The International Treaty

ON PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

Full Project Proposal Guidelines

Third Call for Proposals under the Benefit-sharing Fund

Deadline for submitting full project proposal: 5th of December 2014

at Treaty-Fund@fao.org and PGRFA-Treaty@fao.org

TABLE OF CONTENTS

PROJECT PROPOSAL COVER SHEET

Project No. _____ (*For Treaty use. Do not write anything here)*

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

Project duration: 3 years

Target crops: Bread wheat, durum wheat and barley

Targeted developing country/ies: Morocco (L), Tunisia and Algeria

Other Contracting Party/ies involved: France, Germany and Australia

Project geographic extension (km²): 3259291

Total requested funding _____US$ 496502 _____

Total co-funding _____US$ 60000_____

Please select the type of project you are applying for:

☐ Single-country Immediate Action Project (Window 2)
☐ Multi-country Immediate Action Programme (Window 2)
☐ Single-country Co-development and Transfer of Technology project (Window 3)
☐ **X**Multi-country Co-development and Transfer of Technology project (Window 3)

Applicant

Name of Organization:

International Center for Agricultural research in the Dry Areas (ICARDA)

Type of organization: International

Project Contact: Sripada Udupa, Senior Scientist

E-mail address: S.UDUPA@CGIAR.ORG

Telephone: +212-673346102

Fax: +212-537675496

GENERAL REQUIREMENTS

These guidelines have been prepared to support applicants in the development of full project proposals. They describe the requirements that all applicants should adhere to when developing their full project proposal.

Please make sure you read these guidelines carefully before proceeding to fill in the Project Proposal Form. The full proposal should be prepared taking into account the thematic focus of the Third Call for Proposals, including in particular, the rationale, scope and expected outputs for each Window and sub-Window.

Project proposals must be clear and realistic on the problem to be addressed and objectives it tries to achieve. Project objectives have to fit in the thematic focus of the call and ultimately contribute to food security and poverty alleviation. Project objectives have to be logically interlinked with the planned activities, outputs and expected outcomes. The objectives and outputs have to be feasible in terms of duration and resources requested. The information to be provided in each section has to be focused and straightforward, qualitatively and quantitatively measurable in terms of what will be done, with what purpose, who, why and how will be involved in the activities to be implemented, who and how many will directly and indirectly benefit from the implementation of the project. A good full proposal will have a sound, clear and logically linked methodology of implementation and management.

The full project proposal should contain no more than fifteen (15) pages of text (Appendixes, table of contents and cover sheets excluded). The number of pages allocated to each section is a guide. The information required can be less but not more than the pages stipulated. All Appendixes should be duly filled in according to the provided guidelines as they form an integral part of the full project proposal. Project proposals lacking at least one Appendix, will be excluded from the selection process. The Appendixes will be provided to you in separate files together with the present document.

When submitting the full project proposal, additional attachments (endorsement letters, funding commitments, certification of the status of the organization) can be provided.

Please ensure that the project proposal and all attachments are legible in Times New Roman 12 and provided in two formats (pdf and word). Make sure the signature of the project coordinator is put on the signature page.

The project proposal, if approved for funding by the Bureau of the Sixth Session of the Governing Body, will form an integral part of the contractual agreement (Letter of Agreement) that will be signed with each applicant organization of the approved projects.

SECTION A: EXECUTIVE SUMMARY

1. Executive summary

Bread wheat, durum wheat and barley are the major staple food crops of Morocco, Tunisia and Algeria. In these countries, both wheat and barley are used for making bread and other products for human consumption. Barley is also used as animal feed. The yield levels are low to medium, because of drought, salinity, high temperatures and occurrence of pests and diseases, resulting in lower production. As a result, the three countries are not self sufficient in production of wheat and barley and import approx. 12.7 million tons of wheat and 9.2 million tons of barley during 2011 (FAOSTAT).

