

1. Activity Reporting.

Activity 676-2014

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

Status	On going	Milestone	1.1.1 2014
Start date	2010 Jan	End date	2015 Dec

Description: This activity is modeling the impacts of climate change (CC) for providing policy makers and stakeholder information for action. Previously calibrated biophysical models will be used to assess the impact of CC on the major crops of Central Asia (wheat, cotton, potatoes) and Morocco (wheat and barley). The effects of adaptation technologies, such as supplemental irrigation (SI) and other potential Climate-smart practices, on crop productivity will be modeled and mapped at regional scales used as demonstration tools to stakeholders including NARES, farmers and policy makers. Surveys conducted in Morocco in 2013 will be used to assess the trends in the farming systems as response to climate change, farm-level wheat productivity and farmers' perceptions and adaptation strategies to CC; analysis of policies and national level strategies of adaptation to climate change are being carried out in Morocco; bio-economic models will be used to evaluate options for adaptation of climate-smart agricultural practices in Central Asia and North Africa; Options for enhancing insurance as climate risk management in agriculture will be conducted in Morocco; dissemination workshop will be conducted for policy makers and stakeholders in Central Asia; and analysis of climate change impact on farm income in Tajikistan (Central Asia).

Status: On going. This activity has two components: biophysical component which has crop simulation and climate impact aspects and socioeconomic aspects which has economic aspects. Biophysical component: Two years field work for "Testing of selected facultative wheat varieties for tolerance to heat stress during flowering" completed. This started in September 2012 and finalized in August 2014. Also screening of improved heat-tolerant winter (facultative) wheat germplasm to for heat stress during flowering and to assess associated yield losses completed; field data collected for calibrating a biophysical crop model- CropSyst. In many parts of Central Asia winter is unpredictable, varying from mild, normal or severe. The field trials were implemented on the experimental station of the Kashkadarya Research Institute of Grain Breeding and Seed Production of Cereal Crops (KRIGBSPCC) in Kojar village of Karshi district, Kashkadarya region, Uzbekistan, where such fluctuations of winter conditions are common. Eight wheat varieties (Hazrati Bashir, Bunyodkor, Gozgon, Jaihun, Elomon, Humo, Sanzar 4, Saidaziz) were grown in two cropping seasons (2012-2013 and 2013-2014) to screen for heat tolerance and best sowing time. These facultative wheat entries were planted manually in different time windows, October 21 (optimal planting), November 14 (late planting) and February 15 (spring sowing). Periodic laboratory analyses of soil and plant material

supplemented the field-based agronomic data collected over the growing season. Maximum yields of 4.4-6.6 t/ha was obtained under late planting in 2013-2014 season, while best yields (7.1-9.2 t/ha) were achieved under optimal planting in 2012-13. The data was used to calibrate the CropSyst model, for subsequently assessing the potential of crop management practices; e.g. best sowing time, irrigation scheduling, fertilizer applications, on yields, as well as to assess the effects of future climate change scenarios on crop production in the Central Asian region. The report contains description of soil, weather characteristics of selected sites, experimental management conditions, crop data (plant density, greenness, NDVI), calibrated results for 8 entries planted at different planting dates, statistical analyses of impact of crop management practices (impact of date of sowing on yields), effect of various Genotype and date of sowing on days to maturity, date to flowering and plant height and impact of planting dates on crop phenology and physiology and Conclusions/Outlook.

The economic component: explores the effects of regional trade agreements made among Central Asian countries during the transition period on farmers' adaptation to climate change. The implementation of these agreements remains very restricted which causes limited exchange and flow of agricultural commodities between the countries. These market imperfections caused by state policies, poor market infrastructure and trade restrictions remain the main challenge for small scale producers in Central Asia (Kazakhstan, Uzbekistan, Kyrgyzstan and Tajikistan). This study analyses input and output price differentiation between the countries and discusses the main factors causing those price differences. The paper, then, examines the impact of easing those trade barriers on farm level welfare, especially under different climate change scenarios, filling the gap in knowledge on how trade barriers affect farm gate prices and farmers' welfare in Central Asia under climate change scenarios. The impact of climate change on farm income and consumption is analyzed using an integrated modeling tool which incorporates the climate change module and crop growth simulation model in the expected utility framework. The results show significant differences in farm gate prices of many agricultural commodities. Salient differences were also found between the energy and fertilizer prices among these countries. Political disputes between some Central Asian countries are explained to be the main challenge for restricted trade between the countries. Liberalization of trade may create favorable economic conditions for many regions in Central Asian countries. However, potential gains from market integration are very region and country specific. The integrated model results show that 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.

Gender Component: The gender aspects of this activity is linked to another activity titled "Develop socially and gender- differentiated knowledge of local seed systems and its effectiveness in climate change adaptation strategies", which is also analyzing the gender empowerment and gender differentiated vulnerability to climate change . Progress in gender aspects is reported in that activity.

Objectives:

1. Assess the impact of CC on wheat and barley productivity for specific areas in Morocco using crop simulation models

2. Scale-up the impacts of CC and adaptation technologies on wheat and barley productivity in key cropping areas in Morocco
3. Assess the impact of CC on wheat, cotton and potato productivity for specific areas in Central Asia using crop simulation models.
4. Scale-up the impacts of CC on wheat, cotton and potato productivity in key cropping areas in Central Asia
5. To test selected facultative wheat varieties for tolerance to heat stress during flowering and assess the impact of CC on the productivity of cultivars.
6. Determine and assess farmers' adaptation strategies to climate change in Morocco
7. Assess the impacts of climate change on farm income in Tajikistan
8. Options for enhancing insurance as climate risk management in agriculture will be conducted in Morocco
9. Apply bio-economic models to evaluate options for adaptation of climate-smart agricultural practices in Central Asia and North Africa.
10. Disseminate climate research results at Policy Workshop in Central Asia

Deliverables:

Description	Type	Year	Status	Justification
Recommendations on policy support for climate-smart agricultural practices in Morocco, CA, and Tajikistan	Peer-reviewed journal articles	2014	Complete	
Crop simulation models fully calibrated for Sites in Morocco and Central Asia for Wheat, barley, potatoes and effects of climate change on these commodities estimated.	Research report (i.e. workshop report, consultant's report, discussion paper, project report, student thesis, etc.)	2014	Complete	
The changes on the farming systems and farmers responses and adaptation to climate change in Morocco described	Research report (i.e. workshop report, consultant's report, discussion paper, project report, student thesis, etc.)	2014	Complete	

