PROJECT PROPOSAL COVER SHEET

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

Project Title: Improving food security by enhancing wheat production and its resilience to climate change through maintaining the diversity of currently grown landraces

Project duration: 48 months

Target crops: Wheat

Targeted developing countries: Turkey, Islamic Republic of Iran, Islamic Republic of Afghanistan

Other Contracting Party involved Japan

Project geographic extension (km²) 216,607 (total area of 8 target provinces)

Total requested funding $785,400

Total co-funding $100,000

Please select the type of project you are applying for:

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

Applicant

Name of Organization: International Maize and Wheat Improvement Center (CIMMYT)

Type of organization: International, non-government, non-profit research center

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SECTION A: EXECUTIVE SUMMARY

1. Executive summary

Effect of climate change on wheat production in Afghanistan, Iran and Turkey is expressed through higher temperature and drought resulting in lower and unstable yields especially in remote mountainous farming communities. These subsistence farmers still cultivate wheat landraces which, being adapted to local conditions, have great potential for improvement. Most of the landraces have been collected recently and their evaluation started at research institutes. Majority of them are mixtures of different species and genotypes which can be separated and selected for better adaptation to abiotic stresses caused by climate change (drought and heat). Collecting the landraces from the famers, improving them with farmers' participation, multiplying and distributing the seed back to farmers along with the training on landraces and seed maintenance and agronomy is the main paradigm of this project. It will enhance the food security in selected provinces of Afghanistan, Iran and Turkey by enhancing wheat production and its resilience to climate change through maintaining the diversity of currently grown landraces. In addition, the project will preserve genetic diversity and will make it available through Multilateral System. In the first two year the best lines comprising the landraces will be identified under drought and heat in on-station and on-farm trials using modern genomic and phenotyping tools. In the 3rd and 4th year the improved landraces composed on selected lines (while preserving their original structure) will be progressively multiplied, distributed and promoted to the growing number of farmers. Training will take place with the farming communities on how to maintain the landrace, produce improved seed and apply better agronomy. As a result, resource poor farmers (estimated 3000) will improve their wheat yields, food security and income. New improved landraces more tolerant to drought and heat will assist in mitigation of the climate change adverse effects. The project will involve all the stakeholders: farmers, researchers, extension agencies, NGOs and policy-makers in promotion of the project results with the ultimate objective of establishing the sustainable gender sensitive community conservation systems. The project will target 8 provinces in 3 countries which were selected based on development and poverty indicators, diversity of wheat landraces and possibility of high impact. The improved landraces identified through the project will be deposited with the national gene banks for access through Multilateral System. Key drought and heat tolerant landraces will be selected for incorporation of disease resistance through crosses and F2 as well as BC1F1 seed will be distributed to the breeding programs. The project Consortium includes key institute: Bahri Dagdas Int. Agric. Res. Inst. (Turkey), Dryland Agri. Res. Inst. (Iran), Agric. Res. Inst. (Afghanistan) and Kihara Inst. of Biological Res. (Japan) led by CIMMYT-Turkey. Researchers involved in the project will benefit from application of advanced technologies (genomic, physiological and phenotyping tools) in their programs, training and access to germplasm. Important participants and beneficiaries of the project are members of extension agencies, local administration, NGOs and policy makers. The total number of direct and indirect beneficiaries in three countries will exceed 10,000.

SECTION B: PROJECT DESCRIPTION AND CONTENTS

2.1. Problem definition

Turkey, Afghanistan, and Iran have among the highest per capita wheat consumption in the world with 40 - 50% of daily calories originating from wheat products. Analysis of meteorological parameters and wheat yield since 1961 demonstrated that drought and increased temperature in spring at pre-heading stage and heat during grain filling affected the production (Morgounov et al. 2013). The forecast for the future imply even higher temperature increase and rainfall variation. Wheat grain yield stability is the trait most affected by climate change and affects the food security of rural communities. Remote mountainous and dryland subsistence farming communities are most disadvantaged in terms of exposure to extreme weather events and subjected to food insecurity. These communities still rely on local wheat landraces, despite having access to modern varieties. Farmers grow landraces because their unique adaptations and heterogeneous nature provide stable yields with excellent quality for home products. The recent socio-economic survey in Turkey comprising more than 1400 farmers showed that socio-economic index of the farming communities growing the landraces is at least 20-30% lower compared to average province development figures (Kan et al, 2014; http://arastirma.tarim.gov.tr/bahridagdas/Belgeler/Turkey-Wheat-Landrace-Report-2014.pdf?Web=1). Similar situations exist in Iran and Afghanistan. The Afghan national seed production system has never been able to produce more than 10% of national wheat seed requirement. The farmers in far flung rainfed areas often lack access to improved seed and predominantly cultivate land races (http://aciar.gov.au/files/ias85-afghanistan-web-final.pdf). In Iran, more than 50% of the rainfed winter wheat area, in particular in North West Iran, is sown to landraces or their selections (Braun, pers. comm).

Farmers' inability to maintain and improve the landraces as well as to maintain the seed supply results in their erosion and loss at an alarming rate (Karagoz, 2014). Currently grown wheat landraces in highlands of Afghanistan, Iran and Turkey, as compared to ex-situ collections, are unique in that their adaptations have developed through exposure to the recent changes in climate. These winter, facultative and spring wheat landraces normally represent evolutionary balance of the mixtures of different genotypes comprising the landrace. Modern research and breeding tools will be used to improve currently grown landraces through evaluation of individual components of the landrace and selection of the best lines still representing the diversity of the original landrace. These improved landraces will be co-developed with the farmers through participatory evaluation, selection and delivered to wider communities through enhanced seed production and promotion.

