Theme 1 – Annual Report 2011

1.3 THEME 1 CORE ACTIVITIES SUMMARY

Output 1.1.1 Development of farming systems and production technologies adapted to climate change conditions in time and space through design of tools for improving crops, livestock, and agronomic and natural resource management practices

- Phase II of the Multi-site agricultural trial data repository for climate change analysis (Agtrials) completed. **Deliverables:** Registration of 2380 trials, development new geographic interface allowing making queries, the database structure, new blog and communication protocols. New partnerships developed (i.e University of California, AgMIP project, Tropical Legumes project, Monsanto) and successful integration with the GCP's CropOntology. Generic method and R library created for the analysis of Genotype-by- environment interactions using multi-site trial data and climate databases; two case studies carried out on the use of trial sites data for seasonal forecasting of crop yields (Beans and Potatoes).

- Improvement and evaluation of the Analogue tool.
  Deliverables: Development of online interface of the analogue methodology (http://gismap.ciat.cgiar.org/Analogues/) and evaluation of the analogue tool using agricultural trial data for Rice, Wheat and Maize.

Output 1.1.2 Building of regional and national capacities to produce and communicate appropriate adaptation and mitigation strategies for progressive climate change at the national level (e.g. through NAPAs)

- Development of a novel methodology for interdisciplinary resilience and adaptation research and Social Return On Investment costing.
  Deliverables: PSROI analytical framework developed and pilot studies -including three day workshops- carried out in Kenya and Senegal to test the framework through a combination of methodological tools. CCAFS Working Paper: Community Based Adaptation Costing: An integrated framework for agricultural adaptation analysis using Social Return on Investment (SROI). Available soon at: http://ccafs.cgiar.org/resources/working-papers

- Capacity development of the Analogue methodology:
  Deliverable: Training workshop "Using Climate Scenarios and Analogues for designing adaptation strategies in Agriculture" organized in Nepal; 30 participants from EA, WA and IGP (12 countries).

Output 1.1.3 New knowledge synthesizing institutional arrangements, policies and mechanisms for improving the adaptive capacity of agricultural sector actors and those involved in managing the food system

- Ongoing analysis of the role of rural institutions in enabling adaptation to climate change in the agricultural sector (by the Stockholm Environment Institute).
  Deliverable: Discussion paper that synthesizes institutional arrangements, policies and mechanisms for improving the adaptive capacity of agricultural sector and 2 page executive summary converted into a policy brief (Joint CCAFS-Partner branding)

- Adaptation and Mitigation Knowledge Network (AMKN) officially launched after completion of the proof of concept as a georeferenced aggregator of climate change adaptation and mitigation information.
  Deliverables: Training of CCAFS staff for its maintenance and content curation, and design of a roadmap for the further development of the platform.

Output 1.1.4 Testing of participatory methods that are sensitive to gender, livelihoods categories and other social differentiators, to apply globally

- Ongoing study of farmer's social, cultural and gender specific barriers for enabling behavioral change and improve adaptive capacity, based on farmers' exchanges between climatic analogues locations in the tree CCAFS initial regions.
  Deliverables: Partner organizations contracted (Greenwich University and Oxford university/Adelaide University); initial sites selected; potential local partners identified and preliminary field visits planned for April in Nepal, May in Ghana and Tanzania.

Output 1.2.1 Understanding and evaluating the response of different varieties/crops to climate change in time and space, and generating comprehensive strategies for crop improvement through a combination of modelling, expert consultation and stakeholder dialogue

- Breeding strategies for future climate stresses; Planning workshops held in Cali and first regional workshop held in Addis Ababa.
  Deliverables: Development of a solid research framework and a 3 years action operational plan for CCAFS to support breeders in the design of strategies that will tackle the stresses related to future/ novel climates; engagement with regional crop improvement institutions to identify potential improvement scenarios and begin to incorporate into models. Visions developed and strategies devised for four target crops sorghum, rice, beans and bananas. A total of 50 participants representing the breeding and modeling communities from 16 countries attended the workshops.

- Assessing impacts of progressive climate change on agricultural production of the most important crops within the three CCAFS regions.
  Deliverables: Calibration of EcoCrop model performed with data of Sorghum, Barely and groundnut; EcoCrop model used to predict the impacts of climate change on sorghum, barley and cassava. Two papers submitted to Agricultural and Forest Meteorology and one to Tropical Plant Biology.

- Continued development of crop modelling approaches for major crops to evaluate impacts and run scenario analysis (e.g. crop improvement scenarios) and improved understanding of temperature thresholds used in crop models.
  Deliverables: GLAM crop model runs for Indian Wheat

- Continued development of climate projections, with other themes, including the identification of GCM data for use in CCAFS and the consolidation of downscaled climate surfaces (collaboration with Theme 4). **Deliverables:** new version for ccafs-climate.org portal ready including data produced at ILRI/IFPRI and outputs from PRECIS; CMIP3 projections ready to be added to the portal (infrastructure issue); CMIP5 climate data downloaded and ready to be processed (i.e. downscaled).

- Incorporation of pest and disease models into other crop and cropping systems models.
  Deliverables: Paper "*The effects of climate variability and the color of weather time series on agricultural diseases and pests, and on decisions for their management"* by Garrett et al. submitted to AFM.

Output 1.3.1 New knowledge, guidelines and access to germplasm are provided for using genetic and species diversity to enhance adaptation, productivity and resilience to changing climate

- **Ongoing development of the on-farm rice participatory network** for climate change adaptation and visualization in the Indo-Gangetic Plains (Phase II).

Deliverables: Field trials of 14 and 8 selected rice varieties performed at 18 farmers' fields in India and Nepal, respectively (Karnal, Haryana and Pusa, Bihar in India; and Parwanipur, Nepal); Data on several morphological traits are being recorded. Farmers' field days carried out.

1.4 ACTIVITY REPORTING SUMMARY

See intranet Excel document.

1.5 PUBLICATIONS

Peer-reviewed papers

- **Challinor, A.** 2011. Forecasting Food. Nature Climate Change (1):103-104.
- **Challinor, A. J.,** M. Stafford Smith, P. K. Thornton (submitted). Agro-climate ensembles: emerging tools for quantifying uncertainty and informing adaptation. Agricultural and Forest Meteorology.
- **Challinor, A. J.** (2011) "Commentary on Chapter 2.1: Climate Change Projections in Some Asian Countries" in Climate Change Adaptation and International Development. (Eds. R. Fujikura and M. Kawanishi). Earthscan ISBN 978-1-84971-152-4. p. 63-65
- **Garret K.A.,** Dobson, A. D. M., Kroschel, J. , Natarajan, B., Orlandini, S., Tonnang, H. E. Z., Valdivia, C.The effects of climate variability and the color of weather time series on agricultural diseases and pests, and on decisions for their management. Submitted AFM
- Hawkins, E., T. M. Osborne, Chun Kit Hoa, **A. J. Challinor** (submitted). Calibration and bias correction of climate projections for crop modelling: an idealised case study over Europe. Agricultural and Forest Meteorology.
- Hollaway, M. J., S. R. Arnold, **A. J. Challinor**, and L. D. Emberson (2011). Intercontinental trans-boundary contributions to ozone-induced crop yield losses in the Northern Hemisphere. Biogeosciences, 9, 1–22, 2012
- **Jarvis, A**.; Mulligan, M. 2011.The climate of cloud forests. Hydrological Processes (United Kingdom), 25(3): 327-343.
- **Jarvis, A.; Lau, C**.; Cook, S.E.; **Wollenberg, E.; Hansen, J.; Bonilla, O.; Challinor, A**. 2011. An integrated adaptation and mitigation framework for developing agricultural research: synergies and trade-offs. Experimental Agriculture 47:185-203.
- **Jarvis, A., Ramirez-Villegas, J**., Herrera Campo, B.V., **Navarro-Racines, C.E.** 2011. Is Cassava the Answer to African Climate Change Adaptation? Tropical Plant Biology, accepted for publication.
- Jiménez, D.; Cock, J.; **Jarvis, A**.; García, J.; Satizábal, H.F.; Van Damme, P.; Pérez Uribe, A.; Barreto Sáenz, M.A. 2011. Interpretation of commercial production information: a case study of lulo (Solanum quitoense), an under-researched Andean fruit. Agricultural Systems 104(3):258-270
- Mulligan, M.; Fisher, M.; Sharma, B.; Xu, Z.X.; Ringler, C.; Mahé, G.; **Jarvis, A.; Ramírez, J**.; Clanet, J.C.; Ogilvie, A.; Ahmad, M. 2011. The nature and impact of climate change in the challenge program on water and food (CPWF) basins. Water International 36 (1): 96-124.
- Maxted, N.; Kell, S.; Toledo, Á.; Dullo, E.; Heywood, V.; Hodgkin, T.; Hunter, D.; Guarino, L.; **Jarvis, A.** & Ford-Lloyd, B. 2011. A global approach to crop wild relative conservation: securing the gene pool for food and agriculture. KEW BULLETIN VOL. 65: 561–576.