Description	Type	Year	Status	Justification
Two years field work for “Testing of selected facultative wheat varieties for tolerance to heat stress during flowering” completed. This started in September 2012 and finalized in August 2014. Also screening of improved heat-tolerant winter (facultative) wheat germplasm to for heat stress during flowering and to assess associated yield losses completed; field data collected for calibrating a biophysical crop model- CropSyst. In many parts of Central Asia winter is unpredictable, varying from mild, normal or severe. The field trials were implemented on the experimental station of the Kashkadarya Research Institute of Grain Breeding and Seed Production of Cereal Crops (KRIGBSPCC) in Kojar village of Karshi district, Kashkadarya region, Uzbekistan, where such fluctuations of winter conditions are common. Eight wheat varieties (Hazrati Bashir, Bunyodkor, Gozgon, Jaihun, Elomon, Humo, Sanzar 4, Saidaziz) were grown in two cropping seasons (2012-2013 and 2013-2014) to screen for heat tolerance and best sowing time.	Research report (i.e. workshop report, consultant's report, discussion paper, project report, student thesis, etc.)	2014	Complete	

Description	Type	Year	Status	Justification
The paper describes the increased risk due to global warming which has become embedded in agricultural decision making in Central Asia and uncertainties are projected to increase even further. Agro-ecology and economies of Central Asia are heterogeneous and very little is known about the impact of climate change at the sub-national levels. The bio-economic farm model (BEFM) is used for ex ante assessment of climate change impacts at sub-national levels in Central Asia. The BEFM is calibrated to 10 farming systems in Central Asia based on the household survey and crop growth experiment data. The production uncertainties and the adaptation options of agricultural producers to changing environments are considered paramount in the simulations. Very large differences in climate change impacts across the studied farming systems are found. The positive income gains in large-scale commercial farms in the northern regions of Kazakhstan and negative impact in small-scale farms in arid zones of Tajikistan are likely to happen. Producers in Kyrgyzstan may expect higher revenues but also higher income volatilities in the future. Agricultural producers in Uzbekistan may benefit in the near future but may lose their income in the distant future. The negative impacts could be further aggravated in arid zones of Central Asia if irrigation water availability decline due to climate change and water demand increase in upstream regions. The scenario simulations show that market liberalization and improved commodity exchange between the countries have very good potential to cope with the	Peer-reviewed journal articles	2014	Complete	

Description	Type	Year	Status	Justification
negative consequences of climate change.				
Data sets on crop yields and climate for using climate impact studies and index based insurance studies	Datasets	2014	Complete	
Conference paper	Conference proceeding s/papere	2014	On going	The data needed for this activity was coming very slow and the analysis was delayed for that reasons.
MSc Thesis of student	Research report (i.e. workshop report, consultant's report, discussion paper, project report, student thesis, etc.)	2014	Complete	
Studies of farmer perceptions and bio-economic modeling of climate change impact in North Western Ethiopia	Research report (i.e. workshop report, consultant's report, discussion paper, project report, student thesis, etc.)	2014	On going	This is a new activity partially supported by a bilateral project and will continue for another year
Refereed ISI journal research paper	Peer-reviewed journal articles	2014	Complete	

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Location(s):

Not defined

Activity 671-2014

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	Complete	Milestone	1.1.1 2015 (1)
Start date	2011 Jan	End date	2015 Dec

Description: This research is a multi-faceted assessment that involves a comprehensive set of inter-related disciplines including 1) Agronomic: screening for well-adapted forage and range species, 2) Modeling the impact of climate change, 3) Technology: developing decision support tools for better monitoring and assessment of natural resources, 4) Gender: empowering of women in the most extensive production systems “zero input”, and 5) Capacity development of all stakeholders. It is aimed at enhancing the resilience of the most marginalized human populations (pastoral community) and important ecosystems (communal rangelands). This is achieved through establishing adaptation measures and policy recommendations for decision makers.

Status: Complete. Local knowledge assessment focusing on climate change and gender aspects at the agro-pastoral community of Bani Hashem (Jordan) is complete; -Identification, characterization and dissemination of key range and forage species well adapted to extreme stresses (drought, cold, salinity) is complete; - Screening for cold tolerant cactus species (*Opuntia ficus indica*) for West Asia is complete; - Developing decision support tools and protocols for monitoring rangeland vegetation cover using digital vegetation charting technique is complete; - Local knowledge assessment focusing on climate change and gender aspects at the agro-pastoral community of Bani Hashem (Jordan) is complete; - Livestock migration in Rajasthan State (India): Coping strategy for smallholder livestock in the face of climate change is completed; -Strengthening capacity building and social capital of all stakeholders through joint publications, training workshops, manuals, posters, fliers and booklets) is complete.

Gender Component: The information generated help to strengthen the linkages between gender equality and nutrition- and climate-smart agricultural technologies by identifying specific factors that impact the quality of life.

Objectives:

1. Identifying, characterizing and disseminating key range and forage species that are well adapted to extreme environmental conditions (drought, cold, salinity).
2. Screening for suitable *Opuntia ficus indica* (spineless cactus pear) accessions for West (cold/frost tolerant) and South Asia.
3. Performing ecological modeling to assess the vulnerability of native rangeland plant species to global climate change in regions of West Asia and North African.

4. Developing decision support tools and protocols for monitoring rangeland vegetation cover using digital vegetation charting techniques.
5. Developing coping strategies for livestock smallholders in the face of climate change and soaring feed prices: case study of livestock mobility in the state of Rajasthan.
6. Assessing gender impacts from 'climate-smart' agriculture under climate change/variability for Bani Hashem pastoral community in Jordan.
7. Strengthening capacity building and social capital of all stakeholders through joint publications, training workshops, manuals, posters, fliers and booklets.