The target project areas have been identified using four main criteria: a) level of livelihood with the focus on disadvantaged and poor communities; b) availability and diversity of wheat landraces currently grown by farmers; c) accessibility and security for project participants; d) possibility for scaling out and scaling up the project outcomes. The choice of provinces: Turkey - Konya (Central Anatolia region); Malatya (East Anatolia); Mardin (South East Anatolia) Tokat (Black Sea region); Iran - East Azerbaijan and Kermansah; Afghanistan - Balkh and Herat (Fig.1).

Fig.1. Map of the project target provinces.

The project will be implemented within the framework of Turkey-CIMMYT-ICARDA International Winter Wheat Improvement Program (IWWIP: www.iwwip.org). The project will be led and coordinated by CIMMYT-Turkey and will include key partner institutions with relevant experience in Turkey (Bahri Dagdas International Agricultural Research Institute – BDIARI http://arastirma.tarim.gov.tr/bahridagdas/Sayfalar/AnaSayfa.aspx , ICARDA-Turkey), Iran (Dryland Agricultural Research Institute-DARI and CIMMYT-Iran) and Afghanistan (Agricultural Research Institute of Afghanistan - ARIA and CIMMYT-Afghanistan). Japan Kihara Institute of Biological Research of Yokohama City University (KIBR: http://www.yokohama-cu.ac.jp/eng/research/kihara.html) will be a project partner for the research component of the project. The project will involve all the stakeholders: farming communities in the target regions; extension agents and relevant NGOs. So far IWWIP leads Turkey's national activities on landraces inventory and evaluation. There is a project by Cukurova University to evaluate Turkish landraces and establish a core set and its outcome will be utilized by the current project. SATREPS project in Afghanistan implemented by KIBR (http://pgsource.sci.yokohama-cu.ac.jp/index_en.html) aims to develop wheat breeding material and capacity for sustainable food production and the young Afghan scientists trained in Japan will participate in the project.

All the project countries have almost completed the collections of currently cultivated wheat landraces in the target regions and started their evaluation. In the first year the project will conduct genomic diversity study and on-station evaluation of relevant landraces in order to identify the best landraces and their components for further study and on-farm evaluation. In the second year, both on-station and on-farm trials will take place to identify the drought and heat tolerant landraces for seed production with the farmers and for crosses to incorporate disease resistance. In the third and fourth year the new improved landraces will be multiplied and progressively distributed to target communities for testing and adoption. For disease resistance a small crossing program will develop segregating populations to be used by breeders and farmers for selection of new improved landraces. Project implementation will enable the farming communities to increase wheat yield and its stability, thereby improving food security and resilience to climate change that will be reflected in higher income and better livelihood. Wheat biodiversity will be preserved, wheat landraces will be well characterized, seed and data will be made available to the global community though national gene banks. New drought and heat tolerant germplasm with resistance to yellow rust and common bunt will be developed and made available to the breeding programs. All three countries have adopted strategies on conservation and utilization of PGRFA, which provides the relevant policy framework for project implementation.

2.2. Project objectives: Overall and specific objectives

Overall objective: Improving food security in selected provinces of Afghanistan, Iran and Turkey by enhancing wheat production and its resilience to climate change through maintaining the diversity of currently grown landraces and their improvement.

1. Participatory selection of drought and heat tolerant wheat landraces among the set of the germplasm recently collected from the farming communities in the target countries using modern phenotyping and genotyping tools in collaboration with farming communities, research institutions, NGOs and extension services.
2. Development of germplasm combining drought and heat tolerance with disease resistance (primarily yellow rust and common as well as leaf and stem rust) through crosses, marker assisted selection and backcrossing to the landraces.
3. Promotion of selected drought and heat tolerant landraces in the targeted regions through enhanced on-farm seed production and bulk selection, improved agronomic practices and large scale awareness campaign.
4. Training of farmers, extension services and local administration, policy-makers, NGOs and researchers on sustainable cultivation of wheat landraces and role of biodiversity in mitigation of adverse effects of climate change.

2.3. Targeted outputs, activities and related methodology of implementation

Outputs for Objective 1: **Drought and heat tolerant wheat landraces selected using on-station and on-farm trials and participatory approach.**

1.1. At least 35 currently grown wheat landraces documented, evaluated and characterized through on-station participatory trials for agronomic traits including drought and heat, diseases as well as genomic diversity (Turkey – 20; Iran – 10; Afghanistan – 5).

Activities and methodology: General landrace movement in the project is given in Fig. 2 below. Yield trials on small plots will be conducted in the first year in each country by the partner institutions at the station sites suffering from moisture stress and high temperature. The target output is 35 landraces but since most of them are mixtures with 2-4 different components and several lines from each component will be tested separately - the total number of lines tested in the first year will exceed 150. Modern physiological tools will be used for evaluation, e.g. NDVI and canopy temperature, grain yield under drought and the kernel weight under heat will be key agronomic traits for selection. Additional testing for diseases will be done under artificial inoculation in the diseases hot spots. Farmers representing the target communities will be invited to the stations for joint evaluations. The performance of individual lines from the landraces will be compared to each other, to the initial bulk and to the local checks. DNA based diversity study (Genotyping by Sequencing and/or genome wide neutral markers) of all landraces will be done by KIBR (Japan) and will assist in removing the duplications as well as defining the diversity groups for further selections. The database generated through this activity will be made publicly available through the project web site and respective national gene banks.

1.2. At least 30 wheat landraces superior for drought and heat tolerance and possibly diseases selected for seed production and promotion with the farmers, characterized and deposited to the national gene banks.

