over yields obtained with cowdung (CD) Rice straw caused the highest total gas production (168 ml/g) among roughages, followed by German, Napier, and Para grass.

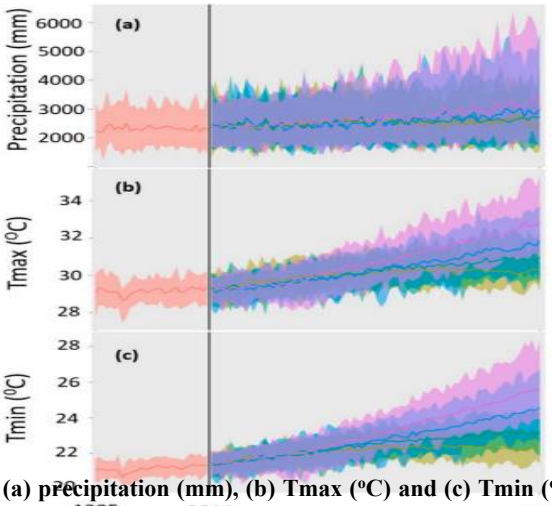


Fig. 1. Annual (a) precipitation (mm), (b) Tmax (°C) and (c) Tmin (°C) in Bangladesh during 1985 to 2100; historical (red), SSP12.6 (light green), SSP2.4 (green), SSP370 (blue), and SSP58.5 (pink) from the mean (solid line) of the MME, with one inter-model standard deviation (shaded area)

Table 1. GHG emissions yields as influenced by management practices in a jute-rice pattern

Treat	Jute				Rice			
	GHG emission (kg/ha)		GWP (kg CO_2 eq/ha)	Fiber yield (kg/ha)	GHG emission (kg/ha)		GWP (kg CO_2 eq/ha)	Grain yield (kg/ha)
	CH_4	N_2O			CH_4	N_2O		
FP	1.08	0.26	100.7	4200	169	0.81	4947	4830
RP	0.95	0.22	85.5	4350	145	0.67	4238	5190
VC	1.13	0.24	96.31	4800	221	0.91	6429	5820
CD	1.29	0.29	112.58	4650	270	1.01	7828	5990

FP = farmers' practice, RP = researcher's practice, VC = vermicompost, CD = cowdung

At temperature humidity index (THI) 80, rectal temperature, heart rate and respiration rate of cows increased significantly by 5.823%, 6.89% and 21.17%, respectively, and milk production, and milk fat and protein contents decreased significantly by 14.74%, and 17.15% and 16.89%, respectively from those in cows in the comfort conditions.

In the ARIMA (autoregressive integrated moving average) analysis tilapia gonad weight indicated an increase with the increase of water temperature up to a certain level. Embryonic and larval development of tilapia under the re-circulatory thermostatic system were higher than that in the traditional hatchery system. Households in both Kishoreganj and Netrakona districts had nearly identical total livelihood vulnerability indexes (LVIs, 0.45). The adaptive capacity of *haor* communities in both districts were lower than those of non-*haor* communities.

Conclusions: In summary, the increasing minimum temperatures in Bangladesh pose significant threats to agricultural productivity, particularly in rice cultivation, while the adoption of non-rice crops and sustainable practices like AWD irrigation can mitigate greenhouse gas emissions. GHG emission (CO_2 eq.) from cattle manure varied depending on farm size, a higher manure CH_4, and CO_2 eq emissioNonenimal/year being observed in larger farms. Future studies should focus on comprehensive GHG inventories in the agricultural sector to inform effective policy measures and enhance resilience against climate change impacts. A total GHG inventory from the agriculture sector is needed for future policy formulations.

On-going Projects

Project Code and Title: CRP-V. Development of upazila land suitability assessment and crop zoning system of Bangladesh

Implementing Organizations: Bangladesh Agricultural Research Council (BARC), Soil Resources Development Institute (SRDI), Institute of Water Modeling (IWM)
Coordinator: Member Director (Crops), BARC
Locations: 195 Upazilas
Budget: Tk 10,38,27,250
Duration: February 2022-January 2025
Introduction: Minimizing yield gaps, increasing resource use efficiency and developing resilience to climate change impacts are the most important challenges in the agriculture sector of Bangladesh. There is an urgent need to develop more efficient and sustainable agricultural production systems where the focus should be on identification of areas capable of producing high agricultural output and areas where the soil and climate are most suitable for particular crop(s). Location-specific information on suitable crops ensuring sustainable use of scarce land and water resources is necessary. Realizing the importance of proper utilization of agricultural lands to increase productivity, profitability and promote accelerated growth, the Bangladesh Agricultural Research Council (BARC) initiated a GIS based crop zoning project for 76 crops in 195 upazilas. The GIS based approach for crop zoning will help identify land capable of producing high agricultural output. It may be mentioned here that the Government of Bangladesh, in the 8th Five Year Plan (FYP), included and emphasized crop zoning policies and strategies for the crop sub-sector of Bangladesh agriculture.

Objectives: Updating and validating land/crop suitability databases and creating an online GIS based software to help design appropriate farming practices to achieve food and nutritional security

Materials and methods: A methodological framework consisting of different processes such as, agro-edaphic suitability, agro-climatic suitability, combined suitability and economic suitability is presented in Fig. 39. The edaphic suitability assessment of crop(s) was carried out considering land and soil properties with respect to maximum attainable yield (MAT). The agro-climatic suitability of crop(s) is based on an assessment of loss, if any, in yield potential due to temperature and/or moisture stress. Agro-ecological suitability classification of a given crop is achieved through combining agro-edaphic and agro-climatic suitability modules as stated in the FAO/UNDP (1988) Land Resources Appraisal of Bangladesh. Geospatial technology is used for crop suitability assessment and zoning. To validate the efficacy of fertilizer doses disseminated through the 'Khamari' mobile app, demonstration trials were conducted during the Rabi season 2022-23 at 16 different locations spanning various agro-ecological zones (AEZs) and encompassing seven distinct crops: Boro rice, wheat, maize, potato, mustard, onion, and lentil. The primary objective of these field trials was to assess the impact of recommended fertilizer doses, comparing them between two key approaches: (i) fertilizer prescriptions provided by 'Khamari' app and (ii) farmers' traditional practices. The trials were conducted by scientists of five different NARS institutes namely, BARI, BRRI, BINA, BWMRI, and SRDI.

Results and Discussion:

Crop Zoning Information System (CZIS)

The development of an online GIS-based crop zoning application system is a major Objective. This system is designed for database management, analysis, output generation, and information dissemination. It encompasses several components that work together to provide valuable agricultural information and support to various stakeholders. Users can access the system at http://cropzoning.gov.bd (Fig. 40) where they can benefit from useful crop zoning information and related tools. This initiative aims to support agriculture and enhance decision-making for farmers and other stakeholders in the country.

The Crop Zoning Information System (CZIS) is the central module of the application system, responsible for data management, analysis, and generating crop zoning outputs. An option for processing suitability assessment for all upazilas for individual crops has been added during the reporting period (2022-23). Additionally, various improvements and changes have been made to the user interface, menus, database, and screen output design.

The Crop Zoning Dashboard is a user-friendly interface designed for policy planners and decision-makers in the field of agriculture. It offers quick access to crucial information for agricultural planning and development. During the reporting period, discrepancies among various outputs were removed when comparing with CZIS and Khamari app. additionally, the user experience and user interface (UX/UI) have been optimized to enhance user interaction with the dashboard.

The 'Khamari' mobile app is a user-friendly tool designed to provide location-specific crop potential, fertilizer recommendations, and other agricultural information to farmers and other stakeholders. The app offers a practical and convenient way to disseminate data to a wide audience, help farmers make informed decisions about their crops. During 2022-23, cropping pattern-based fertilizer recommendations for both plot and union-based approaches were added to enhance the app's capabilities. Additionally, efforts were made to optimize the accuracy level of plot selection using GPS ensuring more precise location data.

Validation trials

Table 16. Comparisons of crop yields and fertilizer costs using fertilizer application based on the Khamari app and farmers' fertilizer doses in validation trials

Crop	Yield (t/ha)		Cost (Tk/ha)		Increase/decrease* (%)	
	Khamari app	Farmers' practice	Khamari app	Farmers' practice	Expense	Crop yield
Potato (2 sites)	34.25	33.41	26943	37587	39.51	2.51
Mustard (3 sites)	1.58	1.47	11975	12275	2.51	7.48
Onion (2 sites)	18.36	17.66	23112	36148	56.40	3.96
Boro Rice (2 sites)	7.31	6.94	13398	17181	28.24	5.33
Lentil (2 sites)	2.1	1.94	3057	4553	48.94	8.25
Wheat (3 sites)	3.01	3.01	30493	29002	-4.89	0.00
Hybrid maize (2 sites)	12.0	10.92	36470	34210	-6.20	9.89
Average			145447	170956	17.54	4.33

*Farmers' practice over Khamari app practice

In the validation trials, plots where 'Khamari' app-based fertilizer recommendations were followed, the average crop yield in the 'Khamari' app-based demonstration plots was 4.33% higher than that in the plots where farmers used their traditional practices (Table 16). Additionally, there was a significant cost advantage in the 'Khamari' app-based fertilizer plots. The average fertilizer cost for these plots was 17.5% lower than that for plots where traditional farmer's practice-based fertilizer application was practiced (Table 16). This cost reduction highlights the economic benefits of using the 'Khamari' app for fertilizer recommendations, offering farmers a more cost-effective approach to crop cultivation. These results indicate that not only did the 'Khamari' app help reduce costs, but it also led to an increased crop productivity.

Field days

Three field days were organized in the Rabi season of 2022-23. On April 29, 2023, a field day event took place at the validation trial site, showcasing Boro rice, at Patgati, Tungipara upazila of Gopalganj district. The event was graced by the presence of the Honourable Secretary of the Ministry of Agriculture, Govt of the People's Republic of Bangladesh and the Executive Chairman of BARC. The Directors General of DAE, BARI, BRRI, SRDI, and BINA, along with the Executive Director of KGF, and other senior officials from BARC, DAE, and NARS institutions as well as personnel from the crop zoning project attended this field event. About 150 local male and female farmers attended the program. The participants expressed their satisfaction with the performance of the 'Khamari' mobile app.

Conclusions: The Government of Bangladesh places significant importance on crop zoning due to the numerous challenges the country faces, including rapid population growth, shrinking arable land, yield gaps, the need for increased resource use efficiency, and the imperative of building resilience against climate change impacts. Recognizing its significance, the Government of Bangladesh has included crop zoning in FYP 8 (2020-25) considering its importance in sustainable agricultural development. This

project assesses the potential of land for higher agricultural output under different crops/cropping patterns in selected upazilas of Bangladesh and attempts to identify areas in the country capable of producing high agricultural output and areas where the soil and climate are best suited to particular crop(s). The database and farmer friendly software created by the project are expected to help develop more efficient and sustainable agricultural production systems in the country. Once the crop zoning system is fully operational it will fulfill the much awaited decision support tool needed for knowledge based, pragmatic agricultural production planning.

Capacity Enhancement Program (CEP)

Completed Projects

Project Code and Title: CEP V/21. Capacity building of some field level extension officers of DAE, DOF, DLS and progressive farmers of Bangladesh

Implementation Organization: Bangladesh Academy of Agriculture (BAAG), BARC Complex, Farmgate, New Airport Road, Dhaka-1215
Coordinator and Principal Investigator: Dr. Abul Kalam Azad, Fellow of BAAG Fellow
Focal Points: (i) Dr. Syed Ali Ahasan, Deputy Director, Department of Livestock Services (DLS), Farmgate, Dhaka. (ii) Mr. Mohammad Abdul Kaioum Majumder, Upazila Agriculture Officer (DPD, Citrus project), Department of Agriculture Extension (DAE), Khamarbari Road, Farmgate, Dhaka-1215, (iii) Ms. Alize Farzana, Senior Assistant Director, Administration Section, Department of Fisheries (DoF), Bangladesh
Locations: BARC and concerned offices of DAE, DOF and DLS
Budget: Tk 161.40 lakh

Duration: October 2021 to January 2025(Three months no cost extension)

Introduction: Bangladesh's economic growth heavily relies on agriculture, which ensures food security and livelihoods for around 170 million people. Since gaining independence, the country has advanced significantly in agriculture through the adoption of modern technologies. The NARS institutes and universities continuously develop new crop varieties, livestock breeds, and production technologies. Key public sector agencies like DAE, DLS, and DoF play a crucial role in spreading these agro-technologies to farmers and entrepreneurs. Extension experts at the grassroots must stay informed about the latest variety releases and agricultural innovations to facilitate their rapid distribution to farmers. This project focuses on sharing the new, validated technologies created by NARS and universities.

Objective: To enhance the capacity of public sector agricultural extension agencies by organizing effective training programs for trainers (ToT)

Materials and Methods: The Bangladesh Academy of Agriculture (BAAG) implemented the project in collaboration with DAE, DoF, DLS, and NARS institutes. Seventeen ToT modules underwent a rigorous program development process involving research scientists and extension experts. The project planned to conduct 50 batches of ToTs (27 for crops, 13 for fisheries, and 10 for livestock) over three years. From July 2022 to June 2023, 20 ToTs were conducted at various locations across the country. The modules addressed topics like summer tomato, BARI Malta, aromatic and biofortified rice, safe vegetable production, wheat and maize production, short-duration rice varieties, citrus canker disease management, BFRI gift tilapia, high-value gulsha and koi fish, and livestock and poultry technologies developed by BLRI, including PPR and FMD disease management, vaccination, anti-microbial resistance (AMR), and fodder and feed management for livestock and poultry, as well as BAU Chicken and repeat breeding of livestock.
Result and Discussion: In the 20 ToTs conducted in different regions of the country during July 2022 to June 2023, there were 600 (30x20) participants in the 20 batches (Table 1). The participants included officials from DAE including SAAOs and local progressive farmers of eight agro-regions (crop sector), and DoF officers of five administrative divisions and local progressive fish farmers (fisheries sector), and DLS officers of two administrative divisions (livestock sector). The participants comprised 240 senior officers and 73 SAAOs of DAE and 47 progressive farmers from the crop sector, 162 officers of DoF and 18 progressive farmers from the fisheries sector, and 60 officers of DLS from the livestock

sector. The respective extension agency, with assistance from departmental focal points, selected the participants. The project focused on junior-level officers, aiming for gender balance while ensuring they had minimal prior exposure to the training topics. Research institutes chose the resource persons for the crop sector, while those for livestock and fisheries were selected collaboratively by research institutes and extension agencies. These highly skilled resource persons delivered engaging lectures based on the training modules. Participants reported high satisfaction after each training batch and recommended extending the duration from two to three days. The ToTs encouraged significant interaction among dignitaries, experts, resource persons, scientists, extension officers, and progressive farmers, fostering research-extension linkages and
enhancing the capacity of extension agencies.

Table 1. ToTs conducted during July 2022 to June 2023 with participants from DAE, DoF and DLS

Subject	No. of ToT	Participants
Summer tomato production technology	2	DAE Senior officers and SAAOs of DAE and progressive farmers of Jashore region
Improved production practices for BARI Malta varieties	3	SAAOs of DAE and progressive farmers of Chuadanga district; senior officers of DAE, Rangpur region; DAE officers from all over Bangladesh working on citrus
Aromatic and biofortified rice production technology	1	DAE officers of Dinajpur region
Safe vegetable production (eggplant, tomato, cucurbit, cole crop, bean and leafy vegetables)	1	SAAOs of DAE and progressive farmers of Cumilla region
Wheat and Maize Production Technology	2	DAE officers of Rangpur region: SAAOs of DAE and progressive farmers of Dinajpur region
Production technologies of short-duration BINA rice varieties	2	Senior officers and SAAOs of DAE and progressive farmers of Mymensingh region
Canker and greening disease management of lemon	1	DAE officers of Sylhet region
Quality monosex seed production and culture techniques of BFRI GIFT tilapia.	2	DoF officers and progressive farmers of Barishal and Sylhet divisions
Fry Production and culture techniques of high value *gulsha* fish	2	DoF officers and progressive farmers of Rajshahi and Dhaka Divisions
Seed production and culture management of *koi* fish	2	DoF officers and progressive farmers of Dhaka and Chattogram divisions
Dissemination of livestock and poultry technologies (production and management of diseases such as, PPR, FMD, immunity and vaccination, animal biosecurity, AMR, animal nutrition, feed and fodder management, UMS, TMR, BAU chicken and repeat breeding)	2	DLS officers of Rajshahi and Khulna divisions

Conclusions: The successful implementation of the 20 Training of Trainers (ToTs) across various agricultural sectors highlights the critical need for ongoing funding to sustain and expand these programs. By investing in continuous training, we can further enhance the skills of extension officers and farmers, ultimately fostering stronger research-extension linkages and driving agricultural innovation and productivity.

Project Code and Title: CEP II-Seaweed. Capacity Building for Conducting Adaptive Trials on Seaweed Cultivation in Coastal Areas (4th Phase)

Implementing organization: On-Farm Research Division, Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur

Name of component/collaborating organization(s): Bangladesh Agricultural Research Council (BARC)
Name of Coordinator: Dr. Md. Abdus Salam, Member Director, Crops Division, BARC, Dhaka.
Location(s): Cox's Bazar

Budget: TK 127.06 (One Hundred Twenty Seven lac and six thousand)
Duration: From 1st July 2023 to 30th June 2025 (24 months)

Introduction: Seaweeds are marine macroalgae without a defined structure like roots or flowers, absorbing nutrients through their thallus. They are rich in minerals, vitamins, and bioactive compounds, making them important in food, beverage, cosmetics, and pharmaceuticals. Since 2016, the Ministry of Agriculture, through BARC, has been running the "Capacity Building for Conducting Adaptive Trials on Seaweed Cultivation in Coastal Areas" project, implemented by BARI. After completing three phases, a new phase began in October 2019 and has been extended to June 2025. This phase focuses on collecting new species, conducting adaptive trials, innovating cultivation technologies, developing carrageenan extraction protocols, raising awareness among entrepreneurs, and improving seaweed marketing and seed production.

Objective(s): The study focuses on screening new seaweed species in Cox's Bazar, evaluating Gracilaria tenuistipitata culture techniques in Khulna and Satkhira, assessing seaweed liquid fertilizer efficacy, and developing carrageenan extraction from Hypnea sp.

Materials and Methods: Bangladesh Agricultural Research Council (BARC) is coordinating the activities. About 215 different species of seaweeds from 102 groups have been recorded in the SMI. Five species were collected from Saint Martin's Island. Collected seaweeds were taken into water tanks with seawater maintaining a temperature of about 15-20º C and transported to the project sites. Sample of each collected seaweed was preserved in formalin solution in the laboratory and adaptive trials were given with nine commercially important seaweed species. *Gracilaria tenuistipitata* was collected from natural bed in Moheshkhali Channel and *Ulva lactuca*, green Japanese seaweed, was raised in the laboratory through "multi-step" seeds.

Results and Discussion:

a. Seasonal production of *Gracilaria tenuistipitata* and *Ulva lactuca* in open sea at Nuniarchara site of Cox's Bazar and monthly variation in yield in relation to different water quality parameters

A study was conducted to find out the production of BARI Seaweed-1 (*Gracilaria tenuistipitata*) and BARI Seaweed-2 (*Ulva lactuca*) in Nuniarchara of Cox's Bazar during October 2023 to March 2024 using semi-floating long line cultivation technique. Results of the studies have been presented in table-1.

Table 1: Monthly variation in yield of *Gracilaria tenuistipitata* and *Ulva lactuca* in relation with different essential water parameters during October 2023 to March 2024 at Nuniarchara, Cox's Bazar.

Month	*Gracilaria*		*Ulva*		Temp. (ºC)	Salinity (‰)	Turbidity (NTU)	pH
	f. wt. (t/ha)	d. wt.	f. wt.	d. wt.				
October 2023	7.52 ±0.37	1.23 ±0.06	-	-	29.06 ±2.71	22.16 ±1.12	31.10 ±2.07	7.85 ±0.12
November 2023	9.09 ±1.76	1.52 ±0.32	2.75 ±0.65	0.38 ±0.10	27.53 ±0.79	22.73 ±0.86	31.52 ±2.34	7.16 ±0.07
December 2023	17.27 ±1.81	2.81 ±0.34	4.78 ±1.13	0.68 ±0.14	25.94 ±0.86	26.94 ±1.10	28.30 ±2.38	8.26 ±0.09
January 2024	20.75 ±1.23	3.55 ±0.57	6.91 ±0.87	0.98 ±0.17	27.17 ±0.56	28.34 ±0.84	26.70 ±2.34	8.08 ±0.12
February 2024	26.58 ±1.53	4.25 ±0.39	8.56 ±1.07	1.15 ±0.21	28.07 ±0.32	28.63 ±0.74	28.120 ±1.27	8.11 ±0.09
March 2024	18.54 ±1.32	2.96 ±0.62	8.25 ±0.72	1.06 ±0.15	30.07 ±0.76	30.34 ±0.77	28.70 ±2.06	8.1 ±0.12
Total	99.75 ±8.02	16.32 ±2.30	31.25 ±4.44	4.25 ±0.77				

n=5, f. wt. = fresh weight, d. wt. = dry weight

Naturally grown healthy *Gracilaria tenuistipitata* seeds were collected from the sand flat of Nuniarchara. After cleaning and sorting, seeds were seeded on synthetic ropes having a length of 15 m and a diameter of 1.0 to 1.5 cm. and maintaining a distance of 50 cm between consecutive ropes. The approximate weight of each seed was 1.5 to 2.0g on average.

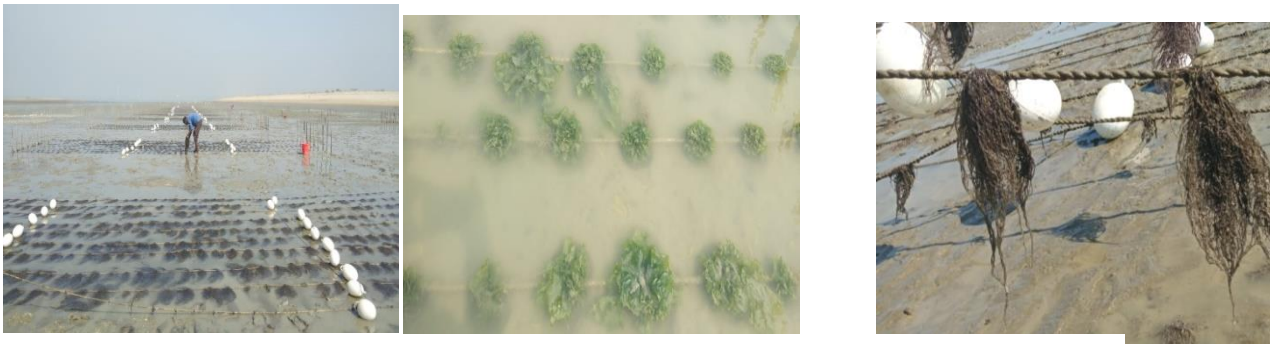


Fig.1: Cultivation of *Gracilaria tenuistipitata* and *Ulva lactuca* at Nuniarchara

Result and Benefits:
The estimated total fresh yield of *Gracilaria tenuistipitata* and *Ulva lactuca* was 99.75±8.02 (≈16.32±2.30 ton dry) ton and 31.25±4.44 (≈4.25±0.77 ton dry) ton per hectare respectively in open sea of Nuniarchara during October/2023 to March/2024.

b. Production of *Gracilaria tenuistipitata* and *Ulva lactuca* in open sea at Rejukhal site of Ukhiya Upazila and monthly variation in yield in relation to different water quality parameters.

Gracilaria tenuistipitata and *Ulva lactuca* were cultivated in open sea of Rejukhal. Seed of seaweeds were collected from Nuniarchara. Seeds were placed in ropes and set in sea using semi floating technique stated above. After 30 days of seeding crops were harvested and yields were recorded. When snails' infestation became prominent, *Ulva* was grown following the floating raft technology where seeded ropes were tied up in raft made of bamboo and then the raft was placed in water with the help of bamboo pole. After one month of setting the raft, the crops were harvested and data were recorded.

Result and Discussions: In case of production of *Gracilaria tenuistipitata* and *Ulva lactuca* at Rejukhal, the growing season prevails from October to march, when the salinity of the water ranged from 19.58-30.94 ppt. The estimated total fresh yield of *Gracilaria tenuistipitata* was 89.95±9.66 (≈14.45±2.38 ton dry) ton during October/2023 to March/2024 and 7.72±1.32 (≈1.78±0.60 ton dry) ton per hectare for *Ulva lactuca* during November/2023 to March/2024 in open sea of Rejukhal.

Table 2: Monthly variation in yield of *Gracilaria tenuistipitata* and *Ulva lactuca* in relation with different essential water parameters during October 2023 to March 2024 at Rejukhal, Cox's Bazar.

Month	*Gracilaria*		*Ulva*		Temp. (ºC)	Salinity (‰)	Turbidity (NTU)	pH
	f. wt. (t/ha)	d. wt.	f. wt.	d. wt.				
October 2023	6.83±0.72	1.14±0.19	-	-	30.77 ±0.81	19.58 ±2.29	19.75 ±9.86	7.80 ±0.36
November 2023	8.84 ±3.45	1.44 ±0.23	0.92 ±0.21	0.18 ±0.03	28 ±0.75	21.60 ±0.67	15.43 ±3.11	8.10 ±0.15
December 2023	16.07 ±1.71	2.67 ±0.32	1.37 ±0.22	0.26 ±0.07	26 ±0.83	24.10 ±0.84	19.29 ±2.20	8.09 ±0.14
January 2024	15.13 ±1.23	2.41 ±0.81	1.45 ±0.28	0.36 ±0.14	27.82 ±0.48	28.96 ±0.74	20.10 ±1.34	8.18 ±0.17
February 2024	19.00 ±1.12	3.04 ±0.45	1.86±0.19	0.42±0.21	28.88 ±0.42	28.33 ±0.43	22.13±1.57	8.10 ±0.09
March 2024	24.08 ±1.43	3.75 ±0.38	2.12 ±0.42	0.56 ±0.15	31.07 ±0.66	30.94 ±0.87	22.60 ±2.16	8.15 ±0.15
Total	89.95 ±9.66	14.45 ±2.38	7.72 ±1.32	1.78 ±0.60				

n=5, f. wt. = fresh weight, d. wt. = dry weight



Fig. Cultivation of *Gracilaria tenuistipitata* and *Ulva lactuca* at Rejukhal

Conclusion: The estimated total fresh yield of *Gracilaria tenuistipitata* and *Ulva lactuca* was 99.75±8.02 (≈16.32±2.30 ton dry) ton and 31.25±4.44 (≈4.25±0.77 ton dry) ton per hectare respectively in open sea of Nuniarchara during October/2023 to March/2024 and 89.95±9.66 (≈14.45±2.38 ton dry) ton during October/2023 to March/2024 and 7.72±1.32 (≈1.78±0.60 ton dry) ton per hectare for *Ulva lactuca* during November/2023 to March/2024 in open sea of Rejukhal.

Project code and Title: CEP VI-BARC/21. Improving Research Qualities of ARIs through Review and Evaluation by an External Panel of Experts

Implementation Organization: BARC, Farmgate, Dhaka
Component Organization: None

Name of Coordinator cum PI: Dr. Suraya Parvin, Director, Technology Transfer and Monitoring Unit, BARC, Farmgate, Dhaka
Locations:BARC and 6 ARI's Headquarters (BARI, BRRI, BINA, BSRI, BJRI, BWMRI) along with their RARS, Sub stations and Res centres.
Budget : TK599.34 lakh
Duration: December 2021 to November 2026 (60 months)

Introduction: This five-year special project is to support functioning and activities of External Panel of Experts constituted by the BARC to evaluate progress of research, identify strength and weaknesses of the 6 ARI's and suggest improvement in the quality of research delivery. Based on the visiting headquarters of 6 ARI's, report on Areas of Concern have been prepared and submitted to BARI, BRRI, BINA, BSRI, BJRI and BWMRI. Panel received their feedback and visited BRRI, BARI, BJRI and BINA to interact with administration and research leaders. Preparation Policy Document on BJRI and BSRI are nearing completed. Panel prepared policy document on unified service rule for the 6 ARI institutions.

Objective: To provide specific guidance for improvement of Institutional capacity and management and research

Materials and Methods: Technology uptake workshops were organized in 2 DAE regions (Khulna, Chattogram). DDs of the district presented information at the workshop. Visited Regional- and sub-stations of ARIs. Panel members visited Mubarakganj and Thakurgaon Sugar Mills, BSRI and two sugar mills in its neighborhood. Organized stakeholders' workshops on research extension linkage, R&D on agribusiness entrepreneurs on seed business and farm machinery manufacturers. Panel visited a farm-machinery manufacturing and trading company in Alim Industries Limited, Sylhet. In order to assist implementing recommendations, Panel also had held meeting with Director (Res.), BARI on certain issues relating strategy of implementing recommendations.

Results and Discussion:

- Outlying stations generally lack facilities for family living making unattractive for serving. Some of the stations do not have enough manpower to form team to run research in a coordinated manner. Sanctioned positions of scientists require to fill in.
- Preliminary assessment indicate that BARI released technologies were slowly adopted. BARI malta-2, BARI hybrid tomato 10 and 11 show promise. BARI released flower varieties have not gained ground in any district or region. Slow adoption or non-adoption of BARI released varieties is attributed mostly to non-availability of seeds and planting materials and lack of effective communication
- BARI/BWMRI released blast resistant variety BARI Gom 33 is quickly spreading even in the southern districts
- BRRI dhan 75, 89, 92 have been quickly adopted. Coverage of modern rice varies ranging between 6 and 68% depending season and regions.
- BJRI Pat-8 variety occupies about 5% of jute area, and boro-jute-T. aman cropping pattern is slowly spreading
- Sugarcane variety, BSRI Akh 47, has been adopted to some extent.
- Adoption of BINA varieties BINA Lebu 1 &2 is being adopted in hill tracts and BINA Sharisha 11 is spreading in Khulna and Mymensingh regions.

- The major reasons of slow or no adoption of other crop varieties are –no space in the existing cropping system of the region, less important to farmers, not known to farmers, no demonstration of the technology, lack of extension activities, and in some cases lack of seed/planting materials and overall weak extension –research linkage.
- Workshop reviewed the progress of research and adoption farm machinery in the country. It was observed that most R&D on farm machinery for developing/improving farm machinery,
- The actionable areas of concern are structured into two parts: (i) Institutional management, and (ii) Research management. The panel has highlighted first the common features of the issues and concerns existent in the ARIs.

Conclusion: Recommendations for improvement of research, physical facilities and management issues of 6 ARI's are being prepared. Through this review and evaluation, weaknesses and limitations related to different aspects of research capacity (both physical and technical) and implementation process in both HQ & outstations will be identified and recommendations are being formulated to correct the institutional weaknesses. Detailed report will be compiled and reflected in the Annual report.

International Collaborative Program (ICP)

Completed Project

Project Code and Title: ICP-II: Nutrient management for diversified cropping in Bangladesh (NUMAN)

Implementing Organizations: BARC, BARI, BRRI, BAU, SRDI, Khulna University (KU), Khulna 9208, Patuakhali Science and Technology University (PSTU), Dumki, Patuakhali

Project Leader/Project Coordinators/Principal Investigators:

Project Leader: Dr. Richard W. Bell, Professor, School of Veterinary and Life Sciences, Murdoch University (MU), 90 South Street Murdoch WA 6150, Australia, Email: R.Bell@Murdoch.edu.au

Project Coordinators:

Dr. Md. Baktear Hossain (BARC), Director. (SAC) and CSO (NRM, BARC)
Dr. Md. Enamul Haque, ACIAR, PIU, MU Dhaka Office, Uttara, Dhaka.,

Associate Coordinator: Dr. S. M. Bokhtiar, Executive Chairman, BARC (for KGF)

Locations: Durgapur (AEZ-11) and Godagari (AEZ-25) Upazilas of Rajshahi and Sadar Upazilas of Thakurgaon (AEZ-1) and Mymensingh (AEZ-9) have been selected as intensive cropping areas; and Dakope of Khulna (AEZ-13) and Amtoli of Barguna (AEZ-13) have been selected for the coastal zone research. Two hub areas have been newly selected at Sayedpur, Nilphamari (AEZ 3) and Damudya, Shariatpur (AEZ 12, 19) mostly for out calling of the project outputs during the extended project period.

Budget: Tk. 5,35,35,000

Duration: January 2018-December 2022

Introduction: Intensive cropping practices and reduced arable land in Bangladesh have raised concerns about crop nutrient management. Cropping intensity has surged to around 200%, with fertilizer use doubling from 2003 to 2020. This increase, coupled with a gap between actual practices and scientific guidelines, negatively impacts farming profitability and soil health. Conservation Agriculture (CA) offers a solution by promoting minimal soil disturbance and crop residue retention, which can improve soil nutrient availability. There is also potential for higher agricultural yields in coastal areas through crop intensification and high-yielding varieties. However, developing balanced nutrient management strategies is crucial for sustainable agricultural production and soil health. By focusing on these strategies, Bangladesh can work towards a more sustainable agricultural system that meets the demands of its growing population.

Objectives:

To develop sustainable nutrient management options, enhancing soil knowledge among stakeholders, and advocating for policies that promote efficient and profitable cropping practices

Materials and Methods: Surveys were conducted to explore socio-economic and gender aspects of fertilizer use, alongside experiments on soil fertility and fertilizer management. Training programs were implemented to enhance fertilizer management skills. Key research hubs for intensive cropping and conservation agriculture included various agro-ecological zones in Rajshahi, Thakurgaon, Mymensingh, and coastal areas like Dacope and Amtali. Data collection involved structured questionnaires and face-to-face interviews with farmers, focusing on cropping patterns, land types, and fertilizer application methods. The Soil Resource Development Institute (SRDI) assessed fertilizer quality, while NARS institutions and universities conducted field experiments in these regions. Post graduate students of the universities and research assistantships of NARS participated executing research activites.

Results and Discussion: The project was initiated in January 2018. Four years and a half of the project have been completed so far successfully. Some important results obtained during this period are summarized below:

Fertilizers use

Socio-economic survey indicated large deviations from recommended fertilizer doses for various crops, ranging from sub-optimal to over-doses. The major factors for these variations were found to be gender, farmers' land holding and resources, crop residue retention, crop rotation, fertilizer use in the previous crop, distance to input/output market, fertilizer price, level of extension contact and region. Insufficient knowledge and training in respect of soil fertility management and financial resources, non-availability of soil testing facilities, high fertilizer prices, inadequate extension services etc. were the major barriers against the application of recommended fertilizer doses for crops.

Fertilizer quality

Macronutrient fertilizers like urea, TSP, DAP, MoP, gypsum were found to meet the quality criteria set forth in the Government specifications, but 100% of samples of the micronutrient fertilizer zinc sulphate monohydrate and zinc sulfate hepta hydrate samples and 75% of the chelated zinc samples were found to be adulterated and very poor in quality. However, fertilizer samples such as Solubor and boric acid, carrying boron, another micronutrient, were of relatively good quality, 82% of the former and 59% of the latter being of acceptable quality.

Nutrient use efficiency

A considerable amount of applied N was found to be lost as NH_3 volatilization which amounted to 15 to 20% of the total N fertilizer input to rice-based systems. Co-application of biochar and compost to Boro rice was found to reduce NH_3 emission by 37% and N application rate from 306 to 141 kg N/ha. Co-application of biochar and nitrapyrine also reduced NH_3 emission by 16.5% from a cabbage field and increased cabbage yield significantly. Nutrient loss by leaching loss was also significant in case of N, K and S. Future research should be directed towards development of nutrient management technologies and strategies that would minimize nutrient losses from the soil-crop system.

Nutrient management for intensively cropped areas

i) At Ishwardi, Pabna (AEZ-11) 125% of recommended doses (RD) of chemical fertilizers for wheat and T. aman rice, and only 20 kg N/ha for mungbean in a wheat-mungbean-T. Aman system gave the highest system productivity and economic benefit sustaining soil fertility for over 20 years.
ii) For calcareous soils (AEZ 11) in Rajshahi optimum fertilizer rates for Boro rice (BRRI dhan81) were found to be 165-29-132-1.8-1.7 kg NPKZnB/ha and for T. Aman rice (BRRI dhan87) 100-22-100-1.6-1.3 kg NPKZnB/ha. For Barind soil (AEZ 26) the optimum rates for Boro rice were 155-34-128-1.6-1.4 kg NPKZnB/ha and for T. Aman rice 100-22-100-1.5-1.4 kg NPKZnB/ha.
iii) At Paba, Rajshahi, application of K fertilizer @ 20 K kg/ha at the tillering stage of T. Aman rice and at maximum tillering (MT) and PI stages of Boro rice in addition to the basal dose gave higher grain yields than that with K application as a basal dose only.

Fertilizer management tools

i) Fertilizer application according recommendations of BARC Fertilizer Recommendation Guide 2018 (FRG 2018) gave significantly higher grain yield of Boro and T. Aman rice compared with that from fertilizers based on the Rice Crop Manager (RCM) tool (IRRI), STB (laboratory analysis or soil test kit based analysis) or farmers' practice (FP).

Implications of CA

i) After 9 years of practicing CA at the BAU farm with high residue retention under strip tillage, the crops had higher N use efficiency, system yield and increased annual gross margin in the rice-wheat-mungbean system.
ii) No significant difference in grain yields of Boro and T. aman rice were observed between non-puddled and puddled systems at Paba, Rajshahi (AEZ 26) which indicated that costs of land preparation and irrigation could be avoided without sacrificing grain yield; ice straw incorporation significantly increased the rice yield.
iii) Strip tillage with 125% STB based fertilizer doses gave the highest system productivity and economic benefit in a Boro-mungbean-T. Aman cropping pattern at Godagari, Rajshahi. Soil fertility was slightly improved after 3 years mainly due to incorporation of mungbean biomass into the soil.
iv) Three years were required to derive benefits from CA in wheat-mungbean-T. Aman and in Boro-T. Aus-T. Aman cropping patterns at the BAU farm. GHG emissions were 16% less than that with conventional tillage (CT). CA with crop residue retention reduced global warming potential (GWP) by 10-16%.
v) After 5 mustard-mungbean-T. Aman rice cropping cycles under CA practices at RARS, Ishwardi, Pabna strip planting coupled with high residue retention was found to increase P availability in soil.
vi) Experiments with a lentil-T. Aus-T. Aman cropping pattern under CA practices at Durgapur, Rajshahi showed that minimum soil disturbance and crop residue retention could positively influence system productivity. However, a high K fertilizer dose was needed to maintain a desirable K balance in soil for this intensive rice-based cropping system.

Agriculture in the coastal zone

i) Moderate to high soil salinity, late drainage, scarcity of fresh water for irrigation and erratic rainfall in the dry season coupled with low soil fertility, particularly deficiencies of N, P and Zn and low soil pH (Amtali) were found to be the major constraints to the production of Rabi crops in Dacope, Khulna and Amtali, Barguna of the coastal region. In addition to these abiotic soil and environmental stresses, anthropololgical factors like faulty sluice gate and polder management area complicated the crop production problems in the coastal districts.
ii) With proper management, including mulching, small scale supplemental irrigation in the dry season with fresh water, use of salt tolerant crops/varieties and recommended fertilizer doses of both wet season and Rabi may be grown with satisfactory yields in the coastal areas. Salinity of the Payra river was found to be low enough to be suitable for irrigating dry season crops like maize, sunflower, wheat, watermelon etc. which could be successfully in the post-T. Aman rice wet soil with zero tillage.
iii) Nitrogen was found to be the most yield limiting nutrient element followed by P, K, S and Zn in both saline and non-saline soils of the project areas in the coastal region. In the coastal areas, crops required relatively high doses of N was is high, but K requirement was negligible.
iv) For Aus rice, 70-80 kg N, 10-12 Kg P and 20-30 kg K per ha were the optimum fertilizer rates in the coastal saline areas of Dacope, Khulna and Amtali, Barguna; for T. Aman rice, the rates were 75-85 kg N, 10-12 kg P, 20-30 kg K and 5 kg Zn per ha. The optimum fertilizer doses for wheat were observed to be 120-130 kg N-15 kg P-10-15 kg K per ha, for maize 225-250 kg N, 25 to 35 kg P and 50-60 kg K per ha and for sunflower 130-150 kg N, 30-35 kg P and 50-60 kg K per ha.
v) Silicon application at the rate of 20 kg Si/ha enhanced salt stress tolerance in rice and maize. Silicic acid, Na silicate and Ca silicate were equally effective as Si sources. Rice husk ash was also found to be an effective source of Siat the rate of 2.5 t/ha for maize and 1 t/ha for T. Aus rice.

Human resources development

There were provisions in the project of financial support for higher studies, six research fellowships for the PhD degree and 20 research assistantships for the MS degree. Research activities of all the Research Fellows have been completed and drafts of their dissertations submitted to their respective supervisors. All 20 MS students have completed their degree programs.

Conclusions: The project involved various activities such as socio-economic studies, basic and applied research in intensively cropped and coastal areas, and emerging cropping systems like conservation agriculture (CA). Nutrient management for diverse cropping in Bangladesh is crucial for sustainable agricultural practices. By improving soil knowledge among stakeholders, we can create effective

nutrient management strategies that enhance crop yields and tackle environmental challenges. Additionally, promoting policies that support efficient cropping systems will aid food security and foster long-term agricultural sustainability in the region.

On-going Projects

Project Code and Title: ICP-I (Phase II): Mitigating risk and scaling-out profitable cropping system intensification practices in the salt-affected coastal zones of the Ganges Delta

Implementing Organizations: Bangladesh Agriculture Research Institute (BARI) and Bangladesh Rice Research Institute (BRRI)

Principal Investigators: Dr. Apurbo Kumar Chaki, SSO, OFRD, BARI and Dr. Priya Lal Chandra Paul, SSO, IWM Division, BRRI

Locations: Barishal and Khulna

Budget: Tk 6293.64 thousands for BRRI and 9440.46 thousand for BARI

Duration: July 01, 2022 to June 30, 2025 (36 months)

Introduction: The coastal zone of Bangladesh, characterized by low elevation and vulnerability to flooding, faces significant agricultural challenges due to water logging, soil salinity, and limited irrigation. Farmers primarily cultivate low-yielding rice varieties, with much land left fallow in the dry season. However, there are opportunities for increased cropping intensity through better water management and agronomic practices. An international research project initiated in 2016 aimed to enhance productivity by introducing high-yielding rice and various Rabi crops, along with improved management techniques. The project concluded in 2020, and a second phase commenced in July 2022, focusing on disseminating these advancements to further boost crop productivity in the coastal region.
Objectives: Increasing cropping intensity and crop productivity in the salt-affected coastal zone by mitigating risk and scaling-out profitable cropping system intensification

Materials and Methods: Field experiments and demonstrations were conducted in Kharif-1, Kharif-2, and Rabi seasons of 2022-23. Conjunctive use of saline and fresh water and improved irrigation methods were used for growing dry season crops (potato, sunflower, maize, onion, water melon etc.).

Results and Discussion:

Upscaling of T. Aman rice varieties

During the T. Aman season, 2022, in the Dacope area, the project tested the varieties BRRI dhan87 and BRRI dhan76 in 12.0 and 18.8 ha with the participation of 97 and 54 farmers, respectively. Farmers traditionally have been growing BR23 in these areas for a long time. In the Amtali area, BRRI dhan87 and BRRI dhan76 covered 7.4 and 12.5 ha with the participation of 24 and 47 farmers, respectively during the same season.



Fig. 42. Bangladeshi and Australian scientists visiting experimental fields in Khulna

Upscaling of Boro rice and non-rice crops

In field demonstrations during Boro/ Rabi season, 2022-23, at Batiaghata and Dacope, Boro rice was grown in about 90 ha of land and non-rice crops like watermelon, sunflower, sweet gourd, and maize were grown in 50 ha with the participation of about 250 farmers. Likewise, at Amtali, Barguna and Kalapara, Patuakhali, Boro rice was grown on about 70 ha of land and about 30 ha was cropped to non-rice crops like watermelon, sunflower, sweet gourd and cucumber were demonstrated with the participation of about 470 farmers.

Upscaling of zero tillage potato with mulching

Results of field demonstrations in 3.5 ha of farmers' fields (47 farmers) at different locations of Khulna on zero-tillage potato cultivation with mulching are given in Table 19. BARI Alu-72 with a yield of 27.7 t/ha outperformed the other varieties which yielded around 24-25 t/ha.

Table 19. Yield of different potato varieties grown under zero-tillage conditions at different locations of Khulna district during the Rabi season of 2022-23

Location	Yield (t/ha)			
	BARI Alu-72	**BARI Alu-73**	**BARI Alu-78**	**BARI Alu-79**
Koyra	23.22	-	24.71	22.62
	25.13	-	25.13	23.13
	24.99	-	26.81	22.44
Dacope	27.3	26.61	23.1	
	29.86	24.63	26.7	23.67
	28.1	24.75	24.8	23.48
	24.1	21.99		
Batiaghata	35	25.6	20.5	29.25
	32	25	28	24
	27.1	24.3	26.3	23.5
Average yield	**27.68**	**24.70**	**25.12**	**24.01**

Upscaling of garlic, sunflower and watermelon

Field demonstrations in Khukna on garlic, sunflower and watermelon were conducted in 3-8 ha land areas with the participation of about 50 farmers. The yields of the crops were 4.2-8.1, 1.5-2.0 and 22-50 t/ha, respectively.

Conclusions: Encouraging results were obtained in the field trials with T. Aman and Boro rice and assorted non-rice crops in the Rabi season. With improved and integrated crop-soil-water management practices, large areas of fallow land can be brought under cultivation in the coastal saline areas to increase cropping intensity and land productivity. The upscaling programs will be run for the next two years under this project and the data will be used to run the Agricultural Production Systems sIMulator (APSIM) crop model empowering researchers to explore the performance of farmer management adaptations under both historical and future climate scenarios.

Project Code and Title: ICP IV/2020/1338: Development of short-duration cold-tolerant rice varieties for *Haor* areas of Bangladesh

Implementing Organizations: International Rice Research Institute (IRRI), Bangladesh Country Office, House: 103, Road: 01, Block: F, Banani, Dhaka-1213
Component Organization: Bangladesh Rice Research Institute (BRRI), Joyebpur, Gazipur-1701

IRRI component: Dr. Mohammad Rafiqul Islam, Project Lead, KGF-IRRI-BRRI *Haor* Project and Rice Breeder, IRRI Bangladesh Country Office, House: 103, Road: 01, Block: F, Banani, Dhaka-1213
BRRI component: Dr. Partha Sarathi Biswas, Chief Scientific Officer, Plant Breeding Division, BRRI,
Joyebpur, Gazipur-1701

Locations: 11 sites in 4 locatopms

a) BRRI HQ, Gazipur
b) Kishoreganj: Pachrukhi, Mozlishpur, Purbagram of Nikli Upazilla

c) Habiganj: BRRI Regional Station, Ajmeriganj, Baniachang and Nabiganj Upazilla
d) Sunamganj: Moddhyo Tahirpur, Baliajuri and Chiksa of Tahirpur Upazilla

Budget: BDT. 13,70,49,000 [8,89,49,000/- (IRRI Part); 4,81,00,000/- (BRRI Part)]

Duration: 01 September 2020 – 31 August 2025 (60 months)

Introduction: Farmers in the Haor regions primarily grow Boro rice since much of the land is submerged during the wet season. To reduce the risk of flash flooding, some have attempted to plant earlier, around the last week of October, during the Boro season. However, this can lead to cold shock during the reproductive phase, causing grain sterility and lower yields. Thus, farmers require rice varieties that are cold-tolerant and have shorter growth periods to harvest before floods occur, minimizing losses. Short-duration, cold-tolerant rice varieties that satisfy market needs in the Haor areas of Bangladesh are essential for risk mitigation and sustainable food security.

Objective: To develop a short-duration cold-tolerant rice variety based on the market demands of the Haor areas of Bangladesh.

Materials and Methods

- **Market segment study:** This study was carried out by IRRI in the sampled study sites, which broadly represented the Haor areas. Data collected on market segments from different actors in the rice value chain, including farmers, millers, consumers, and other stakeholders.

- **Varietal development research:** In Boro 2023-2024 DS, Observational Yield Trial (OYT), Advanced Yield Trial (AYT), and Regional Yield Trial (RYT) experiments were carried out at four locations (Gazipur, Nikli, Taherpur, and Habiganj) for varietal development.

- **Communication and information management strategies:** The information and evidence generated by the project will be disseminated to the relevant stakeholders, such as farmers, extension workers, researchers, input dealers, private organizations, government officials, policymakers, media persons etc.

Results and Discussion: In the Boro 2023-2024 season, 836 breeding lines/varieties were evaluated at Gazipur and three Haor locations. In the Regional Yield Trial, in total, 8 advanced breeding lines were evaluated against four standard check varieties at 10 haor locations under 3 seeding intervals (Late October (early) seeding, 1st week of November (slightly early) and Mid November (regular) seeding. Twenty-eight breeding lines from 136 genotypes tested in AYT and 72 lines from 719 lines tested in OYT trial have been selected preliminarily based on visual phenotypic acceptability for further evaluation.Five lead breeding lines were identified as suitable for haor areas. These lines showed minimum yield reduction due to cold stress compared to cold susceptible varieties. Among these lines, BR11894-R-R-R-R-169 were found to yield on an average 5.97 t/ha even under severe cold stress of below 20^{0}C at the booting stage for 6-7 days (sowing seeds in 3rd week of October) and up to 7.66 t/ha under regular sowing in 3rd week of November with a growth duration of 144-147 days. Sowing seeds in the 4th week of October, the crop of this line was possible to harvest during the 4th week of March at Nikli during Boro 2022-23. BR11894-R-R-R-R-169 and a previously identified TP16199 have been evaluated in the adaptive trials during Boro 2023-24 as a part of the variety release pipeline.

Table 1: Trial location in the Boro season of 2023-2024 DS

SN	Location	Trial Area	Trial Name
1	**Nikli, Kishoreganj**	Majlishpur	RYT
		Panchrukhi 1	AYT, RYT
		Panchrukhi 2	RYT
2	**Taherpur, Sunamganj**	Moddho Taherpur	AYT, RYT
		Baliajuri	RYT
		Chiksha	RYT
3	**Habiganj**	BRRI Station	OYT, AYT, RYT
		Imambari-Nabiganj	RYT
		Jalshukha-Ajmeriganj	RYT
		Kagapasha-Baniachong	RYT
4	**BRRI-HQ, Gazipur**	Gazipur	OYT, AYT, RYT

OYT: Observational yield trial, AYT: Advanced yield trial, RYT: Regional yield trial

So far, 836 germplasms from IRRI-HQ have been shared with BRRI. The BRRI scientists conducted trials to determine the short-duration cold-tolerant rice. IRRI-HQ scientists also shared 96 advanced lines with BRRI to see their performance in Bangladesh's environmental conditions. The IRRI-Bangladesh Office (IBO) shared the local germplasm with Dr. Damien. Now, he is working on those materials to identify the QTLs and develop new lines resistant to cold. Cold stress facilities are newly set up at IRRI-HQ.

Conclusion. In conclusion, the successful identification of cold-tolerant breeding lines, particularly BR11894-R-R-R-R-169, highlights the potential for enhancing rice production in Bangladesh's haor regions. Continued collaboration between BRRI and IRRI will be crucial in developing resilient varieties that ensure food security amidst climate challenges.



Photo: During OYT, RYT, and ALART field visits in the Haor areas.

Project Code and Title: (ICP VI-CIMMYT (ACIAR)/21. Managing wheat blast in Bangladesh: Identification and introgression of wheat blast resistant gene(s) into varietal development and rapid varietal dissemination

Implementing organization: Bangladesh Wheat and Maize Research Institute (BWMRI)
Component organization: None
Principal Investigator: Dr. Muhammad Rezaul Kabir, SSO, BWMRI, Dinajpur
Location: Dinajpur and Jashore
Budget: TK 2,28,83,000/=
Duration: 28 December 2021 to 27 December 2026 (60 months)

Introduction: Wheat blast was first recorded outside South America in Bangladesh in 2016, affecting wheat-growing regions. By 2024, it had spread to 29 districts, indicating the pathogen's establishment. The 2016 outbreak prompted several projects, including an international collaboration funded by ACIAR and KGF, executed by BWMRI and CIMMYT. A precision phenotyping platform (PPP) was set up at BWMRI's Regional Station in Jashore for large-scale screening of wheat accessions against blast, leading to the release of two resistant varieties (Fig. 1). Most identified resistant lines contain the

2NS/2AS translocation. However, virulent strains can evolve, making the identification of non-2NS resistant genotypes crucial. Further screening will help find new resistance sources, and disseminating these varieties is vital for boosting farmers' confidence in wheat cultivation.

Objectives

- **i)** Screening diverse wheat germplasm to identify blast resistant sources
- **ii)** Development of wheat blast resistant varieties/ lines
- **iii)** Identification of aggressive isolates and study their population biology and development of potential differential lines
- **iv)** Dissemination of resistant varieties seeds to reach farmers' fields

Materials and methods:
A total of 4,127 lines from 16 nurseries were assessed under controlled conditions. Approximately 38 resistant genotypes were tested again against wheat blast in a greenhouse to verify their resistance. The highly susceptible cultivar BARI Gom 26 and the resistant variety BARI Gom 33 (Kachu/Solala) served as standards. Five elite lines were screened alongside these checks to find resistant sources. One hundred ten crosses were made (84 single, 20 top, and 6 backcross). Evaluations included 70 F1, 139 F2, 66 F3, 5 F5, and 62 F6, leading to the selection of 70 F1, 80 F2, 41 F3, 49 individual plants, and 16 lines. Four populations with RmgGR119 and Rmg8 were assessed in PPP. In the 2023-24 season, 150 demonstrations took place across 6 districts.