- **Ramirez-Villegas, J**., Jarvis, A., Laderach, P. In press. Empirical approaches to assess the impacts of climate change on agriculture: The EcoCrop model and a case study with grain sorghum. *Agricultural and Forest Meteorology*. http://dx.doi.org/10.1016/j.agrformet.2011.09.005
- **Ramirez-Villegas, J**., Salazar-Villegas, M, Jarvis, A. and Navarro-Racines, C.E. 2011. A way forward on adaptation to climate change in Colombian agriculture: Perspectives towards 2050. *Climatic Change*, accepted for publication
- **Ramirez-Villegas, J**., Challinor, A. 2011. Assessing relevant climate data for agricultural applications. Submitted to *Agricultural and Forest Meteorology.*
- Watson, J. and **A. J. Challinor** (submitted). The relative importance of rainfall, temperature and yield data for a regional-scale crop model. Agricultural and Forest Meteorology.
- Vermeulen S.J.; Aggarwal,P.K.; Ainslie,A.; Angelone, C.; Campbell, B.M.; **Challinor A.J.;** Hansen, J.W.; Ingram, J.S**.; Jarvis, A**.; Kristjanson, P.; **Lau, C**.; Nelson, G.C.; Thornton P.K.; Wollenber, E. 2011. Options for support to agriculture and food security under climate change. *Environmental Science and policy*.
- Vermeulen, S., R. Zougmore, E. Wollenberg, P. Thornton, G. Nelson, P. Kristjanson, J. Kinyangi, **A. Jarvis, J**. Hansen, A. J. Challinor, B. Campbell and P. K. Aggarwal (2012). Climate change, agriculture and food security: a global partnership to link research and action for low-income agricultural producers and consumers. Current Opinion in Environmental Sustainability, 4:1–6

Book chapters

- Beebe, S., **Ramirez, J.**, **Jarvis, A.,** Rao, I.M., Mosquera, G., Blair, M., and Bueno, J.M. 2011. Chapter 16: Common Beans and the Challenges of Climate Change. *In:* Yadav, S., Redden, B. Hattfield, J.L., and Lotze-Campen, H. (Eds.) Crop Adaptation to Climate Change. Wiley-Blackwell.
- Ceballos, H., **Ramirez, J.**, Belloti, A.C., **Jarvis, A**., and Alvarez, E. 2011. Chapter 19: Adaptation of Cassava to Changing Climates. *In:* Yadav, S., Redden, B. Hattfield, J.L., and Lotze-Campen, H. (Eds.) Crop Adaptation to Climate Change. Wiley-Blackwell.
- **Jarvis, A**.; **Ramirez, J**.; **Bonilla-Findji, O**, and Zapata, E. 2011. Impacts of Climate Change on Crop Production in Latin America, Chapter 3.1. In Crop Adaptation to Climate Change, ISBN: 978-0-8138-2016-3, 632 p
- Laderach P.; Lundy M.; **Jarvis A.; Ramirez J**. Perez-Portilla, E; Schepp K. and A. Eitzinger. 2011. Predicted Impact of Climate change on Coffee Supply Chains. In: *The Economic, Social and Political Elements of Climate Change*, 703–723, W.L. Filho (ed,). Available:http://www.springerlink.com/index/10.1007/978-3-642-14776-0
- Padulosi, S.; Heywood,V.; Hunter, D.; and **Jarvis, A**. 2011. Underutilized Species and Climate Change: Current Status and Outlook, Chapter 26. In Crop Adaptation to Climate Change, ISBN: 978-0-8138-2016-3, 632 p.
- **Ramirez, J.**, **Jarvis, A.,** Van den Bergh, I., Staver, C., and Turner D. 2011. Chapter 20: Changing Climates: Effects on Growing Conditions for Banana and Plantain (*Musa* spp.) and Possible Responses. *In:* Yadav, S., Redden, B. Hattfield, J.L., and Lotze-Campen, H. (Eds.) Crop Adaptation to Climate Change. Wiley-Blackwell.
- Snook, L.K., Dulloo M.E., **Jarvis, A**., Scheldeman, X. and Kneller, M. 2011. Crop Germplasm Diversity: The Role of Gene Bank Collections in Facilitating Adaptation to Climate Change, Chapter 25. In Crop Adaptation to Climate Change, ISBN: 978-0-8138-2016-3, 632 p.
- Schaefleitner, R., **Ramirez, J.**, **Jarvis, A**., Evers, D., Gutierrez, R., and Scurrah, M. 2011. Chapter 11: Adaptation of the Potato Crop to Changing Climates. In: Yadav, S., Redden, B. Hattfield, J.L.,

and Lotze-Campen, H. (Eds.) Crop Adaptation to Climate Change. Wiley-Blackwell, ISBN: 978-0-8138-2016-3, 632 p.

Proceedings

- Fonte, S.J.; González, A.; Graefe, S.; Guimaraes, E. Perpétuo; M.G.; **Jarvis, A**.; Lavelle, P.; Lundy, M.; Peters, M.; Quintero, M.; Rao, I.; Tapascco, J.; Etter, A.; Martínez, C.; Murgueitio, R.,E.; Reis, C.J.; Rodríguez, C.A. 2011. Strategy in action abridged version: Amazon region eco-efficient landscapes = Estrategia en acción versión abreviada: Región Amazónica paisajes eco-eficientes . Centro Internacional de Agricultura Tropical (CIAT), Cali, CO. 2 p. (CIAT Strategy in action No. 2 (abridged version) CIAT Estrategia en acción No. 2 (versión abreviada)
- **Jarvis, A.; Ramirez, J.;** Castañeda, N.; Guarino, L. 2011,The critical role of crop wild relatives in ensuring long-term food security and their need for conservation, XXIX Congreso Latinoamericano de quimica, September 2011, Cartagena, Colombia.
- Khoury, C.; Castañeda-Alvarez, N.P.; Vincent, H.; **Jarvis, A.;** Maxted, N.; Eastwood,R.; Guarino, L.; 2011, Planning for Collecting the Crop Wild Relatives of the World's Major Crops, World Botany Conference, USA, May 2011.
- Rao, I.; Polania, J.; Rivera, M.; Ricaurte, J.; Borrero, G.; Grajales, M.; Cajiao,C.; Monserrate, F.; Butare, L.; Asfaw, A.; Makunde, G.; Alemaheyu, F**.; Ramirez, J.; Jarvis, A.;** and Beebe, S.; 2011, Improving genetic adaptation of common bean to climate change, IAEA annual meeting, Vienna, 2011.
- Van den Bergh, I., **Ramirez-Villegas, J**., Staver, C., Turner, D., **Jarvis, A.,** and Brown, D. 2011. Climate Change in the Subtropics: Impacts of Projected Averages and Variability on Banana Productivity. *Acta Horticulturae, in press.*
- Warren, R.; Price, J.T.; Vanderwal **J.; Ramirez, J.; Jarvis, A.;** Shoo, L.; Goswami, S.; 2011. Making scientific data available to adaptation practitioners: the Wallace Initiative and ClimaScope, AGU Fall Meeting, San Franisco, December 2011.

