CGIAR Challenge Program on
WATER & FOOD

Proposal

G2 Productive, profitable, and resilient agriculture and aquaculture systems

IRRI

April 2011

PART A: SUMMARY

1. Project Data

BDC: **Ganges Basin**
Project Title: **G2 Productive, profitable, and resilient agriculture and aquaculture systems**
Project Lead Organization: **IRRI**
Consortium partners (who receive budget): WFC, BRRI, BFRI, BRAC, CSSRI, CIBA
Project Leader (name and contact details): **To Phuc Tuong, Crop and Environmental Sciences Division, International Rice Research Institute (IRRI), DAPO Box 7777, Metro Manila, Philippines; +63 2 580 5600; t.tuong@cigiar.org.**
Duration: **36 months**
Target start date: **30 April 2011**
Finish date (not later than 30 April 2014): **30 April 2014**
Maximum budget requested from CPWF (in US$): 1,275,000
Any matching funds offered (provide brief explanation): **US$93,706**
IRRI's Project STRASA works in the same area and will provide matching fund 10% of time of Dr. Ismail and Tao Li in 3 years. Some amount will be designated to the attendance of IFWF.

2. Project Summary

The brackish-water coastal zone of the Ganges is home to some of the world's poorest, most food insecure, and most vulnerable people. The Research for Development Program of the Ganges Basin Development Challenges (BDC) is set up with a goal to reduce poverty, improve food security, and strengthen livelihood resilience in coastal areas through improved water governance and management, and more productive and diversified farm systems. Project G2 will contribute to this goal through developing and introducing more productive, diversified, and resilient agriculture/aquaculture production systems in the fresh-/brackish-water coastal zones of the Ganges delta in Bangladesh and India. The project has five specific objectives, and each will produce an output contributing to the above overall objectives: (i) validate new germplasm suitable for various agricultural cropping systems and establish seed distribution networks in target zones; (ii) develop and disseminate more productive, profitable, resilient, and diversified rice-based cropping systems (including rice-aquaculture); (iii) enhance the productivity of homestead production systems; (iv) develop novel brackish-water aquatic production systems for zones too saline for agricultural crops; and (v) produce technology and policy recommendations for up- and out-scaling. The project maintains strong linkages with other projects in the Ganges BDC, builds on the success of the Phase 1 CPWF projects in the Ganges, notably PN 10 and PN 7, and will leverage the ongoing work of other projects in the coastal zones of Bangladesh and India, especially STRASA, USAID-CSISA, and BRAC's agricultural program. It will use two complementary approaches: (i) farmer participatory validation/demonstration of promising crops, cropping patterns, homestead farming, and aquacultural technologies; and (ii) in-depth process analysis of new crop/aquaculture systems—using on-station experiments and simulation modeling. The expected outcomes of the project include (i) decision-makers/policymakers endorse the use of modern varieties, technologies, and homestead and cropping systems and provide policies/support that enable widespread adaptation of research findings; (ii) seed producers will produce adequate validated varieties for farmers; and (iii) large-scale adaptation of the more productive, profitable, and stable cropping systems in fields and in homesteads.

PART B: PROJECT DESCRIPTION

3. BDC Goals to which the project will contribute

The goal of the Ganges BDC is to reduce poverty, improve food security, and strengthen livelihood resilience in coastal areas through improved water governance and management, and more productive and diversified farm systems.

The project will contribute to this goal through developing and introducing more productive, diversified, and resilient agriculture/aquaculture production systems in the fresh-/brackish-water coastal zones of the Ganges delta in Bangladesh and India, for the benefit of poor rural households.