Deliverables:

Description	Type	Year	Status	Justification
Well adapted range and forage species identified and fully characterized. A special emphasis will be on cold tolerant <i>Opuntia ficus indica</i> . Promising cactus accessions disseminated based on their agro-ecological characteristics	Non-peer reviewed articles	2014	Complete	
Vulnerability of native rangeland plant species to global climate change in regions of West Asia and North African assessed using ecological modeling	Peer-reviewed journal articles	2014	Complete	This paper is submitted to Land Degradation & Development journal
Decision support tools and protocols for monitoring rangeland vegetation cover using digital vegetation charting techniques developed	Other	2014	Complete	
Coping strategies for livestock smallholders in the face of climate change and soaring feed prices: case study of livestock mobility in the state of Rajasthan (India) developed.	Video	2014	Complete	
Gender impacts from 'climate-smart' agriculture under climate change/variability for Bani Hashem pastoral community in Jordan assessed.	Research report (i.e. workshop report, consultant's report, discussion paper, project report, student thesis, etc.)	2014	Complete	
Capacity building and social capital of all stakeholders enhanced through joint publications, training workshops, manuals, posters, fliers and booklets.	Workshop	2014	Complete	

Description	Type	Year	Status	Justification
1. To assess differences in salinity tolerance of halophytic forage species, and 2. To elucidate the morphological and physiological mechanisms responsible for the differences.	Research report (i.e. workshop report, consultant's report, discussion paper, project report, student thesis, etc.)	2014	Complete	
Identification and characterization of key range and forage species well adapted to extreme stresses.	Research report (i.e. workshop report, consultant's report, discussion paper, project report, student thesis, etc.)	2014	Complete	
Field Day	Workshop	2014	Complete	
Publication, Type: Conference proceeding	Peer-reviewed journal articles	2014	Complete	
Training courses	Capacity	2014	Complete	
	Peer-reviewed journal articles	2014	Complete	

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Location(s):

Countries: India, Jordan, Lebanon, Syria,

Activity 674-2014

Develop socially and gender- differentiated knowledge of local seed systems and its effectiveness in climate change adaptation

Status	On going	Milestone	1.1.1 2014
Start date	2012 Jun	End date	2015 Dec

Description: This activity will build on the participatory gender analysis work carried out in 2012, and will continue the focus groups in order to determine the gender disaggregation of climate impacts as well as the different perceptions, and strategies that men and women farmers adopt and access to. The study goes beyond the traditional assumption that men and women have different agricultural roles and responsibilities within the household, and will analyze how these differences affect the impacts of climate change on men and women, what kinds of strategies do they use, how are the difference in access to information between men and women affect their strategies and decision making. The focus of the study will be major wheat growing areas of Morocco. The study is linked with another CCAFS activity looking at the climate impacts of wheat production in Morocco.

Status: On going. The fieldwork of this activity is completed during July 25, 2014 through December 4, 2014, where the PhD student lived in the village of Had el Bkhati, conducted qualitative surveys, focus groups, and in depth interviews, identified 2 communities for analysis within the village; one of a low migration community- Taaouniate Sidi Aabid with 68% of households experiencing male migration; the other- Jnanda, with high migration where 98% of households experiencing male migration, both within the cereal-producing region of Abda, Morocco. The research include 32 qualitative baseline surveys (16 non migration households/ 16 migration households), 4 focus group discussions (in Taaouniate Sidi Aabid), and 10 in depth life history interviews with key informants in the community. It also entailed participant observation work daily through fieldwork in the village, accompanying village members to the market, and joining them for meals on a daily basis. In the focus group discussion, methodologies used in previous fieldwork in Morocco were implemented and improved upon. Participatory drawing methods were used whereby the community members draw what an empowered, disempowered (and any levels of empowerment that should fall between the two extremes) person looks like. They were asked to draw attributes about the empowered person that would demonstrate what we should look for if we were trying to identify what empowerment looks like in the context of this community. These attributes (or, indicators) were then ranked according to level of importance in determining one's level of empowerment. Across the board, the most empowered woman was identified as being in this position because of economic need. The women from the wealthiest household was often identified as the least empowered because she was most dependent upon her husband, and also experienced the most restrictions to leaving the home. The life history interviews have weaved an interesting story about climate change, migration, and women's empowerment in rural Morocco. It seemed to be a unifying piece that, when triangulated, brought meaning to the information gained in the qualitative baseline surveys and the focus group

discussion. These in depth interviews allowed for more detailed discussion about how climate change had affected agricultural livelihoods in the community. People in the community reported dramatic reduction in agriculture production particularly on the main food crop, wheat; due to climatic changes; and most families are not producing enough to cover costs of production. Migration became only alternative livelihood strategy, and most male migrate to get construction jobs in cities and towns. Also as production declined, tensions between family members have begun to intensify. Where households previously contained an elderly father and/or mother as well as each of their sons and their families, houses are increasingly changing to reflect a nuclear family structure. However these disputes within the family are such that they do not provide support for the women left behind. Her only option is to go out and take on the responsibilities herself. Thus, gendered roles and norms are changing within the community due to migration. A final written report of data collected is to be completed in Spring of 2015.

Gender Component: The activity is a strategic gender research looking at the gender implications of climate change induced changes in farm income and migration of males in search o better livelihoods. The emerging picture for gender balance is at times conflicting and confusing, but overall women who have taken non-traditional roles are showing a sense of empowerment and they gave gained a lot form these newly found strength.

Objectives:

1. Determine how gender differences in farm activities, access to information affect differently men and women farmers strategies, decision making and impacts of climate change.

Deliverables:

Description	Type	Year	Status	Justification
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.	Peer-reviewed journal articles	2014	On going	
Recommendations on how to enhance equitable information access to rural women farmers.	Articles for media or news (radio, TV, newspapers, newsletters, etc.)	2014	On going	
Assessment of different factor (social, economic, cultural and attitudes) that influence rural women's empowerment and recommendations to address these factors with practical interventions.	Data	2014	On going	
Presentation of initial research findings were presented to INRA, Morocco, staff in Rabat as seminar on December 4, 2014. The aim of the seminar was to build the gender awareness of researchers and inform them about the sex-disaggregated effects of climate change and that research and policy should take these into consideration	Presentations	2014	Complete	

Description	Type	Year	Status	Justification
The PhD student, Chesney Mc Omer, from University of Florida, delivered a presentation of preliminary field study findings and observations to ICARDA staff in Amman Jordan in December, 2014, with the aim of informing the research community about the study and its findings and also providing the student opportunity to get feed back for her research. The results was great.	Workshop	2014	Complete	

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Location(s):

Not defined

Activity 677-2014

Developing and disseminating guidelines for drought risk management in the context of progressive climate change: Data processing, technology testing and dissemination and model use

Status	Complete	Milestone	1.1.1 2014
Start date	2011 Jan	End date	2014 Dec

Description: This activity develops methodology, and collects sets of secondary data needed for computing drought indices such as SPI and their correlations with cereal yields; conducts surveys and field trials and field measurements to estimate the effects of production practices such as supplemental irrigation, planting dates and varieties on adaptation to drought and climate change. Improved package of supplemental irrigation will be also disseminated through on-farm demonstration plots. This will help develop tools and options of drought risk management in the dry area.