Other publications

- **Ramírez, J**., Lau, C., Köhler, A.-K.,Signer, J., Jarvis, A.,Arnell, N., Osborne, T., Hooker, J. 2011. Finding tomorrow's agriculture today. Working Paper 12. Cali, Colombia: CGIAR Research Program on climate Change, Agriculture and Food Security (CCAFS). Available online at: www.ccafs.org
- **Jarvis, A.** 2011. Facilitating REDD in the Amazon: tools and methodologies to inform decision making= REDD en el Amazonas: herramientas y metodologías para tomar decisiones . Centro Internacional de Agricultura Tropical (CIAT), Cali, CO. 2 p. (CIAT Hoja Informativa No. 17 CIAT Brief No. 17)
- **Jarvis, A**.; Méndez, E. 2011. Prioritizing food security and livelihoods in climate change mitigation mechanisms: experiences and opportunities for smallholder coffee agroforestry, forest communities and REDD+. Centro Internacional de Agricultura Tropical (CIAT); Prisma, San Salvador, SV. 8 p. (PolicyBrief)
- **Lau, C**.; **Jarvis, A**.; **Ramírez, J**. 2011. Colombian agriculture: adapting to climate change= Agricultura Colombiana: adaptación al cambio climático. Centro Internacional de Agricultura Tropical (CIAT), Cali, CO. 2 p. (CIAT PolicyBrief No.1 CIAT Políticas en Síntesis No. 1)
- Vermeulen, S.J.; Aggarwal, P.K.; Ainslie, A.; Angelone, C.; Campbell, B.M.; Challinor, A.J.; Hansen, J.W.; Ingram, J.S.I.; **Jarvis, A**.; Kristjanson, P.; **Lau, C**.; Nelson, G.C.; Thornton, P.K.;

Wollenberg, E. 2010. Outlook for knowledge, tools and action. Climate change, agriculture and food security, report No. 3.

1.6 CASE STUDIES

Case study 1. Pilot study on the use of 'Social Return on Investment (SROI) as a prioritizing tool for adaptation/mitigation interventions – methodological development'.

Type: Social differentiation and Gender/ Capacity strengthening

- **Brief description of the activity:**

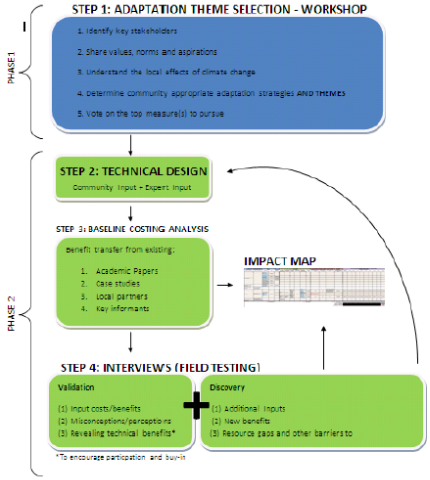
Choosing the best climate change adaptation and mitigation strategies in agriculture can be a challenging task for decision makers and farmers alike. Given the many options available, it is important that scarce resources are used to support measures that are both cost effective and reflect the needs of communities vulnerable to the impacts of climate change.

CCAFS joined forces with Oxford University, ViAgroforestry, CARE international and the International Red Cross to pilot a new way of identifying community appropriate adaptation and mitigation strategies and determining their associated costs and benefits.

The approach built on a novel cost-benefit framework called Social Return on Investment (SROI), a participatory method for discovering the costs and benefits (economic, social and environmental) of an organization, policy or project. It uses focus groups and interviews with stakeholders to create visual *Impact Maps* that tell the story of how change is being created and how the impacts can best be measured – all from the perspective of those directly affected. These pilots in agricultural adaptation and mitigation provided a new context for SROI's application.

- **Result of activity**

A novel Participatory Social Return on Investment (PSROI) analytical framework has been developed and pilot studies on community based adaptation prioritization and costing were conducted in Kenya (Kochiel and Othidhe) and Senegal (N'Dodji). Two complementary activities took place; (1) A three day workshop for the community to self-identify appropriate adaptation and mitigation strategies and (2) individual interviews to measure the costs and benefits of those strategies.



Following the identification of the adaptation strategies and preliminary community planning via back-casting, a final intervention in each community was designed through a technical approach in consultation with local partners and key informants. The interventions were ultimately costed using the SROI analysis and steps for the implementation of those strategies were identified, including potential barriers and incentives for

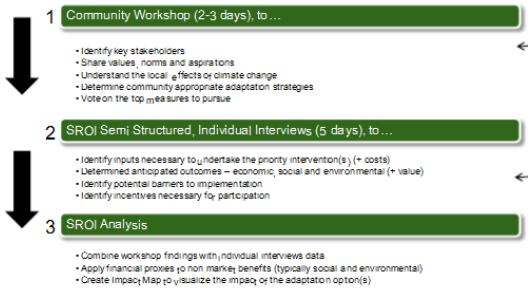
participation.

In Kochiel, the community prioritized tree planting as the adaptation intervention that they wanted to work on. In N'Dodji, the prioritization of the key interventions was divided along gender lines. The women identified adequate water sources as being the key priority for future adaptation whereas the men identified the need for more agricultural.

- **Partners involved and their role:** Environmental Change Institute at the University of Oxford (scientific co-leadership), Vi Agroforestry and CARE (local support in EA), International Red Cross in Senegal (local support in WA)

- **Research on which the activity is based**
  Theme 1, Objective 1.3

- **Web address for further information** (if available)
  - Overview on SROI approach: http://www.slideshare.net/cgiarclimate/community-basedcosting-sroi
  - CCAFS Working Paper: Community Based Adaptation Costing: An integrated framework for agricultural adaptation analysis using Social Return on Investment (SROI). Available soon at: http://ccafs.cgiar.org/resources/working-papers



  - Blog posts published:
    What really matters to people experiencing climate change effects?
    http://ccafs.cgiar.org/blog/whatreallymatters
  - Kenya: A glimpse of climate-smart agriculture: http://ccafs.cgiar.org/blog/kenya-glimpse-climate-smart-agriculture-bad11
  - Nyando's Army of Madmen: http://ccafs.cgiar.org/blog/nyando%E2%80%99s-army-madmen
  - Photos on display at Agriculture and Rural Development Day in December; they were also featured on the Guardian Global Development Blog.

Case study 2: *Development and implementation of the Analogue methodology*

Type: Capacity strengthening

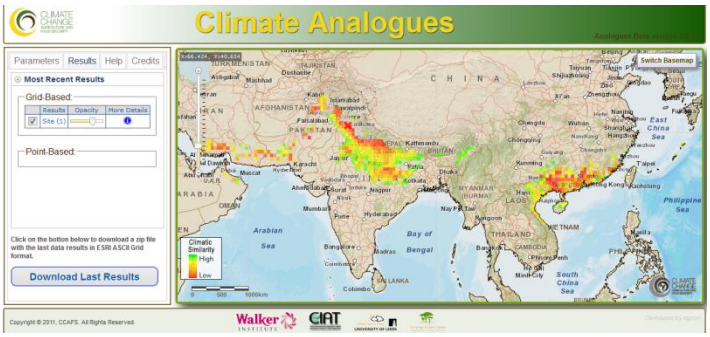
- **Brief description of the activity:**

Scientific evidence gathered in the last couple of decades suggests that climate conditions are changing rapidly and that this trend will likely continue and even accelerate. Future farming and food systems will face substantial impacts but while some regions may benefit from more favorable climatic conditions to production, others will face increased climate change-related biotic and abiotic stresses. It has been estimated that under climate change by 2100 there is likely to be 30% novel climates meaning also that 70% of projected climates already exist.

The Analogue approach developed by CCAFS uses current spatial variability in climate as a means of having a real experiment of what the future holds for a site. Developed in R programming, the analogues tool allows to identify and map sites with statistically similar ('analogous') climates, across space (i.e. between locations) and/or time (i.e. with past or future climates). It's a novel way of supporting climate and crop models with on-the-ground empirical testing. It will permit validation of computational models and trialing of new technologies/techniques and provide new opportunities to facilitating farmer-to-farmer knowledge exchange.

- **Result of activity**

A CCAFS working paper **Climate Analogues: Finding tomorrow's agriculture today** has been published.



The analogue tool has been continuously improved and a Beta version of an online interface has been developed (http://gismap.ciat.cgiar.org/Analogues/). Users may manipulate the tool in the free, open-source R software, or access a simplified user-friendly version online. Two indexes (CCAFS dissimilarity index and Hallegatte index) can be used to systematically identify climate analogues across the world, for certain regions, or among specific locations. Users may use default criteria or choose from a variety of global climate models (GCMs), scenarios, and input data.

Evaluation studies of the analogue tool using agricultural trial data for Rice, Wheat and Maize are ongoing and a climatic validation phase is envisaged for 2012.