Climate change (CC), growing populations, water scarcity and limited natural resources currently present a great challenge to the food security of the three target countries and NENA region. CC further aggravate the already existing problems, such as drought, salinity and heat stresses; pests and diseases and loss of biodiversity. Plant genetic resources, which are the raw materials used to create new crop varieties, play a strategic role in helping agriculture adapt to a dryer climate and related challenges. Drought- and salinity-tolerant crop varieties, for instance, contribute to saving scarce water resources and allow more water for other crops.

Traditional breeding approaches aimed at developing improved cultivars with better tolerance to stresses and end-use quality take long time (10-15 years). These approaches are inefficient for selecting these traits phenotypically because of high environmental errors, or expensive to assess, and in many cases the trait assay procedures are destructive.

Developments in genomics, wheat and barley have provided new tools (including genotyping by sequencing and large scale SNP analysis) for discovering and tagging novel alleles and genes. These tools can enhance the efficiency of breeding programs through their use in marker-assisted selection (MAS). Integration of *in vitro* culture techniques such as doubled haploid (DH) and genomics tools greatly increase the efficiency and effectiveness of the introgression and development of improved cultivars. In order to integrate these tools in the crop improvent programs, there is a need to impart training and enhance capacity in application of these new genomic tools in National Agricultural Research Systems (NARS). However, not much work has been done in this direction in the region.

This project proposal was developed to address these issues, with overall objective to improve adaptation to climate change and enhance the food security of resource-poor farmers and with specific objectives intended to characterize local landraces of the three target countries both at phenotypic and genome levels and perform genome-wide association studies and mapping to indentify new loci, genes and alleles important for adaptation to CC; integrate genomics and *in vitro* techniques for fast track improvement of local landraces, and empower the NARS researchers and students in handling these tools by imparting training and enhancing their capacity. The project covers the three countries with geographic extension of 3259291 km^2. The intended beneficiaries are the Moroccan, Tunisian and Algerian PGR scientists, plant breeders, researchers, technicians, professors, and students and ICARDA, who are involved directly in project development, implementation and co-development of the outputs. The benefitted professors and researchers will further transfer the information and technology from the project during the project period to a large number to students (~4500 students) through teaching (~ 250 students/Professor/year). The final beneficiaries of the improved and resilient germplasm from this project are resource-poor farmers, farm women, farming communities in North Africa, which in turn will decrease the vulnerability of farmers to the consequences of abiotic stresses, pests, diseases and CC.

SECTION B: PROJECT DESCRIPTION AND CONTENTS

2.1. Problem definition

Bread wheat and durum wheat (here after collectively referred as wheat) and barley are the major staple food crops of Morocco, Tunisia and Algeria. In these countries, both wheat and barley are used for making bread and other food products for human consumption. Barley is also used as animal feed. The yield levels are low to medium, because of drought, salinity, low and high temperatures and occurrence of pests and diseases, resulting in lower production. As a result, the three countries are not self sufficient in production of wheat and barley. For instance, in 2011, the three countries produced 10.18 million tons of wheat and 4.1 million tons of barley, which was insufficient for feeding their population, thereby imported 12.7 million tons of wheat and 9.2 million tons of barley (http://http://faostat.fao.org/).

Climate change (CC) is the biggest threat to environment, with significant impacts on agriculture in the North Africa region and across the globe. Some of the predicted impacts due to climate change in the region are warmer and more variable weather, an increase in extreme weather events (including spells of very high temperatures, droughts and torrential rains) and a significant drop in annual rainfall (4-27%), which may affect crop yields and further aggravate the already existing problems, such as drought, salinity and heat stresses; pests and diseases and loss of biodiversity. The effect of CC on crop production is already visible in these countries. Recent surveys have showed that distribution of pests and pathogens of wheat and barley are changing over the years in North Africa. For example, the pests such as the Hessian fly confined to arid and semiarid regions of Morocco in the past is becoming an important pest in the favourable wheat growing regions, causing severe yield loss. The rust diseases are well known in wheat and barley. Countries have successfully managed rusts over the past decades using the disease-resistant varieties. Today, the situation and the threat from the rust is fundamentally different from the past. Changes in temperature and rainfall patterns have encouraged the emergence of new races of rust that overcome the currently resistant wheat varieties. The strategic national plans in these countries (Green Morocco Plan of Morocco, Algerian National Agricultural Development Program and Tunisia's Agricultural Strategy, as outlined in the five-year plan 2009-14) have also indentified CC is as a threat to food security.