Status: Complete. This activity develops methodology, and collects sets of secondary data needed for computing drought indices (SPI, Palmer, remote sensing); and, through surveys, field measurements and trials, collects field data needed to run water allocation model and estimates the effects of production practices such as supplemental irrigation and water harvesting on adaptation to climate change.

In 2014, a scientific paper on the “Assessment of the severity and impact of drought spells on rainfed cereals in Morocco” was prepared and published in “African Journal of Agricultural Research, Vol .9 (49): 3519-3530, December 2014”. Moreover, a review on “Drought Early Warning and Mitigation in Dry Areas” was prepared

Experiment trials on the interaction "supplemental irrigation x planting date x variety of wheat" and "supplemental irrigation x zero tillage x variety of wheat" were continued in Morocco and data on water use and yields were collected.

On-farm trials on the improved package of deficit supplemental irrigation was conducted in 7 farms and a second adoption study of this package was conducted to consolidate the results of last year. A field day on improved package of deficit supplemental irrigation was organized for more than 50 farmers and extension staff.

Dissemination of Vallerani technology (mechanized contour ridge making plow for water harvesting constructed) in Jordan was extended from Majdya and Mhareb regions to Karak region through CRP 7 and CRP Dryland Systems. The government of Jordan has disseminated the technology through development programs the technology in other areas of the agro-pastoral regions.

Gender Component: Not defined

Objectives:

1. Identify and promote strategies and methods of drought mitigation and risk management in dry areas

Deliverables:

Description	Type	Year	Status	Justification
Spatial and temporal drought severity assessed in Morocco and Jordan using SPI and its impact on cereal production evaluated in Morocco in the context of progressive climate change	Peer-reviewed journal articles	2014	Complete	
Techniques/technologies of drought risk management, such as supplemental irrigation and crop management practices will be tested and evaluated with farmers and drought risk management package developed.	Research report (i.e. workshop report, consultant's report, discussion paper, project report, student thesis, etc.)	2014	Complete	

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Location(s):

Global

Activity 672-2014

Searching Genetic Resources for Traits of Adaptation and Mitigation to Climate Change

Status	On going	Milestone	1.1.1 2014
Start date	2010 Jan	End date	2017 Dec

Description: This activity builds on earlier work on developing new algorithms and new data sets that enable to efficiently search for CC related traits along with the development of subsets with traits to adapt to CC extremes (drought, heat and cold). Some of the subsets are currently under evaluation in conjunction with the development of phenotyping prototype to better capture PGR CC related traits including potential CC traits (root system traits). A new platform for evaluation of PGR subsets is being launched involving universities and research institutions globally.

Status: On going. The potential of genetic resources to address climate change has been demonstrated and presented in several forums including farmers networks such as SustaiNet. This network consists of nearly 1.5 million farmers from East Africa, particularly the Horn of Africa. The network emphasizes the promotion and transfer of innovations to farming communities and on tackling access to quality seed and related technologies. The approach followed to demonstrate the relevance of genetic resources to climate change combines the practical aspects with the mathematical theoretical aspects. The results of which were presented also during the 2014 Lillehammer (Norway) International Conference on “Genetic Resources for Food and Agriculture in a Changing Climate” where genetic resources have been highlighted to be more important for farming than any other environmental factor, as they enable adaptation to changing environmental conditions. A workshop on applied mathematics to genetic resources was also carried out in Rabat (Morocco) as a follow up to the Mathematics of Planet Earth event (MPE2013.ORG - Montreal 2013-2014). In addition to the participants who attended the Rabat workshop, there were thousands of views via internet of the workshop blog. This has also led to the publication of numerous articles in the media such as BBC (BBC News on 15 August 2014 - <http://www.bbc.com/news/science-environment-28789716>). In parallel new germplasm subsets were developed and they have been grown to identify the sought-after traits including complex traits such as root traits in relation to salinity tolerance.

Gender Component: Gender is an integral part of the climate change platform, the aim of which:

- a) to develop further the approach and its allied applications,
- b) to generate climate change related trait sets and develop new subsets for CC extremes,
- c) to evaluate some of these subsets phenotypically and genotypically,
- 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.

The platform involves gender and youth (women researchers) in the planning and implementation of GR CC platform research in GR vis a vis climate change.

Objectives:

1. Develop algorithms to search PGR collections for traits to adapt to climate change (extremes).
2. Develop PGR subsets with traits to adapt to climate change.
3. Develop algorithms to capture climate change related traits to adapt to climate change.
4. Evaluate subsets vis a vis CC related traits.
5. Establish a global platform for evaluation and development of collaborative research proposal to search for CC related traits involving gender and youth
6. Filling the gaps in PGR collections vis a vis CC related traits - methodology.
7. Search for traits of mitigation - phytolith C sink (PhytOC) variation in genetic resources

Deliverables:

Description	Type	Year	Status	Justification
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 and South/Central Asia	Data	2014	On going	
Germplasm with drought and heat tolerance and resistance to insect pests and diseases identified for East Africa and South/Central Asia Region.	Workshop	2014	On going	
Applied mathematics to search for CC related traits: Applied mathematics approaches have the potential to help in searching for genes that are not yet readily available within the current crop improvement gene pools for adaptation to climate change. Recent research using mathematical models has led to the discovery of previously undiscovered genes and useful variants of known genes for resistance to serious pests and diseases as well as in traits related to tolerance to climate change. The mathematical modelling process involves different layers of available omics including genomics.	Workshop	2014	On going	
Development of rapid GR phenotyping prototype for CC related traits - phenoGR_CC	Platforms - Data Portals for dissemination	2014	On going	

