



RESEARCH PROGRAM ON  
**Climate Change,  
Agriculture and  
Food Security**



**ICARDA**  
**2013 technical report**

## 1. Activity Reporting

### Activity 671-2013 (Milestone 1.1.3 2014 (1).)

**Title:** Community-based identification and evaluation of rangeland and forage species for tolerance to drought, cold and salinity, as potential sources of climate change adapted germplasm.

**Status: Partially complete.** - Identification, characterization and dissemination of key range and forage species well adapted to extreme stresses (drought, cold, salinity is in progress); - Screening for cold tolerant cactus species (*Opuntia ficus indica*) for West Asia in progress;- Ecological modeling to assess the vulnerability of native rangeland plant species to global climate change in the West Asia and North African regions is complete;- Developing decision support tools and protocols for monitoring rangeland vegetation cover using digital vegetation charting technique is in progress;- Assessing gender impacts from 'climate-smart' agriculture under climate change/variability for pastoral community in Jordan is complete.- Strengthening capacity building and social capital of all stakeholders through joint publications, training workshops, manuals, posters, fliers and booklets) is partially complete.

#### **Gender component:**

Women play an important role in food production, producing between 60 and 80 per cent of the food in most low-income countries. Agriculture interventions, considered 'climate smart', should therefore provide long-term benefits for women. In other words, when we look at the value and practicality of different approaches to climate smart agriculture, it is important to understand the gender aspects of their impact. In West Asia, women are becoming increasingly important within agriculture, including earning incomes as well as providing labor, but the extent to which women participate in, and benefit from, agricultural changes varies from place to place. The activity aims to strengthen the linkages between gender equality and nutrition- and climate-smart agricultural technologies by identifying specific factors that impact on quality of life and will put forth strategies for programme enhancement, community-building and policy change.

#### **Deliverables:**

- Design and develop an integrated data acquisition system for vegetation monitoring.

A new algorithms that separate living organisms from non-living organisms based on the red, green and blue spectral bands the visible spectrum. This technique has evolved over time from using film camera to using high resolution digital camera with built-in GPS capabilities to using smartphone more recently. The technique is referred to as Digital Vegetation Charting Technique (DVCT). Though the technique was developed for rangeland vegetation, it has proven to be of value to agronomic fields (monocropping) as well as other applications such as monitoring sunn pest. The technique developed offers a rapid assessment and monitoring tool for scientists, managers and extension specialists to take appropriate measurement as preparedness for challenges such as climate change (recurrent droughts). At the same time, when mapping the degree of land degradation (or stress on plant growth) the information gathered would be used to pay close attention to endangered species (conserving biodiversity). The generated data and maps provide key information provide to make sound recommendations for policy makers and farmers aimed to alleviate and/or stop land degradation and sustainable development of our natural resource base.

- Publish factsheets on potential key range and forage species for drought and salt affected soils. Several factsheets are complete and printed. Others are being edited and finalized before final printing and dissemination.

- Screen and identify cactus accessions for cold tolerance in WANA region.

1. Prepared two proceedings papers (see attached papers): Louhaichi, M., Alex G. Park, Ricardo Mata-Gonzalez, Yasser M. Mohawesh and D.E. Johnson. 2013. A Preliminary Model of *Opuntia ficus-indica* (L.) Mill. Suitability for Jordan. VIII International Congress on Cactus Pear and Cochineal. 28-31 October 2013 Palermo, ITALY

Louhaichi, M., Ali Nefzaoui, Serkan Ates and Sawsan Hassan. 2013. Screening for cold tolerant cactus species (*Opuntia ficus indica*) for West Asia. VIII International Congress on Cactus Pear and Cochineal. 28-31 October 2013, Palermo, ITALY

2. Prepared two and presented the following papers in Desert Technology conference in San Antonio Texas.

Nefzaoui, Ali., M. Louhaichi and Hichem Ben Salem. 2013. Cactus as a tool to mitigate drought and to combat desertification. Desert Technology 11th International Conference. 19-22 November 2013, San Antonio, TX, USA

Nefzaoui, Ali. Mohamed El Mourid and M. Louhaichi. 2013. Appropriate technologies for drought mitigation in North Africa. Desert Technology 11th International Conference. 19-22 November 2013, San Antonio, TX, USA.

- Enhance capacity of NARS partners in resource mapping and sustainable use of natural resource base.

On-going activity: In 2012, one group training took place at IRA Mednine, in Tunisia. In 2013, another training course was organized on Digital Vegetation Charting Technique in Amman, Jordan. This activity is on-going. In 2014, at least one training will be organized for several countries.

- A package of adaptation options that demonstrate how integrated crop-range-livestock production system in drylands will adapt to future climate variability.

Work is progressing but details will be included in the 2014 report.

**Partners:**

NCARE; OSU; INRA; UoJ

**Locations:**

Other, East Africa (EA)

**Activity 672-2013 (Milestone 1.1.3 2014 (1).)**

**Title:** The use of the Focused Identification of Germplasm Strategy (FIGS) to select best bets for adaptation to climate change.

**Status: Complete.** This year's research vis a vis the sub-setting to develop best bets for adaptation to climate change spans the continuum from development of new data sets related to climate change, development of CC related algorithms, development of CC subsets, their evaluation and validation. This was carried out while consolidating and expanding PGR climate change platform along with the of development of the phenotyping prototype to better capture CC related traits including root system architectural traits. As result of these and the synergies among CC platform partners several publications were published including 2 publications in ISI journals. Communications were also carried out in international conferences forums (Italy, Sweden, Canada, and Norway). Reference to PGR CC platform and CCAFS program is also made in a PR publication titled "A new

approach to mining agricultural gene banks – to speed the pace of research innovation for food security. ICARDA Research to Action no.3. 2013. Suggestions as well as recommendations were made to have the results of this research as evidence in CC applications for calls on "climate-smart agriculture". The 2013 cumulative research results will also be presented at the International Conference on "Genetic Resources for Food and Agriculture in a Changing Climate" in Norway (<http://climate.nordgen.org/>).