The project has five specific objectives:

1. Validate new germplasm suitable for various agricultural cropping systems and establish seed distribution networks in target zones

Numerous salt-tolerant and submergence-tolerant varieties of rice are now available but have not been sufficiently tested for adaptation and suitability to replace the low-yielding rice landraces currently being used by farmers in coastal areas. Besides being tolerant of prevailing stresses, these varieties have higher yields, are short-maturing, and are more responsive to inputs, which will facilitate cropping intensification and further improve and stabilize the overall productivity of the region. These varieties will be widely evaluated with farmers in participatory varietal selection (PVS) trial settings and seeds of suitable varieties will be made available to farmers.

2. Develop and disseminate more productive, profitable, resilient, and diversified rice-based cropping systems (including rice-aquaculture)

The productivity of many coastal areas with low to medium salinity is very low and dominated by monocrops of rice during the wet season. There is potential to double or, in most cases, triple cropping, and increase current system productivity, farmers' income, and food production. Rice varieties selected in activity 1 and water management will be used as the entry points to design more productive and sustainable rice-based systems.

3. Enhance the productivity of homestead production systems

Homestead farming provides opportunities for integrated aquaculture, agriculture, horticulture, and livestock activities, which could be profitable if managed scientifically. Women normally play major roles in homestead activities, including input supply and marketing. However, for most farmers in coastal areas, homestead farming has low productivity, but with enormous potential to enhance food diversity and economic conditions of farmers because of the sustainable production of various food sources that have a good market price. Farmers' ponds can effectively be used for producing high-quality fish, and this can be integrated with other agricultural and horticultural activities to enhance the nutritional value of homestead products.

4. Develop novel brackish-water aquatic production systems for zones too saline for agricultural crops

These systems will be developed in areas with scarce freshwater resources during the dry season. Environmentally friendly low-input poly-culture aquaculture with improved and specially adapted fish/shrimp species will be developed. Increasing productivity in the dry season also helps alleviate farmers' vulnerability to typhoons. Farmers thus have more stable and improved livelihood.

5. Produce technology and policy recommendations for up- and out-scaling

Efforts will be made to ensure ownership and support of policymakers and decision-makers to support the transfer of knowledge and technology. Government policy-enforcing agencies will be

included during various stages of the project, and policy briefs, extension material, and interaction with local media will be extensively used as a means for further dissemination. We hope the outcome will be the recognition of the importance of suitable policies to strengthen the large-scale adaptation of new varieties, new technologies, and cropping systems in fields and in homesteads.

4. Research questions and methodologies

Research Questions	Methodologies
For output 1 (*new germplasm validated and seed distribution network established*) • Which varieties will be adapted to the coastal area and under which conditions, and how they will be made available to farmers?	The project will match modern germplasm (crop varieties, newly available or in the pipeline) to the resource profile (rainfall, salinity, and flood risks) of targeted areas. Though new upland crop varieties will also be tested, the project will focus on rice as this is the most important crop in the coastal zones. Because of their shorter duration and tolerance of most of the prevailing stresses, new rice varieties provide considerable opportunities for enhancing system productivity through adjusting cropping patterns and resource management to reduce the level and duration of stress. Breeder seeds of stress-tolerant rice varieties will be provided through BRRI and further multiplied using current networks established through STRASA and CSISA for distribution to farmers at target sites. Farmers' participatory varietal selection trials (PVS) will be used for validation and demonstration of existing and new varieties and breeding lines. This will build on progress made in Phase I and other ongoing projects. Emphasis will be placed on the evaluation of varieties tolerant of submergence in flood-prone areas, salinity in areas affected by salt stress any time during the season, and varieties combining both salt and submergence tolerance for areas experiencing both stresses during the season.
For output 2 (*rice-based cropping systems*) • Which technologies and/or rice-based cropping systems offer the best opportunities for increased productivity and livelihood resilience for small and marginal households? • Under which conditions (socioeconomic, financial, natural resource, germplasm) can the technologies/cropping systems be successful?	Rice-based cropping systems will be tailored to local environmental (especially salinity and risk of flooding) and socioeconomic conditions. The systems will be designed to increase "crop" diversification and land-use intensity in a sustainable manner. Currently, small poor landholders grow only one crop per year using low-yielding rice varieties in the rainy season or they have low-yielding aquaculture ponds. This will be increased to two or three "crops" per year, where "crop" refers to whatever is harvested (rice; upland crops such as legumes, oilseeds, or cereals, e.g., wheat, maize; and aquatic organisms such as prawns, shrimp, fish, crabs). The new systems will involve rice-based cropping systems (in areas with salinity < 4 ppt more than 7 months/year), using either (i) two crops per year (rice-rice or rice-upland, e.g., aus-aman, aman-boro, aman-upland) or (ii) three crops per year (rice-rice-upland, e.g., aus-aman-upland, aman-boro-upland). In areas with higher salinity, the project will increase the productivity of the rice phase of rice-shrimp systems with new rice varieties with enhanced tolerance of salinity and submergence and with mixed culture of rice and prawn or fish. In all tested cropping systems, modern varieties with short duration and enhanced tolerance identified in activity 1 will be