Description	Type	Year	Status	Justification
ISI articles along with summary workshop proceedings on the potential of genetic resources to adapt and mitigate climate change. Participation in international events to present the research results vis avis CC, such as the international conference on Genetic Resources for Food and Agriculture in a Changing Climate to be held at Lillehammer, Norway early 2014.	Non-peer reviewed articles	2014	On going	

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Location(s):

Global

Activity 673-2014

Monitoring of population changes and adaptation of insect pests and diseases of cereals and legumes

Status	Complete	Milestone	1.2.1 2014
Start date	2011 Jan	End date	2015 Dec

Description: This activity surveys insect pests and diseases of cereals (wheat and barley) and food legumes (chickpea, lentil and faba bean) in Morocco, Uzbekistan and Ethiopia, and examines the intensity of their incidence due to climate variables, and works with breeders to identify tolerant and resistant plants. The activity maps the risk of these pests and diseases in three regions (East and southern Africa, Central Asia and North Africa) using regional climatic data. The survey provides information on pest status and other maps (farming systems) to fine tune the pest risk maps. The two season survey data will be published at in 2013.

Status: Complete. Survey of diseases and insect pests of cereals and cool-season food legumes in Ethiopia, Morocco and Uzbekistan were done for 2-3 years. The results were presented in annual conference and preliminary risk map for yellow rust is developed that will be refined in the future with additional information. Minor and new diseases and insect pests identified and germplasm screening started for anticipatory plant breeding.

Gender Component: During the survey some women farmers in Ethiopia expressed the impact of new diseases and insect pests will affect their livelihood more than men due to shortage of resources (buying pesticides; weeding etc) to combat the pests.

Objectives:

1. To develop risk distribution maps of cereal and food legume insect pests, parasitic weeds and diseases in central Asia, North & East Africa and South Asia.

Deliverables:

Description	Type	Year	Status	Justification
1) Major changes in population structures of insect pests and diseases monitored in West Asia 2) Distribution maps for pests and diseases produced for the three regions; 3) Trained NARS partners (including women) in pests & diseases monitoring. These deliverables will contribute to designing new strategies for coping with new emerging pests & diseases.	Peer-reviewed journal articles	2015	Incomplete	
The reports summarizes the key diseases and insect pests of cereals and food legumes recorded during 2013/14 cropping season	Research report (i.e. workshop report, consultant's report, discussion paper, project report, student thesis, etc.)	2014	Complete	
It is a survey report on the outbreak of lentil rust in Ethiopian highlands that affect lentil production due to an usual extended rainfall (Climate variability)	Research report (i.e. workshop report, consultant's report, discussion paper, project report, student thesis, etc.)	2014	On going	Since the disease outbreak affects the incomes of many farmers, introduction and scaling out of resistant lentil cultivars will be done in 2015/16 cropping season through government funding and CRP-GL

Description	Type	Year	Status	Justification
The report summarizes key insect pests and diseases of cereals and food legumes during short and long rainy season in Ethiopia.	Research report (i.e. workshop report, consultant's report, discussion paper, project report, student thesis, etc.)	2014	Complete	
The map showed yellow rust distribution based on survey data	Research report (i.e. workshop report, consultant's report, discussion paper, project report, student thesis, etc.)	2014	On going	In order to fin tune the disease risk map, additional surveys are needed that can be supported with other sources
	Data	2014	On going	
The 2-3 years survey results were presented in 11th ACPP, Amman, Jordan, November 2014	Workshop	2014	Complete	

Partners:

- 1- Ethiopian Institute of Agricultural Research (EIAR):
Dr. Tebkew Damte <tebkew@yahoo.com>
- 2- Institut National de la Recherche Agronomique (INRA):
Dr. Saadia Ihaloui <lhaloui@hotmail.com>
- 3- Amhara Regional Agricultural Research Institute (ARARI):
Mr. Beyene Bitew <beyenebitew@yahoo.com>

Location(s):

Countries: Ethiopia, Morocco, Uzbekistan,

Activity 675-2014

Monitoring and modeling of the effects of extreme rainfall events on land, water and productivity to formulate adaptation strategies

Status	Complete	Milestone	2.1.2 2014
Start date	2014 Jan	End date	2015 Jan

Description: The activity will analyze the most critical period during the year where extreme events are happening and to predict the trend in the future according to climate change. Land use and land degradation experts from two countries with different agro-ecosystems and climatic setups (Jordan and Ethiopia) will suggest the best adaptation strategies through changing land use and management practices (tillage, planting time and harvesting, crop varieties, soil and water conservation intervention, water harvesting, and other SLM that will help farmers to protect their land during these critical periods. these options will be tested and verified using calibrated model (SWAT) to understand their efficiency in controlling land degradation and improving productivity. The promising SLM and the use of the model to understand their impact will be disseminated to the stakeholders. It is anticipated that these will help in improving farmers' livelihoods and reduce their vulnerability to the expected occurrence of extreme events. In addition to these anticipated benefits, this activity is highly justified since the impact of and mitigation strategies against the occurrence of extreme rainfall events are very scarce in the literature, especially from practical point of view.

Status: Complete. The funding of the corresponding activity ended in 2014 – nevertheless, climate change research, incorporated within the different projects in Ethiopia and Jordan, is still ongoing. The impacts of proposed climate change scenarios and proper adaptation is expected to be a major key to assure certain level of livelihood in regions threatened by ongoing land degradation and/or desertification. Some of the set targets for 2014 have been achieved, whereas some other activities related to the targets set for 2014 are still in progress to fully satisfy the proposed outcomes. The effects of climate change and specifically potential SLM adaptations require profound regional knowledge and the assessment of the local farmers' needs and willingness. Collaborative evaluation of potential SLM techniques was found to be essential to achieve proper climate change adaptation.

Gender Component: Gender integration plays a major role within the Ethiopian climate change activities. The promotion of fuel efficient cooking technology was a great success in the Ethiopian watershed, reducing energy supply by approximately 50 percent, and thus, reducing dangerous emissions for health and environment likewise. Eventually, 800 stoves were produced and 570 stoves were distributed in the considered area (stage 2014). Moreover, the payment of the stoves was linked to ecosystem related workloads, which strengthens regional SWC effectivity connected to other watershed activities funded by WLE and ADA. Hence, the gender activity initiated through CCAFS will be prolonged in the future and the fuel saving cooking technology will be further promoted in close collaboration with different governmental and development offices.