Results and Discussions: During the 2023–24 season, 4,127 wheat genotypes—including bread wheat, winter wheat, durum wheat, synthetic lines, and landraces—were evaluated under artificially inoculated conditions for resistance to wheat blast. These genotypes originated from CIMMYT-Mexico, Bangladesh, India, Afghanistan, Japan, Nepal, and Canada. Screening results showed 33% resistant, 15% moderately resistant, 15% moderately susceptible, 20% susceptible, and 17% highly susceptible genotypes. BARI Gom 33 exhibited strong resistance (<5% disease index), while BARI Gom 26 was highly susceptible (>85% infection). Thirty-eight resistant lines were re-evaluated in greenhouse trials, with sixteen maintaining resistance; notably, BAW 1374, BAW 1390, BAW 1474, and BAW 1479 were most promising. Nine isolates were used to identify virulence, with FAR230001, BHO230001, and MAG230001 confirmed as virulent. Morphological diversity among 12 isolates was recorded across different media, revealing significant variation. Eleven resistant lines were re-tested to develop a differential set, and two lines showed immunity. Whole genome sequencing of 94 blast isolates is complete, with bioinformatics underway to assess genetic diversity. Additionally, 120 single crosses, 3 top crosses, and 10 back crosses were made. To promote resistant varieties, 150 block demonstrations were conducted in six blast-prone districts, facilitating seed distribution to farmers.

Table 1: List of germplasm screened for identification of resistance sources against wheat blast under inoculated conditions during 2023-24 cropping cycle at RS, BWMRI, Jashore

Sl No.	Nursery Name	No. of lines
1	New Biparental Populations	1006
2	F5 WB POP KT020	203
3	F5 WB POP WC	151
4	F5 BLAST GR119 POP 1	274
5	F5 BLAST GR119 POP 2	268
6	BC5 BLAST KT020 POP 2	288
7	56th (International Bread wheat Screening Nursery (IBWSN)	231
8	OFANS	60
9	15th Helminthosporium Leaf Blight Screening Nursery (HLBSN)	52
10	15th High Zinc Advance Nursery (HZAN)	232
11	CT24BAN_BLAST	195
12	55TH International Durum Screening Nursery (IDSN)	157
13	Wheat Blast Screening Nursery (WBSN1) 2023-24	280
14	Wheat Blast Screening Nursery (WBSN2) 2023-24	192
15	22IND SEL.	160
16	Indian Wheat lines 2023-24	378
Total		4127



Photo 01: Precision phenotyping platform (PPP),



Phot 02: Demonstration plot: WMRI Gom 3

Conclusion: Expanding resistant germplasm, monitoring virulence, and engaging farmers are vital for resilient wheat systems. As virulent strains evolve, identifying non-2NS resistance is crucial. Continued screening will uncover new sources, while timely dissemination boosts farmer confidence. Donor support remains key to scaling innovations and delivering climate-adaptive, science-based solutions to vulnerable communities. These efforts not only protect yields in blast-prone areas but also strengthen food security and ensure sustainable agriculture in the face of growing disease threats.

Lump Sum Grants (LSG)
Completed Projects

38. Project Code and Title: LSG 12 C/22. Generation advancement and molecular characterization of rice blast resistant lines with their pathotypic reactions in blast endemic areas

Implementing Organization: Bangladesh Rice Research Institute (BRRI)
Principal Investigator: Dr. Tahmid Hossain Ansari, Chief Scientific Officer (Plant Pathology), BRRI Regional Station, Satkhira
Locations: BRRI, Gazipur and BRRI Regional Station, Satkhira
Budget: Tk 12.00 lakh
Duration: March 2022 to June 2023

Introduction: The blast disease poses a significant threat to rice production in Bangladesh, causing yield losses between 11% and 46.4%, particularly affecting Boro rice, which accounts for over 55% of the country's output. The 2014-15 season saw severe outbreaks in BRRI dhan28 and BRRI dhan29, with up to 90% neck infection reported in Rangpur. Many recently released rice varieties, including fine grain and salinity-tolerant types, are highly susceptible to the disease. Early recognition by farmers is challenging, leading to potential crop failures. However, host resistance through genes Pita2 and Pi9 shows promise, offering 80-84% resistance against local blast isolates.

Objective: Evaluation of advanced monogenic resistant lines/germplasm in blast endemic areas and advancement of blast resistant gene pyramided lines for development of pre-breeding lines/varieties

Materials and Methods: Breeding lines were developed through crosses between BRRI dhan29 and IRBL-9W, and BRRI dhan29 and IRBL-ta2Pi, followed by pyramiding of Pi9 and Pita2 blast resistance genes via multiple crosses. Lines containing Pita2 were advanced for fixed line identification and evaluated in Advanced Yield Trials (AYT), Multi-Location Trials (MLT), and Regional Yield Trials (RYT) under separate BRRI programs. Marker Assisted Selection (MAS) and field evaluations were conducted at BRRI Gazipur and Satkhira stations. Additionally, a field trial was established at the blast hotspot in Keshabpur, Jashore, and screening was performed in the Uniform Blast Nursery (UBN) to assess resistance under high disease pressure. Field trials to evaluate the genotypes (containing *Pi9*) in respect of blast incidence/severity were conducted at 13 different locations.

Table 1. Yield and Growth durations and yields of blast resistant (*Pita2*) lines at BRRI, Gazipur, Boro 2022-23 (BR29 X IRBLta2-Pi)

Entry no	Growth duration (d)	Yield (t/ha)
BR(Path)15855-BC3-2HR-5		
BR(Path)15855-BC3-2HR-11	157	7.8
BR(Path)15855-BC3-2HR-35	156	7.3
BR(Path)15855-BC2-3HR-8	156	7.0
BR(Path)15855-BC2-3HR-78	157	7.2
BR(Path)15855-BC2-3HR-23	158	7.8
BR(Path)15855-BC2-3HR-47	158	7.5
BR(Path)15855-BC2-3HR-95	156	7.4
BRRI dhan29	157	7.5
LSD (0.5%)		NS

Results and Discussion:
MLTs were performed with seven resistant entries alongside two standard checks in farmers' fields across five locations. Meanwhile, RYTs took place at eight regional stations of BRRI, located in Gazipur, Rajshahi, Rangpur, Kustia, Khulna, Satkhira, Sonagazi, Cumilla, and Habiganj. Breeding lines that included the Pita2 gene were assessed for blast resistance and yield performance in AYT at BRRI, Gazipur, and Satkhira. The presence of the resistance gene(s) in all tested lines was verified through Marker Assisted Selection (MAS). The growth durations and yields of the seven lines that incorporated the Pita2 gene in the AYT at Gazipur were comparable to those of the blast-susceptible check BRRI dhan29.

The introgression of Pi9 and Pita2 into BRRI dhan29 was conducted in distinct manners, resulting in the production of F1 seeds. Subsequently, a cross was made between the Pi9 and Pita2 plants. Ultimately, fixed lines were developed and assessed in the BRRI UBN with artificial inoculation, where they exhibited resistance (score 0). Eight advanced lines were evaluated at BRRI, Satkhira, yielding over 7.9-8.4 t/ha compared to the check varieties which yielded 7.1-7.5 t/ha (Table 1). The selected lines are slated for further evaluation in RYT and MLT during the upcoming Boro season.

Conclusions: The blast disease poses a significant threat to rice production in Bangladesh, causing yield losses of 11% to 46.4%. Host resistance utilizing multiple genes, specifically Pita2 and Pi9, shows promise for managing this disease. Five selected lines demonstrated grain yields of 6.9-7.5 t/ha, comparable to established varieties. Eight lines with the Pita2 gene and ten pyramided lines combining Pi9 and Pita2 were identified for further evaluation. The project ended with promising results in respect of the development of blast resistant rice varieties in the near future. With additional funding, the development of blast-resistant rice varieties could advance significantly.

Project Code and Title: LSG 13-C/22. Adaptation trial of promising salt tolerant soybean genotypes in coastal region of Bangladesh

Implementing Organization: Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMTRAU)
Principal Investigator: Professor Dr. M. Abdul Karim
Locations: Subornachar upazila of Noakhali district, Komolnagar, Laksmipur Sadar, Raipur and Ramgati upazilas of Laksmipur district, and Bhola Sadar upazila of Bhola district
Budget: Tk 9.90 lakh
Duration: 01 July to 30 June 2023

Introduction
Bangladesh's soybean production remains far below demand—just 162,000 MT harvested in 2021–22, while 2.8 million MT were imported to meet rising feed needs, costing Tk. 24,508 crore in oil imports alone. Yet cultivation in key zones like Noakhali and Laksmipur has stalled since 2017, challenged by land competition, poor market access, and worsening soil salinity. In response, BSMRAU's Department of Agronomy is trialling over 200 genotypes from BARI, AVRDC, and Kyoto University to identify salt-tolerant varieties. Early standouts—AGS313, BD2330, G00028, and G00056—show promise. This

project seeks to validate their performance across saline and non-saline fields, unlocking new potential for coastal soybean revival.

Objectives: Evaluation of the adaptability of promising salt tolerant soybean genotypes in the coastal region, and development of salt tolerant high-yielding soybean variety(s)

Materials and Methods:
Saline resistant soybean genotypes AGS313, BD2330, G00028 and G00056, selected from a screening program at BSMRAU were used in the trials. In Kharif-II of 2022, seeds of the selected materials were grown in Char Puragacha (Ramgati upazila), and Char Lorence and Daspara (Komolnagar). Farmers were directly involved in the study. In Rabi of 2022-23 adaptive trials were conducted involving promising germplasm of BSMRAU, BU soybean2, BARI soybean6 and BINAsoybean-2 in different upazilla of Noakhali, Laksmipur and Bhola. Each experimental plots was 50 decimal in size. Farmers were trained on soybean cultivation trchniques. Project scientists visited farmers time to time and discussed about the progress and the performance of the genotypes. The nutrient contents of the promising soybean genotypes were analyzed at Kyoto University, Japan and National Research Council, Saskatoon, Canada.

Results and Discussion: The seeds were sown by the last week of January' 23. The salinity level was less than 3 dS/m, except a few having 4 dS/m at sowing which increased to 5- 13 dS/m at harvest. At harvest yield and yield contributing characters were measured appropriately. Although some yield could be salvaged at soil salinity of EC<8 dS/m, None of the genotypes produced seeds at higher soil salinity levels. Salinity decreased plant height, number of pods/ plant, 1000-seed weight and grain yield, and shortened growth duration. However, AGS313 and G00028 were affected less than the other genotypes. Under non-saline conditions higher grain yield was found in G00056 (2342 – 3391 kg/ha), AGS313 (2612 – 3267 kg/ha), G00028 (2582 – 3374 kg/ha) and BU soybean2 (2333 – 3397 kg/ha). However, under saline conditions, G00028 performed well (866 – 1375 kg/ha) followed by AGS313 (860 – 3267 kg/ha) irrespective of location. Other genotypes including the popular varieties produced very low yield compared to G00028 and AGS313 in the saline fields.

Nutrient analysis results revealed that AGS313 had the highest N (6.50%) followed by BD2330, G00028 and BU soybean2, while G00056 had the lowest N in seeds; P content was highest in BU soybean1 (7.79 mg/g) followed by AGS313 (7.49 mg/g), though G00028 had the lowest P content (5.01 mg/g); K was highest in G00056 (20.31 mg/g) and BD2330 had the minimum K. BU soybean2 had the maximum Ca (3.86 mg/g) followed by BU soybean1; BD2330 had the minimum Ca. BD2330 had the highest amount of Zn (0.075 mg/g), while in BU soybean1 and BU soybean2 the Zn was non-detectable. Aluminum was maximum in BD2330 (0.135 mg/g) followed by AGS313, while BU soybean2 had the minimum Al. BU soybean1 had the highest amount of Se (0.011 mg/g) followed by BU soybean2, while Se was non-detectable in BD2330 and AGS313.

AGS313, the salt tolerant genotype, had the highest protein (41.9 %) followed by G00028 (salt tolerant) and G00056. BU soybean1 had the minimum protein (34.1%) among the tested genotypes. Oil content was the highest in BU soybean2 (21%) followed by AGS313 (20.6%). Oil content was minimum (15.5%) in G00056 followed by BD2330. Omega3 fatty acid was found maximum in AGS313 (12.6 mg/g) followed by G00028. BU soybean2 had the minimum omega3 fatty acid (6.1mg/g). Tripsin inhibitor was the highest in BU soybean2 (65.88 TUI/mg) while AGS313 had the minimum (30.29 TUI/mg). Thus, the salt tolerant genotypes AGS313 and G00028 had acceptable amounts of protein and omega3 fatty acid. AGS313 also a high oil content and low amount of tripsin inhibitor which is a useful constituent of animal feed.

Conclusions: The trials revealed AGS313 and G00028 as promising salt-tolerant soybean genotypes, maintaining acceptable yields under EC <8 dS/m and outperforming others in saline conditions. AGS313 stood out for its high protein (41.9%), oil (20.6%), and omega-3 content, with minimal trypsin inhibitor—ideal for feed use. G00028 also showed resilience and nutritional value. These findings offer a pathway to restore soybean cultivation in coastal Bangladesh. Future efforts will focus on multi-location trials, seed multiplication, and integrating these genotypes into climate-resilient cropping systems to ensure food, feed, and nutritional security under increasing salinity and climate variability.

On-going Projects
Project Code and Title: LSG-10-C/21. Adaptability trial of promising saline tolerant wheat genotypes in the coastal region of Bangladesh
Implementation Organization: Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Sripur, Gazipur
Principal Investigator: Dr. M. Moynul Haque
Locations: Patuakhali, Barguna, Khulna and Satkhira districts
Budget: Tk 9.78 lakh, **Duration:** November 2021 to October 2024

Introduction: Wheat is the second most important cereal crop in Bangladesh, primarily grown in the north and north-western regions. Recent efforts have been made to cultivate wheat in coastal areas, where land remains fallow during the Rabi season due to high soil salinity. However, the expansion has been limited by the absence of salt-tolerant wheat varieties. The Department of Agronomy at BSMRAU has screened 100 wheat genotypes, identifying five that can tolerate salinity levels of 10 to 15 dS/m. Ongoing studies aim to assess the adaptability of these genotypes in coastal environments through yield trials on farmers' fields, contributing to sustainable food security.
Objective: To study the adaptability of five salt tolerant wheat genotypes to the saline environment in the coastal belt of Bangladesh

Materials and Methods: In the 2022-23 season, five salt-tolerant wheat genotypes, namely BU-1370-7, BU-2050-2, BU-904-5, BU-2261-12, and BU-2008-4, were assessed using BARI Gom-25 as a control. The trials took place in four coastal districts: Patuakhali, Barguna, Khulna, and Satkhira. Farmers were directly involve in crop management activities (Fig 1). Fertilizers were applied following the BARC FRG recommendations from 2018. The harvest -occurred from March 22 to 28, 2023. Morphological data, including yield and yield-related metrics, were collected from five randomly chosen plants. Soil salinity and moisture levels were measured at three different growth stages of the wheat. The biochemical and nutrient composition of grains was analyzed. The data were statistically analyzed using the Statistics 10 software, and means were separated by LSD.



Fig. 1. Field demonstration of salt tolerant wheat genotypes in a coastal saline area

Table 1. Grain yield of wheat (t/ha) by genotype and location

Genotype	Location			
	Patuakhali	Borguna	Khulna	Satkhira
	Grain yield (t/ha)			
BU-1370-7	2.15 cC	1.98 bD	2.92 bcB	3.14 bA
BU-2008-4	2.45 aB	2.31 aB	3.58 aA	3.73 aA
BU-904-5	1.42 eD	1.79 cC	2.67 cB	2.79 cA
BU-2261-12	1.67 dC	1.26 dD	2.75 cA	2.51 dB
BU-2050-2	2.18 bcC	1.95 bcD	3.01 bB	3.27 bA
BARI Gom-25	2.30 bBC	2.11 bC	2.87 bcAB	3.19 bA

Results and discussions: The interaction between wheat genotype and location significantly influenced grain yield performance (Table 1). BU-2008-4 exhibited superior yield stability across all sites, with the highest grain yield recorded in Satkhira (3.73 t/ha) and Khulna (3.58 t/ha), indicating its broad adaptability to diverse agro-ecological conditions. In contrast, BU-904-5 and BU-2261-12 showed comparatively lower yields, particularly in Borguna and Patuakhali, suggesting greater sensitivity to environmental variation. BU-2050-2 and BARI Gom-25 demonstrated moderate yield performance, with consistent results in Khulna and Satkhira. Overall, Satkhira and Khulna emerged as the most favorable locations for wheat cultivation, while genotype-specific responses underscore the importance of targeted varietal deployment to optimize productivity under location-specific constraints.

Conclusion: BU-2008-4 and BU-2050-2 demonstrated strong adaptability across coastal environments, particularly in Satkhira and Khulna, supporting resilient wheat production. Their performance underscores the potential of climate-smart genotypes to enhance food security and sustainability in disaster-prone coastal zones under increasing climate variability.

Project Code and Title:LSG 17-SV/23 "Formulation of National Seed Vision 2030"

Implementing Organization: Crops Division, Bangladesh Agricultural Research Council (BARC), Farmgate, Dhaka-1215
Coordinator: Dr. Shah Md. Monir Hossain, Chief Scientific Officer, Crops Division, Bangladesh Agricultural Research Council (BARC), Farmgate, Dhaka-1215
Principal Investigator: Dr. Md. Mahfuz Alam, Principal Scientific Officer, Bangladesh Agricultural Research Council (BARC), Farmgate, Dhaka-1215
Location(s): Crops Division, Bangladesh Agricultural Research Council (BARC), Farmgate, Dhaka-1215
Budget: 10,00,000 (Ten Lakh Taka only)
Duration: 12 months; From May 01, 2023 to April 30, 2024; No cost extension: From May 01, 2024 to April 30, 2025

Introduction: The National Seed Vision 2030 is being formulated. As the population of Bangladesh continues to grow, the available land for food production is diminishing. The seed sector is crucial for sustainable agricultural production and plays a vital role in ensuring the country's food and nutrition security. High-quality seeds that are free from diseases and pests, including improved varieties and hybrids, can potentially increase yields by 15% to 20%. For Bangladesh, enhancing seed technologies is essential for reaching middle-income status by 2026 and evolving into a developed nation by 2041. The Seed Vision's objectives include improving crop yield and productivity, increasing incomes, generating jobs, and enhancing seed exports while lowering imports. Meeting these goals will play a vital role in ensuring food and nutrition security, ultimately leading to self-sufficiency in quality seeds for improved varieties and hybrids.

Objective of the project: to formulate **National Seed Vision 2040** by implementation of the **National Seed Vision 2040**

Materials and Methods: Activities included review of literatures of collection secondary information from all of the stakeholders institutes viz. NARS, BADC, DAE, agricultural universities and private seed organization. Organized stakeholder meetings at BARC. A draft of National seed vision 2030 was prepared and presented in the stakeholders meeting and collected their opinions and counsel. The draft national seed vision 2030 was finalized in the technical committee meeting and workshop.

Results and Discussion: The literature review of the secondary data collected from NARS, BADC, DAE, agricultural universities, and private seed organizations was guided to prepare a draft for the National Seed Vision 2040. The concept of National Seed Vision 2040 is to ensure quality seeds to improve the socio-economic conditions of farmers. A sustainable and competitive seed system ensures that farmers have consistent access to high-quality seeds for improved crop production. It is a realistic plan for seed production of various crops from 2024-25 to 2039-40, especially rice, wheat, potato and jute (breeder, foundation, certified). This involves a multi-faceted approach, including strengthening both formal and farmer-managed seed systems, promoting seed diversity, and ensuring equitable access to quality seeds. The formulated **National Seed Vision 2040** is divided into a total of 7 chapters.

Chapter I: The first chapter focuses on seeds and seed classification in the context of Bangladesh, characteristics of quality seeds, seed technology and seed management in Bangladesh
Chapter II: The second chapter discusses on overview of seed sector Bangladesh seed industry and timeline of development in seed sector, role of institutions and organizations in seed sector development and seed management, seed policy environment, current seed development projects, current status and prospects of seed sector, characteristics of seed sector in Bangladesh, seed policy reform in Bangladesh and its impact, seed sector in Bangladesh its impact, seed market, growth, Trends, COVID-19 impact,

and forecast (2024-2030 and 2030-2040), opportunities and prospects of the seed industry, barriers to seed sector development, challenges and recommendations for the seed sector in Bangladesh and gaps and interventions in the seed sector are discussed.

Chapter III: The third chapter analyzes the seed value chain in Bangladesh and conceptual framework of the seed value chain; variety development and maintenance, variety release and registration, hybrid variety development, number of crop varieties developed by various institutions, variety maintenance, international linkages and cooperation, seed propagation, seed chain of various institutions, seed processing and storage, seed marketing, import substitution, and export promotion, seed utilization, seed replacement rate (SRR), national seed policy and issues, Public- private- partnership (PPP), conservation and sustainable use of indigenous plant genetic resources (PGR) are described.
Chapter IV: The fourth chapter shads light on the objective and strategic direction of the National Seed Vision.
Chapter V: The fifth chapter provided guidance on seed sector development strategy and implementation guidelines, enabling factors, milestones and indicators for seed development strategy, activity action matrix and expected outcomes.
Chapter VI: This chapter covers the vision's impact on poverty and food security, job creation, biodiversity conservation and climate change, and gender equality and social inclusion.
Chapter VII: The 7th chapter provides guidance on the Seed Vision monitoring, evaluation and performance measurement framework. It also contains the conclusion.

Conclusion: The National Seed Vision 2040 aims to enhance seed security, boost crop productivity, and increase farmers' income. It focuses on seed import substitution, export promotion, and improving food security. Additionally, it promotes employment generation, biodiversity conservation, climate change adaptation, and gender equality.

Project code and title: LSG 21-CProject Code and Title: LSG- 21/C/23 Upscaling of the BRRI mini rice mill suitable for individual household

Implementing Organization: BRRI
Component Organization : None
Name of Principal Investigator: Ms. Haimonti Paul, Agriculture Engineer, Farm Machinery and Post-harvest Technology Division, Bangladesh Rice Research Institute (BRRI), Gazipur-1701
Location(s): Gazipur, Netrakona and Rajbari
Budget: Tk. 1428075.00 Taka
Duration: 10 January 2024 to 09 January 2025 (No cost extension up to: 30/06/2025)
Introduction: Rice milling plays a crucial role in Bangladesh's rice value chain, yet the majority of rice is processed using outdated and inefficient systems like the Engelberg huller, leading to nutritional loss and poor recovery. To address this, BRRI's Farm Machinery and Postharvest Technology (FMPHT) Division has developed a Mini Rice Mill suitable for household use with the philosophy of "rice conservation instead of over-polishing" under the lump-sum grand project "upscaling of the BRRI mini rice mill suitable for individual household".

Objectives: To develop jigs, fixtures, and dies for BRRI mini rice , fabricate 12 copies of BRRI mini rice mills for upscaling to 12 families, train 5 manufactures on the design and development of the BRRI mini rice mill

Materials and Method: The BRRI Mini Rice Mill was designed and fabricated using locally available materials in the FMPHT research workshop. The compact unit consists of a feed hopper, rotor, crushing chamber, sieve, and discharge outlet, powered by a 3 HP electric motor with an efficient power transmission system (Fig 1).

Results and Discussion: So far, 12 mini mills have been fabricated, and 11 units have been distributed to farmers for field-level feedback. Field trials using BRRI dhan87 and BRRI dhan96 in an un-parboiled condition showed promising results. Milling capacity ranged from 60–67 kg/h, with milling recovery between 62–65%. Head rice recovery varied from 68–73%, indicating efficient preservation of grain quality. Data also indicated significant effects of rice variety, rotor speed, and polishing pressure on performance parameters such as broken rice percentage, fine broken, uniformity, husk, and bran yields.

A total of 10 individuals received hands-on training on the operation, repair, and maintenance of the mini rice mill to promote local manufacturing and upscaling. Additionally, jigs, fixtures, and dies for fabrication have been developed, and manufacturers are being engaged to facilitate future scaling. This technology demonstrates strong potential to enhance milling efficiency, nutritional quality, and economic return for rural households, thus contributing to sustainable mechanization and food security in Bangladesh.

Conclusion: The BRRI Mini Rice Mill presents a viable solution for enhancing rice milling efficiency at the household level in Bangladesh. By minimizing nutritional loss and improving grain recovery, it fosters better food quality and income generation for rural households. Fabricated locally, tested in the field, and user-friendly, this innovation is in line with the objectives of sustainable mechanization. With continuous training for users, the mini mill is ideally suited for broader adoption and scaling up. Its effective implementation can greatly aid in food security and bolster rural livelihoods throughout the nation.



Fig. 1. BRRI Mini Rice Mill- demonstrated before the farmers



Technical Progress

LIVESTOCK



Domestic animals comprise an essential component of farm economy being important sources of farmers' cash income. Today, livestock contributes about 1.5% to the GDP of Bangladesh. Over the last one decade, there has been a substantial boost in the livestock population of the country. On the other hand, livestock productivity increased spectacularly. This was made possible by research and development of animal husbandry and veterinary technologies. KGF has so far sponsored livestock research pertaining to animal health and husbandry services, breed up-gradation, local genome conservation, training and technology dissemination, entrepreneurship development and value addition. In 2021-22, of the total of 67 KGF sponsored projects, 7 were on livestock. Considering the importance of livestock in human nutrition and food security in Bangladesh, KGF has plans to expand support for projects to address diverse problems in animal husbandry and veterinary services especially for marginal lands like the hill tracts and coastal saline areas and for the climate change adversity situation.



Competitive Grants Program (CGP)
3.2 LIVESTOCK
3.2.1 Competitive Grants Program (CGP)
3.2.2 CGP 4th Call
3.2.2A Completed Projects
Project Code and Title: TF 77-L/20: Molecular characterization of Newcastle disease virus (NDV) in-search for a virulent virus for the development of a thermo tolerant vaccine.

Implementing Organization: Chattogram Veterinary and Animal Sciences University (CVASU), Khulshi, Chattogram

Component Organization: Gazipur Agricultural University (GAU), Salna, Gazipur

Principal Investigators: Professor Dr. Pankaj Chakraborty (CVASU) and Dr. Md. Robiul Karim (GAU)

Location(s): (a) Department of Medicine and Surgery, Department of Microbiology and Veterinary Public Health, Faculty of Veterinary Medicine (FVM) and Poultry Research and Training Center (PRTC), Chattogram Veterinary and Animal Sciences University (CVASU), Khulshi, Chattogram-4225.
(b) Department of Medicine, Faculty of Veterinary Medicine and Animal Science (FVMAS), Gazipur ahman Agricultural University (GAU), Salna, Gazipur-1706.

Budget: 120 lac BDT
Duration: 48 months; 13 December 2020 to 12 December 2024 (No-cost extension of 12 months).

Introduction: Newcastle disease (ND), known as Ranikhet disease, is an economically important viral disease of chickens in Bangladesh. To protect the backyard chickens against ND, vaccination is usually practiced with BCRDV and RDV produced by LRI, Bangladesh. However, as both the vaccines are thermolabile, it causes lyophilized vaccine viruses to be inactivated prior to and/or during the vaccination in rural areas due to inappropriate maintenance of cold chain. A thermostable ND vaccine could therefore be a possible solution of this problem. Thus, the aim of this project was to detect and characterize avirulent/low virulent ND strains from backyard chickens of Bangladesh in order to select vaccine candidate for the development of an effective thermotolerant/ thermostable vaccine to overcome losses incurred by ND.

Objective: Characterization of avirulent Newcastle disease virus strain(s) from backyard chickens of Bangladesh to select vaccine candidate in order to develop a thermotolerant Newcastle disease vaccine.

Materials and Methods: During the whole project period, 1520 cloacal and oropharyngeal samples were obtained from unvaccinated backyard chickens from various rural areas of Bangladesh. These samples were inoculated into allantoic cavity of 9-10 days old embryonated eggs. After 4-5 days, allantoic fluids were collected and haemagglutination (HA) test were done to check the presence of any haemagglutinating virus. The HA positive samples were then screened for the presence of NDV using haemagglutination inhibition (HI) test. In the next step, RNAs were extracted from HI positive samples and conventional RT-PCR was performed followed by partial F gene sequencing to differentiate between virulent and avirulent NDV. Thermostability test of non-virulent NDV strains was performed at 25ºC, 37ºC, 42ºC and 56ºC. Further characterization of avirulent/ non-virulent NDV strains was done by ICPI (intracerebral pathogenicity index). For the selection of vaccine candidate, whole genome sequencing (WGS) of the samples was performed at the commercial viral whole-genome sequencing unit of CHRF (Child Health and Research Foundation) Genomics Center in Dhaka, Bangladesh. Following WGS, phylogeny analysis was done in which the evolutionary history was inferred using the Neighbor-Joining method. The percentage of replicate trees in which the associated taxa clustered together in the bootstrap test (1000 replicates). Evolutionary analyses were conducted in MEGA X software.

Results and Discussion: Out of 1520 samples, 155 samples were found to have titres for HA test. These 155 samples were then screened for the presence of NDV using HI test and 73 samples were tested positive for HI. In the next step, RNAs were extracted from HI positive samples and conventional RT-PCR was performed using primers designed to amplify specific portion of fusion (F) gene. The RT-PCR test was followed by partial F gene sequencing to differentiate between virulent and non-virulent NDV. Out of 28 RT-PCR positive samples, thirteen (13) samples were identified as non-virulent NDV strains through partial F gene sequencing as the strains had 'G-R-Q-G-R-L' amino acid motif at positions 112-117. This amino acid motif is also present in all non-virulent and vaccine NDV strains which confirms that our isolated NDV strains are non-virulent NDV strains. To check if these strains are thermo tolerant, thermo stability test was performed using SPF (specific pathogen free) eggs. Thermo stability test of 13 samples at different temperatures revealed 37°C is the most suitable temperature (**Pic. 1**) because at this temperature 7 samples showed thermo stability for at least 4 weeks (**Table 1**). Further characterization of non-virulent NDV strains done by ICPI test brought about the values over 0.5 which can arguably be taken into account considering the overall experimental condition. Seven (7) samples were sent for WGS for the selection of vaccine candidate. Of these, 5 samples passed the QC (quality control) test and WGS was performed consequently. Following WGS, phylogenetic analysis revealed that among the 5 samples, four (4) were found to be low virulent which grouped with previously reported F strains of NDV and remaining one (1) sample came out as a virulent strain (**Fig. 1**). Therefore, these 4 low virulent isolates can be considered as possible candidate(s) to develop a thermos table NDV vaccine as no report has been published so far regarding the thermos table nature of these isolates.



Pic. 1: Allantoic fluids are kept at 37°C for thermostability test.

Table 1. The average HA titres of samples after thermostability test at 37°C.

Sample ID	Day 0	Day 28
37o	$2^{4.5}$	$2^{4.5}$
287	2^{6}	$2^{2.5}$
349	2^{9}	$2^{7.5}$
BBC-163	2^{9}	2^{7}
BBT-491	2^{12}	2^{8}
BBT-499	2^{7}	2^{3}
KPT-36	2^{8}	2^{7}

Conclusion: Newcastle disease (ND) is one of the most economically important viral diseases of backyard chickens which causes huge financial loss to the small holder poultry farmers of Bangladesh. As currently used ND vaccines are thermo labile, our research was aimed to select possible candidate(s) to develop a thermos table ND vaccine. To accomplish this goal, the first task was to identify thermos table virulent/ low virulent NDV strains and so far we have identified and characterized four (4) no virulent NDV strains which are thermos table at 37°C for 28 days. It is expected that any or all of these four low virulent strains might be useful in developing a thermos table ND vaccine.

Project Code & Title: TF 78 - L/20. Selection of Crossbred Dairy Cattle Using Phenotypic and Genomic Information for Efficient Productivity and Resilience in Tropical Environment of Bangladesh

Implementing Organization: Department of Animal Breeding and Genetics, BAU, Mymensingh-2202

Component Organization : Department of Livestock Services (Central Artificial Insemination Laboratory, Saver, Dhaka) and BRAC AI Enterprise (Bull and Buck Station, Shambhuganj, Mymensingh)
Principal Investigator: Professor Dr. Mohammad Shamsul Alam Bhuiyan, Department of Animal Breeding & Genetics, BAU, Mymensingh
Location (s): Main site: Selected crossbred dairy animals owned by farmers belong to Bangladesh Dairy Farmers Association (BDFA) or others under Dhaka, Mymensingh, Khulna, and Chattogram Division.

- Satellite site 1: Central Artificial Insemination Laboratory, Savar, Dhaka.
- Satellite site 2: BRAC Bull and Buck Station, Mymensingh.

Budget: 99.95 Lakh
Duration: December 2020 to June 2024 (42 Months)
Introduction: Selection is an essentially important routine task in cattle breeding for choosing appropriate animals to reproduce better performed progenies. The accuracy of selection largely depends on sample size, genetic relationships among the individuals as well as pedigree, performance and genomic information. The ultimate goal of the project was to select superior breeding bulls and cows based on their pedigree, phenotypic performances and genomic information in order to improve the existing phenotypic performance-based selection with better selection accuracy for Holstein-Local (HF×L) and Sahiwal-Local (SL×L) crossbred cattle populations of Bangladesh.

Objective:

- To quantify and evaluate the productive, reproductive, resilience and semen production performances of Holstein-Local and Sahiwal-Local crossbred cattle.
- To estimate genetic diversity measures, population structure and genomic admixture analysis of both indigenous and crossbred cattle using high-density SNP data.
- To establish genetic evaluation system based on genomic predictions aimed at evaluating the optimum genetic proportion for improved productivity with better adaption in hot-humid climatic condition.
- Selection of cows and bulls of superior genetic merit for breeding with the aim of developing productivity efficient and resilient crossbred dairy population.

Materials and Methods: Initially, Herdbook based record keeping was performed for establishing phenotypic performance database on 677 HF×L and 234 SL×L crossbred cattle. In addition, recorded information on productive and reproductive traits of 4319 daughters of different graded HF×L crossbreds bulls were incorporated in breeding bulls' evaluation process. Besides, single nucleotide polymorphism (SNP) genotyping information of 770 individuals from indicine and taurine cattle populations were utilized for comprehensive genomic analysis. Different bioinformatic tools and software were used for phenotypic performance and SNP genotypic data processing and analysis. Selection index was constructed using adjusted breeding values and variable economic weightage for each trait. Finally, top-ranked 20% animals (breeding bulls and cows) were selected based on their index values.

Results and Discussion: Better production performances were found in 75%HF×25%L crossbred cows. However, reproductive performances were mostly heterogenous in nature and were not consistent for a particular genotype. The heritability estimates (h^2) were found moderate for all considered traits except service per conception. The genomic heritability estimates (h_g^2) were found relatively higher than the conventional estimates (h^2) for the investigated traits. Genetic correlations among the considered traits were found mostly low to moderate except the traits between DMY and PMY. The genomic architecture, diversity measures and breed composition of HF×L and SL×L crossbred bulls and cows disclosed for the first time in Bangladesh using SNP data. The findings of genomic study revealed quite large genetic variations in HF×L crossbreds those possessed 17.4% (L), 6.7% (SL), 4.1% (NEL/BRA/HAR), 29.8% (HF), 3.3% (JER) and 38.9% undefined genetic background. In contrast, the genetic base of SL×L crossbreds were quite narrow and is comparable with other indicine crossbred cattle possessed 36.0% (L), 55.5% (SL) and 4.9% (NEL/BRA/HAR) background. The genome-wide association study (GWAS) identified a number of candidate genes' variants associated with productive and reproductive traits. Among them, the genetic polymorphisms in the U1, ANO2, CELF4, PIK3C2G, CCDC57, TMC1, EDNRB, STARD7, WDFY2 and SNORD112 genes are noteworthy. Multi-trait selection index under three different economic weight models manifested almost similar efficiency in

selecting top-ranked animals. Moreover, comparison between phenotype alone and phenotype plus genome guided selection index showed 70% similarity among the top-ranked breeding bulls and cows. The top-ranked 20% animals could be utilized as parents for future breeding program with batter accuracy.

Table 1. Genetic composition of crossbred cattle populations of Bangladesh compared with indicine and taurine breeds

Population	N	Cluster 1 (L)	Cluster 2 (SL)	Cluster 3 (NEL/BRA)	Cluster 4 (HF)	Cluster 5 (JER)	Cluster 6 (NS)	Cluster 7 (NS)
L	198	0.775	0.129	0.075	0.008	0.004	0.006	0.004
SL	28	0.356	0.448	0.182	0.003	0.005	0.006	0.000
BRA	25	0.117	0.038	0.784	0.011	0.028	0.015	0.009
NEL	21	0.008	0.002	0.990	0.000	0.000	0.000	0.000
HAR	18	0.449	0.113	0.426	0.000	0.001	0.007	0.004
SL × L	140	0.360	0.555	0.049	0.014	0.008	0.010	0.005
HF × L	289	0.174	0.067	0.041	0.298	0.033	0.186	0.203
HF	30	0.000	0.000	0.000	0.779	0.009	0.128	0.084
JER	21	0.000	0.000	0.000	0.000	0.999	0.000	0.000

Table 2. Genetic diversity indices for Bangladeshi cattle populations and selected indicine and taurine cattle breeds

Population[1]	N	Ho ± SE	He ± SE	MAF (P≤0.05)	F_{IS}
L	198	0.185 ± 0.012	0.187 ± 0.012	0.130	0.017
SL	28	0.162 ± 0.034	0.177 ± 0.033	0.125	0.084
BRA	25	0.199 ± 0.036	0.200 ± 0.035	0.140	0.009
NEL	21	0.169 ± 0.042	0.163 ± 0.039	0.116	-0.042
HAR	18	0.290 ± 0.043	0.282 ± 0.037	0.203	-0.026
SL× L	140	0.192 ± 0.014	0.192 ± 0.014	0.133	-0.004
HF × L	289	0.352 ± 0.009	0.343 ± 0.008	0.258	-0.027
HF	30	0.329 ± 0.032	0.325 ± 0.029	0.244	-0.016
JER	21	0.292 ± 0.043	0.285 ± 0.039	0.213	-0.023

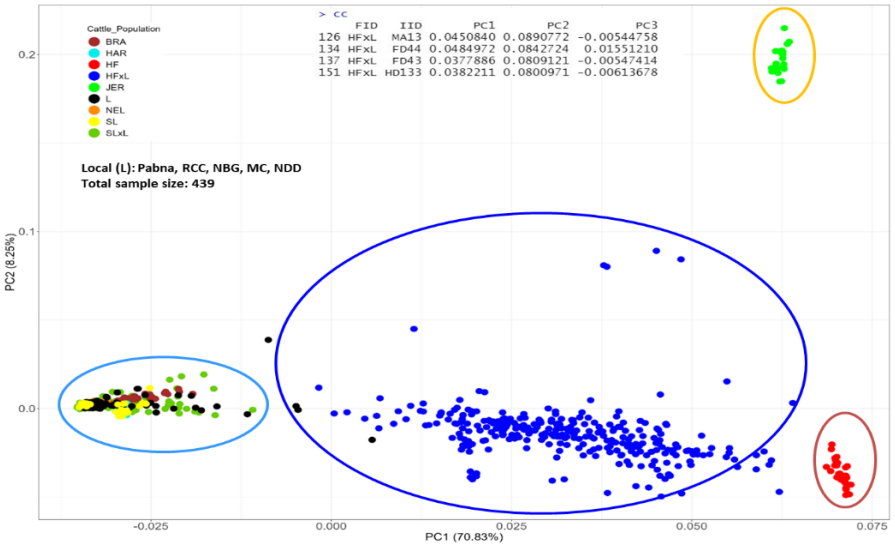


Fig. 1. Principal component analysis of the first two axis in 439 samples from 9 taurine and indicine cattle

Conclusion: Multi-trait selection index was constructed based on trait specific breeding values (EBV or gEBV) under three different models where all three indices manifested almost equal efficacy in selection process of sires and dams. About 70% similarity was observed among the top-ranked breeding bulls and cows when two different approaches were employed in construction of selection index. The rank order of every individual was performed on the basis of index value and top ranked 20% breeding bulls and cows were selected those could be utilized in future breeding for production of better progenies with known genetic merit.

Project Code and Title: TF 82-L/20: Value addition in composting poultry manures for better compost quality and reduction of environmental pollution

Implementing Organization: Bangladesh Agricultural University (BAU), Mymensingh
Component Organization: None
Principal Investigator: Professor Dr. Md. Mukhlesur Rahman, Department of Animal Science, Bangladesh Agricultural University, Mymensingh
Location(s): Bangladesh Agricultural University, Mymensingh
Budget: TK. 6636200/-
Duration: From 03 March, 2021 to 2 November, 2024 (45 months)
Introduction: Struvite containing compost obtained from poultry litter is enriched with N, P & K that are essential for plant growth. Struvite is the crystal of Magnesium Ammonium Phosphate ($Mg\ NH_4\ PO_4 \cdot 6H_2O$) and used as a slow-release crystal fertilizer. Struvite is an appropriate fertilizer for container plants, turfs, tree seedlings, ornamentals, vegetables, and flower boards. It is essential to investigate the application rate for the yield of cereal grains, vegetables, fruits and fodder. This was a repeated field trial to identify application rate of struvite containing compost for maize fodder and grain yield due to natural disaster occurred last year.
Objective: To identify suitable application rate of struvite containing compost for hybrid maize fodder and grain production
Materials and Methods: The land was prepared well by ploughing and cross ploughing three four times with a power tiller followed by laddering to obtain the desirable tilth. The land was divided into 24 plots and the size of each plot was 12 m^2 (5 m×2.4 m), spacing of line-to-line 60 cm and plant-to-plant 25cm. The treatments were T_1 (no compost and no chemical fertilizer at all), T_2 (Fully chemical fertilizer@ basal dose), T_3 (2-ton struvite containing compost/ha + 50% chemical fertilizer), T_4 (4-ton struvite containing compost/ha + 50% chemical fertilizer), T_5 (6-ton struvite containing compost/ha + 50% chemical fertilizer), T_6 (2-ton struvite containing compost/ha), T_7 (4-ton struvite containing compost/ha) and T_8 (6-ton struvite containing compost/ha). Fodder was harvested after 65 days and the grain was harvested after 97 days of sowing seeds.
Results and Discussion: The maize plant height and circumference along with fodder yield were observed at different levels of struvite containing compost. The highest plant height was found in T_2 (245.33 cm) followed by T_4 (244.26 cm) and there were no significant differences among these two groups. Significant higher stem circumference was found in T_2 (8.83 cm) followed by T5 (8.80 and T4 (8.63 cm) compared to others. The highest fodder biomass yield was found in T_5 (42.73 ton/ha) followed by T_2 (41.84 ton/ha). The T_4 had produced 39.60 ton/ha fodder which was statistically similar with T_5 and T_2. Fodder yield of this experiment was near to 10 timed more than last year's yield might be due to favorable environmental condition. In case of nutrient content of maize fodder at different levels of struvite containing compost, the significant highest CP content was found in T_2 (9.43%) followed by T_5 (8.84%), T_4 (8.63%) and T_8 (8.25%). There were no statistical differences among these treatments. The highest P content was found in T_2 (0.33%) followed by T_5 (0.27%), T_4 (0.26%), T_8 (0.26%) and T7 (0.25%) and these values were statistically similar. On the other hand, other treatments showed significant lower P contents. The higher K contents were found in T_2 (0.61%) followed by T_4 (0.53%) and T_5 (0.53%) and these values were also statistically similar.
Significant higher grain yield was found in T_5 (13.82 ton/ha) followed by T_2 (12.56 ton/ha), T_4 (12.23 ton/ha) and T_7 (12.10 ton/ha) compared to other treatments. Also, there were no statistical differences among these four treatments. Therefore, we can say from the repeated experiment, the growth pattern and nutrient contents of maize fodder and grain yield was statistically similar in T_2, T_4, T_5 and T_7 also. Therefore, we can recommend for T_4 or T_7 for maize fodder and grain yield.

Table 1. Analysis of maize production status as fodder produced by different levels of struvite containing compost utilization (Repeated Trial)

Sl. No.	Parameters	Treatments								P value	Level of sig.
1		T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8		
	Plant height (cm)	139.15^{b}±18.33	245.33^{a}±6.98	229.33^{a}±11.83	244.26^{a}±12.16	248.34^{a}±10.17	220.00^{a}±4.93	228.00^{a}±5.77	225.32^{a}±3.78	<0.001	**
2	Stem circumference (cm)	4.27^{b}±0.33	8.83^{a}±0.20	7.8^{a}±0.47	8.63^{a}±0.12	8.80^{a}±0.61	8.17^{a,b}±0.88	8.20^{a,b}±0.28	8.33^{a,b}±0.60	0.0001	**
3	Fodder yield (ton/ha)	17.21^{d}±1.25	41.84^{a}±1.85	35.68^{b,c}±0.31	39.60^{a,b}±1.32	42.73^{a}±1.14	31.34^{c}±0.55	33.29^{b,c}±1.46	35.00^{b,c}±4.04	<0.001	**

T_1 (no compost and no chemical fertilizer at all), T_2 (Fully chemical fertilizer@ basal dose), T_3 (2-ton struvite containing compost/ha + 50% chemical fertilizer), T_4 (4-ton struvite containing compost/ha + 50% chemical fertilizer), T_5 (6-ton struvite containing compost/ha + 50% chemical fertilizer), T_6 (2-ton struvite containing compost/ha), T_7 (4-ton struvite containing compost/ha) and T_8 (6-ton struvite containing compost/ha.

Table 2. Chemical analysis of maize fodder produced by different levels of struvite containing compost utilization (Repeated Trial)

Sl. No.	Parameters	Treatments								P value	Level of sig.
		T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8		
1	DM	24.50^{b,c}±0.58	25.83^{b}±1.20	29.50^{a}±0.58	27.17^{a,b}±0.72	25.50^{b}±0.58	25.00^{b}±1.04	22.00^{c}±0.58	28.83^{a}±1.69	0.0010	*
2	CP	6.41^{c}±0.36	9.43^{a}±0.233	6.83^{c}±0.44	8.63^{a,b}±0.40	8.84^{a,b}±0.37	6.47^{c}±0.31	7.14^{b,c}±0.17	8.25^{a,b}±0.144	0.001	**
3	CF	24.33^{a}±0.44	24.33^{a}±0.44	23.00^{a,b}±0.57	23.33^{a,b}±0.44	25.50^{a,b}±0.57	24.67^{a,b}±0.88	23.83^{a,b}±1.42	25.50^{b}±0.57	0.227	NS
4	EE	1.55^{b,c}±0.06	1.72^{a}±0.06	1.48^{c}±0.06	1.56^{a,b}±0.04	1.68^{a,b}±0.01	1.33^{c}±0.01	1.55^{a}±0.01	1.65^{a,b}±0.10	0.0016	*
5	Ash	0.90^{b,c,d}±0.04	1.2^{a}±0.05	0.94^{b,c}±0.01	0.80^{d}±0.20	0.83^{c,d}±0.04	0.93^{b,c}±0.005	0.97^{b}±0.008	0.94^{b,c}±0.04	0.001	*
6	P	0.21^{d}±0.05	0.33^{a}±0.08	0.22^{b}±0.08	0.26^{c}±0.05	0.27^{b,c}±0.05	0.21^{b,c}±0.08	0.25^{a}±0.08	0.26^{b,c}±0.08	0.001	**
7	K	0.33^{d}±0.005	0.61^{a}±0.008	0.41^{b,c}±0.06	0.53^{a,b}±0.04	0.55^{a,b}±0.08	0.30^{b,c}±0.15	0.32^{a}±0.06	0.42^{b,c}±0.05	0.001	**
8	pH	6.40^{e}±0.05	6.17^{a,b}±0.08	6.00^{b,c}±0.20	6.70^{d}±0.05	6.20^{e}±0.	6.20^{a,b}±0.05	6.80^{c,d}±0.05	6.40^{a}±0.05	0.001	*

T_1 (no compost and no chemical fertilizer at all), T_2 (Fully chemical fertilizer@ basal dose), T_3 (2-ton struvite containing compost/ha + 50% chemical fertilizer), T_4 (4-ton struvite containing compost/ha + 50% chemical fertilizer), T_5 (6-ton struvite containing compost/ha + 50% chemical fertilizer), T_6 (2-ton struvite containing compost/ha), T_7 (4-ton struvite containing compost/ha) and T_8 (6-ton struvite containing compost/ha.

Table 3. Analysis of maize grain yield at different levels of struvite containing compost utilization (Repeated Trial)

Sl. No.	Parameters	Treatments								Level of sig.
		T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	
1	Cob Length (cm)	9.33^{d}	17.33^{a}	15.12^{b}	16.82^{a,b}	17.25^{a}	13.33^{c}	15.17^{b}	16.15^{a,b}	*
2	Cob circumference (cm)	11.52^{d}	17.17^{a}	15..23^{b}	16.26ab	15.62^{b}	14.60^{c}	15.52^{b}	15.71^{b}	**
3	Dry grain yield (t/ha)	4.81c	12.56^{ab}	11.17^{b}	12.23^{ab}	13.82^{a}	9.98^{b,c}	12.10^{a,b}	12.11 ^{a,b}	**

T_1 (no compost and no chemical fertilizer at all), T_2 (Fully chemical fertilizer@ basal dose), T_3 (2-ton struvite containing compost/ha + 50% chemical fertilizer), T_4 (4-ton struvite containing compost/ha + 50% chemical fertilizer), T_5 (6-ton struvite containing compost/ha + 50% chemical fertilizer), T_6 (2-ton struvite containing compost/ha), T_7 (4-ton struvite containing compost/ha) and T_8 (6-ton struvite containing compost/ha.

Conclusion: Layer manure contains lots of NH_4 and PO_4 that can be a good source of plant nutrients. Addition of $MgCl_2$ with the composting materials enhanced struvite precipitations in the compost. This struvite containing compost enhances the plant growth. The findings of the experiment showed that the struvite containing compost had a significant influence on maize fodder and grain yield. Struvite in the compost is a new innovation in field of waste utilization and it will be the only sustainable technology for food and animal production in near future when all rock P will be exhausted. Identification of application rate is very important because it's a new fertilizer for plant growth.



Pic 1.: Visiting the experimental plot by the research team



Pic 2.: Mature maize fodder with cob and tassel



Pic 3.: Investigating the maize cob by the monitoring and evaluation team



Pic 4g.: Mature cobs obtained from different levels of struvite containing compost utilization

Project Code and Title: TF 101–L/21. Influence of maternal dietary energy and protein levels during gestation on performance of Black Bengal kids
Implementing Organization: Bangladesh Agricultural University
Component Organization : None

Principal Investigator: Professor Dr. Mohammad Moniruzzaman
Location(s): Goat, Sheep and Horse Farm, Bangladesh Agricultural University, Mymensingh-2202
Budget: TK 68,23,060.00
Duration: 18 November 2021 To: 31 December 2024 (37 months)

Introduction: Goats are important in generating employment, income, capital storage and improving household nutrition. Black Bengal goats are dwarf meat-type goats usually distributed in Bangladesh and its surrounding areas in India. They are popular for their adaptability in hot and humid environment, high prolificacy, delicious meat and high-quality skin. Insufficient colostrum and milk yield of does, low birth weight and low growth rate of kids are major drawbacks that cause high kid mortality and reduced goat production in Bangladesh. Insufficient intake of milk is the major factor affecting neonatal survival. Inadequate nutrition during gestation delays lactogenesis onset, reduces colostrum and milk production. It is thought that maternal

nutrition during pregnancy plays a key role in the well-being of goats and their newborn kids. The multipurpose demands of nutrients in pregnancy make it difficult to fill the energy requirements of the pregnant animal to accelerate milk yield and the high birth weight of kids. A high level of kid mortality represents a significant barrier to the productivity of Black Bengal goat. Black Bengal goats yield poor amount of milk. As a result, newborns get a minimum amount of nutrients that they require. Early growth rates of kids are largely determined by the management practices from birth onwards. Some researchers reported an increase in milk production of Alpine goats at higher pre-partum dietary energy intake. Higher milk intake ensures increased average daily gain for kids. For goats, in general, live weight is associated with reproductive performance and ovulation rate, carcass attributes, meat production and sale value at the end of their productive life.
It is also known that the establishment of tissues and organs is achieved during vital periods of fetal development. Therefore, it is proposed that long-term malnutrition reduces fetal development leading to low birth weight in kids. A group of researchers reported that the low protein (8.8% CP) diet may be inadequate to meet the does' protein requirement during late gestation, but there was no apparent advantage in feeding the high (14.3% CP) rather than medium protein (11.0% CP) diet. However, the effects of energy and protein levels during pregnancy on milk yield and reproductive efficiency of the dam, and birth weight, growth rate and muscle development of kids are still unclear in Black Bengal goats.

Objective: The proposed research aimed to increase milk yield and reproductive efficiency of does and performances of their kids through manipulation of maternal dietary energy and protein during pregnancy.

