Accelerating Agriculture Productivity Improvement (AAPI)

Integrating Greenhouse Gas (GHG) Emissions Mitigation into the Feed the Future Bangladesh Fertilizer Deep Placement Rice Intensification (GHG) Project

Quarterly Report

(October-December 2012)

Submitted to

USAID/Bangladesh
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by

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Table of Contents

Page

Introduction 1

Project Description 2

The Project Timeframe 2

Progress Against the Time Frame 4

Phase I: Capacity Building on the Quantification of N losses 5

- Fixed Obligation Grants with BAU and BRRI 5
- Appointment of AAPI Staff 6
- Procurement, Calibration and Shipment 6
- Setup and Installation at Relevant Institutes with Scientists 7
  - Field Laboratories 7
  - Installation of Equipment 8
  - Initial Soil Characterization 8
- Establishment of Field Trial with GHG Monitoring 8
- N Fluxes Measurement from Chambers 9
- Soil and Air Temperature and Soil Moisture Data 9
- Runoff and Leaching Data 9
- Operating Manual for GHG Measurement 9
- Bangladeshi Scientists Trained for GHG Measurement 10

List of Acronyms

AAPI	Accelerating Agriculture Productivity Improvement
BAU	Bangladesh Agricultural University
BRRI	Bangladesh Rice Research Institute
CDCS	Country Development Cooperation Strategy
FDP	Fertilizer Deep Placement
FTF	Feed the Future
GCC	Global Climate Change
GCCI	Global Climate Change Initiative
GHG	Greenhouse Gas
IFDC	International Fertilizer Development Center
N_2O	Nitrous Oxide
NBR	National Board of Revenue
NH_3	Ammonia
NH_4^+	Ammonium
NO_2^-	Nitrite
NOx	Nitrogen Oxide
PDB	Power Development Board
USAID	United States Agency for International Development
VAT	Value Added Tax

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Introduction

In October 2011, the United States Agency for International Development (USAID)/Bangladesh submitted a proposal for a Global Climate Change (GCC) integration pilot project. This project targeted the integration of two Presidential Initiatives: the Feed the Future (FTF) Initiative and the Global Climate Change Initiative (GCCI). It also reflected the integration of two development objectives in the Bangladesh Country Development Cooperation Strategy (CDCS) 2011 -16.[1]

The major nitrogen (N) loss reduction results from negligible runoff loss, as indicated by lower amounts of N measured in the floodwater and lower ammonia (NH_3) volatilization loss. Fertilizer deep placement (FDP) in flooded soils reduces nitrification (N fertilizer is deep-placed in anaerobic soil); hence, emissions of nitrogen oxide (NOx) and nitrous oxide (N_2O) gases are reduced. Under both upland and flooded conditions, the highly localized urea, ammonium (NH_4^+) and nitrite (NO_2^-) concentrations inhibit urease and nitrifier activities (Shah and Wolfe, 2003), reducing gaseous N emissions (Khalil et al., 2006).

[1] Development Objective 2: Food Security Improved and Development and Objective 4: Responsiveness to Climate Change Improved.

The activities of the proposed concept note allow the quantification of the environmental impacts, particularly N_2O emission reduction through fertilizer deep placement (FDP) technology, lay the basis for carbon credit payments and strengthen the capacity of the Bangladesh national research institutes. The proposal was accepted in February 2012. This led to a contract addendum signed on September 25, 2012.[2]

This progress report is part of the AAPI ninth quarterly report and is intended to brief stakeholders on the progress of the GHG Emissions Mitigation into the Feed the Future Bangladesh Fertilizer Deep Placement Rice Intensification Project (GHG Project) in the first three months – September 25 to December 31, 2012.

Project Description

The GHG Project will measure GHG fluxes and other nitrogen losses associated with urea fertilizer applied to rice crops at two sites – the Bangladesh Agricultural University (BAU) at Mymensingh and the Bangladesh Rice Research Institute (BRRI) at Gazipur. Working within these institutions will enhance their capacity, enabling them to achieve excellence in research that addresses climate change issues and improves understanding of the dynamics that impact climate change.