Activities and methodology: Based on the first year results, selection of the best landraces will be made for the second year which will expand to on-farm testing/evaluation in the target provinces. It is expected that majority of the landraces will be selected for the second year (total of at least 100 lines considering different components of the landraces) and the trials will have

bigger plot size as well as increased replications. The same stations will be involved in trials and at least one on-farm trial will be conducted in each of the targeted provinces (Turkey – 4; Iran – 2; Afghanistan – 2). However, not all landraces will be tested in all on-farm trials but only the ones collected from those regions or similar to them in their agronomic and genomic nature. Researchers and farmers (with their wives) will play active role in evaluations and selections along with the extension agents and NGO representatives. After harvest, grain quality will be evaluated to assure it meets the farmer's criteria. Taking into consideration two years of data, landraces with drought tolerance (at least 10% higher yield under moisture stress compared to checks or population average) and heat tolerance (less than 5% reduction in 1000 kernel weight under heat stress compared to checks or population average) with disease resistance (if available) will be selected for seed production and promotion with the farmers. Agreed set of landraces will be exchanged between the three countries and deposited to the national gene banks for access through Multilateral System.

1.3. At least 20 useful alleles for drought and heat tolerance, disease resistance and grain quality identified in selected bread wheat landraces.

Activities and methodology: The data collected on wheat landraces in on-station replicated trials in the second year will be used for association mapping and/or genomic selection analysis of important traits related to climate change adaptation: growing period, plant height, disease resistance, yield under moisture stress and high temperature. Genotyping work would be done already by KIBR (Japan) in activity 1.1. Merging the phenotypic and genomic data will allow identification of useful alleles for resistance to abiotic and biotic stresses. This information will be made available through publications and the landraces seed will be made available from the national genes banks for utilization of these genes.

1.4. "Passport" and associated genomic and phenotypic information on wheat landraces used in the project systematized and disseminated to research communities.

Activities and methodology: The leading partner institutions in each country will consolidate all the relevant information from the field, laboratory and genomic studies into the uniform database which will be made available through the project WEB site, national gene banks and DivSEEk portal of International Treaty PGRFA when it is available.

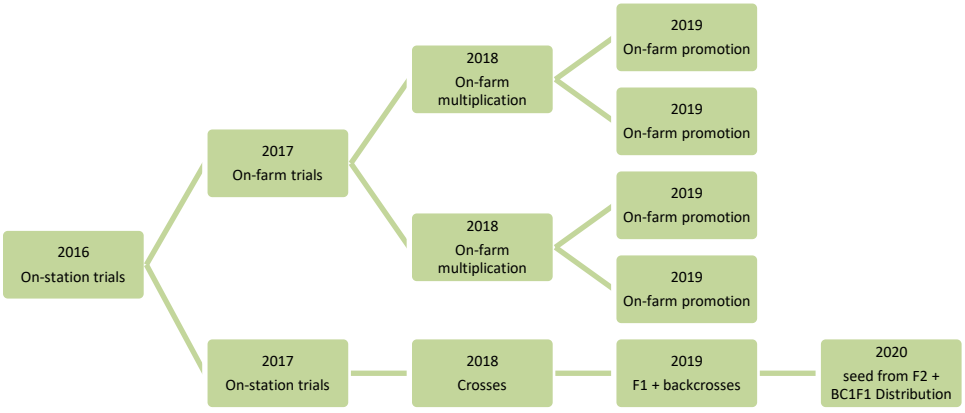

Fig. 2. Landraces movement in the project.

Outputs for Objective 2: Wheat germplasm combining drought and heat tolerance with disease resistance developed through crosses and selection.

2.1. At least 30 useful segregating populations with resistance to drought, heat and diseases developed and distributed to the breeding programs in the region.

Activities and methodology: Based on the recent results it is unlikely that the landraces used in the project will have sufficient degree and diversity of disease resistance (Morgounov et al. 2014). To incorporate disease resistance from other landraces or from modern varieties, segregating populations will be produced which can be utilized by the breeding programs and possibly provided to farmers for evolutionary selection. Once the best landraces are identified in activity 1.2, selection will be made to identify recurrent landrace parents for improvement of disease resistance. At least 10 parents will be selected from different countries and in year 3 of the project they will be crossed to known sources of a) resistance to yellow rust targeting adult plant resistance (APR) genes like *Lr34/Yr18* as well as other APR and major genes; b) resistance to common bunt targeting gene *Bt10* or others. The F1 generations originating from these crosses will be grown in the 4th year of the project and will be backcrossed to the landraces. BC1F1 will be grown after the project completion and the seeds of BC1F2 will be distributed to the interested breeding programs in three countries for marker assisted or classical selection of drought and heat tolerant, yellow and common bunt resistant progenies. Marker assisted selection will be applied on a pilot scale in each of the countries as a breeding and training exercise. Interested farmers from the project target areas will also obtain the seeds of these populations for on-farm participatory selection. This output will lay down the foundation for longer term impact through better varieties combining resistance to abiotic and biotic stresses.

2.2. At least 3 modern technologies for characterization and improvement of PGRFA introduced and disseminated in the region.

Activities and methodology: The project will introduce and promote three modern technologies which are not yet widely used for wheat improvement. A) Use of genomic methods for diversity analysis and selection of landraces. KIBR group will implement this component through practical work and training. B) Utilization of physiological tools in selection for drought and heat tolerance. Remote sensing (NDVI), infra-red temperature meters, root scanning, leaf senescence, rate of biomass increase and rate of grain fill, stem carbohydrates content and other traits will be used for drought and heat response characterization. C) Disease resistance transfer through backcrosses and marker assisted selection with the assistance of KIBR.