	incorporated. We will carry out participatory experiments/demonstrations in farmers' fields as well as process studies in the BRRI research stations in the target areas. In both types of studies, we will utilize an inter-disciplinary approach, as required by cropping systems analyses. This will require integrative inputs from all partner institutions, capitalizing on their unique skills and specialization. Financial analyses of inputs/outputs and cost/benefit will be carried out to assess the capital requirements of the technologies and farmers' potential income increase brought about by the new cropping systems. In the process studies, on-station experiments will be carried out to evaluate the effects of crop varieties/species, nutrient and water management, and cropping calendar on agronomic and economic performance of different rice-based cropping systems. These systems are designed according to the resource profile of the study sites. Experimental parameters (weather, soil, water, crops) will be monitored. These will be used to evaluate existing models such as ORYZA2000 and APSIM, which will be used to explore the potential in areas outside of the tested sites, in years with different climate conditions, and with varying cropping calendars. Project G2 will limit in calibration, evaluation of the models and use them in analysis of different present and future (from Project G4) scenarios of climatic and hydrological condition. The Project will collaborate with the ACIAR – SAARC project "*Developing capacity in cropping systems modeling to promote food security and the sustainable use of water resources in South Asia*"in the model development. The Project will build on and enhance the success of CPWF Phase 1 project PN 10 in Bangladesh (www.waterandfood.org/page/PN10, Alam et al 2008). It will work closely with Project G3 to explore the possibilities for intensification and diversification that can take advantage of better water governance at polder level. Collaboration with G3 is important at the start of the experiment, to ensure water management at landscape level will be compatible with the field level requirements of the tested cropping systems
For output 3 (*Improved homestead production systems)* • What are the homestead options that provide efficient use of resources, diverse food sources, and additional income and nutrition to households, especially women?	In both southern Bangladesh and West Bengal of India, seasonal hunger and malnutrition are common among landless and near-landless rural people. These groups are particularly vulnerable because of low and irregular cash income. Many use the small area around their houses to grow food to supplement field crops. Homestead farming also contributes to improved nutrition (Hellen Keller International/AVRDC 1993, Talukder et al 2000). This activity will involve the evaluation of the input efficiencies, productivity, and nutritional value of different models of homestead farming in selected villages, representing different salinity and flooding risks. The project will pay special attention to the role of female farmers.