Objectives:

1. Provide robust model to evaluate impact of climate change and extreme events on land and water resources and provide options to maintain productivity and halt land degradation
2. Formulate adaptation strategies by changing land use and/or land management practices to help farmers to escape the effect of extreme event

Deliverables:

Description	Type	Year	Status	Justification
Stakeholder workshop to discuss model outputs and suggest changes in land use practices and formulate adaptation strategies	Workshop	2014	On going	Final stakeholder workshop is planned to be held in 2015. However, in 2014, a climate change workshop 'Adaptation to Extreme Climatic Events Through Sustainable Land Management' was held in Amman, to mainstream climate change understanding and its implementation in modeling. The scenarios and constraints were defined in collaboration with representatives and scientists from Jordan University and Ministries, and reflect one major part of the proposed climate change dialogue. In the relative workshop report (attached) meteorological observations and statistical analysis procedures related to Ethiopian and Jordan sites were documented. The diverse climate change modeling understanding raised during the modeling workshop reinforced SWAT specific CC consideration and discussion - which lead to a follow up CC modeling workshop scheduled for May 2015. This reflects the importance of the topic for both governmental but also scientific organizations. However, a final CC adaptation workshop including different stakeholders and scientists is planned to be undertaken in 2015.

Description	Type	Year	Status	Justification
Calibrated model that enable users to change land use practices and test the impact on adapting to extreme events	Platforms - Data Portals for dissemination	2014	Complete	SWAT model was set up and calibrated for Ethiopia and Jordan sites. Specifically the Jordan (Zarqa River Basin) SWAT model shall be used as a basis for discussion and demonstration of climate change impacts and potential adaptation strategies. The output of different SLM scenarios is shown in the attached workshop report (Deliverable 1). However, the final output will be provided in accordance to the stakeholder workshop, which is planned to be given in 2015.
Dessimation of model procedure and facilitate use by stakeholders	Articles for media or news (radio, TV, newspapers, newsletters ,etc.)	2015	Incomplete	
Publication of the role of model and adaptation strategies (options) to cope with climate change, especially extreme events	Peer-reviewed journal articles	2014	On going	Peer reviewed journal publication is not yet finished. As for a progress reference - in attachment there is a progress report of the planned publication (Zarq river basin.pdf) and an Abstract submitted for a local conference presentation of Dr. Michel Rahbeh. Finishing of the paper is expected for 2015.

Partners:

1- Texas A&M University:

Raghavan Srinivasan <r-srinivasan@tamu.edu>

2- National Center for Agricultural Research and Extension (NCARE):

Mohammed Mudabbar <mmudaber@yahoo.com>

3- University of Jordan (UoJ):

Awni Taimeh <ataimeh@ju.edu.jo>

4- Water, Energy and Environment Center (WEEC):

Maisa Shammout <maisa_shammout@hotmail.com>

5- Amhara Regional Agricultural Research Institute (ARARI):
Birru Yitaferu <birru_yitaferu2002@yahoo.com>

Location(s):

Countries: Ethiopia,

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

Output: 1.1.1

Summary: 1) SPI for drought assessment and drought prediction; new genotypes of durum wheat tested;

2) supplemental irrigation package and water harvesting systems for adaptation to drought in changing climate.

Output: 1.2.1

Summary: A climate change workshop 'Adaptation to Extreme Climatic Events Through Sustainable Land Management' was held in Amman from 7th to 9th of January, 2014. Different scientists and Ministry representatives defined potential climate change scenarios to be modelled (SWAT) to gain a deeper insight into the different effects of climate change on the water balance and also crop productivity. A final workshop related to proper SLM strategies will be held in 2015.

Also in Ethiopia a 'Climate Change and Smallholder Agriculture in Ethiopia' workshop was given on 15 and 16 December 2014, funded by USAID and CCAFS. In this manner, a poster was presented under the title 'Agricultural Technologies to Enhance Farmers' Adaptation Capacity to Climate Change Impacts: Lessons from Gumara-Maksegnit Watershed'. Conclusions from the workshops will be used to define proper adaptation strategies in collaboration with farmers and crop and soil scientists in the watershed.

Output: 2.1.2

Summary: In example watersheds in both activity related countries (Jordan and Ethiopia), Soil and Water Assessment Tool (SWAT) was used to model present watershed characteristics. The set-up and calibrated model can be used as a tool to simulate defined future climate change scenarios – and thus to conclude on potential future conditions and to allocate endangered regions concerning land degradation e.g. Ongoing discussion with governmental and non-governmental organizations rises the awareness and enforces consideration of proper SLM strategies.

3. Communications.

Media Campaigns:

Several articles on applied mathematics to assess genetic resources for climate change related traits appeared in different media:

Mathematics helps find food crops' climate-proof genes

By Mark Kinver, BBC News on 15 August 2014

– <http://www.bbc.com/news/science-environment-28789716>

– <http://www.bcfoodsecuritygateway.ca/modules.php?name=Content&pa=showpage&pid=17437>

– <http://www.globalharvestinitiative.org/index.php/author/admin/>

– <http://www.afaas-africa.org/> (African Forum for Agricultural Advisory Services)

The Water Warriors: 12 Hot Drought-Fighters in the Advanced Bio-economy

By Jim Lane, 17 August 2014

– <http://www.biofuelsdigest.com/bdigest/2014/08/17/the-water-warriors-12-hot-drought-fighters-in-the-advanced-bioeconomy>

Mathematical models help sort through the cupboards of the world's agricultural genebanks

By Lucy Holt (CCAFS), 24 August 2014

– <http://ccafs.cgiar.org/blog/mathematical-models-help-sort-through-cupboards-worlds-agricultural-genebanks#.VBA6yPmSz3Q>

FIGS identifies climate-proof crop varieties

By CGIAR Consortium, 01 September 2014

– <http://www.cgiar.org/consortium-news/figs-identifies-climate-proof-crop-varieties/>

Africa's farmers face 'failed seasons' risks

By Mark Kinver, 02 September 2014

– <http://www.bbc.com/news/science-environment-29015418>

Big Data's Big Role in Agriculture

By Stephen F. DeAngelis, 03 September 2014

– <http://www.enterrasolutions.com/2014/09/big-datas-big-role-agriculture.html>

Blogs:

In parallel to the session of the workshop on applied mathematics and omics to genetic resources, information on different session were deployed in the web at:

<http://figs.icarda.org/blog/update-5-workshop-applied-math-genetic-discovery-climate-change>

Websites:

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

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

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

Social Media Campaigns:

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- <http://www.afaas-africa.org/> (African Forum for Agricultural Advisory Services)

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Big Data's Big Role in Agriculture

By Stephen F. DeAngelis, 03 September 2014

- <http://www.enterrasolutions.com/2014/09/big-datas-big-role-agriculture.html>

Newsletters:

A 'Field day on Grazing Management under water harvesting systems' newsletter was produced and distributed at various project events.