Outputs for Objective 3: Improved drought and heat tolerant landraces adopted by resource poor farmers in the targeted project regions.

3.1. At least 30 wheat landraces are subjected to seed production and promotion activities in the target regions and delivered to farming communities.

Activities and methodology: Already in the second year of the project the farmers will participate in the selection and improvement of their landraces at a few selected farms and communities (at least one in each target province). In the third year the project will expand testing and multiplication to different farmers within the same village and to different villages within the target province depending on the seed availability. In the 3rd year in each province at least 2-3 different landraces will be tested in 2-3 villages by 1-2 farmers. The farmers from the neighboring villages will be invited for participatory evaluation of the landraces as well as for training how to make selection within the landraces, how to maintain the seed and how to improve the agronomy so that the yield, its stability and climate resilience improves. In the 4th and final year of the project the seeds of selected landraces will reach at least 5 farming communities in each of the target provinces and will be planted for seed production and further distribution in these villages and beyond. Local landraces collected from the provinces will be improved through selection and high quality seeds will be produced. These two improvements coupled with better agronomy will raise the yield by at least 10-20% relative to checks while also

enhancing yield stability. This activity will be led the partner research institutions in each country in close collaboration with the provincial extension services, local administration and, most importantly, with the farmers and communities as ultimate beneficiaries of the project.

3.2. At least 3,000 subsistence farmers (10% women) will adopt improved wheat landraces and technologies of their maintenance as well as agronomy practices and will benefit through better adaptation to drought and heat.

Activities and methodology: The distribution of the seed to the increasing number of farmers and communities from year to year will be accompanied by a large scale training, field days and promotion activities to spread the knowledge about the importance of maintaining genetic, crop and varietal diversity on the farmers' fields. Using field days, training seminars, informal discussions, publications, media and social media Farmers in the project targeted communities will receive training in the following areas: A) Improved seed production: allocation of parts' of the field for seed production and taking special measure to maintain and harvest clean seed from this field section; B) Landrace maintenance techniques: mass selection of spikes and conscious maintenance of different landrace components if needed; C) Improved agronomy practices: timely operations; weeds, pests and disease control; seeding rates and soil preparation; elements of conservation agriculture; fallow management and others. The concept of combating abiotic stresses associated with the climate change by maintaining and enhancing the genetic diversity of improved wheat landraces is very attractive and, if accompanied by distribution of the seed and training, has very good chance of spreading fast to areas well beyond the immediate project target.

Outputs for Objective 4. Farmers, extension services and local administration, policy-makers, NGOs and researchers trained on sustainable cultivation of wheat landraces and biodiversity maintenance

4.1. Community conservation systems recognizing gender roles developed in all target countries and provinces, ensuring long-term cultivation of wheat landraces and enhanced food security.

Activities and methodology: The overall project activities starting from on-station selection of the landraces and continuing to on-farm testing and participatory selection followed by seed production of improved landraces and their promotion in increasing number of villages will result in farming communities' realization of the importance of biodiversity for their livelihoods. Community level informal conservation systems will be established in the target project areas and it is likely that other regions will follow. There is no fixed recipe how to make a community system though there are several important principles: the system should be need driven and deliver benefits to the communities; it should comprise all the diversity including wild nature; it shall take into consideration gender issues as well as the values of rural Muslim society; it shall be based on the established structure of the communities where senior villagers play important role. The project partners will work with the farming communities to develop a framework and action plan for establishing such system and then work together with the communities to realize it. The project will conduct workshops (at least 32), lectures (at least 100), field activities and field days (at least 300), conferences (at least 3).

4.2. Sustainable linkages developed between the farmers, researchers, extension services, NGO and policy makers; the national and international institutions.

Activities and methodology: from its inception the project will involve all the stakeholders interested in conservation and utilization of genetic diversity starting from resource-poor farmers to researchers in the target countries and beyond; from local administration and village seniors to policy makers including the relevant ministries and law-makers. The

cooperative work during the project and communication will result in establishment of long-lasting and beneficial linkages on a local and provincial level as well as on national, regional and international levels. The practice shows that formal involvement in the project results in informal linkages and friendship based on sharing the same values. These informal linkages are very important as they are life-long. This project is unique in a sense that no other region in the world grows such a diversity of wheat landraces and this is for the first time landrace improvement efforts will be implemented on a large scale. Therefore, high project visibility will attract attention of international wheat breeding and research community and important international linkages will be established. All project partners and beneficiaries will contribute to this output.

2.4. Targeted PGRFA

The project will use currently grown wheat landraces in Afghanistan, Iran and Turkey according to Table 1. There are both bread wheat dominating and Durum wheat dominating landraces (http://arastirma.tarim.gov.tr/bahridagdas/Belgeler/MUSTAFA%20KAN.pdf?Web=1). The project will work with both wheat species since they are both important for beneficiaries. The majority of these landraces have been collected already in the last 3-5 years but the revision will be made and if necessary additional collection will be made in 2015 for planting and evaluation in the fall of 2016. Though the landraces are well adapted to local conditions, there is a potential for landrace improvement by selection of the lines comprising the landrace for adaptation to drought and heat. The data from Turkey (unpublished) shows that some phenotypically identical lines from the same landrace can vary in yield under drought and heat by 10-20%.

Table 1. The target provinces and wheat landraces which will be included in the project.