The project is designed in two phases:
Phase I: Quantification of N losses and capacity building.
Phase II: Effect of enhanced efficiency technologies on N emissions and yield.

The Project Timeframe

The Program Description Addendum proposes a time frame over six seasons, starting with *Boro* 2012-2013 (see Table 1).

[2] Modification No. 3.

Table 1. Timeline and Milestones

Project	**Integrating GHG Emissions Mitigation into the Feed the Future Bangladesh Fertilizer Deep Placement Rice Intensification Project**											
Objective	**To quantify N losses using standardized procedures and capacity building on measurement of GHG fluxes and mitigation of these fluxes with enhanced efficiency nutrient and water technologies.**											
Phase I: Capacity building on the quantification of N losses												
	Boro-1				*Aus*-1				*T. Aman*-1			
• Procurement, calibration and shipment												
• Setup and installation at relevant institutes with scientists												
• Initial soil characterization												
• Establishment of field trial with GHG monitoring												
• N fluxes measurement from chambers												
• Soil and air temperature and soil moisture data												
• Runoff and leaching data												
• Operating manual for GHG measurement												
• Training of Bangladeshi scientists for GHG measurement												
Phase II: Effect of enhanced efficiency technologies on N emissions and yield												
	Boro-2				*Aus*-2				*T. Aman*-2			
• Establishment of water regime x FDP trials												
• Comparison of N emissions: urea vs. FDP												
• Comparison of N emissions: flooded vs. reduced water use												
• Comparison of N emissions: rice vs. fallow vs. non-rice												
• Quantification of runoff and leaching loss in above systems												
• Quantification of volatilization loss in above systems												
• Assessment of impact of FDP on yield and N emission												
• Assessment of impact of drying on yield and N emission												
• Highly qualified and trained staff for GHG measurement												

Source: Attachment 2 – Program Description Addendum. Modification No. 3.

Progress Against the Time Frame

The timeframe in Table 1 starts with *Boro* season, beginning in December 2012 and continuing through May 2013. As soon as the project addendum was signed in September 2012, the project commenced. In fact, under the AAPI project, each institution had established an *Aman* 2012 trial on land designated for the GHG project, with treatments that followed the GHG project protocol. This was used to collect and report agronomic data (yield response to treatments) and collect water samples and measure ammonium in standing water above the fertilizer treatments (potential loss). The results were reported in the AAPI Quarterly Progress Report, October-December 2012.

Table 2 shows progress against the timeline. All activities began on time but have stretched beyond their timelines. In hindsight, the timeline was ambitious. Phase I has many facets that are interdependent and need to synchronize to obtain measurements in the field. Nevertheless, all will be in place for complete data collection for *Aus* season. It was never expected that a full set of GHG data would be available for the first *Boro* season.

Table 2. Progress Against Timeline

Phase I: Capacity building on the quantification of N losses												
	Boro-1						*Aus*-1			*T. Aman*-1		
	Dec 2012	Jan 2013	Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013	Jul 2013	Aug 2013	Sep 2013	Oct 2013	Nov 2013
• Procurement, calibration and shipment												
• Setup and installation at relevant institutes with scientists												
• Initial soil characterization												
• Establishment of field trial with GHG monitoring												
• N fluxes measurement from chambers												
• Collection of soil and air temperature and soil moisture data												
• Collection of runoff and leaching data												
• Development of operating manual for GHG measurement												
• Training of Bangladeshi scientists for GHG measurement					US	within Bangladesh						

Phase II: Effect of enhanced efficiency technologies on N emissions and yield												
	Boro-2				*Aus*-2				*T. Aman*-2			
	Dec 2013	Jan 2014	Feb 2014	Mar 2014	Apr 2014	May 2014	Jun 2014	Jul 2014	Aug 2014	Sep 2014	Oct 2014	Nov 2014
• Establishment of water regime x FDP trials												
• Comparison of N emissions: urea vs. FDP												
• Comparison of N emissions: flooded vs. reduced water use												
• Comparison of N emissions: rice vs. fallow vs. non-rice												
• Quantification of runoff and leaching loss in above systems												
• Quantification of volatilization loss in above systems												
• Assessment of impact of FDP on yield and N emission												
• Assessment of impact of drying on yield and N emission												
• Highly qualified and trained staff for GHG measurement												

Activity completion Expected completion

Phase I: Capacity Building on the Quantification of N losses

It is only Phase I that will be reported herein. Phase II is scheduled for the second year, although much of the data required in Phase II will be collected in Phase I.