### **Gender component:**

The PGR CC platform to search for CC traits included gender perspective in carrying out the sub-setting research and the setting up of the research agenda. The platform includes women researchers from several countries partners in this new platform where their role is crucial to achieve and the platform objective: a) to develop further the approach and its allied applications,b) to generate climate change related PGR/Agro-biodiversity trait sets and develop new subsets for CC extremes (heat, cold and drought),c) to evaluate some of these subsets phenotypically and genotypically (along with the development of a prototype forThe PGR CC platform to search for CC traits included gender perspective in carrying out the sub-setting research and the setting up of the research agenda. The platform includes women researchers from several countries partners in this new platform where their role is crucial to achieve the platform objective: a) to develop further the approach and its allied applications,b) to generate climate change related PGR/Agro-biodiversity trait sets and develop new subsets for CC extremes (heat, cold and drought),c) to evaluate some of these subsets phenotypically and genotypically (along with the development of a prototype for phenotyping CC related traits),d) to develop an on line support system in conjunction with the development of the approach, e) to develop proposals for further consolidation of the platform.We also expect as 2014 onwards to join events emphasising the participation of women and especially young girls in the mathematics of plant earth events (<http://mpe2013.org/>) with whom we plan to include the modelling of extreme events in our modelling tools to search for CC related traits (Montreal press release of 2013-2014 at <http://mpe2013.org/>).See also the 2014 workplan. phenotyping CC related traits),d) to develop an on line support system in conjunction with the development of the approach, e) to develop proposals for further consolidation of the platform.We also expect as 2014 onwards to join events emphasising the participation of women and especially young girls in the mathematics of plant earth events (<http://mpe2013.org/>) with whom we plan to include the modelling of extreme events in our modelling tools to search for CC related traits (Montreal press release of 2013-2014 at <http://mpe2013.org/>).See also the 2014 workplan.

### **Deliverables:**

- At least 5 subsets of genetic resources with higher frequency of drought, heat tolerant germplasm (lentil, chickpea, grasspea, faba bean, wheat, barley), and resistance to insect pests and diseases generated for East Africa.

Contact have been made in 2013 in preparation to develop subsets for Sudan and Ethiopia. The subsets were developed for North Africa for both food legumes and cereals and they re currently grown for their evaluation and validation during the cropping season of 2013/2014.

- Germplasm with drought and heat tolerance and resistance to insect pests and diseases identified for East Africa Region.

Contact have been made in 2013 in preparation to develop subsets for Sudan and Ethiopia. The subsets were developed for North Africa for both food legumes and cereals and are currently grown for their evaluation and validation during the cropping season 2013/2014. The sub-setting will continue in 2014.

- Gap analysis and two joint collecting (germplasm) missions in West Asia.  
Collecting was carried out in the previous season (2012/2013).

**Partners:**

UQ; Concordia University; University of Helsinki; CAAS; IBC; ICAR; AGB; ANAS; AVRDC; INRA; BNG; ; CSIRO; CIMMYT; ICARDA; ARC; BI; ARCAD

**Locations:**

Latin America (LAM), East Africa (EA)

### **Activity 673-2013 (Milestone 1.2.1 2015 (3).)**

**Title:** Monitoring of population changes and adaptation of insect pests and diseases of cereals and legumes.

**Status: Partially complete.** Pest surveys were done in Morocco, Ethiopia and Uzbekistan on wheat, barley and food legumes. Major diseases: 1. Wheat: Rusts (yellow, stem and leaf rust): Yellow and leaf rusts were at epidemic proportion in the three countries due to extended rainfall and governments were obliged to do fungicide sprays to minimize the impact. Other diseases were Septoria, tan spot and powdery mildew. 2. Barley: The major diseases were leaf diseases, rusts and viruses. 3. Food legumes: The major diseases of faba bean were chocolate spot, rust root rot. In Ethiopia a new disease (faba bean gall) which was not reported before has devastated major faba bean growing areas. Chickpea and lentil were affected by ascochyta blight and wilt root rot. In Ethiopia due to unusual extended rainfall, chickpea fields were killed by rust which is only sporadic disease. Non-of the varieties were able to resistance since they were not screened for this disease. B. Major Insect pests: 1. Wheat: Wheat was affected by different species of aphids (all countries surveyed), Sunn pest Hessian fly and cereal leaf beetles in Uzbekistan and Morocco. 2. barley: It was affected by different species of Aphids and cereal leaf beetles. 3. food Legumes: Faba bean (Morocco and Ethiopia) was affected by aphids, Sitona beetles and Lixus where the latter two were minor but during this season, they were a major problem in Morocco. Chickpea was affected by pod borer in the three countries and leaf minor was key constraints in Morocco and Uzbekistan. key lentil pests in Ethiopia were green pea aphids and pod borers. Anticipatory breeding is being initiated for new and/or minor pests through germplasm screening.

**Gender component:**

Farming system and climate change affects pest impacts on economic crops; and this impact could be different between men and women farmers and across socio-economic status; this study, therefore, opportunity to include how the effect of crop disease on income and its control practices affect gender relations and the welfare of men and women. This should be strengthened in the 2014 plan.

**Deliverables:**

- Major changes in population structures of insect pests and diseases monitored in Central Asia, North and East Africa.

The three years data are being compiled and interpreted to be submitted to refereed journals and presentations in 11th Arab Congress of Plant Protection to be held in Amman, Jordan, November 9-13, 2014 .

- Survey data on pest status mapped and published.

The preliminary risk maps were developed based on these in-situ data and climate parameters for major

diseases and pests. The country level pests and diseases risk maps has been develop for Morocco, Uzbekistan and Ethiopia and a combined regional maps for entire CWANA. The remote sensing indices and time series profile will be integrated into the risk model. The MODIS time series data for year 2000-2013 has been collected and processed for vegetation indices. Integrated risk model will develop in 2014 by integrating the field data, climate and biophysical parameters. We also planned to downscale the climate data to produced fine resolution risk maps in combination with satellite data. Preliminary mapping results were presented in international conference. Biradar, C., Tulayamat, E., Saadia, L., Ziyaev, Z., Damte, T., 4, Mustapha, E.B., Safaa, Kumarse, N., Kemal, S. A., 2013. Mapping and monitoring cereal and food legume pest risk in the Central Asia, North Africa and East Africa under changing climate. In 7th International Pest Risk Mapping Workgroup (IPRMW-VIII), October 14-17, 2013. Raleigh, North Carolina, USA.