The results of the previous Treaty funded project in Morocco (during the first call) , the current project in Tunisia (PR-351) and the research results of ICARDA and its national program partners have showed that the local landraces and their wild relatives offer an important gene pool as sources of adaptation and tolerance to many of the above biotic and abiotic stresses and CC. Introgression of these resistance/tolerance traits to well adapted farmers preferred landraces and cultivars, which can greatly enhance adaptation to CC and food security.

Traditional breeding approaches aimed at developing improved cultivars with better tolerance to stresses and end-use quality take long time (10-15 years). These approaches are inefficient for selecting these traits phenotypically because of high environmental errors, or expensive to assess, and in many cases the trait assay procedures are destructive. Developments in genomics, wheat and barley have provided new tools (including genotyping by sequencing and large scale SNP analysis) for discovering and tagging novel alleles and genes. These tools can enhance the efficiency of breeding programs through their use in marker-assisted selection (MAS). Integration of *in vitro* culture techniques such as doubled haploid (DH) and genomics tools greatly increase the efficiency and effectiveness of the introgression and development of improved cultivars. However, not much work has been done on the landraces and cultivars from in the North Africa region. In order to integrate these tools in the crop improvent programs, there is a need to impart training and enhance capacity in application of these new genomic tools and technologies in National Agricultural Research Systems (NARS).

2.2. Project objectives: Overall and specific objectives

Overall Objective: To improve adaptation to climate change and enhance the food security of resource-poor farmers in Morocco, Tunisia and Algeria, by strengthening the sustainable management of plant genetic resources for food and agriculture (PGRFA)

Specific Objectives:

1. Characterization of phenotypic and genomic diversity of landraces and cultivars of wheat and barley from Morocco, Tunisia and Algeria and genome-wide association studies and mapping to indentify new loci important for adaptation to climate change.

2. Integration of genomics and *in vitro* technologies for fast track improvement of the local landraces of wheat and barley for resistance to rusts, the hessian fly, and other stresses to cope with climate change in the target countries.

3. Technology transfer, training and capacity building of national agricultural research systems (NARS) of Morocco, Tunisia and Algeria in application of genomics and *in vitro* technologies in wheat and barley improvement.

2.3 Targeted outputs, activities and related methodology of implementation

Specific Objective 1. Characterization of phenotypic and genomic diversity of landraces and cultivars of wheat and barley from Morocco, Tunisia and Algeria and genome-wide association studies (GWAS) and mapping to indentify new loci important for adaptation to climate change.

Activities: The landraces of bread wheat (BW), durum wheat (DW) and barley had been already procured from the international and national gene banks during previous projects periods in Tunisia (PR-351) and Morocco (during the 1st Call of BSF). Additional accessions were added to this collection from the germplasm collection missions undertaken in the previous projects. All these accessions are held in the respective National Gene Banks. INRA-Algeria has its own collection of BW, DW and barly landraces and cultivars from Algeria. Based of the previous information on the phenotypes, an association mapping panel of around 200-300 lines each for wheat and barley will be assembled to cover the phenotypic variability for the breeding traits that will be evaluated in the present study. Genotyping platform used in this study will be Genotyping by Sequencing (GBS, a Next Generation Sequencing [NGS] based technology and/or other GBS [DArT Seq] and SNP platforms). The LD analysis will conducted on the whole collection. The patterns of genetic diversity and linkage disequilibrium within subgroups will be estimated. The marker–phenotype association analysis will be based on the polymorphisms present in SNPs at different polymorphic loci in the whole collection and in the sub-sample, respectively. At least one bi-parental mapping population of wheat and barley segregating for the trait of interest will be used for QTL mapping with SNPs (Illumina iSelect HD Chip, 90K wheat chip and 16K barley chip).