Fixed Obligation Grants with BAU and BRRI

An agreement for a fixed obligation grant was signed with the BAU Soil Science Department and the BRRI Soil Science Division effective November 1, 2012, with an anticipated completion data of August 31, 2014. The amount of $45,271 is a fixed contribution to be used by each institution to carry out field trials, gas measurements and laboratory analysis according to protocols provided by AAPI. It requires that institutions appoint junior scientists full-time for the full term of the project (22 months). The junior scientists will be responsible for the day-to-day implementation of the project. AAPI will provide one month's training for the junior scientists

(one from each institution) on the operation and maintenance of the equipment. This training is to be held at IFDC headquarters, Alabama, USA.

BAU appointed Mr. Azmul Huda on November 5, 2012. He has also enrolled as a Ph.D. student and will incorporate aspects of the project within his thesis. BRRI appointed Mr. S.M. Mofijul Islam on November 5, 2012. Both institutions have nominated senior staff to oversee the project and serve as contact points. Both scientists obtained their USA visas after receiving international travel approval from USAID.

Appointment of AAPI Staff

The project budget has provision for a resident expert, short-term experts and a local environment specialist. Short-term experts will be sourced from within IFDC.

The positions for resident expert and local environment specialist were advertised through appropriate media. A resident expert as well as a local environment specialist with appropriate skills remains under consideration.

Procurement, Calibration and Shipment

The system to measure NO and N_2O was custom built at IFDC headquarters, Alabama, USA. It requires (for each site) 12 chambers to be placed over fertilizer treatments within the rice field trials. The system works on a three-hour cycle. It is controlled and data is collected by a Campbell Scientific CR3000 Data Logger with an AM16/32 Channel Relay Multiplexer (for temperature and soil water potential sensors) and two 16 Channel AC/DC Relay Controllers (for sampling valves and air control valves). NO is measured with a Teledyne API T200 Chemiluminescence Analyzer. N_2O is measured with a Teledyne T320U Gas Filter Correlation Analyzer, and calibration gases are made with a Teledyne T700 Dynamic Dilution Calibrator. The equipment includes a Dell Latitude 6330 notebook PC.

This equipment has been procured, assembled and packed and is awaiting shipment.

The AAPI project has been exempted from paying value added tax (VAT) vide National Board of Revenue's (NBR's) Special Order No. 17/MuSaKa/2012 of November 15, 2010. Exemption

from other duties and taxes imposed by the Customs Authority is being sought with the support of USAID.

Each site requires calibration gases of high purity. These are being procured locally through Linde Bangladesh Limited through a special order that normally requires three months' lead time. An order for gases, regulators, valves and spare parts was placed with Linde on December 11, 2012. Linde advised that the order will arrive in Bangladesh on March 13, 2013.

An air compressor, maximum pressure 125-175 psig, and a storage tank of 25 cubic feet with a built-in regulator to set the output pressure of 70 psig will be purchased locally. Cost quotes have been collected. This is an off-the-shelf item, and its purchase will be timed to coincide with equipment installation.

Setup and Installation at Relevant Institutes with Scientists

Both BAU and BRRI have assigned land to accommodate the field trials for the duration of the project. Both have approved construction of field laboratories to house the equipment, and both have appointed their resident engineers to liaise with AAPI and its contractor for the construction of the field laboratories.