Events:

Annual project meeting in Bahir Dar, Ethiopia, in January 2014, including project partners and representatives from regional government organizations and development agencies (ADA).

Field day on Grazing Management under water harvesting systems in the Al-Majdiyya watershed in May 2014.

A workshop on "Applied mathematics and omics to assess genetic / biodiversity" for climate change adaptive traits was held in Rabat June 2014. This event was conducted as a follow up to the major global events related to mathematics (Mathematics of Planet Earth even) and Genetic Resources for

Food and Agriculture in a Changing Climate, 27-29 January 2014, Lillehammer, Norway - <http://climate.nordgen.org/program>).

Videos and other Multimedia:

Several of blogs were produced as follows:

1. Posted a blog on CCAFS website: A livelihood on the move: Surviving on marginal lands in India
<http://ccafs.cgiar.org/blog/livelihood-move-surviving-marginal-lands-rajasthan-india#.VHyMjctxID8>
2. Posted a blog on ICARDA website: A Livelihood on the Move: Surviving on marginal lands in Rajasthan, India
<http://www.icarda.org/livelihood-move>
3. Produced a short movie which was posted on CRP CCAFS for South Asia and on youtube:
https://www.youtube.com/watch?v=unUe5BWM_AE&list=UUwzPIJDIXyBNQuEL-YdzRpQ
4. Posted a blog for the CGIAR Talking Science Competition:
<http://dialogues.cgiar.org/blog/feet-too-sore-looking-for-forage/>
Won Second Prize as a winner by public vote
5. Posted a blog for the CGIAR Talking Science Competition titled “Feet too sore looking for forage?”
<http://dialogues.cgiar.org/blog/feet-too-sore-looking-for-forage/>
6. A website was created to provide students and professionals with information about ecosystem monitoring throughout the developed and developing world. <http://www.vegmeasure.org/>
The video “Introduction to rangeland measurement, monitoring and analysis” introduces students to digital charting.
<https://www.youtube.com/watch?v=6YKqP-yRXXc>
7. “Cursory review of basic statistics for rangelands measurement and analysis” video provides the basic statistics for rangelands measurement and data analysis
<https://www.youtube.com/watch?v=UfIWutA4z7E>
7. Five factsheets were developed and posted on the ICARDA websites for public use:
Louhaichi M. and A.O. Belgacem. 2014. Cenchrus ciliaris: A resilient, drought-tolerant forage species to alleviate feed shortages and feeding costs. ICARDA's publication (Factsheet)
<http://www.icarda.org/sites/default/files/Bufel-grass-Factsheet.pdf>
Louhaichi M. and M. Neffati 2014. Retama raetam: A resilient, pioneer plant for rangeland rehabilitation and stable ecosystems. ICARDA's publication (Factsheet)
<http://www.icarda.org/sites/default/files/Retama-Shrub-Fact-Sheet.pdf>
Louhaichi M. and A.O. Belgacem. 2014. Stipa lagascae: A heavy, adaptable grass that provides high quality hay. ICARDA's publication (Factsheet)
<http://www.icarda.org/sites/default/files/Stipa-lagascae-Factsheet.pdf>
[Louhaichi](http://www.icarda.org/sites/default/files/Stipa-lagascae-Factsheet.pdf) M. and M. Abu Zanat. 2014. Mediterranean saltbush: mitigating highly saline soils. ICARDA's publication (Factsheet)
<http://www.icarda.org/sites/default/files/Mediterranean-saltbush-Factsheet.pdf>
8. Field day on Grazing Management under Water Harvesting Systems

http://icarda.org/wli/news_Field-day-on-Grazing-Management.html

Other Communications and Outreach:

A five page brochure (acknowledged to WLE, ADA and CCAFS) was printed and is in use for various project events such as annual meetings.

Damania A, S. Dayanandan, and A. Bari (ed.), 2014. Abstracts of the International Workshop on Applied Mathematics and Omics Technologies for Discovering Biodiversity and Genetic Resources for Climate Change Mitigation and Adaptation to Sustainable Agriculture in Drylands, 24–27 June 2014, Rabat, Morocco. International Center for Agricultural Research in the Dry Areas (ICARDA). Rabat Institute, Morocco.- ISBN 02-9127-460-7

4. Case studies.

Case Study #1

Title: Adoption of Deficit Supplementary Irrigation and water harvesting by farmers in Morocco

Author: Mohammed Karrou, Mohamed Boutfirass and Abdeljabbar Bahri

Type: Participatory action research ;

Project Description:

West Asia and North Africa (WANA) like other dry areas worldwide is characterized by low and extremely variable rainfall, frequent droughts and land degradation which are exacerbated by climate change. Consequently, Agricultural productivity is low and unstable. One strategy that has the potential to provide large productivity gains and sustainability and hence improve the livelihoods of poor people who live in rainfed and marginal areas of WANA region is the development and use of proactive systems of drought preparedness and mitigation.

Introduction / objectives:

This activity develops methodology, and collects sets of secondary data needed for computing drought indices (SPI) and their correlations with cereal yields; conducts surveys, field trials and on-farm demonstrations to evaluate the impacts of drought mitigation techniques/technologies such as supplemental irrigation, crop management (planting date, zero tillage, varieties of wheat) and water harvesting. This will help develop tools and options of drought risk management in the dry area.