Country	Provinces	Currently grown landraces
Afghanistan	Balkh	Mawrey, Chapa Pero, Sorkh Sarak,Watani,Speedcha,Yak ber Sad, Chambali, Seya Borat, Qara Ghorch, Qezel Sal, Surkh Cha, Sakhi Boz, Shuter Dandan
	Herat	Safedak kala, Safedak dasa, Omid dasa, Omid badon, Omid basa, Sorkin khosha
Iran	E. Azerbaijan	Sardari, Germezghen, Sariboghda, Gerdish (DW*)
	Kermansah	Sardari, Parisht, Shisheh, Zardak
Turkey	Konya	Karakilcik (DW), Sari Bugday (DW), Koca Bugday (DW), Bugday (DW), Akyarnaz (DW), Goderedi, Kilcikli Bigday, Akbugday
	Malatya	Kirmizi Bigday (DW), Sari Bursa (DW), Siverek (DW), Cakmak (DW), Kunduru (DW), Asurelik Bugday, Akbugday, Polatli, Zerun Cupruz, Sari Bursa, Ohlemaz, Kirmiz Kunduru
	Mardin	Bagacak (DW), Haciali (DW), Havrani (DW), Hinta (DW), Karakilcik (DW), Kirmizi Bigday (DW), Sorgul, Sergun, Sorik, Zinebe, Tilki Kuyrugu, Beyaz Bugday
	Tokat	Sofu Bugday (DW), Uveyk Bugday (DW), Akdimenit, Aksunteri, Kirmizi basak, Cam Bugday, Zerun, Calibasan, Ormece

* - Durum Wheat

Applying the methodology described in activities 1.1 and 1.2 the output of the project will be landraces improved for drought and heat and possibly for disease resistance while maintaining its integrity in terms of composition and end use. These will be delivered to the farmers. The best landrace components maintained as pure lines with enhanced resistance to drought and heat stress combined with other useful agronomic traits will be deposited in national Gene Banks along with the "passport" information to be accessed through Multilateral System. In addition, segregating populations originating from the crosses between drought and heat tolerant landraces and the sources of disease resistance to yellow rust and common bunt will be delivered to the

breeding programs. Original research papers will be published in refereed journals and will contribute to the wide spread dissemination of results. The technologies developed and utilized through the project will be promoted through the national and regional training course as well as through refereed publications.

2.5. Target groups and beneficiaries

Wheat landraces are normally grown in remote mountain rainfed areas with limited access to general rural services and lower than average income. In Turkey the socio-economic development index (based on 58 variable from social and economic spheres - https://ideas.repec.org/p/wiw/wiwrsa/ersa06p858.html) of the target provinces is close to zero or negative: Konya: 0.5308; Malatya: -0.0785; Mardin: -1.3591; Tokat: -0.3821 (SEGE, 2011). In the North-West of Iran, including East Azerbaijan and Kermansah, human development index is lower than the country average (Kiadaliri et al. 2014). In Afghanistan while Balkh province is almost self-sufficient in wheat grain, Herat province deficiency is up to 50,000 t per year (Anonymous, 2014). Therefore, the immediate beneficiaries of the project are poor and vulnerable farming communities. The total number of direct beneficiaries is estimated in the following manner: in the 4th year of the project the seed of improved wheat landraces will reach at least 5 villages in each of 8 target provinces in 3 countries. Considering that there are on average 50 family farmers in each village – the total number of direct beneficiary farmers in the target villages will be 2,000. There will be 1000 more farmers from other villages who will be invited to the field days and have access to information, technologies and the seed. So the total number of direct beneficiaries will be 3,000. Women play key role in the small subsistence farming communities though the frequency of women as head of farms is low in the region. It is estimated that at least 10% of beneficiaries will be rural women. If farmers' wives are considered as direct beneficiaries – the number increases to 6,000 with 50% women. The indirect beneficiaries are all the farming communities cultivating wheat landraces in the target and neighboring provinces - estimated 10,000 farmers. Direct beneficiaries will be involved in the project from from the first year of on-station to participatory selections in the second year during on-farm trials as well as heavily involved in the 3rd and 4th years for seed production, field days and training.

The wheat breeding and research communities in the key partner institutions will benefit from preservation of unique landraces and identification of the best lines with stress tolerance through their use in breeding as sources of important traits. They will also benefit from application of new technologies and utilization of segregating populations developed by the project. These direct beneficiaries will be researchers from BDIARI (15 individuals) and National Gene Bank (10) in Turkey, DARI (15) and National Gene Bank (10) in Iran and ARIA (15) and Gene Bank (5) in Afghanistan. The total estimate of these direct beneficiaries will be at least 70 scientists across all institutions. The researchers in other national institutes will benefit from the new technologies, training courses, access to the landraces and segregating populations. These will be indirect beneficiaries. There are 12 institutes involved in wheat research in Turkey; 5 in Iran and 5 in Afghanistan. The total number of researchers who will indirectly benefit from the project will exceed 250. The share of women in these researchers is at least 30%.

The extension agents and local administration in the target provinces will benefit through enhanced knowledge and cooperation with the researchers on one hand and the farmers on the other hand. They will be able to better assists farmers and will acquire technical knowledge for more conscious decisions for the benefit of diversity and the livelihood of farming communities.

The estimated number of extension agents and local administration benefitting from the project is 80 (10 per target province) and indirect – at least 160 from neighboring provinces (20% women). From the very beginning the extension agents and local administration will participate in most project activities with special emphasis on Outputs 3 and 4. The role of NGO in the rural areas of the target countries is unfortunately still weak or hardly existent but the ones present and actively working (like TEMA in Turkey) will be invited for active participation in all stages of the project and estimated number of direct beneficiaries is 20 while indirect – 50 (40% women). The final group of beneficiaries is policy makers including province level officials, Ministries of Agriculture staff and parliament members. They will be consulted from the initiation of the project and will be regularly invited to the project sites. The annual and final reports will be shared with them. The estimated number of policy makers who will directly benefit from the project is at least 40 and the indirect beneficiaries – 120 (20% women).

