Bangladesh Institute of Nuclear Agriculture

Work Plan for IAEA TC BGD 5029 (2015-2017)

Plant Breeding & Biotechnology

Experiment	:	Marker-assisted backcrossing (BC_2F_2 of Binadhan-7×FL-478) for development of salt tolerant rice lines
Objective(s)	:	To introgress salt tolerant genes
Location	:	Glasshouse, BINA HQ
Experiment	:	Evaluation of selected salt tolerant rice lines with better grain quality in multi-location trials
Objective(s)	:	To identify salt tolerant rice lines from PVS
Location	:	Satkhira sadar, Kaliganj, Shyamnagar and Dumuria, Khulna
Justification	:	Salt tolerant rice variety is crying need for saline areas in Bangladesh. We developed some salt tolerant rice lines which possess better grain quality (long slender) and cooking quality.
Experiment	:	Screening of high yielding breeding rice lines possessing both salinity and submergence tolerance.
Objectives	:	To select desirable lines for both salinity and submergence tolerance for salt and submerged affected areas
Location	:	Mymensingh, Sherpur, Patuakhali and Kurigram
Justification:	:	In southern part of Bangladesh is mostly affected by salinity. Some of the parts are also affected by flood where water comes from sea through river, channel and even tidal flood. We tested some lines in these conditions where salinity and submergence prevail together. Four lines were selected which are dual tolerance.
Experiment	:	Screening of both salinity and Zn deficiency tolerance elite breeding rice lines
Objectives	:	To select desirable rice lines for Zn deficiency and salt tolerance
Location	:	Satkhira sadar, Kaliganj, Shyamnagar, Chokoria and Bashkhali
Justification	:	In southern part of Bangladesh is affected by salinity and soil shows Zn deiciency. Ten promising lines were found both salinity and Zn deficiency tolerance.
Experiment	:	Zonal yield trial with M_5 and M_6 mutants of NERICA-10 rice under rainfed condition in the aus and aman seasons
Objectives	:	To assess performance of the mutants under rainfed (non-irrigated) condition
Justification:	:	For producing a Kg of paddy it needs 1500-4000 liter of irrigation water which is a serious threat for our agriculture. For this we need rice varieties that can be grown under rainfed condition, specially for aus (March-July) anad aman (July- December) seasons. Moreover, one third of total irrigation water is needed for puddling the soil. This big amount of irrigation water could be saved though direct seed sowing.
Locations	:	BINA Hq farm, Sub-stations at Rangpur, Ishurdi, Magura and Chapainawabganj)

Experiment	:	Screening of recurrent carbon ion irradiated M_2 population of Swarna in T.Aman season
Objectives	:	To select disease tolerant (sheath blight and blast) high yielding plant/progeny from
Justification	:	Swarna is extensively cultivated by the farmers of particularly border areas of Bangladesh in the T. aman season. But it is highly susceptible to different diseases.
Locations	:	BINA hq farm, Mymensingh
Experiment	:	valuation and selection of M3 population of groundnut
Objectives	:	To select early maturing salt and drought tolerant mutants with higher yield
Experiment	:	Growing of M_1 generation of wheat
Objectives	:	To create variability for short duration, salinity tolerance and heat tolerance and higher yield
Justification	:	Wheat can be grown with ½ irrigations and from vegetative to maturity it can tolerate up to 12 dS/m salinity although there is genotype difference. In the coastal area of Bangladesh flood water recedes later in the month of December. But wheat yield is drastically reduced when transplanted in December. This means we need saline and heat tolerant wheat for our saline areas.
Locations	:	BINA hq farm, Mymensingh

SOIL MANAGEMENT

Project-1	:	**Integrated nutrient management and soil fertility for increased crop production**
Justification	:	Bangladesh with high demand of food has 2.8 million hectare of rice land currently affected by different degree of salinity. Saline soil in reluctant to agricultural crop production. For sustainable crop production it is important to develop economically suitable combination of chemical fertilizers and organic manure. And to generate technologies to overcome exploitation of nutrient resources and to sustain soil productivity in different areas as well as to build up and maintain long-term soil fertility to prevent soil degradation.
Experiment-1	:	**Monitoring, management and nutrient dynamics of saline soil for increased crop production**
Objectives	:	-To monitor the salinity of soil throughout the year -To see the suitability of crops grown under different salinity condition -To see any improvement in soils due to use of organic manure and crop residues with chemical fertilizers.
Season(s)	:	Irrigated/Dry season-Rainfed
Crops/cropping pattern	:	Rice
Location(s)	:	Satkhira
Experiment-2	:	**Contribution of rice straw to potassium supply and its impact on soil fertility in saline area**
Objectives	:	-To evaluate the contribution of rice straw to potassium supply -To manage the adverse effect of salinity for crop growth