• What are the trade-offs for women and men between investments in homesteads and in fields?	In this activity, we will undertake an extensive literature review to understand the present knowledge on homestead economy and farming systems in the coastal zones of Bangladesh and India. Depending on the outcome of the literature review, a participatory rural appraisal (PRA) or household survey will be carried out to quantify the productivity of homestead farming systems in different target zones. The literature review and PRA/survey outcome will lead to the identification of model systems that are more likely suitable for particular target areas. Selected models will then be evaluated in selected villages for participatory validation. Experiences from the successful homestead model VAC (V for horticulture, A for fishpond, and C for household animal husbandry) in Vietnam can also be tested for improving crop combinations suited to the environmental, social, and economic conditions in the brackish-water deltaic regions of the Ganges in both countries. Nutrition and market values of product will be important parameters in the selection of systems to be tested.
For output 4 *(Brackish-water aquatic production systems)* How can effective and sustainable aquaculture systems be developed in areas that are too saline for agricultural crops?	In areas too saline for agricultural crops (with salinity < 4 ppt for less than 4 months per year), farmers typically produce one crop of shrimp with low yield and low economic income. Present knowledge and improved aquatic organisms will permit poly-culture of diversified aquaculture systems with improved cultural practices. The system of shrimp (outside) + fish (cage–GIFT/Red tilapia/seabass nursing) will be validated. The project will develop and disseminate the raising of small indigenous brackish-water fish species (e.g., *Mystus, Etroplus suratensis*) and promote low-input low cost shrimp aquaculture (LILCSA)—2 crops/year and shrimp production based on organic principles. Besides monitoring the bio-parameters to quantify growth and yield of aquaculture organisms, the project will also monitor water quality in the pond to ensure that the technologies developed are environmentally friendly. Financial analyses of inputs/outputs and cost/benefit will be carried out to assess the capital requirements of the technologies and farmers' potential income increase brought about by the new cropping systems.
For output 5 (*on technology and policy recommendations*) • How can the technologies and production systems generated through the project be supported by suitable policies and effectively out-scaled to reach men, women, and poor households?	Various strategies will be employed to ensure ownership and support of policymakers and decision-makers and for the transfer of knowledge and technology. Government policy-enforcing agencies will be included during various stages of the project, in field visits and meetings. In collaboration with Project G5, the project will organize dialogues with decision-makers and policymakers to timely inform them of the project findings and to "lobby" for policies inducive to the large-scale adaptation of the varieties, technologies, and cropping systems generated by the project. Knowledge generated through the project will also be made available through different means, including extension material, news releases, policy briefs, and scientific publications.

5. Links to previous and ongoing work

With full knowledge of other ongoing or completed initiatives in the Ganges, Project G2 will ensure the complementarity and add value to them. It will build on the successes of CPWF Phase 1 projects, especially from PN 10 (www.waterandfood.org/page/PN10) and PN 7 (Ismail and Tuong 2009, Ismail et al 2010), in using short-duration stress-tolerant varieties and on-farm water management for increasing opportunities for cropping intensification. The new varieties with short duration and enhanced tolerance of abiotic stresses (salinity, submergence) developed by BRRI, BINA, IRRI, CIMMYT, BARI, and ICRISAT provide further opportunities for crop intensification and diversification. The project will leverage on the BWDB's work on Integrated Planning for Sustainable Water Management (IPSWAM, BWDB 2011) in improving polder infrastructure and management. In addition, G2 will select BWDB-rehabilitated polders as study sites to test varieties and cropping systems. It will revisit land use policies and land zonation proposed by the Integrated Coastal Zone Management Project (Islam, 2006). Experiences learned from CP10 in stocking of prawn and fish with rice in the rice phase of the shrimp-rice system will contribute to enhancing productivity (Alam et al 2008).

In addition, G2 will link with the following projects:

Stress-Tolerant Rice for Africa and South Asia (STRASA)
STRASA is funded by the Bill & Melinda Gates Foundation. Its first phase ended in January 2010 and a new phase started in February 2011. This project focuses on developing stress-tolerant rice varieties for South Asia and sub-Saharan Africa, together with proper packages of management. Numerous varieties were developed in recent years that are adapted to local conditions of Bangladesh but with high tolerance of persisting abiotic stresses, particularly drought, submergence, and salt stress. Four of these varieties were recently released in Bangladesh. These varieties are also short-maturing and more responsive to inputs, offering great opportunities for better cropping systems. Seeds of these varieties will be provided through the existing STRASA network operating throughout Bangladesh. Considerable efforts are needed to demonstrate the advantages of these varieties in target areas of Bangladesh and to provide sufficient seeds, together with knowledge on their proper management. This will be carried out in activity 1 of this project. The link of G2 with STRASA is direct through common staff in both IRRI and Bangladesh/India NARES and also through common sites in both countries.