Materials and Methods: The experiment was conducted at the Goat, Sheep and Horse farm and also the Animal Biotechnology laboratory under the Department of Animal Science, Bangladesh Agricultural University, Mymensingh. Rations were formulated for pregnant does to supply the animals required level of nutrition following the NRC feeding standard (1981). Diets with 3 different levels (High, medium and low) of energy and 3 levels of crude protein (18%, 14% and 10%) were formulated using commonly available feed ingredients such as napier grass, wheat bran, crushed maize, soybean meal, molasses, DCP (dicalcium phosphate) and common salt to feed pregnant does (n=63). The feeding trial was conducted from conception to parturition of goats. The Metabolizable Energy (ME) requirement is determined according to the following formula provided by NRC (1981). High, medium and low levels of diets comprised 115%, 100% and 85% of total metabolizable energy (ME) required for each goat following the NRC feeding standard (1981). The medium (M) diet, with the optimum level of nutrients, was formulated to contain 10.4 MJME/Kg DM (NRC, 1981). Other diets, High (H) and Low (L) differed from medium one by 15%.

Live weight changes, milk yield, reproductive efficiency of does, birth weight, survival rate, weaning weight, growth rate and reproductive efficiencies of kids were recorded. Progesterone, estrogen, and prolactin hormone concentrations were measured by using the Enzyme-linked Immunosorbent Assay (ELISA) method using an ELISA kit following the instruction of the manufacturers. After assessments, hormone concentrations were recorded, and data were analyzed. Total protein (TP), Triglyceride (TG), and Glucose concentrations of Blood were determined by using commercial diagnostic kits following the instruction of the manufacturers. The influences on the expression of genes related to muscle fiber development were also studied through real-time PCR analysis. The $2^{-\Delta\Delta Ct}$ analysis method was used to calculate the relative expression values for the qPCR assay. Data are presented as least squares mean ± standard error of the mean of relative fold change calculated by the ΔΔCt (Critical threshold) method with *β-actin* serving as the internal control. If differences in treatment means were detected by ANOVA, Duncan's Multiple Range Test was used to separate means.

Results and Discussion: The average live weight gain of does during gestation and lactation and birth weight, live weight gain and weaning weight of kids were higher in high energy and high protein consumed group (Hh) than others. Milk yield and lactation length were higher in Hh group. The udder parameters (udder volume, diameter of gland cistern, udder depth, udder circumference, teat length, teat diameter, distance between teat and ground) were higher in the Hh group than others. Milk constituents (milk fat, milk protein, total solids and solids not fat) and blood parameters (serum glucose, total protein, albumin, globulin, triglyceride and blood urea nitrogen levels) were significantly higher in the Hh group. Post-partum anestrous was lower in Hh group. Reproduction related hormones (estrogen, progesterone and follicle-stimulating hormone) were positively influenced by maternal dietary energy and protein. The maternal dietary high energy and high protein (Hh) positively influenced the growth rate, carcass weight, dressing percentage (45.8%) and survival rate of their kids. The density of muscle fiber was higher in the Hh group of kids. The *Myf5* gene expressions were higher in Hh group kids than others and *MSTN* gene was higher in Ll group of kids (Fig. 1). Thus, maternal dietary energy and protein during pregnancy positively influence live weight, milk yield, lactation length, milk

composition, udder development, reproductive hormones, blood metabolites and post-partum anestrous of does and also, birth weight, weaning weight, live weight gain, carcass trait, muscle development and gene expression related to muscle fiber development of kids. In conclusion, the productivity of Black Bengal goat can be improved by manipulating the maternal dietary energy and protein during gestation.



Pic 1: Kids from treatment groups: Hh-High energy high protein, Mm-Medium energy medium protein, Ll-Low energy low protein.

Table 1: Effect of maternal dietary energy and protein levels during gestation on live weight changes of Black Bengal kids

Energy	Dietary treatments									Probability		
	High			Medium			Low					
Protein / Parameters	high	medium	low	high	medium	low	high	medium	low	E	P	E*P
Birth weight (kg)	**1.4 ± 0.05^{a}**	1.3 ± 0.08^{ab}	1.1 ± 0.08^{bcd}	1.2 ± 0.05^{abc}	1.2 ± 0.03^{bc}	1.1 ± 0.05^{bcd}	1.0 ± 0.1^{cd}	1.0 ± 0.05^{cd}	0.9 ± 0.05^{d}	0.00	0.04	0.00
Slaughter weight (kg)	**8.6 ± 0.2^{a}**	7.7 ± 0.1^{b}	7.2 ± 0.16^{bc}	7.0 ± 0.2^{bc}	6.8 ± 0.1^{cd}	6.2 ± 0.14^{de}	5.9 ± 0.06^{ef}	5.2 ± 0.4^{fg}	4.9 ± 0.40^{g}	0.00	0.00	0.01
Total live weight gain (kg)	**7.3 ± 0.2^{a}**	6.36 ± 0.06^{b}	6.0 ± 0.2^{b}	5.8 ± 0.2^{bc}	5.6 ± 0.08^{bcd}	5.13 ± 0.18^{cd}	4.9 ± 0.13^{de}	4.23 ± 0.4^{ef}	4.0 ± 0.35^{f}	0.00	0.00	0.02

Note: ^{a,b,c} means on the same column with different superscripts differ significantly ($p<0.05$), E= Energy, P=Protein

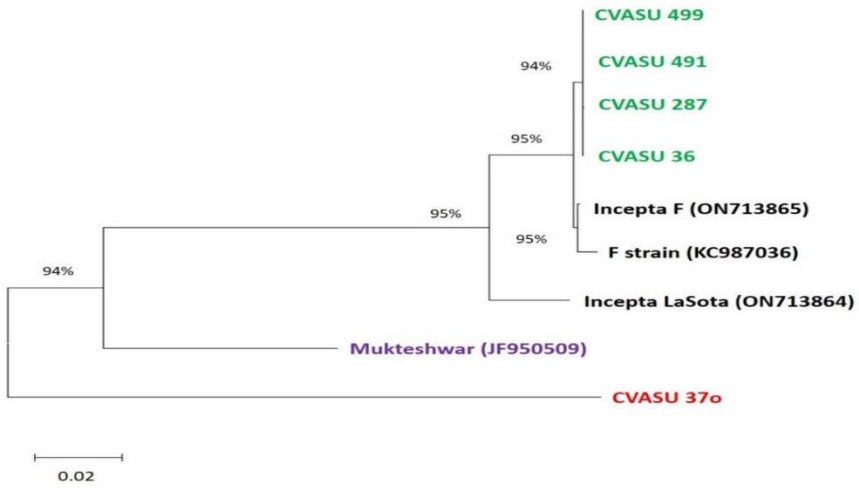


Fig. 1: The evolutionary tree showing the position of isolated and existed NDV strains.

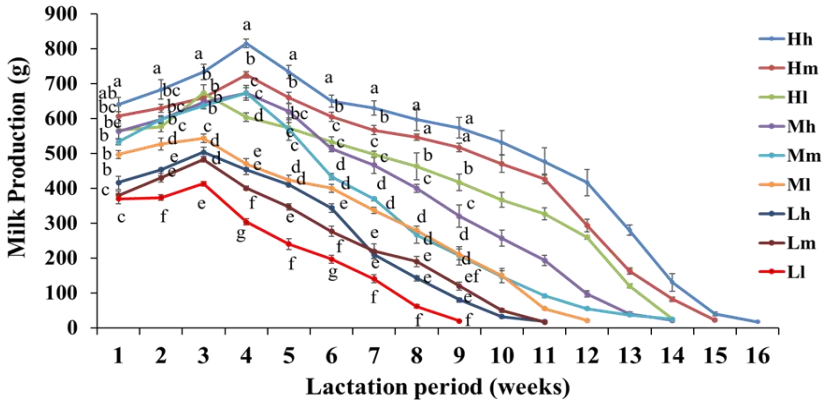


Fig. 2: Effect of energy and protein on milk yield of Black Bengal does. Hh- High energy high protein , Hm- High energy medium protein , Hl- High energy low protein, Mh- Medium energy high protein , Mm- Medium energy medium protein , Ml- Medium energy low protein, Lh- Low energy high protein , Lm- Low energy medium protein , Ll- Low energy low protein (n=16 each)

Conclusion: The maternal dietary high energy and high protein (Hh) significantly ($p<0.05$) positively influenced the live weight changes before parturition, live weight changes during lactation, milk production, hormonal changes, blood metabolites of does and birth weight, live weight gain, weaning weight, carcass weight, dressing percentage (45.8%), muscle fiber diameter, myogenic regulatory factor 5 (*Myf5)*, heart fatty acid binding protein (*H-FABP)* gene expression of their kids. Kid mortality was also found lower in kids from high energy and high protein (Hh) consumed does. The density of muscle fiber and myostatin (*MSTN*) gene expression was significantly ($p<0.05$) higher in kids from low energy and low protein (Ll) consumed does. Thus, the results show that dietary energy and protein during pregnancy positively influence the performances of Black Bengal does and their kids. From these experiments, it can be concluded that the productivity of the Black Bengal goat can be improved by manipulating the maternal dietary energy and protein during gestation.

Project Code & Title: TF-102-L/21: *Analyses of innate and adaptive immune responses in cattle against fascioliasis*

Implemented Organization: Department of Parasitology, Faculty of Veterinary Science, Bangladesh Agricultural University (BAU, Mymensingh-2202
Component Organization (if any): None
Principal Investigator: Dr. Anisuzzaman, Professor, Department of Parasitology, BAU Mymensingh
Location: Mymensingh
Budget: TK. 50,00,000.00
Duration: 18 Nov 2021 to 17 Nov 2024 (36 months); + No cost Ext up to 17 May 2025)

Introduction: Fascioliasis is a zoonotic disease caused by *Fasciola gigantica* and *F. hepatica*, which are commonly known as liver flukes. It is a foodborne parasitic disease and transmitted by snails. The disease is prevalent throughout the world, however, more common in tropical and sub-tropical settings. A liver fluke can survive more than a decade within the liver of ruminants. They produce many effector molecules to modulate and efficiently exploit the host's immune response to ensure their survival, feeding and reproduction. Hepatic immuno-inflammatory mechanisms are essential to maintain liver homeostasis. Abnormal production of cytokines and/ or transcription factors can hamper control of flukes.

Objectives: Estimation of prevalence and economic impact in terms of condemnation of livers; detection of cellular responses; detection of molecular interplay: Analysis of various cytokines and transcription factors and detection of anthelmintic resistance.

Materials and Methods:

1. **Histology:** Thin sections were prepared and stained with H&E, Massion's trichrome (MT) and congo red (CR).
2. ***ELISA:*** Total protein was extracted from liver and concentration of interleukeins (IL) in liver lysate were estimated using commercially available sandwich ELISA kits.
3. ***Ex vivo culturing and estimation of efficacy of anthelmintics*:** Two adult flukes in each well in a total volume of 2 ml, were incubated in DMEM supplemented with 20% fetal calf serum, 20% bovine bile in a 24-well plate at 37°C in 5% CO_2. Flukes were treated with nitroxynil (NTX), triclabendazole (TBZ), oxyclozanide (OCZ), clorsulon (CRL), praziquantel (PZQ), albendazole (ABZ) and levamisole (LEV) and scored.

Results and Discussion:

1. **Pathological change:** Chronic fascioliasis was characterized by the presence of heavy calcification of the bile ducts. Bile ducts became dark and showed heavy deposition of dark or dark brown salts. Bile ducts become thick, prominent and lumen of the duct was almost obliterated. During digital palpation they were felt as hard solid mass. During cutting with knife, they gave metallic sounds and sandy appearances. By histological examinations, we found that the normal architecture of the liver was almost replaced by the extensive fibrosis. By CR staining, we showed massive infiltration of eosinophils in the affected tissues (**Fig. 1**).

2. **Estimation of IL13 and IFN γ by ELISA:** We found that the production of IL-13 was significantly ($p<0.05$) in heavily infected liver. However, production of INF γ was at basal level both in the heavily or moderately infected cattle livers (**Fig. 2**).

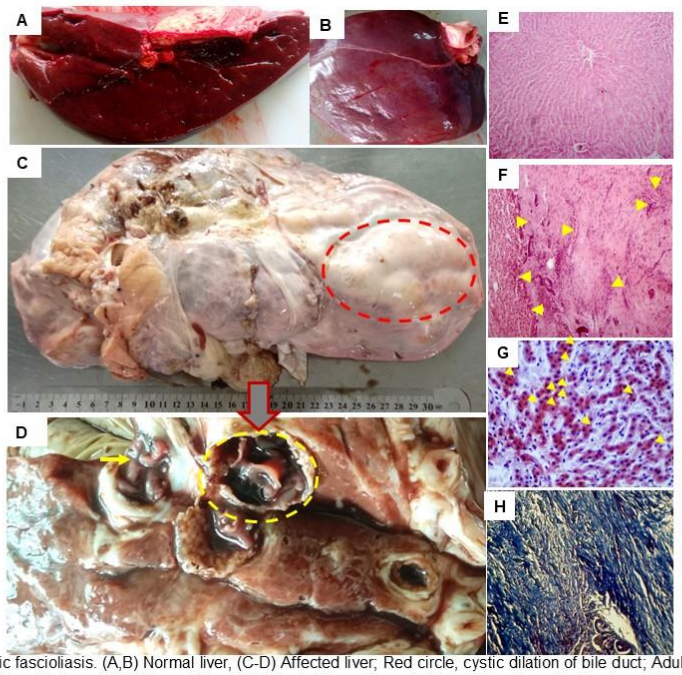


Fig. 3 Chronic fascioliasis. (A,B) Normal liver, (C-D) Affected liver; Red circle, cystic dilation of bile duct; Adult *Fasciola* in pocket. Histopathology of (E) Normal liver; (F) Affected liver, Arrow indicates fibrosis and infiltration; (G) Eosinophils by CR and (H) Fibrosis by MT; .

Efficacy of anthelmintics against both aspF and spFg: We found that NTX and OCZ killed efficiently both sFg and asF in a concentration and time dependent manner. Surprisingly, TBZ and CRL did not affect the viability score of the flukes treated and even at 200 µg/ml concentration both sFg and asF survived well. Similarly, neither PZQ, ABZ nor LEV did not kill the fluke.

Conclusions: The fluke induces severe liver cirrhosis and cause very high condemnation of livers, resulting huge economic losses. Fascioliasis elicit very high level of IL-13, but not, INF γ production in affected livers. We found that none but only NTX and OCZ killed efficiently both sFg and asF. Our results suggest that control of fascioliasis is very essential for the profitable ruminant farming in Bangladesh, and the veterinarians and farmers should be careful about the treating of the ruminants affected with fascioliasis.

3.2.2.B On-going projects

Project code & Title: TF 120-L/23: Improvement of broiler meat quality and quantity by prolonging rearing period with cost effective dietary regime

Implementing Organization: Bangladesh Agricultural University, Mymensingh-2202, Bangladesh
Component Organization: None
Principal Investigator: Dr. Md. Abul Kalam Azad, Professor, Department of Animal Science, BAU, Mymensingh
Location (s): Department of Animal Science, Bangladesh Agricultural University, Mymensingh-2202
Budget: TK 35 lac
Duration: May 2023 to April 2026 (36 months)

Introduction: Consumers' preferences drastically shift from commercial broiler meats to local or cross-breed Sonali chickens due to several speculations like incomplete myogenesis, less tough and flavored meat, and insipid taste. Moreover, propaganda with respect to antibiotics and steroids uses in broilers feed is now a growing concern. Therefore, it is of importance to introduce tough broiler meat to hold the valued customers. Initially, a survey through constructed questionnaire to identify the consumer classes, reasons of their choice, and others associated to overweight broilers. There is a huge demand for broilers with an average body weights of 1.25 to 1.35 kg, 1.5 to 1.7 kg and over 2.0 kg to respective participants. Accordingly, we have started series of experiments with the above ranges of body weights of broilers with a view to calculate firstly the cost-benefit ratio amd secondly the overall nutritive and eating quality profiling of those slaughtered broilers.

Objectives: To identify the consumer classes, reasons for their choices and others associated relates to different BW broilers; find out economic efficiency and quality attributes of various BW broilers

Materials and Methods: At first, a KAP based survey has been conducted with poultry farmer, dealer, retailer, general consumer, restaurant owner, poultry professionals, poultry industrialist, ready-to-eat meat processors to identify the consumer classes, reasons of their choice, and others associated to different BW broilers. There is a huge demand for broilers with an average body weights of 1.25 to 1.35 kg, 1.5 to 1.7 kg and over 2.0 kg to respective participants. Accordingly, we have started series of experiments with the above ranges of body weights of broilers with a view to calculate firstly the cost-benefit ratio and secondly the overall nutritive and eating quality profiling of those slaughtered broilers.

Results and Discussions: Our survey expresses the results that there is a huge demand (35% or more) of broilers with the BW of 1.25 to 1.35 kg which takes around 25 days to gain such weight. This market ages of birds mainly goes to fast-food catteries such as grill, tandoori and others. The second tire (20%) holds family consumption and broilers with the market age of 35-40 is purchased mainly by the hotels. Birds with 2 kg and above is used for meat products development and also consumed by general consumers. Table 1 shows the results of body weight gain, feed conversion efficiency and mortality rate at different slaughter ages of commercial broiler chickens. There is an interesting results outcome from this experiment that birds with early (25 days) and late (greater than 40 days) shows an improved feed. Table 2 shows the cost benefit ratio of broilers marketed at different ages. It is clear from this study that farmers get maximum returns while they sell their birds at the ages of 25 days or 40 days above. Because birds can convert feed into muscle more with the slaughter age (Table 1). Table 3 show the proximate nutrient composition at muscle of broilers with different slaughter ages. Birds with intermediate slaughter ages (i.e., 30 to 40 days) shows relatively higher nutrient composition in their breast and thigh muscle in terms of moisture, protein and ash compared to early and the late slaughter age groups.

Table 1. Production performance of commercial broilers at different slaughter age (1000 birds)

Parameter	Slaughter age				
	SA1	SA2	SA3	SA4	SA5
Average slaughter age (day)	0-25	0-30	0-35	0-40	0-45
Initial body weight (g)	36.7±0.28	36.7±0.28	36.7±0.28	36.7±0.28	36.7±0.28
Final weight (g)	1413±11.04	1670±7.89	1975±10.06	2225±6.95	2875±13.56
Weight gain (g)	1377±11.61	1634±9.81	1939±14.23	2189±15.13	2839±17.15
Feed intake (g)	1675±14.08	2451±28.23	3230±37.57	4012±51.71	4797±52.26
FCR	**1.22±0.02**	1.5±0.01	1.67±0.04	1.83±0.02	**1.69±0.03**
Survivability (%)	96.63	97.41	96.38	92.15	89.21

Table 2. Cost-benefit calculation of commercial broiler conversion efficiency compared to the slaughter ages of 30 to 40 days. This may be due to larger birds (2.8 kg) can consume less feed but returns more weight. at different slaughter age (1000 birds)

Parameter	Slaughter age				
	SA1	SA2	SA3	SA4	**SA5**
	0-25	0-30	0-35	0-40	**0-45**
Variable cost					
DOC price per bird Tk. 50	**50**	50	50	50	**50**
Feed price per kg Tk. 67.38	**113**	165	218	270	**323**
Fixed cost					
Vaccine cost per bird	**2.1**	3.6	4.4	4.4	**4.4**
Medicine cost per bird	**3.5**	3.5	3.5	3.5	**3.5**
Litter cost per bird	**4.5**	4.5	4.5	4.5	**4.5**
Electricity cost per bird	**3.1**	3.1	3.1	3.1	**3.1**
Labor and others	**15**	15	15	15	**15**
	28	30	31	31	**31**
Cost per bird (Tk.)	**191**	245	299	351	**404**
Return (160 Tk./kg)	**226**	267	316	356	**460**
Profit per bird	**35**	22	17	5	**56**

Table 3. Proximate composition of broiler breast and thigh with different slaughter age

Traits (%)	Slaughter age				
	SA1	SA2	SA3	SA4	SA5
	0-25	0-30	0-35	0-40	**0-45**
Breast					
Moisture	75.29	77.68	76.91	75.87	75.63
Protein	21.70	23.58	23.62	21.93	21.62
Fat	0.13	0.17	0.19	0.16	0.21
Ash	0.99	1.00	1.09	1.17	1.31
Thigh					
Moisture	76.97	78.46	76.19	77.24	76.21
Protein	20.04	20.52	20.91	20.55	20.14
Fat	1.48	1.29	1.11	1.21	1.25
Ash	0.89	0.96	1.07	1.05	1.03





Conclusion: There is an increased trend of two sla ughter ages of broilers to the consumers. Because they have high conversion efficiency of feed to muscle and also return cash to a greater extent to the farmers. Interestingly, intermediate groups have more protein and others proximate nutrients than the counterpart. The present findings suggest that broilers could be reared either 25 days or 40 days above to get maximum economic returns.

Project Code and Title: TF-121-L/23. Profiling of bovine colostrum in dairy cows.

Implementing Organization: Patuakhali Science and Technology University, Barishal Campus, Babuganj, Barishal
Component Organization: None
Principal Investigator: Professor Dr. Dibyendu Biswas, PSTU
Location(s): Dept. of Medicine, Surgery and Obstetrics, Faculty of Animal Science and Veterinary Medicine
Budget: BDT 34,70,000/-
Duration: 36 months
Introduction: Good quality of colostrum feeding is indicator for developing an adequate immunity of calf. Firstly, a newborn calf must be fed colostrum *ad libitum* within short time after birth. Just after birth the efficacy of Ig absorption is chance immune deficiency and later these animals were susceptible to infection by many diseases in their early life. However, in Bangladesh, about 16.73% pre-weaned calves were died due to different diseases in early stage of life and it was higher from Europe and USA due to deprive of *ad libitum* colostrum feeding at early life. However, the quality of colostrum often depends on the age of the cow, dry period nutrition, length of dry period and parity of cows. Among the colostrum contents immunoglobulins (IgG, IgA, IgM) are the most important and it increased as the number of parities increased. However, there is no difference in the quality of colostrum by different breed of cows. The Department of Livestock Services, Dhaka published some guidelines on calf management, but there is a dearth of information on the profiling of colostrum. There has been little research on calf mortality rates and calf rearing practices in Bangladesh but, there was lack of research on the immune status of calves after feeding of colostrum, which is a new milestone for calf management in our country. From the above information, it was hypothesized that, in Bangladesh contrast, the colostrum profile and passive immune transfer value will be differed from the standard value. Therefore, the objectives of the present study were to analyze the bovine colostrum profile of dairy cattle and to analyze the passive immunity transfer profile of calf after colostrum feeding.

Objectives: To analyze the colostrum profile of dairy cattle and analyze the passive immunity transfer profile of calf after colostrum feeding

Materials and Methods: The colostrum milk and blood samples were collected from the cow and newborn calf, respectively throughout the year. Colostrum IgG concentration was measured by brix refractometer. One drop of colostrum was placed on a prism of brix refractometer and the Brix score was recorded as a percentage. The colostrum was collected day 1, day 2 and day 3. The blood samples were collected from the new born calf at day 2, day 4 and day 6 in a clot activator vacutainer tube. The collected serum was stored at -20^0C until analysis. The data were input in Excel spreadsheet and statistical analyses were performed using SPSS software. The ELISA work did not finish due to late arrive the kit. The results will be prepared in the next time.

Results and Discussion: In the present study three types of dairy cattle was found dairy farms. In the 1st day of delivery, the colostrum was used to measure the brix% and it was found that the average reading was 22.35% at first day (Table-1). It was gradually decreased at day 2 and day 3. However, on day 1, the average brix% was higher in Holstein-Frisian cross bred cows compared to Sahiwal cross bred and local cows. The brix reading of good quality bovine colostrum is about 22% equal to ≥50gm/dl IgG (Sockett *et al*., 2023). Only good quality colostrum at the right time feeding could increase the transfer of passive immunity (TPI) (Abuelo *et al*., 2021). It is well-established that calf health and wellbeing, future milk production, and longevity in the herd are highly correlated with successful TPI.

Table 1: Brix meter reading of colostrum at different days of different breed of cows
HF X: Holstein Friesian cross, Sh X: Sahiwal cross

Breed of cow	Brix reading (average) at		
	Day 1	Day 2	Day 3
HF X	22.35	13.75	9.71
Sh X	15.00	8.00	7.00
Local	14.33	11.00	8.00

In this study, three different color colostrum were found namely deep yellow, yellow and light yellow. Deep yellow colostrum contained more IgG concentration as the brix meter reading was higher, 27.43 at day-1 post calving compared to yellow and light-yellow colostrum (Fig.-1). It was proved that good quality colostrum contained high level of calcium (Mehra *et al*., 2021) and also high calcium ion was present in multi-parous cows' colostrum than the primiparous cows.

Table 2: Effect of different color of colostrum and brix meter reading

Color of colostrum at 1st day	Brix reading (average) at		
	1st day	2nd day	3rd day
Deep yellow	27.43	14.71	10.57
Yellow	22.86	14.43	9.71
Light yellow	13.71	10.11	7.71

During the last trimester the growing calf needed more calcium and mostly the demands was filled from mothers' body fluids. Deep yellow color colostrum contained high level of beta-carotene compared to regular milk and these levels decrease rapidly during the first week after postpartum (Surjowardojo *et al*., 2023). But the deep yellow color was gradually fade and also the brix reading was gradually decreased to light yellow color. According to standard brix reading <22% was not suitable for 1st day colostrum feeding to calf due to low quality of IgG concentration. In this study, at day-1, the light-yellow color colostrum showed very low brix reading indicated very low-quality colostrum.

Conclusion: From this result it was concluded that average brix meter reading was higher in HF X breed colostrum than the other two breed. However, the deep yellow color colostrum shows highest brix reading than the light-yellow color colostrum at 1st day of calving.

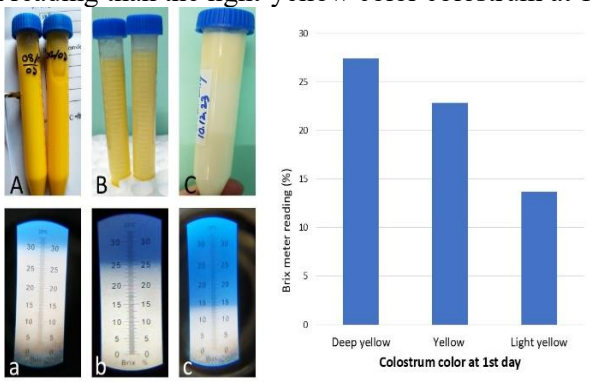


Figure 1: Different types of day-1 bovine colostrum with their representative brix reading were shown (A,a; B,b and C,c) and the average brix values of different types of bovine colostrum were shown in bar graph.



Fig. 2: A day-1 old calf sucked 1st colostrum

Project code with Title: TF122-L/23. Biogenic extraction of nanoparticle from shrimp waste as antimicrobial in broiler farming

Implementing Organization: Department of Microbiology and Hygiene, Bangladesh Agricultural University, Mymensingh
Component Organization: None
Principal Investigator: Professor Dr. Md. Shafiqul Islam, BAU

Location: Department of Microbiology and Hygiene, Bangladesh Agricultural University, Mymensingh
Budget: Tk. 50.00 Lakh
Duration: May 2023 to April 2026 (36 months)

Introduction: Antibiotic residues in poultry and poultry products have been considered as major public health threat because of their association with emergence of resistance environmental microflora. Exploring the use of natural antimicrobial materials would be the immediate step for such purpose. Recently, many scientists employed Chitosan, Cellulose, Gelatin etc. [1–3] from animal sources as natural antimicrobial agent against many bacterial infections. However, the bulk state of those materials are not feasible for such purpose because huge dose of those materials makes farming costly [4,5]. Therefore, nanoformulation of natural antimicrobial biomaterials would be an ideal approach towards this direction. Therefore, this research will develop Chitosan Nanoparticles (NPs) from collected shrimp chitin for utilizing against circulating microflora as an alternate of commercial antibiotics. Herein, shrimp waste was employed as natural source of chitin for biogenic extraction of chitosan using isolated decomposer bacteria. Finally, the biogenically extracted chitosan powder will be employed for green synthesis of Nanoparticles.
Objectives: Isolation of potential shrimp waste decomposer bacteria for extraction of chitin and chitosan Biopolymer; development of suitable methods for the synthesis of chitosan nanoparticles from extracted chitosan polymer; evaluation of the antibacterial activity of synthesized chitosan nanoparticles against bacteria isolated from poultry; biosafety evaluation of synthesized chitosan nanomaterials using cell culture and lab-animal model and application of synthesized antibacterial nanoparticles for antibiotic-free safe broiler production.

Materials and Methods: Materials: Nutrient broth, Nutrient Agar, Blood Agar, MacConkey Agar, Cetrimide Agar, MRS Agar, TSA Agar, MRS Broth, Gram's staining reagents, Biochemical reagents, primers (*463F* and *463R*, *LbiMA1* and *R161*, and *PA-GSF* and *PA-GSR* primers) PBS, Falcon tubes, pH Meter, Magnetic Stirrer, Anaerobic Jar etc. Shrimp waste and Shrimp shell
Methodologies: For accomplishing the 1st year assign tasks, potential decomposer bacteria were isolated from shrimp waste and identified by colony morphology, Gram's staining, biochemical test, and PCR characterization. The isolated decomposer bacteria's laboratory adaptability and fermentation ability were determined by measuring OD and pH changes. Thus, the fermenting bacteria were subjected to demineralization and deproteinization of shrimp shells to extract Chitosan powder biogenically. Finally, the biogenically extracted chitosan powder formation was confirmed by physical characterization with FTIR and X-RD investigation.

Results and Discussion:
Identification of bacteria: The white, fried egg round-shaped colonies appeared on the TSA, rod-shaped with square ended purple color structure, and the amplified band for *463F* and *463R* primers at 463 bp (Fig. 1a) indicated Gram-positive *Bacillus* spp. Likewise, the small, round whitish creamy colony appeared on MRS agar, rod-or spherical-shaped purple color, and the amplified band for *LbiMA1* and *R161* primers at 250bp (Fig. 1b) indicated the Gram-positive *Lactobacillus* spp. Additionally, the large, greenish, round colony appeared on the Cetrimide Agar, small-rod with pink colour, and the amplified band for *PA-GSF* and *PA-GSR* primers at 618bp (Fig. 1c) indicated Gram-negative *Pseudomonas* spp.
Determination of Adaptability and fermentation ability of bacteria: The laboratory adaptation and fermentation ability was determined by measuring the OD and pH changes. The changes of pH for the decomposer bacteria were monitored daily till the suitable pH 5.0 for demineralization (*Lactobacillus* spp.) and pH 8.5 for deproteinization (*Bacillus* spp. and *Pseudomonas* spp.). The pH 8.8 and 8.4 were achieved at day 7 post incubation (DPI) by the *Bacillus* spp. and *Pseudomonas* spp. respectively. While pH 5.07 was achieved at day 7 DPI by *Lactobacillus* spp. (Fig. 2a). The trend of pH change indicated the gradual increase of alkalinity and acidity of the solution with culture periods (Fig. 2b). Thus, *Bacillus* spp., *Pseudomonas* spp. and *Lactobacillus* spp. were selected as potential decomposers of shrimp waste.
Physical Characterization of Chitin and Chitosan: FTIR investigation and then XRD analysis primarily confirmed the chemically and biogenically extracted Chitin and Chitosan powder formation. The low FTIR spectra at 564 cm^{-1}, 711 cm^{-1}, and 1174 cm^{-1} for C–O–C, CH_2, and C–O chemical

groups indicated the formation of chitosan powder during both chemically and biogenically extraction process (Fig. 3a and 3b) [6–8].
The XRD analysis of the deacetylated chitosan demonstrated sharp diffraction with intensity peaks at 10.24°, 21.29°, 29.29°, 31.7°, 35.28°, 50.51°, and 60.21° (Fig. 3c) and low full indicated that the yielded powder was crystal in nature [9–11]. The average crystallite size of chitosan from the Debye-Scherrer formula was 17 nm.

Yield of Chitin and Chitosan powder: For determination of the percentages of biogenically extracted chitin and chitosan yield, different batches (Batch No. 1 to Batch No. 5) of reaction were performed (Table 1). The percentages of the yield of demineralized, deprotonated, and deacetylated chitin and chitosan were increased with the increase of shrimp shell where the desired level (16%) of chitosan yield was found from Batch No. 3 (2g shrimp shell: 200 ml Nutrient broth). The percentages of chitosan yield from shrimp shells was found between 15-17% in several studies published elsewhere [8,9] [12,13].

Table 1: Percentages of chitosan yield

Batch No.	Amount of ingredients			Yield of products		
	Shrimp (g)	NB (ml)	Bacteria (OD)	Demineralized chitin	Deproteinized chitin	Deacetylated chitosan
1	0.5	200ml	1 Abs (10^8cfu/ml)	24% (0.5/0.12g)	16% (0.5/0.08g)	6% (0.5/0.003g)
2	1.00	200ml	1 Abs (10^8cfu/ml)	25% (1/0.25g)	20% (1/0.2g)	11% (1/0.11g)
3	2.00	200ml	1 Abs (10^8cfu/ml)	31.5% (2/0.63g)	25% (2/0.5g)	16% (2/0.32g)
4	3.00	200ml	1 Abs (10^8cfu/ml)	47.2% (3/1.6g)	33% (3/1.1g)	18% (3/0.6g)
5	4.00	200ml	1 Abs (10^8cfu/ml)	52.5% (4/2.1g)	45% (4/1.8g)	31.25% (4/1.25g)

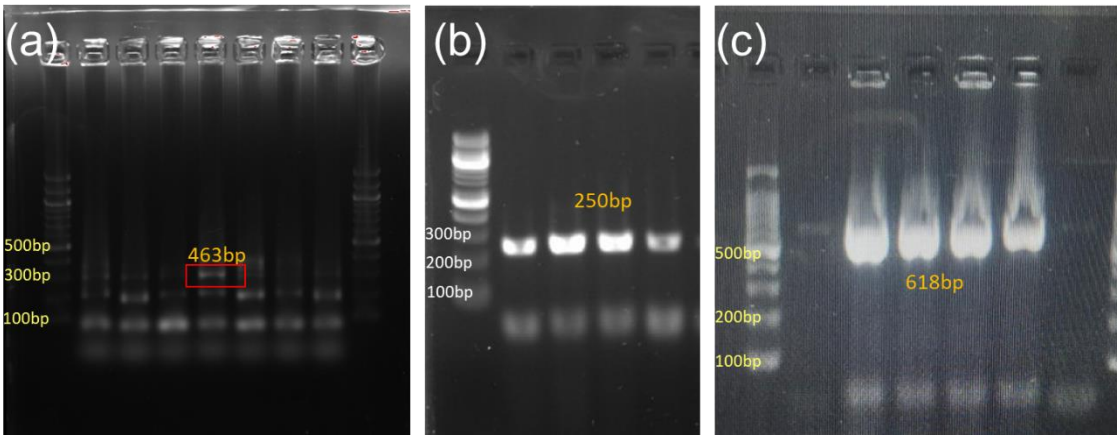


Fig. 1. The PCR confirmation of decomposer bacteria where the amplified bands of *463F* and *463R* primers at 463bp for *Bacillus* spp. (a), amplified bands of *LbiMA1* and *R161* primers at 250bp for *Lactoacillus* spp. (b), and amplified bands of *PA-GSF* and *PA-GSR* at 618 bp for *Pseudomonas* spp. (c).

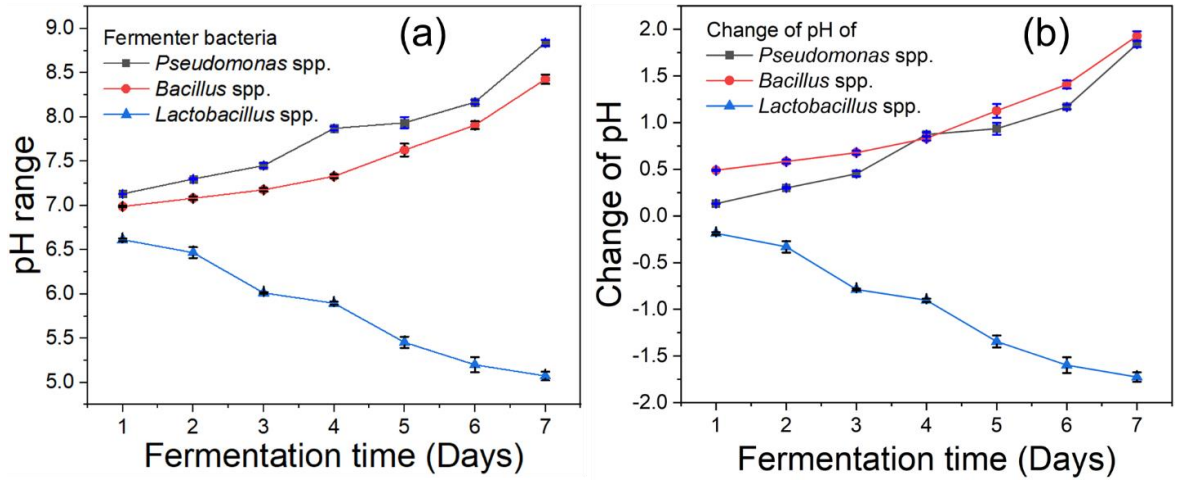


Fig. 2. Determination of the fermentation ability of the isolated bacteria, a) pH change, b) Acid-alkali production rate.

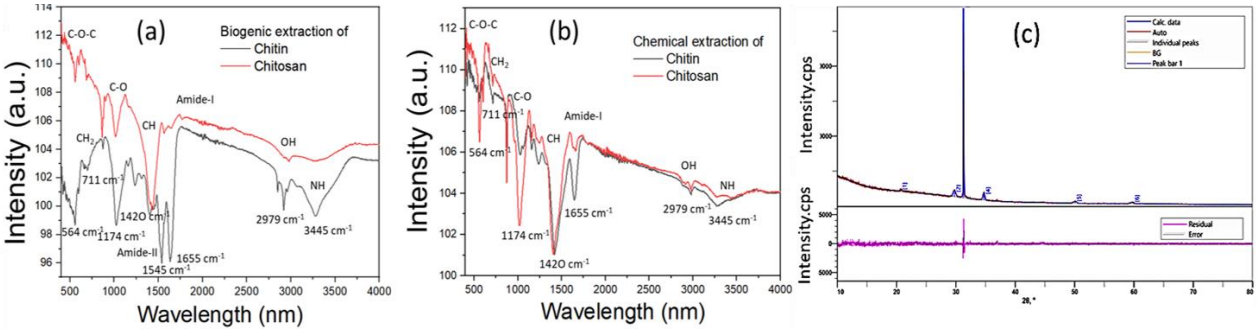


Fig. 3. Fourier Transform Infrared Spectrum and X-R of a) Biogenically extracted chitin and chitosan, b) Chemically extracted chitin and chitosan, and XRD analysis of c) Biogenically extracted chitosan powder

Conclusion: The potential decomposer bacteria were isolated and identified from shrimp waste samples collected from different shrimp processing areas of Satkhira, Bangladesh. The fermentation ability of the isolated decomposer bacteria was confirmed both aerobically and anaerobically at the bacteriology laboratory by measuring the change of pH (using pH meter) and turbidity (OD of UV Vis spectroscopy) of the culture broth. The chitosan powder was biogenically extracted by demineralization, deproteinization, and deacetylation by using isolated decomposer bacteria. The deproteinization and deacetylation of chitosan were confirmed with FTIR and X-Ray diffraction analysis. The confirmed chitosan powder was preserved for further use in green synthesis of Chitosan nanoparticles.

Project Code and Title: TF 123-L/23. Conservation and multiplication of native chicken and Pigeon germplasm at Sylhet region

Implementing Organization: Sylhet Agricultural University, Sylhet
Component Organization: None
Principal Investigator: Professor Dr. Md. Nazmul Haque
Location(s): Sylhet Agricultural University, Sylhet, Lab, Poultry field Shed.
Budget: Tk. 50,00,000/-
Duration: 23 May 2023 to 22 May 2026 (36 months)

Introduction: Sylhet region of Bangladesh possesses a diverse chicken genetic resource mostly of non-descript indigenous type. The low inputs and consequently, low risk is one of the major advantages of indigenous chicken production. The conservation of these valuable chicken genetic resources is necessary in the light of rapid loss of indigenous breeds through commercial dilution and breed replacement. Molecular markers are an indispensable tool to understand genetic structures of populations. The assed phenotypic coupled with genetic information could be a powerful tool towards the promotion of conservation, improvement, multiplication and utilization of native chicken and pigeon genetic resources.

Objective: To set up necessary program (Setting chicken and pigeon Germplasm and aviary) for collection of important native chicken and pigeon genetic resources to determine genetic variation on the basis of whole genome analysis techniques and identify suitable genetic resource required for further development and conservation at Sylhet region.

Materials and Methods: The experiment is ongoing for sample collection, conservation and multiplication of different native chicken and pigeon genotypes at Sylhet region. A chicken aviary system with 66 feet long and 36 feet wide has been established. Experimental birds like Aseel, Frizzle, autosomal dwarf chicken and pigeon Deshi, Giribaz, Jalali and different types of racing homer from different location of Sylhet region in different number have been collected. i. Breeding and Multiplication of different genotypes of chicken and pigeon is going on. In this aspect we have collected Aseel chicken about 50 in number, Frizzle feathered chicken about 100 in number, Autosomal dwarf about 400 in different ages and Pigeon Gola, Giribaj, Homer about 300 in number. It is now in station and phase by phase it will be distributed in the field. To investigate phenotypic features, geographic distribution, productive and reproductive performances and determine genetic variation, distance and relationship on whole genome sequencing is in progressing of the experimental chicken and pigeon. We have set up a mini hatchery capacity to produce about 300 days old chicks/week.

Results and Discussion: The body weights of frizzle and dwarf chickens at different ages and genders reveal their growth trends and meat production capacity. The results confirm the previous study, showing both parallels and variances in chicken breed growth trends. Magothe *et al*., (2010) in Kenya in Nigeria found similar beginning body weights of frizzle hens, indicating a similar growth trajectory. The Deshi chickens had a lower FCR (2.86) than the Frizzle chickens (3.13), suggesting they grew more efficiently in the first four weeks. The literature suggests that Dwarf chickens' smaller bodies use less maintenance energy, resulting in early feed efficiency (Zerjal *et al*., 2013). The average egg weight for dwarf hens in Ferdaus *et al*., (2016) was 38.25 grams, somewhat lower than in our study. However, Faruque *et al*., (2015) found that native Deshi chickens had an average egg weight of 42.94 grams, which was higher than dwarf chickens. The increased reproductive rate of dwarf chickens (91%) in this study is consistent with indigenous chicken breeds in Bangladesh. Faruque *et al*., (2015) revealed in Bangladesh's reproductive rate of Indigenous chicken 85.4% is Considered indigenous chickens were frizzle-feathered. According to Bhuiyan *et al*., (2011), 83% of indigenous chickens in Bangladesh have closely similar fertility with the present result. Dwarf chickens generally hatch better, as shown by the current study's 86% hatchability rate compared to 78% for Frizzle chickens. Subalini et al., (2014) found that Frizzle birds in a semi-intensive system in Sri Lanka had a hatchability rate of 76.13% and naked neck Frizzle birds 79.14%. The average live weight of Aseel chicken at 0, 1, 2, 3, 4, 6, 7, 8 10, 12, 14, 16 and 24 weeks of age were recorded as 31.7, 38.7, 70.4, 126.1, 158.9, 225.4, 282.6, 356.3, 470.3 632.6, 901.8, 1015.1, 1204.6, and 2773.7 gm respectively and these results were supported by another study in Bangladesh which reported that Aseel chicken body weight at 1, 2, 3, 4, 6, 8, 10, 12, 16 and 17 weeks of age were recorded as 31.14, 48.63, 116.57, 138.40, 212.88, 361.00, 577.50, 743.75, 1086.00, 1402.00 and 1432.00 gm respectively(Sarker et *al*., 2012).

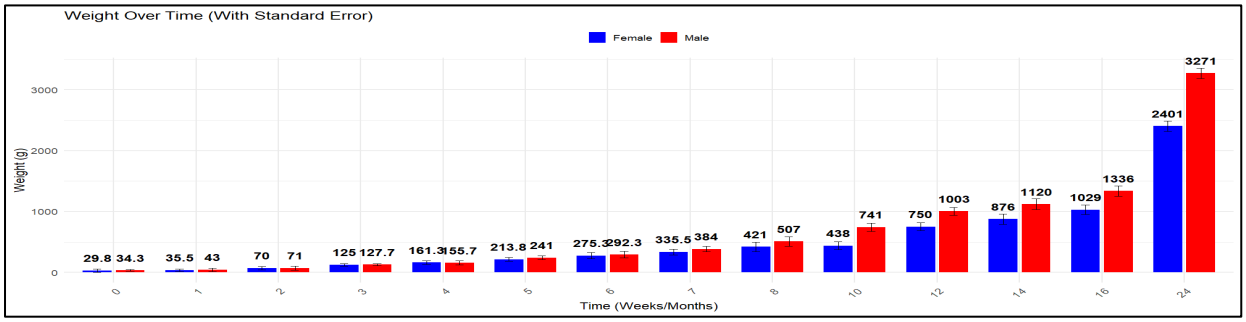


Fig-1: Mean body weight of Aseel chickens by age and sex

Table 1: Reproductive traits of Frizzle and Deshi Dwarf chicken

Traits	(Mean ± SE)	
	Frizzle	Deshi dwarf
Egg weight (gm)	39.82^{b}±0.12	40.60^{a}±0.13
Egg length (gm)	5.42^{b}±0.01	5.2^{a}±0.01
Egg width (cm)	3.76^{b}±0.01	3.84^{a}±0.01
Day-old chick weight (gm)	28.47^{b}±0.10	30.43^{a}±0.16
Age at the first egg laying (week)	23.25^{a}±0.21	20.95^{b}±0.20
Body weight at first egg laying (gm)	1421.40^{a}±14.19	1035.50^{b}±10.73
Hatchability	78%	86%
Fertility	82%	91%

LS=Level of significance; Means with different superscripts along the same column are significantly ($p<0.05$) different.

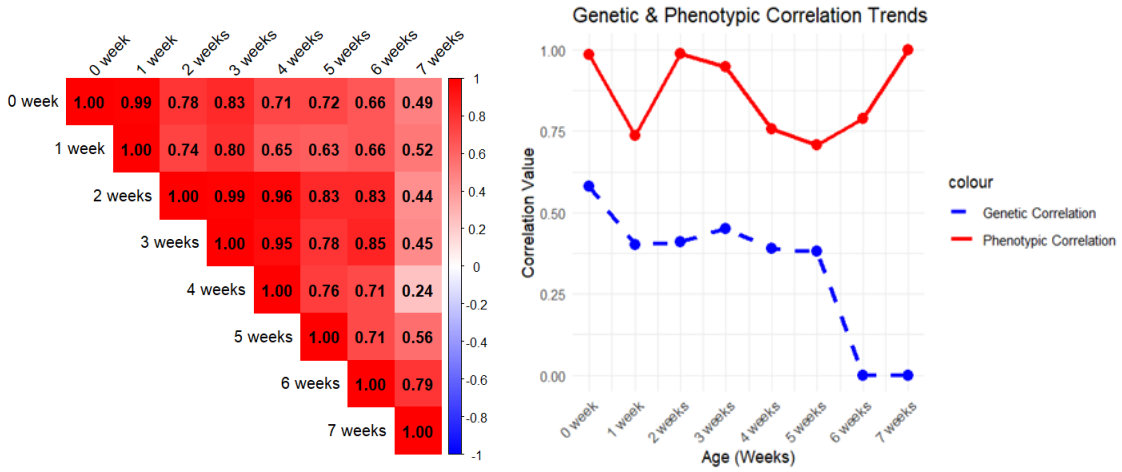


Fig. 2- G & P Correlation of body weight in diff. age of Aseel

Conclusion: To increase the production and reproductive success of Frizzle chickens, it is crucial to improve management procedures and prioritize genetic enhancements. In contrast, the Deshi Dwarf chickens exhibited positive performance results in demanding environments, indicating their potential for ongoing utilization and advancement in poultry farming. In summary, this thesis provides significant knowledge regarding the genetic and managerial techniques that can enhance the performance of Frizzle and Deshi Dwarf, Aseel chickens and pigeons. The study successfully extracted and quantified DNA from Aseel chicken blood samples, demonstrating the viability of molecular techniques in avian genetic research. The results highlighted considerable variations in DNA yield and purity, which could be attributed to differences in sample handling, storage conditions, and extraction efficiency. By advancing molecular research in poultry genetics, these efforts can support conservation strategies, sustainable breeding programs, and the long-term preservation of the experimental chickens and pigeon genotypes.



Project Code and Title: TF 124-L/23: Development of Inclusion Body Hepatitis Vaccine from Local Virus Isolates

Implementing Organization: Department of Microbiology and Hygiene, BAU Mymensingh-2202
Component Organization (if any): Animal Biotechnology Division, National Institute of Biotechnology (NIB), Savar, Dhaka.
Principal Investigator: Dr. Md. Bahanur Rahman, Professor, Department of Microbiology and Hygiene, Bangladesh Agricultural University, Mymensingh-2202
Locations: Department of Microbiology and Hygiene, BAU Mymensingh
Budget: BDT: 40,00,000/-
Duration: May 2023 to May 2026 (36 months)

Introduction: Inclusion Body Hepatitis (IBH), a deadly liver disease of broiler chickens caused by Fowl Adenovirus (FAdV), has become a growing concern in Bangladesh, with outbreaks leading to high morbidity, mortality and economic loss. This study, part of a three-year project, focuses on detecting and characterizing IBH viruses from suspected broiler chickens across several districts of Bangladesh. Molecular techniques targeting Hexon and Polymerase genes revealed a high infection rate in suspected broiler chickens, with dominant strains identified as FAdV Class E, Serotype 8b. The ultimate goal of this study is to develop an inactivated IBH vaccine using local IBH virus isolates to protect broilers, reduce losses, and support national poultry production.

Objective: To isolate, characterize IBH virus for the development of an inactivated IBH vaccine from local virus isolates.

Materials and Methods: Broiler samples showing suspected IBH symptoms were collected from major poultry-producing districts. Liver and heart tissues were harvested, processed, and inoculated into 9–11-day-old embryonated chicken eggs. Viral DNA was extracted and subjected to PCR targeting DNA polymerase and hexon genes. Positive isolates were partially sequenced to determine their serotypes and virulence. Sequence analysis and phylogenetic comparisons were performed to match them with known global strains. The identified isolates were used for trial vaccine development.

Protocol for IIBH virus isolations:

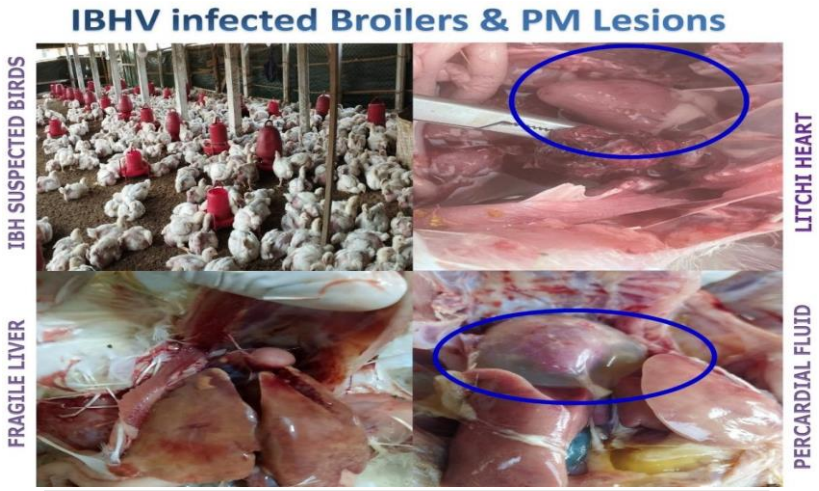


Fig. 1: IBH sample collection

- Liver and heart samples from IBH-suspected broilers were collected from various districts in Bangladesh.
- Samples were processed and directly tested for IBH virus via PCR.
- Inoculums were prepared and injected into 9–11-day-old embryonated chicken eggs via CAM and allantoic routes.
- DNA extraction was performed using FAVORGEN kits following standard protocol.
- PCR targeting **polymerase** and **hexon** genes confirmed virus presence.
- Electrophoresis confirmed amplified products.
- Positive isolates were sequenced for molecular characterization.

- Sequencing was conducted in collaboration with NIB for serotyping and phylogenetic analysis.

Results and Discussion: A total of 110 suspected samples were collected from broiler chickens showing signs of Inclusion Body Hepatitis (IBH) across four districts of Bangladesh. Among these, 98 samples (89.09%) tested positive for IBH virus by PCR targeting the *Hexon* and *Polymerase* genes. District-wise analysis revealed high virus occurrence: Netrokona (90.47%), Gazipur (90.91%), Mymensingh (88.68%), and Dinajpur (66.67%) (Table-1, Fig. 1)).