**Partners:**

EIAR; Uzbek Scientific Production Center for Agriculture; INRA

**Locations:**

Global

**Activity 674-2013 (Milestone 1.3.1 2014 (1).)**

**Title:** Develop socially and gender- differentiated knowledge of local seed systems and its effectiveness in climate change adaptation strategies.

**Status: Partially complete.** After the literature review and the diagnostic study last year, the team aimed at understand what empowerment means in the context of the community. The team experienced a methodological evolution of empowerment analysis, and in the process developed participatory tools that engaged the community and helped to develop an overall understanding of how to improve empowerment for vulnerable groups within the community. Initially, the team utilized the Women’s Empowerment in Agriculture Index to formulate questions that reflected indicators of empowerment. The focus group participants were asked to evaluate the extent to which each of the indicators listed were more (a score of 5) or less (a score of 1) empowering for women. While these indicators were prefaced with an open discussion of what ‘empowerment’ meant to the community, our indicators often redefined this organic definition into terms of financial indicators of empowerment. As a result, in the second community, we facilitated an interactive drawing activity by which participants identified three ideal typical categories of empowerment. In each category, the community developed a narrative with traits that contributed to that ideal type level of empowerment. For example, the community identified that women in the most empowered community often had at least completed primary school education and had a source of income. It was clear that men and women did not always identify the same characteristics of empowerment for men and women (this will be discussed later in the results section). Finally, we asked the community to identify which ideal type (highly empowered, moderately empowered, least empowered) most typified the women in this community. When two ideal types were empowered, we asked the participants to estimate the proportion of the people in their community resembled each ideal type. Overwhelmingly, women were identified as the least empowered ideal type was in the community. The aim of the study is to identify the most vulnerable households and household members (men and women) and then

device action to address the problem. The study will continue in 2014.

**Gender component:**

The study is gender specific study examining the role of socioeconomic and gender differences in determining vulnerability to climate change in the target communities in Morocco.

**Deliverables:**

- Gender and socially disaggregated analysis of access to climate information and its impacts on strategies and climate change impacts on men and women farmers in Morocco.

This work is progressing well. Detailed description is given in the progress of the activity. This deliverable will be completed in 2014 work plan.

- Recommendations on how to enhance equitable information access to rural women farmers.

In the 2013, there are emerging ideas and understanding for recommendations but these will be further investigated in 2014 before final recommendations are developed.

**Partners:**

INRA; UF

**Locations:**

Other

### **Activity 675-2013 (Milestone 2.1.3 2013 (1).)**

**Title:** Monitoring and modeling of the effects of extreme rainfall events and soil and water conservation practices on land, water and vegetation resources at field and watershed levels.

**Status: Incomplete.** The trend analyses were accomplished based on 32 years (report attached). The impact on runoff and sediment yield for the basin was produced. These results were communicated with researchers and stakeholders from Ministries and Universities from Jordan and Ethiopia during a dedicated workshop. The participants discussed ways to improve the rainfall intensity data in their routine work (presentation attached). The participants suggested sustainable land management (SLM) options to mitigate and adapt to the extreme events. The suggested SLM considered the time of the occurrence and severity of the extreme events during the year and how to protect the soil from extensive erosion. These were selected based on their efficiency as well as acceptance based on the experience of the national partners. The model was implemented to simulate the impact of these on reducing soil and water losses (presentation attached). The SLM were verified again based on the model results and fine-tuned to produce recommendations of successful SLM that reduce the impact of extreme rainfall events. The participation of national experts from different sectors will facilitate the integration of the model in the decision making process. Further dissemination of these results, the model capacity and the recommended SLM is needed to mainstream this in the decision making activities. The final report and potential publication is under preparation. The impact of rainfall intensity, land use, antecedent soil moisture and slope on soil erosion was published in a referee journal (attached). A scientific report in the form of working paper detailing the impact of community based soil and water conservation interventions on soil erosion, in response to rainfall events, was published (attached-CCAFS intranet). Two presentations and abstracts regarding the effectiveness of soil and water conservation interventions on soil erosion were delivered at the European

Geoscience Union were delivered (attached in CCAFS intranet)

### Gender component:

A focus group discussion and several meetings with local research institutes and NGOs were held and the options for implementing fuel saving stoves were identified as a strategy to reduce effects of climate change in the area. The project will distribute 1,000 stoves and will train the women who will make the stove using locally available materials and distribute it among households in the watershed. The project will identify indicators to measure the impact of these stoves on the livelihoods of rural households and on save the trees in the surrounding area that would have otherwise been cut and used as firewood. This will also reduce the time needed by women to collect fuel and will allow them to do more productive activities at household level. A Memorandum of Agreement was signed with ARARI to facilitate fund transfer and implementation. A workshop to explain gender related activities and the link with climate change will be organized for the national partners.

### Deliverables:

- Characterization of past, present and future frequency, intensity and distribution of extreme rainfall events. In addition to the attached files and the description of the activity progress, a Global Weather Data for SWAT was published at <http://globalweather.tamu.edu/>The site is open access and enable users to download hourly and daily weather data for 32 years. So far, there are 12,000 downloads from around the world.

### Partners:

Texas A&M University; NCARE

### Locations:

East Africa (EA),Other

## Activity 676-2013 (Milestone 2.1.1 2014.)

**Title:** Modeling (Biophysical and Economic) to assess impacts of climate and generate recommendations on adaptation options in central Asia and North Africa.

**Status: Partially complete.** 1. Biophysical modelling of crop production under future climate change scenarios: To date a large body of data and information has been collected and currently being used to calibrate biophysical crop models for the major crops in Central Asia (wheat, cotton, potato; Kazakhstan, Uzbekistan, Kyrgyzstan, Tajikistan) and Morocco (wheat, barley). In 2014 work on calibrations will continue. In collaboration with DMN (Meteoro Maroc) and INRA, validated models will be used in an existing GIS platform, CGMS-MOROCCO, to assess the impacts of CC on large-scale crop production systems relative to the current situation and the feasibility of future production. Strategies such as new crops or crop rotations, irrigation, and nutrient management will be identified as alternatives for sustainability and profitability and communicated with the relative stakeholders including the NARES, government ministries, farmers associations and policy advisors.2.

