



Third Call for Proposals of the Benefit-sharing Fund Window 3: projects on technology co-development and transfer

I. Background

Given that in the past calls for proposals, the co-development and transfer of technologies did not receive the substantive and coherent focus expected by the Contracting Parties, an additional thematic window (Window3) for the Third Call of Proposals of the Benefit-sharing Fund was established to enhance non-monetary benefit-sharing by promoting technology transfer, capacity building and information exchange, in line with the first overall priority of the Benefit-sharing Fund.

The twelve (12) projects approved under Window 3 are of two types:

1. Single country projects that have a duration of 24 months. A total of three (3) single country projects have been approved.
2. Multi-country projects that have a duration of 36 months. A total of nine (9) single country projects have been approved.

Projects supported through Window 3 aim to promote international cooperation in support of the Treaty by linking institutions across national boundaries. Funding is provided for both the co-development and transfer of key technologies which will enable the exchange of value added information about PGRFA, and in particular those that are related to the use of species in the genepool of the Multilateral System. Projects are thus expected to focus on plant genetic resources for food and agriculture listed in *Annex I* of the Treaty.

Technologies that will be co-developed and/or transferred with support from Window 3 projects will have the potential to make a significant impact on the conservation and/or use of plant genetic resources in resource-poor rural communities. Special attention has been paid, in the appraisal and selection of the approved projects, to technologies which generate information and germplasm that could enhance the ability of farmers to adapt to climate change, especially through increased resistance to drought, heat and associated biotic stresses. Most of the approved projects involve partnerships between institutions located in developing countries, and institutions from either the private or public sector in another Contracting Party. Research institutions and genebanks in developing countries are actively involved in these partnerships.

II. Overview of approved projects

A. Single country projects

1. W3A-PR-07-Indonesia

Title: *Development of Biomarkers Tools for Improved Production and Climate Change Resistance in Indonesian Rice*

Executing institution: *Bina Nusantara University*

Bioinformatics and Data Science Research Center (BDSCR) of Bina Nusantara University (Jakarta, Indonesia) leads the project, provides information technology support, and is responsible for project logistics. The Indonesian Center for Agricultural Biotechnology and Genetic Resources, Indonesian Agency for Agriculture Research and Development, and Ministry of Agriculture (Bogor, Indonesia) provides genomic and phenotypic data, reviews results, performs follow-up experiments, and assists in result dissemination to relevant parties. BDSCR and their network of collaborators will provide state-of-the-art statistical modeling expertise and software for this project. Activities will include the following:

- Integration of genotypes, trait, heredity, stress, and climate data for a diverse set of rice planted in various locations with distinct climate conditions across multiple seasons in a relational database and the linking of these data to other resources;
- Analysis of the performance of genome-wide and genome-environment-wide (GxE) of complex traits in a diversity panel of rice varieties using appropriate generalized linear modeling;
- Development and utilization of statistical methodologies to assess the relationships among numerous factors (e.g. genetic, ancestry, climatic, soil) within relevant abiotic biological pathways;
- Combined evidences from independent datasets and consortia, and evaluate replicable and predictive properties of promising models;

Approximately 30 major rice breeders will benefit from the implementation of the project by having the ability to conduct trials and marker-assisted selection based on biomarkers the tool uncovers. The toolkit will enable scientists to study genetic influences on desirable phenotypes found in Indonesian rice varieties. Through International Rice Research Institute meetings and high-impact publications, over 2,500 scientists will benefit indirectly. Statistical framework accounting for genetic and environmental factors has general applicability for improving other Southeast Asia treaty countries' rice varieties.

2. PR-27-DPR Korea

Project title: *Genetic base broadening and germplasm enhancement for the development of drought tolerant cultivars of wheat and barley in DPR Korea*

Executing institution: *Academy of Agricultural Sciences (AAS)*

In the DPR Korea, wheat and barley are grown as the first crops. However, wheat and barley cultivars that are tolerant to drought are not available, which necessitates the urgent initiation of wheat-barley breeding programmes for DT-cultivars. In this regard the project will include the following activities:

- Transfer technologies for drought-tolerance breeding and germplasm management, particularly with regard to wheat and barley;
- Collect, characterize and conserve 100 local and exotic accessions and cross among them to make 5 F2 generations for selection and generation advancement;
- Make up and initiate a joint research programme between PCGRI and JKI for the pre-breeding and breeding of elite drought tolerant cultivars of winter wheat and/or spring barley, and
- Training and capacity building

Direct beneficiaries of the project include a total of 65 persons (63 researchers and 2 officials of AAS) as well as 9 farmers' cooperatives for a total of around 600 farmers. It is estimated that around 500 researchers and breeders, including 300 households will also benefit from the achievements of the

project. Ultimately, more than 4,387,000 producers at about 3080 farmers' cooperatives, crop breeders, breeding institutes and seed producers will indirectly benefit from the implementation of this project.