Table 1: IBH occurrence in collected field sample in different districts of Bangladesh

District	Number of Collected Samples	Number of IBH Virus Positive PCR Samples	IBH Virus occurrence (%)
Netrokona	21	19	90.4761905
Gazipur	33	30	90.9090909
Mymensingh	53	47	88.6792453
Dinajpur	3	2	66.6666667
Total	**110**	**98**	**89.0909091**

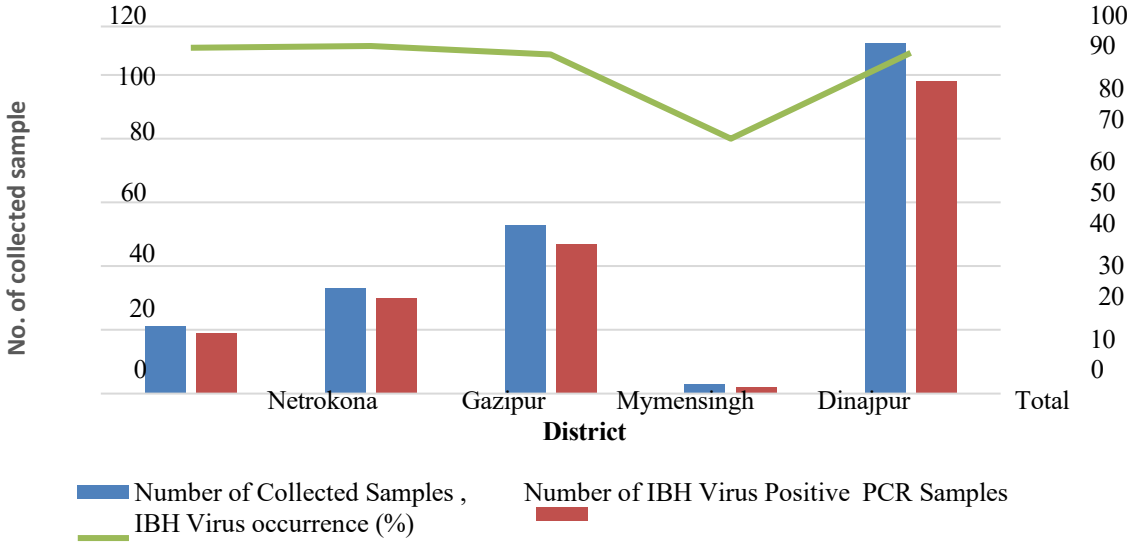


Fig. 2: *IBH virus occurrence in IBH suspected sample from broiler*

To propagate the virus, 26 of the PCR-positive samples were inoculated into 10-day-old embryonated chicken eggs via allantoic and chorioallantoic membrane (CAM) routes. All 26 amples (100%) successfully propagated, 100% re-isolated, confirmed by PCR as IBH virus, indicating the virus's viability and infectivity under controlled conditions.

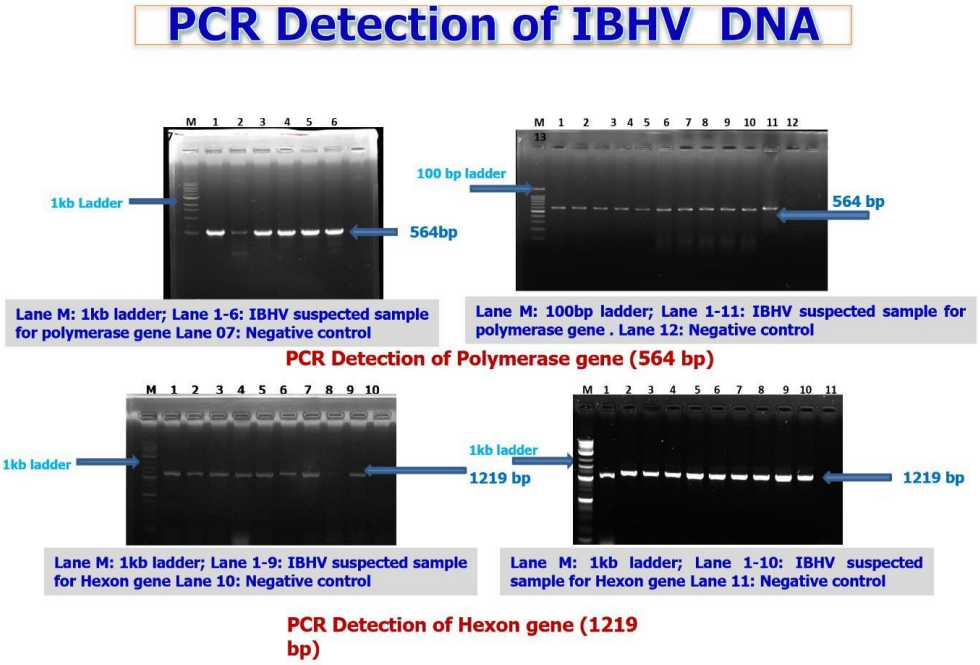


Figure 3: PCR based detection of IBH virus

Partial sequencing was conducted for molecular characterization of 13 selected IBH virus isolates. The evolutionary relationships of these Bangladeshi isolates were analyzed using sequences from *Hexon* (1062 bp) and *Polymerase* (564 bp) genes. This analysis confirmed their genetic similarity to other global FAdV strains and helped determine the serotypes (Fig. 4)

Conclusion: A total of 110 samples from IBH-suspected broiler birds were collected, of which 98 (89.09%) tested positive for IBH virus by PCR targeting *Hexon* and *Polymerase* genes. Among these, 26 samples were successfully re-isolated in embryonated chicken eggs and reconfirmed by PCR. Partial gene sequencing identified FAdV Class E, serotype 8b in four samples from Mymensingh and Gazipur, and these isolates have been preserved at -80°C for inactivated vaccine development. Ongoing work includes WGS, detecting additional virulent serotypes (4 and 11) through continued molecular screening. Future goals include vaccine formulation, efficacy and safety testing, and field validation to protect poultry against IBH.

Project Code and Title: Project ID. No. TF-125-L/23. Development of Technology Package for Prevention and Control of Subclinical Mastitis in Lactating Dairy Cows.

Implementing Organization: Department of Medicine, Faculty of Veterinary Science, Bangladesh Agricultural University, Mymensingh
Component Organization (If any): Not pplicable
Principal Investigator: Dr. Md. Ariful Islam, Department of Medicine, BAU, Mymensingh
Location(s): Laboratory location: Department of Medicine, BAU, Mymensingh.
Project sites: Mymensingh (Sadar: 20 farms, and Fulbaria: 20 farms), and Shahajadpur, Sirajganj: 20 Farms
Budget: TK 35,00,000.00
Duration: From 24 May 2023 to 23 May 2026 (36 months).

Introduction: Dairy animals are key to the rural economy, especially for poor farmers in Bangladesh, but lactating cows often suffer from subclinical mastitis (SCM). SCM is an inflammation of the udder in which cows do not show clinical signs but produce less and lower quality milk. Thus, early detection of SCM in cow is important for most dairy farmers to reduce production losses and to enhance prospects of recovery. In many countries, udder health management and SCM control packages have been developed, but to our best knowledge, no specific program exists in Bangladesh.

Objective: The overall aim of the project will be to develop a technology package of best practices to prevent and control of SCM which is tailored to the situation in Bangladesh to support the dairy sector for the production of safe milk and to improve the quality of life of rural poor famers in the study area.

Materials and Method: To achieve the objectives, a pretested, semi-structured questionnaire was administered to 120 dairy farmers in 60 dairy units to collect base-line data on herd management and milking practices in Mymensingh and Sirajganj districts. Initial on-farm screening was performed in two farms by Electric Conductivity to detect cow-level and herd-level SCM and SCM was confirmed with somatic cell count was done by Horizon Unlimited Milk Analyzer.

Results and Discussion: The base-line survey revealed that (i) most of the farmers (93.5%) were not aware of SCM and its effect on milk yield and quality but they knew about clinical mastitis (CM), (ii) udder washing was practiced by all farmers, but they lacked knowledge about washing the hands with soap and wiping the udder with towels before milking, (iii) 100% farmers do not practice pre/post milking teat dipping, (iv) only 35% farmers provided feed after milking or at the end of milking. Overall, prevalence of SCM was 52.5% and 29.42% for cow and quarter level, respectively. Multiparous cows, high yielding and BCS >3 cows were significantly reported for SCM. A flyer consisting of ten tips for controlling SCM/CM and a video documentary for improving farmer awareness has been developed. In addition, a good husbandry practices training module has developed for adoption and intervention studies in selected dairy units. Effectiveness of training, adoption and intervention study will be conducted in selected farms very soon.

Identified farmer's knowledge gaps:

- No idea SCM & its diagnostic EC test
- No hand wash with soap before milking
- No pre / post milking teat dipping
- No provide feeds at immediately after milking to cows

- ✓ Overall, prevalence of SCM : Cow: 52.5%, and Quarter level : 29.42%
- ✓ Risk factors: Parity, BCS, lactation stage, breed
- ✓ To improve farmers awareness:
  - Ten tips to control & prevention SCM
  - One short film to improve farmers awareness
  - Training modules & diagnostics techniques

Conclusion: SCM is a prevalent issue in dairy farming and poses a significant obstacle to the advancement of dairy industry in Bangladesh. Understanding and adopting identified risk factors could be crucial for developing effective control strategies for SCM. To combat the disease, SCM screenings regularly, good hygiene, improved milking practices and farmer awareness are recommended in the studied area even over the country



Photo 1: Milk test by Ekomilk Horizon Unlimited milk analyzer



Photo 2: Electric Conductivity test of milk by Draminski Mastitis Detector (MD4x4-Q2)



Photo 3: Milk sampling for EC test



Photo 4: Electric conductivity test of milk

Project Code & Title: TF-126-L/23. Development of Contagious Ecthyma vaccine seed from circulating local isolates

Implementing Organization: Animal Health Research Division, Bangladesh Livestock Research Institute (BLRI).

Component Organization: None

Principal Investigator: Md. Shahin Alam, PhD

Location (s): Savar, Dhaka.

Budget: TK 34.04 lacks

Duration: June 2023 to May 2026 (36 months)

Introduction: Contagious ecthyma (CE) or Orf or contagious pustular dermatitis is one of the contagious, communicable, zoonotic, economically important viral skin disease that affects sheep, goats, and other domesticated and wild ruminants. In human the infection is first defined by Walley in 1890 and typically associated with occupational animal contact. The disease is characterized by the formation of vesicular and scabby lesions on the oral commissure's, lips, nose, ears, udder, etc. It is more common in young animals of 3-6 months of age, but mature animals may also be affected. The virus is transmitted by direct or indirect contact. The high mortality in young animals is due to the inability of the animals to feed due to oral lesions associated with secondary infections leading to anorexia. The economic importance of this disease is notable as it is related in causing severe impact in young lambs and kids. Very few studies are reported on CEV from Bangladesh. Contagious ecthyma being a viral disease with no suitable antiviral therapeutic schedule, vaccination is the only option for effective control of this virus infection.

Objective: Identification and molecular characterization of Contagious Ecthyma viruses, isolation and propagation of Contagious Ecthyma viruses in primary lamb testis or kidney cell, adaptation and attenuation of Contagious Ecthyma viruses in cell line for the development of live attenuated vaccine seed and application of vaccine at experimental level.

Materials and methods:

Activity-1: Identification and molecular characterization of CEV from CE suspected field samples: A total of 67 scab tissue samples from different outbreak areas namely Jashore (6), Chuadanga (7), Satkhira (6), Jhinaidah (4), Meherpur (8), Chattragram (6), Chapainowabgonj (22) and Dhaka (8) districts in Bangladesh. All the samples were labeled, transported to the SAARC PPR laboratory, BLRI, and stored at−20°C until use. The tissue samples were grounded and prepared in a 20% (W/V) suspension aseptically using phosphate buffer solution (PBS) and then centrifuged at 2000 x g for 10 min. The collected samples were processed, and DNA was extracted using the protocol of the DNA extraction kit (Monarch®, USA). Polymerase chain reaction (PCR) was performed for the amplification of the VIR and B2L genes of CEV (OIE, 2012).

Activity-2: Isolation and propagation of CEV in primary lamb kidney or testis cell: Primary lamb testicular cells (LTC) were prepared from 1–7-day-old lamb at our laboratory. Inoculum was prepared from PCR-positive samples according to the method described in OIE (2017), and subsequently, 0.5 ml was inoculated into a 25 cm 2 cell culture flask containing a monolayer of primary LTC and observed regularly until 10 days post-inoculation.

Results and Discussion: Out of 67 suspected CEV field samples, 40.29% (27/67) were found positive by PCR targeting the B2L and VIR genes. From our survey, it was found that 6–12-month-old kids are more affected, and more CE cases were noticed in the winter season, particularly in the months of December and January. For the primary isolation of CEV, each PCR-positive sample was inoculated into primary LTC, and five blind passages were conducted. At each time, we checked the harvested sample (virus-inoculated LTC) by PCR and stored it at -80°C. Two CEV isolates were confirmed by observing the cytopathic effect in LTC and PCR. In addition, we have checked and confirmed two previous CEV isolates, but can't grow those isolates in primary LTC as well as in Vero cell line. Three (3) PCR-positive samples of CEV were prepared for characterization by gene sequencing (B2L genes) and phylogenetic analysis.

Table 1: Positive percentage of contagious Ecthyma virus from suspected field sample

Location (s)	Total number of collected samples	No of PCR Positive samples	Positive (%)
Dhaka	08	3	37.5
Meherpur	08	3	37.5
Jhinaidah	04	2	50.00
Chuadanda	07	2	28.57
Satkhira	06	3	50.00
Jashore	06	2	33.33
Chattogram	06	2	33.33
Chapainowabgonj	22	10	45.45
Total	**67**	**27**	**40.29**



Fig.1-2: Typical clinical lesions of contagious ecthyma in nostrils and mouth region & process of collection of scab materials from mouth regions of contagious ecthyma

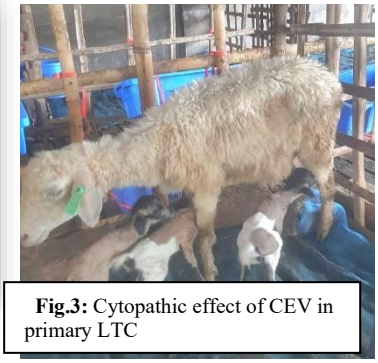
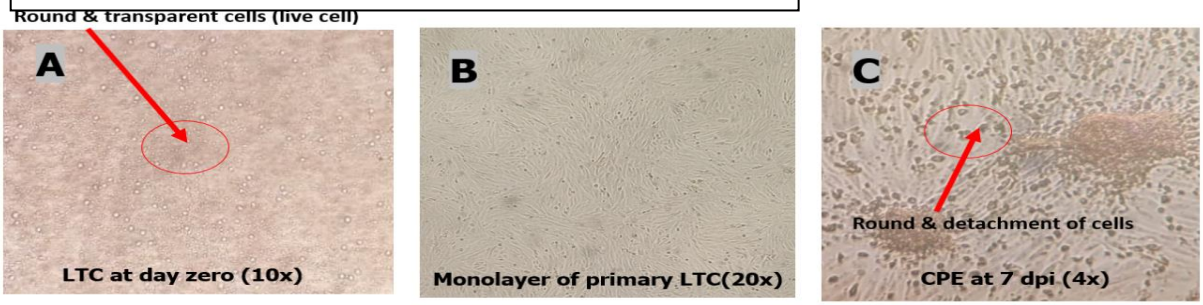


Fig.3: Cytopathic effect of CEV in primary LTC



Pictures showing the CE virus isolation in LTC; a) LTC at day zero; b) confluent monolayer; c) CPE at 7 days of post inoculation (dpi) (4x).

Conclusion: Contagious ecthyma being a viral disease with no suitable antiviral therapeutic schedule, vaccination is the only option for effective control of this virus infection. To get a suitable vaccine candidate virus it is essential to collect as many as circulating viruses from the field. Based on their biological and molecular properties a strain then can be chosen to produce vaccine. The main aim of this research is isolation and identification of CE virus from the field samples with a target to develop an inactivated and/or live attenuated vaccine to control CE.

Project Code & Title: TF 127-L/23: Productivity improvement of Garole sheep through feeding and nutritional management in Satkhira area of Bangladesh.

Implementing Organization: Department of Animal Science, BAU University, Mymensingh
Component Organization (If Any): Not applicable
Principal Investigator: Professor Dr. Md. Ruhul Amin
Location (s): Shamnagar and Assasuni Upazila of Satkhira district
Budget: Tk 35 Lacks
Duration: May 24, 2023 to May 23, 2026 (36 Months)

Introduction: The potentialities of Garole sheep to meet present and future demands of rapidly growing population deserves special attention because of its extraordinary merits rarely or not even observed in other sheep breeds of the world. Considering the above state- of-the art, this research was undertaken to identify socio-demographic condition of the farmers and recent husbandry practices of Garole sheep in the Sundarban delta region of some selected areas of Satkhira district (Assasuni and Shamnagar) and to investigate economic feed-level production packages for maximum productivity of Garole sheep through scientific approaches of feeding and nutritional management. The successful research will ensure improvement of livelihood of Garole sheep farmers and assure food and nutrition security in Bangladesh.

Objective: To identify socio-demographic condition of the farmers, recent husbandry practices and economic feed-level production packages for maximum productivity of Garole sheep in the Sundarban delta region of Shamnagar and Assasuni Upazilas of Satkhira district in Bangladesh.

Materials and methods: The research is carried out at Shamnagar and Assasuni Upazila of Satkhira district. A baseline field survey was conducted with the pretested questionnaire to get basic

information's of Garole sheep farmers and on recent husbandry and management practices of Garole sheep in the selected areas. Feeding trials are conducting with protein and energy based diet to determine the productive and reproductive performances of Garole sheep in selected areas.

Results & Discussion: Socio-demographic condition of the Garole sheep farmers in the selected Upazilas of Shamnagar and Assasuni of Satkhira district identified. Current productive and reproductive performances of Garole sheep in the selected areas identified.Recent husbandry practices of Garole sheep in the selected areas of Satkhira district identified. Proximate composition of the available feeds and fodders was evaluated. Initially, body weight of Garole ewes are increasing gradually with the increased doses of concentrate supplementation compared to control. Other parameters are in progress and will be addressed in the next available reports.

Table 1: Proximate composition of feeds available in the selected areas of Satkhira.

Feedstuffs	% DM	% DM							
		OM	CP	CF	ADF	NDF	EE	NFE	Ash
Dhubla/durba grass	90.07	80.37	10.94	21.4	16.95	34.56	2.30	55.66	09.70
Samna/Lona grass	87.12	76.41	11.98	21.34	30.63	64.40	3.22	52.75	10.71
Khata grass/sag	89.40	79.76	10.65	36.94	30.24	59.00	2.56	42.21	09.64
Straw	86.49	71.59	03.90	35.90	20.53	70.34	1.40	43.90	14.90
Rice polish	93.40	78.00	10.80	12.80	13.31	33.00	10.6	50.40	15.40
Wheat bran	96.00	87.00	14.80	14.00	14.80	43.10	4.90	57.30	09.00
Crushed maize	87.95	82.25	12.14	08.79	03.63	14.27	2.72	48.57	05.69
Broken rice	87.40	84.2	09.30	23.58	02.90	11.95	2.12	61.80	03.20

.



Photograph 1: Garole Sheep Flock (Left) and Garole Lamb (Right)

Conclusion: Investigation of economic feed-level production packages for maximum productivity of Garole sheep through scientific approaches of feeding and nutritional management will facilitated different productive and reproductive parameters. These will increase meat production and income, improve livelihood, knowledge and skills of the Garole sheep farmers. Institutional capacity for education and research on Garole sheep will also be developed and help to achieve SDG goal. This study not only created awareness of the farmers on Garole sheep management practices in Satkhira district but it also serves as a call to action for stakeholders to collaborate in improving the socioeconomic conditions of farmers and the overall development of livestock sector in Bangladesh.

Project Code and Title: TF 128-L/23: Isolation, molecular characterization and vaccine development against Bovine Babesia in Bangladesh

Implementing organization: Bangladesh Agricultural University, Mymensingh
Component Organization: None
Principal Investigator: Professor Dr. Thahsin Farjana, Department of Parasitology, Faculty of Veterinary Science, BAU, Mymensingh
Location(s): Mymensingh
Budget: TK. 30.00 Lakh
Duration*:* 24 May 2023 to 23 May 2026 (36 months)

Introduction: *Babesia* is tick-borne haemoprotozoa, widely distributed in tropical and subtropical areas of the world. Bovine babesiosis has got huge economic impact due to its direct relation to morbidity, mortality, production losses, cost of treatment and tick control. Chemotherapy is important for controlling the disease but sometimes the anti-babesial drugs cannot kill the protozoa. Reasonably, vector control is difficult because of the complicated life cycle of the tick. However, immunization has been proven important to control and prevent babesiosis. A country like Bangladesh, research efforts are still needed to develop an effective vaccine against *Babesia* spp to control babesiosis in cattle.

Objective: Identification of *Babesia* species affecting cattle in Bangladesh by microscopy and PCR, Genetic characterization of *Babesia spp* by gene sequencing and phylogenetic analysis and Isolation of *Babesia* and development of effective vaccine against *Babesia* prevailing in Bangladesh

Materials and Methods:
Collection of samples: We collected blood samples from suspected cattle from Mymensingh, Sirajganj and Pabna (**Fig-1a**).
Morphological identification of *Babesia* and other blood protozoa: Thin blood smears were prepared with Giemsa stain to identify the organisms with microscopy (**Fig-1b**).

Molecular confirmation of *Babesia* and other blood protozoa: For molecular confirmation of *Babesia* and other blood protozoa, total genomic DNA from the whole blood samples were extracted with QIAamp-DNA mini-kit, subjected to PCR detection of *Babesia* and its co-infection using the specific published primers (**Fig-1c**).

Gene sequencing and phylogenetic analysis: Gene sequencing was done commercially. Phylogenetic tree was constructed by unrooted neighbor joining method and tree was read by Tree View software.

Establishment of *in vitro* culture and isolation of *Babesia*: *In vitro* culture media was prepared with M199 or RPMI-1640 media, 2% penstrep and 20% bovine serum by mixing gently. Parasite was cultured in a total volume of 1 ml (900 µl working solution, 90 µl fresh RBC and 10 µl infected RBC) in the 24 well culture plate at 37°C and 5% CO_2 in a humidifier incubator followed by subculture. The growth of organism was observed by microscopy in every alternate day (**Fig-1d).**

Preparation of glycerin stock: Glycerin stock was made of infected RBC from culture with glycerol and DMSO, then cryovials were preserved at -80^{0}C for further use.

Results and Discussion: Morphological identification of *Babesia* and other blood protozoa: We examined the blood of suspected cattle in which 96.4% of the samples were found positive for any of three blood protozoa, *Babesia* and/or *Theileria* and/or *Anaplasma,* and 95.5% samples were positive having *Babesia* . All of the cattle (100%) having clinical signs of hemoglobinuria with high fever were positive for *Babesia* organism. Among the positive cases, only one (0.9%) case was detected as single *Babesia* infection, and rest of the positive cases (99.1%) were mixed infection with *Theileria* and/or *Anaplasma*. Triple infections with three pathogens (*Babesia, Theirleria* and *Anaplasma*) contributed the majority (66.7%) of co-infections, whereas double infections were observed in 24.7% of the animals and only 8.6% have single infection with *Anaplasma* (7.7%) and *Babesia* (0.9%). We identified 3 species of *Babesia* in cattle in Bangladesh, where *B. bigemina* were the major species (63.8%) followed by *B. naoakii* (40.0%) and *B. bovis* (3.8%) Age, sex and breed of the cattle had significant effect on *Babesia* infection in cattle in Bangladesh.

Molecular Identification of babesia and other blood protozoa: We identified 3 blood protozoa with published primers**.** In this study we could not identify all the *Babesia* species with published primers, so we established a self-designed genus- and species-specific primer sets to amplify the 18S rRNA genes of *Babesia* to do nested PCR**.** To establish the *in vitro* culture, RBC viability has been tested in laboratory and found that RBC remain alive for 57 days in laboratory condition. *In vitro* culture protocol of *Babesia* has been optimized to culture *Babesia* in bulk. *Babesia* was viable in culture for 10 days**.** When percentage of parasitemia exceeded 10%, subculture was done, where cells were viable for 8 days**.**

Gene sequencing and phylogenetic analysis: Gene sequencing of 35 samples were done commercially and Phylogenetic characterization of *Babesia* has been done.

Glycerin stock for further use: Glycerin stock was made with 400 µl of infected RBC from culture with 500 µl glycerol and 100 µl DMSO (Dimethyl sulfoxide) and has been preserved in 2ml cryovials in -80°C for further use.

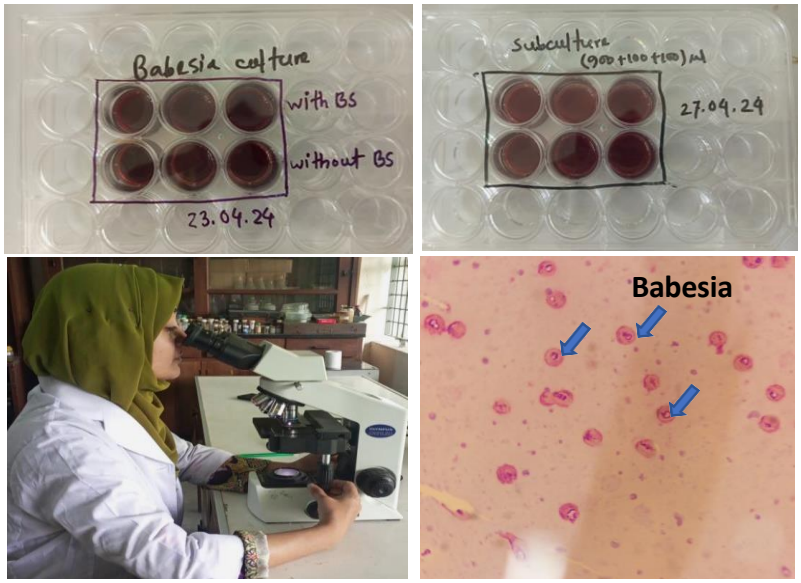


Fig 1: Observation of culture by Giemsa's stain

Conclusions: Altogether, till to date, results of this study showed that 96.4% of the cattle in Bangladesh infected with piroplasms while 95.5% of the studied cattle were infected with *Babesia*. In 99.1% cases, *Babesia* was found co-infected with *Theileria* and *Anaplasma*. In this study, we established a self-designed genus and species-specific primer sets to amplify the 18S rRNA genes of *Babesia. Babesia bigemina, B. naoakii* and *B. bovis* were identified in cattle in Bangladesh. We optimized the *in vitro* culture protocol of *Babesia* in laboratory, made glycerin stock of infected RBC which preserved in cryovials in -80°C for further subculture.

Project Code and Title: TF 129-L/23. Isolation, molecular characterization and vaccine development against bovine *Anaplasma* in Bangladesh

Implementing Organization: Department of Pathology and Parasitology**,** Faculty of Veterinary Medicine, Chattogram Veterinary and Animal Sciences University (CVASU), Chattogram
Component Organization: None
Principal Investigator: Prof. Dr. AMAM Zonaed Siddiki
Location(s): Chittagong, Khagrachori (Manikchori), Bandarban, Chokoria, Teknaf
Budget: Tk. 30.00 Lakh
Duration: 05 July, 2023 to 04 July 2026 (36 months)

Introduction: Anaplasmosis is one of the most common endemic rickettsial vector borne diseases in tropical and sub-tropical countries including Bangladesh. Farm level economic losses are directly related to morbidity, mortality, production losses together with the cost of veterinary diagnosis, treatment, and tick control. An alternative to the traditional vector control is developing immunity through use of locally circulating parasite species. It is essential to collect circulating field isolates/ strains/species of *Anaplasma* and their *in vitro* culture method development using IDE-8 cell lines derived from *Ixodes* tick species. Using the cell culture derived rickettsia, we aim to develop an autogenous killed or frozen vaccine for subsequent field trial.

Objective: Development of *in vitro* culture methods and identify novel vaccine candidates for anaplasmosis in dairy cattle

Materials and Methods:

a) **Collection of samples:** Blood samples and vector tick samples will be collected from selected areas and examined for taxonomy.
b) **Microscopy and PCR assay:** Blood samples (n=500) will be collected from the jugular vein/ ear vein/ coccygeal artery in vials containing EDTA. Giemsa staining will be followed by PCR assay for molecular identification of *Anaplasma sp.*
c) ***In vitro* culture of parasite materials:** The IDE-8 cell lines will be collected from the Tick cell Biobank in University of Liverpool, UK/ TIDREC, University of Malaya and kept in 32 C at the Parasitology Laboratory of CVASU
d) **Experimental infection in cattle:** Vaccine seed from *in vitro* culture of IDE-8 cells will be used for infection trial. ELISA will be employed for assessing antibody level

Results and Discussion: A total of 300 blood samples were collected from Chakoria (n=100), Teknaf (n=100) and Manikchari (n=100). In microscopic examination, 56 (18.67%) samples were found to be positive from the three districs, where 24 samples were found to be positive from Chakoria, 10 samples were from Teknaf, and 22 samples were positive from Manikchari (Table 1). Genomic DNA were extracted from the apparently positive blood samples (n=100) using DNA extraction Kit according to manufacturer's instruction, and the quality and quantity of the extracted DNA were tested using Qubit Fluorometer. In PCR assay, 34 (11.33%) samples were found to be positive for *Anaplasma* sp, of which 18 from Chakoria, 6 from Teknaf, and 10 were positive from Manikchari (Table 1). Alongside, 108 tick specimens were collected from cattle from Chakoria (n=75) and Manikchari (n=33). Four different tick species were identified through microscopy of which 92 were *Haemaphysalis* sp, 5 were *Rhipicephalus* sp, 9 were *Boophilus* sp and 2 were *Dermacentor* sp. (Table 1).

Table 1: Descriptive statistics of samples (Blood, tick) from three selected areas.

Chakoria (N=100 cattle)			Teknaf (N=100 cattle)			Manikchari (N=100)		
Blood sample (100)		Tick sample (75)	Blood sample (100)		Tick sample (0)	Blood sample (100)		Tick sample (33)
Microscopic examination	PCR	Microscopic examination	Microscopic examination	PCR	Microscopic examination	Microscopic examination	PCR	Microscopic examination
24 positives	18 positives	*Haemaphysalis* sp (71)	10 positives	06 positives	No tick sample was found in body	22 positives	10 positives	*Haemaphysalis* sp (21)
		Rhipicephalus sp (1)						*Rhipicephalus* sp (4)
		Dermacentor sp (2)						*Boophilus* sp (8)
		Boophilus sp (1)						

Conclusion: During the last one year, 300 blood samples were collected from three study areas. Alongside hundreds of tick vectors were collected and identified through morphotaxonomy. From blood samples the circulating *Anaplasma sp.* were characterized using conventional Giemsa staining and microscopy. In addition, PCR assay were performed for reliable molecular diagnosis of positive cases for future cell culture propagation. The sequence data will be crucial to explore molecular epidemiology. We have initiated infecting the cell line under culture in CVASU lab. The infective *Anaplasma* is now under careful purification steps which will ensure pure culture of *Anaplasma* in IDE-8 cells which will be used as a possible vaccine material. Over the next few months, we will establish *in vitro* cell culture with purified *Anaplasma sp*. and collect sufficient amount of vaccine seeds for subsequent challenge infection and WGS analysis.

Project Code and Title: TF: 130-L/23. Up-scaling of small-scale sheep rearing model for lamb production in Barind area

Implementing Organization: Department of Veterinary and Animal Sciences, University of Rajshahi
Component Organization: None
Principal Investigator: Professor Dr. Md. Jalal Uddin Sarder
Location(s): Paba and Godagari Upazilla of Rajshahi
Budget: TK. 40.0 Lack
Duration: May 2023 to March 2026 (36 months)
Introduction: Sheep is used for meat, milk and wool worldwide but only for mutton in Bangladesh. Sheep are indigenous type but very prolific. It is an important source of income for the sheep farmers involving minimum investment, care and management. The sheep is neglected species in Bangladesh but its meat value is superior to other animals. The Barind region has a high concentration of indigenous sheep, known for resilience but low productivity. Despite superior meat quality, sheep rearing remains neglected due to unawareness. This project aims to enhance production through improved management, breeding, and awareness programs.

Objective: To disseminate small-scale sheep rearing model among the farmers in Barind area as well as to increase awareness about sheep rearing and family income.

Materials and Methods: The project was conducted at Paba and Gadagari upazilla under Rajshai district. A total of 40 sheep farmers were selected based on prior sheep-rearing experience, economic status, and interest. Beneficiaries received training, five adult sheep (4 ewes + 1 ram), feed in scarcity, participatory housing, and veterinary support. Public awareness were raised through social media and yard meetings. Data on inputs, outputs, and income were recorded for cost-benefit analysis to assess project impact.

Results and Discussion: The project successfully scaled up small-scale sheep rearing in the Barind area through 4 FGDs and surveys, 40 committed farmers were selected, and two-days training program was conducted to increase farmer's technical knowledge on sheep keeping and marketing. Disseminating the Small-Scale Sheep Rearing Model:

- Forty participatory sheep shelters (80 sq. ft each) were built with financial support practices, overcoming challenges like resource constraints through continuous technical support of 5,000 BDT per farmer.

- 200 sheep (160 females, 40 males) were distributed among 40 farmers. A total of 177 lambs were born by this time total sheep population is now 377.
- Farmers adopted scientific management for sheep keeping.

Awareness & Income enhancement:

- Organized twoyard meeting in every alternative month to build up awareness about popularization of lamb and lamb meat.
- School campaigning, leaflet, folder, booklet distribution for awareness about lamb or sheep keeping and lamb meat consumption is going on.
- Article publication on sociodemographic status of the selected farmers is under proceed.
- In sociodemographic, 80% of farmers were middle-aged (31–50 years). Among them women-led participation (87.5%) highlights female empowerment.
- 92% of total selected farmers were marginal farmers (<1 acre landholding), requiring continued financial and technical assistance.
- Sheep rearing experience was low (10.0%) but record-keeping (2.0%) and vaccination (10%) showed strong adoption of best practices.
  After training the record keeping, vaccination, deworming and practices of sanitation were adapted and maintained.



Photo2: KGF Executive Director Dr. Nathu Ram Sarker with sheep farmers after 2 days training on sheep rearing at RU campus



Photo-1 Sheep distribution among the sheep farmers in the presence of project investigators and Chief guest Prof. Dr. Golam Sabbir Sattar, Vice Chancellor of RU

Table-1: Socioeconomic status of sheep farm at study area

Parameters	Frequency	Percentage (%)
Sex involvement of sheep farmers		
Men	4	10%
Women	36	90%
Cast of sheep farmers		
Muslim	35	87.50%
Non-muslim	5	12.50%
Land size		
< 01 Acre	37	92.50%
> 1 acre	3	7.50%
Experience on sheep farming		
Yes	8	20%
No	32	80%
Deworming and vaccination		
Yes	6	15%
No	34	85%

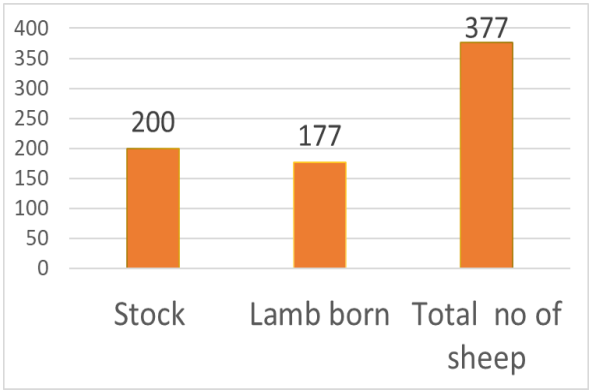


Figure 1: Current status of sheep

Conclusion: The project's structured approach to selection, training, and financial support demonstrates strong potential for scaling up and improving farmer's assets and marketing facilities as well as livelihood develop of rural people in barind region of Bangladesh. The project also significantly boosted lamb production, increasing the total sheep population from 200 to 377 (88.5% growth). Training (100% completion) improved farmers' skills (housing 40 units) and moral ability in sheep keeping, marketing as well as uplifting their living standard that ensure sustainable sheep farming.

Project Code and Title: TF 131-L/23. Adaptation of BLRI Developed Native Chickens to Improve Livelihood of Women in Selected Coastal areas of Bangladesh

Implementing Organization: Bangladesh Livestock Research Institute, Savar, Dhaka
Component Organization: None
Principal Investigator: Dr. Kamrun Nahar Monira, PSO, BLRI
Location(s): Bagerhat districts, Kachua and Bagerhat Sadar upazilla
Budget: TK-45.00 lac
Duration: 21 July 2023 to 30 June 2026 (36 months)

Introduction: Around 29% of the population, live in the coastal zone. The people living in the coastal area have been facing vulnerabilities. Cyclone and storm surge, land erosion, flood and salinity intrusion, incursion of sea water into coastal soils, frequent flood and cyclone**.** This situation is very alarming for natural resource management as well as for future generation. In this situation, poultry species have seen to provide an effective contribution.

Objective: The present research was conducted with the objectives (i) to find out the present status of chicken rearing system in selected coastal areas (ii) to adapt of BLRI developed native chicken in selected areas and (iii) to observe the impact of BLRI developed native chicken rearing on livelihood improvement and income generation.

Materials and Methods: Conducting baseline survey to know the current status of poultry in relation to productive & reproductive performances, processing of products, service facilities, diseases incidence and marketing of poultry in the coastal areas of Bangladesh. Formation of farmers group for practicing improved poultry rearing. Introducing BLRI developed Naked Neck & Non-descriptive Desi chicken (Male: Female=5:35 ratio = 08x40x4=1280 pullets at two upazilla) at selected farmers. Formulation of low-cost ration and development of feeding system for NN and ND chickens. Finally, selection of beneficiaries and collect the required data measurement of livelihood changes compared to baseline survey.

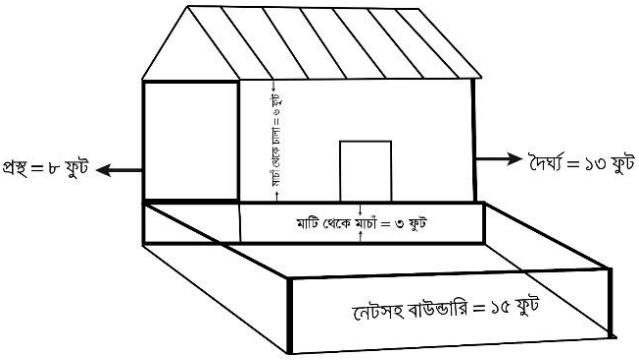
Results and Discussion: The majority of respondents were female (95.25%) compared to male (04.75%). The average age of the respondent's was 39.86±1.89 years. The average year of schooling was 6.95±0.65 years indicating the farmers were not much educated only primary level education they have finished. The level of education was found slightly higher in Kachua Choto Andarmanik village. 100% of respondent's found housewife as their main occupation. Poultry rearing experience were highest in Bagerhat sadar-Mulghar village 14.03±9.10.

Conclusion: The average body weights of growing chicken at 7th week of age were, ND male-655g & female-551g and NN male-630 & female-558g respectively and the difference was significant (P<0.001). These findings revealed that Naked Neck (NN) and Non-Descript Deshi (ND) compare to almost similar performance up to date. Data from laying hen is collecting for analysis. The 1st and half year activities have completed successfully. Satisfactory result was obtained and for further activities project should be continued.

Table 1: Demographic Characteristics of Native Chicken Rearing Farmers

Characteristics	**Categories**	**% of respondents**	**Mean**	**SD**
Age (years)	Young (up to 35)	42.94	28.30	6.93
	Middle (36 to 50)	32.72	42.83	4.22
	Old (above 50)	23.93	58.50	6.89
Education (years of schooling)	Illiterate (0)	0.00	0.00	0.00
	Primary (1–5)	55.62	5.00	0.00
	Secondary (6–10)	50.72	8.58	0.93
	Higher secondary (11–12)	9.41	11.93	0.25
	Graduation or above (>12)	5.93	16.00	0.00
Family size (no.)		**489**	4.93	1.74
Gender	Female	89.57	244.5	273.65
	Male	10.43	12.75	20.17
Occupation	Agriculture	12.88	01.00	0.00
	Business	04.09	01.80	0.00
	Service	04.09	02.85	0.00
	Day laborer	0.82	04.00	0.00
	Housewife	79.61	340.40	0.00
	Others	0.00	0.00	0.00
Experience	Year (0-10)	69.94	5.85	3.18
	Year (11-20)	23.72	15.84	3.18
	Year (above 20)	6.13	28.00	5.17
Farm size (decimal)	Small (0-50)	48.06	19.75	15.08
	Medium (51-246)	44.17	109.77	52.79
	Large (247-above)	7.57	348.57	101.34

a. Age is categorized according to the national youth policy of Bangladesh [58]; SD= standard deviation.



চিত্রঃ মুরগির ঘরের ছবি (৪০ টির জন্য -২.৬ বর্গফুট/বার্ড)



Photo 1:: Low- cost chicken house

Project Code and Title: TF 134-CC/23. Validation and Refinement of Processed Cheese Making Technology through Entrepreneurship Development in Satkhira, Thakurgaon and Shirajgonj Districts

Implementing Organization: Department of Dairy Science, Bangladesh Agricultural University, Mymensingh
Component Organization : None
Principal Investigator: Professor Dr. Raihan Habib
Location(s): Department of Dairy Science, Bangladesh Agricultural University, Mymensingh.
Budget: BDT 40 Lakh
Duration: 01 June 2023 to 31 May 2026 (36 months)

Introduction: : Processed cheese is a long-life cheese variety made from milk curd and/or leftover of other types of cheese with added emulsifying salt through cooking at specific temperature. This variety is occupying roughly 30% of the world cheese market including Bangladesh. It is estimated that around 2,400 tons of processed cheese is imported annually worth around BDT 240 crore. The retail prices of processed cheese ranges from BDT 700 – 1200 in Bangladesh. However, this project and its predecessor NATP Phase-2 invented processed cheese formulation which costs only BDT 350. There is a thriving cheese industry in Thakurgaon, Shirajgonj and Shatkhira districts where around 155 cheese factories are under operation. Many of these entrepreneurs are interested in making processed cheese. Hence, extension and validation of this technology is a demand of time.

Objective: Standardize and disseminate technology for making processed cheese through real life factory application along with cost-benefit analysis.

Materials and Method: Value chain analysis and Supply chain analysis were done following proper methods. Laboratory refurbishment was done to facilitate the development and validation of cheese production techniques. The prospective cheese entrepreneurs have been selected and included in this project. Different trials on manufacturing of processed cheese at pilot scale and factory level were performed. Detailed quality evaluation of the products carried out to refine and standardize the technology. Shelf life of the products was also studied. Cost-benefit analysis of the product was carried out to confirm the profit. Analyses of available commercial cheese products performed which are now available in Bangladesh. Validation of the technology through threadbare analysis of product quality, operational defects identification, repeatability, preference by the manufacturers, and consumer response at selected markets

Results and Discussion: The following 2 Masters' theses have been published entitled "Properties of spreadable processed cheese prepared from acid curd and rennet curd" and "Effect of fat content on the quality of cooking paneer". One PhD thesis under way entitled "Modeling Supply and Value Chains of

Dairy Industry in Bangladesh: Structure, Market Access, Traceability and Resilience of Micro- and Macro-Enterprises". It was observed that processed cheese can successfully made from cooking paneer. It was also found that the manufacturing cost of processed cheese was BDT 560/kg whereas the retail value of imported processed cheese was found to be BDT 960 – 1600/kg, Hence, there has been huge prospect for commercialization of the technology. In total 36 cheese makers have been selected for training and dissemination of the technology: 22 in Thakurgaon, 8 in Shirajgonj and 6 in Shatkhira.
Table-1: Composition of processed cheese made under Masters research entitled "Properties of spreadable processed cheese prepared from acid curd and rennet curd"

Parameter	Spreadable cheese prepared from Acid curd	Spreadable cheese prepared from Rennet curd	P value
Dry Matter (g/kg)	492.67±1.01	482.33±0.77	0.243
Fat (g/kg)	248.33±0.33	247.67±0.29	0.437
Protein (g/kg)	196.00±0.79	180.00±0.22	0.029
Ash (g/kg)	3.07±0.15	3.43±0.15	0.087
Acidity (%)	0.25±0.01	0.18±0.01	0.010

Conclusion: The project aims at inventing and validating the processed cheese making technology for the dairy industry of Bangladesh toward technology transfer, entrepreneurship development and certification followed by patent application. The results so far obtained is highly promising as it shows that processed cheese can easily be made from low-fat acid curd. Hence a low break-even point can be achieved with higher profitability of the manufacturers. Hence this technology is highly promising for the dairy industry in Bangladesh.

Project Code and Title: TF 154-L/23. Finding gaps in broiler supply chain and formation of control strategies

Implementing organization: Department of Pathology, Faculty of Veterinary Science, Bangladesh Agricultural University (BAU), Mymensingh
Component organization: None

Name of Principal Investigator: Prof. Dr. Emdadul Haque Chowdhury, Department of Pathology, Faculty of Veterinary Science, Bangladesh Agricultural University, Mymensingh-2202.
Location (s): Laboratories -Department of Pathology, Department of Pharmacology & Interdisciplinary institute of food safety, BAU, Mymensingh. Field – Poultry farms and markets of Mymensingh and Dhaka division.

Budget: TK. 35.00 Lakh

Duration: October 2023 to September 2026 (36 months)

Introduction: Commercial broiler farming grown rapidly in Bangladesh early in this century but now become stagnant. The demand for broiler meat grew rapidly among the people because of availability, price and ethnic reasons. So, the farmers begin chicken farming with great enthusiasm but become discouraged as they do not receive significant benefits. Broiler prices have come to the lowest in the last few years because of changes in consumer preferences. Marginal farmers are incurring losses and shutting down their farms. If it continues this way, the whole industry may run into serious challenges and the country's nutritional security will be threatened.

Objective: The Objective is to identify and validate the various aspects of the growth and sustainability of the broiler industry in Bangladesh through popularization of broiler meat among people.

Materials and Methods: Three major methodologies were selected to conduct the research. As- the field survey; to identify the broiler supply chain and the per-perceptions of the consumers against rejection of broiler meat and the sayings of the stakeholders (along the supply chain) about these perceptions to identify the gaps in the supply chain.

Then to validate these gaps (weather right or wrong) by laboratory analysis of suitable number of judicious field samples from different stakeholders by HPLC & ELISA and finally some brainstorming activities at different level of the supply chain to popularize the broiler meat among the Bangladeshi consumers.



Fig.1. FGD at dealer point, Kishoreganj

Results and Discussion: The following supply chain has been identified and finalized for the sample collection and data analysis in the survey (Fig. 1).

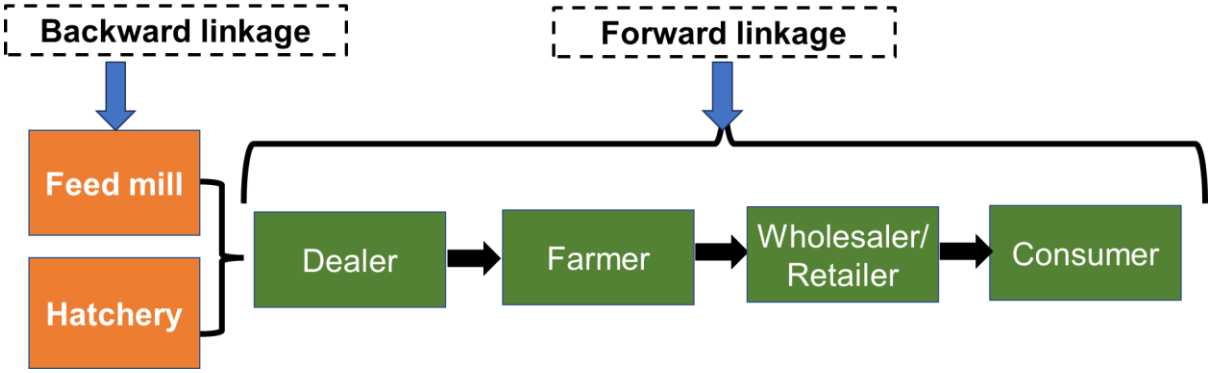


Fig: 1. Supply chains finalized for the current study

During the survey a lot of disputes about commercial broilers among consumers, farmers and other stakeholders was identified mainly with the use of antibiotics, anabolic steroids and hormonal growth promoters. So, methods for residues detection of these substances were validated. ELISA has been found best for the detection of anabolic steroids (Dexamethasone and prednisolone) and HPLC was found best suited for antibiotics (Ciprofloxacin and oxytetracycline) and sex hormones (Estrogen, Progesterone & testosterone). 135 different field samples were collected from feed mills, poultry farms & markets for analysis (Tab.1)

Table.1. sample collection from different sources for analysis

	Feed	water	Muscle	Liver	Viscera	Total
Feed mill	5	2	-	-	-	7
Farmer	10	10	10	10	10	50
Whole seller	8	8	8	7	7	35
Retailer	8	8	8	8	8	40
Total						**135**

Our analysis reveals that, antibiotic residues are high in all samples, dexamethasone and prednisolone residues were within limit and estrogen and progesterone were absent in samples analyzed. Testosterone analysis is yet to be done.

Conclusion: The findings of this study indicate a significant presence of antibiotic residues in all analyzed samples, highlighting potential risks to public health and the need for stricter regulation and monitoring of antimicrobial use in food-producing animals. Although dexamethasone and prednisolone residues were within acceptable limits, the consistent detection warrants continued surveillance. The absence of estrogen and progesterone suggests that these hormones may not be commonly used or persist in the sampled products. Further analysis, including testosterone detection, is necessary to complete the hormonal residue profile. These results underscore the importance of enforcing withdrawal

periods, promoting responsible drug use, and strengthening food safety monitoring systems within the broiler supply chain.

Project Code and Title: TF 160-L/23: Development of recombinant vaccine against hemorrhagic septicemia

Implementing Organization: Department of Microbiology and Hygiene, Bangladesh Agricultural University, Mymensingh

Component Organization: None

Principal Investigator: Sukumar Saha, PhD

Location: Department of Microbiology and Hygiene, BAU, Mymensingh

Budget: 40.0 lakh

Duration: 36 months, from 31 October 2023 to 30 October 2026

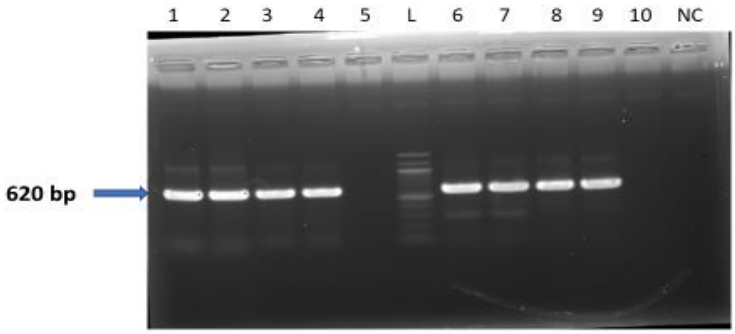
Introduction: Haemorrhagic septicemia (HS), caused by *Pasteurella multocida* B:2 affects livestock, causing high morbidity and mortality with economic loss of US$148.6 million annually in Bangladesh, together with anthrax and black quarter. Vaccinations are the only practical approach to prevent HS, including inactivated vaccines, live vaccines, purified capsular extract vaccines and combination vaccines. Despite traditional vaccines, there is growing interest in modern vaccines, including recombinant vaccines, developed for HS prevention. The present study aims to develop a recombinant HS vaccine by developing the outer membrane protein H of the *P. multocida* B: 2 strain using recombinant DNA technology.

Objective: To develop a recombinant HS vaccine and evaluate the immunogenicity of the developed vaccine in mice and cattle.

Materials and Methods: *Pasteurella multocida* B:2 was cultured in nutrient and BHI broth at 37 °C in a shaking incubator and then the enriched broth was inoculated into Bood agar media. The non-hemolytic colonies from blood agar were gram`s Gram-stained and observed under a microscope. Biochemical characterization of the isolates was also performed. Finally, for molecular detection of *Pasteurella multocida* type B: 2, Polymerase Chain Reaction (PCR) was conducted using 6B gene-specific primers. Subsequently, PCR was done to detect the OmpH gene of *Pasteurella multocida.* Afterwards, the purified *Pasteurella multocida* extracted DNA has been sent to a commercial laboratory for whole genome sequencing.

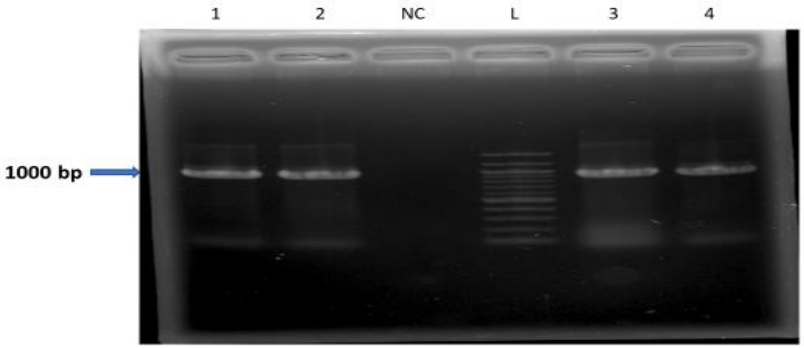
Results and Discussion: *Pasteurella multocida* B: 2 is considered an important veterinary pathogen, being the causative agent of bovine Haemorrhagic septicemia (HS) of cattle and buffaloes (Adlam and Rutter 1989) with high morbidity and mortality rates (Griffin et al., 2010). *P. multocida* serovar B: 2 is the predominant strain in Asia, including Bangladesh. *Pasteurella multocida* B: 2 can be isolated and identified through cultural, morphological, biochemical and molecular characteristics (MA Rahman et al., 2024). The previous study methodologies for the isolation and identification of *P. multocida* B: 2 are aligned with our study, through which we have identified and isolated *P. multocida* B: 2. The disease can be controlled by many strategies, including vaccination. There are several candidate immunogens for the HS vaccine. The porin protein is a conserved antigen among *P. multocida* strains and therefore has been viewed as a potential vaccine candidate (Hatfaludi et al., 2010; Joshi et al., 2013; Kharb and Charan 2011). The outer membrane protein H (OmpH) is a surface-exposed antigen of *P. multocida* and is recognized as a potential immunodominant porin. This highly antigenic OmpH of *P. multocida* (B: 2) has protective and immunodiagnostic potential (Muenthaisong et al., 2020). Considering the valuable statement of these previous studies, the OmpH gene of the isolated *Pasteurella multocida* has been detected through PCR in our study and purified *Pasteurella multocida* extracted DNA has been sent to a commercial laboratory for whole genome sequencing. After completion of sequencing, the cloning and expression of OmpH gene of *Pasteurella multocida* in the expression vector of *E. coli* will be performed for the preparation of recombinant HS vaccine.