USAID CSISA project "Expansion of the Cereal Systems Initiative for South Asia (CSISA) in Bangladesh"
G2 will have strong links with the CSISA Bangladesh expansion project. CSISA will establish three hubs in southern Bangladesh in 2011 (Khulna, Noakhali, Jessore) and another in Barisal in 2012, with the primary aims of large-scale validation, adaptation, and deployment of improved varieties and crop and aquaculture technologies. The technologies being developed in G2 will feed directly into CSISA for further validation and dissemination. The link is direct through common staff across both projects—within IRRI and within WorldFish Center.

ACIAR-SAARC project "Developing capacity in cropping systems modeling to promote food security and the sustainable use of water resources in South Asia"
G2 will use crop models to explore management options for individual crops (especially rice), and explore options for more intensive cropping systems (rice-rice-upland, rice-rice-rice), with the guidance of cropping system modelers. This will be possible through a direct link with the ACIAR-

SAARC cropping systems project, which will include sites in Bangladesh, and a common staff member across the CPWF-G2 and ACIAR projects within IRRI.

Proposed ACIAR project "Salinity and water management for intensifying cropping in coastal areas of southern Bangladesh in a climate change environment"
This project will complement the CPWF project though studies and modeling of salinity dynamics in polder areas. IRRI will be a partner in this project.

6. Links to other BDC projects

Research outputs	Dependencies on other BDC projects to produce them	Use of research outputs by other BDC projects	Risks and assumptions
1. Germplasm suitable for various cropping systems validated; seed distribution networks established	G1: current land-use maps G1 and G3: site characterization and extrapolation domains, other information to facilitate choice of suitable crops and varieties	G1: characteristics of available varieties, tolerance levels, and other adaptive traits to determine extrapolation domains and land-use options	Accurate information on sites becomes available, including changes in hydrology and salinity during and between seasons; prevailing and future stresses
2. More productive, profitable, resilient, and diversified rice-based cropping systems	G1: information on polders (daily weather, water and soil salinity, river water levels, canal/drainage networks and storage capacity, topography, flood incidences, etc.); current land use; preliminary maps for likely extrapolation domains G3: Facilitate community implementation of water management (e.g., canals, sluice gates for drainage and irrigation, etc.) to enable implementation of preferred cropping patterns G4: maps of future sea level/salinity scenarios	G1: GPS locations of project sites and field boundaries, characteristics of appropriate technologies for particular sites, and revised recommendations. Data needed to accurately plan the land-use requirement of the tested cropping systems for identification of extrapolation domains and land-use options; in the present condition as well as in future scenarios as depicted in G4. Expert opinions to validate extrapolation domains G3: cropping systems likely suitable for each polder and water requirement	Accurate information available from G1 and G3; natural disasters and abnormal weather events
3. Improved homestead	G1 and G3: likely availability and scale of	G1: information needed to accurately describe	Farmers retain sufficient land and

production systems	land and water resources, and market opportunities G5: sensitize policy support and up-scaling	extrapolation domains G5: technical knowledge for distillation and up-scaling	ponds for homestead farming; farmers adopt appropriate models; natural disasters
4. Novel brackish-water aquatic production systems for zones too saline for agricultural crops	Links to G1, G3, and G4 in similar manner as Output 2	Links to G1 and G3 in similar manner as Output 2	Lack of strong policy and community support for proper implementation; abnormal weather events and natural disasters; lack of accurate data for extrapolation
5. Technology and policy recommendations for up- and out-scaling	G3: Identify governance structures that enable implementation of the technologies G5: communication with policymakers and with other projects, GOs, and NGOs; distill knowledge in suitable format to bring about appropriate policy changes	G5: local contact person(s) to develop communication strategies and for frequent meetings; technical knowledge for up-scaling	Lack of strong drive for other GDC projects to work together; abnormal weather events and natural disasters distracting attention