2.6. Impact and impact pathways

The project will establish a model for maintaining on-farm diversity of landraces handled by trained farmers in cooperation with researchers and extension services enhancing food security through better adaptation to climate change. This model can be adopted and applied to other regions, countries, and crops for the benefit of farming communities and poverty reduction. Since this project addresses remote, disadvantaged communities, it will contribute to poverty reduction and will demonstrate how, cooperatively, crop diversity can improve livelihoods. The project directly contributes to Millennium Developments Goals 1 (Eradicate extreme poverty) and 7 (Ensure environmental sustainability).

2.6.1. Food security and poverty alleviation

The project will deliver higher yielding wheat landraces and better seed to the farmers. Preliminary data shows that some landraces components out-yield the initial bulk mixture by 10-20%. The project will improve drought and heat tolerance of the landraces by selecting better components while maintaining the original composition. This will be coupled with the provision of improved seed of these landraces and enhancement of agronomy practices. The on-farm yield increase may be from 30 to 50%. It will allow reducing the wheat area and growing other crops like vegetables which have better nutritional value. It will allow taking part of the harvest to the market and increasing the income to buy better nutritious food, clothing for children and education opportunity. Women will benefit from access to house appliances and field mechanization equipment purchased using additional income. To achieve this impact, simple seed distribution is not enough and this project will emphasize training to ensure full impact of better wheat landraces, seed and agronomy. The impact pathways will also include wide publicity campaign (especially on local TV and newspapers). The research components of the project will contribute to the food security and poverty alleviation through incorporation of disease resistance. This will give a longer-term impact within 10-15 years when these improved landraces will reach and be adopted by the farming communities.

2.6.2. Adaptation to climate change and environmental sustainability

The ability of improved landraces to withstand moisture deficit and high temperature will contribute to yield stability, the trait most severely affected by climate change. Some of the improved landraces will possess resistance to diseases and will not require chemical protection, which is a huge benefit for the farming community and environment. Currently grown landraces represent valuable genetic diversity and their conservation is

important for future use to achieve food security and develop wheat lines resilient to climate adaptation as well. The farming communities which grow wheat landraces need to improve productivity while enhancing sustainability. The project will provide better options and through training will emphasize communal philosophy for improving the livelihood while maintaining the natural resource base, crop and nature diversity. This philosophy is very rewarding and there is a likelihood that it will be disseminated to a large number of farmers and villages. The important impact pathway here is close cooperation and communication with the farming communities and all stakeholders.

2.6.3. Scientific impact

This Window 2 project must first deliver improved wheat landraces to the farming communities and, secondly, make scientific impact through development and application of new improved germplasm and technologies. The following scientific findings related to PGRFA will be delivered: a) wheat lines selected from the landraces with improved drought and heat tolerance will be made available to the research community through the Multilateral System; b) segregating populations combining adaptation to drought and heat with disease resistance delivered to relevant breeding programs; c) genetic diversity analysis of wheat landraces from three countries will allow identification of similar landraces and will result in development of a core set; d) association mapping of the landraces will identify a number of new alleles controlling important agronomic traits; e) novel technologies will be applied in breeding and research; f) passport information for the germplasm will be made available. The uniqueness of this project is scientific work with the landraces still grown by the farming and the scientific impact will be very high. Global wheat research community will be interested in the outcome of this work and will utilize the relevant finding. The impact pathways here will also include presentations at the workshops and conferences of national, regional and international scope. The project will operate its own WEB site to increase the awareness.

2.6.4. Capacity development and empowerment

The research capacity of the scientists involved in the project will be improved through targeted training and utilization of new technologies. A number of training courses will be conducted addressing the key technologies and methods for each of the project partner institutions. The project does not plan to purchase expensive equipment since most of it is available. However, if limited improvement to equipment or machinery is needed, the project will assist. The development capacity of the scientists will be improved through continuous work with farmers, extension agents and training. They in their term will improve the capacity to collaborate with the research community, thus, creating a win-win situation. Very important capacity enhancement that will take place – improvement of farmers ability for sustainable maintenance of wheat landraces. This is the key for project success and also the key for scaling out and scaling up the project impact. Women will be empowered since the families higher income will provide them assistance tools for house and field work and will save the time for family life, children and education. In general, the national systems for PGRFA and on-farm bio-diversity conservation and utilization will develop better capacities. The spill-over effect here is possible to the countries of Central Asia which maintain close ethnical, cultural and economic linkages with the target countries. The impact pathways here will include training courses and joint work in the project implementation.

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

Afghanistan, Iran and Turkey are all parties to Convention on Biological Diversity and their respective documents including National Biodiversity Strategy Action Plan are placed at http://www.cbd.int/countries/profile . All three countries are contracting parties of International Treaty on PGRFA, thus, committing to the Multilateral System. The Near East and North Africa Strategy on Conservation and Sustainable Use of PGR has specific reference to *in-situ* conservation of landraces for the benefit of poor and climate change mitigation (Anonymous, 2011). In 2010 Afghanistan and Turkey published Country Reports on the State of PGRFA with very good description of the current status, legal and technical frameworks and priorities for the future (http://www.fao.org/agriculture/crops/core-themes/theme/seeds-pgr/sow/sow2/country-reports/en/). The final chapters of the reports make linkages between PGRFA and food security. All three target countries developed strategies for reaching the Millennium Developments Goals and have made good progress towards its implementation (http://www.undg.org/content/achieving_the_mdgs/monitoring_and_reporting/national_mdg_reports). Considering the above, this regional project will contribute to all the national action plans related to poverty alleviation, food security, biodiversity and PGRFA. The project will work very close with the International Treaty Focal Points in each country and relevant state agencies to assure that planning and implementation is well coordinated with other efforts in this area.