Pasteurella multocida type B:2 is identified by PCR



Lane L : 100 bp Ladder, Lane NC : Negative control
Lane 1-4, 6-9 : Positive for *P. multocida* type B:2 at 620 bp
Lane 5, 10 : Negative for *Pasteurella multocida* type B:2

OmpH gene of *Pasteurella multocida* type B:2 is identified by PCR



Lane L : 100 bp Ladder, Lane NC : Negative control
Lane 1-4: Positive OmpH gene of *P. multocida* type B:2 at 1000 bp

Conclusion: *Pasteurella multocida* B: 2 causes bovine Haemorrhagic septicemia in cattle and buffaloes, primarily in Asia. Potential vaccines include porin protein, which is outer membrane protein H (OmpH). The OmpH of *P. multocida* serotype B: 2 has been identified and targeted for the development of a recombinant vaccine.

Project Code and Title: TF 161-L/23. Ensiling Maize Fodder, Maize Stover and Local Grasses for Feeding Livestock in Haor Area of Bangladesh

Implementing Organization: Bangladesh Agricultural University, Mymensingh
Component Organization: Sylhet Agricultural University, Sylhet
Principal Investigator: Prof. Dr. Khan Md. Shaiful Islam, Department of Animal Nutrition, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh
Location(s): Mymensingh
Budget: TK. 35.00 Lack
Duration: October 2023 to September 2026 (36 months)

Introduction: The project was undertaken to evaluate the impact of improved feeding practices using silage technology on dairy cattle performance in the Haor areas of Bangladesh. It aimed to address the

scarcity and seasonality of green fodder by introducing cost-effective and nutritionally rich silage. This initiative targeted smallholder farmers with limited resources and technical knowledge, providing them with training, technical support, and access to high-quality silage. The intervention was expected to enhance milk production using local resources after ensiling for scarcity period. In this study considered maize, chela grass and maize stover for ensiling.

Objective: To evaluate feasibility of silage-based feeding to dairy cattle for further milk production in haor area of Bangladesh using maize, maize stover and locally available grasses.
Materials and Methods: Initially Mohongonj, Mithamoin and South Surma area was surveyed for selection of site for the study. The study was conducted over six months involving 3.0 maize producer for grain and 3.0 maize silage producer as well as 30 dairy farmers from Mithamoin area. High-quality maize silage was produced using locally available materials and stored in airtight conditions in bag, small trance and bunker. Farmers were trained in silage production; silage making and baseline data on milk yield and cattle health were collected. Chemical composition, nutrient yield and economics were studied for silage production and grain production. Feedback from farmers was gathered via structured interviews and field observations to evaluate economic, technical, and environmental impacts of silage feeding.
Results and Discussion: Silage production from maize as per existing cropping pattern were profitable than the production of grain, except some limitations. From the locally available maize produces high quality silage which pH was less than 4.0. Chela grass required wilting for ensiling and possible to produce good quality silage. Farmers have less interest to ensile maize Stover. Farmers reported that the silage was new in haor, but livestock's like to feed silage very much. Farmers encourage making silage for the next year to reduced dependency on seasonal green fodder, leading to greater resilience during dry months. Farmers appreciated the time and labor savings associated with silage feeding, as it reduced the need for daily forage collection. The preserved nature of silage ensured consistent feed availability and quality, which was reflected in more stable production levels.

Table 1. Comparison profitability of maize grain and maize silage production under existing cropping system in haor area of Bangladesh.

Factor	Maize Grain Production	Maize Silage Production
Return (BDT/acre)	80725 ±1693	139088 ±1126
Production cost/acre	48440 ± 146	84818 ± 1180
Profit/acre	32261 ±1632	54253 ± 126
Market Demand	High, stable demand for grain	Growing demand for silage in livestock
Risk Factors	Storage, pest, and moisture risks	Spoilage if not stored airtight

From a technical perspective, the project demonstrated that silage preparation and storage could be effectively managed by smallholder farmers with proper training. Challenges included initial skepticism, lack of storage containers, and labor during ensiling, which were mitigated through continuous support and demonstrations.

Conclusion: Maize silage production has the potential for higher profit margins than maize grain production, but requires careful management in storage and ensiling. With appropriate training and support, smallholder farmers can adopt silage technology, reducing reliance on seasonal green fodder and enhancing climate resilience. The initiative also encouraged efficient use of crop residues like maize Stover and local grass (e.g. Chela grass). Further investment in infrastructure and farmer education is recommended for broader impact.

Project code and title: TF 162-L/23: 'Inimical impacts of injudicious use of drugs and additives on the production performance, meat quality and profitability of small-scale broiler farming'

Implementing organization: Department of Poultry Sciecne, Bangladesh Agricultural University, Mymensingh
Component organization: None
Principal investigator: Dr. Shubash Chandra Das, Prof. Department of Poultry Science, BAU
Locations: Department of Poultry Science, BAU Mymensing
Budget Tk, 35 Lacs35,00,000.00 (Thirty five lakh only).

Duration: November 2023 to October 2026 (36 months)

Introduction: Small- and medium-scale farmers are the principal contributors to broiler enterprises, accounting for around 80% of overall meat-type poultry production in Bangladesh. Poultry dealers provide various inputs (DOC, feed, medicines) as credit, and later in return to the credit, farmers are obliged to buy the mentioned inputs. Since the poor farmers received all supports from dealers as credit, dealers therefore take the weakness of farmers as "opportunity" and exploit them in various ways for their own benefits. In this dealer-farmer interaction, farmers are being tempted or forced by dealers to utilize medications and additives without proper rationale or judicious consideration. The imprudent use of various drugs and additives may lead to an additional production cost of approximately 7-8%, inferior meat quality, or health risks for consumers. Thus, it is crucial to understand whether commercial broilers may be successfully produced by avoiding the injudicious use of drugs and additives.

Objectives: To produce the safe, quality broiler production and minimize the cost of production by avoiding injudicious use of drugs and additives

Materials and Methods: The baseline survey was carried out at different locations of the country with dealers, and small-scale poultry farmers to understand the existing scenario of broiler farming, with special reference to the use of unnecessary use of drugs and additives. The cost-benefit of farming was also focused. In the objective 2, the evaluation of the growth performance, carcass traits, and meat quality of commercial broiler chickens raised with or without the injudicious use of drugs and additives was performed. This experiment was carried out at 'on-station' field trial at the BAU Poultry Farm with 480 DOCs. The birds were distributed with six different treatment groups. For the metagenomic analysis, samples have been provided to BCSIR, followed by primary processing.

Results and Discussion: For the field trial, the DOCs were distributed into the six treatments as, T1 ((SFF-JUDA)= Self-formulated feed with judicious use of drugs and additives; T2 (CF-DrugF) = Commercial feed completely free from drugs and additives; T3 (CF-ADDI) = Commercial feed with additives; T4 (CF-ANTI) = Commercial feed antibiotics; T5 (CF-JUDA)= Commercial feed with a judicious use of drugs and additives, and T6 (CF-InJUDA) = Commercial feed with injudicious use of drugs and additives, as practiced by the farmers. The results presented in Table 1 depicts the changes in growth performance and survival rates of broiler chickens subjected to different regimens of medications and additives. The parameters examined, including final body weights (FBW), body weight gains (BWG), and feed conversion ratio (FCR), were significantly affected by the sole inclusion of antibiotics or additives, judicious or injudicious use of drugs and additives with self-formulated feed (SFF) or with the commercial feed (CF) purchased from the local market. The final body weight of the birds at 5^{th} weeks of age was significantly lower in those fed self-formulated feed with judicious drugs and additives (SEF-JUDA) compared to the other treatment groups receiving various courses of drugs and additives with commercial feed. Similarly, the final body weight increase was significantly higher in the SEF-JUDA groups compared to the other treatment groups; nevertheless, feed intake (FI) remained constant across all treatment groups. The SEF-JUDA group exhibited the highest FCR value compared to the other treatment groups.

A limited number of birds died across all treatment groups, regardless of the feed type, the incorporation of various medications, additives, or antibiotics, resulting in a statistically non-significant impact on the birds' survivability. We have regular contact with the concerned scientist of the BCSIR for the results

of metagenomic analysis, which would more interesting to unveil the insight of microbial dynamics, as affected by the treatments.

Parameters	T_1 (SFF-JUDA)	T_2 (CF-DrugF)	T_3 (CF-ADDI)	T_4 (CF-ANTI)	T_5 (CF-JUDA)	T_6 (CF-InJUDA)	P Value	LS
IBW (g/b)	50.50 ± 0.54	49.87 ± 0.24	50.00 ± 0.00	50.25 ± 0.60	49.88 ± 0.66	49.38 ± 0.38	0.639	NS
FBW (g/b)	1791.30^{b} ± 19.81	2061.74^{a} ± 33.53	2076.97^{a} ±38.53	2121.76^{a} ± 15.99	2074.72^{a} ± 17.15	2117.68^{a} ± 29.51	0.000	**
BWG (g/b)	1740.80^{b} ± 19.68	2011.86^{a} ± 33.47	2026.97^{a} ± 38.53	2071.51^{a} ± 15.84	2024.84^{a} ± 16.50	2068.30^{a} ± 29.24	0.000	**
FI (g/b)	3033.53 ± 21.86	3006.53 ± 27.83	3086.58 ± 43.45	3031.04 ± 65.25	3055.90 ± 44.16	3056.73 ± 57.29	0.869	NS
FCR	1.75^{a} ± 0.02	1.50^{b} ± 0.01	1.53^{b} ± 0.01	1.46^{b} ± 0.02	1.51^{b} ± 0.01	1.48^{b} ± 0.01	0.000	**
Survival (%)	95.00 ± 0.00	96.25 ± 1.25	93.75 ± 1.25	96.25 ± 1.25	96.25 ± 1.25	95.00 ± 2.04	0.701	NS

Table 1. Changes in growth performance and survival of broiler chickens reared with various courses of drugs and additives.

^{a,b}Means bearing uncommon superscripts in a row differ significantly; NS= Non-significant ($p > 0.05$); ** = ($p < 0.01$). Values indicate- Mean± Standard Error (SE); LS= Level of significance, **T_1 (SFF-JUDA)** = Self-formulated feed with judicious use of drugs and additives, **T_2 (CF-DrugF)** = Commercial feed completely free from drugs and additives, **T_3 (CF-ADDI)** = Commercial feed with additives, **T_4 (CF-ANTI)** = Commercial feed antibiotics, **T_5 (CF-JUDA)** = Commercial feed with a judicious use of drugs and additives, **T_6 (CF-InJUDA)** = Commercial feed with injudicious use of drugs and additives, as practiced by the farmers. Here, FBW= Final body weight; BWG= Body weight gain; FI= Feed intake; FCR= Feed conversion ratio.

Conclusion: The survey results clearly demonstrated that almost all the small- and medium-scale broiler farmers use drugs and additives without justifying the actual bird's health condition. The farmers usually do not follow the prescription Nonedvise of registered veterinarians for treatment, rather they follow pre-listed drugs and additives on regular basis, mostly prescribed by the dealers. On-station research results showed that the broilers rared with imjudicoius drugs and additives did not yield significant differences in growth and meat quality. Thus, commercial broilers may be produced successfully without injudicious use of drugs and additives, even the final body weight of the birds reaed drug free treatment was almost close to the other treatment groups fed commercial feed.

Project Code and Title: TF 164-L/24; An Artificial Intelligence-Based Harness Tag for Estrus Detection in Cattle

Implementing Organization: Bangladesh Livestock Research Institute (BLRI)
Component Organization: Adorsho praniSheba Ltd
Principal Investigator: Dr. Md. Amirul Hasan (Implementation Organization) SSO, Animal Health Research Division, BLRI, Savar, Dhaka-1341
Principal Investigator : Dr. Rezaul Alam Reza (Component organization), Chief Veterinary officer, Adorsho Prani-Sheba Ltd Head Office, Mohakhali, Dhaka and R&D Farm, Ashulia, Savar, Dhaka
Location(s): Bangladesh Livestock Research Institute, Savar, Dhaka-1341 and adorsho praniSheba Ltd Head Office, Mohakhali, Dhaka and R&D Farm, Ashulia, Savar, Dhaka.
Budget: BDT 60 Lacs
Duration: 28 Jan 2024 to 27 Jan 2027 (36 months)
Introduction: Following a public call by Krishi Gobeshona Foundation, our concept note was shortlisted. A full proposal was submitted, reviewed, and refined based on feedback. After final submission, the proposal was selected, and an award letter and LoA were signed on 28 January 2024 with KGF.

Objective: To make a sustainable remote estrus detection system through the integration of IoT-based devices & Machine Learning solutions for farmers' doorstep for successful reproduction.

Materials and Methods: The project uses biosensor-equipped harness tags mounted on cattle to monitor rumination, temperature, movement, and ovarian changes. Data is transmitted via nRF24L01 modules to a base station, then to a central server using MQTT over Wi-Fi/Ethernet. Machine learning algorithms are trained on this data to predict estrus. Field trials will refine the algorithm and system performance. The

setup ensures real-time monitoring and reliable data transmission, optimizing farm management and improving cattle breeding efficiency.

Results and Discussion: We conducted a thorough literature review on AI-based cattle estrus detection, exploring machine learning, deep learning, and computer vision techniques. Key trends included neural networks for movement analysis and IoT-enabled real-time monitoring. A simulation using MPU6050 sensors and NRF24L01+ modules with microcontrollers (Arduino/STM32) demonstrated efficient data collection and transmission. Emphasis was placed on power efficiency and rugged design for farm conditions. Cloud platforms like AWS, Google Cloud, and Azure were evaluated, and GPU-enabled virtual machines were deployed for model training and real-time inference. A robust data pipeline was established to manage large sensor data streams for scalable, real-time analysis and system development. We developed core system components, including a harness tag for sensor data collection and a base station for aggregation. A robust database infrastructure was implemented, and data collection is underway. Real-time statistical analysis enables differentiation between estrus and non-estrus stages, with high fluctuations indicating estrus activity in cattle.

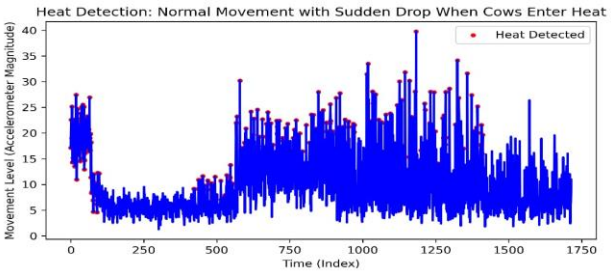


Fig. 1: Statistical analysis of accelerometer data

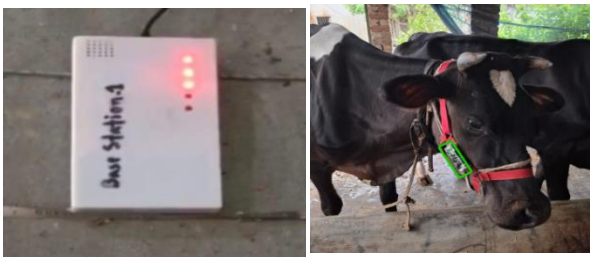


Photo 1: Wearable tag and base station

Conclusion: In the first year, we developed an IoT-based biosensor system using machine learning for real-time estrus detection, supported by collaboration across disciplines, aligning with project goals for cattle production.

Technology Commercialization Program (TCP)
On-going Projects

Project Code and Title: TCP-1. BAU-Bro chicken conservation and piloting their producer-group farming

Implementing Organization: Department of Poultry Science, Bangladesh Agricultural University, Mymensingh

Component Organizations: (i) Palli Karma-Sahayak Foundation (PKSF) and (ii) Protein Mart (BD) Ltd.

Principal Investigator: Dr. Md. Bazlur Rahman Mollah, Professor, Department of Poultry Science, Bangladesh Agricultural University, Mymensingh

Location(s): Department of Poultry Science, BAU Mymensingh: Kishoregoanj, Gazipur, Jamalpur, Joypurhat, Bogura, Naogaon, Natore, Rajshahi and Chapainawabganj district of Bangladesh.
Budget: Tk 5,55,22,400/- (Five crore fifty five lac twenty two thousand four hundred taka only)
Duration: April 2023 to March 2026 (36 months)

Introduction: We developed two meat type chicken strains, BAU-Bro white and BAU-Bro color in 2014 to reduce the dependency on imported chicken strains and later on a validation and refinement study was conducted in different areas of Bangladesh (KGF Project: TF-17-ARI/15). The findings of the farmer's farm level study indicated that the developed strains could be reared at farms level profitably and there is a significant demand of BAU-Bro chickens is prevailing. Therefore, the proposed project will be carried out to establish a "BAU Chicken Conservation and Research Centre" at BAU for the purpose of commercialization of these strains of chicken.

Objective: Conservation and improvement of the parental lines of BAU-Bro chickens and upscaling their production to increase its market share.

Materials and Methods: A "BAU Chicken Conservation and Research Center" will be established by utilizing the previously developed infrastructure (Feed Mill, Hatchery, Renovated Sheds, Laboratory etc., developed previously through KGF Project: TF-17-ARI/15) and other required infrastructures proposed in this project. The sire and dam lines will be selected at every generation for body weight, growth, egg size and egg production. Selected poultry farmers will be given practical training. A "forward linkage (BAU Poultry Conservation and Research Center → Local Hatchery → Farmers)" will be developed. Palli Karma-Sahayak Foundation (PKSF) will be facilitated distribution of chicks through its partner organizations. TRACEABILITY and BRANDING of live and dressed chickens will be carried out in association with Protein Mart BD Ltd.

Results and Discussion: After inception, the project was suffered significantly due to land allocation issues, Covid-19 pandemic and other complexities that had arisen previously at the implementing organization. Later on, the project timeline was rescheduled in April, 2023 and the required land for the construction work has been allocated by the university authority. The land development work was completed and the construction of different proposed infrastructures has been started as per the new schedule. In addition, the procurement of goods required for the project is going on. It is expected that the construction works will be completed by October, 2024. Genotyping of parental lines has been started from the previously isolated DNA form generation 16 (G16). The construction of Pure Line Stock Shed (Tunnel Ventilated), GP Shed (Tunnel Ventilated), Parent Stock Shed, Growing Stock Shed, Hatchery Room and Egg Storage Room are going on at BAU Poultry Farm. Almost 70% of the construction works were completed as estimated from the physical progress of construction work. A total of 6450 DOCs of different lines were hatched and their phenotypic data collection is going on while 2,85,985 nos. of DOCs of BAU chicken were distributed to the farmers in association with PKSF. Two training session on BAU chicken rearing and management for field personnel of NGOs were completed. Technical supports were provided to more than 300 farmers.

Table 1. Reproductive traits of highly inbred chicken lines

Traits	ELC	FDL	FLC	FLW	MLC	SLW
Hen Day Egg Production (62 wks)	$196.38^{b} \pm 21.84$	$144.34^{c} \pm 25.11$	$176.38^{b} \pm 21.84$	$184.65^{b} \pm 28.84$	$178.32^{b} \pm 19.25$	$205.88^{a} \pm 15.44$
Age at sexual maturity (days)	$149.54^{b} \pm 11.33$	$141.74^{b} \pm 12.55$	$147.34^{b} \pm 15.45$	$153.44^{ab} \pm 13.81$	$163.23^{a} \pm 13.41$	$152.62^{ab} \pm 14.24$
Body weight at Sexual Maturity (g)	$1785.97^{b} \pm 94.24$	$1175.85^{c} \pm 62.84$	$1654.97^{b} \pm 124.31$	$1810.33^{b} \pm 54.35$	$2078.60^{a} \pm 102.44$	$1748.53^{b} \pm 86.35$
Egg weight at peak (g)	$56.91^{a} \pm 2.41$	$43.25^{c} \pm 2.14$	$54.91^{b} \pm 2.82$	$55.98^{a} \pm 2.41$	$57.48^{a} \pm 3.44$	$58.04^{a} \pm 3.21$
Hatchability at peak Egg Production	$82.15^{b} \pm 2.40$	$89.11^{a} \pm 3.25$	$83.87^{ab} \pm 3.11$	$79.34^{c} \pm 2.82$	$84.44^{a} \pm 2.77$	$83.95^{a} \pm 3.56$
Hatchability at 62 weeks of age	$78.2^{ab} \pm 3.78$	$84.14^{a} \pm 3.56$	$79.48^{ab} \pm 3.87$	$74.68^{c} \pm 3.86$	$78.08^{b} \pm 3.96$	$79.26^{a} \pm 4.05$
Egg Color	Brown, light Brown	White, creamy white	Light brown, creamy white	Light brown	Brown, light brown	Dark Brown, brown
Inbreeding coefficient	0.93	0.88	0.90	0.94	0.91	0.92

NB. Data are least squared means from subsequent two generations. No. of females >150 in every generation. Hatchability was calculated on the basis of total eggs set. Means with different superscripts

letter within a row differ significantly ($p<0.05$). MLC: Male Line Color, FLW: Female Line White, FLC: Female Line Color, ELC: Egg Line Color and FDL: Fayoumi Derived Line.



Photo1: Newlv constructed Pure line stock



Photo 2: Ready to market BAU-Bro color chicken at farmer's farm (Trishal

Conclusion: The project was suffered significantly due to land allocation issues, covid-19 pandemic and other complexities that had arisen previously at the implementing organization. The project timeline was rescheduled and the required land for the construction work has been allocated by the university authority. The land development work is completed and the construction of different proposed infrastructures has been started as per the new schedule. It is expected that the construction works will be completed by December, 2024. Genotyping of parental lines has been started from the previously isolated DNA form generation 16 (G16). As per the revised timeline, the multiplication of parental stocks was started and 6450 DOCs from different lines were hatched. As per our project plan, day-old BAU-Bro chicks were distributed among the farmers by the help of 34 NGOs in association of PKSF.



Technical Progress

FISHERIES





Bangladeshis have traditionally been reputed as regular and avid fish-eaters. Fish is the major source of animal protein in the Bangladeshi diet. As a riverine country, Bangladesh has been historically well known the world over for producing fish. Bangladesh for the first time has become self-sufficient in fish production with a per capita fish consumption of 62.58 g/day. The target set in Vision-2021 is to produce 4.55 million tons by 2021. To achieve this target sustainable growth of fisheries with improved production technologies and management methods including community based fisheries management, restoration of habitats establishment and maintenance of sanctuaries expansion of cage and pen farming in feasible water areas, adoption of climate smart technologies, etc. is essential. In recent years, KGF sponsored projects on fisheries have addressed some of these issues.



FISHERIES

Competitive Grants Program (CGP)
Completed Projects
CGP 4th Call



Project Code and Title: TF 75-F/20; Study the effects of probiotics on growth and reproduction of selected farmed fishes in Bangladesh

Implementing Organization: Bangladesh Agricultural University (BAU), Mymensingh

Principal Investigator: Prof. Dr. Md. Shahjahan, Department of Fisheries Management, BAU

Location: Department of Fisheries Management, BAU

Budget: Tk. 70 lakh

Duration: December 2020 to November 2023 (36 months)

Introduction: The interest in probiotics as an environmentally friendly alternative is increasing and its application is both empirical and scientific. The main objective of using probiotics for fish culture is to re-establish a favorable association between beneficial and harmful microorganisms that make up the micro-biota in fish intestine. Bacteria present in the aquatic environment influence the composition of the gut micro-biota in fish and vice versa. Probiotics are used for increasing growth, improvement of water quality and enhancement of fish reproduction. This project is designed to study in detail the effect of probiotics on fish in aquaculture.

Objective: To investigate the effects of selected probiotics on performances of Rohu, Nile tilapia, *Gulsha* and *Shing* in aquarium, ponds and biofloc system
Materials and Methods: The first study was aimed to assess the effect of probiotics on the growth, survival and histometry of intestine and liver in the Gangetic mystus (*Mystus cavasius*) in two separate experiments for a period of 8 weeks (in aquaria) and 16 weeks (in earthen ponds). Three different probiotic treatments were incorporated:
1. T1 = Pond Care (T1), 2. T2 = Everfresh (T2), 3. T3 = Laboratory developed probiotic (Lab dev.), 4. T4 = Control

The second study examined the influences of selective probiotics on the growth, hematology, microbes, and morphology of the intestine of Stinging catfish (*Heteropneustes fossilis*) in a biofloc system. Additionally, this study evaluated the benefit-cost ratio (BCR) of using probiotics in the biofloc system. Stinging catfish fingerlings (average weight 0.86 ± 0.26 g) were equally distributed (250 fingerlings/400 L water-filled PVC tank) into three treatment groups and reared for 16 weeks. Two commercial probiotics (CP-1 and CP-2) and one laboratory-developed probiotic were used in the study.

Results and Discussion: The best growth (weight gain and specific growth rate), feed efficiency, and upgrading intestinal morphology of fish were observed in fish reared with the laboratory developed probiotic. This probiotic also significantly improved the immune response indicators such as, fattening of the intestinal mucosal fold, width of lamina propria, width of enterocytes, and abundance of goblet cells were also scrutinized in fish. (Fig. 1). In another study, the best growth (weight gain and specific growth rate), feed efficiency, and upgrading intestinal micro-biota and morphology of fish were observed in biofloc with laboratory developed probiotics. Moreover, significantly increased immune response indicators such as fattening of the intestinal mucosal fold, width of lamina propria, width of enterocytes, and abundance of goblet cells were also scrutinized in fish reared with Laboratory developed probiotics. The least intra cellular distance between liver tissues was observed in laboratory developed probiotic (Fig. 2). Business profitability (BCR) was also found to be the highest for the

laboratory developed probiotics in biofloc. The locally developed putative probiotics performed better than the commercial probiotics in terms of growth of *Gulsha* in the aquarium and Shing in the biofloc system. Maturity and reproduction of Rohu (*Labeo rohita*), Nile tilapia (*Oreochromis niloticus*), *Gulsha* and *Shing* were found satisfactory with the developed putative probiotics.

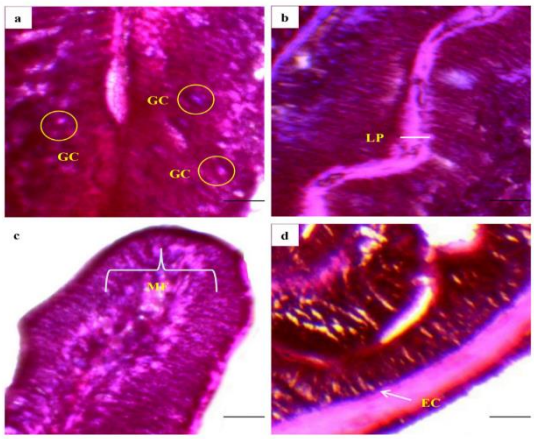


Fig. 1. Immune response indicators of the Gangetic mystus, Gulsha *Mystus cavasius* reared with different probiotics in aquarium for 8 weeks; GC= goblet cell, MF= mucosal folds, LP= lamina propria, and EC= enterocyte. Image 40x; scale bar = 400 µm.

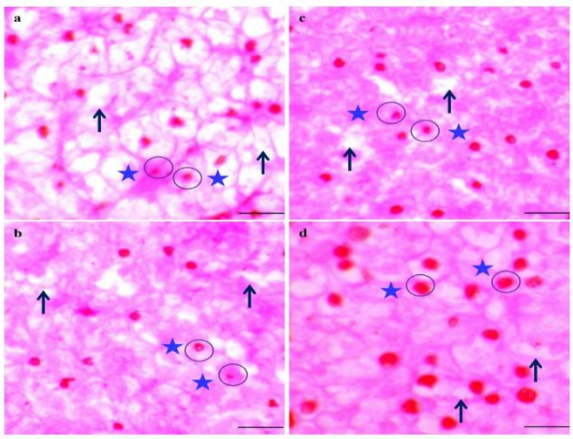


Fig. 2. Histological alterations of liver of the Gangetic mystus (*Mystus cavasius*) reared with different probiotics in earthen ponds for 16 weeks; (a) control, (b) Everfresh, (c) Pond care, and (d) Lab developed. Arrows show space among hepatocyte cell and circles show nucleus shaped. Image 40x; scale bar = 400 µm

Conclusions: A survey showed that 88 different probiotic products from 36 companies are being used in aquaculture farms of Bangladesh supposedly to promote growth, control disease and for water treatment. Probiotic yeast enhanced the growth of fish. Locally developed putative probiotics performed better than commercial probiotics in terms of growth of *Gulsha* in ponds and *Shing* in the biofloc system. Maturity and reproduction of Rohu (*Labeo rohita*), Nile tilapia (*Oreochromis niloticus*), *Gulsha* and *Shing* were found better with the developed putative probiotics than the commercial probiotics.

Project Code and Title: TF 76-F/20, Development of Locally Engineered Low-cost Recirculating Aquaculture System (RAS) in Bangladesh

Implementing Organization: Sher-e-Bangla Agricultural University (SAU), Dhaka
Component Organization: Bangladesh Agricultural Research Institute (BARI), Gazipur
Principal Investigator: Prof. Dr. A. M. Shahabuddin, Department of Aquaculture, Sher-e-Bangla Agricultural University (SAU), Sher-e-Bangla Nagar, Dhaka 1207
Location: Sher-e-Bangla Agricultural University (SAU), Sher-e-Bangla Nagar, Dhaka
Budget: 15960.00 (Thousand TK),
Duration: December 2020 to December 2024
Introduction: Recirculating Aquaculture System (RAS) offers a sustainable method for high-density fish production under controlled environmental conditions with minimal water use. In Bangladesh, developing a low-cost, locally engineered RAS using indigenous materials and simple technology is crucial for promoting climate-smart aquaculture. This project aims to design, fabricate, and validate an affordable RAS tailored for commercial fish species, ensuring efficient water reuse and reduced energy consumption - ideally through solar power. By adapting RAS to local conditions and resources, this initiative supports intensified fish farming, enhances food security, and opens new market opportunities for quality fish production.

Objective: To design, develop, and validate a locally engineered Recirculating Aquaculture System (RAS) using indigenous materials and technology for the efficient and sustainable production of commercially important fish species in Bangladesh

Materials and Methods: A 5000 m^2 shed was constructed to develop and test a gravity-flow based, locally engineered RAS. Simple design, emphasizing energy efficiency and use of local materials were the main issues of these systems. Two systems-a standard RAS (60 m^3) and a locally fabricated unit

(60 m^3) were installed with similar layouts for performance comparison. Components such as tanks, filters, biofilters, oxygen cones, and UV units were developed locally. Trials were conducted using sex-reversed Nile tilapia (*Oreochromis niloticus*), Catfish {Pabda (*Ompok bimaculatus*), Gulsha (*Mystus cavasius*), Tengra (*Mystus tengara*)} and indigenous Sar Punti (*Puntius sarana*). Fish growth, feed use, water quality, and system efficiency were monitored. Data were statistically analyzed using SPSS at a 95% confidence level.

Results and Discussion: The performance evaluation of the locally engineered RAS demonstrated high system efficiency, stability, and suitability for fish production under Bangladesh's environmental conditions. The system, designed with a gravity flow layout (Fig. 1) and solar-supported low-head pumps, maintained optimal water quality parameters -dissolved oxygen (6.5-8.5 mg/L), ammonia (<0.55 mg/L), nitrite (<0.50 mg/L), nitrate (<20 mg/L), comparable to those in the standard RAS. The turbine-based mechanical filters and locally developed biofilters ensured continuous water circulation, minimal clogging, and effective removal of suspended solids and metabolic waste (Fig. 2).

Production trials were conducted with various species, including sex-reversed Nile Tilapia, Pabda, Gulsha, Tengra and indigenous Sar Punti. Growth performance of fish in the locally engineered RAS was found to be statistically similar ($p > 0.05$) to that of those reared in the standard RAS. Tilapia reached an average weight of 300-350 g in 120 days, with a survival rate above 90%. Pabda, Gulsha and Tengra showed promising growth with good feed conversion ratios (FCR 1.4-1.6). Indigenous Sar Punti also adapted well, showing uniform growth and high market acceptability. The system was able to support a stocking density of 60-70 kg/m^3 without compromising water quality or fish health. The solar-powered components ensured 24-hour operation at minimal energy cost. Importantly, the locally fabricated RAS reduced setup costs by over 50%, and the production cost per kilogram of fish was significantly lower compared to standard or imported RAS.

These trials confirmed that the locally engineered RAS is technically feasible, economically viable & suitable and socially acceptable for commercial farming of multiple species. The success of this system not only supports sustainable aquaculture intensification but also contributes to capacity building, technology transfer (Fig. 3), and income generation in rural communities.

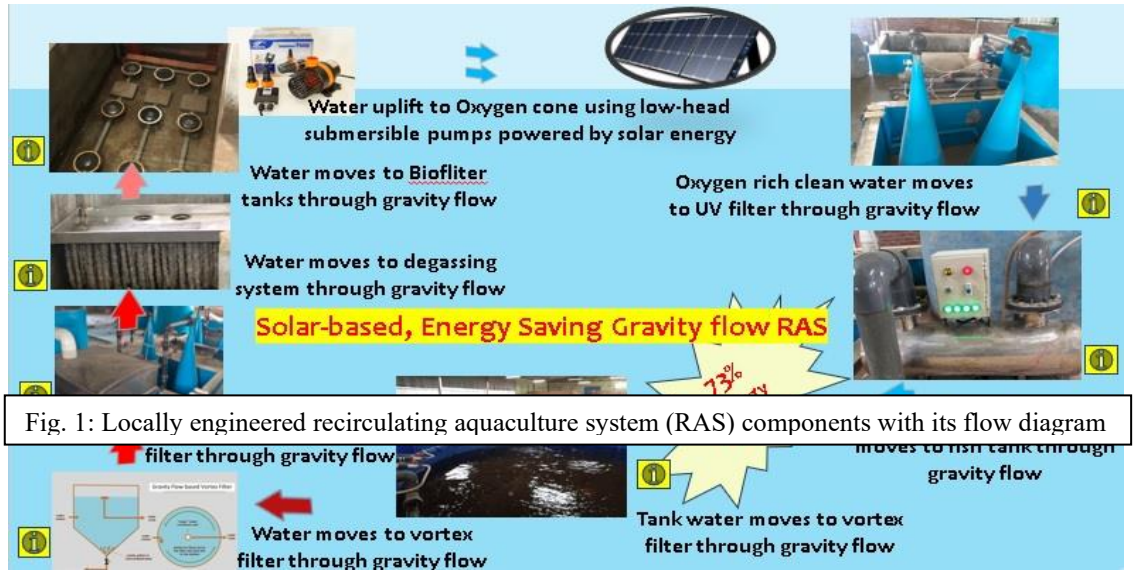


Fig. 1: Locally engineered recirculating aquaculture system (RAS) components with its flow diagram



Recirculating Aquaculture System at SAU Dhaka



Photo 3: Exposure visit government officials of the National Youth Development Academy, Savar

Project Code and Title: TF 85 F-20. Development of sustainable mass seed production technology for Golda shrimp (*Macrobrachium rosenbergii*) and production of quality broodstock in captivity

Implementing Organization: Bangladesh Agricultural University, Mymensingh

Principal Investigator: Dr. Md. Samsul Alam, Professor, Department of Fisheries Biology and Genetics, FoF, Bangladesh Agricultural University, Mymensingh

Location(s): Bangladesh Agricultural University, Mymensingh

Budget: Tk. 10016.10 thousand

Duration: March 2021 to March 2025

Introduction: Unpredictability in Post-larvae (PL) production in the hatcheries is the major shortcoming of expanding Golda shrimp (*Macrobrachium rosenbergii*) farming, one of the most important contributors to the foreign exchange earning of Bangladesh. Prawn hatcheries have been encountering difficulties in PL production for long due to high mortality and many hatcheries have already been closed. Dependency on the unpredictable and decreasing wild source for berried (mother) prawn is another constraint of Golda hatchery sector. Comprehensive identification of the key problems and development of mitigation measures of the hatchery operation problems on one hand and reliable supply of on-farm developed broodstock on the other could help overcome the problem of Golda shrimp seed production.

Objective: To develop a sustainable mass seed production technology by mitigating the problems encountered and development of broodstock of Golda shrimp *Macrobrachium rosenbergii* in pond conditions by nutrition, health, and genetic management.

Materials and Methods: Bacterial isolates grown from the hatchery water, berried prawn and larvae were identified by molecular technique involving PCR amplification of bacteria-specific 16SrRNA gene fragment and sequencing. The disc diffusion method was used to test antimicrobial susceptibility assay according to the recommendation of the Clinical and Laboratory Standards Institute. PCR was also performed to confirm the antibiotic-resistant genes against those antibiotics which were found to be resistant. An experiment was conducted to evaluate the effects of feed supplements on growth. Microsatellite marker genotyping was performed to assess the genetic variations in the progeny obtained from maturation of berried prawn under different sex ratios.

Results and Discussion:
Identification of bacterial species by sequencing of 16SrDNA: A total of nine species of bacteria including the genus *Vibrio*, *Aeromonas*, and *Bacillus* were found in the berried, larvae and water samples used in the hatchery (Table 1).
Antibiotic sensitivity: Nine bacterial isolates detected in the berried and larvae were tested for antibiotic susceptibility against 12 commonly used antibiotics. Out of the nine, five isolates were found to be resistant to all 12 antibiotics. Eight were sensitive to Norfloxacin; two were sensitive to Tetracycline, Oxytetracycline and Doxycycline; two isolates were resistant and seven were either intermediate/sensitive to Ciprofloxacin. Tetracycline, Oxytetracycline and Doxycycline were found to show mixed results. PCR amplification of *tet*A and *aadA1* genes to detect Tetracycline and Streptomycin resistant species, *tet*B and *aac(3)-IV* genes to detect Tetracycline and Gentamicin resistant species, and *era*A gene to detect Erythromycin resistant species. All the isolates were found to contain Tetracycline resistant gene and Gentamycin resistant gene.

Effect of feed supplement on growth of prawn: Quality brood stocks of *M. rosenbergii* were developed under pond conditions (Photos 1 & 2). The comparative growth of prawn reared with basal Golda/Bagda feed of Mega feed (Control) and the basal feed supplemented with Acilina (Spirulina), vitamins and fish oil (Treatment). The mean weight of the prawn of the control group was 56.67 g and that of the treatment group was 67.53 g.

Table 1. Bacterial species identified from the berried, larvae and hatchery water of *M. rosenbergii*

Name of sample	ID	Identified as	Sequence Length (bp)	Query cover (%)	Identity (%)	GenBank Accession
Berried/Larvae	11	*Vibrio fluvialis*	1044	99	98.26	CP053664.1
Berried	12	*Vibrio cholerae*	1028	99	97.12	OP185340.1
Water	13	*Vibrio cholerae*	1044	98	97.44	MN371822.1
Water	14	*Vibrio furnissii*	1045	98	97.43	KJ753847.1
Water (LRT)	3	*Bacillus amyloliquefaciens*	1041	96	97.93%	OL589611.1
Larvae	7c	*Aeromonas caviae*	1042	94	93.59	OQ848197.1
Larvae	7d	*Aeromonas hydrophila*	1020	97	96.94	FJ660445.1
Larvae	8b	*Vibrio parahaemolyticus*	909	89	84.39	MG593213.1
Larvae	9b	*Vibrio vulnificus*	1041	93	97.06	OQ147526.1
Larvae	9c	*Vibrio cidicii*	967	97	97.17	CP035922.1

Assess the genetic parameters of the captive developed broodstock and compare with wild broodstock

Four microsatellite DNA markers were scored, and all were found to be polymorphic. The locus Mbr5 had the highest number of alleles (11) (Fig. 1). The average number of allele in the three groups were almost the same (5.25-5.50) however, the observed heterozygosities of 1:1 and 1:3 sex ratio was higher than that of 1:5 sex ratio.

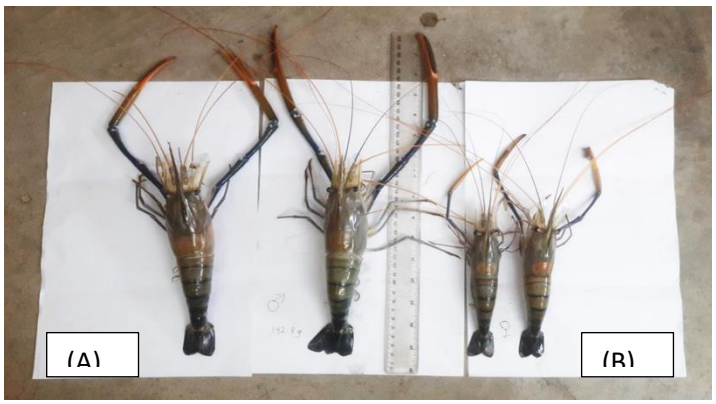


Photo 1. Production of quality broodstock of *M. rosenbergii* in pond the conditions. (A) Male and (B) female prawn. The males (Av. 174 g) are



Photo 2. Production of quality broodstock of *M. rosenbergii* in ponds of the Fisheries Field Laboratory Complex, BAU Mymensingh



Fig. 1. Electropherogram of the microsatellite DNA markers (Mbr5) of *M. rosenbergii*. M: Molecular weight marker. Individual prawns are numbered 1-20

The genetic variability parameters, including the number of polymorphic sites, mutations, nucleotide differences, parsimony informative sites are presented in Table 1. Some variable sites are known as PIS (a characteristic that can usefully distinguish between samples at a genetic level). Six polymorphic sites were found in prawns of both the river and pond sources. The percentage of polymorphic loci observed in the pond source (56%) was found to be higher than that of the river source (44%). Nucleotide diversity in pond reared prawn was higher (0.00241±0.00059) than that for the river-origin prawn (0.00147±0.00047), and the haplotype diversity (0.65224±0.016) was found to be higher in the latter. The number of nucleotide differences (1.443) of the pond reared prawn were found to be higher than that of the river-origin prawn. So, the genetic variation of the pond reared prawn was not lower than that of the wild or river stock prawn.

Conclusions: Unpredictability in post-larvae (PL) production in the hatcheries is a major problem in expanding *Golda* shrimp farming, one of the most important contributors to the foreign exchange earning of Bangladesh. Brood stock of *Golda* shrimp in captivity was developed, and PL production was done in the BRAC hatchery. The project scientists could develop berried whose sizes and fecundity are similar to the berried of the river sources. Responses to dietary administration of nucleotide and beta-glucan including the immune response of *Golda* shrimp PL were assessed. Six bacterial species in samples of berried prawn and larvae were detected. Molecular genetic variation parameters between the river and pond reared prawn genetic were studied and the variations in the two sources were found to be very similar.

Conclusions: A total of nine potential pathogenic bacteria were isolated and identified from the hatchery water, berried and larvae of *M. rosenbergii*. Out of the nine, five isolates were found to be resistant to all 12 antibiotics. Eight were sensitive to Norfloxacin; two were sensitive to Tetracycline, Oxytetracycline and Doxycycline; two isolates were resistant and seven were either intermediate/sensitive to Ciprofloxacin. Tetracycline, Oxytetracycline and Doxycycline were found to show mixed results. Antibiotic resistance gene in the bacteria were also identified. All of the four microsatellite markers scored were found to be polymorphic. Inclusion of feed supplements showed positive effects on growth of prawn. The average number of allele in the three groups were almost the same (5.25-5.50), however the observed heterozygosities of 1:1 and 1:3 sex ratio were higher than that of 1:5 sex ratio.

Project Code and Title: TF 100-F/21. Isolation and identification of indigenous microalgae from southeastern region of Bangladesh and its utilization as live feed for aquaculture industry

Implementing Organization: Chattogram Veterinary and Animal Sciences University (CVASU)

Principal Investigator: Dr. Helena Khatoon, Associate Prof., Faculty of Fisheries (FoF), CVASU

Location(s): Institute of Coastal Biodiversity, Marine Fisheries & Wildlife Research Center, (CVASU), Cox's Bazar and Live Feed Research Corner, FoF and Disease and Microbiology Laboratory, CVASU.

Budget: Tk. 71.30 lakh

Duration: November 2021 to February 2025

Introduction: Microalgae are the primary food sources for aquatic organisms and have an important role in aquaculture since it is the desired food for early growth stages of many commercially important aquatic animals. In Bangladesh, many farms and hatcheries are unaware about the use of microalgae as a nutritional supplement of larvae for their growth. The purpose of this project was to isolate indigenous microalgae and utilize as live feed for shrimp larvae.

Objective: To isolate, identify indigenous microalgae from south-eastern coastal region of Bangladesh for mass production to use as live feed for Aquaculture Industry

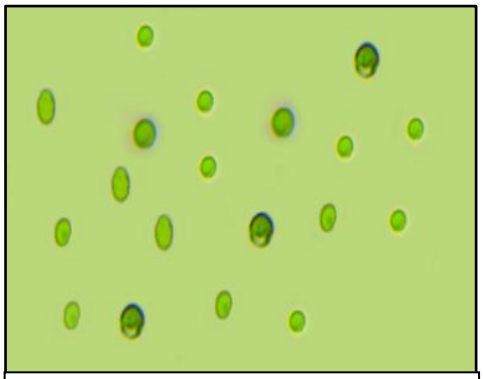
Materials and Methods: Samples were collected from eight different waterbodies of south-eastern region of Bangladesh to isolate and identify the potential microalgae based on morphological and molecular identification. Optimization of growth phases of selected microalgae were done under different culture conditions. Proximate composition of selected microalgae was evaluated using standard protocol. Feeding trial was done to evaluate the growth performance, survival and proximate composition of shrimp (*Penaeus monodon*) post-larvae fed with live microalgae as a potential diet.

Results and Discussion: A total of 48 different microalgae species were successfully isolated from the eight different sampling sides on the basis of morphological identification until genus level using microscope based on morphological features. Morphological identification of microalgae samples was further verified up to species level using DNA extraction technique. Four selected microalgae were identified until molecular label. Growth phase study of different microalgae showed different cell concentration according to the different growth phases. According to the cell density stationary phase were determined for the isolated species.

Table 1: Mean values ± standard error of proximate composition of post larvae (*Penaeus monodon*) reared in different treatments

	Protein	Lipid	Carbohydrate
Indigenous microalgae	68±0.2	9±0.1	5±0.3
Imported microalgae	69±0.1	7±0.2	4±0.1
Rotifer enriched with indigenous microalgae	70±0.3	9±0.1	4±0.2
Rotifer enriched with imported microalgae	68±0.2	8±0.2	4±0.1

Selected microalgal isolates were optimized for their maximum growth, proximate composition based on nutrient (N & P stress) and environmental parameters. *Chlorella* sp. (Fig. 1) has found that cultured in lower concentration of $NaNO_3$ had significantly ($p < 0.05$) higher growth regarding the cell density compared to the higher concentration. *Nannochloropsis* sp. showed significantly higher growth when cultured in higher concentration of nitrogen compared to lower concentration. On the other hand, *Tetraselmis* sp. cultivated in a $NaNO_3$ conc. of 500 mg L^{-1} had significantly ($P < 0.05$) higher growth in terms of cell density compared with other concentrations. Significantly ($P < 0.05$) the highest growth of *Gonyostomum* sp. was observed at pH 8 followed by pH 7, and pH 9 respectively. The salt concentration of 15ppt favors the highest growth of the microalgae with a significant difference in growth ($P < 0.05$) compared to the 20, 30 and 40ppt respectively. In the present study, *Gonyostomum* sp. exhibited significantly ($p < 0.05$) higher cell density when cultured at outdoor natural conditions compared to indoor culture. Outdoor culture was reached stationary phase earlier (on day 7) than the indoor culture (on day 10). Mass culture was done until the stationary phase and harvested for proximate composition. Variation in proximate composition content among different species of microalgae noticed. The selected microalgae were used as live feed for shrimp larvae with significant, survival (Fig. 2), growth performance and nutritional profile of larvae (Table 1) compare to commercial feed. The results indicated rotifer enriched with indigenous microalgae *Gonyostomum* sp. as a nutritionally rich treatment, specially, for protein content a critical factor in dietary applications.



Fig, 1: *Chlorella* sp. isolated from the sampling site

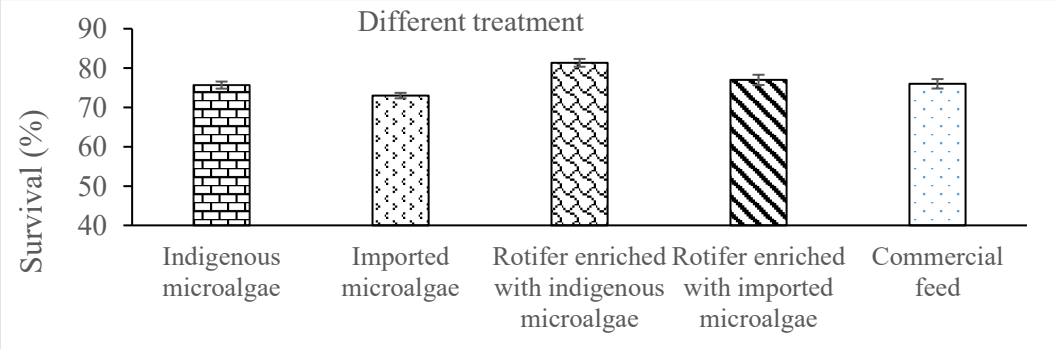


Fig. 2: Survival of shrimp post larvae (*Penaeus monodon*) in the different treatment tanks after a culture period of 10 days. Values are mean ± SE

Conclusion: These findings are able to establish a complete isolation procedure of microalgae. Findings of this project will help the hatcheries and fisheries communities to supply the indigenous microalgae as a live feed for the larvae culture. Transfer of such knowledge will help to establish Industry for producing live feed for larval and early rearing of shrimps. Growth performance, survival and proximate composition of shrimp (*Penaeus monodon*) post-larvae fed with live microalgae were found satisfactory.

Ongoing Projects

Project Code and Title: TF 132-F/23: Assessment of Plastics in the Riverine Fishes and their Ecosystems of Bangladesh

Implementing Organization: Sher-e-Bangla Agricultural University (SAU), Dhaka-1207
Component organizations: None

Principal Investigator: Mir Mohammad Ali, Assistant Professor, Assistant Professor, Department of Aquaculture, Faculty of Fisheries, Aquaculture and Marine Science, SAU

Location(s): Padma, Meghna, Jamuna, Surma, Turag, Pasur, Halda, Karnaphuli, Sangu, Matamuhuri Rivers

Budget: Tk. 28.0 lakh
Duration: May 2023 to May 2025 (36 months)
Introduction: The project aims to assess the extent of microplastic and metal pollution in major riverine ecosystems of Bangladesh. It focuses on quantifying the presence of microplastics in water, sediments and commercially important fish species, alongside measuring heavy metal concentrations and evaluating their public health implications. The initiative seeks to provide scientific evidence for policy advocacy and riverine resource management.

Objective: To assess the presence and impacts of microplastics and heavy metals on riverine fishes and ecosystems in Bangladesh for environmental and public health risk management.

Materials and Methods: Water, sediment, and fish samples were collected from ten major rivers across Bangladesh during the summer and winter seasons (Fig. 1). Samples were analyzed for microplastic presence using digestion, filtration, and microscopic analysis (Fig. 2). Heavy metal concentrations in water were measured using atomic absorption spectrophotometry. A risk assessment was conducted to evaluate ecological and human health threats, and an in vivo exposure trial was initiated to assess physiological impacts of microplastic ingestion.

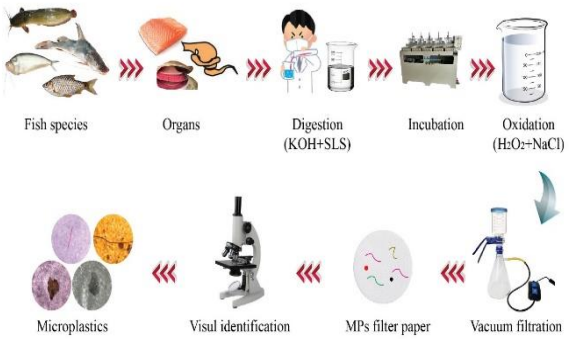


Fig. 2: Sample preparation, digestion, and analytical methods utilized for identifying MPs in fishes collected from ten rivers

Results and Discussion: Preliminary results reveal a concerning presence of microplastics across all ten rivers, with the River Turag showing the highest concentration in water, sediment and fishes. Microplastics were significantly more abundant in sediments compared to water, indicating long-term accumulation. Fish collected from urban-adjacent rivers such as Turag showed higher ingestion of microplastics, suggesting anthropogenic influence. Heavy metal concentrations were found within the national guideline limits; specific exceedances were noted in densely populated or industrial areas. The project also observed behavioral anomalies and growth reduction in Tilapia fry exposed to microplastic-polluted water, signifying potential ecological consequences. Seasonal variation and multi-river data comparison are ongoing.



Fig. 1: Water sample collection from the studied rivers

Conclusion: This project has provided initial evidence that microplastic and heavy metal contamination in riverine ecosystems of Bangladesh is significant and poses threats to aquatic life. River Turag and similar urban rivers are at higher risk. The ongoing analysis will further strengthen the data pool and assist in shaping national river pollution monitoring and mitigation strategies.