The impact of more open agricultural trade on small holder farmers' adaptation to climate change: We analyzed input and output price differentiations between the Central Asian countries (Kazakhstan, Uzbekistan, Kyrgyzstan and Tajikistan) due to trade barriers; and examined the impacts of easing those trade barriers on farm level welfare, under different climate change scenarios. We applied stochastic bio-economic farm model (BEMF) calibrated earlier for 10 representative farm types in four Central Asian countries (Uzbekistan,

Kazakhstan, Tajikistan, Kyrgyzstan). This analysis involved analysis of the farm level input-output prices and household consumption patterns using the data obtained from farm surveys conducted in previous years. The results show liberalization of trade may create favorable economic conditions for many regions in Central Asian countries and easing commodity exchange between the countries may improve the adaptive capacity of the small scale producers especially in Uzbekistan and Tajikistan under different climate change scenarios. This information can contribute to the dialogue and efforts promoting more cooperative regional trade policies that are essential for small farmer adaptation to climate change and also for overall economic growth.<sup>3</sup> **Review of Morocco's implementation of climate policies in the agriculture sector:** We conducted a review of Morocco climate change adaptation and mitigation policies and compiled information from wide range of stakeholders involved in climate-related research and development activities in the country. The aim of this review was to set the stage for ICARDA-CCAFS integrated climate research in Morocco with national and other international partners and will help to design informed research questions of the highest priority building on previous efforts. The review provides lessons learned from the past efforts and generates questions for further research and policy advice that promote adaptation and mitigation (where feasible) of climate change.<sup>4</sup> **The changes in Moroccan farming system due to climate change- a diagnostic study:** In connection with above point, we also conducted a diagnostic field study aiming at understanding the changes in the farming systems of selected Moroccan regions as a result of climate change and other external factors using participatory diagnostic methods, with focus on three regions (mixed cropping systems in Abda and Chaouia, and pastoral farming system in Chaouia) which are among the most affected. This study reveals the changes in the dry land farming systems of Morocco due to climate change and other factors. Farmers adopted different strategies depending on their resource endowments, the agro-ecological system and policies. However, there is clear gap of information on more formal analysis of the determinants of different adaptation measures and their benefits at the farm level in different farming systems. <sup>5</sup> **Index-based insurance product:** We analyzed the agro-ecological, economic and social benefits of – and the institutional challenges to – establishing index-based insurance markets to catalyze rural development in Syria. The study examined the potential of three index insurance schemes for minimizing risk: (1) a statistical index, (2) an index based on agro-meteorology and (3) a remote sensing-based index. It also discusses how index-based insurance markets contribute to rural development in scenarios of increasing climate risks. The study identifies that all three insurance schemes have a very high potential to cope with increasing climate risk. Insurance schemes designed according to these indexes performed very well in terms of covering revenue losses in most of the extreme drought years observed in the country. Farmers purchasing an insurance contract may have better access to credit and find it easier to invest in agricultural production and improve productivity. Because such alternative index-based insurance programs are low cost, they are more affordable for poor farmers and thus can potentially make an excellent contribution to economic growth in rural areas.

#### **Gender component:**

The activity in Morocco has a gender component which is an activity by itself but the two activities are integrated, although they will have separate reports.

#### **Deliverables:**

- Wheat production data, climate data used for crop modeling.

A large amount of data for crop modeling has been collected in the past three years. Currently this data is in Excel format and not very manageable. The data will be put into a database and be provided to CCAFS in the first

quarter of 2014

- Policy brief of the main messages of the CA study.

A policy brief based on the bio-economic modeling assessing climate change impacts in Central Asia and other studies carried out within this activity is developed ; that provides clear recommendations supporting for the Central Asian countries (document available in the intranet). These recommendations are mostly applicable to all Central Asian countries but more country specific recommendations are being also prepared. These policy briefs will be used as communication material in the planned Policy Workshop for Central Asia in 2014.

- Recommendations on policy support for climate-smart agricultural practices in Morocco, CA, and Tajikistan

The bio-economic modeling was extended to regional trade in Central Asia and finds that more open trade among countries in the region could be an important factor in supporting small farmers adaptation to climate change. In Morocco, we analyzed the past climate-related research & development efforts and agricultural policies of the Moroccan government which provide a good basis for analyzing what worked and what did not work for learning lessons, identifying gaps of information and designing further research questions. In Morocco, we also conducted diagnostic analysis of the changes in the farming systems of selected regions of Morocco, to form a basis for evaluating farmer adaptation strategies, the determinants of their adoption and their impacts; and derive policy advice form that.

- Parameters of CropSyst model for major wheat varieties grown in Morocco.

Three wheat varieties were calibrated in the CropSyst model. The calibrated models will be used as input to a GIS modeling platform in collaboration with DMN (Moroccan meteorological bureau) in ongoing activities in 2014.

**Partners:**

INRA; Uzbek Cotton Growing Research Institute; IAMO; KRIGBSPCC

**Locations:**

Other

**Activity 677-2013 (Milestone 2.1.1 2013.)**

**Title:** Developing and disseminating guidelines for drought risk management in the context of progressive climate change: Data processing and models calibration And alidation.

**Status: Incomplete.** In 2013, the collected data on rainfall was analyzed and the standardized precipitation index (SPI) was calculated for 20 weather station in Morocco and 8 stations in Jordan. The correlation between cereals yields and SPI was computed for the Moroccan stations. A draft of a scientfici report is in the process of preparation for the case of Morocco. Experiment trials on the interaction "supplemental irrigation x planting date x variety of wheat" and "supplemental irrigation x zero tillage x variety of wheat" have been conducted in MoroccoData on water use and yields were collected for these trialsOn-farm trials on the improved package of deficit supplemental irrigation was conducted in 7 farmsThe adoption study of this package was conducted.

**Gender component:**

**Deliverables:**

- Methodology and sets of secondary data needed for computing drought indices (SPI, Palmer, remote sensing)

1) Rainfall data collected for Morocco and Jordan and Standardized precipitation index (SPI) was calculated for 20 weather stations in Morocco and 08 stations in Jordan; 2) Correlation between SPI and cereal yields computed for selected regions in Morocco; 3) Preparation of a scientific report is in progress.