To strengthen regional capacities a training workshop "Using Climate Scenarios and Analogues for designing adaptation strategies in Agriculture" was conducted in Katmandu (Nepal). It involved 30 participants from EA, WA and IGP (12 countries).

As part of our effort to make climate change adaptation a more tangible endeavor, the analogue approach is also been applied from a socio-cultural perspective to encourage farmer-to-farmer exchanges between spatial analogues in order to promote knowledge sharing between producer communities regarding current agriculture practices that can help them maintain productivity in the future. The approach encompasses a gender and social differentiation component and will also permit the participatory diagnosis of capacities and needs, thus aiding in the design of community-appropriate adaptation strategies. Two so called "Farms of the future" projects are ongoing in Tanzania, Ghana and Nepal with exchanges occurring from May to July.

- **Partners involved and their role:** *Methodological development*: CCAFS theme 1; Walker Institute, University of Readings; University of Leeds. *Farms of the Future*: Oxford University (Nepal) and Greenwich University (EA,WA); Regional support: African Highlands Initiative (Tanzania)

- **Research on which the activity is based**
  Theme 1, Objective 1.1

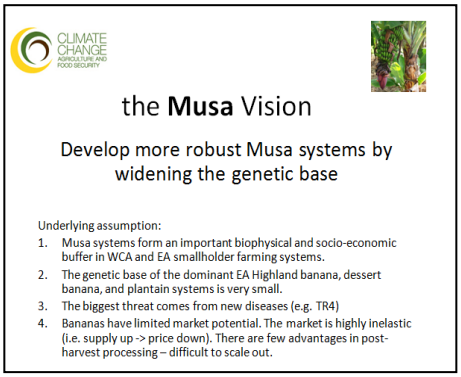
- **Web address for further information** (if available)
  - Analogue online interface: http://gismap.ciat.cgiar.org/Analogues/
  - CCAFS working paper: http://ccafs.cgiar.org/sites/default/files/assets/docs/ccafs-wp-12-climate-analogues-web.pdf
  - Blog post Regional Trianing: http://ccafs.cgiar.org/events/19/sep/2011/using-climate-scenarios-and-analogues-adaptation
  - Official launch in Durban at COP 17, Press room*:* http://ccafs.cgiar.org/news/media-centre/climateanalogues

Case study 3: Developing Breeding strategies for future climate stresses

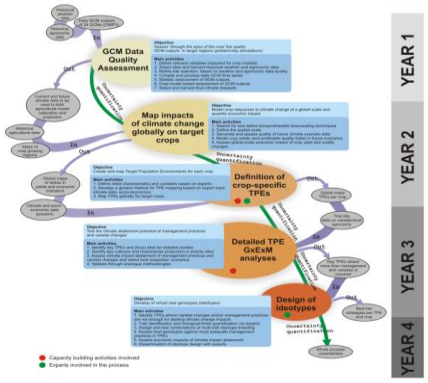
Type: Capacity strengthening

- **Brief description of the activity:**

Within CCAFS Adaption to Progressive Climate Change theme, one of the objectives is to generate comprehensive strategies for crop improvement through a combination of modeling, expert consultation and stakeholder dialogue, and translating these insights into coordinated global, regional and national research and technology investment policies.



- **Result of activity**



Planning workshops held in Cali and first regional workshop held in Addis Ababa.
Development of a solid research framework and a 3 years action operational plan for CCAFS to support breeders in the design of strategies that will tackle the stresses related to future/ novel climates; engagement with regional crop improvement institutions to identify potential improvement scenarios and begin to incorporate into models. Visions developed and strategies devised for four target crops sorghum, rice, beans and bananas. A total of 50 participants representing the breeding and modeling communities from 16 countries attended the workshops.

- **Partners involved and their role:** Ethiopian Agricultural Research Institute (EARI), WACCI

- **Research on which the activity is based**
  Theme 1, Objective 1.2

- **Web address for further information** (if available)
  - Presentation: http://www.slideshare.net/cgiarclimate/climate-smart-ccafs
  - Blog posts:
    We have a plan! : http://ccafs.cgiar.org/blog/we-have-plan-climate-proofing-crop-improvement
  - http://ccafs.cgiar.org/blog/mitigating-change-climate-relations-breeders-and-modelers-africa-unite-climate-smart-crops
  - Videos: Crop specific visions developed during the Addis Workshop:
    Banana- Musa Vision: http://www.youtube.com/watch?v=QMiHHHvU_PI
    Common Beans: http://www.youtube.com/watch?v=oX4jzKugk1A
    Sorghum vision 2030: http://www.youtube.com/watch?v=clKONgzTG80 and http://www.youtube.com/watch?v=wCyy6V4LJCI
    Rice Strategy: http://www.youtube.com/watch?v=YgpeMeczsug
  - Concluding remarks by Andy Jarvis , Addis Workshop:
    http://www.youtube.com/watch?v=mqOhu7cOdpc

1.7 SYNTHESIS OF THEME ACTIVITIES

Theme Leaders will provide a synthesis of all Program Participant activities, arranged by Output as per the CCAFS logframe. These reports will be 3-5 pages.

Output 1.1.1- Development of farming systems and production technologies adapted to climate change conditions in time and space through design of tools for improving crops, livestock, and agronomic and natural resource management practices

Work in 2011 has focused on developing the baseline information on what technologies exist, and how they perform under current conditions, and through modeling how they may perform in the future. An online repository of agricultural trial data has been established (http://www.agtrials.org), and populated with >3,000 different trials on varietal performance, conservation agriculture technologies, water and irrigation management, and pest and disease resistance, covering some 16 different crops. This work is ongoing in 2012. A thorough review has also been made in two major catchments that are crucial to regional food security (Nile and Volta) on their vulnerability to climate change from a water resources perspective, and an initial evaluation of adaptation options including water storage and water allocation policies.

Methods have been developed to facilitate appropriate spatial targeting of promising adaptation technologies and climate smart farming system options, including the analogue tool (http://gismap.ciat.cgiar.org/analogues/), and analytical methods for better understanding the climate response of individual technologies.

Some promising adaptation technologies are currently being tested in target sites to evaluate their potential in targeted future climates, including for example salt and heat tolerant rice in the Mekong, water-logging tolerant forage varieties in Latin America, and heat tolerant livestock in the Middle East.

Output 1.1.2 Building of regional and national capacities to produce and communicate appropriate adaptation and mitigation strategies for progressive climate change at the national level (e.g. through NAPAs)

A range of methods and approaches have been developed that support communities, governments and development practitioners ensure that science based plans and strategies for adapting to progressive climate change are put in place. One highlight comes from Sri Lanka, where vulnerability assessment methodologies were used to quantify impacts of climate change on agricultural and water sectors, the results of which were a direct input into the development of the 2011 National Adaptation Plan (NAPA). Similar studies have been made in Thailand, Lao PDR, Vietnam, Philippines, Colombia, Ecuador, Peru, and Kenya, and 2012 activities will strengthen in-country capacities to use these approaches and incorporate them into national plans and strategies. A number of training events were held in Africa and in South Asia providing training to researchers in NARS and universities on the use of crop models, analogue methods and vulnerability assessments.

Output 1.1.3 New knowledge-synthesizing institutional arrangements, policies and mechanisms for improving the adaptive capacity of agricultural sector actors and those involved in managing the food system

A policy baseline was developed in 6 countries in Sub-Saharan Africa by evaluating how climate adaptation is considered in current national level policies. Specific analyses of climate change impacts and policy response mechanisms were made in four countries in Central Asia, through a combination of agricultural modeling and household data analysis. Furthermore, a thorough review of institutional arrangements and policies that enhance adaptive capacity in maize and wheat systems was completed and published. An adaptation framework in supply chains was developed to facilitate adaptation processes in the food system, and applied to identify adaptation pathways in three countries, in a novel collaboration with Oxfam. Finally, the Adaptation and Mitigation Knowledge Network (http://www.amkn.org) was launched as a portal for knowledge management of adaptation options and strategies at multiple scales.

Output 1.1.4 Testing of participatory methods that are sensitive to gender, livelihoods categories and other social differentiators, to apply globally

Three pilot community adaptation planning workshops were held in Kenya and Senegal, trialing a Participatory Social Return on Investment approach which understands socially disaggregated visions for adaptation, and goes about detailed mapping of actions required to achieve the adaptation measure. This method was developed in collaboration with local NGOs, and has resulted in 3 detailed plans for adaptation in communities in CCAFS benchmark sites. Gender disaggregated vulnerability assessments were also made at the community level in Guatemala, Jamaica and Colombia as part of an analysis of supply chain vulnerability assessment and adaptation priorities.