7. Suggested sites

The target area of the project is the brackish-water coastal zones in the Ganges Basin with maximum salinity greater than 5 ppt in the dry season, and with lower salinity during the wet season. In Bangladesh, the area will cover approximately seven districts: Patuakhali, Barguna, Jhalakati, and Pirojpur of Barisal Division and Bagerhat, Khulna, and Satkhira of Khulna Division. It will also include East Medinipur, Haora, North 24 Parganas, and South 24 Parganas districts of the coastal zone of West Bengal, India.
Within the target area, sites are selected to carry out experiments according to the following criteria:
- Representing a range of different salinity conditions (high, medium, and low)
- Accessible, for ease in transporting experimental supplies and making field visits
- Near experiment stations of one of the partner institutes
- In Bangladesh, priority is given to polders

- With water management already improved by IPSWAM work (www.ipswam-bwdb.org.bd/).
- There are ongoing activities by projects to which G2 can link.
- Historical long-term household survey data exist.

Bangladesh:
The following three polders were selected:
1. Polder 3 (Kaligonj, Shatkira): This polder is characterized by high salinity, especially during the dry season. Mostly only one crop of rice is grown during the dry season, but, in a few areas, a rice-shrimp system is practiced. Good potential exists for increasing productivity of the rice-shrimp

system and for enhancing aquacultural production in the dry season by introducing modern technology of mixed farming of shrimp, fish, etc. Rice yield during the aman (wet) season could also be increased considerably by replacing the current local varieties with improved salt-tolerant varieties with shorter maturity to escape the periods of higher salinity and increase duration for the shrimp season, as well as the period required for land preparation between seasons. Historical long-term household survey data are also available for this polder for use as baseline information. The polder is also moderately accessible. Despite the enormous potential for improving annual productivity in this polder, not much has been done so far with regard to adaptive research to enhance rice and/or shrimp productivity or in formulating proper community-based water management groups for proper water management.

2. Polder 30 (Batiaghata, Khulna): This polder covers about 4,500 ha, mostly affected by medium to high salinity during the dry season and early in the wet season (Mondal et al 2010). Cropping intensity is low, about 140%, despite the potential for two to three crops per year. Possibilities also exist for incorporating fish culture with rice during the wet season and cage culture in canals in aman and part of the boro season. This polder is more accessible and long-term historical household survey data are available as a baseline. The research team is familiar with this polder as it was used for some of the initial studies of both PN 10 and PN 7 during Phase I (Mondal et al 2010), and also a water management group is in place.

3. Polder 43/2/F (Patuakhali, Barisal): This polder has low to medium salinity intrusion and low cropping intensity but potential for a substantial increase, and potential for triple cropping. Rice productivity can also be further increased by replacing the current local varieties with more productive salt-tolerant modern varieties. Baseline socioeconomic data are also available for this polder. Not much research has been done so far in this polder. In addition, the polder is accessible and has good potential for organizing water management groups.

India:
The activities in India will be conducted in West Bengal, with two institutions:
1. Central Soil Salinity Research Institute-Regional Research Station (CSSRI-RRS) at Canning Town: research will be conducted in North 24 Parganas District in areas under Sandeshkhali (police station).
2. Central Institute for Brackish water Aquaculture (CIBA) covering South 24 Parganas District in areas under the Kakdwip Research Centre, CIBA, Kakdwip (police station).

At both sites, research activities will explore different options of crop intensification based on available resources, including rice-fish and rice-shrimp in brackish-water areas, poly-farming with selected stocking (including potential for establishing a small-scale feed mill), and homestead farming, which will integrate aquaculture, agriculture, horticulture, and livestock farming.