Project Code & Title: TF 158-F/23: Development of Tilapia Vaccine Against Infectious Diseases

Implementing Organization: Bangladesh Fisheries Research Institute (BFRI), Mymensingh-2201
Component organization: None
Principal Investigator: Dr. Md. Shirajum Monir, Senior Scientific Officer, FS, BFRI
Location: Freshwater Station, Bangladesh Fisheries Research Institute, Mymensingh-2201
Budget: Tk. 30.00 Lakh
Duration: October 2023 to September 2026 (36 months)
Introduction: Among different cultured fishes, Tilapia (*Oreochromis* sp.) has great potential, but unknown diseases are causing serious economic losses because of their mass mortality. To address the losses due to emerging diseases in Tilapia, antibiotics are the only option for farmers (Monir *et al.*, 2020). Therefore, the aetiological agents of these fish diseases need to be identified, and an effective preventive measure should be taken against these diseases to sustain the productivity of cultured Tilapia in Bangladesh. However, vaccination can be one of the most important and effective prophylactic techniques for preventing outbreaks of different infectious bacterial diseases in Tilapia aquaculture.

Objective: To identify and characterize bacteria causing Tilapia (*Oreochromis* sp.) mortality, develop feed-based inactivated whole-cell vaccines from local isolates, and evaluate their efficacy through a formulated vaccination regimen.

Materials and methods: During the reporting period, 575 diseased Tilapia were collected from 60 farms in Mymensingh, Gazipur, Cumilla, and Chattogram and processed at BFRI, Mymensingh. Bacteria were isolated, cultured on TSA and selective media, and characterized by morphology, Gram reaction, and biochemical tests and molecular methods. The PCR products were Sanger sequenced at First BASE Laboratories, Malaysia, and analyzed for homology using BLAST (NCBI, USA). An experiment on tilapia assessed bacterial pathogenicity using intraperitoneal (*i.p.)* injections, with 120 fish in aquaria, monitored for 14 days, and bacterial re-isolation performed post-mortem. The antibiotic susceptibility of *Streptococcus sp. and Aeromonas sp.* was assessed using the Kirby-Bauer disc diffusion method, following CLSI (2006) guidelines, and MAR index was also calculated.

Results & Discussion: Tilapia (*Oreochromis*) were collected from 60 fish farms in Mymensingh, Gazipur, Cumilla and Chittagong districts whereas, the mortality recorded in the infected Tilapia farms was up to 60 to 80% within two weeks. Around 40% of the infected fish showed gross lesions that were associated with motile septicemia, including necrosis and haemorrhages in fins and tails (Figs. 1a & 1b). Ocular haemorrhages accompanied by exophthalmia (uni- or bilateral exophthalmia) were observed some of the infected fish, alongside skin lessions on the body (Figs. 1c & 1d). Upon dissection, the liver, spleen and kidney of the infected fish were enlarged with moderate to severe congestion. Additionally, haemorrhages in the brain were also found most of the infected fish. Bacterial infections (73%) were the primary cause, followed by fungal (11%), parasitic (9%), and poor water quality (7%) issues. A total of 90 bacterial samples were isolated from 450 samples of diseased Tilapia. The sources of these strains are presented in Table 1. The isolation frequencies of these 90 strains upon anatomical parts of infected Tilapia were lesion (skin and fin) 11 (12.22%), liver/spleen 16 (17.78), head kidney 18 (20.00%) and brain/eyes 45 (50.00%) (Table 1).



Figure 1: Haemorrhages in the tail (a); lesions with haemorrhages on the skin, different fins, and tail (b); ocular opacity with unilateral exophthalmia

Most isolates were Gram-positive cocci in chains, positive for sucrose and mannitol, but negative for oxidase, VP, catalase, indole, H_2S, and urease tests. *Streptococcus agalactiae* and *Aeromonas veronii* were identified by BLAST analysis of 16S rRNA sequences (Fig. 2). *Streptococcus* sp. infections peaked at 75% in July, with cumulative cases between April and October. Moreover, experimental infection with the isolated bacteria caused fish to show hemorrhagic septicemia symptoms similar to natural cases, with *Streptococcus* sp. causing 87% and *Aeromonas* sp. 67% mortality, confirming their role as primary pathogens. In addition, *Streptococcus* sp. showed 71.4% resistance and 14.3% susceptibility to the tested antibiotics, while *Aeromonas* sp. exhibited 57.1% resistance, 28.6% susceptibility, and 28.6% intermediate response under *in-vitro* conditions.

Table 1. Bacteria isolated from different organs of infected Tilapia

Isolated bacterial strains	Distribution (Number & %) of different bacterial stains (n=90) according to site of isolation				Total
	Anatomical parts of infected Tilapia				
	Infected area (skin & fin)	Liver/ Spleen	Head kidney	Brain/ Eyes	
Streptococcus sp. (SM-26)	1 (1.11)	0(0)	4(4.44)	9(10.00)	14(15.56)
Streptococcus sp. (SC-27)	1(1.11)	3(3.33)	2(2.22)	11(12.22)	17(18.89)
Streptococcus sp. (ST-22)	0(0)	0(0)	3(3.33)	9(10.00)	12(13.33)
Streptococcus sp. (SC-21)	0(0)	2(2.22)	2(2.22)	8(8.89)	12(13.33)
Streptococcus sp. (SG-28)	0(0)	1(1.11)	2(2.22)	8(8.89)	11(12.22)
Aeromonas sp. (SM-21)	4(4.44)	5(5.56)	2(2.22)	0(0)	11(12.22)
Aeromonas sp. (SC-22)	5(5.56)	5(5.56)	3(3.33)	0(0)	13(14.44)
Total	11(12.22)	16(17.78)	18(20.00)	45(50.00)	90(100)

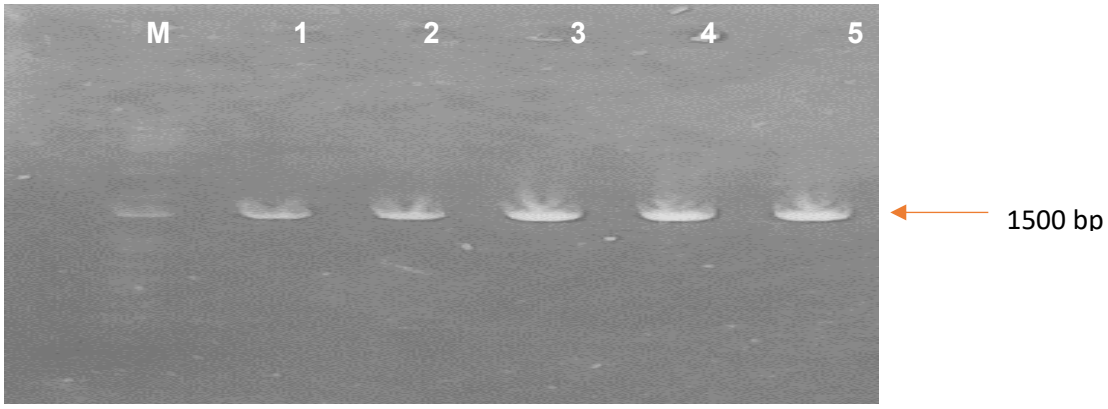


Figure 2: Agarose gel electrophoresis of PCR amplification generated by isolated bacteria at ~1500 bp. Lanes: (M) 1 kbp DNA marker; (1-5) positive (*Streptococcus agalactiae*) samples from field.

Conclusion: Tilapia farming in Bangladesh faces significant challenges due to the emergence of bacterial diseases, particularly those caused by *Streptococcus* sp. and *Aeromonas* sp. The study highlights the alarming mortality rates (60-80%) and the associated economic losses in infected farms. Comprehensive diagnostic analyses identified bacterial infections as the primary cause of these outbreaks, with *Streptococcus* sp. exhibiting alarming levels of antibiotic resistance. The findings underscore the urgent need for effective preventive measures, such as the development of vaccines and improved farm management practices, to mitigate the impact of these diseases and sustain Tilapia productivity in Bangladesh.

Project Code and Title: TF 159-F/23: Up-scaling of BFRI Suborno Rui (*Labeo rohita*) and Boirali (*Barilius barila*) polyculture through on-farm trial

Implementing Organization: Bangladesh Fisheries Research Institute (BFRI)
Principal Investigator: Dr. Md. Moshiur Rahman, Senior Scientific Officer, FS, BFRI
Location (s): Fulpur, Mymensingh and Saidpur, Nilphamari
Budget: Tk. 49.86 lakhs
Duration: October 2023 to September 2026 (36 months)

Introduction: The Bangladesh Fisheries Research Institute recently developed the fourth generation BFRI Suborno Rui (*Labeo rohita*), which is 20.12% more productive than the existing Rui species. This species is also registrant to common carp diseases. Polyculture of this species with other carps yet not been practiced. *Barilius barila* (locally known as Boirali) is also an important fish species of Bangladesh whose induced breeding technology has introduced by Freshwater Sub-Station, Saidpur of BFRI in 2020. It is one of the vulnerable fish species of Bangladesh. This species has a delicacy and is sold at an exorbitant price. Despite its great economic importance, several wild populations have been suffering drastic reduction. Therefore, pond culture of this species might be a solution for its extinction, and it will also enhance the production and economics of pond aquaculture in Bangladesh.
Objective: To test the semi-intensive polyculture and economics of BFRI Suborno Rui (*Labeo rohita*) and Boirali (*Barilius barila*) in farmer's ponds against the normal Rui and other carp species.
Materials and methods: Two separate experiments were conducted within the study period in two different locations. Experiment 01 i.e. Polyculture of BFRI Subarno Rui with other carps was conducted at Fulpur upazila of Mymensingh district and Experiment 02 i.e Polyculture of Boirali with other carps was implemented at Saidpur of Nilphamari district. In all cases the pond area was 30 decimal, and the pond depth was 1.5m. The different treatment combinations of two experiments are shown below:

Experiment-01: Polyculture of BFRI Suborno Rui with other carps

Variables	Technology testing of BFRI Suborno Rui		
	Pond 1	**Pond 2**	**Pond 3**
Species	Silver carp, Catla, Rui, Mrigal.	Silver carp, Catla, BFRI Suborno Rui, Mrigal.	Silver carp, Catla, BFRI Suborno Rui, Mrigal.
Socking density (nos. /deci.)	12 (Silver carp 2, Catla 2 Rui 5, Mrigal 3)	12 (Silver carp 2, Catla 2, BFRI Suborno Rui 5, Mrigal 3)	12 (Silver carp 2, Catla 2, BFRI Suborno Rui 5, Mrigal 3)
Individual stocking size (g)	200-250 g	200-250 g	200-250 g

Experiment-02: Polyculture of Boirali with other carps

Variables	Technology testing of polyculture of Boirali		
	Pond 1	**Pond 2**	**Pond 3**
Culture system	Polyculture of carps	Polyculture of Boirali with carps	Polyculture of Boirali with carps
Species	Silver carp, Catla, Rui, Mrigal.	Silver carp, Catla, Rui, Boirali, Mrigal.	Silver carp, Catla, Rui, Boirali, Mrigal.
Socking density (nos. /deci.)	12 (Silver carp 2, Catla 2 Rui 5, Mrigal 3)	510 (Silver carp 1, Catla 2, Rui 5, Boirali 500, Mrigal 2)	510 (Silver carp 1, Catla 2, Rui 5, Boirali 500, Mrigal 2)
Individual stocking size (g)	200-250 g	Carps 200-250 g, Boirali 5-6 g	Carps 200-250 g Boirali 5-6 g

Results and Discussion:

Polyculture of BFRI Suborno Rui (*Labeo rohita*) with other carps through on-farm trial (Expt 01):

The weight gain of BFRI Suborno Rui, Catla, Silver carp and Mrigal at ponds-1 and 2 were 1112 & 1029g, 1221 & 1218g, 1302 & 1352g and 1013 & 918g, respectively. The weight gain of Local Rui, Catla, Silver carp and Mrigal at ponds-3 was 936g, 1202g, 1319g and 939g, respectively (Table 1). The average survival of fish in the two farmer's pond was almost identical which was found to be varied between 91 and 98%. The main factor that may have attributed to the high survival was proper stocking of healthy sized fingerlings, freedom from predation, favorable ecological conditions and proper feeding, etc. After completion of the culture period, the production of BFRI Suborno Rui was 1645 and 1570 kg/ha in P-1 and P-2, respectively. In comparison, the production of Local Rui was 1318kg/ha. Cost and return were performed to estimate the net profits of polyculture. Estimating cost of production, variable costs towards lease value, labour, lime, fingerlings, feed and harvesting costs were taken into consideration. The net benefit of Tk. 352151, Tk. 325628 and Tk. 258920 were obtained from P-1, P-2 and P-3, respectively (Table 2).

Details of stocking, harvesting and production of Boirali and other carps are presented in Table 3. The weight gain of Rui, Catla, Silver carp, Mrigal and Boirali at ponds-1 and 2 were 708 & 675g, 777 & 785g, 827 & 819g, 630 & 604g and 7.51 & 8.33g, respectively. The weight gain of Rui, Catla, Silver carp and Mrigal at ponds-3 was 810g, 961g, 992g and 667g, respectively.



Plate 01: Sampling and harvesting of Suborno Rui and other carps





Plate 2: Polyculture of BFRI Suborno Rui (*Labeo rohita*) and Boirali (*Barilius barila*) with other carps through on-farm trial

Table 1: Growth performance of Suborno Rui with other carps at polyculture system

Pond	Species	Stocking density/dec	Initial wt. (g)	Final wt. (g)	Weight gain (g)	SGR (% bw/day)	FCR	Survival (%)	Yield/ha (kg)
01	BFRI Suborno Rui	5	271±14.52	1387±24.57	1112 ±21.52	0.68±0.03	1.49	96	1645
	Catla	2	219±17.10	1435±29.22	1221±25.19	0.78±0.05		98	699
	Silver	2	332±21.54	1634±26.79	1302±24.31	0.66±0.04		95	773
	Mrigal	3	261±19.10	1262±23.45	1013±18.73	0.66±0.05		96	899
02	BFRI Suborno Rui	5	271±14.52	1298±23.69	1029±22.63	0.65±0.04	1.58	98	1570
	Catla	2	219±17.10	1435±26.13	1218±22.97	0.78±0.06		99	697
	Silver	2	332±21.54	1684±31.97	1352±19.61	0.68±0.05		96	805
	Mrigal	3	261±19.10	1195±25.54	918±20.96	0.63±0.04		98	867
03	Local Rui	5	245±21.57	1176±21.65	936±19.59	0.65±0.05	1.71	91	1318
	Catla	2	219±17.10	1425±29.43	1202±25.65	0.78±0.06		97	684
	Silver	2	332±21.54	1645±25.98	1319±21.83	0.67±0.06		95	778
	Mrigal	3	261±19.10	1204±26.56	939±19.47	0.64±0.03		96	857

Table: 2: Cost benefit analysis of BFRI Suborno Rui polyculture

Item	Pond-01		Pond-02		Pond - 03	
	Quantity	Amount (Tk.)	Quantity	Amount (Tk.)	Quantity	Amount (Tk.)
Pond Preparation	-	5000	-	4000	-	5000
Fingerlings	420 nos.	10500	360 nos.	9000	420 nos.	10000
Supplementary Feed	845 kg	44785	755 kg	40015	877 kg	46481
Fertilizer/Salt/Lime	-	3000	-	2500	-	3000
Netting	-	4000	-	4000	-	4000
Other costs	-	5000	-	4000	-	5000
Total cost	-	72285	-	63515	-	73481
Gross return:	567 kg	122185	479 kg	103065	514 kg	110170
Gross Margin/pond	-	49900	-	39550	-	36689
Gross margin/ha	-	352151	-	325628	-	258920

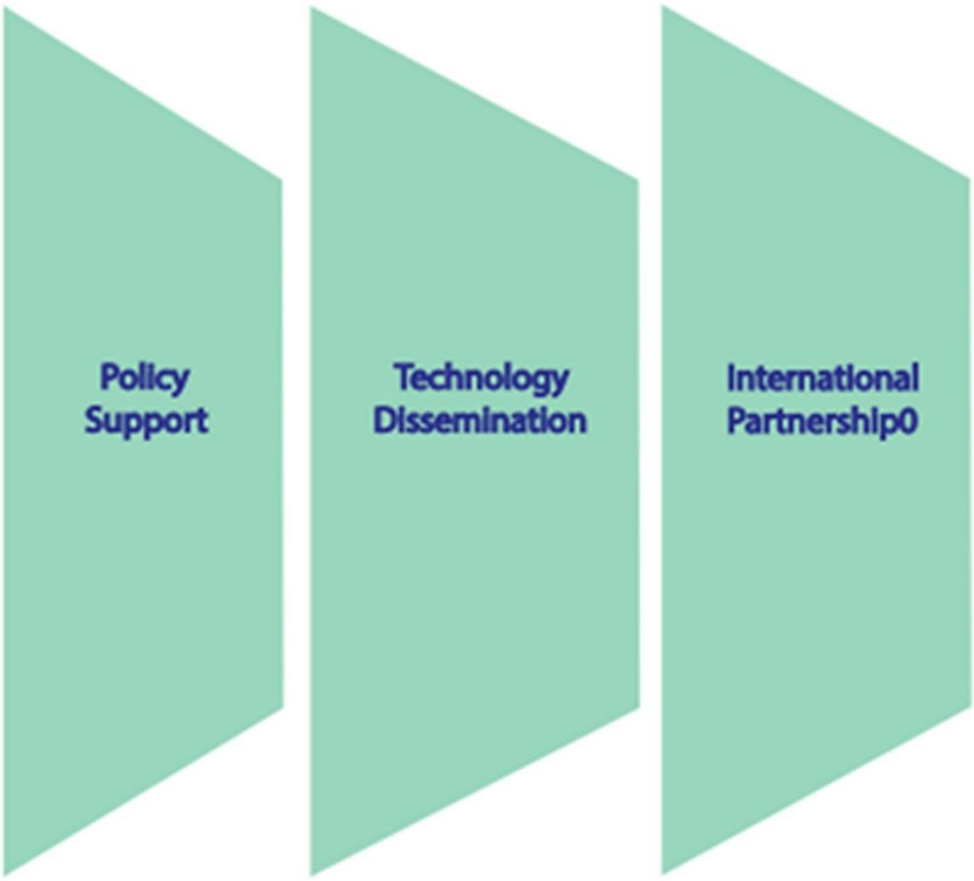
Table 3: Growth performance of Boirali with other carps at polyculture system

Pond	Species	Stocking density/dec	Initial wt. (g)	Sampling wt. (g)	Weight gain (g)	Daily weight gain (g)	SGR (% bw/day)
01	Rui	5	119±11.56	823±21.62	708±20.97	2.93±0.92	0.81±0.07
	Catla	2	136±14.75	911±24.07	777±21.19	3.23±0.73	0.79±0.05
	Silver	1	129±10.63	956±18.16	827±20.48	3.45±0.67	0.83±0.09
	Mrigal	2	123±11.41	753±19.53	630±17.98	2.63±0.76	0.75±0.05
	Boirali	500	**1.5±0.46**	**8.98±2.74**	**7.51±2.47**	**0.03±0.01**	**0.75±0.04**
02	Rui	5	121±9.98	796±17.48	675±15.65	2.81±0.51	0.78±0.06
	Catla	2	141±16.28	926±23.17	785±21.23	3.27±0.73	0.78±0.08
	Silver	1	132±13.87	947±22.56	819±23.37	3.40±0.71	0.82±0.05
	Mrigal	2	127±10.92	728±21.81	604±19.59	2.50±0.49	0.73±0.06
	Boirali	500	**1.5±0.39**	**9.86±3.11**	**8.33±2.97**	**0.03±0.01**	**0.78±0.08**
03	Rui	5	124±10.59	934±25.41	810±22.98	3.38±0.87	0.84±0.04
	Catla	2	131±18.23	1092±23.26	961±25.71	4.00±1.01	0.88±0.05

	Silver	2	143±14.78	1135±26.19	992±21.87	4.13±0.94	0.86±0.07
	Mrigal	3	117±12.49	784±19.60	667±20.49	2.78±0.41	0.79±0.09

Conclusion: This study has demonstrated the impact of improved strain in enhancing growth and economic viability to sustain in the farmer's field. This study also reported the growth performance of Boirali with other carps. BFRI Suborno Rui exhibited better weight gain and economic return than normal Rui in polyculture system. The culture viability of Boirali with other carps in the polyculture system will be studied after final harvesting. The improved strains can substantially increase fish production and productivity, which have a positive impact on the fish farmers' livelihoods.

Other Initiatives and Services



Other Initiatives and Services

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 2023-24, a good number of 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 the KGF funded projects.

Technical support to policy makers

KGF had assigned agriculture experts to provide policy support to the Ministry of Agriculture on technical aspects of various agricultural R&D, production and contingency issues of national importance.

KGF continues policy research and remains prepared to assist government planners and policy makers in the formulation of plans and policies related to R&D and production in the agriculture sector of Bangladesh.

Awareness building and technology dissemination

KGF initiated an awareness and technology dissemination drive through regular TV broadcasts. Video clips of relevant project activities in farmers' fields and interviews of farmers/scientists/extension workers are recorded and telecast. Four remaining episodes as per contract have been broadcasted in Channel 24 during 2023-24.

International partnership: Information, Knowledge and technology exchange:

KGF participated with international organization/ institutes and donors through executing co-funding projects. During 2023-24, 4 projects with internation collaborations with few international R & D organizations like CIMMYT, IRRI, ACIAR were continuing that help to share and generate information and knowledge and technology exhange.

Organizational, Administrative and Financial Responsibilities



Organizational, Administrative and Financial Responsibilities

Besides supporting, overseeing and managing implementation of agricultural R&D programs like CGP, CRP, ICP, CEP and TPP. In addition, the Foundation has certain other responsibilities to look after, such as, providing policy inputs to the Ministry of Agriculture, organizing functional, strategic and policy making meetings, national and international seminars, symposia, workshops, regular dissemination and diffusion of information and knowledge through assorted publications, promotional activities, media campaigns, etc. are also an important part of the KGF brief.

Governance

The Board of Directors (BoDs)

The Board of Directors (BoDs) of KGF comprise seven elected members from the General Body (GnB) who are reputed personalities in diverse fields of agricultural research and development. A list of members of the KGF BoD and BoD is furnished in Annex-1. BoD has the authority to take any decision needed for the smooth functioning of KGF.

Meetings of the Board of Directors

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 decisions pertaining to KGF functions, operations and 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).

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, review BARC prioritized researchable areas, select issues appropriate for inviting proposals for KGF funding, identify areas where new initiatives may be required and recommend resource allocations for CGP and other projects. To accomplish this, several TAC meetings were arranged by KGF. A list of KGF projects so far approved by TAC since the inception of KGF is provide in Annex-2??.

Workshops/seminars/consultation meetings/ Training programs

KGF organizes short- to medium-term training programs for capacity building of professionals engaged in agricultural research and extension work at NARS institutions, universities, DAE, NGOs, etc. Also, internal workshops mostly in relation to monitoring of on-going projects and national workshops are regularly organized by KGF to strengthen coordination and support for work on agricultural R&D issues. The Foundation also assists in organizing international workshops to establish linkages and collaboration between national and international agricultural research organizations and universities.



In addition to regular activities like management of on-going projects, monitoring, reviewing and evaluation, KGF organized meetings of the Board of Directors and held research review workshops. So far during 2023-24 about 100 workshops, seminars, consultation meeting, training programs were organized by KGF.

In the year under report, KGF organized and held 100 project inception/coordination/ review/completion report out workshops participated in by working scientists of the KGF sponsored projects, KGF professionals and relevant reviewers and experts invited by KGF. Also, during the year,

The Executive Director and other KGF scientists participated, as invited experts, several meetings, seminars and workshops organized by national international organizations such as, BARC, NARS institutions, universities, NGOs, etc. Several national and international degrees visited KGF and exchanged views with the Executive Director and other KGF professionals. All these events and activities were supported by BKGET funds. Besides, KGF responded to queries from different bodies like MoA, BARC, KGF Board, etc. through reports or presentations.

Monitoring and Evaluation

The Monitoring and Evaluation (M&E) program is meant for assessing and reviewing implementation status 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 inv estigators/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 in 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 like internal and external monitoring. KGF professionals regularly monitor ongoing projects in two ways, i.e., (i) desk monitoring and (ii) field monitoring. KGF also evaluates these ongoing projects through hiring external teams.





KGF professionals regularly monitor on-going projects in two ways i.e., (i) desk monitoring and (ii) field monitoring. KGF also evaluates these ongoing projects hiring external teams. A 15-member Independent Monitoring Team (IMT), engaged by KGF, comprising senior experts from various disciplines of agricultural sciences, such as horticulture, agronomy, plant breeding, plant pathology, entomology, livestock, fisheries, agricultural engineering, and agricultural economics monitored the 37 ongoing projects. The team was provided with the structured monitoring formats, inception reports, latest annual reports and lists of projects with project details. The team carried out systematic field and monitoring and scrutiny of financial transactions related to implementation of KGF sponsored projects by various agricultural research institutions and organizations and extension agencies. A comprehensive monitoring report has been furnished by IMT. During 2023-24, a 15-member monitoring team monitored and evaluated 50 on-going KGF-funded projects.

Internal and external monitoring

Internal project monitoring is done by assigned desk officers (technical experts of KGF) through a) desk monitoring to ensure timely submission of reports on activities and documents related to i) inception workshops, ii) annual workshop, iii) timely submission of biennial and annual project reports, etc., and b) field monitoring through occasional visits for physical verification of trials at the planned sites. 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.



External project monitoring is done by hiring teams comprising competent and experienced agricultural scientists and academicians of the country (Annex-3). The monitoring teams independently visit the project sites and extensively interact with implementing scientist(s) at the concerned research stations and on-farm sites for two to three weeks and furnish detailed monitoring and evaluation reports to KGF. Based on these reports, the KGF management, if necessary, revises the project funding and work strategies. The external monitoring team, following field visits and rigorous evaluation of the technical and financial performances of the projects reported that the projects were being implemented satisfactorily. However, the team members provided some feedbacks on the project activities for better implementation of the projects.



Consultation Workshop between Board and TAC

বিগত ১৯/০২/২০২৪ খ্রি: তারিখে কেজিএফ বোর্ড ও ঞঅঈ সদস্যদের নিয়ে একটি কনসালটেশন ওয়ার্কশপের আয়োজন করা হয়েছে। উক্ত ওয়ার্কপে ৬ষ্ঠ কলের আওতায় ঞযবধসধঃরপ জবংবধৎপয অৎবধং ওংঁবং ঞঅঈ কর্তৃক সুপারিশকৃত কেজিএফ বোর্ড এর মাধ্যমে অনুমোদিত হয়। পরবর্তীতে কেজিএফ এর ওয়েব সাইড সহ বহুল প্রচারিত দুইটি (১টি বাংলা ও ১টি ইংরেজি) দৈনিক পত্রিকায় শুধুমাত্র খরাপ্রবন বরেন্দ্র অঞ্চল ও উপকুলীয় লবনাক্ততাপ্রবন অঞ্চলে প্রতিকুল কৃষি বাস্তুতন্ত্রের জরুরী প্রযুক্তির প্রয়োজনীয়তা বিবেচনা করে সিজিপি ৬ষ্ঠ কলের প্রকল্প প্রস্তাব আহবানের লক্ষ্যে বিজ্ঞপ্তি প্রকাশ করার বিষয়ে সিদ্ধান্ত গৃহীত হয়।



Reviewer panel

In each year, the reviewer panel of KGF is reformed/revised through adding eminent agricultural experts of the country. 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 presented in this report. However, it is available at the KGF office.

Publications

Annual report

The annual report, published yearly, is a key document detailing major KGF activities, implementation status and progress statements related to projects sponsored and funded by KGF. This publication endeavor has been continued and maintained through the years following the inception of KGF in 2007. This draft annual report 2023-24 is the 15th of the series of annual reports of KGF.

Journal of Agricultural Innovation and Development (JAID)- KGF Journal: is an open-accessed peer-reviewed bi-annual Journal published by the Krishi Gobeshona Foundation (KGF) which is a non-profit organization for sustainable support to agricultural research & development in Bangladesh. This is an inclusive Journal to publish scientific advancement in agriculture and allied disciplines. The Journal publishes original research articles, review papers, case studies and short-communications covering the areas of crop science, horticulture, animal science, fisheries, natural resource management, mechanization and post-harvest processing, agro-forestry, agricultural economics and rural development, climate change, social science and any other cross cutting issues in agricultural sciences. After inception of Journal, KGF has published four issues of Journal.

Technical Bulletin: KGF has been published 65 technical bulletins on the results of the successful BKGET funded Competitive Grants Program and other projects

Projukti Barta: KGF published two volumes of projukti barta on the successful technologies of the completed BKGET funded projects of 2nd and 3rd calls on CGP Projects during 2023-24.

Booklets/leaflets

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.

List of Sponsored Publications from Different Scientific Forum

- Smart Agronomy for Sustainable Crop Production
- Plant Tissue Culture & Biotechnology Conference.
- Food and Nutritional Security for Achieving Sustainable Development Goals (SDGs) in SAARC Countries: Revisiting Extension Approaches and StrategiesTowards Tomorrow
- Sustainable Improvement in Health and Production of Livestock in the context of 4th Industrial Revoluation
- Biotechnology in Health and Agriculture 2023: Biotechnology for Sustainable Development in Agriculture, Environment and Health.
- Roadmap for Creating climate resilience livestock in Bangladesh
- গল্পঘর
- চিন্ময়ী
- কালজয়ী

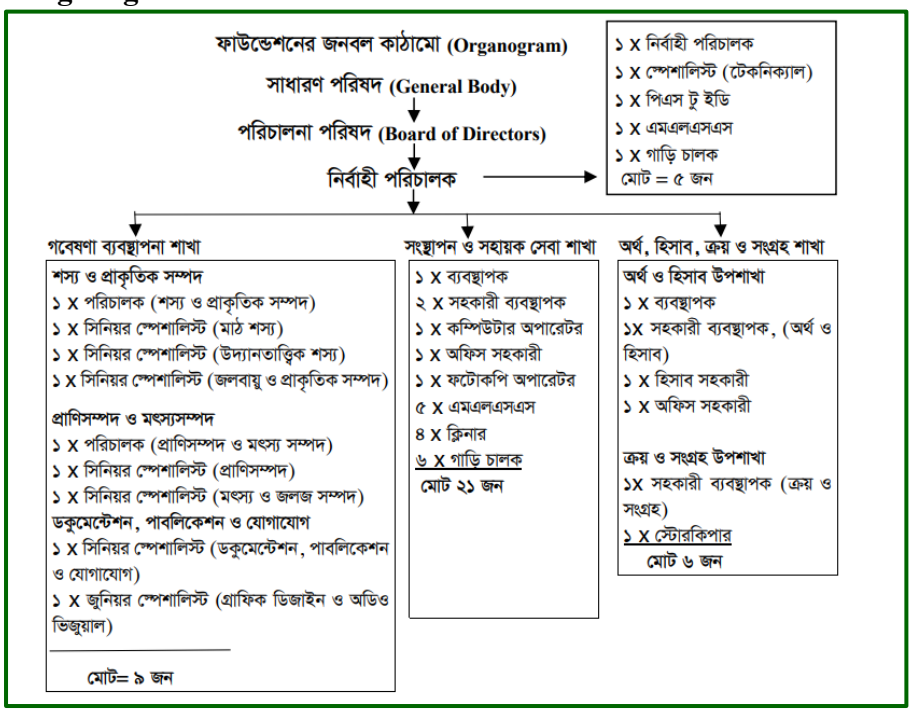
International visits and delegations

কেজিএফ ও ACIAR এর যৌথ অর্থায়নে পরিচালিত ICP-I:(Phase-II): Mitigating risk and scaling-out profitable cropping system intensification practices in the salt-affected costal zones of the Ganges Delta (CSI4CZ-II) ' শীর্ষক প্রকল্পের আওতায় Can Tho University Vitetnam এ অনুষ্ঠিতব্য ÔACIAR Salinity Vet Future Symposium এ বিশেষজ্ঞ হিসেবে ড. নাথু রাম সরকার, নির্বাহী পরিচালক (অ.দা) এবং ড. মো: আককাছ আলী, পরিচালক, শস্য ও প্রাকৃতিক সম্পদ, কেজিএফ, অংশগ্রহণের লক্ষ্যে বিগত ৩-৭ মার্চ ২০২৪ খ্রি: পর্যন্ত Vietnam এ সফর করেন। উল্লেখ্য যে, উক্ত সফরে সকল ব্যয়ভার CSIRO বহন করেছে। কেজিএফ হতে কোন অর্থ খরচ হয়নি।

International delegations

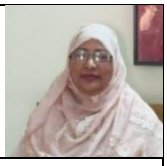
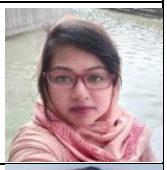
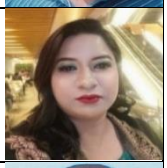
এছাড়াও ACIAR, CIRDAP, IFRI, FAO, IRRI, Wageningen University, Cornel University, ICP, CIMMYT, CIP, CATALIST funded by UK, SDC and Danida, Murdoch University (Australia), IDE, ICDDRB, SAARC, BKGET, IRRI, BLRI ইত্যাদি সহ বিভিন্ন টিমের সাথে বিভিন্ন সময় কেজিএফ এর সভা অনুষ্ঠিত হয়।

The KGF organogram



The KGF team

1.	Dr. Nathu Ram Sarker Executive Director (Additional Charge) Livestock and Fisheries	
2.	Dr. Md. Akkas Ali Director Crops and Natural Resources	
3.	Ms Nasrin Akter Senior Specialist Documentation, Publication and Communication	
4.	Dr. Naresh Chandra Deb Barma Senior Specialist Field Crops	
5.	Dr. Monowar Karim Khan Senior Specialist Climate and Natural Resources	
7.	Dr. Md. Ershaduzzaman Senior Specialist Livestock	
8.	Dr. Md. Khalilur Rahman Senior Specialist Fisheries & Aquatic Resources	
9.	Dr. Shahrina Akhtar Specialist (Technical)	
10.	Mr. Md. Mehedi Hasan Manager Establishment and Support Service	

11.	Ms. Fatema Parvin PS to ED	
12.	Mr. Md. Rafiqul Islam Akanda Assistant Manager Support Service	
13.	Mr. Md. Abul Khair Assistant Manager Procurement	
14.	Ms. Fatema Tuz Johora Assistant Manager Establishment	
15.	Mr. Aminul Islam Khan Storekeeper	
16.	Ms. Jarin Tasmim Accounts Assistant	
17.	Mr. Md. Rashidul Hasan Accounts Assistant	
18.	Mr. Bidyuth Kumar Chokkraborti Office Assistant	
19.	Mr. Md. Abu Sayeed Photocopy Operator	
20.	Mr. Md. Salauddin Liton Driver	
21.	Mr. Md. Motalab Hossain Driver	

22.	Mr. Nur Mohammad Mostafa Chokdar Driver	
23.	Mr. Md. Saydul Islam Driver	
24.	Mr. Md. Faruque Hossain Driver	
25.	Md. Abdul Kader Driver	
26.	Md. Zakir Hossain Driver	
27.	Mr. Md. Kawsar Raton MLSS	
28.	Mr. Md. Iqbal Hossain MLSS	
29.	Mr. Md. Amirul Alam Khan MLSS	
30.	Mr. Md. Mazharul Islam MLSS	
31.	Mr. Md. Alam Mia MLSS	
32.	Mr. Md. Hamid Ali MLSS	

33.	Most. Rehana Khatun Cleaner	
34.	Ms. Ranu Akter Cleaner	
35.	Ms. Rojina Begum Cleaner	
36.	Ms. Parvin Begum Cleaner	

Financial Management

Statement of expenditure (SoE)

Total expenditure Tk. 3565.56 lac as of 30th June 2024 against a total fund of Tk. 3437.2453 lac from BKGET and Tk. 5.4541 lac from various closing project, Bank Interest, Vehicle rent. Financial Achievement 85% of Total Budget. 2023-24 approved annual budget: Tk. 4200.00 lac; Fund expenditure: Tk. 3565.56 lac. Progress on approved budget 85% and Progress on fund received 99.74%. The KGF statement of expenditure (SoE) for 2023-24 is shown in Annex, the activity plan for 2024-25 in Annex, the proposed budget for 2025-26 in Annex and the audit report for 2023-24 in Annex-6.

Budget for fiscal 2023-24

Annual work plan 2024-25

The Foundation has prepared the annual work plan for 2024-25. The detailed plan (gang chart) by items is given in Annex-5.

Annual proposed budget 2024-25

The budget proposed for fiscal 2023-24 for approval of the Board of Directors and General Body of KGF is Tk. Tk. 3437.2453 lac crore. The detailed budget by items is given in the Annex-6.

Audit

The accounts and audit functions of the Foundation are regulated in accordance with Clauses 78-89 of the Memorandum and Articles of Association of KGF. The KGF General Body approved the balance sheet for the period ending June 2024 and fiscal year 2023-24. The detailed audit report is presented in Annex-7.

Annex-1

List of Members of the General Body (GnB) and Board of Directors (BoD)

Sl	Name	Position	Photo
01	Dr. Shaikh Mohammad Bokhtiar Executive Chairman Bangladesh Agricultural Research Council (BARC) Farmgate, Dhaka-1215 Email: ec-barc@barc.gov.bd, bokhtiarsm@yahoo.com	GnB and BoD	
02	Dr. Md Shahjahan Kabir Director General Bangladesh Rice Research Institute (BRRI) Joydebpur, Gazipur-1701 Email: dg@brri.gov.bd/kabir.stat@gmail.com	GnB and BoD	
03	Dr. Debasish Sarker Director General Bangladesh Agricultural Research Institute (BARI) Joydebpur, Gazipur-1701 Email: dg.bari@bari.gov.bd, dspsarker@gmail.com	GnB and BoD	
04	Mr. Benojir Alam Director General Departmentn of Agricutural Extension (DAE) Khamarbari, Farmgate, Dhaka-1215 Email: dg@dae.gov.bd	GnB and BoD	
05	Mr. Md. Manjurul Hannan Managing Director Horticulture Export Development Foundation (Hortex) Sech Bhaban (3rd Floor, Western Side) 22 Manik Mia Avenue, Sher-e-Bangla Nagar Dhaka-1207 Email: manzurhannan@gmail.com	GnB and BoD	
06	Dr. F H Ansarey Managing Director and CEO ACI Agribusinesses 245 Tejgaon Industrial Area Bir Uttam Mir Shawkat Sarak, Dhaka-1208 Email: mdab@aci-bd.com/edab@aci-bd.com	GnB and BoD	

Sl	Name	Position	Photo
07	Dr. Md Shahidur Rashid Bhuiyan Vice Chancellor Sher-e-Bangla Agricultural University Sher-e-Bangla Nagar, Dhaka-1207 Email: ipbscfc2009@gmail.com	GnB	
08	Dr. M. Khalilur Rahman Member of the Expert Pool Ministry of Agriculture Government of the People's Republic of Bangladesh E-mail: drmkrahman1957@gmail.com	GnB	
09	Dr. Md. Kabir Ikramul Haque Former Executive Chairman Bangladesh Agricultural Research Council Email: kikramhaque@gmail.com		
10	Dr. Debashis Das Director (Administration) Department of Livestock Services Krishi Khamar Sarak Farmgate, Dhaka-1215 Email: dg@dls.gov.bd	GnB	
11	Dr. Humnath Bhandari Country Representative for Bangaldesh International Rice Research Institute (IRRI) IRRI Bangladesh Office House 103, Road 1, Block F Banani, Dhaka-1213 Email: h.bhandari@irri.org	GnB	
12	Dr. Kashfia Ahmed Chairman Win Miaki Ltd. Plot 8, Road 19/A, Block E Banani, Dhaka-1213 Email: kashfia.ahmed@miaki.co	GnB	

List of BKGET Funded Projects

A. Competitive Grants Program (CGP)

CGP 1st Call

Sl	Project title, code no. and commencement date	Coordinator/PI/CI	Location
1	TF 01-C: Validation and up-scaling of high value vegetable crops production in Sylhet region. Date of commencement: May 13, 2013	Dr. Md. Shahidul Islam, Sylhet AU Cell: 01916662421	Habiganj Sadar, Bahubal, Nabiganj of Habiganj; Biswanath, South Surma, Sylhet sadar of Sylhet
2	TF-02-C: Development/validation and up-scaling of dry direct seeded Boro rice system for improving crop productivity in areas with limited water supply. Date of commencement: May 13, 2013	Dr. Md. Moshiur Rahman, BAU, Mymensingh Cell: 01711072561	Godagari of Rajshahi and Rangpur Sadar
3	TF 03-C: Adaptation of high yielding soybean in polder areas in Barguna and Patuakhali districts. Date of commencement: May 13, 2013	Dr. MA Mannan, BSMRAU, Gazipur Cell: 01816020290	Amtali of Barguna and Kalapara of Patuakhali
4	TF 04-C: Screening and testing of Improved Aus rice varieties/genotypes suitable for rainfed aerobic soil condition of Bangladesh Date of commencement: May 13, 2013	Dr. A S M Masuduzzaman, BRRI, Joydbpur. Cell: 01721964002	Manda of Naogaon, Mohanpur of Rajshahi, Habiganj Sadar, Chunarughat of Habiganj, Fenchuganj of Sylhet, Rajnagar of Moulvibazar
5	TF 05-C: Year-round Production of Some Selected HYV and Hybrid Vegetable Varieties in Southern and Hilly Regions of Bangladesh Date of commencement: May 13, 2013	Dr. G M A Halim, BARI, Joydebpur Cell: 01715179366	Bauphal, Dashmina, Galachipa of Patuakhali and Bandarban Sadar
6	TF 06-C: Validation and up scaling of HYV brinjal, tomato, bottle gourd, ash gourd and pointed gourd in hilly areas of Moulvibazar Date of commencement: May 13, 2013	Dr. Zashim Uddin, BARI, Moulvibazar Cell: 01554330576	RARS, BARI Moulvibazar
7	TF 07-C: Adaptation of newly released HYV oil seeds (mustard, groundnut, soybean and sesame) in charland of Padma Date of commencement: May 13, 2013	Dr. Md. Abul Khayer Mian, BARI, Joydebpur Cell: 01914661801	Ishwardi of Pabna and Bheramara, Daulatpur of Kushtia
8	TF 08-NR: Evaluation and up-scaling of resource conservation technologies (RCTs) for improving productivity in the drought prone areas Date of commencement: May 13, 2013	Dr. Md. Ilias Hossain, RWRC, BARI Rajshahi. Cell: 01712632167	Godagari of Rajshahi and Nachole of Chapai Nawabganj
9	TF 09-NR: Validation and up-scaling of Tricho-products for soil borne disease management in vegetable crops. Date of commencement: May 13, 2013	Dr. Mosammat Shamsunnahar, HRC, BARI Gazipur Cell: 01674876252	Jashore Sadar and Sherpur of Bogura

List of BKGET Funded Projects

A. Competitive Grants Program (CGP)

CGP 1st Call

Sl	Project title, code no. and commencement date	Coordinator/PI/CI	Location
10	TF 10-F: Adaptation of community enterprise approach for intensification of floodplain fish production in Chalan Beel Date of commencement: May 13, 2013	Sakiul Millat Morshed, ED, SHISUK Cell: 01713037796	Tarash of Sirajganj, Bhangura of Pabna and Singra of Natore
11	TF 11-C: Validation and up scaling of off-season jute seed production technologies in different jute growing areas of Bangladesh Date of commencement: May 13, 2013	Md. Abdul Alim, BJRI Cell: 01911395624	Babuganj upazila of Barishal and Sadar upazila of Patuakhali
12	TF 12-L: Investigation on livestock diseases and development of appropriate control measures in hilly areas Date of commencement: Sep13, 2013	Shonkor Kumar Das, BAU, Mymensingh Cell: 01716-855186	Sadar, Lama and Rowanchari of Bandarban
13	TF 13-F: Production enhancement of aquaculture through innovative technologies in cage culture system in *haor* areas of Karimganj, Kishoreganj. Date of commencement: Dec 13, 2013	Dr. A.K.M. Nowsad Alam, BAU, Mymensingh Cell: 01711446315	Karimganj (*hoar* area) of Kishoreganj
14	TF 14-C: Sustainable management of flower and fruit dropping of mango. Date of commencement: Apr 14, 2014	Dr. Syed Nurul Alam, BARI, Joydebpur. Cell: 01711907886	Chapai Nawabganj; Rajshahi; Natore; Naogaon; Rangpur; Dinajpur; Thakurgaon; Jashore; Kushtia; Meherpur; Satkhira; Chuadanga; Mymensingh; Gazipur

CGP 2nd Call

Sl	Project title, code no. and commencement date	Coordinator/PI/CI	Location
1	TF 15-SF: Improvement of soil fertility and crop yield through adoption of conservation agriculture in mustard -Boro-T. Aman CP. Duration: Mar 2015 to Feb 2018	Dr. Jahiruddin, Soil Sc. BAU: 01718813889	BAU and Muktagacha Mymensingh; Dhanbari, Tangail
2	TF 16-WF: Collection, evaluation and introduction of white maize for human consumption in Bangladesh Duration: Mar 2015 to Feb 2018	Prof Jafar Ullah, SAU, Dhaka Cell: 01552331605	Dhaka, Barishal, Rangpur, Dinajpur, Nilphamari, Bandarban, Rangamati and Khagrachari
3	TF 17-ARI: ARI Refining and validation of BAU-Bro chickens Duration: Mar 2015 to Feb 2018	Prof Ashraf Ali, BAU Cell: 01675145096	BAU, Mymensingh
4	TF 18-EM: Exploring epidemiology, anthelmintic resistance and genetic diversity of some common gastrointestinal nematodes of small ruminants in Bangladesh Duration: Mar 2015 to Feb 2018	Prof Zahangir Alam, BAU Cell: 01746611162	BAU, Mymensingh

CGP 2nd Call

Sl	Project title, code no. and commencement date	Coordinator/PI/CI	Location
5	TF 19-EM: Community engagement in biosecurity (CEB) for the prevention of infectious diseases of poultry based on epidemiological risk analysis. Duration: Apr 2015 to Feb 2018	Prof Rafiqul Islam, BAU Cell: 01759674267	BAU, Mymensingh
6	TF 20-EM: Studies of pigeon diseases in northern Bangladesh. Duration: Apr 2015 to Mar 2017	Prof Jalal Uddin Sarder, Department of Animal Husbandry and veterinary Science, RU Cell: 01556308564	Rajshahi, Natore and Pabna
7	TF 21-DL: Use of probiotic to improve nutritional value of rice straw and its impact on dairy cow production Duration: Apr 2015 to Mar 2018	Dr. Abu Sadeque Md. Selim Cell: 01718370722	BSMRAU, Salna, Gazipur
8	TF 22-PS: Productivity enhancement of goor and chewing type sugarcane through management of major diseases in NMZ. Duration: Sep 2015 to Aug 2018	Dr. Shamsur Rahman, BSRI Cell: 01716165669	Ishurdi, Shibganj, Sirajganj Sadar, Manikganj, Narail
9	TF 23-AM: Improvement and validation of BARI seeder for grain crops under different cropping patterns and soil conditions. Duration: Mar 2017 to Feb 2020	Dr. Ayub Hossain, FMPE, BARI Cell: 01716979034, Email: mahossin.fmpe @gmail.com	Gazipur, Patuakhali, Rajshahi
10	TF 24-EM: Epidemiological and patho biological investigation of repeat breeding syndrome and development of strategies for improving the fertility of repeat breeder dairy cattle. Duration: Aug 2015 to Jul 2018	Prof Nasrin Sultana Juyena, Vet Sc. BAU Cell: 01759674267	Trishal, Mymensingh, Sahjadpur, Sirajganj, Patiya, Chattogram
11	TF 26-ARI: Validation and up-scaling of bee keeping practices for improving yield and quality of bee products Duration: May 2015 to Apr 2018	Dr. Sakhawat Hossain, SAU, Dhaka Cell: 01716092747	Satkhira, Shirajganj and Gazipur
12	TF 27-SF: Adaptation of improved soil fertility management practices for variable soil conditions under intensively cropping systems Duration : Jun 2015 to May 2018	Dr. Mustafizur Rahman, BSMRAU Cell: 01718186642	Rajshahi, Kushtia, Tangail, Gazipur, Kurigram, Lalmonirhat, Faridpur, Chandpur, Jashore, Cumilla
13	TF 29-AM: Design and development of two stage drying technique for drying high moisture grain. Duration : Mar 2017 to Feb 2020 (extended up to: Aug 2020)	Md. Sazzad Hossain Sarker, HDSTU: Cell: 01713163347 Email: mshsarker_hstu @yahoo.com	HSTU, Dinajpur
14	TF 30-AP: Sustainable development of aquaculture in the north-west region of Bangladesh under climate changes scenario Duration: Nov 2015 to Aug 2018	Prof Istiaque Hossain, RU, Rajshahi Cell: 01726514232, Email: bitanrubd @yahoo.com	Rajshahi and Bogura
15	TF 31-VC: Market and value chain studies of selected fruits and vegetables with special references to post harvest losses and food safety in Bangladesh	Dr. Abdul Matin, Agril Economics, BARI Cell: 01725694481, Email: matinecon61	Bogura, Rajshahi, Jhenaidah and Jashore

CGP 2nd Call

Sl	Project title, code no. and commencement date	Coordinator/PI/CI	Location
	Duration: Mar 2017 to Feb 2020 (extended up to: April 2020		
16	TF 32-SF: Integrated Nutrient Management for Intensive cropping in coastal and charland areas of Bhola district Duration : Sep 2015 to Aug 2018	Md. Shahidul Islam, BARI, Bhola Cell: 01718638771	Sadar, Daulatkhan, Charfashion and Monpura of Bhola
17	TF 33-ARI: Farm productivity improvement in haor areas through integrated farming systems approach Duration: Aug 2015 to Jul 2018 (extended up to: Feb 2020)	Prof Dr. Md. Abul Kashem, Professor, Dept. of Soil Sc, Faculty of Agriculture, SAU, Sylhet Cell: 01712213707 Emaill: reem98k@yahoo.com; makashem.agri@gmailcom	Sunamganj
18	TF 35-SF: Integrated nutrient management for sustaining soil fertility and crop productivity under intensive cropping system Duration : Jul 2015 to Jun 2018	Previous PI: Dr. Mahbubur Rahman, OFRD, BARI Cell: 01712598035 Present PI: Dr. Akkas Ali Cell: 01718637801 Email: akkasbari@gmail.com	Jamalpur, Sherpur, Mymensingh, Kishoreganj, Joypurhat, Rangpur, Rajshahi
19	TF 36-FP: Maximizing forage production in saline prone areas of south-west coastal belt through improved management practices. Duration: Dec 2015 to Nov 2018	Prof Shafiqul Islam, Khulna University Cell: 01711190798	Paikgacha of Khulna, Mollahat of Bagerhat, Tala of Satkhira

CGP 3rd Call

Sl	Project title, code no. and commencement date	Coordinator/PI/CI	Location
1	TF-37-F/17: Development of health management strategy against bacterial diseases in the aquafarms of Bangladesh Duration: Dec 2017 to Nov 2020	Dr. Gias Uddin Ahmed, Prof, Aquaculture, BAU, Mym, Cell: 01712564528 Email: gias50@gmail.com	Chattogram, Khulna, Mymensingh
2	TF-38-F/17: Post-harvest loss reduction and value addition of fresh water fish Duration: Mar 2018 to Feb 2021	Prof. Nowshad Alam Faculty of Fisheries, BAU, Mymensingh Cell: 01711446315	BAU, Mymensingh, Kishoreganj, Cumilla

CGP 3rd Call

Sl	Project title, code no. and commencement date	Coordinator/PI/CI	Location
3	TF-39-F/17: Adaptation of disease management strategy in the existing culture practices of shrimp through aquamimicry system. Duration: Dec 2017 to Nov 2020	Dr. SM Rafiquzzaman, Dept of Fisheries Biology and Aquatic Environment, BSMRAU, Gazipur Cell: 01754041311	BSMRAU and Satkhira
4	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 Duration: Dec 2017 to Nov 2020	Dr. Zakir Hossain, Prof, Fisheries, Biology and Genetics, BAU, Mymensingh Cell: 01724939693	BAU, Mymensingh
5	TF41-SBR/17: Development and adoption of cotton-based cropping system for drought-prone highland of Chattogram Hill Tracts Duration: Feb 2018 to Jan 2021	Dr. Md. Farid Uddin, ED, CDB, 6th Floor, Rear Building, Khamarbari, Dhaka-1215 Cell: 01711020798	Bandarban, Khagrachari, Rangamati
6	TF42- E/17: Development and adoption of low cost small potato planter and harvester for profitable potato production. Duration: Nov 2017 to Oct 2020	Dr. Md. Arshadul Haque CSO, Farm Machinery & Postharvest Division, BARI, Gazipur Cell: 017126355030 Email: mdisrail@gmail.com	Gazipur, Munshiganj, Debiganj
7	TF43-C/17: Livelihood improvement through farming system research and development in floating agriculture system Duration: Nov 2017 to Oct 2020	Dr. M. Akkas Ali, PSO, OFRD, BARI, Gazipur Cell: 01718637801 Email: alim.akkas@yahoo.com	Nazirpur of Pirojpur, Sadar, Tungipara Kotalipara of Gopalganj, Mollarhat of Bagerhat
8	TF-44-L/17: Livestock and human brucellosis: molecular diagnosis, treatment and control Duration: Jan 2018 to Dec 2020	Dr. Prof. Md. Siddiqur Rahman, Dept of Medicine, BAU, Mymensingh Cell: 01918181550, Email: msrahman4364 @gmail.com	Dept of Medicine, BAU, Mymensingh
9	TF-45-L/17: Epidemiological investigation on tuberculosis and campylobacteriosis associated with dairy farming practices in the selected districts of Bangladesh Duration: Jan 2018 to Dec 2020	Prof. S.M. Lutful Kabir, Microbiology and Hygiene, BAU, Mymensingh Cell: 01754987218 Email: lkabir79@gmail.com	Dhaka and Mymensingh; Lab: Dept Microbiology/Hygine and Phermacology, BAU; Dept of Microbacteriology, ICDDRB, Dhaka
10	TF-46-L/17: Study on zoonotic diseases of pets and assessment of risk factors of commonly occurred zoonoses for better management. Duration: Jan 2018 to Dec 2020	Dr. Jahangir Alam, CSO, Animal Biotechnology Division, National Institute of Biotechnology, Ganakbari, Ashulia, Savar, Dhaka-1349 Cell: 01712819098, Email: alamjahan2003 @yahoo.com	Dhaka and Chattogram