Output 1.2.1 Understanding and evaluating the response of different varieties/crops to climate change in time and space, and generating comprehensive strategies for crop improvement through a combination of modelling, expert consultation and stakeholder dialogue

Significant advances were made in developing methods and models for evaluating varietal-level responses to climate change for a range of crops. A new model for potato and sweet potato has been developed, and applied for several varieties of importance to sub-Saharan Africa. Likewise, Ecocrop DSSAT and CropSyst models have been further developed and applied widely on a number of crops across different regions and globally, including maize and beans in Central America, wheat in the Middle East, and sorghum in Sub-Saharan Africa and South Asia. A white paper and conceptual paper were developed outlining the needs and priorities for pest and disease modeling in order to better understand priorities for biotic resistance under a changed climate, and reviews were made on the pest and disease risks associated with climate change on crops including maize, wheat, cassava and barley.

Four chapters were published on breeding challenges in the face of climate change for bananas, beans, potato and cassava. Analyses were also developed for sorghum. The ORYZA 2000 model was used to identify the potential benefits of different crop breeding scenarios for rice in Asia, identifying substantial

economic benefits in the development of a combined drought- and submergence- tolerant rice variety under future climate change. These initial assessments are to be subjected to more in-depth analyses during 2012.

Output 1.2.2 Breeding strategies disseminated to key national agencies and research partners

Results from this output are scheduled to happen later in the program's implementation; however some preparatory work was achieved in 2011. A major workshop was held to develop visions for 2030 climate smart crops, which involved breeders form NARS and CGIAR centers involved in work on banana, beans, rice and sorghum.

Output 1.2.3 Differential impact on different social groups of strategies for addressing abiotic and biotic stresses induced by future climate change, variability and extremes are identified, evaluated and disseminated

Socially differentiated varietal level preferences were evaluated for beans in Kenya and Malawi, showing significant gender-related differences in preference for drought resistant materials. This initial study has shown the importance of ensuring gender-differentiated strategies in breeding plans, and will be expanded to other crops in 2012.

Output 1.3.1 New knowledge, guidelines and access to germplasm are provided for using genetic and species diversity to enhance adaptation, productivity and resilience to changing climate

Projects implemented in multiple countries on a number of crops developed approaches for selecting and distributing germplasm that meets farmers' needs and is likely to be adapted to future climates. In Ethiopia and Papua New Guinea (PNG) innovative climate modeling and geographic information system (GIS) tools were used to select germplasm of durum wheat and barley, taro and sweet potato from genebanks. Multi-location trials took place in Ethiopia for 100 varieties each of barley and durum wheat selected from 12,500 screened. Crop suitability maps were also developed. One project evaluated 200 samples of buckwheat and oat in ten different regions of China. In Bolivia and Malaysia, complementary research consisted in farmers screening and selecting germplasm of potato and rice (respectively), subsequently distributed for planting and evaluation. Additional studies carried out in Ethiopia, PNG, Malaysia and Bolivia focused on analyzing seed flows for various crops to understand better how traditional seed systems could be enhanced to facilitate distribution of seeds. Cultural factors influenced the way different kinds of seeds were shared in different locations.

Evaluation work of genetic resources also identified germplasm with novel traits likely to be of importance for climate change adaptation. These include heat tolerant potato, chickpea, groundnut, pearl millet accessions, drought tolerant bean genotypes, and water-logging tolerant forage germplasm.

Output 1.3.2 New information, knowledge, guidelines and germplasm are made available to farmers, breeders, local communities and scientists and promoted through knowledge sharing, peer reviewed articles, information systems and media

Socioeconomic surveys in Ethiopia and Papua New Guinea probed farmers' knowledge of climate change and its impacts, as well as seed systems and barriers to accessing seed. In Malaysia and Bolivia, information was collected on local practices for seed selection and production management of rice and potatoes that could be used for climate change adaptation. An international training course was also offered in Nepal to train trainers in tools for agrobiodiversity assessment and monitoring.

Output 1.3.3 – Policies to enable access to and use of genetic resources for climate change adaptation and diffusion of adapted germplasm

Activities under this output were articulated around three objectives: 1) understanding which policies impact on Plant Genetic Resources for Food and Agriculture (PGRFA) users' ability to access and use genetic resources for climate change adaptation; 2) supporting the adoption of policies and legal frameworks that facilitate the exchange of germplasm potentially useful for climate change adaptation, in particular the multilateral system (MLS) of access and benefit-sharing under the International Treaty on Plant Genetic Resources for Food and Agriculture; and 3) documenting and publishing experiences and lessons learnt from activities under 1 and 2, and from previous relevant Bioversity projects in the same area, ensuring that this information was made available to relevant international policy making bodies. Under objective 1, research focused on gathering information about how germplasm flows between the CGIAR Centres and their partners, and the factors facilitating or hindering this process. Preliminary results have been documented in a CCAFS research paper which will be submitted for publication in early February 2012. Under Objective 2, participant countries were selected and a *"University Platform"* was created, in collaboration with three partner universities, aimed at providing research support to advance quality research on topics related to the implementation of the Treaty's MLS on access and benefit-sharing, and access to information and technologies related to germplasm use, including the use of the Climate Analogues tool to identify potentially adapted germplasm in each of the eight project countries. Several publications, including a multi-authored peer reviewed book, and an article in a scientific journal, have been completed under Objective 3. Bioversity submitted reports and research papers to the FAO Commission on Genetic Resources for Food and Agriculture and the Governing Body of the International Treaty, and organized several side events during the bi-annual regular sessions of these international bodies. The written submissions and side events introduced the CCAFS programme and highlighted the importance of ensuring the flow of genetic material necessary for climate change adaptation.

Theme 2 2011 Annual Technical Report

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Case Studies

Case study 1: Consultation with Global Food Security Decision-Makers Leads to High Impact Case Studies on Opportunities for More Timely Food Security Interventions in Ethiopia

Case type: Non-research partnerships

Brief description of the activity

Effective engagement and collaboration with international, regional, and national stakeholders is essential to the success of Theme 2's objective on Food System-level interventions. In order to compliment Theme 2's pioneering work on technical analysis of climate information and food security, the information and tools must be package in a way that stakeholders can apply them. In September 2011, in partnership with the Food Security Information Network (FAO, WFP, IFPRI), CCAFS held a Global Food Security Stakeholder Consultation with 30 leaders in food security information and response to identifying priority issues, gaps (e.g., knowledge, methods, tools, evidence) and opportunities, where CCAFS research might make a valued contribution. The consultation was attended by the leaders from WFP VAM, USAID FEWSNET, FAO and key regional bodies (SAARC, ASEAN, EAC, and ECOWAS).

Result of activity

The consultation highlighted specific areas of high demand for research and policy advice related to food systems and climate variability. The topic identified as highest demand was research that can shed light on the decision-making processes, mechanisms, and frameworks used to trigger emergency response. In follow up discussions, representatives expressed frustration that advanced warning available prior to a climate driven disaster did not trigger early responses from donors, humanitarian agencies, and national governments. Practitioners also noted that evidence of the potential value of advanced information and the types of information that decision-makers need has not changed the status quo. With further input from FEWSNET, FAO, WFP and IFPRI, CCAFS decided to act quickly on a case study on government food security decision-making in Ethiopia. A preparatory study reviewed decision processes and calendars for government intervention in the face of climate-related food production shortfalls, and consulted with key decision makers at the national level and in two priority states. The study identified sources of information that drive key decisions, the risks associated with essential decisions along the pathway, and interaction with donors and humanitarian groups across the decision-making calendar at national and state levels. In 2012 and 2013, CCAFS will provide demand-driven policy analysis and support for early response mechanisms, and package results and lessons for up-scaling though the Africa Union with the support of collaborating organizations.

Partners involved and their role

USAID-FEWSNET, FAO, WFP, IFPRI, TANGO International, SAARC, ASEAN, EAC, and ECOWAS attended the consultation. GEOSAS (Ethiopia) led the preparatory Ethiopian case study. FEWSNET, WFP, FAO and IFPRI fostered the connection with FSIN and provided guidance on the case study.