Outputs related to Specific Objective 1:

Output 1.: Phenotypic diversity in the germplasm accessions of wheat and barley from Morocco, Tunisia and Algeria will be estimated

Output 2: Genome-wide genetic diversity analysis and patterns of linkage disequilibrium in the landraces of wheat and barley from the 3 target countries estimated

Output 3: The marker–phenotype associations estimated and QTL mapping performed

Specific Objective 2. Integration of genomics and *in vitro* technologies for fast track improvement of the local landraces of wheat and barley for resistance to rusts, the hessian fly, and other stresses to cope with climate change in the target countries.

Activities: The targeted crosses will be made in cooperation with breeders and F1 will be used to produce DHs at initially at IGG and in Morocco, as a part of training for the scientists and students from NARS. Later part of the period, the DH production activities will be initiated in other target countries. The information on most of the donors wheat lines to be used in this project for crossing is available at http://maswheat.ucdavis.edu/ and for barley available at http://www.barleycap.org/ All the exotic donor

lines of wheat (includes exotic cultivars and synthetic wheat) and barley (includes exotic cultivars and wild relatives) carrying the know genes interest were already procured and is being crossed with the well adapted and farmer preferred local landraces and cultivars of the target countries during 2014-15 season. These F1s will be used for producing DHs at Institute of Genech, France as a part of training program for the students and scientists of the target countries. Either the haploids or the DH will be screened for the target traits using molecular markers linked to the traits in the respective countries. The selected DH will multiplied for seed increase in the greenhouse and evaluated in the field for the target traits.

DH technology will be integrated with conventional breeding schemes such as pedigree and back cross breeding schemes. Whenever, molecular markers available for the target traits, marker-assisted selection will be performed at various stages (backcross F1, F1 or DH generations or other generations)

Outputs related to Specific Objective 2:

Output 4: Doubled haploids of wheat and barley available for field testing

Output 5: Marker-assisted selection (MAS) applied in the breeding program and desired variants selected using molecular marker

Output 6: Improved wheat and barley lines developed through DH and MAS available for field screening

Output 7: Farmers preferred wheat and barley lines identified through farmers participatory selection

Specific Objective 3: Technology transfer, training and capacity building of national agricultural research systems (NARS) of Morocco, Tunisia and Algeria in application of genomics and *in vitro* technologies in wheat and barley improvement.

Activities: Training of researchers, technicians and students on DH production, genomics technology and genomics-assisted selection will be initiated in the first year of the project. The training workshop for 1 to 2 weeks will be conducted by ICARDA and its partners during the first year and third year of the project period. The partners from France, Germany and USA will be participating in the workshop as lectures. At least 3 key researchers from the target countries will be trained in the training workshops. In addition, individual specialized training courses will be conducted in Rabat based on the research need of the participating researchers. The research results of project will be presented in national and international symposiums and meetings, in addition to publications in refereed journals.

Outputs related to Specific Objective 3:

Output 8: Training workshop for the researchers, students and technicians of participating countries during first year and the third year of the project period

Output 9: Post graduate students will be integrated into the project to carry out the thesis research

Output 10: High throughput computing system will be established at each country at to analyze the genomic data

Output 11: Students/young researchers completed the specialized individual trainees courses in the project