		-To maintain sustainable production of rice in saline area
Season(s)	:	Rainfed
Crops	:	Rice
Location(s)	:	Satkhira
Project-2	:	**Soil management options for flood prone areas**
Justification	:	Submergence areas of Bangladesh covered about 15% of the total cultivable land. Flash flood regularly affects over two million hectare of low land rice crop which cause damage of rice production. BINA has developed Binadhan-11 and Binadhan-12 which can survive 25-30 days under complete submergence. After flood water removal the plant needs suitable management options for its better production. Now it is very important to make a good soil management options for increase crop production for flood prone areas.
Experiment-3	:	**Improve management practices for submergence tolerant variety (Binadhan-11 & 12) in flood prone area**
Objectives	:	-To manage the adverse effect of submergence/flesh flood for crop growth -To maintain sustainable production of rice in submergence area
Seasons	:	Irrigated/Dry season-Rainfed
Crops/cropping pattern	:	Rice
Location(s)	:	Nalitabari, Sherpur
Experiment-4	:	**Management of soil for optimized productivity in drought areas**
Objective		-To develop suitable management practices for better crop production as well as maintain soil health with -To maintain sustainable production with crop rotation in drought area
Seasons	:	Irrigated/Dry season-Rainfed
Crops/cropping pattern	:	Wheat, Rice, Ground nut, Mungbean etc.
Location(s)	:	Northern part of Bangladesh
Project-3		**Fertilizer recommendation for elite mutants/lines developed by BINA**
Experiment-5	:	**Fertilization recommendation for different mutants/lines developed by BINA**
Objectives	:	-To evaluate the fertilizer use efficiency and the fertilizer requirement of the elite mutants developed at BINA -To recommend fertilizers for different mutants varieties of the crops of BINA
Season(s)	:	Irrigated/Dry season-Rainfed
Crops	:	Rice (Mutants), Mustard-rapeseed(Mutants), Soybean(Mutants), Onion (Mutants) and Wheat (Mutants)
Location(s)	:	BINA substation farm

Agricultural Engineering

Project 1. Irrigation management for Pulse and Oil-seed lines and mutants using nuclear technique

Rationale

To date, Bangladesh is importing pulses and edible oils. The reasons of less production include low yield potential of the cultivars, lacking of adoption of appropriate management techniques, policy, etc amongst others. BINA developed several high yielding mutants/lines of pulses and oil-seeds. We are trying to develop appropriate irrigation managements packages for optimum and sustainable yield.

With a view to this, we have planned to conduct several experiments on irrigation management effects on onion seed production, water-logging effects on sesame mutants at different growth stages and durations.

Objectives:

- To establish irrigation schedules of cereal and non-cereal crops based on the soil and atmospheric conditions of major AEZ under limited and unlimited water supplies
- To determine the appropriate water management practices for saving the irrigation water without sacrificing yields
- To identify water-logging tolerant cultivars.

Experiment: Irrigation management for optimizing Onion seed production

Objective: To determine optimum irrigation requirement for higher seed yield of Onion

Location : Field and Lysimeter, BINA, Mymensingh

Method:

Irrigation treatments will be applied at different growth stages of Onin along with full irrigated control. Best irrigation practice will be identified based on the seed yield.

Experiment: Response of sesame mutants to water-logging at different growth stages for different durations

Objectives	:	- To study the response of sesame to water-logging - To determine the critical stages of sesame for water-logging
Location	:	BINA farm, Mymensingh
Growing season	:	February 2015 – June 2015
Method	:	Water-logging will be created by saturating the root zone and ponding water by 3 cm. Duration of water logging will be 18, 24, and 36 hours.
Project 2	:	Irrigation management for Cereals
Rationale	:	In Bangladesh, rice is the staple food. To feed the growing population, we have to produce more cereals. Genetic improvement is a continuous process. The improved varieties need more care for potential yield. The adverse climatic condition and climate change issue are of great concern in this regard. Management technologies should be generated under such climatic and water scarce situation.