Case study 2: CCAFS Works to Strengthen Climate Information for Agriculture through the "Climate Services Partnership;" and Explores with USAID Up-scaling Potential of Mali's Innovative Agrometeorology Advisory program

Case type: Non-research partnerships

Brief description of the activity

Mali's 30-year-old agrometeorlogical advisory program provides farmers with monitored and forecast weather information, village rain gauges and management advisories. The program has been maintained by the Government of Mali since external funding stopped. Mali's program is often cited as a model for other African countries, and has attracted the attention of development donors and other meteorological services in West Africa. CCAFS has partnered with co-sponsor USAID, the IRI and West African partners in an evaluation of Mali's innovative program, with a view to scaling up elsewhere in West Africa. The ongoing evaluation will provide evidence of the use and benefits of the information and advisories at the village level; and provide insights about how aspects of the program have contributed to its uptake, impact and sustainability. The Mali study is one of the flagship activities of the new Climate Services Partnership (CSP), which was launched at the International Conference on Climate Services (New York, 17-19 October 2011). The CSP provides a platform for linking CCAFS – a recognized sponsor of CSP – with a global network of climate service providers, researchers, interested donors, and the UN's Global Framework for Climate Services.

Results of the activity

CCAFS input in a series of Adaptation Partnership regional workshops contributed to USAID's interest in building on the Mali experience. Co-sponsorship and productive collaboration in the ongoing Mali study has cemented a partnership with USAID's Adaptation Partnership. The activity helped connect CCAFS and elevate its profile with a broader community of potential partners through the CSP. As a result of the USAID and CSP partnerships, Theme 2 has expanded its emphasis on climate services for agriculture and food security in CCAFS regions, through learning from other successful case studies and fostering South-South exchange between South Asia and Africa.

Partners and their role

CCAFS leads the institutional component of the study, and enlisted ICRISAT and Mali's Institute for Rural Economy (IER) to co-design and support the village-level assessment. The USAID Adaptation Partnership leads the village component, and (via its contractor IRG) co-funds the evaluation. The IRI leads the assessment of the program's climate information. AGRHYMET participates in the institutional and climate information components.

Case study 3: Participatory Studies in Kenya and Senegal Train Farmers to Use Seasonal Forecasts and Examine Impacts on Management

Case type: Capacity strengthening

Brief description of the activity

Seasonal climate forecasts can, in principle, provide farmers opportunity to adopt improved technology, intensify production and replenish soil nutrients when climatic conditions are favorable; and to more effectively protect families and farms against adverse extremes. However, widespread use has been limited by mismatch between farmers' needs and the design of available forecast information, and by the complexity of probabilistic forecast information. CCAFS is working to improve the design and communication of seasonal forecast information for smallholder farmers and other local agricultural decision-makers. A workshop-based process for training farmers to understand and respond to downscaled, probabilistic seasonal forecasts was piloted at CCAFS sites at Wote, Kenya and Kaffrine, Senegal. The process starts with historic variability, and walks participants through a process of deriving, understanding and interpreting forecasts as a shifted probability distribution. Culturally relevant analogies help participants relate seasonal forecast use to other decisions that they make with uncertain information. Breakout discussion groups facilitate co-learning, and identify promising management responses.

Results of the activity

Farmers demonstrated their understanding of forecasts and identified a set of reasonable management responses during breakout groups. However, separating breakout groups by gender in Wote revealed that older women in particular struggled with the way the probabilistic information was presented. Feedback will guide future training workshops and materials. Ongoing evaluations will document management responses to the information. Partnership with national meteorological services and agricultural research systems strengthened their interest and exposed them to opportunities to improve the design and communication of seasonal forecasts. World Vision, one of the world's largest humanitarian NGO's, asked CCAFS to partner in scaling up the communication of seasonal forecasts in Senegal and Tanzania.

Partners and their role

The Senegalese National Weather Agency (ANAMS) led the work at Kaffrine and provided climate information. Partners included the district agricultural extension officer from the national agency for agricultural and rural advice (ANCAR) who enlisted participants, the Ministry of Agriculture (SDDR), and an economist from the national agricultural research institute (ISRA) who guided the evaluation. In Kenya, ICRISAT led the effort and linked it with projects on forecast-based management advisories. The Kenyan Agricultural Research Institute (KARI) led the workshops, in partnership with the district agricultural extension office, Kenya Meteorological Department, University of Nairobi and ILRI.

Synthesis of Theme 2 Activities

Output 2.1.1 Synthesized knowledge and evidence on innovative risk management strategies that foster resilient rural livelihoods and sustain a food secure environment

Knowledge synthesis is essential for translating the CGIAR's place-based research into international public goods, and contributes to CCAFS' coordination role across the CGIAR and an expanded set of partners. Theme 2 synthesis activities distilled knowledge from field research, literature, and consultations with experts and practitioners. Topics included characterizing climate risks to major production systems, indicators of vulnerability, farmers' risk management knowledge and strategies, and promising risk management innovations such as index-based insurance. Results of these activities set the foundation for strategic research across the CGIAR and partners, and strategic interventions with rural communities in target regions.

Qualitative and quantitative assessments of current formal and informal risk management strategies have been linked to mapping/classification of climate risk in all CCAFS baseline sites, which was complemented by supplemental surveys by CGIAR centers in eight countries covering CCAFS regions. The goal of these studies is to measure climate related risk, document management strategies, and understand information sources that drive risk management strategy. CIMMYT has completed mapping and characterization in 120 households in the IGP. ICRISAT has conducted in-depth climatic analysis at different scales (national, regional district, and village) to explore long-term climatic trends comparing this data to socio-economic indicators and farm surveys to better understand grass root level adaptation strategies in six partner countries. ILRI led a comparative study that documents how agro-pastoralists are coping with climate risk in West Africa. ICRAF conducted field research in western Kenya to investigate how recent climate related shocks and stresses have affected subsistence-farming communities. World Fish studied the impact of climate vulnerability on fish value chains in Uganda to reveal context-specific response strategies. While the bulk of this work covered indigenous strategies, it also evaluated new technological interventions associated with ICT, including a CYMMIT study on ICT-based and other information models to manage climate-related food crises and price volatility in East Africa and the Indo-Ganetic Plains.

A strength of CCAFS's cross-center approach is the ability to synthesize the results from these studies and coordinate a coherent strategy to address demand and opportunities identified through research across centers. A workshop, cosponsored by I4 and hosted by IFPRI, engaged representatives of most of the major research groups working on index insurance for agriculture. Objectives were to identify priority gaps that limit the benefits of index-based insurance to the rural poor in the developing world, contribute to a strategic research agenda, and inform CCAFS partnership and value-addition strategy. A systematic review on the role of diversification in climate risk management and adaptation is in progress. The review, led by Bioversity, with collaborators from three other Centers and two universities, will produce a report and engage a broader community in a planned workshop. A synthesis analysis of indigenous risk management strategies across CCAFS baseline sites is started in late 2011 with a report ~~die~~ due in early March 2012. Future projects will synthesize results from the baseline survey (ICRAF/ILRI) along with related surveys conducted by CYMMIT, World Fish, and ICRISAT.

Output 2.1.2 Analytical framework and tools to target and evaluate risk management innovations for resilient rural livelihoods and improved food security

Theme 2 collaborated with 4.1 on a review ("A review of farm household models with a focus on food security, climate change adaptation, risk management and mitigation") that will inform

collaborative development, in 2012, of a framework and tools for modeling the impact of adaptation interventions on farm household risk and resilience.

Output 2.1.3 Development; and demonstration of the feasibility, acceptability and impacts; of innovative risk management strategies and actions for rural communities

Participatory action research on climate risk management is at varying stages of development across CCAFS benchmark locations. At Kaffrine, the Senegalese National Weather Agency (ANAMS) led work on training farmers and other stakeholders to understand and apply downscaled, probabilistic seasonal rainfall forecasts; and evaluate how farmers are acting on them. The work at Wote, Kenya, led by ICRISAT, combined a similar approach to communicating probabilistic seasonal forecasts, with forecast-based advisories; and applied an experimental design to assess their impact, alone and in combination, on management and livelihoods. Work in Borana, Ethiopia and Khulna, Bangladesh focused on partnership development, and participatory diagnosis of needs and opportunities for managing climate-related risk and fostering climate-resilient livelihoods.