B. Multi-country projects

1. W3B-PR-02-Jordan

Project title: *An Integrated Approach to Identify and Characterize Climate Resilient Wheat for the West Asia and North Africa Region*

Executing institution: *ICARDA*

Target countries: *Jordan, Egypt, Ethiopia and Sudan*

The project will be implemented through a partnership between ICARDA and NARS scientists in the targeted countries to execute the following targeted activities:

- Identification and utilization of wheat accessions from drought and heat stress prone areas using an improved FIGS approach and wheat breeding material;
- Identification of molecular markers linked to traits conferring drought and heat stress tolerance in the collected wheat material;
- Identification of new alleles for drought and heat tolerance using a genome wide association mapping approach;
- Deployment of marker assisted selection using high-throughput genotyping platforms in ICARDA and NARS breeding programs;
- Development of user friendly open access web-based tools to facilitate data and information exchange between participants;
- Training courses and workshops targeting NARS scientists and breeders to acquire skills in specific areas of molecular breeding.

Wheat germplasm identified in this study will directly benefit ICARDA and national partners' wheat breeders in WANA region. Training young scientists and breeders from the selected countries and the development of data sharing tools will allow direct technology transfer and wider access to information that will help breeders improve wheat production in WANA region.

2. W3B-PR-05-Peru

Project title: *Marker assisted selection for potato germplasm adapted to biotic and abiotic stresses caused by global climate change*

Executing institution: *Universidad Nacional Agraria la Molina (UNALM)- Instituto de Biotecnología (IBIT)*

Target countries: *Peru Ecuador and Venezuela*

The project will identify in a short-term and develop in medium-term, varieties with better adaptation and resilience to adverse environmental conditions by undertaking the following activities that will be implemented by the Universidad Nacional Agraria La Molina (Peru) in collaboration with INIAP (Ecuador), Universidad de Los Andes (Venezuela) and NEIKER (Spain):

- Evaluation of potato germplasm for tolerance to late blight (*Phytophthora infestans*) and resistance/tolerance to abiotic stress factors: drought, cold, heat as to identify suitable cultivars for immediate cultivation and promising germplasm for breeding;

- Detection of useful candidate genes (CG) for abiotic and associated biotic stresses applying different molecular Tools (RNAseq, Analysis of known Genes, Amplicon Sequencing, RAD sequencing);
- Molecular characterization of the allelic variation in these CG and of allelic composition in the evaluated accessions to detect useful alleles and superior genotypes;
- Association mapping to detect the effects of specific CG alleles or allele combinations on the tolerance levels of the analysed stresses, development of molecular markers for MAS;
- Model building to assign parental breeding values and predict progeny performances for performing improved crosses and increase breeding efficiency;
- Pre-breeding activities to combine favourable characteristics improving adaptation to climate change applying the developed markers and models;
- Transfer applied technologies between partners and dissemination and transfer of project results (accessions and breeding clones) to partners, scientific community and to the agricultural sector.

3. W3B-PR-08-Indonesia

Project title: *Co-Development and transfer of Rice Technologies*

Executing institution: *Indonesian Agency for Agricultural Research and Development*

Target countries: *Indonesia, Malaysia, Lao PDR and Philippines*

The project will focus on sharing information and data base on genomic and morpho-agronomical characters of traditional varieties from each participating institutions, and on creating a gene-pool of such varieties. Selected pure (homogenous) traditional varieties in the gene-pool will be phenotypically and molecularly evaluated in the field by participating countries. Molecular characterization will be done by participating countries, international organization such as the IRRI, or outsourced to a specialized company. The markers used for the characterization comprise universal primers for DNA fingerprinting analysis important for variety identity, and markers associated with yield components and desired traits such drought and/or diseases.

The main activities and related outputs will be the:

- Development of breeding lines from the crossing between NILs and local varieties in each participating country, and application of molecular markers such as SSR and SNP, corresponding to productivity and tolerance to biotic and/or abiotic stresses, to identify target alleles in segregated populations;
- Shared database and exchanges of released modern varieties from participating countries;
- Participatory varietal selection for the modern varieties in each participating country;
- Transfer of improved varieties from one or more participating for evaluation for their adaptability to the local conditions.

The direct beneficiaries of this project will be around 60-80 farmers, rice scientists and breeders in the targeted countries. An estimated 60.000-80.000 farmers in the surrounding areas of the testing fields will indirectly benefit from the availability of the new varieties. Rice scientists and breeders, as well as extension workers will benefit from the new varieties, data, information and research finding from the project.