- Data needed to calibrate/validate Water allocation model and watershed management model (Surveys, field measurements, trials).

Data collection

- Analysis of the effects of supplemental irrigation and water harvesting on crops/plants.

1) Deficit supplemental irrigation package tested with farmers; 2) Data on yield and water use collected from trials conducted on the response of different combination of "supplemental irrigation x planting date x wheat variety" and of "supplemental irrigation x tillage method x wheat variety",

**Partners:**

NCARE; INRA

**Locations:**

Other

## 2. Succinct summary of activities and deliverables by Output level

### Output: 1.1.3

#### Summary:

ICARDA continued to develop and validate a procedure that can more efficiently identify germplasm sample sets that have the highest chance of retaining climate-related traits (drought and heat tolerance). The procedure exploits the natural genetic variation which displays patterns within boundaries set up by ecological and co-evolutionary processes. Such patterns, such as the differentiation traits of adaptation, have helped in tracing back the origin and diversity of crops and in discovering rare adaptive traits. This method mimics the co-evolutionary processes to locate and search for traits associated with heat and drought. Already the method has identified germplasm sets for bread wheat, durum wheat, barley and food legumes. These germplasm sample sets are now being evaluated in different research stations. As the method is validated it is capable of generating samples of more crop from gene bank for breeders to evaluate. Several publications are provided in the report. Another activity has identified, characterized and disseminated key range and forage species well adapted to extreme stresses (drought, cold, salinity is in progress); including cold tolerant cactus species (*Opuntia ficus indica*). The germplasm identified and characterized by both activities along with guidelines will be made available to users and will be widely distributed. Contact person (A.bari@cgiar.org); (M.Louhaichi@cgiar.org)

### Output: 1.2.1

#### Summary:

Climate-induced outbreak of stripe rust in Ethiopia in 2010, with dramatic impact on wheat production, has been successfully addressed by providing new varieties resistant to that fungal disease to smallholder farmers in Ethiopia. Over 2,200 lines of those varieties were made available to Ethiopian reach partners. A rapid seed production and distribution process based on participatory seed production and involvement of private seed companies was deployed to increase and distribute quality seed quickly. The result was that 26% of the wheat area in Ethiopia was cultivated with high yielding rust-resistant varieties within 3 years. Preliminary risk maps were developed based on the agro-ecological data and climate parameters for major diseases and pests. The country level pests and diseases risk maps have been developed for Morocco, Uzbekistan and Ethiopia and a combined regional map for entire CWANA. Contact: Kumarse Nazari (K.Nazari@cgiar.org).

### Output: 1.3.1

#### Summary:

The diagnostic gender research in Morocco is not complete yet, but it has already revealed good understanding about gender relations, the vulnerability of different households, both men and women, the underlying social, cultural and economic factors defining gender inequity. This understanding will form the basis for discussion to develop institutional arrangements and policies that address gender gaps in many areas: income, mobility and market access and which internally define the vulnerability of rural households in areas affected by climate change

in Morocco. In this analysis, the community identified that women in the most empowered community often had at least completed primary school education and had a source of income. Programs to strengthen women capacity through education (there is high female illiteracy), access to female extension agents, participation in community organizations or forming women only cooperatives with sufficient support from civil society and public organizations we considered priority to reduce poor household vulnerability to climate change and particularly to women's vulnerability. Follow-up transformative research to test these recommendations is planned. Contact: [A.aw-hassan@cgiar.org](mailto:A.aw-hassan@cgiar.org).

**Output: 2.1.1**

**Summary:**

Three index-based insurance schemes for minimizing risk: (1) a statistical index, (2) an index based on agro-meteorology and (3) a remote sensing-based index were evaluated using weather data, crop simulation results, and inputs-outputs prices. All the three insurance schemes have a very high potential to cope with increasing climate risk, and they should be evaluated by public-private cooperation. The team plans to replicate the work in Morocco which faces high drought incidence but farmers are unwilling to use insurance because of presumably cultural reasons. The task of the team will therefore be to test schemes that are considered culturally sensitive and that could dramatically increase enrollment in crop insurance programs thus giving farmers another tool to manage climate risk and increase livelihood resilience. Contact: Ihtiyor Bobojonov [Bobojonov@iamo.de](mailto:Bobojonov@iamo.de).

**Output: 2.1.3**

**Summary:**

The effects of extreme events on runoff and sediment yield for the basin using 32 years data were demonstrated. The results were communicated with researchers and stakeholders from Ministries and Universities from Jordan and Ethiopia during a dedicated workshop. The participants discussed ways to improve the rainfall intensity data in their routine work (presentation attached). The participants suggested sustainable land management (SLM) options to mitigate and adapt to the extreme events. The suggested SLM considered the time of the occurrence and severity of the extreme events during the year and how to protect the soil from extensive erosion. These were selected based on their efficiency as well as acceptance based on the experience of the national partners. Simulation model was implemented to simulate the impact of these on reducing soil and water losses (presentation attached). The SLM were verified again based on the model results and fine-tuned to produce recommendations of successful SLM that reduce the impact of extreme rainfall events. Further dissemination of these results, the model capacity and the recommended SLM will continue to mainstream this in the decision making activities. Two presentations and abstracts regarding the effectiveness of soil and water conservation interventions on soil erosion were delivered at the European Geoscience Union were delivered (attached in CCAFS intranet) In addition to the attached files and the description of the activity progress, a Global Weather Data for SWAT was published at <http://globalweather.tamu.edu/>. Contact: [F.Ziadat@cgiar.org](mailto:F.Ziadat@cgiar.org).

### 3. Publications

#### Publication #1

**Type:** Journal papers

**CCAFS Themes:** Theme 1

**Citation:** Karrou M (2013). Tillage system and genotype effects on early vigor and water use in bread wheat in the Mediterranean region. *African Journal of Agricultural Research* 8(41): 5069-5075.