CIMMYT has conducted on-farm trials on options for system diversification and intensification in CA systems in the IGP. Farmers' participatory field trials for exploring options for diversification through intensification have been undertaken using innovative management options (CA, raised beds, intercrops, relay crops). Sugarcane intercropped with wheat, garlic, onion, chickpea etc. increased farm income by US$400-1000 ha^{-1} in North-west IGP. Whereas in eastern IGP, maize intercropped with legumes using raised beds have been found much remunerative. Relay planting of wheat in cotton in western IGP has resulted in significant gain (US$350 ha^{-1}) in farm profitability. CIMMYT also led on-farm trials on options for system diversification and intensification in CA systems in EA. Intercropping, relay cropping and "double-intercropping" (i.e. intercropping followed by relay cropping) to maximize resource use efficiency (mainly water) are being tested on-station (4 in Ethiopia and 4 in Kenya) and on-farm (60 in Ethiopia and 48 in Kenya).

WorldFish conducted a study to investigate observed and projected impacts of climate change in coastal portions of Bangladesh, one of the most vulnerable countries in the world. Climate change will exacerbate existing natural and manmade vulnerabilities to flooding, waterlogging and salinization of land and water. The objective of this work was to analyze the vulnerability context of people in four villages in southern Bangladesh. The report suggests specific intervention strategies, including providing advanced climate/weather information, as well as the use of index-based insurance to hedge against flood risk in aquaculture systems.

Output 2.1.4 Tailor and disseminate research results for evidence-based policy and technical support for farm- to community-level risk management strategies

ICRISAT conducted a series of country specific policy dialogues on "Building climate resilient agriculture in Asia" for Sri Lanka, Thailand and Vietnam. The policy statements were conveyed in a September 2011 workshop to the key persons from ministries, government and non-governmental organizations as well as development agencies belonging to the respective countries. ICRAF held a workshop with FAO and World Bank on Climate Smart Agriculture, 26-28 July 2011 in Rome. The workshop was held with the purpose of discussing the scope and outline of a Sourcebook on Climate Smart Agriculture and a related web portal, as well as the modalities for an international partnership to support, further develop and transmit climate smart knowledge to stakeholders. The meeting was attended in total by around 100 participants, of which 25 were external experts and 75 staff of FAO, the World Bank, IFAD and WFP. See:
http://www.climatesmartagriculture.org/2979501142282b2e217996d2d41b42c1e0cb63.pdf

Output 2.1.5 Identify and evaluate differential impact of agricultural risk management strategies on different social groups, particularly women and men, and communicate findings through technical and policy support activities

A joint CIMMYT and ICRISAT study, titled "Gender and Food Security: Empirical Evidence from Kenya," tested if female-headed households (FFHs) are more likely to be food insecure compared to male-headed households (MHHs). The probit model (binary food security) results show that FHHs are 13% less likely to be food secure than MHHs. However, using covariate matching methods the food security gap between FHHs and MHHs declines to 1.3- 2.8%, indicating that the remaining food security gap (the part that cannot be explained by observed characteristics) may be attributed to less observable factors, such as discrimination and other non-observable factors including ability and motivation. See "Gender and Food Security: Empirical Evidence from Kenya" (http://iaae.confex.com/iaae/portal.cgi?e=m.kassie@cgiar.org&p=672227&r=norole)

Output 2.2.1 Enhanced knowledge of impacts of climate fluctuations on food security, and how to use advance information to best manage climate-related risk through food delivery, trade, crisis response and post-crisis recovery

A three-country study of relationships between historic climate variability and components of food security (e.g., production, staple food prices, rural incomes, humanitarian assistance), led by WFP, produced a report for Nepal ("Climate risk and food security in Nepal: Analysis of climate impacts on food security components") included a detailed analysis of livelihoods and revealed that regional patterns of food insecurity, particularly in the most vulnerable areas in western Nepal, are highly sensitive to climate trends. It also found that it is likely that climate change will exacerbate livelihood vulnerabilities and food insecurity trends in the most at-risk areas. The report concluded that efforts to mediate climate impacts on food security in Nepal should therefore prioritize these regions. Reports in preparation for Senegal and Ethiopia are expected in April 2012.

Output 2.2.2 Synthesized knowledge and evidence of the impacts of alternative risk management interventions within the food system on food security and rural livelihoods, to inform policy and practice

A consultation with international food security stakeholders (Output 2.2.3) led to a shift in focus – from a food security intervention costing study, toward a demand-driven process focused on government food security decision-making in Ethiopia. A preparatory study reviewed decision processes and calendars for government intervention in the face of climate-related food production shortfalls, and consulted with key decision makers at the national level and in two priority states. The fieldwork for this research has concluded and a full report is expected in March 2012. The Global Consultation also helped to build a partnership strategy with FEWSNET, WFP, FAO, and the African Union, which will provide the backing of key institutions to scale up results from this study.

Output 2.2.3 Platform and tools for sharing knowledge and fostering improved coordination among food crisis response, the market-based food delivery system, and agricultural research and development

A workshop in Nairobi brought about 30 leaders in food security information and response to identifying priority issues, gaps (e.g., knowledge, methods, tools, evidence) and opportunities, where CCAFS research might make a valued contribution. It followed and built on the first Consultative Conference of the new Food Security Information Network (FSIN) Consultative Conference. This report along with regional food security stakeholder consultations will inform

strategy for future CCAFS work on food systems. The workshop also helped to shore up partnerships with FEWSNET, WFP, and FAO for future work in this area, including the work initiated in 2011 (2.2.2) in collaboration with WFP and national government partners in Ethiopia.

Output 2.2.4 Identify and evaluate differential impact of tools and strategies for climate risk management on different social groups, particularly women and men, and inject findings into support to agencies

No activities were planned or reported in 2011 under this output.

Output 2.3.1 Improved climate information tools and products to support management of agricultural and food security risk

A set of web-based analytical "maprooms" that incorporating the APHRODITE gridded daily rainfall data set, was developed to facilitate visualization and analysis of agriculturally-important rainfall statistics and their predictability at a seasonal lead time. Analysis of the data indicate that there is a promising degree of predictability of summer monsoon rainfall at CCAFS sites in India (Punjab or Haryana, and Bihar) and Nepal, using different climate models for eastern and western sites, but that there seems to be little evidence of seasonal prediction skill in Bangladesh.

Gaps in space and time in historic meteorological records, and major shortcomings in existing gridded data sets that incorporate satellite data, are major obstacles to several promising options for reducing vulnerability to climate. A set of partners (AGRHYMET, Ethiopia NMA, U. Reading, Princeton U., IRI) was commissioned to develop, test and apply methods to reconstruct historic daily weather data needed for agricultural modeling and adaptation interventions. Initial results support the feasibility of reconstructing daily historic observations for most agriculturally relevant meteorological variables (precipitation, temperature, dewpoint, potential evapotranspiration), and suggest that the blended daily rainfall product captures actual rainfall better than existing satellite or interpolated products.

CIMMYT identified maize germplasm that tolerates multiple, climate-related biotic and abiotic stresses, that are potentially suited to resource-poor, climate-vulnerable farmers. The stress-resilient germplasm will be further tested in 2012 and used to develop multi-stress resilient products for Asia and Africa.

ICRISAT and partners developed decision aids that integrate locally relevant information on climate, soil, crop and markets for climate risk management in planning farm operations. Three spreadsheet-based tools support quick characterization of historic climate data (observed and generated), and are currently being updated to make them more user-friendly. Ex-ante analyses of risks and returns associated with production technologies, based on crop simulation and historic climate data suggest that substantial risk may act as a major constraint to adoption in for of the five districts studied in Kenya. Project partners from Kenya, Tanzania, Ethiopia and Madagascar; and graduate students from Kenya, Sudan and Ethiopia were trained to use long-term climate records, stochastic weather generators and crop simulation to analyze impacts of a variable climate on crops and production practices.

ICRAF and partners assessed the feasibility of using stable isotopes in tree rings to reconstruct the climate of the past five centuries in Eastern and West Africa. The resulting proxy records will enhance understanding of how the climate has varied in Africa in response to drivers such as the El Niño-Southern Oscillation, and inform agroforestry management and adaptation options.