Objectives:

- To determine the optimum irrigation schedule of different rice varieties for higher water use efficiency under drought environment
- To develop low-water demand and water availability based rice non-rice cropping pattern for increasing water use efficiency and non-rice crop cultivation in the drought prone Barind area
- To make the effective uses of profile soil moisture, surface and ground water resources for increasing water use efficiency and crop productivity

Experiment: Comparative assessment of water saving in Binadhan-14 (A Braus variety)

Objective : 1) To determine optimum water requirement of Binadhan-14 for optimum production
2) To find out the water savings by Binadhan-14 compared to conventional cultivars

Duration : 2014 - 2018

Design and replication : RCBD, 04

Location : BINA Farm, Mymensingh, BINA sub-station Rangpur, Comilla, and Ishurdi

Growing season : Boro and Aus (Jan. – June)

Method : As the cultivar Binadhan-14 has the potential to grow at late Boro season (transplanting up to 1st week of March), and the rainy season starts from the month of April; experiment will be devised to examine the irrigation water requirement under different transplanting times (from 3rd week of January to 2nd week of March).

Variety: V1 = Binadhan 14, V2 = BRRIdhan 29, V3 = BRRIdhan 28

Experiment : Evaluation of NERICA mutants and GSR for drought tolerance under field condition

Objectives : - To study the response of GSR and NERICA mutants to water-stress
- To determine the critical stage(s) of GSR and NERICA mutants to water-stress
- To develop appropriate water management strategy for GSR and NERICA mutants

Design and replication RCBD, 3

Total sites : 04

Location : (1) Chapainawabgonj: Sadar and Nachol
(2) Rajshahi: Godagari and Tanore

Growing season : (1) Aus (March 2015 – May 2015)
(2) Aman (July 2015 – Oct. 2015)

Method : Different techniques of rain-water storage in the field will be tested along with farmers practice. In addition, irrigation will be applied at different stages if plant available soil-moisture drops below 50% level.

Number of cultivars : 06

Experiment: Evaluation of GSR and NERICA mutants for drought tolerance under controlled condition (pot experiment)

Objective : - To study the response of NERICA mutants to water-stress

- To determine the critical stage(s) of NERICA mutants to water-stress
- To develop appropriate water management strategy for NERICA mutants

Design and replication RCBD, 3

Location : BINA Head-Quarter, Mymensingh

Growing season : (1) Aus (March 2015 – May 2015)
(2) Aman (July 2015 – Oct. 2015)

Unit plot size : Container size (1.5 m x 1.0 m x 0.28 m)

Method:

Water stress will be created by withholding irrigation at different growth stages. Irrigation will be applied when the plant available soil moisture will drop below a certain percent (e.g. 50 %).

Experiment: ^{13}C isotopic discrimination of Wheat cultivars at varying water stress in Lysimeter

Objective : To assess the water-use efficiency of the cultivar under water stress at different growth stages.

Design and replication: Single replicated

Location : BINA Farm, Mymensingh

Method:

Water stress will be imposed at different durations throughout the growing period along with normal irrigated control. Sampling of leaves will be done to determine ^{13}C/ ^{14}C data.

Cultivars: V1 = L-880-43, V2 = BARIghom-26

Project 3: Studies on groundwater recharge for sustainable use of groundwater using tracer and other advanced techniques

Rationale:

Sustainable use of groundwater must ensure not only that the future resource is not threatened by overuse and depletion, but also those natural environments that depend on the resource. Quantitative determination of the rate of natural groundwater recharge is a pre-requisite for efficient groundwater resource management. Recharge is also critical in any analysis of groundwater systems and the impacts of withdrawing native water from them.

Objectives:

(1) To quantify natural groundwater recharge from rainfall
(2) To determine rainfall-recharge relationship
(3) To suggest sustainable use of groundwater based on actual recharge

Experiment : Quantifying natural groundwater recharge using tracer technique

Location : BINA Head-Quarter, Mymensingh (Field)

Treatments : Application of tracer (Chloride)

Method : Aluminum Tubes will be installed in the field (having different depths – 50, 70, and 100 cm). Tracer will be applied in the control tube and will be allowed to accept natural rainfall. At the end of rainy season, the vertical movement of the tracer will be recognized by analyzing the soil column for the tracer. The vertical movement will indicate the recharge.