Field Laboratories

The detailed drawings for the BRRI field laboratory were drafted by the BRRI engineer. The drawings for the BAU field laboratory were drafted by the AAPI engineer. Tenders were called on November 23, 2012. Selection committees (technical and financial) were appointed and met on December 8, 2012 (technical committee) and December 9, 2012 (financial committee). The work orders were issued to the selected tenders on December 17, 2012. AAPI appointed a junior civil engineer to supervise construction at each site. Construction started on December 23, 2012, at BRRI and December 24, 2012, at BAU. The buildings are expected to be completed by the first week of March 2013. This will include all electrical wiring and water supply.

The BAU site requires an electrical transformer and water supply. BRRI has both power and water on-site. An 1100 KVA main transmission line passes over the BAU site. Approval for and installation of a transformer was required to supply 15 KVA, single-phase 220V power to the

field laboratory. BAU sought and received approval for installation of the transformer from the Power Development Board (PDB). The project will purchase the transformer, and the PDB will make the connection. Quotations for the transformer were sought from suppliers recommended by the PDB. A preferred supplier has been selected, and the work order will be placed during February 2013. It is expected that the transformer will be connected within 10 days of its arrival on-site. This will be about the same time as the building's completion.

The water supply for the BAU site will be sourced from a deep tube well with a submersible pump. Quotations have been called from drilling contractors. Drilling requires electrical supply for pump testing while drilling. The work order for the drilling will be issued when the electrical connection is confirmed. It is expected to take two to three days.

A back-up generator is required for both BAU and BRRI. Cost quotations were sought, and the preferred supplier was selected on February 10, 2013. This will be an off-the-shelf purchase, and the work order will be issued to allow delivery after the completion of the building and before the installation of the equipment.

Installation of Equipment

Installation of equipment is expected to commence when the junior scientists and local environment specialist return from training in May 2013. The principal research scientist from IFDC will be on site for one month to oversee the installation and calibration of the equipment. This will coincide with the *Boro* harvest.

Initial Soil Characterization

Both institutions have completed soil analysis of their sites (BAU in January 2012 and BRRI in February 2012).

Establishment of Field Trial with GHG Monitoring

Trial protocols were prepared by IFDC. Each site has two trials in adjacent fields: (a) fully irrigated GHG trial; and (b) reduced irrigation GHG trial. Each trial has eight fertilizer treatments with three replications. Treatments include a control, broadcast urea, UDP and NPK deep placement.

Trials were transplanted in the last week of January 2013, in the case of BAU, and in the first week of February 2013, in the case of BRRI. Water samples are to be collected over a period of six days after each fertilizer application. Samples are analyzed for ammonium. Protocols for this are in place, and both institutions were engaged in these activities through 2012 as part of the AAPI project, as reported in each AAPI quarterly report.

It is expected that GHG monitoring equipment will be installed during May 2013 at the time of *Boro* harvest. Therefore, no meaningful GHG results will be recorded for *Boro*, but all will be in place for a full set of results for the *Aus* season.

N Fluxes Measurement from Chambers

Equipment installation is expected to occur in May 2013. The rice crop will likely be harvested in late May 2013 or early June 2013 (depending on the weather). Any measurements taken would essentially be for settling the procedures. This will allow the system to be ready for the *Aus* season that will be planted in mid-June 2013.

Soil and Air Temperature and Soil Moisture Data

This will follow the same timetable as N fluxes measurement from chambers.

Runoff and Leaching Data

From *Boro* 2012 (December 2011), AAPI collaborated with BAU and BRRI to establish trials under the GHG Project protocols. These trials collected agronomic data, and ammonium N was measured in floodwater in each treatment after fertilizer application. The procedure for sampling water in flooded fields was provided by the USAID mission environment officer, and the analysis took place in the laboratory of each institution.

Operating Manual for GHG Measurement

This will be prepared by IFDC.

Bangladeshi Scientists Trained for GHG Measurement

Approval for training in Alabama was requested on November 27, 2012, and approved by USAID/Bangladesh on December 18, 2012. Each trainee received a visa and was scheduled to travel on January 11, 2013. The training program was drafted and set for one month. However, the BRRI junior scientist is a government officer, and delays in receiving his Government Order have led to the training's postponement until April 1, 2013.