CGP 3rd Call

Sl	Project title, code no. and commencement date	Coordinator/PI/CI	Location
11	TF-47-L/17: Value addition to feeds and fodder through bioactive component-rice herbs for safe livestock production Duration: Feb 2018 to Jan 2021	Dr. Al Mamun, Prof. Dept of Animal Nutrition, BAU, Mymensingh Cell: 01715051093 Email: Mamunshimu @yahoo.com	BAU, Mymensingh
12	TF-48-L/17: Improving lamb production potentiality of native sheep through selection and genetic enhancement Duration: Feb 2018 to Jan 2021	Prof. Md. Munir Hossain, Animal Breeding and Genetics, BAU, Mymensingh Cell: 01716540609 Email: mmhabg@gmail.com	BAU, BLRI, Ghaibandha
13	TF-49-L/17: Value addition to straw for enhancing dairy production in Bangladesh Duration: Apr 2018 to Mar 2021	Dr. Mohammad Mohi Uddin, Assistant Prof, Animal Nutirtion, BAU, Mymensingh Cell: 01818429023 Email: mohammad.uddin @bau.edu.bd	Animal nutrition analytical lab, BAU, Dinajpur and Sirajganj
14	TF-50-C/17: Management of wheat blast caused by *Magnaporthe oryzae* pathotype *Triticum* introduction Duration: Jan 2018 to Dec 2020	PI 1: Dr. Naresh Chandra Deb Barma, Director, WRC, BARI, Nashipur, Dinajpur Cell: 01712226755 Email: ncdbarma@gmail.com Present PI 1: Dr. Israil Hossain, Director General, BWMRI, Nashipur, Dinajpur Cell: 01713363630 Email: dg.bwmri@gmail.com	Jashore, Dinajpur, Mymensingh, Gazipur, Meherpur, Chuadanga
15	TF-50-C/17: Assessment of cropping patterns for sustainable intensification in drought and saline-prone ecosystems using remote sensing and geospatial modeling Duration: Jan 2018 to Dec 2020	Dr. Md. Golam Mahboob, SSO, ASICT Division, BARI, Gazipur Cell: 01816194986 Email: golam.mahboob @gmail.com	Rajshahi, Chapai, Nowgaon, Bogura, Natore, Sirajganj, Gainbandha, Joypurhat, Dinajpur, Rangpur
16	TF-52-C/17: Adaptation of BARI released hyacinth bean varieties and up-scaling the farmer's innovation for productivity enhancement in Narsingdi region Duration: Feb 2018 to Jan 2021	Dr. Syed Md Mizanur Rahman, PSO, RHRS, BARI, Shibpur, Narshingdi Cell: 01819448805 Ex PI: Dr. Moshiur Rahman, PSO, RHRS, BARI, Shibpur, Narsingdi Cell: 01716838586 Emai: moshiur.bari @yahoo.com	Shibpur, Belabo, Palash, Sadar of Narsingdi

CGP 3rd Call

Sl	Project title, code no. and commencement date	Coordinator/PI/CI	Location
17	TF-53-C/17: Production and dissemination of BARI released year round jackfruit variety and its management packages. Duration: Feb 2018 to Jan 2021	Dr. Md. Jillur Rahman, SSO, Pomology Division, HRC, BARI, Gazipur Cell: 01715082555, Email: jillurhrc@gmai.com	Gazipur, Mymensingh, Khagrachari, Narsingdi
18	TF-54-SBR/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. Duration: Jan 2018 to Dec 2020	PI: Dr. Kawsar Uddin Ahammed, PSO, RARS, BARI, Gazipur Ex PI: Dr. Md. Sirajul Islam, CSO, RARS, BARI, Jashore-7400 Cell: 01712142042	Khulna, Satkhira
19	TF-55-AE/17: Development and adoption of a solar cabinet dryer for vegetable seeds Duration: Jan 2018 to Dec 2020	Dr. Nurul Amin, SSO, FFPE Division, BARI, Gazipur Cell: 01717734248 Email: naminbari @gmail.com	Gazipur, Jashore
20	TF-56-C/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 Duration: Jan 2018 to Dec 2020	Prof. Lulful Hasan, GPB, BAU, Mymensingh Cell: 01715091096, Email: lutfulhassan @yahoo.com	BAU, Mymensingh, BARI, Khulna, Satkhira, Bagherhat, Barishal, Patuakhali, Barguna
21	TF-57-C/17: Identification of resistant sources against gall midge and development of tolerant advanced breeding lines Duration: Feb 2018 to Jan 2021	Dr. Moffazzel Hossain, PSO, Entomology Division, BRRI, Gazipur Cell: 01731386113, Email: mofazzel70 @yahoo.com	Kapasia (Gazipur), Natore (Sadar), Kaharul (Dinajpur, Chunarughat (Habiganj), Sadar (Cox's Bazar)
22	TF-58-C/17: Sustainable management of maize insect pests with special emphasis on the com borer, the emerging species through innovative, participatory and collaborative research. Duration: Feb 2018 to Jan 2021	Prof. Khandakar Shariful Islam, Dept. of Entomology, BAU, Mymensingh-2202 Cell: 01716370731 Email: ksharif_bau @yahoo.com	BAU, Mymensingh; Chuadanga, Gaibandha
23	TF-60-SBR/17: Improvement of agroforestry practices for better livelihood and environment in charland area of Tista River Basin Duration: Mar 2018 to Feb 2021	Dr. Md. Shafiqul Bari, Prof, Agroforestry and Environment, HMDSTU Cell: 01713163399 Email: barimdshafiqul @gmail.com	Kurigram, Gaibanda
24	TF-61-C/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-	BAU, Mymensingh

CGP 3rd Call

	Duration: Mar 2018 to Feb 2021	2202 Cell: 01715523202 Email: fakirmsa @gmail.com	

CGP 3rd Call

Sl	Project title, code no. and commencement date	Coordinator/PI/CI	Location
25	TF-62-L/17: Validation of good practices of on-farm lamb production systems Duration: Feb 2018 to Jan 2021	Prof. M. A. Hashem, Animal Science, BAU, Mymensingh Cell: 01721310621, Email: hashem_mdabul @yahoo.com	Sherpur, Rajshari, Noakhali and Feni
26	TF-63-Char/17: Diffusion of innovative mgt. practices for sustainable crop production in charlands of Bangladesh Duration: Nov. 2018 to Oct. 2021	Prof. Md. Safiul Islam Afrad, Agricultural Extension and Rural Development, BSMRAU, Gazipur, Cell: 01972584820 Email: afrad69@gmail.com	*Char* lands of Ramgati, Raipur, Kamalnagar upazilas of Lakshmipur district
27	TF-64-Fruit/17: Exploring and in situ development of under-utilized fruits to improve nutritional food security and livelihood of the poor communities of southern Bangladesh Duration: Jan 2018 to Dec 2019	Prof. Dr. Md. Abdur Rahim, Department of Hoticulture, BAU, Mymensingh	BAU,Khulna,Barisha l, Patuakhali
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28	TF-65-C/19: Post-harvest management, processing and marketing of jackfruits loss reduction and value addition of fresh water fish Duration: May 2019 to January 2022	Dr. Md. Miaruddin, CSO, Post-Harvest Technology Division, BARI, Gazipur	Dhaka, Gazipur, Tangail, Khagrachhari, Rangamati, Mymensingh, Moulvibazar, Narsinghdi, Dinajpur and Rangpur
29	TF-66-C/19: On Farm validation and up-scaling of integrated pest and disease management packages for quality and safe country bean production in Mymensingh region. Duration: April, 2019 to March 2022	Dr. Md. Shahadath Hossain, PSO, Entomology Section, HRC, BARI, Gazipur Dr Md. Akkas Ali, CSO, OFRD, BARI, Gazipur	Sadar and Nandail upazilas of Mymensingh, Durgapur and Kalmakanda upazilas of Netrakona, and Nalitabari and Nokla upazilas of Sherpur
30	TF-67-C/19: Survey of watermelon diseases and integrated management of wilt and stem blight disease. Duration: Nov 2019 to Oct 2022	Dr. Md.Mahfuz Alam, SSO, Plant Pathology Divisiton, BARI, Gazipur	Gazipur, Noakhali and Patuakhali

CGP 4th Call

Sl	Project title, code no. and commencement date	Coordinator/PI/CI	Location
1	TF 68-C/20: Molecular characterization of biovars *of Ralstonia solanacearum*, the causal agent of bacterial wilt of solanaceous crops and its integrated management Duration: Dec 2020 to Nov 2023	Dr. Mafruha Afroz, SSO, Plant Pathology Section, HRC, BARI Cell: 1716011482 Email: mafruha_afroz @yahoo.com	HRC, BARI, Gazipur; Tuber Crop Research Sub Center, BARI, Bogura and Agriculture Research Station, BARI
2	TF 69-C/20: Adaption, validation, multiplication and maintenance of lilium genotype in Bangladesh Duration: Dec 2020 to Nov 2023	Dr. Farjana Nasrin Khan, PSO, Floriculture Division, HRC, BARI, Gazipur Cell: 1910047191 Email: khan_farjana @yahoo.com	Dhaka (Savar), Gazipur (Gazipur Sadar), Rangpur (Rangpur Sadar), Jashore (Jhikargacha)
3	TF 70-C/20: Technology development for lisianthus (*Eustoma grandiflorm*) production and its varietal improvement for flower industry development in Bangladesh Duration: Dec 2020 to Nov 2023	Dr. Abul Faiz Md. Jamal Uddin, Dept. of Horticulture, SAU, Sher-e-Bangla Nagar, Dhaka Cell: 1731840979 Email: jamal4@yahoo.com	Department of Horticulture, Faculty of Agriculture, SAU
4	TF 71-CC/20: Sustainable management of blast, sheath blight and bacterial blight diseases of rice through nano-particles (NPs) Duration: Dec 2020 to Nov 2023	Dr. Md. Abdul Latif, CSO & Head Plant Pathology Division, BRRI, Gazipur Cell: 01715034094 Email: alatif1965 @yahoo.com	BRRI, Gazipur
5	TF 72-NRM/20: Management of soil fertility with profitable and agro-ecologically suitable crop varieties for increasing cropping intensity in northern region of Bangladesh Duration: Dec 2020 to Nov 2023	Prof. Dr. A. K. M. Zakir Hossain, Dept. of Crop Botany, BAU, Memensingh-2202 Cell: 1713113559 Email: zakir@bau.edu.bd	Mithapukur upazila of Rangpur and Shahjahanpur upazila of Bogura district
6	TF 73-NRM/20: Increasing crops and soil productivity through climate smart conservation technologies (CSCTs) in Drought and non-traditional areas of Bangladesh Duration: Dec 2020 to Nov 2023	Dr. Md. Illias Hossain, PSO (Agronomy), BWMRI Regional Station, Shyampur, Rajshahi Cell: 1712632167 Email: iliasrwrc @gmail.com	Narail and Rajshahi districts
7	TF 74-NRM/20: Field based applied research on Aquifer storage and recovery (ASR) technology for increasing cropping intensity of Bangladesh Duration: Dec 2020 to Nov 2023	Dr. Sara Nowreen, Asstt. Prof, IWFM, BUET Cell: 1553636657 Email: sara.sohel @gmail.com	Rajshahi (Paba), Natore (Naldanga) and Tangail (Mirzapur)

CGP 4th Call

Sl	Project title, code no. and commencement date	Coordinator/PI/CI	Location
8	TF 75-F/20: Molecular approaches to study the effects of probiotics on growth and reproduction of cultivable fish species in Bangladesh Duration: Dec 2020 to Nov 2023	Prof. Md. Shahjahan, Department of Fisheries Management, BAU, Mymensingh-2202 Cell: 01718590903 Email: mdshahjahan @bau.edu.bd	BAU, Mymensingh
9	TF 76-F/20: Development of low-cost recirculating aquaculture system (RAS) for the sustainable intensification and mechanization of aquaculture in Bangladesh Duration: Dec 2020 to Nov 2023	Dr. M.A. Shahabuddin, Associate Professor, Dept. of Aquaculture, SAU, Sher- e- Bangla Nagar, Dhaka Cell: 1835950573 Email: amsu.aqua @sau.edu.bd	Sher-e-Bangla Agricultural University (SAU), Dhaka
10	TF77-L/20: Molecular characterization of virulent Newcastle disease virus (NDV) strains circulating in Bangladesh: In search for a thermos table NDV vaccine for backyard chickens Duration: Dec 2020 to Nov 2023	Dr. Pankaj Chakraborty, Associate Professor and CASR, CVASU, Khulshi, Chattogram-4225 Cell: 1712976747 Email: pcb23m @yahoo.com	CVASU
11	TF 78-L/20: Development of crossbred dairy cattle using genomic information for efficient productivity and resilience in tropical environment of Bangladesh Duration: Dec 2020 to Nov 2023	Prof. Mohammad Shamsul Alam Bhuiyan, Dept. of Animal Breeding and Genetics, BAU, Mymensingh-2202 Cell: 01745748849 Email: msabhuiyan @gmail.com	BAU
12	TF 79-SoE/20: Shifting in conventional agriculture towards high value enterprise for better livelihood of the rural people Duration: Dec 2020 to Nov 2023	Prof. Dr. M Zulfikar Rahman, Dept. of Agricultural Extension Education, BAU Cell: 01714074313 Email: zulfikarbau64 @gmail.com	BAU
13	TF 80-NRM/20: Development of biochar enriched fertilizer for enhancing nutrient use efficiency in agriculture Duration: Mar 2021 to Feb 2024	Dr. Shamim Mia, Associate Professor, Dept. of Agronomy, PSTU, Dumki, Patuakhali-8202 Cell: 01786308562 Email: smia_agr @pstu.ac.bd	PSTU, BARI and University of Sydney, Australia
14	TF 81-NRM/20: Intervention in surface water utilization through integrated minor irrigation schemes for escalating water and land productivity in coastal region Duration: Mar 2021 to Feb 2024	Mir Nurul Hasan Mahmud SSO, Irrigation and Water Management Division, BRRI, Gazipur-1701 Email: nurul.iwm @brri.gov.bd	Patuakhali and Barguna

CGP 4th Call

Sl	Project title, code no. and commencement date	Coordinator/PI/CI	Location
15	TF 82-L/20: Value addition in composting poultry manures for better compost quality and reduction of environmental pollution Duration: Mar 2021 to Feb 2024	Prof. Md. Mukhlesur Rahman, Dept. of Animal Science, BAU, Mymensingh-2202 Cell: 01933-548922 Email: mmrahman.as @bau.edu.bd	BAU, Mymensingh
16	TF 83-L/20: Designing a sustainable feeding strategy for dairy cow production in Bangladesh Duration: Mar 2021 to Feb 2024	Prof. Dr. Mohammad Ashiqul Islam, Dept. of Dairy Science, BAU, Mymensingh-2202, Cell: 01712-428472	BAU Dairy Farm, Mymensingh
17	TF 84- SoE: Adoption of climate resilient crop varieties in selected environmentally vulnerable areas of Bangladesh and its impact on farm productivity. Duration: Mar 2021 to Feb 2024	Professor Dr. Hasneen Jahan, Dept. of Agricultural Economics, BAU, Mymensingh Cell: 1712291417 Email: hasneen.jahan @bau.edu.bd	Rajshahi, Tangail, Jashore, Satkhira and Sunamganj
18	TF 85-F/20: Development of sustainable mass seed production technology for *Macrobrachium rosenbergii* and production of quality broodstock in captivity Duration: Mar 2021 to Feb 2025	Prof. Md. Samsul Alam, Dept. of Fisheries Biology and Genetics, BAU, Mymensingh Cell: 01727163054 Email: samsul.alam @bau.edu.bd	BAU, Mymensingh
19	TF 86-C/21: Feasibility study of the IoT based precision agriculture for sustainable crop production in Bangladesh Duration: March 2021 to Feb 2012	Dr. Nazmun Nahar Karim Member-Director (Livestock), BARC, Dhaka Cell: 01715013033 Email: nazmun.karim @barc.gov.bd	Lab of ASICT Division and research field of BARI, Gazipur
20	TF 87-SC/21: Strengthening sugarcane research and development in Chattogram Hill Tracts Duration: Mar 2021 to Feb 2025	Dr. Md. Anisur Rahman, CSO, BSRI, Ishwardi, Pabna Cell: 01703488606 Email: anisurbreedbsri @gmail.com	Sadar, Rawangchari and Lama upazilas of Bandarban district, CHT
21	TF 88-C/21: Scaling-up premium quality rice in northern region of Bangladesh Duration: Mar 2021 to Feb 2024	Dr. Biswajit Karmakar, PSO and Head, BRRI Regional Station, Sirajganj Cell: 01715181609 Email: biswajitbrri @gmail.com	Ten upazilas of 5 northern districts

CGP 4th Call

Sl	Project title, code no. and commencement date	Coordinator/PI/CI	Location
22	TF 89–AM/21: Validation and up-scaling of rice transplanting and harvesting technology in the selected sites of Bangladesh Duration: Mar 2021 to Feb 2024	Dr. Md. Anwar Hossen, SSO, Farm Machinery and Postharvest Technology Division, BRRI, Gazipur Cell: 01712675130 Email: ahossenbrri @gmail.com	Netrakona and Habiganj districts
23	TF 90–C/21: Improving productivity and adaption of BARI developed selected vegetable crops through integrated management approaches (IMA) in *char* areas of northern districts Duration: Mar 2021 to Feb 2024	Dr. Md. Abdul Goffar, PSO, Olericulture Division, BARI, Gazipur-1701 Cell: 01552442512 Email: mgoffar @yahoo.com	*Char* areas in Shariakandi of Bogura and Kaunia of Rangpur, and BARI, Gazipur
24	TF 91–Tea/21: Selection of drought and pest tolerant tea clones with integrated management of red spider mite for sustainable tea production Duration: 36 mo	Prof. Dr. A F M Saiful Islam, Department of Crop Botany and Tea Production Technology, Faculty of Agriculture, Sylhet Agricultural University, Sylhet-3100 Cell: 01711978392 Email: afmsislam@gmail.com, afmsislam@yahoo.com	Tea Germplasm Center, Sylhet Agricultural University, Burjan Tea Estate, Khadimnagar, Sylhet Rajnagar Tea Estate, Moulvibazar, Nalua Tea Estate, Chunarughat, Habiganj Chandpur Tea Estate, Chunaru Ghat, Habiganj
25	TF 92-FNS/21: Omics food and nutritional security-platform technologies to enhance crop genetic resources and food value chains in Bangladesh Duration: Mar 2021 to Feb 2024	Coordinator: Dr.Md. Abdus Salam Member Director (P&E), BARC Cell: 01552398504 Email: masalamsso @yahoo.com	BARC, BARI, BRRI, BSMRAU, BWMRI, Hortex Foundation
26	TF 93-FNS/21: Assessing adoption and diffusion of agricultural innovations in Bangladesh Duration: Mar 2021 to Feb 2023	Dr. Nazrul Islam, Visiting Professor, Department of Economics, School of Business and Economics, North South University (NSU), Basundhara, Dhaka Cell: 01534934781 Email: nazrul.islam03 @northsouth.edu	Dhaka, Chattagram, Rajshahi and Barishal divisions
27	TF 94-SBR/21: Up-scaling of agro-ecological farming technologies through participatory action research Duration: Mar 2021 to Feb 2024	Dr. Md. Nazim Uddin, SSO, Olericulture Division, Horticulture Research Center, BARI, Gazipur Cell: 01715087383 Email: nazim.64 @gmail.com	Gazipur, Mymensingh and Jhenaidah

CGP 4th Call

Sl	Project title, code no. and commencement date	Coordinator/PI/CI	Location
28	TF 95-C/21: Prevalence of major pre and post-harvest diseases of onion and their management Duration: Mar 2021 to Feb 2024	Dr. Monirul Islam, SSO, Plant Pathology Division, BARI, Gazipur Cell: 01718755404 Email: monirulbari @yahoo.com	Faridpur, Bogura and Gazipur
29	TF 96-SBR/21: Up-scaling of improved water management practices for sustainable productivity in the *haor* areas Duration: Mar 2021 to Feb 2024	Dr. Mahbubul Alam, SSO, IWMD, BRRI, Gazipur-1702 Cell: 01961233768 Email: alam.mm71 @gmail.com	Tahirpur upazila and adjacent areas of Sunamganj
30	TF 97- C/21: Deployment of doubled haploid technology in rapid wheat variety development Duration: Mar 2021 to Feb 2024	Dr. Mahbubur Rahman, SO (Wheat Breeding), Regional Center, BWMRI, Rajshahi Cell: 01711289091 Email: mahbubrwrc @yahoo.com	Regional Centre, BWMRI, Rajshahi and Regional Centre, BWMRI, Jashore
31	TF 98-C/21: Productivity enhancement of beans in Sylhet region through on station and on farm research approaches Duration: Mar 2021 to Feb 2024	Prof. Md. Shahidul Islam, Dept. of Horticulture, Sylhet Agricultural University, Sylhet Cell: 01916662421 Email: shahidulhrt @gmail.com	Sylhet division (Sylhet, Moulvibazar, Habiganj and Sunamganj districts)
32	TF 99-F/21: Genomic investigation of AHPND (acute hepatopancreatic necrosis disease) in *Penaeus monodon* (*bagda* shrimp) using RT-qPCR and NGS (next generation sequencing) to develop a suitable prevention method Duration: Mar 2021 to Feb 2024	Dr. Md. Mer Mosharraf Hossain, Associate Professor, Fisheries and Marine Bioscience, Jashore University of Science and Technology, Jashore-7408, Cell: 01731143787 Email: mmm.hossain @just.edu.bd	Khulna, Sathkira and Bagherhat
33	TF 100-F/21: Isolation and identification of indigenous microalgae from different coastal regions of Bangladesh and its utilization as live feed for aquaculture industry Duration: Mar 2021 to Feb 2024	Dr. Helena Khatoon Assistant Professor, Dept. of Aquaculture, Faculty of Fisheries, CVASU, Khulshi, Chattogram Cell: 01716396008 Email: helena@cvasu.ac.bd	Mymensingh, Dhaka, Bogura and Chattogram Institute of coastal Biodiversity, Marine Fisheries and Wildlife Research Centre, CVASU, Cox's Bazar and Live Feed Research Corner, Faculty of Fisheries

CGP 4th Call

Sl	Project title, code no. and commencement date	Coordinator/PI/CI	Location
34	TF 101-L/21: Influence of maternal dietary energy level during gestation on performance of Black Bengal kids Duration: Mar 2021 to Feb 2024	Prof. Mohammad Moniruzzaman, Dept of Animal Science, BAU, Mymensingh-2202 Cell: 01726491107 Email: monir.as @bau.edu.bd	Goat and Sheep Farm, Dept of Animal Science, BAU and Rowarchar, Muktagacha upazilla, Mymensingh
35	TF 102-L/21: Analysis of innate and adaptive immune responses in cattle against fascioliasis Duration: Mar 2021 to Feb 2024	Prof. Anisuzzaman, Dept of Parasitology, BAU, Mymensingh-2202 Cell: 01711044593 Email: zaman.a.bau @gmail.com	Mymensingh
36	TF 103-SBR/21: Sorjan based eco-friendly farming systems research for agricultural intensification in southern Bangladesh Duration: Mar 2021 to Feb 2024	Dr. Md. Alimur Rahman, PSO, BARI RARS, Rahmatpur, Barishal Cell: 01712158612 Email: alimurbd@yahoo.com	Barishal (Babuganj and Banaripara), Bhola (Char Fasson, Jhalokati (Nalchhiti) and Pirojpur (Nesarabad)

CGP 5th Call Projects

Sl #	Project code #	Name of Project	Location	Principal Investigator (PI)
1	TF 104-C/23	Updating and publication of Fertilizer Recommendation Guide-2023	BARC, Dhaka	Dr. Md. Baktear Hossain, Director (Manpower and Training), Chief Scientific Officer Soil, BARC, Farmgate, Dhaka.
2	TF 105-C/23	Smart detection of rice disease and insects through 4IR technologies	BRRI Head Quarter and all regional stations.	Md. Mahfuz Bin Wahab, Programmer, ICT, Agricultural Statistics Division, BRRI, Gazipur-1701.
3	TF 106-C/23	Processing and preservation of fruits (pineapple, banana, papaya) in Madhupur Region	Bangladesh Agricultural University, Mymensing and Madhabpur, Tangail.	Dr. Poly Karmoker, 26 November, Associate Professor, Department of Food Technology and Rural Industries, Bangladesh Agricultural University, Mymensing
4	TF 107-C/23	Insecticide Resistance and Resurgence Management of Tungro Disseminating Green Leafhopper	Cumilla, Rangpur, Mymensingh	Dr. Md. Nazmul Bari, Principal Scientific Officer, Entomology Division, Bangladesh Rice Research Institute (BRRI), Gazipur
5	TF 108-C/23	Integrated Management of Arthropod Pests of Citrus and Dragon Fruit Crops in Madhupur Tracts of Bangladesh	Ghatail, Madhupur and Dhanbari Upazilla of Tangail District.	Professor Dr. Md. Ruhul Amin, Department of Entomology, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur,

Sl #	Project code #	Name of Project	Location	Principal Investigator (PI)
6	TF 109-C/23	Development of processing, preservation and marketing techniques for value addition of major spices crops	Bogura, Gazipur, Bandarban, Sylhet, Faridpur	Dr. Md. Masud Alam, Senior Scientific Officer, Bangladesh Agricultural Research Institute (BARI),
7	TF 110-C/23	Pest and Disease Surveillance & Management of Honey Bee Colony and Effect of Electromagnetic Radiation on Honey bee Growth and Development	Dhaka	Dr. Mohammed Sakhawat Hossain Professor Department of Entomology Sher-e-Bangla Agricultural University Dhaka-1207
8	TF 111-C/23	Integrated management of invasive rugose spiralling whitefly in coconut.	Barishal, Jashore and Gazipur	Dr. Nirmal Kumar Dutta Chief Scientific Officer & Head, Entomology Division, Bangladesh Agricultural Research Institute (BARI) Entomology Division, BARI, Gazipur
9	TF 112-C/23	Bio-ecology, morpho-molecular characterization and laboratory evaluation of some new generation insecticides against rugose spiralling whitefly	Laboratory Study- Department of Entomology, BAU, Mymensingh, Survey Study to collect RSW- 30 AEZ of Bangladesh, Poulation Dynamic study- Mymensingh, Rajshahi and Moulovibazar.	Dr. Gopal Das, Professor Department of Entomology BAU, Mymensingh-2202
10	TF 113-C/23	Adopting and scaling up climate-resilient minor cereals in the Active Brahmaputra-Jamuna and Ganges Floodplains	BSMRAU, Gazipur, (ii) OFRD, BARI - Saghata (Gaibandha), Sujanagar (Pabna) and Chilmari (Kurigram).	Professor Dr. Md. Rafiqul Islam, Department of Agronomy, BSMRAU, Gazipur
11	TF 114-C/23	Increasing Crop Productivity in the Char lands Through Climate Resilient Farming	The Project will be carried out in the char areas of the 8 Upazillas of 7 Districts under favorable eco-system areas of Bangladesh. Upaziillas are- Ulipur- Kurigram, Fulchari-Gaibandha, Sonatola-Bagura, Pabna Sadar- Pabna, Bhuapur-Tangail, Pangsha-Rajbari, Islampur, Jamalpur Sadar-Jamalpur.	Dr. Md. Mazharul Anowar, Chief Scientific Officer & Head, On-Farm Research Division, BARI, Gazipur
12	TF 115-C/23	Adaptation and upscaling of improved Watermelon production technologies for crop intensification in the coastal region.	Cox's Bazar, Bhola, Patuakhali, Khulna	Dr. Md. Harunor Rashid, Principal Scientific Officer c. BARI, OFRD, Daulatpur, Khulna

Sl #	Project code #	Name of Project	Location	Principal Investigator (PI)
13	TF 116-C/23	Establishment of disease-free citrus sapling production system in Bangladesh	Bangladesh Agricultural Research Institute (BARI) , Citrus Research Station , Jaintapur Sylhet.	Dr. MHM Borhannuddin Bhuyan, Scientific Officer, Citrus Research Station, BARI, Jaintapur, Sylhet
14	TF 117-C/23	Development of simplified hydroponic technologies and their adaptive trials for commercial cultivation	Olericulture Division, HRC, BARI, Gazipur, RARS Jessore, OFRD, Rangpur and OFRD Pabna.	Dr. Md. Asaduzzaman, Senior Scientific Officer Olericulture Division, HRC, BARI, Gazipur
15	TF 118-C/23	Production and scaling-up jute seed production technology at farmers' level	BJRI Regional Station and Sub-station as well as their commanding areas, Namely- Jute Agricultural Extenison Station, Manikgonz, Jute Regional station , Rangpur, Jute Regional Station, Kiroshoregonj, Jute Research Sub-Station, Monirumpur, Jashore and Jute seed production and Research Sub-Station, Dinajpur.	Dr. Md. Babul Hossain, Senior Scientific Officer, Bangladesh Jute Research Institute, Manik Mia Avenue, Dhaka
16	TF 119-C/23	Development of improved pineapple-based agroforestry systems for mitigating climate change impacts	Madhupur Garh and Moulovibazar of Bangladesh.	Dr. Md. Saifullah, Member Director (A&F) (CC) & CSO (AC), Forest Unit. NRM Division, BARC, Farmgate, Farmgate, Dhaka-1215
17	TF 120-L/23	Improvement of broiler meat quality and quantity by prolonging rearing period with cost effective dietary regime	Department of Animal Science, BAU, Mymensingh.	Dr. Md. Abul Kalam Azad Professor, Department of Animal Science, BAU
18	TF 121-L/23-IW	Bovine colostrum's quality evaluation and its effect on calf health and subsequent growth.	Theriogenology Unit, Dept of Medicine , Surgery and Obstetrics , Faculty of Animal Science and Veterinary Medicine , Patuakhali Scinece and Technology University, Barishal Campus, Babuganj, Barishal.	Professor Dr. Dibyendu Biswas, PSTU, Dept. of Medicine, Surgery and Obstetrics, Faculty of Animal Science and Veterinary Medicine, Babuganj, Barishal.
19	TF 122-L/23	Biogenic extraction and nano-formulation of new antimicrobial from shrimp waste and their applications in poultry farming as an alternative to antibiotic	Deapartment of Microbiology and Hygiene, BAU, Mymensingh.	Professor Dr. Md. Abdul Kafi, Department of Microbiology and Hygiene, Faculty of Veterinary Science, Agricultural University, Mymensingh

Sl #	Project code #	Name of Project	Location	Principal Investigator (PI)
20	TF 123-L/23	Conservation, improvement and multiplication of native chicken and pigeon Germplasm at Sylhet Region	Sylhet Agricultutal University, Sylhet	Dr. Md. Nazmul Haque, Professor Dept. of Genetics & Animal Breeding, Sylhet Agricultural University, Sylhet -3100
21	TF 124-L/23	Development of Inclusion Body Hapatitis Vaccine from Local Virus Isolates	Department of Microbiology and Hygiene, BAU and Animal Biotechnology Division, National Institute of Biotechnology, Ganakbari, Ashulia.	Dr. M. Bahanur Rahman Professor, Dept. of Microbiology and Hygiene, Faculty of Veterinary Science, Bangladesh Agricultural University, Mymensingh
22	TF 125-L/23	"Implications of Good Veterinary Practices for Improving the Udder Health and Welfare of Cows to Control Subclinical Mastitis in Selected Milk Producing Areas of Bangladesh".	Study Site- Mymensingh and Sirajganj District-Milk producing areas of Bangladesh. Laboratory Location-Department of Medicine, Faculty of Veterinary Sciences, BAU, Mymensingh.	Dr. M. Ariful Islam, Professor, Animal Welfare Research House, Department of Medicine Faculty of Veterinary Science, Bangladesh Agricultural University, Mymensingh-
23	TF 126-L/23	Isolation, Identification and Characterization of Contagious Ecthyma Virus for the Development of Vaccine Seed	Bandarban, Rajshahi, Jessore, Meherpur, Jhenaidha, Chuadanga	Dr. Md. Shahin Alam Senior Scientific Officer & Director (SAARC PPR Ref. Laboratory) Animal Health Research Division BLRI, Saver, Dhaka
24	TF 127-L/23	Improvement productivity of Garole sheep through feeding and nutritional management in Satkhira area of Bangladesh.	Assasuni, Shyamnagar, Debhata, Kaligonj Upazilla of Satkhira district and Goat, sheep and horse fram, Department of Animal Science , BAU, Mymensingh.	Dr. Md. Ruhul Amin Professor, Department of Animal Science, Department of Animal Science, BAU, Mymensingh.
25	TF 128-L/23	Isolation, molecular characterization, vector screening and vaccine development against bovine Babesia in Bangladesh	Parts of Tista silt Basin and Gangetic alluvim (Pabna-sirazgonj). Brahmaputra Basin (Mymenisngh-Dhaka) and Coastal belt (Chokoria-Cox's Bazar)	Professor Dr. Thahsin Farjana, Mailing Department of Parasitology, BAU, Mymensingh
26	TF 129-L/23	Isolation, molecular characterization, vector screening and vaccine development against bovine Anaplasma in Bangladesh	Diffrenent endemic areas under 6 diffrenet Districts namely Dhaka, Narshingdi, Chattogram, Rajshahi, Sylhet, Khulna.	Professor Dr. AMAM Zonaed SiddikiDepartment of Pathology and Parasitology Faculty of Veterinary Medicine, CVASU, Khulshi, Chittagong, Cell: 0171 771 8884 (mobile) Email: zsiddiki@gmail.com; zsiddiki@cvasu.ac.bd

Sl #	Project code #	Name of Project	Location	Principal Investigator (PI)
27	TF 130-L/23	Up-scaling of the Small-scale sheep model for processing safe and quality Lamb in Barind Area	Boalia, pabna and Godagari Upazillas of Rajshahi.	Professor Dr. Md. Jalal Uddin sarder, Dean, Faculty of Veterinary & Animal Sciences, University of Rajshahi, Rajshahi
28	TF 131-L/23	Development of Women Community Poultry Model through BLRI developed chickens for livelihood improvement in Selected Areas of Coastal Bangladesh.	Selected two Upazilas of Batiaghata at Khulna district and Bagerhat Sadar at Bagerhat District. Poultry Production Research Division (PPRD) and the Jeshore Regional Research Station of BLRI will coordinate this project.	Ms. Kamrun Nahar Monira, Principal Scientific Officer, Poultry Production research Division, BLRI
29	TF 132-F/23	Assessment of plastics in the riverine fishes and their ecosystems of Bangladesh: Impacts on the aquatic biodiversity and trophic transfer to the food chain	Nine Important Rivers (Padma, Meghna, Jamuna, Karnaphuli, Halda, Turag, Pasur, Sangu and Matamuhuri) in Bangladesh.	Mir Mohammad Ali, Department of Aquaculture, Sher-e-Bangla Agricultural University, Dhaka-
30	TF 133-SoE/23	Impact Assessment of Saline Tolerant Varieties developed by BINA and NARS institutes.	Satkhira, khulna, bagerhat, barguna, barishal, Ptuakhali, Bhola, Noakhali, Chattogram and Cox's Bazar districts of Bangladesh.	Dr. Md. Habibur Rahman, Principal Scientific Officer and Head Agricultural Economics Division, BINA
31	TF 134-CC/23	Validation and Refinement of Processed Cheese Making Technology through Entrepreneurship Development in Satkhira, Thakurgaon and Shirajgonj Districts	a. Bangldesh Agricultural University, Mymensingh 2202. b. Cheese factories/prospective entrepreneurs in Satkhira, Thakurgaon and Shirazgonj Districts.	Professor Dr. Raihan Habib, Department of Dairy Science, Faculty of Animal Husbandry, Bangladesh Agricultural University, Email: raihan789@yahoo.com; Raihanh_habib@bau.edu.bd
32	TF 137-C/23	Development of Novel Nano and Microbial Technologies for Remediation of Toxic heavy metals and arsenic in Soil-Water-Plant System	Two highly heavy metal (Madhabpur of Habigong and Sonargaon of Narayanganj) and two highly arsenic (Faridpur Sadar and Matlab of Chandpur) contaminated upazilas will be selected for the study areas.	Professor Dr. GKM Mustafizur Rahman, Department of Soil Science, BSMRAU, Gazipur, Email: mustafiz@bsmrau.edu.bd Cell Phone: +8801718186642

Sl #	Project code #	Name of Project	Location	Principal Investigator (PI)
16	TF 150-C/23	Development of N2-fixing and P-solubilizing Bio-Fertilizers with Plant Growth Promoting Bacteria for Enhancing Nutrient Use Efficiency of Sugarcane.	Thakurgaon (AEZ-1), Panchagarh (AEZ-1), Joypurhat (AEZ-3), Jamalpur (AEZ-8), Gazipur (AEZ-28), Ishawardi (AEZ-11), Rajshahi (AEZ-11), Chapainababgonz (AEZ-26), Chuadanga (AEZ-11), Faridpur(AEZ-12), Barishal (AEZ-13), Subarnachar (AEZ-19), Bandarban (AEZ-29), Habiganz (AEZ-29), Gaibandha (AEZ-27).	Dr. Gazi Md. Akram Hossain, Chief Scientific Office (CC), Soils and Nutrition Division, BSRI, Ishurdi-6620, Pabna. Email: hossaingma@yahoo.com, Cell:01738 271164

Basic Research Projects (BR)

Sl	Project title, code no. and commencement date	Coordinator/PI/CI	Location
1	BR 1-C/17: Study of the physical mechanism related to water and heat stress tolerance in wheat genotypes. Duration: Mar 2017 to Feb 2020	Dr. Imrul Mosaddek, BARI, Gazipur Cell: 01716458606 Email: imrulbau @gmail.com	BARI, Gazipur
2	BR 2-C/17: Linkage and QTL mapping of Tungro resistance in rice. Duration: Mar 2017 to Feb 2020	Dr. Md. Abdul Latif, Plant Pathlogy Division, BRRI, Gazipur	BRRI, Gazipur

Basic Research Projects (BR)

Sl	Project title, code no. and commencement date	Coordinator/PI/CI	Location
3	BR 3-C/17: Exploring new sources of blast resistance and pyramiding blast resistant genes into Boro rice Duration: Mar 2017 to Feb 2020	Dr. Tahmid Hossain Ansari, Plant Pathlogy Division, BRRI, Gazipur Cell: 01716839404 Email: tahmidhansari @yahoo.com,	BRRI, Gazipur
4	BR 4-C/17: Physiological mechanism of waterlogging tolerance in sesame Duration : Mar 2017 to Feb 2020	Dr. A F M Shamim Ahsan, SO, BARI Cell: 01713311332 Email: shamim.agro @yahoo.com	RPRS, BARI Madaripur
5	BR 5-C/17: Identification and expression of heat tolerant genes at reproductive stage and their inheritance in wheat Duration: Mar 2017 to Feb 2020	Dr. Golam Faruque, RWRC, BARI Gazipur Cell: 01725444555 Email: faruqrwrc @gmail.com	BARI, Joydebpur; RARS Jashore; RARS Barisaal; RARS Hathazari; HARC Khagrachari
6	BR 7-C/17: Rice physiological development through trait discovery for boosting rice yield in changing climatic conditions. Duration: Mar 2017 to Feb 2020	Dr. Md. Ansar Ali, BRRI, Gazipur Cell: 01925053582 E-mail: maalibrri @yahoo.com, Dr. Sazzadur Rahman, PSO, Plant Physiology Division, BRRI, Cell: 01722210429	BRRI, Gazipur
7	BR 8-C/17: Chloroplast genome sequencing and QTL analysis of heat tolerant and late blight resistant potato varieties Duration: Mar 2017 to Feb 2020	Dr. Md. Mosharraf Hossain Molla, BARI Cell: 01552403728 Email: mhmolla @hotmail.com	BARI, Joydebpur; RARS Burirhat, Rangpur; RARS Lebukhali, Patuakhali

B. Commissioned Research Program (CRP)

Sl	Project title, code no. and commencement date	Coordinator/PI/CI	Location
1	CRP-I: Harnessing the potential of hill agriculture Duration: Jul 2013 to Sep 2018	Dr. Md. Nurul Alam, Coordinator, KGF Cell: 01911668399, 01711822586 Email: drmnalam @hotmail.com, crphilagri@gmail.com	Bandarban, Khagrachari and Rangmati
	Component-I: Watershed management for sustainable agricultural production	Dr. Munshi Rashed Ahmed, CSO, RHARS, Khagrachari, BARI Cell: 01748717603 Email: munshirashid	Selected watersheds in Bandarban (1), Khagrachari (3) and Rangamati districts

B. Commissioned Research Program (CRP)

Sl	Project title, code no. and commencement date	Coordinator/PI/CI	Location
	Duration: Jul 2013 to Sep 2018	@gmail.com	
	Component-II: Sustainable land management Duration: Jul 2013 to Sep 2018	Prof. A J M Sirajul Karim, Department of Soil Science, BSMRAU, Gazipur Cell: 01552601070 Email: alokpaulsau @yahoo.com	Selected locations in Bandarban, Khagrachari and Rangamati districts
	Component-III: Development and delivery of intensive crop production technologies for hill agriculture Duration: Jul 2013 to Sep 2018	Dr. Md Khalilur Rahman Bhuiyan, CSO, RARS, BARI, Hathazari, Chattogarm Cell: 01552410199 Email: csohathazari @gmail.com	Selected locations in Bandarban, Khagrachari, and Rangamati
	Component-IV: Entrepreneurship and value chain development for linking farmers with market Duration: Jul 2013 to Sep 2018	Dr. Md. Jamal Uddin, SSO, RARS, BARI, Hathazari, Chattogram Cell: 01815425857 Email: jamaluddin1971 @yahoo.com	Selected locations in Bandarban, Khagrachari and Rangamati
	Component-V: Program coordination Duration: Jul 2013 to Sep 2018	Coordinator: Dr. Md. Nurul Alam, KGF	
2	CRP-II (2nd phase): Modeling climate change impact on agriculture and developing mitigation and adaptation strategies for sustainable agricultural production in Bangladesh Duration: Dec 2020 to Nov 2023	Coordinator: Dr. Jatish C. Biswas, KGF Cell: 01715332857 Email: jatishb@ yahoo.com	Gazipur, Mymensingh
3	CRP-III: Strengthening sugarcane research and development in the Chattogram Hill Tracts. Duration: Apr 2015 to Jun 2020	Dr. Amzad Hossain, DG, BSRI, Iswardi, Pabna Cell: 01718426200	Bandarban, Rangamati and Khagrachari
4	CRP-IV: Hill livestock development Duration: Apr 2017 to Mar 2022	Prof Kabirul Islam Khan, Dept of Genetics and Animal Breeding, CVASU, Chattogram, Cell: 01732986741, Email: kik1775 @yahoo.co.uk	PRTC, CVASU (Chattogram), Bandarban (Sadar and Naikhangchari), Khagrachari (Sadar, Panghari)
5	CRP-V: Development of upazila land suitability assessment and crop zoning system of Bangladesh Duration: Jan 2017 to Dec 2019	Dr. Zilani, MD Crops, BARC Cell: 01552355393; Dr. Moqbul Hossain, SRDI Cell: 01710287841 Email: az.chowdhury @barc.gov.bd	300 upazilas of the country

C. Capacity Enhancement Program (CEP)

Sl	Project title, code no. and commencement date	Coordinator/PI/CI	Location
1	CEP-1: Capacity enhancement of NARS through agricultural research management information system (ARMIS) Duration: Jan. 2019 to Dec. 2021	Dr. Md. Moslem Uddin Mia, Research Management Specialist	BARC, Dhaka
2	CEP-II (3rd phase): Capacity building for conducting adaptive trials on seaweed cultivation in coastal areas. Duration: January 2016 to Sep 2019	Coordinator: Dr. S M Bokhtiar, Member-Director, Planning and Evaluation Division, BARC, Dhaka	Cox's Bazar
3	CEP-III: Mitigating greenhouse gas (GHG) emissions from rice-based cropping systems through efficient fertilizer and water management Duration: Sep 2015 to Aug 2019 (BRRI) Feb 2016 to Jan 2019 (BAU)	Dr. Rafiqul Islam, CSO, BRRI, Gazipur Prof. M. Rafiqul Islam, Soil Sc, BAU, Mymensingh Cell: 01711985414	BRRI and BAU farms
4	CEP-IV: Training program of PRTC at CVASU Duration: Mar 2017 to Feb 2020	Dr. Paritosh Kumar Biswas, Director, PRTC, CVASU Cell: 01718318926	CVASU, Chattogram
5	CEP-V/21: Capacity building for some field level extension workers of DAE, DoF and DLS as well as some progressive farmers of some selected areas of Bangladesh Duration: Oct 2021 to Oct 2024	Dr. Abul Kalam Azad, BAAG Fellow Cell: 01714-179048 Email: drakazad61 @gmail.com	BARC and concerned offices of DAE, DLS and DoF
6	CEP VI-BARC/21: Improving research qualities of ARIs through review and evaluation by an external panel of experts Duration: Oct 2021 to Oct 2024	Dr. Suraya Parvin, PSO, Technology Transfer and Monitoring Unit, BARC, Dhaka Cell: 01745856610	BARC and NARS institutes

D. International Collaborative Program (ICP)

Sl	Project title, code no. and commencement date	Coordinator/PI/CI	Location
1	ICP- I: Cropping system intensification in the salt affected coastal zones of Bangladesh and India Duration: Aug 2016 to Jul 2019	Dr. Md. Ansar Ali, Director (Research), BRRI, Gazipur; Cell: 01925053582	Dacope, Khulna and Amtali, Barguna
2	ICP- II: Nutrient management for diversified cropping in Bangladesh Duration: Dec 2017 to Nov 2020	Dr. Baktear Hossain, CSO, Soil, BARC, Cell: 01711201441	Takurgaon, Rajshahi, Ishurdi, Barguna, Khulna, Mymensingh

D. International Collaborative Program (ICP)

Sl	Project title, code no. and commencement date	Coordinator/PI/CI	Location
3	ICP- III: Incorporating salt tolerant wheat and pulses into small holder farming system in southern Bangladesh Duration: Jan 2018 to Dec 2021	Dr. Rais Uddin Choudhury, Director (Pulse), BARI, Gazipur Cell: 0175333679	Khulna, Satkhira, Jhalokhati, Pirojpur, Barishal, Patuakhali, Barguna
4	ICP-IV: Development of short-duration cold-duration rice varieties for haor areas of Bangladesh Duration: Apr 2020 to Mar 2025	Dr. M. Rafiqul Islam, Scientist (Plant Breeder), IRRI Bangladesh, Banani, Dhaka 1213 Dr. Partha Sarathi Biswas, PSO, Plant Breeding Division, BRRI, Gazipur	Habiganj, Sunamganj and Kishoreganj
5	ICP-VI: Managing wheat blast in Bangladesh: Identification and introgression of wheat blast resistant gene(s) into varietal development and rapid varietal dissemination	Dr. Muhammad Rezaul Kabir, SSO (Wheat Breeding), BWMRI, Nashipur, Dinajpur Cell: 01796586039 Email: rezaulw @yahoo.com	BWMRI, Nashipur, Dinajpur and Regional Station, BWMRI, Jashore

F. Lump Sum Grants (LSG)

Sl	Project title, code no. and commencement date	Coordinator/PI/CI	Location
1	LSG-1-C/20: Research to find out the reasons for the prices increase of rice, potato and onion Duration: 6 months	Dr. Md. Mosharraf Uddin Molla, Member Director (cc), AERS Division, BARC Email: md-aers@ barc.gov.bd	Dacope, Khulna and Amtali, Barguna
2	LSG-2-L/21: Environmental disaster due to lead exposure in Magura Sadar: exposure evaluation and rapid disaster mitigation Duration: 8 months	Prof. Kazi Rafiqul Islam, Dept of Pharmacology, Faculty of Veterinary Science, BAU, Mymensingh	Takurgaon, Rajshahi, Iswardi, Barguna, Khulna, Mymensingh

E. Lump Sum Grants (LSG)

Sl	Project title, code no. and commencement date	Coordinator/PI/CI	Location
3	LSG-3-F/21: Challenges of biofloc technology in Bangladesh aquaculture: an ambigous media hype Duration: 6 months	Prof. S.M. Rafiquzzaman, Dept. of Fisheries Biology and Aquatic Environment, BSMRAU, Gazipur, Email: rafiarib @yahoo.com	Takurgaon, Rajshahi, Iswardi, Barguna, Khulna, Mymensingh
4	LSG-4-C/21: Method development for comb honey production Duration: 6 months	Prof. Mohammed Sakhawat Hossain, Dept of Entomology, SAU, Sher-e-Bangla Nagar, Dhaka-1207	Khulna, Satkhira, Jalokhati, Pirojpur, Barisal, Patuakhali, Barguna
5	LSG-5-C/21: Exploring the status and potentials of minor cereals in Bangladesh Duration: 6 months	Prof. Md. Rafiqul Islam, Dept of Agronomy, BSMRAU, Gazipur-1406	Khulna, Satkhira, Jalokhati, Pirojpur, Barisal, Patuakhali, Barguna
6	LSG-6-C/21: Invasion of exotic rugose spiraling whitefly in Bangladesh: A baseline survey study on its geographical distribution, host plants dynamics and infestation severity Duration: 6 months	Prof. Gopal Das, Dept of Entomology, BAU, Mymensingh-2202, Cell: 01749285388, 01306406215 Email: gopal_entom @yahoo.com,	Khulna, Satkhira, Jalokhati, Pirojpur, Barisal, Patuakhali, Barguna
7	LSG-7-C/21: Distribution of minikits of salt tolerant rapeseed and mustard varieties BAU Sharisha-1, BAU Sharisha-2 and BAU Sharisha-3 in salt –affected coastal regions of Bangladesh Duration: 12 months	Prof. Dr. A B M Arif Hasan Khan Robin, Dept of Genetics and Plant Breeding, BAU, Mymensingh Cell: 1714239469 Email: gpb21bau @bau.edu.bd	Coastal districts
8	LSG-8-C/21: Collection of rice-based heritage for displaying in the BRRI rice museum Duration: 12 months	Md. Abdul Momin Senior Liaison Officer, Research Wing, BRRI Cell: 01716540380 E-mail: momin_sm @yahoo.com	BRRI, Gazipur
9	LSG 9-MH/21: Assessment of plastic and other anthropogenic debris pollution in beach and marine habitats with its prevalence in fishes of Saint Martin's Island Duration: 6 months	Prof. Kazi Ahsan Habib Dean, Faculty of Fisheries, Aquaculture and Marine Science, SAU, Dhaka Cell: 01713682290 Email: ahsan_sau @yahoo.com,	Saint Martin's Island
10	LSG 10-C/21: Adaptability trial of promising saline tolerant wheat genotypes in coastal region of Bangladesh Duration: 36 months	Prof. Md. Moynul Haque, Dept of Agronomy, BSMRAU, Gazipur Cell: 01711908640 E-mail: moynul60 @yahoo.com	Coastal districts

E. Lump Sum Grants (LSG)

Sl	Project title, code no. and commencement date	Coordinator/PI/CI	Location
11	LSG 11-FE/22. Agricultural development for fragile ecosystem in Bangladesh: Challenges and way forward	Dr. Shaikh Mohammad Bokhtiar Executive Chairman, BARC, Dhaka	BARC, KGF
12	LSG 12-C/22. Advancement and molecular characterization of blast resistant lines with its pathotypic reaction in blast endemic areas	Dr. Tahmid Hossain Ansari PSO, Plant Pathology Division, BRRI, Gazipur	BRRI, Gazipur
12	LSG 13-C/22. Adaptation trial of promising salt tolerant soybean genotypes in coastal region of Bangladesh	Prof. M. Abdul Karim Dept of Agronomy, BSMRAU, Gazipur-1706,	Coastal districts
14	LSG 14-C/22. Dissemination of vegetable varieties developed by BSMRAU through single season front line demonstration	Prof. A. K. M. Aminul Islam, Dept of Genetics and Plant Breeding BSMRAU, Gazipur	BSMRAU
15	LSG 15-C/22. Evaluation of fruit bearing and fruit yield of BARI developed jackfruit varieties in the established orchard	Dr. Md. Jillur Rahman, SSO, Pomology Division, HRC, BARI, Gazipur	BARI, Gazipur