#### Publication #2

**Type:** Journal papers

**CCAFS Themes:** Theme 1

**Citation:** Karrou M (2013). Combined effect of tillage system, supplemental irrigation and genotype on bread wheat yield and water use in the dry Mediterranean region. *African Journal of Agricultural Research* 8(44):5398-5404

#### Publication #3

**Type:** Journal papers

**CCAFS Themes:** Theme 2, Theme 4.2, Theme 4.3

**Citation:** Ouled Belgacem Azaiez and M. Louhaichi. 2013. The vulnerability of native rangeland plant species to global climate change in the West Asia and North African regions. *Climatic Change* 119:451–463

#### Publication #4

**Type:** Conference proceedings

**CCAFS Themes:** Theme 4.2

**Citation:** Larson L.L., M. Louhaichi, P.E. Clark, D.E. Johnson. 2013. A Suggested Sampling Protocol for Sagebrush/Grassland Monitoring. 22nd International Grasslands Congress. Revitalising grasslands to sustain our communities. 15 - 19 September 2013. Sydney, Australia. Volume 2: 877-878

#### Publication #5

**Type:** Conference proceedings

**CCAFS Themes:** Theme 4.2

**Citation:** Louhaichi, M., M. D. Johnson, P.E. Clark, and D.E. Johnson. 2012. Developing a coherent monitoring system for Mediterranean grasslands. In: Acar, Z., Lopez-Francos, A., Porqueddu, C. (Eds.). *New Approaches for Grassland Research in a Context of Climatic and Socio-Economic Changes*. Options Méditerranéennes. 102: 47-

51.

### Publication #6

**Type:** Journal papers

**CCAFS Themes:** Theme 2

**Citation:** Ihtiyor Bobojonov, Aden Aw-Hassan & Rolf Sommer , Climate and Development (2013): Indexed insurance for climate risk management and rural development in Syria, Climate and Development

### Publication #7

**Type:** Conference proceedings

**CCAFS Themes:** Theme 2

**Citation:** Brenner, Claire Brenner, Stefan Strohmeier, Feras Ziadat, and Andreas Klik. 2013. Soil conservation measures in the Ethiopian Highlands: The effectiveness of stone bunds on soil erosion processes. Geophysical Research Abstracts Vol. 15, EGU2013-5392-3, 2013

### Publication #8

**Type:** Conference proceedings

**CCAFS Themes:** Theme 2

**Citation:** Zehetbauer, Ingrid, Stefan Strohmeier, Feras Ziadat, and Andreas Klik. 2013. Runoff and sediment monitoring in an agricultural watershed in the Ethiopian Highlands. Geophysical Research Abstracts Vol. 15, EGU2013-5640-3, 2013

### Publication #9

**Type:** Journal papers

**CCAFS Themes:** Theme 2

**Citation:** ZIADAT, F. M., and A. Y. TAIMEH. EFFECT OF RAINFALL INTENSITY, SLOPE, LAND USE AND ANTECEDENT SOIL MOISTURE ON SOIL EROSION IN AN ARID ENVIRONMENT. Land degradation & development Land Degrad. Develop. 24: 582–590 (2013).

### Publication #10

**Type:** Journal papers

**CCAFS Themes:** Theme 1

**Citation:** Khazaei H, Street K, Bari A, Mackay M, Stoddard FL (2013) The FIGS (Focused Identification of Germplasm Strategy) Approach Identifies Traits Related to Drought Adaptation in *Vicia faba* Genetic Resources.

PLoS ONE 8(5): e63107. doi:10.1371/journal.pone.0063107

### Publication #11

**Type:** Journal papers

**CCAFS Themes:** Theme 1

**Citation:** Khazaei, Hamid, Kenneth Street, Arja Santanen, Abdallah Bari, Frederick L. Stoddard

Do faba bean (*Vicia faba* L.) accessions from environments with contrasting seasonal moisture availabilities differ in stomatal characteristics and related traits? *Genetic Resources and Crop Evolution* 60: 2343 - 2357. DOI:10.1007/s10722-013-0002-4

### Publication #12

**Type:** Conference proceedings

**CCAFS Themes:** Theme 1

**Citation:** BARI A., STREET K., AMRI A., NACHIT M., MACKAY M., OUABBOU H. KEHEL Z., GHANEM M.E., DE PAUW E., NAZARI K., EL BOUHSSINI M., TSIVELIKAS A., HUMEID, B. SEARCHING FOR CLIMATE CHANGE RELATED TRAITS IN PLANT GENETIC RESOURCES COLLECTIONS USING FOCUSED IDENTIFICATION OF GERMPLASM STRATEGY (FIGS). International Durum Wheat Symposium. Genetics and Breeding of Durum Wheat. 27-30 May 2013, Rome, Italy. <http://dwis.academiax1.it/>

## 4. Communications

### Media campaigns:

Meetings

Newspaper article: Link to (<http://oujda-portal.net/ma/fkih-ben-salah-pour-une-meilleure-optimisation-de-la-gestion-de-lor-bleu-85030.html>)

Interview of ICARDA Senior entomologist with Freelance writer:

26 SEPTEMBER 2013 | VOL 501 | NATURE | S17

### Blogs:

ICARDA and CCAFS website

### Websites:

<http://www.icarda.org/>

### Social media campaigns:

None

### Newsletters:

None

### Events:

Farmer field demonstration days

### Videos and other multimedia:

<http://www.youtube.com/channel/UCwzPIJDIXyBNQuEL-YdzRpQ>

### Other communications and outreach:

None

## 5. Case studies

### Case Study #1

**Title:** Adoption of Deficit Supplementary Irrigation by farmers in Morocco

**Author:** Mohamed Boughlala and Mohamed Karrou

**Type:** Participatory action research ,Food security

#### Project description:

Deficit supplemental irrigation is a concept where basically the crop is irrigated with amount of water less than the requirement. This technique reduces the risk of crop loss, and ensures profitable yields, while saving water when compared to full irrigation. It is an effective practice to adapt to droughts which are becoming frequent in Morocco and similar dry areas due to climate change. After 2 years of demonstrations and field days attended by about 70 farmers, the adoption of the deficit supplementary irrigation has taken off in Morocco. The technological package including the application of small amount of water to the crop when rain is not enough, and improved management practices, were developed after years of trials by ICARDA and national partner (INRA-Morocco). The demonstrations and field days were conducted with the extension services who also learned the value of deficit supplemental irrigation .