Output 12: The results presented in the national and international conferences

2.4. Targeted PGRFA

Bread wheat, durum wheat and barley in local landraces and cultivars have been already procured from the national, ICARDA and other international gene banks. Many of the germplasm are coming out of the previous projects in Morocco and Tunisia funded by the BSF. These germplasm have the useful traits required for adaptation to marginal areas where resource poor farmers cultivate landraces for their livelihood. The exotic wheat germplasm (cultivars and synthetic wheat lines) and barley (cultivars and *Hordium spontanium*) with key traits such as resistance to leaf rust, yellow rust, stem rust, drought, salinity and other traits required for adaptation to CC and better end-use quality traits are already available with ICARDA and will be distributed to the partners for introgression (pre-breeding) into the farmers preferred local landraces and cultivars. At the end of the project, we anticipate the availability of information on

phenotypic and genomic diversity, prevailance of duplicate accessions in the genebanks/on-farm conservation and marker-trait associations, and germplasm with introgression of the key traits in the genetic background of farmer preferred cultivars and landraces. The germplasm generated will be conserved in the respective national gene banks and the ICARDA genebanks. The information generated will be presented in national and international symposium and published in refereed journals, public sequence databases.

2.5. Target groups and beneficiaries

The intended beneficiaries are the Moroccan, Tunisian and Algerian genetic resource specialists, plant breeders, researchers, technicians, professors, students and other scientific communities and ICARDA, who are involved directly in project development, implementation and co-development of the outputs. The benefitted professors (from INAT, INA, Moroccan Universities) and researchers from the institutes (INRAT, INRAA and INRAM) will further transfer the information and technology from the project to a large number to students through teaching (on an average 250 students/Professor/year). We have at least 2 professors per country, which are directly involved in the project activities, thereby approximately 4500 students are the indirect beneficiaries. The final beneficiaries of the improved germplasm from this project are resource-poor farmers, farm women, farm families and communities in the North Africa, where BW, DW and barley are being grown. The outputs of this project will reach farmers through formal and informal seed distribution systems. The screening of materials for abiotic and biotic stresses will provide plant breeders with the materials to develop improved varieties for farmers, which in turn will decrease the vulnerability of farmers to the consequences of abiotic stresses, pests, diseases and CC.

2.6. Impact and impact pathways

The Strategic Plans of Morocco, Tunisia and Algeria (see section 2.1) aim at improving agricultural production including in marginal areas, where wheat and barley landraces being grown and to achieve self sufficiency in wheat and barley production, without damaging environment, thereby stimulating rural economy and enhancing food security in rural community and rural jobs. The plans aim also to preserve biological diversity and protect genetic resources, boost scientific research in agricultural biotechnology and promote sustainable genetic diversity for research into plant breeding and crop improvement. They were designed to improve coordination among operators — researchers, farmers and other organizations — in conservation and sustainable use of genetic resources.

2.6.1. Food security and poverty alleviation

Bread wheat, durum wheat and barley landraces are mainly grown in the marginal areas, where they play an important role for livelihood, food and nutritional security of the resource-poor farmers, farming families and the rural communities. Genome-wide diversity analysis not only helps in identification of homonymy and synonymy of the landraces, but also tagging of genomic regions controlling adaptive traits, which are useful for deployment of the landraces for on-farm conservation and maintaining on-farm diversity. These activities are in line with one of the priority areas “Managing and conserving plant genetic resources on-farm”, set out by BSF, reflecting Global Plan of Action priority activity 2. The landraces are rich in micronutrients such as Zn and Fe, contributes to nutritional security of resource poor farmers and farming families and helps in combating malnutrition. Improved lines developed through application of in vitro techniques and genomics, enhance productivity thereby increasing income of the farmers and contributes to food security at national level and regional level.

2.6.2. Adaptation to climate change and environmental sustainability

The identified uselful traits and their genomic regions in the landraces speed up the development of resilient and climate smart wheat and barley cultivars, which enhances adaptation to CC, thereby widening the options for sustaining the livelihood of the poor and vulnerable through protection and sustainable management of natural resources.

2.6.3. Scientific impact

Genetic mapping and genome-wide association studies in the local landraces and cultivars identify the useful genomic regions, markers and alleles which can be readily deployed in marker-assisted selection for fast track improvement of wheat and barley in the NARS of the North Africa regions and beyond. The improved germplasm developed through this project can be further developed into varieties or used as parents in future breeding programs.