F. Technology Piloting Program (TPP)

Sl	Project title, code no. and commencement date	Coordinator/PI/CI	Location
1	C-HF-103: Validation of improved agricultural technologies at farmer's field in hill farming system. Implemented by BARI	Dr. Md. Mohabbat Ullah, PSO, Hill Agril. Research Station, BARI, 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, Tuber Crops Research Sub-Center, BARI Munshiganj-1500 Cell: 01711488619	
3	C-CA-113: Adaptation of improved Sesame varieties in Khulna District optimizing sowing time and Nitrogenous fertilizer management. Khulna University	Prof. Md. Sarwar Jahan, Agrotechnology Discipline, Khulna University, Khulna-9208 Cell: 01712813106	

F. Technology Piloting Program (TPP)

Sl	Project title, code no. and commencement date	Coordinator/PI/CI	Location
4	C-S-161: Water management practices for increasing cropping intensity in Chapai Nawabganj district of Bangladesh	Dr. Md. Asgar Ali Sarker, CSO (cc), Agriculture Engineering Division, BINA, Mymensingh-2202 Cell: 01715998145	
5	P-1: Crop intensification in Barind area through effective drought management. BSMRAU	Dr. Md. Abdus Salam, SSO, OFRD, BARI, Rajshahi Cell: 01712092122	
6	P-2: Management and control of mites in coconut through farmers' capacity enhancement. BARI	Dr. Md. Nazrul Islam, PSO, Regional Horticultural Research Station, Shibpur, Narshingdi Cell: 01715855239	
7	P-3: Increasing rice production adopting improved production technologies in the tidal floodplain. BARI	Prof. Md. Jafar Ullah, Dept of Agronomy, SAU, Dhaka Cell: 01552331605	
8	P-4: Up-scaling of mubgbean-rice pattern in the charlands of Kurigram	Prof. Md. Abdul Karim, Dept of Agronomy, BSMRAU, Gazipur Cell: 01716752414	
9	P-5: Upscaling improved jhum cultivation introducing intercropping rice with cotton.	Dr. Md. Farid Uddin, Additional Director, Cotton Development Board, Khamarbari, Dhaka Cell: 01711020798	
10	P-6: Integrating crops and fish culture through land conversion into-ditch-dyke system	Prof. Md. Mofazzal Hossain, Dept of Horticulture, BSMRAU, Gazipur Cell: 01819433225	
11	P-7: Up-scaling and validation of a proven technology on management of the major diseases of brinjal and tomato	Dr. Biresh Goswami, CSO, TCRC, BARI, Gazipur Cell: 01716519187	
12	P-8: Validation and piloting of improved production technologies in Gopalganj Basin	Dr. Ashraf Hossain, PSO, Pulses Research Sub-station, BARI, Gazipur Cell: 01712948871	Gopalganj and Madaripur
13	P-9: Validation of up-scaling of improved rice- based cropping systems incorporating mustard and potato in northern districts	Dr. ASM Mahabubur Rahman, CSO, OFRD, BARI, Gazipur Cell: 01712598035	
14	P-10: Up-Scaling and validation of rhizome rot disease management	Dr. Atika Ayub, CSO, Plant Pathology Division, BARI, Gazipur Cell: 01716549366	Nilphamari, Rangpur, Bogura, and Tangail
15	P-11: Validation and scaling up of T. Aman - potato/mustard-mungbean-T. Aus cropping system in northern districts of Bangladesh	Prof. Md. Moynul Haque, Dept. of Agronomy, BAU, Mymensingh Cell: 01711908640	Dinajpur, Gaibandha and Nilphamari

F. Technology Piloting Program (TPP)

Sl	Project title, code no. and commencement date	Coordinator/PI/CI	Location
16	P-12: Up-scaling of cost-effective formula feeds and improved management practices for increasing milk and meat production from buffaloes	Prof Md. Ruhul Amin, Dept of Animal Science, BAU, Mymensingh. Cell: 01714217157	
17	P-13: Adaptation of community enterprise approach in tidal floodplains for crop-fish culture - Jhalokathi Model Duration: February 2015 to April 2018	Mr. Zillur Rahman, Program Director, SHISUK	Jhanjhania, Pirojpur; Uttampur, and Bishnudia of Jhalokati
18	P-14: Up-scaling and campaigning of rice-cotton intercropping in Bandarban and Khagrachari districts Duration: February 2015 to April 2018	Dr. Md. Farid Uddin, Executive Director, CDB, Dhaka	Chatttogram Hill Tracts (CHT)
19	P-15: Upscaling of high-value shing fish culture technology in homestead household ponds Duration: Dec. 2015 to January 2017	Prof. Md. Jahangir Alam, Dept. of Fisheries Biology and Aquatic Environment, BSMRAU, Gazipur; Cell: 01715143521	Sadar, Palash, Shibpur, Raipura, Belabo, and Monohardi of Narsingdi
20	P-16: Improving the animal health and productivity through mobile veterinary services Duration: May 2017 to April 2020	Prof. Emdadul Haque Chowdhury, Department of Pathology, BAU, Mymensingh Cell: 01712 017381	Fulbaria, Mymensingh, Nokla, Sherpur and BAU
21	P-17: Up-scaling of Tricho-compost and Tricho-leachate production for disease management in vegetable and spices (rhizome and bulb crops Duration: Jan 2018 to Dec 2020	Dr. Shamsunnahar, PSO, HRC, BARI	Gazipur, Jashore, Comilla and Bogura
22	P-18: Scale up of community enterprise approach (CEA) for intensification of floodplain fish production in Chalan Beel Duration : Apr 2017 to March 2020	SHISUK, Dept. of Genetics and Fish Breeding, BSMRAU, Gazipur	Pabna, Natore, Sirajganj
23	P-19: Validation and dissemination of newly released high yielding and climate smart potato varieties. Duration: November 2017 to August 2018	Dr. Bimal Chandra Kundu, PSO, TCRC, BARI, Gazipur Cell: 01712681181 Email: kundubc @yahoo.com	Different districts of Bangladesh
24	P-20: Productivity enhancement of goor and chewing type sugarcane through management of major diseases Duration: Jan 2020 to Dec 2022	Dr. Md shamsur Rahman, PSO & Head, Pathology Division, BSRI	Different districts of Bangladesh

G. Technology Commercialization Program (TCP)

Sl	Project title, code no. and commencement date	Coordinator/PI/CI	Location
1	TCP-1: BAU-Bro chicken conservation and piloting their producer-group Duration: Dec 2019 to Dec 2022	Prof. Md. Bazlur Rahman Mollah, Dept of Poultry Science, BAU, Mymensingh Cell: 01711304172 Email: mbrmollah.ps @bau.edu.bd	BAU, Mymensingh

Annex-2

Technical Advisory Committee (TAC), KGF

SL. No.	TAC Member	Designation
1	Dr. Muhammad Abdul Hamid Miah Former Executive Chairman, BARC House-76, Road-18, Sector-11 Uttara Model Town, Dhaka-1230 Cell: 8801752934125 Email: mhmiah46@gmail.com	Chairman
2	Dr. Md. Abdur Razzaque Former Executive Chairman Cell: 8801714179831 Email: marazzaque1951@gmail.com	Co-chairman
3	Dr. M. Jahiruddin Professor, Department of Soil Science Bangladesh Agricultural University Mymensingh 2202, Bangladesh Cell: +8801718813889 Email: m_jahiruddin@yahoo.com	Member
4	Dr. Md. Aziz Zilani Chowdhury Former Member Director (Crops), BARC House-8 (1-E/6-8), Road-6, Block-E, Section-1, Mirpur-1 Mobile: 01552355393 Email : zilani71@gmail.com	Member
5	Professor Mohammad Mizanul Haque Kazal Department of Development and Poverty Studies, Faculty of Agribusiness Management Sher-e-Bangla Agricultural University Cell: 01712502840, Email : mhkazal@gmail.com, mhkazal@sau.edu.bd	Member
6	Professor Dr. Md. Kamrul Hassan Department of Horticulture Faculty of Agriculture, BAU, Mymensingh Contact No: +8801714238614 Email: kamrulhassan.hort@bau.edu.bd	Member
7	Prof Dr. Md. Mahbubar Rahman Former Vice- Chancellor, BSMRAU, Gazipur House # 1, Road # 3, Block E, Kaderabad Housing Estate Ltd Katasur, Mohammadpur, Dhaka 1207 Cell: 01911340387 Email: drmahbubarr@gmail.com	Member
8	Prof. Dr. Md. Ali Akbar Former Vice Chancellor, BAU, Mymensingh House-14, Road-19, Sector-13, Uttara Model Town, Dhaka Cell 01715004752 Email: aakbar3@gmail.com ; ali.akbar@bau.edu.bd	Member
9	Dr. Md. Abdul Muyeed Former Director General, DAE House # D -5, Building # 1, Navana Spring Dale, Mirpur- 13, (near police convention hall), Dhaka- 1216 Cell: 01716940311 Email: muyeedbd61@gmail.com	Member

SL. No.	TAC Member	Designation
10	Dr. Mohammad Abdul Mazid Former Director General, BFRI House No. 02, Road No. 13, Sector No. 12, Uttara Model Town, Dhaka 1230 Cell# 8801711544919 Email: mazid.res@gmail.com	Member
11	Dr. Biresh Kumar Goshami, Former Director General, BINA, Mymensingh, House-1102, Building-3C, Rajuk Uttara Apartment, Uttara-18, Dhaka-1230 Cell: 01813158197 Email: bkgbari@yahoo.com	Member
12	Dr. Moin Us Salam Agricultural Scientist and Crop Systems Modeler, International Maize Wheat Improvement Center (CIMMYT), Bangladesh House-10/B, Road-53, Gulshan-2 Cell: 01855871938 Email: moinsalam1@gmail.com	Member
13	Dr. Md. Akkas Ali, Member Secretary of TAC and Director (Crops and Natural Resources), KGF Cell: 01718637801, Email: akkasbari@gmail.com	Member Secretary

Annex-3.

Independent Monitoring Team

Sl. No.	Name & address of Team Reviewers	Position in the Team
01.	Professor Dr. Shah-e Alam Former VC, SAU & Former Professor, **Plant Breeding,** BAU	Team Leader (will also act as editor in compiling the report)
02.	Dr. Md. Rafiqul Islam Mondal (**Crop Science/ Agronomy/Farming Systems**) Former Director General BARI 51/C, (2nd) Floor), Asad Avenue, Mohammadpur, Dhaka Mobile: 01712630006 Email: mrimondal54@gmail.com	Member
03.	Dr.Md. Giasuddin Former, CSO and Director National HPAI lab, BLRI Flat no: 1303, Building-9, Kapatakkho Sector-18, Uttara, Dhaka Cell 01711055597, Email: mgias04@yahoo.com	Member
04.	Dr. Jalal Uddin Ahmed (**Crop Physiology**) Former Professor, Department of Crop Botany, Bangabandhu Sheikh Mujibur Rahman Agricultural University Mobile: 01710-838890 Email: jahmed06@gmail.com	Member
05.	Dr. B.A.A Mustafi (**Agricultural Economics**) Former Director, BRRI, Mobile: 01712-105868 Email: bmustafi01@yahoo.com	Member
06.	Dr. Dinabandhu Pandit (**Breeding**) Former CSO, BARI Cell: 01712130599 Email:dina.pandit@gmail.com	Member
07.	Dr. A. S. Mahbubur Rahman Khan (**Agronomy**) Former CSO and Head, OFRD, BARI Flat-C-4,Houes-175, Road-12-A Dhanmondi R/A, Dhaka Mobile:01712598035 Email:mahbuburofrd@gmail.com	Member
08.	Dr. Md. Abdul Mazid Former CSO (**Agronomy & Soil Science**), BRRI Mobile:01730348473/01711804597 Email: mamazid1952@gmail.com	Member
09.	Dr.Md. Abdul Wohab Ex. Director General Bangladesh Agricultural Research Institute, Gazipur House # 12, Road # 6 Sector # 11, Uttara, Dhaka, Cell: 01711288081, Email: <m.wohab@yahoo.com>	Member
10.	Dr. Paresh Chandra Golder (**Horticulture)** Former Member Director (Planning & Evaluation) Bangladesh Agricultural Research Council Former Environmental & Social Safeguard Specialist NATP-2, Department of Agricultural Extension Khamarbari, Farmgate, Dhaka Cell:01735832059 Email: pcgolder59@yahoo.com	Member
11.	Dr. Md. Shamsul Alam Former Entomologist of International Institute of Tropical Agriculture (IITA), Nigeria and BRRI, Bangladesh	Member

	House 4, Road 11, Sector 1, Uttara, Dhaka-1230 Cell: 01718533770, Email: m.shamsulalam@yahoo.com	
12.	Mr. Badrul Hassan (**Fisheries)** Former Add. Secretary Cell: 01712120289 Email:babulrang06@yahoo.com	Member
13.	Dr. Md. Ebadul Haque **(Animal Husbandry)** Former Head, Training, Planning and Technology transfer Division, BLRI, Savar, Dhaka-1341 Cell: 01712 142110 Email: ebadul11@yahoo.com	Member
14.	Dr. Salehuddin Ahmed (**Fisheries)** Former Director, Bangladesh Fisheries Research Institute (BFRI), Mobile: 01718-305952, Email: ahamed_su@yahoo.com	Member
15.	Dr. Amzad Hossain (Biotechnology & Physiology) Former Director General, BSRI, Ishurdi, Pabna Cell:01718426200, Email:amzadbiotech@yahoo.com	Member

Annex-4

Krishi Gobeshona Foundation
Statement of Expenditure (SoE): July 01, 2023 to June 30, 2024

Tk in Lakh

Fund Sources/Income Head	Approved Annual Budget (2023-24)	Fund Received from BKGET, 2023-24	Quarterly Exp. (01 April, 2023 to 30 June 2024)	Cumulative Exp. 2023-24	Unspent Balance	Progress
Opening Balance 01/07/2023 (Cash at Bank Tk. 131.86182 (Lakh) + Petty Cash in hand Tk. 0.25 (Lakh)	0	132.11182	0	0	0	0
Fund Received from BKGET during July 2023 to June 2024	0	3437.245342	0	0	0	0
Un-Spent Balance received from closing project during the year	0	2.575905	0	0	0	0
Received Form Interest on STD accounts	0	1.64759	0	0	0	0
Received Form Vehicles Rent	0	0.391	0	0	0	0
Received Form Advance Adjustment	0	0.83963	0	0	0	0
Total Fund for the period of July 2023 to June, 2024	**0.00**	**3,574.8113**	**0.0**	**0.0**	**0.0**	**0.0**
Research Cost:	-	-	-	-	-	-
Research Grants Projects (on-going):	-	-	-	-	-	-
(a) Competitive Grants Projects (CGP)	-	-	-	-	-	-
(i) CGP (2nd Call)	-	-	-	-	-	-
(ii) CGP (3rd Call)	17.83	17.00	-	16.71	1.12	94%
(iii) CGP (4th Call)	365.32	282.00	13.07	281.67	83.65	77%
(iv) CGP (4th Call-Interim-2)	422.00	421.00	72.31	420.42	1.58	100%
(v) CGP (5th Call)	919.47	669.00	186.83	668.07	251.40	73%
(vi) LSG Projects	68.65	49.00	2.55	48.19	20.46	70%
(vii) Basic Research	1.55	1.50	-	1.50	0.05	97%
Sub- Total- CGP	**1,794.82**	**1,439.50**	**274.76**	**1,436.56**	**358.26**	**80%**
(b) Commissioned Research Projects (CRP)	530.00	527.00	100.00	526.64	3.36	99%
(C) (i) Technology Piloting Projects (TPP)	-	-	-	-	-	-
(ii) Technology Commercialization Project (TCP)	-	-	-	-	-	-
(d) International Collaborative Projects (ICP)	260.00	257.00	88.18	256.03	3.97	98%

(e) Capacity Enhancement Projects (CEP)		303.02	172.00	31.32	171.22	131.80	57%
(f) Up -Coming Research Grants Projects: CGP 6th Call, CRP, ICP, TPP, TCP etc.		10.00	1.92	-	-	10.00	0%
(g.) Research Related Other Expenses:		-	-	-	-	-	-
Seminar & Workshop, Training, Honorarium, Audio Video/ film production, Transport Hire, Travel Exp, Petrol, Oil, Gas and lubricants, National /International resource person/ consultant/expert (remuneration, perdiem, fees, airfare, lodging and others cost) etc.		306.60	303.00	82.97	302.23	4.37	99%
	Sub-total of Research Cost	**3,204.44**	**2,700.42**	**577.23**	**2,692.67**	**511.77**	**84%**
2	**Operational Support Cost:**	-	-	-	-	-	-
	Salary & Allowance	535.10	534.00	146.07	533.67	1.43	100%
	Administrative Expenses	119.39	109.00	19.39	108.24	11.15	91%
	Repairs and Maintenance	34.68	25.00	5.97	24.97	9.71	72%
	Sub-total of Operational Support Cost	**689.17**	**668.00**	**171.43**	**666.88**	**22.29**	**97%**
3	**Capital Expenditure:**	-	-	-	-	-	-
	Construction of Office Building	300.00	200.00	100.00	200.00	00.00	67%
	Capital Expenses	6.39	6.39	0.18	6.01	.38	94%
	Sub-total of Capital Expenditure	**306.39**	**206.39**	**100.18**	**206.01**	**100.38**	**67%**
	Grand Total (1+2+3)	**4,200.00**	**3,574.81**	**848.84**	**3,565.56**	**634.44**	**85%**
Progress: Total expenditure Tk. 3565.56 lac as of 30th June 2024 against a total fund of Tk. 3437.2453 lac from BKGET and Tk. 5.4541 lac from various closing project, Bank Interest, Vehicle rent. Financial Achievement 85% of Total Budget							

Summary of SoE
Fiscal Year 2023-2024

2023-24 approved annual budget: Tk. 4200.00 lac; Fund expenditure: Tk. 3565.56 lac. Progress on approved budget 85% and Progress on fund received 99.74%

Annex-5

KGF Work Plan and Implementation Activity Plan for 2025-26

Sl.	List of Activities/Programs	J	A	S	O	N	D	J	F	M	A	M	J
A. Competitive Grants Program (CGP)													
1	TAC evaluation and budget rationalization												
2	Board approval, MoU signing and awarding of grants												
3	Coordination, implementation and management of ongoing CGP, LSG and Basic Research projects												
B. Commissioned Research Program (CRP)													
1	Coordination, implementation and management of ongoing projects												
C. Capacity Enhancement Program (CEP)													
1	Coordination, implementation and management of ongoing projects												
2	Development and implementation of training programs on statistics/advanced breeding/disease forecasting/crop modeling/ IPM/crops management/ molecular biology/IPR, etc.												
3	Need-based consultative meetings, seminars, workshops, etc.												
4	Need-based assistance to develop/improve the physical facilities of the NARS institutes												
D. International Collaborative Program (ICP)													
1	Establishing national and international linkages and collaboration with reputed universities and R&D organizations in Bangladesh and overseas												
2	Coordination, implementation and management of ongoing and upcoming projects												
3	TAC evaluation and budget rationalization of ICP projects												
4	Board approval, MoU signing and awarding of grants to ICP projects												
E. Technology Piloting/Upscaling Program (TPP)													
1	Continue implementation of the ongoing and upcoming projects.												
F. Upcoming Projects													
1	CGP 6th Call												
	MoU/LoA Signing and Inception workshop of approved projects												
G. Monitoring and Evaluation													
1	Concurrent M & E of ongoing projects												
2	Organizing annual/completion progress review and planning workshops												
H. Other Activities													

SI.	List of Activities/Programs	J	A	S	O	N	D	J	F	M	A	M	J
1	Board/AGM/EGM/other meetings												
2	Preparation and printing of annual report (BKGET & KGF)/project brief/data management /technology bulletin/need based fact sheet/ data management/ other reports/ occasional publications /compilation of technical and approved projects												
3	Building Floor for KGF in the 6th Floor of AIC building, BARC Campus												
4	Preparation of action plan/implementation plan/ activity plan, etc,												
5	Misc. other activities (Need based)												

KRISHI GOBESHONA FOUNDATION

Budget for Financial Year: 2025-2026

Figs. in Lakh Tk.

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 (3rd Call)	-	
	(ii) CGP (4th Call)	38.41	1.28
	(iii) CGP (5th Call)	710.35	23.68
	(b) Basic Research (BR)	-	0.00
	(c) Commissioned Research Program (CRP)	270.27	9.01
	(d) (i) Technology Piloting Program (TPP)	-	0.00
	(ii) Technology Commercialization Program (TCP)	123.85	4.13
	(e) International Collaborative Program (ICP)	103.36	3.45
	(f) Capacity Enhancement Program (CEP)	141.10	4.70
	(g) Lum-Sum Grant Program (LSG)	8.93	0.30
	(h) Research Grants Program (Up-Coming): CGP 6th call, CRP, ICP, CEP, LSG etc.	410.78	13.69
	(i) Rsearch related other expenses		
	(i) Seminer/Workshop/Conference	40.00	1.33
	(ii) Training	5.00	0.17
	(iii) Honorium (Coordinator, PI & CoPI's & Othrers)	150.00	5.00
	(iv) Contractual Pay, Consultancy Pay, hiring of vehicles & TA/DA for project visit, publication, documents & video production cost, Fuel, Gas & LPG for project visit.	94.00	3.13
	Total Program Budget	**2,096.05**	69.87
2	**Salary & Allowances:**		
	(a) Salaries: i) Salaries of KGF Officials & CPF/Pension	355.66	11.86
	(b) Allowances: House Rent, Medical, Mobile, Festival, Overtime, Rest & Recreation, Bangla New Year Allowances, service benefits etc.	277.67	9.26
3	**Operating Cost:**		
	Utilities, repair & maintenance/ renovation, supply & services, Audit fees/ financial/ technical services, printing, Office rent, Fuel, Gas & LPG, fees & charges, Office equipments, computer, vehicles, goods and logistics support and services, Meeting and other costs etc.	136.62	4.55
	Sub-total of Salaries & Operational Cost:	**769.95**	25.67
4	**Construction of KGF office Space.**	**100.00**	3.33
5	**Capital Expenses:**	**34.00**	1.13
	Total Budget for the Financial Year 2025-26	**3,000.00**	**100.00**

In word : Taka 3000.00 (Three Thousand Lakh) only

(As per need, line-item costs may be adjusted by the ED, KGF within total budget)

Trust fund grants Taka 3000.00 (Three Thousand Lakh) will be utilized as per objectives of the BKGET Clause iv no.7 (page-10) and the provisions of the Memorandum of KGF.

20/08/2025

(Dr. Nathu Ram Sarker)
Executive Director (Additional Charge)
KGF.

KRISHI GOBESHONA FOUNDATION (KGF)

FUNDED BY BANGLADESH KRISHI GOBESHONA ENDOWMENT TRUST (BKGET)

INDEPENDENT AUDITORS' REPORT

AND

FINANCIAL STATEMENTS

FOR THE YEAR ENDED 30 JUNE 2024

Independent Auditors' Report
Of Krishi Gobeshona Foundation (KGF)
Funded by Bangladesh Krishi Gobeshona Endowment Trust (BKGET)

Qualified Opinion

We have audited the financial statements of Krishi Gobeshona Foundation (KGF), which comprise the statement of financial position as at 30 June 2024, and the statement of comprehensive income and expenditure, statement of receipts and payment for the year then ended, and notes to the financial statements, including a summary of significant accounting policies.

In our opinion, except for effect of the matter described in the Basis for Qualified Opinion section of our report, the foundation financial statements present fairly in all material respects of the statement of financial position of Krishi Gobeshona Foundation as at 30 June 2024,

Basis for Qualified Opinion

1. The financial statements of Krishi Gobeshona Foundation (KGF) have been prepared considering cash basis of accounting which contradict with the Conceptual Framework for Financial Reporting of IRSFs. As per IFRSs, cash basis of accounting is not allowed.

2. The foundation does not charge depreciation against its Non-Current Assets, which is a non-compliance of IAS 16 and matching principal which states that assets through the usage of which an organization expects to be benefited economically must be depreciated to match the cost of an asset with the benefit of its use over time. Therefore, noncharging of depreciation is leading to an overstatement of non-current assets and surplus and understatement of expenses.

3. The foundation has shown the total allocated amount to any project as an expense whether it has been incurred or not. The unused amount of that respective project is refunded to KGF. However, this is inconsistent with the accrual concepts of accounting whereby only those expenses which have been incurred should be charged to the Statements of Income and Expenditure. Moreover, the fund received from BKGET was fully recognized as income irrespective of utilization of fund, which is a noncompliance of IAS-21.

We conducted our audit in accordance with International Standards on Auditing (ISAs). Our responsibilities under those standards are further described in the Auditor's Responsibilities for the Audit of the Financial Statements section of our report. We are independent of the foundation in accordance with the International Ethics Standard Board for Accountants' Code of Ethics for Professional Accountants (IESBA Code), together with the ethical requirements' that are relevant to our audit of the financial statements in Bangladesh, and we have fulfilled our other ethical responsibilities in accordance with these requirements. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our qualified opinion.

Other Information

Management is responsible for the other information. The other information comprises all of the information other than the financial statements and our auditor's report thereon.

Our opinion on the financial statements does not cover the other information and we do not express any form of assurance conclusion thereon.

In connection with our audit of the financial statements, our responsibility is to read the other information and, in doing so, consider whether the other information is materially inconsistent with the financial statements or our knowledge obtained in the audit, or otherwise appears to be materially misstated.

Zoha Zaman Kabir Rashid & Co., a partnership firm registered in Bangladesh and a member firm of MSI Global Alliance, a leading international association of independent legal and accounting firms
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If, based on the work we have performed, we conclude that there is a material misstatement of this other information; we are required to report that fact.

Responsibilities of Management and Those Charged with Governance for the Financial Statements

Management is responsible for the preparation of financial statements that give a true and fair view in accordance with IFRSs, 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.

In preparing the financial statements, management is responsible for assessing the foundation ability to continue as a going concern, disclosing, as applicable, matters related to going concern and using the going concern basis of accounting unless management either intends to liquidate the foundation or to cease operations, or has no realistic alternative but to do so.
Those charged with governance are responsible for overseeing the foundation financial reporting process.

Auditor's Responsibilities for the Audit of the Financial Statements

Our objectives are to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes us opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with ISAs will always detect a material misstatement when it exists.

Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of these financial statements

As part of an audit in accordance with ISAs, we exercise professional judgment and maintain professional skepticism throughout the audit. We also:

- Identify and assess the risks of material misstatement of the financial statements, whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for our opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control.

- Obtain an understanding of internal control relevant to the audit 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 foundation internal control.

- Evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by management.

- Conclude on the appropriateness of management's use of the going concern basis of accounting and, based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on the foundation ability to continue as a going concern. If we conclude that a material uncertainty exists, we are required to draw attention in our auditor's report to the related disclosures in the financial statements or, if such disclosures are inadequate, to modify our opinion. Our conclusions are based on the audit evidence obtained up to the date of our auditor's report. However, future events or conditions may cause the foundation to cease to continue as a going concern.

- Evaluate the overall presentation, structure and content of the financial statements, including the disclosures, and whether the financial statements represent the underlying transactions and events in a manner that achieves fair presentation.

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- Obtained sufficient appropriate audit evidence regarding the financial information of the entities or business activities within the foundation to express opinion on the financial statements. We are responsible for the direction, supervision and performance of the foundation audit. We remain solely responsible for our audit opinion.

We communicated with those charged with governance regarding, among other matters, the planned scope and timing of the audit and significant audit findings, including any significant deficiencies in internal control that we identify during the audit.

From the matters communicated with those charged with governance, we determine those matters that were of most significance in the audit of the financial statements of the current period and are therefore the key audit matters. We describe these matters in our auditors' report unless law or regulation precludes public disclosure about the matter or when, in extremely rare circumstances, we determine that a matter should not be communicated in our report because the adverse consequences of doing so would reasonably be expected to outweigh the public interest benefits of such communication.

Report on other Legal and Regulatory Requirements

a) we have obtained all the information and explanation which to the best of our knowledge and belief were necessary for the purpose 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 foundation so far as it appeared from our examination of those books;

c) the statement of financial position and statement of Income & Expenditure dealt with by the report are in agreement with the books of account;

Dated: 8 May 2025
Dhaka

Md. Iqbal Hossain FCA
Partner, Enrolment No.:596 (ICAB)
Zoha Zaman Kabir Rashid & Co.
Chartered Accountants
DVC: 2505120596AS420881

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Krishi Gobeshona Foundation (KGF)
Funded by Bangladesh Krishi Gobeshona Endowment Trust (BKGET)
Statement of Financial Position
As at 30 June 2024

Particulars	Notes	Amount in Taka	
		30 June 2024	30 June 2023
Assets:			
Non-current assets:			
Property, Plant and Equipments	4.00	34,969,574	34,368,606
		34,969,574	**34,368,606**
Current assets:			
Building and Infrastructures (Capital Work in Progress)	4.01	20,000,000	-
Advances	5.00	-	4,000
Security Deposits	6.00	1,110,000	1,110,000
Cash & Cash Equivalents	7.00	924,935	13,211,183
Total current assets		**22,034,935**	**14,325,183**
Total Assets		**57,004,509**	**48,693,789**
Fund and Liabilities:			
Fund Account (BKGET Fund)	8.00	57,004,509	48,693,789
Other Liabilities		-	-
Total Fund and Liabilities		**57,004,509**	**48,693,789**

The annexed notes 1 to 18 an integral part of these financial statements.

Assistant Manager (F & A) | Manager (F & A) | Executive Director

Signed in terms of our separate report of even date.

Md. Iqbal Hossain FCA
Senior Partner, Enrolment No. 596
Zoha Zaman Kabir Rashid & Co.
Chartered Accountants
DVC: 2505120596AS420881

Dated: Dahka
May 8, 2025

ZOHA ZAMAN KABIR RASHID & CO. Chartered Accountants

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Krishi Gobeshona Foundation (KGF)
Funded by Bangladesh Krishi Gobeshona Endowment Trust (BKGET) Fund
Statement of Income & Expenditure
For the Year ended 30 June 2024

Particulars	Notes	Amount in Taka	
		30 June 2024	30 June 2023
Income:			
Grant	8.02	343,724,535	362,335,615
Interest Received	19.00	164,759	616,145
Other Received & Income	19.00	125,263	-
Total Income:		**344,014,557**	**362,951,760**
Less : Expenditure			
Salaries and Allowances	09.00	53,367,128	62,438,771
Training, Workshop & CGP Related Expenses, Other research Expenses	10.00	30,370,323	28,578,321
Operational Cost	11.00	13,176,313	15,779,536
Competitive Grant Program CGP	12.00	138,687,208	111,872,493
ICP Program	13.00	25,602,500	29,215,364
LSG Project	14.00	4,819,647	5,934,850
Commissioned Research Project CRP	15.00	52,663,395	70,829,309
Pilot Project	16.00	-	2,630,796
Basic Research & CEP II & III	17.00	17,272,713	29,874,530
Loss on Sale of Fixed Assets		-	4,304,721
Others Expenses		-	1,493,069
Total Expenditure:		**335,959,227**	**362,951,760**
Excess of Income over Expenditure		**8,055,330**	-
(Transferred to Fund Account)			

The annexed notes 1 to 18 an integral part of these financial statements.

Assistant Manager (F & A) | Manager (F & A) | Executive Director

Signed in terms of our separate report of even date.

Md. Iqbal Hossain FCA
Senior Partner, Enrolment No. 596
Zoha Zaman Kabir Rashid & Co.
Chartered Accountants

Dated : Dhaka
08 MAY 2025

ZOHA ZAMAN KABIR RASHID & CO. Chartered Accountants

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Krishi Gobeshona Foundation (KGF)
Funded by Bangladesh Krishi Gobeshona Endowment Trust (BKGET) Fund
Statement of Receipts and Payments
For the Year ended 30 June 2024

Particulars	Notes	Amount in Taka	
		30 June 2024	30 June 2023
A. Receipts:			
Opening balance:			
Cash at Bank		13,186,183	9,405,597
Cash in Hand		25,000	25,000
Fund Received	8.01	343,724,535	356,317,935
Refund of Unspent Balance against advance & Poject		255,390	6,277,268
Other Received	19.00	290,022	1,041,503
Total		**357,481,129**	**373,067,304**
B. Payments:			
Building and Infrastructures (Capital Work in Progress)	4.01	20,000,000	-
Salaries and Allowances	09.00	53,367,128	50,419,213
Acquisition of property plant and equipments	Annx-A	600,968	1,013,151
Training, Workshop & CGP related expenses	10	30,370,323	34,965,540
Operational Cost	11	13,172,313	14,535,570
Advances	Annx-B	-	6,403,251
Competitive Grant Program CGP	12.00	138,687,208	111,872,493
ICP Program	13.00	25,602,500	29,215,364
LSG Program	14.00	4,819,647	5,934,850
Commissioned Research Project CRP-5	15.00	52,663,395	70,829,309
Pilot Project	16.00	-	2,630,796
Basic Research & CEP ii & iii	17.00	17,272,713	29,874,530
Others Expenses		-	1,493,069
Total Payments		**356,556,195**	**359,187,136**
Closing balance:			
Cash at Bank	7.00	899,935	13,186,183
Cash in Hand	7.00	25,000	25,000
Total		**357,481,129**	**372,398,319**

The annexed notes 1 to 18 an integral part of these financial statements.

Assistant Manager (F & A) **Manager (F & A)** **Executive Director**

Signed in terms of our annual Report of even date.

Md. Iqbal Hossain FCA
Senior Partner, Enrolment No. 596
Zoha Zaman Kabir Rashid & Co.
Chartered Accountants

Dated: Dhaka

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Krishi Gobeshona Foundation (KGF)
Funded by 'Bangladesh Krishi Gobeshona Endowment Trust (BKGET) Fund
Notes to the Financial Statements
As at and For the year ended 30 June 2024

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.

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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.

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 IAS-8 "Accounting Policies, Changes in Accounting Estimates and Errors".

iii) Reporting Period:

Financial statements of the company cover one year from 1 July 2023 to 30 June 2024.

iv) General:

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

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	Particulars	Amount in Taka	
		30 June 2024	30 June 2023
4.0	**Property, Plant and Equipments**		
	A. Cost:		
	As on 01.07.2023	34,368,606	38,085,534
	Add: Addition during the year	600,968	1,013,151
	Less: Adjustment during the year	-	4,730,079
	As on 30.06.2024	**34,969,574**	**34,368,606**
	Less:		
	B. Accumulated Depreciation:		
	As on 01.07.2023	-	-
	Add: Depreciation charged during the year	-	-
	Less: Adjustment during the year	-	-
	As on 30.06.2024	-	-
	Written Down Value (WDV) (A-B) as on 30.06.2024	**34,969,574**	**34,368,606**
	(Details have been shown in Annexure-A)		
4.1	**Building and Infrastructures (Capital Work in Progress)**		
	Opening Work in Progress	-	-
	Add: Addition During the year	20,000,000	-
	Totall	**20,000,000**	**-**
5.00	**Advances**		
	Rafiqul Islam Akanda	-	4,000
	BARC	-	-
	Total	-	**4,000**
	(Details have been shown in Annexure-B)		
6.00	**Security Deposits**		
	Deposit against office rent	1,080,000	1,080,000
	Security money for Trust Filling	30,000	30,000
		1,110,000	**1,110,000**
7.00	**Cash & Cash Equivalents**		
	Cash in hand	25,000	25,000
	Pubali Bank Ltd. Farmgate Br. A/C# 0522	899,935	13,186,183
	Total	**924,935**	**13,211,183**
8.00	**Fund Account (BKGET Fund)**		
	Opening Balance	48,693,789	49,156,305
	Add: Fund Received during the year **(Note - 8.01)**	343,724,535	356,317,935
	Refund of Unspent Balance (Details have been shown in Annexure-c)	255,390	5,555,164
		392,673,714	**411,029,404**
			-
	Less: Transferred to grant income **(Note-8.02)**	343,724,535	362,335,615
	Add : Excess of Income over Expenditure	8,055,330	-
	Total	**57,004,509**	**48,693,789**

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Particulars	Amount in Taka	
	30 June 2024	30 June 2023

8.01 Fund Received during the year:

Fund received from BKGET Fund	**343,724,535**	**356,317,935**

8.02 Transferred to grant income

Fund received from BKGET Fund	343,724,535	356,317,935
Add: Excess of Income over Expenditure	-	6,017,680
	343,724,535	**362,335,615**

09.00 Salaries and Allowances

Officer & Staff salary	26,321,294	34,071,099
Housing Rent	13,072,747	-
Medical Allowance	2,252,233	-
Mobile/Cellphone Allowance	510,500	-
Festival Allowance	4,830,060	-
Charge Allowance	86,800	-
Bangla New Year Allowance	427,296	-
Special Benefit	907,822	-
Allowance/ Bonus	-	4,000,104
Recreation Allowance	1,026,680	-
Over time Charge allowance	1,393,146	1,311,242
Gratuity	-	3,335,400
Employees Contribution(CPF Fund)	2,538,550	4,959,197
Retention /Remunaration Fees	-	72,000
Earned Leave	-	2,670,171
Advance Adjustment	-	300,000
Total	**53,367,128**	**50,719,213**

10.00 Training, Workshop & CGP Related Expenses, Other research Expenses

CGP meeting, Workshop & Seminar/Conference	3,200,656	1,837,871
Honorioum/Remuneration expense	12,979,010	18,477,096
PHD Scholarship	-	3,600,000
Advance Adjustment	-	4,663,354
Contractual Service salary	4,707,030	11,050,573
Audito Video/ film production	461,092	-
Petrol Oil & Lubricants	1,505,664	-
Publications	715,350	-
Transport hiring	64,128	-
Travel expense	2,395,299	-
Professional Service	3,913,889	-
Training	428,205	-
Total	**30,370,323**	**39,628,894**

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Particulars	Amount in Taka	
	30 June 2024	30 June 2023
11.00 Operational Cost		
Entertainment	339,808	84,670
Car Repair & Maintenance	2,252,815	2,252,399
Other Repair & Maintenance	196,419	195,348
Bank Charge	-	183,680
Electricity Bill	1,833,737	1,687,660
Utility Service charge	100,722	-
Water	9,900	-
Audit fee	154,075	-
Advertising expense	1,292,120	-
Legal Advisor Fees	-	600,000
License Fee	7,383	
Printing and Publication/documents, video	703,324	2,726,976
Miscellaneous Expenses	-	483,929
Books and periodicals	62,883	-
Office Rent	2,760,000	2,964,501
Outsourcing Services	72,000	-
Gas, Fuel & Oil etc.	698,178	2,099,878
Car Insurance Premium	506,836	613,662
Office Supplies & Stationary	456,208	436,731
Newspaper Bill	14,784	-
Postage bill	47,212	26,140
Internet bill	210,798	179,996
Tools and bridge road	127,330	-
Fitnees fee	88,958	-
Hiring of securities service Salary	732,443	668,985
Computer consuables	124,794	-
Stamps and seals	24,902	-
Uniforms	142,823	-
Ceremonies/ Festival	164,611	-
Website Maintainance	47,250	-
Adjustment with advance	4,000	1,243,966
Total	**13,176,313**	**16,448,521**

12.01 1st Call:		
TF 01-C	-	-
TF 02-C	-	-
TF 03-C		-
TF 04-C	-	-
TF 05-C	-	-
TF 06-C	-	-
TF 07-C	-	-
TF 08-NR	-	-
TF 09-NR	-	-
TF 10-F	-	-
TF 11-C	-	-

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	Particulars	Amount in Taka	
		30 June 2024	30 June 2023
	TF 12-L	-	-
	TF 13-F	-	-
	TF 14-C	-	-
	Total 1st Call	-	-
12.02	**2nd Call:**		
	TF 15-SF	-	-
	TF 16-WF	-	-
	TF 17-ARI	-	-
	TF 18-EM	-	-
	TF 19-EM	-	-
	TF 20- EM	-	-
	TF 21-DL	-	-
	TF 22- PS	-	-
	TF23-AM	-	-
	TF 24-EM	-	-
	TF 26-ARI	-	-
	TF 27-SF	-	-
	TF 29-AM	-	-
	TF 30-AP	-	-
	TF 31-VC	-	-
	TF 32-SF	-	-
	TF 33-ARI	-	-
	TF 35	-	-
	TF 36-FP	-	-
	Total 2nd Call	-	-
12.03	**3rd Call**		
	TF-37-F/17	-	-
	TF-38-F/17	-	503,700
	TF-39-F/17	145,900	-
	TF-40-F/17	-	-
	TF-41-SBR/17	-	-
	TF-42-AE/17	-	-
	TF-43-C/17	-	-
	TF-44-L/17	-	-
	TF-45-F/L/17	493,560	-
	TF-46-F/L/17	-	-
	TF-47L/17	-	-
	TF-48-L/17	-	-
	TF-49-L/17	-	154,719
	TF-50-C/17	-	-
	TF-51-SBR/17	671,020	-
	TF-52-C/17	-	-
	TF-53-C/17	-	101,265
	TF-54-SBR/17	-	-
	TF-55-AE//17	-	-
	TF-56-C/17	-	-
	TF-57-C/17	-	-
	TF-58-C/17	143,073	-

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Particulars	Amount in Taka	
	30 June 2024	30 June 2023
TF-60-SBR//17	-	-
TF-61-C/17	111,300	
TF-62-L/17	-	-
TF-63-Char/17	106,422	-
TF-64-Fruits/17	-	319,992
TF-65-C/19	-	-
TF-66-C/19	-	-
TF-67-C/19	-	446,400
Total 3rd Call	**1,671,275**	**1,526,076**
12.04 4th Call		
TF 68-C/20	1,059,740	2,305,000
TF 69-C/20	2,996,064	2,933,540
TF 70-C/20	-	-
TF 71-C/20	2,682,900	2,416,500
TF 72-NRM/20	2,672,350	2,863,000
TF73-NRM/20	728,960	1,871,100
TF74-NRM/20	649,350	1,988,500
TF75-F/20	895,445	2,182,500
TF76-F/20	1,895,130	5,110,000
TF77-L/20	1,962,500	1,962,500
TF78-L/20	551,000	6,159,000
TF79-SoE/20	3,957,500	3,072,500
TF-80-NRM/20	1,336,500	797,000
TF-81-NRM/20	2,520,000	2,837,500
TF-82-L/20	565,600	565,600
TF-83-L/20	1,206,360	1,195,000
TF-84-SOE/20	823,000	2,302,000
TF-85-F/20	1,664,685	3,369,315
TF-86-C/21	1,367,555	1,492,110
TF-87-SC/21	3,438,549	3,304,355
TF-88-C/21	1,856,500	2,416,820
TF-89-AM/21	2,405,574	3,367,960
TF-90-C/21	790,825	2,472,025
TF-91-TEA/21	1,624,534	1,348,693
TF-92-FNS/21	12,932,120	17,620,386
TF-93-SOE/21	7,915,316	6,219,784
TF-94-BR/21	1,366,775	2,661,075
TF-95-C/21	810,000	1,055,000
TF-96-SBR/21	1,403,000	1,167,000
TF-97-C/21	-	-
TF-98-C/21	1,562,500	1,579,000
TF-99-F/21	-	2,152,500
TF-100-F/21	1,945,000	2,614,500
TF-101-L/21	2,191,180	1,095,850
TF-102-L/21	432,700	3,003,250
TF-103-SBR/21	-	1,064,500
	70,209,212	**98,565,363**

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Particulars	Amount in Taka	
	30 June 2024	30 June 2023
12.05 5th Call Project		
TF-104-C/23	2,400,000	3,000,000
TF-105-C/23	1,165,000	83,000
TF-106-C/23	527,334	412,666
TF-107-C/23	1,148,200	247,800
TF-108-C/23	829,440	207,360
TF-109-C/23	839,000	209,000
TF-110-C/23	2,030,080	507,520
TF-111-C/23	661,000	173,000
TF-112-C/23	808,000	202,000
TF-113-C/23	1,499,000	348,000
TF 114-C/23	2,458,500	-
TF 115-C/23	1,008,340	-
TF-116-C/23	904,000	166,000
TF-117-C/23	1,870,400	437,600
TF-118-C/23	1,190,500	338,000
TF 119-C/23	1,795,000	-
TF-120-C/23	1,140,320	285,080
TF-121-C/23	525,500	372,000
TF-122-C/23	1,076,398	394,092
TF-123-C/23	1,546,400	386,600
TF-124-C/23	1,409,600	318,400
TF-125-C/23	1,135,200	314,800
TF-126-C/23	996,200	330,800
TF-127-L/23	956,300	267,200
TF-128-C/23	2,121,100	274,400
TF 129-L/23	1,577,500	-
TF-130-C/23	700,000	403,000
TF-131-C/23	1,180,000	295,000
TF-132-C/23	1,370,000	430,000
TF-133-SOE/23	1,174,240	293,560
TF-134-CC/23	956,600	304,400
TF 135-C/23	905,000	-
TF-137-C/23	1,606,600	385,400
TF 138-C/23	1,377,850	-
TF 139-C/23	1,164,000	-
TF 140-C/23	1,374,000	-
TF 141-C/23	1,394,000	-
TF 142-C/23	1,176,000	-
TF 143-C/23	1,496,000	-
TF 144-C/23	635,000	-
TF 145-C/23	688,000	-
TF 146-C/23	535,200	-
TF 147-C/23	1,075,000	-
TF 148-C/23	639,500	-
TF 149-C/23	1,126,450	-
TF 150-C/23	1,365,924	394,376
TF 151-C/23	785,315	-
TF 152-C/23	1,005,750	-

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Particulars		Amount in Taka	
		30 June 2024	30 June 2023
	TF 153-C/23	792,500	-
	TF 154-L/23	1,188,000	-
	TF 155-C/23	601,500	-
	TF 156-C/23	491,000	-
	TF 157-SOE/23	626,900	-
	TF 158-F/23	813,000	-
	TF 159-F/23	809,830	-
	TF 160-L/23	780,000	-
	TF 161-L/23	592,000	-
	TF 162-L/23	947,850	-
	TF 163-C/23	580,000	-
	TF 164-L/24	1,235,400	-
	Total 5th Call	**66,806,721**	**11,781,054**
	Total CGP Gants	**138,687,208**	**111,872,493**
13.00	**ICP Program**		
	ICP- I (BARI-Part)	2,320,000	377,618
	ICP- I (BRRI-Part)	1,776,500	251,746
	ICP-II (NUMAN)	-	3,150,000
	ICP-IV	17,270,000	20,448,500
	ICP-VI	4,236,000	4,987,500
	Total	**25,602,500**	**29,215,364**
14.00	**LSG Program**		
	LSG-01-C/20	-	-
	LSG-02-L/21	-	-
	LSD-3-F/21	-	-
	LSG-04-L/21	-	-
	LSG-05-C/21	-	-
	LSG-06-C/21	-	-
	LSG-07-RH/21	-	-
	LSG08-C/21	-	385,200
	LSG-09-MH/21	-	100,000
	LSG-10-C/21	352,080	-
	LSG-10-C/22	-	-
	LSG-11-C/22	-	600,000
	LSG-12-C/22	-	360,000
	LSG-13-C/22	99,000	891,000
	LSG-14-C/22	-	900,000
	LSG-15-C/22	99,850	898,650
	LSG-16-C/22	-	1,200,000
	LSG-17-C/23	-	600,000
	LSG 18-F/23	765,900	-
	LSG 19-C/23	600,000	-
	LSG 20-ICT/23	500,000	-
	LSG 21-C/23	903,117	-
	LSG 22-C/23	900,000	-
	LSG 23-C/23	599,700	-
	LSG Total	**4,819,647**	**5,934,850**

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Particulars	Amount in Taka	
	30 June 2024	30 June 2023
15.00 Commissioned Research Project CRP		
Components -I	-	-
Components -II	-	-
Components -III	-	-
Components -IV	-	-
Components -V	-	-
CRP-1 Hill Agriculture	-	-
CRP-2: Modeling Climate Change	21,870,217	29,819,309
CRP-5 (Crop Zonning)	30,793,178	-
CRP-4 (Hill Live Stock)	-	41,010,000
Total	**52,663,395**	**70,829,309**
16.00 Pilot Project		
Pilot Project-3	-	-
Pilot Project-4	-	-
Pilot Project-5	-	-
Pilot Project-7	-	-
Pilot Project-8	-	-
Pilot Project-9	-	-
Pilot Project-10	-	-
Pilot Project-11	-	-
Pilot Project-12	-	-
Pilot Project-13	-	-
Pilot Project-14	-	-
Pilot Project-15	-	-
Pilot Project-16	-	-
Pilot Project -17	-	-
Pilot Project-18	-	-
Pilot Project -19	-	-
Pilot Project -20	-	2,630,796
TCP 1	-	-
Pilot Project Honorioum (Abdul Baten)	-	-
Pilot Project Honorioum (Sochindra)	-	-
Pilot Project Honorioum (Liza Begum)	-	-
Total	**-**	**2,630,796**
17.00 Basic Research : With CEP ii & iii		
BR1-C/17	-	-
BR2-C/17	-	-
BR3-C/17	-	-
BR4-C/17	-	-
BR5-C/18	-	-
BR6-C/17	-	-
BR7-C/17	-	-
BR8-C/17	-	-
BR-8-NR/17	150,177	-
Total	**150,177**	**-**

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Particulars	Amount in Taka	
	30 June 2024	30 June 2023
Capacity Enhancement Program (CEP)		
CEP-I	-	-
CEP-II	-	10,260,000
CEP-III	-	-
CEP-IV	-	-
CEP-V-21 (BAAG Project)	2,264,500	6,073,400
CEP-VI-BARC/21	10,680,950	13,541,130
CEP-II (3rd Phase)	4,177,086	-
Sub Total	**17,122,536**	**29,874,530**
Total Program	**239,045,463**	**250,357,342**

19.00 Other Received

Interest Received	164,759	616,145
Income on Sale of Fixed Assets	-	425,358
Adjustments of previous year exp.	85,763	-
Received from vehicles rent	39,100	-
Sale of confiscated items	400	-
Total	**290,022**	**1,041,503**

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Krishi Gobeshona Foundation (KGF)
Bangladesh Krishi Gobeshona Endowment Trust (BKGET) Fund
Schedule of Fixed Assets
As at 30 June 2024

Annexure-A
Figures in Taka

Particulars	Cost				Rate %	Depreciation				Written down value as on 30.06.2024
	As on 01.07.2023	Addition during the year	Adjustment during the year	As on 30.06.2024		As on 01.07.2023	Charged during the year	Adjustment during the year	As on 30.06.2024	
Vehicles	27,850,065	-	-	27,850,065	0%	-	-	-	-	27,850,065
Computer Accessories	1,081,098	468,245	-	1,549,343	0%	-	-	-	-	1,549,343
Office Equipment	3,074,474	33,322	-	3,107,796	0%	-	-	-	-	3,107,796
Furniture & Fixtures	1,910,963	96,001	-	2,006,964	0%	-	-	-	-	2,006,964
Electric Equipments	452,006	3,400	-	455,406	0%	-	-	-	-	455,406
Total	**34,368,606**	**600,968**	**-**	**34,969,574**		**-**	**-**	**-**	**-**	**34,969,574**

Note: Depreciation has never been charged on fixed assets during the year and previous years.

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KRISHI GOBESHANA FOUNDATION
Schedule of Advance
For the year ended 30 June 2024

Annexure-B
(Amount in Taka)

SL	Name	opening (01-07-2023)	During the year	Refund	Adjusted	Closing (30-06-24)
1	Rafiqul Islam Akanda	4,000	4,328,941	509,844	3,823,097	-
2	Fetema Toz Zahara, Assistant Manager (SS)	-	47,072	135	46,937	-
3	Dr. Naresh Chandra Deb Barma	-	32,000.00	1,345	30,655	-
4	Dr. Monowar Karim Khan	-	8,000.00	219	7,781	-
5	BARC, Building and Infrastructures (Capital Work in Progress)	-	20,000,000	-	20,000,000	-
6	BARC	-	100,000	-	100,000	-
7	Fatema Parvin, PS to ED	-	39,000	-	39,000	-
8	Md. Abdul Kader, Driver	-	8,000	-	8,000	-
9	Md. Abdul Kader, Driver	-	14,000	3,744	10,256	-
10	Md. Faruk Hossain Driver	-	25,000	5,103	19,897	-
11	Md. Motaleb Hossain	-	20,000	1,300	18,700	-
12	Md. Mozibur Rahman, Driver	-	11,000	-	11,000	-
13	Md. Saidul Islam, Driver	-	10,000	980	9,020	-
14	Md. Salauddin Liton, Driver	-	30,000	1,503	28,497	-
15	Mohammad Abul Khair	-	289,785	30,888	258,897	-
	Total	**4,000**	**24,962,798**	**555,061**	**24,411,737**	**-**

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KRISHI GOBESHANA FOUNDATION
Schedule of Refund of Unspent Balance
For the year ended 30 June 2024

Annexure-C

Project Name	Amount in Taka	
	30 June 2024	**30 June 2023**
ICP-iii	-	22,737
Mujib Year	-	1,483,540
Seeweed	-	229,544
ARMIS	-	130,086
CRP-5 Crop Zone	-	285,588
Numan Project	-	572,169
CRP-IV	-	914,894
P-20	-	1,673,600
Dr. Joynal Abedin	-	200,000
TF-99-F/21	40,000	-
TF 53- C/17	5,325	-
TF-66-C/19	210,065	43,006
Total Refund	**255,390**	**5,555,164**

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