SECTION C: OPERATIONS

3.1. Methodology of project implementation

The overall implementation concept will be based on cooperative and collective decision making process, implementation teams, communication, involvement of all stakeholders, reporting and monitoring as reflected in the Fig. 3. The Steering Committee (SC) will be composed of Ministry of Agriculture nominated individuals from each of three countries, farmers and NGO representatives, CIMMYT and ICARDA, and an outside consultant. The responsibility of the SC will be to give directions and assure implementation according to the work plan, advice on technical and managerial issues and to connect to policy-makers at different levels. The SC will meet at least once a year preferably during the wheat season in rotating countries. The management team will be responsible for day to day operations (Table 2). The Country Team main responsibility is implementation of the project activities in a timely, efficient and coordinated manner. The Country Teams will be composed of the Country Project Coordinator from the lead partner research institutes, Country Lead Expert, a representative from International Center, Leader of On-Station Research Team and Leaders of Provincial Teams. On-Station Research Teams will be responsible for on-station trials in the first and second year of the project, phenotyping work and application of new technologies as well as crossing program. The provincial level teams will work with the farmers on all aspects of project implementation including on-farms trial, seed production, field days, and training and promotion campaigns. They will be composed of the researchers, extension agents, representatives from local administration and NGOs as well as progressive farmers cultivating the landraces. The provincial team will have a Leader with the responsibility for project implementation in a province. The provincial teams will work very close with the research teams as well as with each other to learn and share the experience. KIBR-Japan team is responsible for genotyping and application of genomic tools and will be communicating with the country research teams. This implementation methodology assures participation of all stakeholders in all processes from planning to implementation. Participation of the Country Coordinators in the Management Team and their

communication with the Provincial Teams assures that the decision making and implementation processes are well aligned. The project monitoring will be done by ICARDA-Turkey.

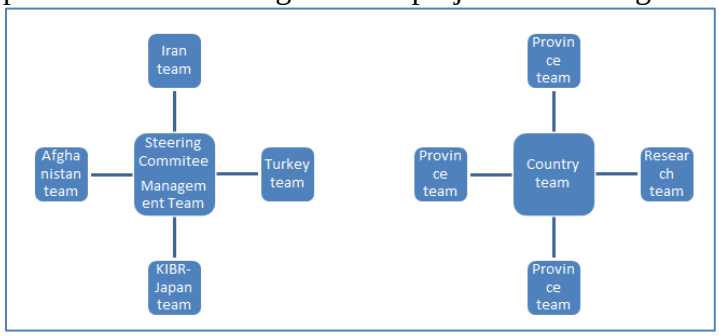

Figure 3. Organizational chart of project implementation methodology

3.2. Partnerships and collaboration arrangements

This Window 2 multi-country project will form a Consortium of several national and international institutions in Afghanistan, Iran, Japan and Turkey. The basis of the project is International Winter Wheat Improvement Program (Turkey-CIMMYT-ICARDA) with a long-term history of collaboration in all three participating countries (www.iwwip.org) and established operational framework in Turkey since 1986. It initiated and implemented national inventory of wheat landraces in Turkey in collaboration with FAO (http://www.fao.org/europe/sec/events-2013/wheat-landraces/en/). The project will be led by CIMMYT-Turkey (Dr. A. Morgunov), a non-government, non-profit international research organization established in Turkey in 1981. CIMMYT headquarters are based in Mexico with access to the state of the art technologies and facilities. CIMMYT HQ will provide technical and administrative backstopping to implementation of this project. CIMMYT offices in Afghanistan (Dr. Rajiv Sharma) and Iran (Dr. Jalal Kamali) will be partners of this project and they have technical knowledge to contribute to the project as well as proven record of implementation of the projects.

The lead partner from Afghanistan is Agricultural Research Institute of Afghanistan (ARIA) - the leading crop research institution in the country with the research staff of over 200. ARIA headquarters are located in Kabul and it has access to stations situated in 11 provinces. Machinery and equipment for experimental field work is available. A number of young research staff went through training at CIMMYT-Mexico or undertake degree study in India, Pakistan and Japan. ARIA staff is very familiar with wheat growing environments in the country and has been involved in collection and evaluation of the landraces. The Director of ARIA Mr. Mohammad Qasem Obaidi will serve as Country Coordinator for this project. ARIA will work in cooperation with CIMMYT-Afghanistan (Dr. R. Sharma).

The lead partner in Iran is Dryland Agricultural Research Institute (DARI) located in Maragheh, East Azerbaijan province. DARI was established in 1992 with prime responsibility to develop varieties and technologies for drylands areas of Iran. There are 57 researchers in DARI including 10 PhD. The institute has a network of 12 research stations in 7 provinces including Kermansah. Each station has the staff of 5-7 scientists and technical personnel. There is machinery and equipment available for conducting on-farm and on-station trials as well as equipment for laboratory evaluations. The cereals department has an excellent record of variety development, collection and characterization of landraces. Wheat landraces and especially variety Sardari play

important role in this part of Iran due specific adaptation and there is good potential for their improvement. DARI Director Dr. Abdolali Ghaffari will be Country Coordinator for the project and will work in cooperation with CIMMYT-Iran (Dr. Jalal Kamali) and other stakeholders. DARI will maintain very close working relations with Iran Gene Bank in Karaj and will deposit the landraces there as well as the relevant phenotypic information.