2.6.4. Capacity development and empowerment

Recognizing the need for well trained human resources (scientists, technicians and students) in NARS for application of genomics tools in conservation and utilization of PGR, this project has envisaged to integrate at least 9 graduate students for conducting the project activities, in addition to need-based individual training for the researchers, technicians and students. At least two training workshops conducted in collaboration with US and French partners will further enhance knowledge and capabilities in application of genomic tools in PGR conservation and plant breeding. The facilities for genomics and high throughput computational analysis will be upgraded in the 3 target countries, which can be used even after completion of the project. These activities are in line with one of the priority areas “Information exchange, technology transfer and capacity-building”, set out by BSF, reflecting Global Plan of Action priority activities 16 and 19.

2.7. Relevance to national or regional priorities in its plans and programs for PGRFA

The present project proposal addresses the key issues related to plant genetic resources, water and food security the North Africa region, which is in line with the Treaty NENA Action Plan. Green Morocco Plan aims at improving agricultural production including resource-poor small holder farmers in marginal areas, where wheat and barley are being grown, without harming the environment. The strategic action plan of the National Gene Bank aims to preserve biological diversity and protect genetic resources, boost scientific research in agricultural biotechnology and promote sustainable genetic diversity for research into plant breeding and crop improvement.

SECTION C: OPERATIONS

3.1. Methodology of project implementation

ICARDA will coordinate this project with the support from the participating NARS from Morocco, Tunisia and Algeria. The coordinator will be supported by his working team to carry out the project activities. The Executive Committee (consists of a Scientist from each of the cooperating institutions from the target countries and the project coordinator) is the supervisory body for the execution of the project activities. There will be a focal point for each of the cooperating institutions. He or she will be responsible for the implementation of the activities from the representing institute. The focal point will be supported by a team of researchers and technicians who will conduct the activities. The partnering institutions were selected based on their specialities. Each target country will have a full team which carry out activities according to the objectives. The Steering Committee is the ultimate authority for monitoring the project progress and its impact assessment according to concrete milestones and indicators. The Steering Committee consists of representatives for the target countries and the coordinator and is chaired by the Program Director of Biodiversity and Integrated Gene Management Program of ICARDA.

3.2. Partnerships and collaboration arrangements

The project was designed in close consultation and partnership with the key stakeholders to achieve the projects' outputs and the outcomes to fulfil the needs of the researchers of the national programs and ultimately benefitting the local farming communities and simultaneously enhance on farm conservation efforts of wheat and barley landraces. Roles of the key partners and stakeholders are presented below:

Morocco

International Center for Agricultural Research in the Dry Areas (ICARDA): ICARDA will coordinate the project, provide necessary technical backstopping for the project and be involved in carrying out research and training activities jointly with INRA-Morocco and other partners. The Gene Bank of ICARDA has the largest germplasm collection of wild relatives and landraces of bread, wheat, durum wheat and barley collected from non-tropical dry areas of the world, which include Tunisia, Morocco and Algeria. ICARDA has the expertise in collection, conservation (on-farm, ex-situ and in-situ), characterization, and documentation of genetic resources, and in the application of genomics and in vitro technologies in genetic enhancement of its mandated crop. ICARDA had collaborated with Morocco and Tunisia to establish the gene bank. ICARDA's biotechnology research in Morocco is carried out jointly with INRA-Morocco. The ICARDA-INRA Biotechnology platform is extensively involved in training and capacity building in the North Africa Region. ICARDA will provide necessary germplasm for the project. ICARDA has partnership agreements with the institutions from Morocco, Tunisia and Algeria involved in this project.

Institut National de la Recherche Agronomique (INRA), Morocco : INRA-Morocco hosts the National Gene Bank has extensive collection of bread wheat, durum wheat and barley collection which will be available for the project. INRA has excellent laboratory and field facilities for conducting the project activities. The expertise in the area of germplasm characterization, tissue culture, genomics, pathology, entomology, plant breeding and plant physiology/agronomy will be available for this project. INRA has collaborative agreements with Hassan II Institute of Agronomy and Veterinary Sciences, National School of Agriculture and other Moroccan Universities for research, teaching and joint supervision of students.