4. W3B-PR-18-Turkey

Project title: *Addressing the challenges of climate change for sustainable food security in Turkey, Iran and Morocco, through the creation and dissemination of an international database to promote the use of wheat genetic resources and increase genetic gains*

Executing institution: *International Center of Maize and Wheat Improvement (CIMMYT)*

Target countries: *Turkey, Iran and Morocco*

High temperatures and rainfall scarcity are the major constraints to wheat yields in the WANA region that is targeted by this project, including Turkey, Iran and Morocco. 'New' plant genetic resources for agriculture resilient to heat and drought will be identified among wheat gene pools to guarantee food security in the region by implementing the following activities:

- Conservation and use of collections of wheat PGRFA for adaptation to climate change (drought and heat), resistance to rust and association with SNP markers by Genome Wide Association Studies (GWAS);
- Co-development and/or transfer of technologies to Turkish and Iranian PGRFA institutions for conservation and sustainable use of PGRFA (phenotyping, routine use of markers, application of GWAS and physiological trait-based breeding);
- Creation and dissemination of a database, including genotypic and phenotypic data and sources of germplasm showing good adaptation to drought and heat;
- Training and capacity building of PGRFA institutions and researchers to conserve and manage PGRFA, like wheat breeding lines, varieties and landraces and information on their adaptation to drought and heat;
- Development of evidence-based plans and technological priorities (e.g. adoption of drought- and heat-adapted varieties) to help resource-poor farmers adapt to climate change.

5 gene banks and 80 breeders and scientists (estimated 10% women; 90% man), including 10 government officials from the Ministry of Agriculture in Turkey will directly benefit from the implementation of the project. In addition, it is estimated that around 10,000 poor-resource farmers (52.3% women; 47.7% man) and their families, for a total of 40,000 people will indirectly benefit from the achievement of the planned outputs of this project.

5. W3B-PR-21-Morocco

Project title: *In vitro culture and genomics-assisted fast track improvement of local landraces of wheat and barley in Morocco, Tunisia and Algeria for enhancing food security and adaptation to climate change*

Executing institution: *ICARDA*

Target countries: *Morocco, Tunisia and Algeria*

Wheat and barley are the major staple food crops of Morocco, Tunisia and Algeria. These crops are constrained by various biotic and abiotic stresses and climate change (CC), resulting in lower productivity and increased vulnerability.

This project will address these issues by characterizing local landraces and cultivars of wheat and barley in the three target countries both at phenotypic and genome levels and perform genome-wide association studies and mapping to identify loci of importance for adaptation to climate change; The main activities and related outputs of the project include:

- Phenotypic diversity in the germplasm accessions of wheat and barley from Morocco, Tunisia and Algeria will be estimated;
- Genome-wide genetic diversity analysis and patterns of linkage disequilibrium in the wheat and barley from the 3 target countries estimated;
- The marker–phenotype associations estimated and QTL mapping performed;
- Doubled haploids of wheat and barley developed;
- Marker-assisted selection (MAS) applied in the breeding program and desired variants selected using molecular markers;

- Training workshop for the researchers, students and technicians of participating countries organized;
- Post graduate students will be integrated into the project to carry out the thesis research.

The direct beneficiaries of the project will be the Moroccan, Tunisian and Algerian genetic resource specialists, plant breeders, researchers, technicians, professors, students and ICARDA scientists. Professors from INAT, INA, Moroccan Universities and researchers from the INRAT, INRAA and INRAM institutes will further disseminate and transfer information and technology from the project to a large number to students through teaching.

6. W3B-PR-26-Malaysia

Project title: *Genetic and trait characterisation of farmer and genebank sources of bambara groundnut for the development of drought tolerant lines in sub-Saharan Africa and Southeast Asia*

Executing institution: *Crops for the Future Research Centre*

Target countries: *Malaysia, Nigeria, Ghana and Indonesia*

The focus of this project is a marker supported international breeding programme for bambara groundnut with a focus on Sub-Saharan Africa (Council for Scientific and Industrial Research-Crop Research Institute, Ghana and the International Institute for Tropical Agriculture, Nigeria) and Southeast Asia (Bogor Agricultural University, Indonesia and Crops for the Future, Malaysia). The project will implement the following activities:

- Collection, collation and maintenance of farmer landraces, selected landraces from genebanks and available novel pure lines and crosses;
- Selection of parental lines for further crossing based on user-defined ideotypes;
- Testing and evaluation of core and 'local' germplasm for crop performance on multiple farm sites in Malaysia, Nigeria, Indonesia and Ghana;
- Identification of lines with improved quantitative values for drought tolerance, acceptability and cookability (shorter cooking time) and testing the best candidate lines by expanded farmer trials.