The lead partner in Turkey is Bahri Dagdas International Agricultural Research Institute (BDIARI) situated in Konya - very representative of wheat production environments of Central Anatolian Plateau. The institute was established in 1914 and currently involved in animal husbandry, agronomy and crop science/breeding research. The research staff of the institute working on crops is 43 including 12 PhD. The institute has 5 on-farm sites used for trials across the region. There is sufficient machinery and equipment for on-station and on-farm project activities and quality lab. The institute staff played a key role in landraces collection in 2009-2014. All 1400 wheat landraces collected in Turkey were planted and evaluated in Konya. The institute has been assigned a role of National Drought Center and has relevant facilities (greenhouse, rain shelter, drip irrigation based drought platform) for conducting the drought and heat experiments. The institute Director Dr. Fatih Özdemir will be Country Coordinator of the Project. He will work in close cooperation with the National Gene Bank in Ankara.

The co-leading partner in Turkey is ICARDA (Dr. Mesut Keser) with office in Ankara since 1980s. ICARDA-Turkey from the very beginning was involved in wheat landraces activities and will provide technical support to the lead partner. ICARDA strength is in dryland agriculture, genetic resources management and application of new technologies in breeding which is very complimentary. ICARDA-Turkey will take leadership for project monitoring.

KIBR-Japan is the center of excellence in wheat research with emphasis on genomic technologies, pre-breeding, characterization and utilization of genetic resources. In the last several years KIBR studied Afghan wheat landraces collected by Prof. Kihara in 1955 and use them to improve wheat for Afghanistan. These landraces have also been studied by CIMMYT-Turkey and the initial cooperation has been established. KIBR and SATREPS project supported young Afghan scientists visit to Turkey for training in 2013 and 2014. The lead program at KIBR is PGR Division headed by Prof. Tomohiro Ban. KIBR will take responsibility for project genomic work, application of molecular markers and training on advanced technologies.

3.3. Project management team

CIMMYT-Turkey will be an executing agency of the project. The lead partners described in chapter 3.2 will be contracted to carry out relevant activities and included in the management team (Table 2). Participation of the stakeholders in the project management will be assured through regular meetings of the Steering Committee as well as through regular formal and informal communication with the beneficiaries. All named members of the management team have PhD and extensive experience in research and development including direct work with farming communities and with wheat landraces. Prof. C. Qualset (UC Davis, USA), a world authority on PGRFA being involved in the regional landrace work for over 30 years, will serve as a project consultant. The previous record of collaboration between all the institutions is an important factor for the success of the team. Only one expert will be hired by the project full time and the rest of the team will be part-time associated with the project while maintaining their main occupation job. There is a balance of technical expertise in the management team with the

administrative, monitoring, reporting expertise. The key element is that the Country Coordinators will be individuals already well connected with the target communities while also having active research role in their institutions and linkages with CIMMYT and ICARDA.

Table 2. Composition and responsibilities of the project management team

Position	Name	Location	Institution	Responsibility
Leader	Alexey Morgunov	Turkey	CIMMYT	Overall project leadership and coordination
Co-Leader, Turkey Coordinator	Fatih Ozdemir	Turkey	BDIARI	Communication. Turkey technical implementation
Co-Leader	Mesut Keser	Turkey	ICARDA	Monitoring
Project Lead Expert*	TBI[1]	Turkey	TBI	Technical implementation, reporting
Financial Officer**	TBI	Turkey	CIMMYT	Financial disbursement and audit
Training Officer**	TBI	Turkey	TBI	Training, workshops, dissemination
Consultant	Calvin Qualset	USA	UC-Davis	Consultation on technical issues
Technology Coordinator	Tomohiro Ban	Japan	KIBR	Technology application and transfer
Afghanistan Coordinator	M. Qasem Obaidi	Afghanistan	ARIA	Afghanistan coordination
Afghanistan Int. Expert	Rajiv Sharma	Afghanistan	CIMMYT	Afghanistan consultation and monitoring
Afghanistan Lead Expert	TBI	Afghanistan	ARI	Afghanistan technical implementation
Iran Coordinator	Abdolali Ghaffari	Iran	DARI	Iran coordination
Iran Int. Expert	Jalal Kamali	Iran	CIMMYT	Iran consultation and monitoring
Iran Lead Expert	Mozaffar Roustaii	Iran	DARI	Iran technical implementation
Turkey Lead Expert	TBI	Turkey	BDIARI	Turkey technical implementation

* - Full time position paid by the project; ** - Part time position paid by the project

[1] – TBI – to be identified

3.4. Sustainability

The sustainability of the project and continuous benefit to the growing number of beneficiaries after the project completion is ensured through the following factors:

- Afghanistan, Iran and Turkey are committed to rural development, poverty reduction and combatting climate change. This project with great impact on farming communities is likely to be scaled out using the government's or other funds after the project completion.
- The capacity of agricultural research and extension system is variable in all three countries but sufficient for project implementation and will be strengthened during the project to assure that it continues operation in the future.
- The project undertakes several activities to assure its sustainability, like establishment of community based diversity systems; training and education to assure the farmers perception includes genetic diversity.
- The nature of the project outputs is long-term: enhanced germplasm, improved seed; useful traits and genes – once delivered to the beneficiaries will be used for long time.

Communication and concrete work with all the stakeholders through training, workshops, formal and informal meeting will be very important for project sustainability and will be emphasized.