Tunisia

National Gene Bank of Tunisia (BNG): BNG will provide necessary germplasm for the project and be involved in phenotypic and genotypic characterization of wheat and barley germplasm. It has well equipped molecular genetics laboratory for germplasm characterization.

Institut National Agronomique de Tunis (INAT): It is a teaching and research institute, which will be involved extensively in screening the grmplasm for biotic stresses and genomics and in vitro culture and

training and co-supervision of students. It has a well equipped biotechnology laboratory. INAT works in collaboration with INRA-Tunisia on breeding of crop plants including wheat and barley. INRAT is is an agricultural research institute involved in wheat and barley breeding and marker-assisted selection.

Algeria

Institut national de la recherche agronomique, Algeria (INRAA) : It has the mandate to carry out research and training. The National Gene Bank of Algeria is under construction. It has a full pledge of facilities to carry out research in the area of germplasm conservation, breeding, plant protection, biotechnology and agronomy. INRAA hosts students from other Algerian Universities for the thesis research. It is involved in the project in carrying out activities related to plant breeding, in vitro culture, phenotyping of wheat and barley landraces, marker-assisted breeding and genetic mapping. Some of the scientists involved in the project are also adjunct professors in the Algerian universities.

Institut National Agronomique, Algeria (INAA): It has a mandate for teaching and research in agriculture. It cooperates with INRAA research and teaching. It is involved in carrying out project activities concerning germplasm screening and training and capacity development.

Partners from the Advanced Research Institutions and Private Sector

***Institute of Genech, Genech, France (IGG):** IGG is well known for its expertise in production of doubled haploids in wheat and barley. IGG is collaborating with ICARDA on research related to in vitro culture. In this project, IGG will contribute to training workshops by giving lecture and it will accept students for short term training. They also have a service provider for production of doubled haploids. At the initial stage of the project, the produce doubled haploid for Algeria and Tunisia.

***USDA-ARS, Fargo, ND, USA:** Hosts the USDA-ARS small grains genotyping laboratory, expertise in performing high-density SNP array genotyping for both wheat and barley; involved in lecturing on high throughput genotyping in this project. They are also service providers for SNP array genotyping for the project.

***Diversity Arrays Technology Pty Ltd, Australia** a private company that will provide service for genotyping for the project using DArT seq technology.

***TraitGenetics GmbH, Germany,** a private company, provides service for genotyping by sequencing.

*Please note that these partners involvement is minimal. They are service provider for the project by offering competitive prices. Based on their offer (prices), suitable service provider will be selected for genotyping the accessions of wheat and barley. IGG and USDA-ARS will also help in lecturing in the training courses. Cost for their visit is budgeted in the project. IGG readyto accept short-term trainees from the project, based on the demand from the NARS.

3.3. Project management team

The expertise and role of individual partners in this project have already been described in the previous section 3.2. The researchers with various scientific expertise, from the different countries required for co-development and achieving the objectives are involved in the project and forms a project team.

	Name	Institution	Country	Speciality	Role in this project*
	Dr Sripada Udupa	ICARDA, Rabat	Morocco	Genetics, Genomics, Biotechnology, Marker-assisted breeding, PGR characterization	Coordination, technical backstopping, training and capacity building of NARS, establishing linkages with Advance Research Institutes and service provider
	Dr.Sanjaya Gyawali	ICARDA, Rabat	Morocco	Barley breeding	Making crosses, generating segregating