The programme will create 'climate change ready' pre-breeding lines, varieties and variety mixes that produce yield in regions unsuitable for major crops and particularly in harsh marginal soils.

This project's target direct beneficiary groups are researchers and small-scale farmers and its indirect beneficiaries will be groups of consumers and product processors in the targeted developing countries.

7. W3B-PR-29-Indonesia

Project title: *Multi-country construction of a test platform for the development and allocation of globally unique identifiers for rice germplasm, linking the MLS information infrastructure and the DivSeek repository*

Executing institution: *Indonesian Agency for Agricultural Research and Development, Ministry of Agriculture*

Target countries: *Indonesia, Rwanda, India and Brazil*

This project will focus on the enrichment and reinforcement of information available on rice accessions and envisages to establish a common approach to facilitate the establishment of automated meaning links through the adoption of permanent unique identifiers. The project

presents a participatory and science-based methodology with multi-country approach and is based on the implementation of the following activities:

- Organize a meeting that will bring together global experts on unique identifiers for rice germplasm, as well as experts from the gene bank community and plant breeders to discuss on the adoption and application of a common existing method for identification of PGRFA to rice material;
- Design the central registry and assess possible host which will develop the plug-in and will liaise with the Treaty Secretariat for the connection of the plug in to the transfers of material within the Multilateral System of Access and Benefit-sharing;
- Upgrade the existing gene bank software supporting the management of information related to SMTA, adding a function to automatically register and identify the accessions, and develop of web-server for SMTA-mediated germplasm transfers.

The direct beneficiaries of this project will be the gene banks that will benefit from the adoption of better tools and methodologies for the documentation of PGRFA information related to rice accessions. Rice plant breeders and users of the multilateral system will benefit from a facilitated access to a global distributed wealth of associated information that will go beyond the passport data.

8. W3B-PR-37-Tanzania

Project title: *Marker assisted selection of useful cassava germplasm adapted to biotic and abiotic stresses caused by global climate change*

Executing institution: *Mikocheni Agricultural Research Institute*

Target countries: *Tanzania and Kenya*

The aim of this project is to characterize cassava germplasm for abiotic and biotic stresses and exploit it through breeding to obtain new cassava varieties adapted to climate change for sustainable agriculture. The main activities planned to be implemented are the following:

- Phenotypic evaluation of cassava germplasm working collection as to identify and cultivate cassava with tolerance to abiotic and associated biotic stresses;
- Detect useful candidate genes (CG) for abiotic and biotic stresses applying RNAseq, in silico Mining and RAD sequencing and undertake the analysis of the allelic variation for these CG in Cassava;
- Detect, through the Association Mapping and Models the effects of specific CG alleles or CG allele combinations on the tolerance levels of the analysed stresses;
- Pre-breeding activities as to obtain genotypes;
- Apply developed markers, allowing improving adaptation to climate change and progeny performance predictions.

It is estimated that over 500 farmers in the targeted countries will access cassava varieties with tolerances and resistances to abiotic and associated biotic stresses which are adapted to the global climate change. Cassava breeders will have improved breeding clones as progenitors at their disposal which can be used to develop novel cassava varieties. At least 20 curators of Germplasm Banks and 30 cassava breeders will participate in project activities.

9. W3B-PR-39-Fiji

Project title: *Using modern biotechnologies to sustain food security in Pacific island countries*

Executing institution: *Secretariat of the Pacific Community*

Target countries: *Fiji, Kiribati, Marshall Islands, Palau, Samoa, Tonga and Cook Islands*

The project aims to extend SPC's capacity to carry out plant genetic resource programs by establishing a facility to carry out DNA fingerprinting. Once the capacity will be established, it will be used to redefine core collections of edible aroids, assist with taro breeding for leaf blight tolerance, monitor *in situ* conservation of diverse genotypes, and to make preliminary studies on salinity and drought tolerance in orphan crops and underutilised species. The main activities and related outputs are:

- Establishment of the DNA-fingerprinting facility at SPC CePaCT;
- Molecular characterization of aroid collections and enhancement of Pacific database with linkages to global databases e.g., DivSeek, Genesys;
- Analysis of genetic diversity of new Samoan breeding lines with global core collection;
- Assess genetic diversity in farmers fields;
- Develop methods for screening diversity for tolerance to salinity and drought as to determine genetic traits of tolerance for the collection for food security breeding programs.

It is estimated that at least 45 scientists from Ministries of Agriculture, Universities and Research institutions will directly benefit from the implementation of the project, including 5 technicians from CePaCT and SPC taro breeders. In addition, around 200 farmers in Samoa, 20 regional student scientists (University of the South Pacific and Fiji National University) will indirectly benefit from the implementation of the project.