Project Results:

- 1) Technologies and farm practices developed and disseminated in Morocco: deficit supplemental irrigation using 2/3 of crop water requirements combined with improved nitrogen fertilizers management, weeds and disease control, adapted variety). Deficit supplemental irrigation can be out-scaled to all agro-systems where rainfall is between 250-500 mm.
- 2) Contour ridges water harvesting system using the Vallerani machine developed and disseminated in Jordan. The Vallerani machine can be out-scaled to all agro-pastoral areas where rainfall is less than 250 mm
- 3) The combination of the use of the Standardized Precipitation Index (SPI) to predict drought and options of drought mitigation (supplemental irrigation package, water harvesting) are tools/guidelines that can be used by stakeholders, especially the NARS and regional extension departments to develop plans for the management of the risk of recurrent droughts in the dry areas. The report on the guidelines was prepared.
- 4) Improved supplemental irrigation package work showed that farmers who used the improved package of deficit supplemental irrigation saved 1200 m³/ha of irrigation water and the grain yields of

their wheat crop increased by 1.1 ton/ha under what climatic conditions.

In the area of 10,000 ha of wheat where the activity is conducted, 4,000 ha are conducted under full supplemental irrigation and 2,000 ha with deficit supplemental irrigation package.

5) In Jordan, the Vallerani water harvesting tool has now been adopted in 2100 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)

NCARE-Jordan

Ministry of Agriculture, Jordan

Case Study #2

Title: In silico evaluation of plant genetic resources to search for traits for adaptation to climate change

Author: Abdallah Bari

Type: Successful communications; Breakthrough science; Food security;

Project Description:

Plant genetic resources display patterns resulting from ecological and co-evolutionary processes. Such patterns are instrumental in tracing the origin and diversity of crops and locating adaptive traits. With climate change and the anticipated increase in demand for food, new crop varieties will be needed to perform under unprecedented climatic conditions. In the present study, we explored genetic resources patterns to locate traits of adaptation to drought and to maximize the utilization of plant genetic resources lacking ex ante evaluation for emerging climate conditions. This approach is based on the use of mathematical models to predict traits as response variables driven by stochastic ecological and co-evolutionary processes. The high congruence of metrics between model predictions and empirical trait evaluations confirms in silico evaluation as an effective tool to manage large numbers of crop accessions lacking ex ante evaluation. This outcome will assist in developing cultivars adaptable to various climatic conditions and in the ultimate use of genetic resources to sustain agricultural productivity under conditions of climate change.

Introduction / objectives:

The present case study uses faba bean crop (*Vicia faba* L.) to test the predictions of the mathematical model to search effectively and rapidly for adaptive traits. The overall objective is to develop new germplasm for breeding purposes to sustain agriculture under rapid global changes including climate change.

Project Results:

The case shows that mathematical and conceptual frameworks can use limited evaluation information to explore genetic resources collections of thousands of accessions lacking ex ante evaluation. Further more there is also possibility to carry out in silico evaluation by predicting key physiological traits that are difficult to measure (such as photosynthetic capacity) using a simple qualitative combination of plant trait characteristics that are easily measured ("soft") and climate variables.

Partners:

Abdallah Bari¹, Hamid Khazaei², Kenneth Street¹, Mikko J. Sillanpää³, Dag T. F. Endresen⁴, Eddy De Pauw¹, Yogen P. Chaubey⁵, Selvadurai Dayanandan⁶ and Frederick L. Stoddard²
Ardeshir B. Damania⁷

¹ International Centre for Agricultural Research in the Dry Areas, ICARDA, Rabat Office, P O Box 6299 Rabat-Instituts, Rabat, Morocco

² Department of Agricultural Sciences, P O Box 27 (Latokartanonkaari 5), University of Helsinki, FIN-00014, Finland

³ Department of Mathematical Sciences, Department of Biology and Biocenter Oulu, P O Box 3000,

FIN-90014 University of Oulu, Finland

4 GBIF Norway, Natural History Museum, University of Oslo, Norway

5 Department of Mathematics and Statistics, Concordia University, 1455 de Maisonneuve Blvd. West
Montreal, Quebec, H3G 1M8, Canada

6 Department of Biology, Concordia University, 7141 Sherbrooke West, Montreal, Quebec, H4B 1R6,
Canada

7 Dept. of Plant Sciences, Mail Stop 3, University of California, Davis, CA 95616, USA

5. Outcomes.

Outcome #1:

Adoption of supplemental irrigation technique by farmers in wheat 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 and deficit irrigation package of wheat crop in the Tadla region of Morocco on 6000 hectares as adaptation strategy to climate change (increased frequency of droughts experienced by farmers).

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?

Supplemental irrigation and improved cropping management package of wheat

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?

Surveys; Farmers and extension service testimony

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 in wheat by farmers as adaptation to Climate Change.

The outcome is the adoption of farmers on up to 10000 full supplemental irrigation and deficit supplemental irrigation package adopted by farmers on wheat 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 this climate variability 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 m³ of irrigation water, on average.

Supplemental irrigation (SI) work on wheat started 8 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 full supplemental irrigation package and 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 deficit supplemental irrigation 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 m³ of irrigation water, on average.

Surveys were implemented in 2013 and 2014 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.

In the area of 10,000 ha of wheat where the activity is conducted, 4,000 ha are conducted under full supplemental irrigation and 2,000 ha with deficit supplemental irrigation package.

Evidence:

- 1) Surveys of 100 + 120 farmers were conducted and showed that 72% of farmers adopted FSI and 21% of them applied DSI.
- 2) The testimony of farmers and extension services.

Outcome Indicator:

Breeding strategies of regional and national crop breeding institutions in three target regions are coordinated, informed by CCAFS-led crop modeling approaches that are developed and evaluated for biotic and abiotic constraints for the period 2020 to 2050

Achievements:

Based on survey results, key new and emerging pests (faba bean stem borer, lentil rust and faba bean gall) were identified and development of resistance germplasm is being developing by the breeding program in at ICARDA and Ethiopian National Program

Evidence:

Selected materials can be shared with NARS upon requests.

Outcome Indicator:

Global database and set of tools for climate-smart agriculture established and used by key international and regional agencies

Achievements:

Geo-referenced pest incidence data collected for three years from Ethiopia, Morocco and Uzbekistan are kept at GIS Unit of ICARDA for current and future pest predication modeling

Evidence:

Evidence not defined

8. Leveraged funds.

There is no Leverage funds

9. Publications.