					populations for low input barley, participate in the selections with NARS
	Dr Ramesh Verma	ICARDA, Rabat	Morocco	Barley breeding	Making crosses, generating segregating populations for high input barley, participate in selections with NARS
	Dr Jamal El Haddoury	INRA, Settat	Morocco	Breeding of cereals, Tissue culture, wide hybridization, pre-breeding	Production of doubled haploids, making crosses, generating segregation populations, Genomics, MAS, field evaluation
	Dr Jilal Abderrazek	INRA, Rabat	Morocco	Barley breeding	Making crosses, generating segregating populations, MAS
	Mrs Sahar Bennani	INRA, Meknes	Morocco	Wheat breeding	MAS and field evaluation
	Dr Hassan Ouabbou	National Gene Bank, INRA, Settat	Morocco	Gene Bank Manager, Genetic resources specialist, Physiology/Agronomy	Germplasm characterization, screening for abiotic stresses
	Dr Sadia Lhaloui	INRA, Settat	Morocco	Plant Protection	Screening for biotic stresses
	Dr Amine Slim	National Gene Bank, Tunis	Tunisia	Genetic resource characterization,	Screening for abiotic stresses
	Dr Mohamed Ali	National Gene Bank, Tunis	Tunisia	Genetic resource characterization,	Field evaluation
	Prof Sonia Hamza	INAT, Tunisia	Tunisia	Molecular genetics, plant protection	Screening for biotic stresses, MAS
	Dr Medini Maher	National Gene Bank, Tunisia	Tunisia	Molecular characterization	Molecular characterization

	Dr Mariem Bouhadida	INRAT	Tunisia	Plant breeding	Wheat molecular breeding
	Prof Dr Benbelkacem Abdelkader	INRAA and Adjunct Prof at Univ Constanstine	Algeria	Plant breeding and genetic resources specialist	Phenotyping, Breeding,
	Mrs Chafika Djenadi	INRAA	Algeria	In vitro culture, Genomics	Doubled haploid production and MAS, genetic characterization
	Prof. Aïssa Abdelguerfi	INA, Algeris	Algeria	Plant breeding & biotechnology	Co-supervision and training of students
	Prof Mariam Laouar	INA, Algeria	Algeria	Plant breeding & biotechnology	Training and capacity building

*Additional expertise as and when needed available from the ICARDA's North Africa Platform, Rabat, Morocco.

3.4. Sustainability

The National Gene Bank/INRA-Morocco and National Gene Bank of Tunisia (BNG) have a strong commitment for PGR conservation and sustainable utilization. They have allocated substantial resources for their function, PGR activities and created facilities for molecular genomic characterization and biotechnology. INRA-Morocco and ICARDA jointly developed a Biotechnology Plateform in Morocco, which is available for training and research of NARS from the region. NARS researchers from developing countries are undergoing training in this platform. BNG has an ongoing collaboration with ICARDA on PGR conservation and would like to expand further on genomics through this project. INRA-Algeria has already established an Experimental Station for Biotechnology with the inputs from ICARDA and constructing a new gene bank in Algeris. The current project will help in adaptation of new tools of genomics (NGS, GBS and SNP technologies) in these countries. All the other partner institutions from the three countries have long term partnership agreement with ICARDA and committed for long term research partnerships including on PGR conservation and utilization, plant breeding and biotechnology. Therefore, these institutions continue invest for R4D in the above areas, in sustainable mannes as a part of their research agenda, even after completion of this project.

SECTION D: APPENDIXES

APPENDIX 1: INFORMATION ON THE APPLICANT

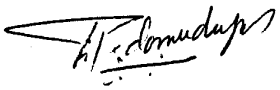
APPENDIX 2: LOGICAL FRAMEWORK

APPENDIX 3: WORK PLAN (Gantt Chart)

APPENDIX 4: BUDGET

APPENDIX 5: DISBURSEMENT INFORMATION

By signing this submission form for full proposal, the applicant confirms that all the above statements, including the attached Appendixes, are true to the best of his/her knowledge. Any deliberately untruthful response will lead to the automatic exclusion from the further screening and appraisal process, and may lead to the denial of awarded grants from the Benefit-sharing Fund.



Signature of contact person: **Date and location: 5-Dec-2015; Rabat, Morocco**