8. Project Outcome Pathways

Please refer to Annex A Project workbook, worksheet PNX-OLM.

9. Activities and Implementation Plan

Please refer to Annex A Project workbook, worksheet PNX-Gantt Chart.

10. Communications

Within the project

We will use the project management tools developed for this project (Gantt chart and Milestone tables) to monitor our progress and achievements. The project will involve a postdoctoral scientist familiar with the project activities and sites, who will be directly involved in the implementation, monitoring, and reporting, and who will provide periodic updates to the project PI and co-PIs. Field trips will be carried out by all PIs from IRRI and WFC to the project sites each season and periodic meetings will be held to ensure that activities are on target and to make any adjustments where and when needed. Channels of communication between all partners will include email exchange, phone (and Skype), and direct discussions during meetings.

Among the Ganges BDC Projects

Communication with the other projects within the BDC will involve direct communications with the projects that work closely with G2, particularly G1 and G3, as well as communication through the PIs with the other projects and with the Basin Coordinator of G5, as indicated in Section 6. The project postdoctoral scientist based in Bangladesh will provide a communication channel for daily managerial matters. Furthermore, the GBC Annual Reflection meetings and the International Water Forums will provide further exchange of information and discussion.

To outside communities

This will be achieved through several channels of communication:

(i) Development of a strong link with ongoing projects in the study areas, notably the USAID CSISA Bangladesh project, the STRASA project, and BRAC's agricultural activities at the study sites. The community between G2 and these projects was discussed in Section 5.

(ii) Farmer participatory testing/demonstrations at many locations (chosen to be already visible and accessible to many locals).

(iii) Field days—to which farmers, extension workers (government, agribusiness, NGOs, CSISA and STRASA staff), and local policymakers will be invited.

(iv) Production of guidelines for farmers and extension workers in local languages.

(v) The conduct of training courses for farmers and extension workers.

(vi) Use of various media, including TV, radio, newspapers, etc.

(vii) The project will join policy dialogues organized by G5 to brief ministerial-level policymakers of the research findings and to recommend enabling policies and produce policy briefs.

(viii) Communicate with researchers/scientists through International Water Forums and other conferences and via publications.

PART C: CONSORTIUM DETAILS, INDICATIVE BUDGET AND REFERENCES

11. Consortium Details

Lead Institution

IRRI has long played a leading role in rice research and development and in capacity strengthening of NARES partners, with a history of 50 years of collaboration with national research institutions, including many in Bangladesh and India. IRRI also led numerous projects funded by the CPWF during Phase 1; two of them involved partners in the same geographic locations where Project G2 will be implemented (CN 7 and CN 10). IRRI is well equipped with needed facilities and expertise to lead this project, and will build on accomplishments made during Phase 1 as well as through projects supported by other donors. This project will complement our current activities in germplasm development and dissemination (through the Stress-Tolerant Rice for Africa and South Asia, STRASA, project) and in cropping systems/resource management (through the Cereal Systems Initiative for South Asia, CSISA). IRRI also maintains a strong reputation in the management of research projects over many decades. In this project, IRRI is responsible for the over whole research management of the project, for the integration of partners to ensure high quality scientific as well as technological outputs.

Project Partners

Partner 1. The *WorldFish Center (WFC)* was involved in both CN 34 and 35 of Phase 1. WFC brings considerable experience, with a South Asia regional headquarters in Dhaka active for many years with wide experience in implementing research and development projects in the Ganges-Brahmaputra-Megna system, and excellent relations with government, NGOs, and other development partners in Bangladesh and India. WFC will work closely with research institutes in Bangladesh and India and will be in charge of aquaculture systems (output 4), and the aquaculture activities in rice-aquaculture systems (output 2) and homestead farming (output 3). It will give due guidance to the Bangladesh Fishery Research Institute (BFRI) and Central Institute for Brackish-Water Aquaculture (CIBA), Indian Council of Agricultural Research, of India in the above activities.