Experiment : Estimation of groundwater recharge using ^{14}C dating
Location : BINA HQ, Mymensingh
Method : Water samplings from different observation wells, DTW. Water sample will be analyzed for ^{14}C data. Water-table data will also be taken.

Experiment : Estimation of groundwater recharge using Lysimeter
Location : Field Lysimeter, BINA Head-Quarter, Mymensingh
Treatments : Not applicable
Replication : 10
Method : Drainage will be collection and volume will be measured from each Lysimeter box (next day of each heavy rainfall events, and 7 days interval for the remaining days). The depth to water-table will be recorded 7 days interval, and next day of each heavy rainfall events.

Socio-economic Studies/ Impact assessment for Stress tolerant crop varieties and other technologies
Objectives : - To assess farmer's income generation
-To study the improvement of livelihood of farm community

Varieties/Technologies- Binadhan-8 Binadhan-10, Binadhan-11 and Soil-water management.

Methods- At least 1000 farmers will be interviewed for each variety/technology from stress prone areas.

AGRONOMY DIVISION

Project-1		**Adaptability and management studies for advanced lines/mutant varieties in problem areas in different cropping patterns at various AEZs**
Experiment-1	:	**Study on relay cropping of wheat with T. aman rice in saline areas**
Objectives		- To increase cropping intensity in saline areas
Season(s)	:	2015-16 & 2016-17
Crops/cropping pattern	:	T. Aman (Binadhan-7/ Binadhan-8) –Wheat (3 lines with check variety BARI Gom-26)
Location(s)	:	Shyamnagor, Satkhira
Justification		Bangladesh with high demand of food has 2.8 million hectare of rice land currently affected by different degree of salinity. Relay cropping leads to zero tillage which improves the soil structure, reduces soil compaction and is helpful in maintaining organic matter content of soil. It also reduces farm labour and conservation of soil moisture.
Experiment-2	:	**Improving the yield of salt tolerant rice genotype/ variety through sloping bed transplanting and gypsum application**
Objectives	:	- To find out the suitable management of transplanting arrangement for productivity improvement of rice under natural salinity condition
Seasons	:	Boro season, 2015-16 & 2016-17
Crops/cropping pattern	:	Rice
Location(s)	:	Shyamnagor, Satkhira
Justification		Bangladesh with high demand of food has 2.8 million hectare of rice land currently affected by different degree of salinity due to heavy

		withdrawal of surface and groundwater for irrigation and intrusion of seawater. Therefore, introduction of salinity tolerant rice varieties in combination with agronomic management practices for the amelioration of salinity stress effect is the key for improving crop productivity in the salinity affected area of Bangladesh.
Experiment-4	:	**Effect of date of sowing on the yield and yield contributing characters of rice mutants/varieties in Aus season at drought prone areas**
Objective		- To observes the yield potentiality of rice mutants/varieties in drought prone areas
Seasons	:	Aus, 2014-15 & Aus, 2015-16
Crops/cropping pattern	:	Rice-N_4/350/P-4 (5), N_{10}/350/P-5-4, N_4/250/P-4 (2) , N_4/250/P-2 (6)-26, GSR-3 & BRRI dhan48
Location(s)	:	Godagari, Rajshahi & Nachole, Chapainawabgong
Justification		The Barind tract situated in the North West region of Bangladesh has the lowest rainfall. It is the driest part of the country. Insufficient and uneven distribution of rainfall in Bangladesh creates drought stress in rainfed ecosystem which eventually reduced rice yield. With these view, an experiment was conducted to find the yield potentiality of rice mutants/varieties in Bangladesh under artificial drought situation.

Agricultural Economics Division

1. Title:

A Socio-Economic Impact Assessment of Salt Tolerant Rice Varieties Growing Farmer's Among the Coastal Region Of Bangladesh.