#### Introduction / objectives:

Drought is the major constraint of wheat production in Morocco and this is exacerbated by climate change. The objective of this study is to evaluate the adoption rate of deficit supplemental irrigation in Tadla region of Morocco where the farmers apply full irrigation..

#### Project results:

Adoption survey conducted in 2013 for a sample of farmers in the region of Tadla in Morocco showed that 21% of them who irrigated wheat in the rainy season applied deficit supplementary irrigation (DSI), and on 96% of their wheat area. This is certainly a good start and the promotion and monitoring process is on-going. The farmers adopting DSI and the associated agronomic package produced in average about 1.1 t/ha more grains than the other farmers; while, on average, the irrigation water saving was 1,100 m<sup>3</sup> per ha.

#### Partners:

INRA Morocco Extension department of the Ministry of Agriculture in Tadla region of Morocco (Office regional de Mise en Valeur Agricole de Tadla)

#### Links/sources for further information:

See file in CCAFS intranet under ICARDA, activity 677-2013.

## Case Study #2

**Title:** Quick response strategy for addressing climate-induced diseases outbreaks that threaten food security and livelihoods: The case of stripe rust in Ethiopia

**Author:** Kumarse Nazari; Rajita Majumdar; Seid Ahmed Kemal and Mustaf Bouhsini

**Type:** Successful communications, Capacity enhancement, Food security

### Project description:

Stripe rust, which infects wheat, is a serious threat to food security globally and to rural livelihoods in developing countries. The severity of infection of this fungal disease like other pests and diseases depends on climate. When stripe rust swept across Ethiopia in 2010, prompted by that year's unusually cool temperatures and above average rainfall, it caused significant losses and economic hardship. Appearing suddenly, this destructive fungal disease severely stunted and weakened wheat crops, affecting an estimated 400,000 hectares (ha) nationwide – in some provinces the losses reached up to 80%. In a bid to rapidly strengthen the national wheat breeding program, the Ethiopian Institute of Agricultural Research (EIAR) implemented an initiative funded by USAID and backed by a team of scientists from ICARDA, under the CGIAR Research Program on Climate Change Agriculture and Food Security (CCAFS).

### Introduction / objectives:

The objective of the EIAR –ICARDA project was quickly to develop, release rust-resistant, high-yielding wheat varieties, and to rapidly produce and distribute quality seeds to smallholder farmers by implementing innovative seed production and distribution systems.

### Project results:

ICARDA scientists screened over 5000 cultivars and landraces for resistance to all forms of wheat rust. Over 2,200 lines of those were further screened by EIAR partners. The high yielding, rust-resistant seed increased farmer yields from 3.7 tons/ha in 2011-12 to 3.3 tons per ha in 2012-13; much higher than the national average of 2 tons/ha. Once disease resistant varieties were identified, rapid seed production and distribution was initiated using a novel participatory on-farm seed multiplication strategy. Participating farmers multiplied seeds and passed to neighboring farmers; cutting the time-lag between development and distribution of quality seeds. Private seed companies and cooperatives did large-scale seed multiplication. Since its inception, the project has delivered improved seed to over 13,200 farmers across 45 districts through direct distribution, informal exchange and formal sale. In the initial two years of the project, new rust-resistant wheat varieties reached about 26% of Ethiopia's total wheat growing area, benefiting close to 67,600 people in villages.

### Partners:

Ethiopian Institute for Agricultural Research, ICARDA, CCAFS supporting, and USAID-funding

### Links/sources for further information:

## Case Study #3

**Title:** Seeking natural genetic variation for climate change adaptive traits in plant genetic resources: *Vicia faba* L. as a test case.

**Author:** Abdallah Bari, Hamid Khazaei, Kenneth Street, Mikko J. Sillanpää, Dag T. F. Endresen, Eddy De Pauw, Yogen P. Chaubey, Selvadurai Dayanandan and Frederick L. Stoddard

**Type:** Breakthrough science

### Project description:

Natural genetic variation displays patterns within boundaries set up by ecological and co-evolutionary processes. Such patterns, such as the differentiation traits of adaptation, have helped in tracing back the origin and diversity of crops and in discovering rare adaptive traits. This study mimics the co-evolutionary processes to locate and search for traits associated with heat and drought using faba bean as case study. Faba bean crop is a commonly grown food legume in the dry areas that are most likely to be impacted by climate change and the genetic resources of faba bean consist exclusively of accessions sampled from the cultivated form, since its wild relatives or ancestors are either extinct or undiscovered. It is thus a timely case for searching for natural genetic variation in traits related to climate change adaptation. This study tests also the *in silico* evaluation approach with data acquired from actual evaluation.

### Introduction / objectives:

The objective of this study is to search for climate change related traits associated with heat and drought and to develop a procedure to carry out *in silico* evaluation for such traits.

### Project results:

The results show presence of patterns *vis a vis* the traits of adaptation to climate change where the traits were considered as a response variable, driven by stochastic ecological and co-evolutionary processes. The high values of the accuracy metrics between models predictions and actual *a posteriori* trait evaluation support the possibility to carry out *in silico* evaluation and thus manage the lack of *ex ante* evaluation that would help in the use of plant genetic resources in crop improvement and, ultimately, of biodiversity to sustain agriculture production and adaptation to climate change. Currently the procedure is used to identify sets of different crops that have climate related traits (heat and drought resistance) and these are being evaluated by researchers in different locations. This procedure will increase the efficiency of search for climate related traits.

### Partners:

ICARDA; Dep. of Agr. Sciences, Un. of Helsinki, Finland; Dep. of Math Sciences, Dep. of Biology Un. of Oulu, Finland; GBIF Norway, Natural History Museum, University of Oslo, Norway; Dep. of Math & Stats, & Dep. of Biology, Concordia Un, Canada.

### Links/sources for further information:

<http://climate.nordgen.org/program>

## 6. Outcomes

### Title:

Adoption of supplemental irrigation technique by farmers as adaptation to Climate Change.