Partner 2. The *Bangladesh Rice Research Institute (BRRI)* has been involved in both PN 7 and PN 10 of Phase 1. BRRI is the prime institute in Bangladesh with the mandate for rice research. Many rice varieties and technologies produced by BRRI are now widely adapted by farmers and have contributed greatly to increasing rice production and alleviating poverty in the country. In this project, BRRI will provide certified seeds of rice varieties to be used in rice-based cropping patterns. It will be involved (together with IRRI, BRAC, other partners in planning, execution, and monitoring of different trials and in linkages with farmers, ensuring outputs 1, 2, and 5. BRRI maintains three regional stations in the project area of southern Bangladesh, and at least two of them, Shatkhira and Barisal, will be involved in the project activities.

Partner 3. *BRAC* is an international NGO with nine regional research stations and more than 60 seed production farms scattered in Bangladesh. BRAC has a strong network with farmers in the south and is handling a project for crop intensification in some polders in the saline areas of southern Bangladesh. BRAC will be involved in on-farm adaptive research and dissemination, seed increase, and demonstration trials, using mostly their own resources, with minimal needs from the project.

Partner 4. The *Bangladesh Fishery Research Institute (BFRI)* is the prime research institute in fisheries research in Bangladesh. BFRI has established an excellent reputation in being involved in many international projects and networks. BFRI maintains a brackish-water regional research station in the coastal zone of Bangladesh and has actively contributed to PN 10 during Phase I. In this project, BFRI will work closely with IRRI, BRAC, BRRI in outputs 1, 2; with IRRI, BRAC and WFC in output 3 and with WFC in output 4.

Partner 5. The *Central Soil Salinity Research Institute-Regional Research Station (CSSRI-RRS)*, Regional Station, Canning City, West Bengal, India, is well staffed, with expertise working on improving the productivity of the coastal areas of India. It also has a long history of collaboration with IRRI in numerous projects focusing on developing salt-tolerant varieties, alternative cropping systems, and management practices for salt-affected areas. CSSRI-RRS, in collaboration with IRRI, will be involved in conducting experiments of outputs 1 and 2 in farmers' fields in North 24 Parganas District of West Bengal. It will collaborate with the *Central Institute for Brackish-Water Aquaculture in output 3.*

Partner 6. The *Central Institute for Brackish-Water Aquaculture (CIBA)* research center in Kakdwip, West Bengal, has collaborated successfully in many projects with WFC in developing aquaculture systems in brackish-water as well as freshwater environments. In this project, CIBA will work closely with WFC on aquaculture systems (output 4) and with IRRI, CSSRI-RRS on homestead systems (output 3) and more productive, profitable, resilient, and diversified rice-based cropping systems (output 2) in the coastal zones of India, and will conduct trials with farmers in South 24 Parganas of West Bengal.

Other partners. These partners will be involved based on needs and capabilities as the project progresses. Potential partners will include the regional universities, Khulna and Barisal universities in Bangladesh, and Calcutta University in India. In addition, NGOs (such as Shushilan, Uttaran) working at the project sites in both Bangladesh and India will be involved, particularly in on-farm research activities. We will work with small seed (for agriculture) and feed (for aquaculture) companies, example are Kapotakkha Enterprise (at Tala, Satkhira) and Urban Agro Seed (at Fultola, Khulna). In India, some small NGOs also produce seeds for West Bangal, such as Tagore Society, Gotra, Cooperative.

12. Indicative breakdown of budget

Please refer to Annex A Project workbook, worksheets PNX $ Summary, PNX $ Comments, PNX $ Time Allocation, PNX $ By Outputs, and PNX $ By Institution.

13. Bibliography

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Annexes

A: Project Workbook
B: Team leader and team member's C.V.s.