2. Objective(s):

i. To determine the profitability of salt tolerant variety of Binadhan-8 and Binadhan-10;
ii. To assess the impact of salt tolerant rice varieties cultivation on income of farmer's and;
iii. To find out the factors influencing the farmers to accept these varieties;
iv. To identify the farmers preferences and constrains for cultivation of these variety

3. Justification:

Bangladesh has a coastal area of 2.5 million of hectares or about 20% of the country. Out of this, approximately 1 million of hectares or about 53% of the coastal areas have already been affected by different levels of salinity. Again, the coastal areas of Bangladesh cover more than 30% of the cultivable lands of the country. IPCC estimates predict that due to the impact of climate change, sea level in Bangladesh may rise by 14 cm by 2025, 32cm by 2050 and 88 cm by 2100. In Bangladesh, rice production may fall by 10% and wheat by 30% by 2050 (Climate change in Asia 'too alarming to contemplate'-report, IPCC, 2007).

It is clear from the above that salinity has become an ever escalating threat to food security in the coastal areas of Bangladesh. Salinity, among other natural hazards, has pushed the costal people to acute food insecurity in the recent years. Introduction of salinity tolerant rice varieties in the coastal area of Bangladesh would be an effective way of increasing crop production. Considering all of these, scientist of Bangladesh Institute of Nuclear Agriculture (BINA) and Bangladesh Rice Research Institute (BRRI) introduced some new salt tolerant rice varieties, which are capable in producing maximum yield in both Aman and Boro season than the traditional varieties in the

coastal areas of Bangladesh. Therefore an impact study on the farmers' level and adaptability of this saline tolerant rice variety is of utmost importance.

4. **Location:** Satkhira, Khulna, Bagerhat, Coxes-Bazar and Chittagang.

5. **Methodology:** To conduct this study total 500 sample farmers will be used including 100 from each location. Both primary and secondary will be used in the study. Moreover, the following procedures will be done to conduct this study.

1) To determine the profitability of salt tolerant rice varieties, Cost and return analysis will be done using the following profit equation.

$$\Pi = \sum P_m Q_m - \Sigma (Px_i X_i) - TFC$$

Where,

Π = Net return (Tk/ha);

P_m = Per unit price of produce (Tk/kg);

Q_m = Quantity of the production per hectare (kg);

Px_i = Per unit price of i th inputs (Tk);

X_i = Quantity of the i th inputs per hectare (kg);

TFC = Total fixed cost (Tk); and

i = 1,2,3,.....,n (number of inputs).

Undiscounted benefit cost ratio (BCR) was used to compare the profitability of Binadhan-8 and Binadhan-10

2) To measure the impact on farmer's income: mainly tabular analysis will be done. Statistical tools like average, percentages, ratio etc. were applied to arrive at meaningful findings in this study.

3) To find out the factors influencing the farmers to accept these varieties, the following probit regression function was fitted as follows:

$$Y = a + ß_1X_1 + ß_2X_2 + ß_3X_3 + ß_4X_4 + ß_5X_5 + ß_6X_6 + ß_7X_7$$

Where,

Y = types of farmers (0=adaptor and 1=not adaptor), X_1 = Age of farmers, X_2 = Year of schooling of the farmers, X_3 = Occupation of the farmers (1=agriculture, 2=others), X_4 = Household income, X_5 =Farm size, X_6 = salinity, X_7=Higher production, a = intercept, ß = Coefficient of the factors.

4) To identify the farmers preferences and constrains for cultivation of these variety some relevant information will be collected.

1. **Title: Economic Impact of Submergence Tolerant Rice Variety Binadhan-11**
2. **Objectives:**

i. To study the cost and return of the variety;

ii. To find out the contribution of the variety on farmers income and national income; and

iii.To identify the factor that affect the yield of Binadhan-11.

3. Justification:

Submergence reduces rice yield on 20 million ha in Asia and thus worsening food insecurity. Bangladesh is the largest deltaic country in the world. Its ecology and climatic conditions offer fertile land for agricultural production. However, the land is also vulnerable to water submergence, which is contributing to reduce the yield of rice production. By realizing this problem BINA had developed submergence tolerant rice variety Binadhan-11. Now, it is necessary to find out the contribution of the variety in farmers income as well as national income.

4. Location: Mymensingh, Sherpur, Jamalpur and Kurigram**.**

5. **Methodology:** Total 300 farmers will be interviewed for this study including 75 from each district. Mainly tabular analysis will be done to conduct this study