### What is the outcome of the research (i.e. use of research results by non-research partners)?

The outcome is the adoption by farmers of deficit supplemental irrigation package in the Tadla region of Morocco as adaptation strategy to climate change (frequent droughts).

### What outputs produced in the three preceding years resulted in this outcome?

A technological package of deficit supplemental irrigation consisting of agronomic management and the application of amount of water (less than the full crop requirement) in the rainy season, when rainfall is not sufficient, was developed and tested in farmers fields.

The package allowed significantly higher yields than those obtained by farmers management, the reduction of the risk of crop loss, and the water saving as compared to full irrigation method of farmers.

### What partners helped in producing the outcome?

INRA-Morocco and extension services of the Moroccan Ministry in the Tadla region (Office Regional de Mise en Valeur Agricole de Tadla or ORMVAT)

### Who used the output?

The farmers, extension services

### How was the output used?

The farmers implemented the technology on their fields. There are no special devices needed, all it needs is farmers awareness and their willingness to reduce the volume of water applied...

### What is the evidence for this outcome? Specifically, what kind of study was conducted to show the connection between the research and the outcome? Who conducted it? Please provide a reference or source.

Evidence:

1) Results of the adoption study (Survey) conducted on 100 farmers conducted in 2013 in Tadla region show that adoption rate was 21% and the degree of adoption was 96%.

2) Testimony/witness of a farmer in a local newspaper (in French). see link below:

<http://oujda-portail.net/ma/fkih-ben-salah-pour-une-meilleure-optimisation-de-la-gestion-de-lor-bleu-85030.html>

## 7. Outcome indicators

### Outcome indicator:

One to five flagship technical and/or institutional approaches identified and developed with farmers, key development and funding agencies (national and international), civil society organizations and private sector in three regions, which would directly enhance the adaptive capacity of the farming systems to the climate change conditions

### Achievements:

Outcome title: Adoption of supplemental irrigation technique by farmers as adaptation to Climate Change. The outcome is deficit supplemental irrigation package adopted by farmers in the Tadla region of Morocco. Full supplemental irrigation (FSI) is defined here as the addition of irrigation water to essentially rain-fed crops, in order to meet their requirements and improve and stabilize yields during times when rainfall falls to provide sufficient moisture for normal plant growth. These rainfall deficit situations are a result of more frequent droughts resulting from changing climate in Morocco. In order to further increase the resilience of dry land farmers to these climate variabilities and change, an even more economical use of water is advised. This new practice is called “Deficit Supplemental Irrigation”. Deficit supplemental irrigation (DSI) is the application of a portion of the irrigation water required by the crop as supplementary (70% of FSI in this case). On-farm trials conducted on wheat in Tadla region of Morocco for two years showed that the application of improved packages of FSI and DSI by the participating farmers increased yield, in average, by 1.1 t/ha as compared to common farmer irrigation and crop management practices. Moreover, DSI allowed a saving of around 1,100 m<sup>3</sup> of irrigation water, on average. Supplemental irrigation (SI) work started seven years ago in the region by the collaboration of ICARDA and the Moroccan national research organization (INRA or Institut National de la Recherche Agronomique). Trials were conducted first on the response of wheat to different amounts of supplemental irrigation (SI) and on the interaction between SI and one of the agronomic factors such as planting date, nitrogen and variety. These trials were undertaken both in the experiment station and at the farm level and they were fully managed by scientists. The output of this work was the development of improved package of deficit supplemental irrigation and associated agronomic package. During the last two years, this package has been tested and compared to the farmers’ conventional crop management with full irrigation. These demonstration trials were conducted and managed directly by farmers in their own fields under the supervision of the researchers and extension agents. The application of the improved package, as mentioned above, increased yield, in average, by 1.1 t/ha as compared to common farmer irrigation and crop management practices. Moreover, DSI allowed a saving of around 1,100 m<sup>3</sup> of irrigation water, on average. Each year, two field visits and meetings, one at heading stage and one at maturity of wheat, were organized for around 70 farmers and extension agents in the region to discuss with them and with the farmers conducting the demonstration trials the results and the role of the improved package in saving water and improving yields and the net return. Also, extension agents (around 10) received, since the beginning, on-the-job trainings on scheduling deficit supplemental irrigation and crop management. These extension agents played an important role in the dissemination of the package. The public awareness on the improved package was also ensured through publications in newspapers, diffusion in TV and radio that were always invited to the field days and

meetings with farmers. A survey was implemented in summer of 2013 as an effort to establish the level of adoption of the deficit supplemental irrigation as adaptation measure to climate change. A questionnaire was prepared by ICARDA and INRA-Morocco. Trained enumerators carried out the survey on a randomly selected sample of 100 farmers using pre-tested questionnaire. Four enumerators (2 technicians from INRA and 2 from extension services) were involved in the survey under the supervision of INRA agricultural economist. Both the rate and the degree of adoption were computed. The analysis of the data showed that 72% of farmers adopted FSI and 21% of them applied DSI. The application of deficit supplemental irrigation is effective method of saving water while at the same time substantially reducing the chances of crop failure in the time of drought and ensuring farmers' income. The farmers who applied DSI applied the practice on 96% of their land. A draft report of the study is attached in the report.

**Evidence:**

1) A survey of 100 farmers was conducted and showed that 72% of farmers adopted FSI and 21% of them applied DSI. The degree of the adoption of DSI was 96%. 2) The testimony of farmers during a workshop conducted in the region. See Newspaper article at (<http://oujda-portal.net/ma/fkih-ben-salah-pour-une-meilleure-optimisation-de-la-gestion-de-lor-bleu-85030.html>)

**Outcome indicator:**

Findings and evaluation tools on mitigation and livelihoods benefits of alternative agricultural development pathways used by global agencies and decision-makers in two countries in each of the three regions

**Achievements:**

Note from AP - 1 activity under Theme 3 (Fabrice)

**Evidence:****Outcome indicator:**

Agriculture mainstreamed into the global climate change policies, and major international food security initiatives fully incorporate climate change concerns

**Achievements:**

Note from AP - two activities under this theme (Jacob/Adam)

**Evidence:**

## 8. Leveraged funds

**Title:**

Support for data sharing

**Partner name:** Dryland Systems CRP

**Budget:** \$25000

**Theme:** T1