Output 2.3.2 Synthesized knowledge and evidence on institutional arrangements and processes for enhancing climate services for agriculture and food security

CCAFS partnered with co-sponsor USAID and the IRI in an ongoing evaluation of Mali's innovative and well-established agrometeorological advisory program with a view toward up-scaling its positive elements elsewhere in West Africa. Theme 2 became a sponsor and member of the Coordinating Group of the new Climate Services Partnership, which provides a platform for engaging a global network of climate service providers, researchers, interested donors, and the UN's Global Framework for Climate Services.

ICRISAT and partners developed and tested agricultural management advisories as a way to help farmers use seasonal forecast in five districts of Eastern Kenya. Nearly all participating farmers rated the advisories as "extremely useful," and most expressed willingness to pay if required. In semi-arid Zimbabwe, ICRISAT worked with partners to test seasonal forecast information delivered to farmers alone, and in combination with advice, and advice plus participatory modeling of crop management options. Analysis, using a participatory farm management approach, indicated that the enhanced information treatments contributed to adoption of forecast information for farm decision-making. Surveys and focus group discussions showed that farmer perceptions of climate change can be inconsistent with climate data, although the data supported perceptions of increasing temperature. In Andhra Pradesh, India, ICRISAT produced drought maps for farmers, and estimated surface water available to meet village requirements and runoff. They provide daily rainfall data and advisories to farmers through ICT-based village knowledge centers. Long-term cropping system experimental data were simulated to characterize risk, and analyzed to provide farmer recommendations based on ENSO state in two districts.

Output 2.3.3 Improved knowledge, tools, data sets and platforms for monitoring and predicting agricultural production and biological threats, and informing management, in response to climate fluctuations

A study by the IRI and NASA-JPL developed and tested methods for assimilating remote sensing vegetation and soil moisture information into a crop simulation model to improve the accuracy of crop yield forecasts. Prototype software assimilates vegetation and soil moisture remote sensing dynamically into the DSSAT CSM maize model using ensemble Khalman filtering. Tests show improvements in county-scale yield simulations in contrasting farming systems in the USA, and highlight challenges for further research in heterogeneous smallholder environments.

Because initial plans to adapt an existing suite of crop forecasting tools proved to be infeasible, a review of existing tools was commissioned to guide the development or adaptation of a CCAFS crop forecasting software platform. The Climate Impact Analysis toolkit has been identified as a promising starting point.

A policy brief ("Agro-Climate Tools for a New Climate-Smart Agriculture") was developed to promote and inform investment by development donors in decision-support tools for managing climate-related agricultural risk.

IITA and partners contributed to knowledge and methodology for managing climate impacts biological threats through: (a) modeling the impacts of climate on the distribution of cassava, banana and plantain pests; (b) studies of how weather influences flower thrips, and the phenology of six fruit fly species, to inform model development; and (c) a review of the effects of climate change on below-ground microorganisms. On-farm surveys in the moist and dry savannas of Benin and Cameroon, which show that most farmers perceive recent change in climate variability and have changed their planning in response, will inform future adaptation research.

AfricaRice initiated a review of literature and inventory of available data on impacts of climate fluctuations on crop yields and on bird damage to rice in West Africa. The study and database will fill gaps in knowledge on the effects of meteorological conditions on bird damage, and disentangle the effects of bird damage from direct weather losses.

Output 2.3.4 Enhanced capacity of national and regional climate information providers, NARES and communication intermediaries to design and deliver climate information products and services for agriculture and food security management

Participatory action research at CCAFS sites in Senegal and Kenya provided opportunity to expose national meteorological service staff to new, downscaled, probabilistic seasonal climate forecast products, and a workshop-based strategy for training farmers and other local decision-makers to understand and act on the information. In Senegal, the national meteorological service led the project, and helped develop the downscaled forecast presented to Kenyan farmers.

Two senior staff members (Deputy Director, and Senior Divisional Meteorologist) of the Nepal Department of Hydrology and Meteorology spent 1-1/2 weeks at the IRI to receive training in seasonal climate forecasting methodology and its applications, work with new maproom products for South Asia, and design a national climate risk atlas.

Output 2.3.5 Identify and evaluate differential impact of climate information services on different social groups, particularly women and men, and inject findings into support to farmers

No activities were planned or reported in 2011 under this output.

Theme 3 Pro-Poor Climate Change Mitigation
Annual Report
2011

February 2012

Synthesis of 2011 Activities by Output

3.1. Low-carbon agricultural development pathways

3.1.1 Analysis of agricultural development pathways and the trade-offs among mitigation, poverty alleviation, food security and environmental health

Modeling and economic analysis enabled a first iteration of understanding of the mitigation impacts of different agricultural development options. Two studies compared business-as-usual and simple scenarios for emissions. In one study for Vietnam, IFPRI used a spatially explicit model of land use and a partial equilibrium model (IMPACT) to show the effect of policy reforms, infrastructure investments and new technologies. Methods will be extended potentially to Bangladesh, Philippines, Colombia, and Gabon in 2012.

In the second study, Brown et al. used the IPCC framework and land cover datasets based satellite imagery to estimate current and simulated greenhouse gas (GHG) emissions from the agricultural sector for four East African and five West African countries. Most emissions (84%) were from activities related to livestock and fewest were from fertilizer use (0.7%). Testing mitigation options consistent with maintaining food security, the authors found that changes in soil management alone sequestered about 0.4 to 5 t CO2e ha-1yr-1, while soil and vegetation management (agroforests and conversion of marginal lands to native ecosystems) raised rates to 6 to 22 t CO2e ha-1yr-1. Avoided conversion of carbon-rich lands had the highest mitigation impacts, suggesting that intensification of land use should be a priority.

Empirical studies complemented the modeling. In a historical analysis Gockowski et al. from IITA tested the possibilities for intensified cocoa production in Ghana, and concluded that a ten-year high tech fertilizer and pesticide intensification program for cocoa enabled higher production than would have been possible even if all forest in the study area had been cleared. The intensification program plus forest protection policies and enforcement enabled 402 km² of forest to be conserved and a stock of avoided carbon emissions of 17.6 Mt CO_2.e. The study estimated that the productivity gain from one ton of fertilizer substituted for 2.84 ha of low input extensive cocoa technology.

Building support at the national level for using these data and interest in conducting analysis started with a series of four national policy workshops (Mali, Ghana, Ethiopia and Kenya) where selected findings were presented to national decision makers.

Next steps for this output will be to improve activity data and link the economic and biophysical modeling among these complementary efforts. More empirical studies of agricultural

intensification are needed to improve models and better understand relationships. Training will be conducted in 2012 to strengthen national modeling capacities.[1]

3.1.2 Enhanced tools, data and analytical capacity in regional and national policy and research organizations to analyze the implications of different development scenarios and mitigation strategies

Tools were developed to support mitigation decision-making at the landscape and household levels. Two involved spatial modelling and provide foundational frameworks for planning. ICRAF developed a spatial land use simulation tool for planning for low-emissions development strategies ("LUWES"). The tool was developed for assisting local government to explore strategies that reduce emissions with minimum negative impact on economic development. Alternative land use scenarios can be compared. The tool was applied in two districts in Indonesia and well received.

CIAT developed an online tool, based on digital map server technology, for evaluating biomass and carbon in the context of deforestation, land use, population and natural resources was developed for the Amazon region. This is supported by Terra-I, which detects land-cover changes resulting from human activities in near real-time, producing updates every 16 days. Terra-I runs for the whole of Latin America and is being expanded in 2012 to the entire tropics.

To model decisions as the household level, ILRI and ICRAF modified the household data collection and analysis IMPACT tool (Integrated Modeling Platform for Mixed Animal-Crop Systems) to enable assessment of greenhouse gas emissions and related economic benefits and costs, and to include agroforestry options. A pilot test of data collection was conducted in Nyando, Kenya and will be expanded in 2012. This activity is linked to Outputs 3.2 and Theme 4.

3.1.3 Analysis of the gender and social differentiation implications of alternative agricultural pathways and findings built into communications and capacity building activities

As preferences for alternative development pathways can differ, research supporting marginalized farmers to negotiate successfully can lead to outcomes that better meet their interests. ICRAF worked with multiple stakeholders in two districts in West Kalimantan, Indonesia to support performance-based negotiated agreements and land use planning. The study used measurements of carbon stocks and analysis of opportunity costs and abatement costs to support local stakeholder decisions about REDD and agroforestry interventions, aiming to reduce emissions by 26%. Social analysis was completed that described how oil palm expansion into forest areas was shaped by negotiations between the oil palm company and communities. Farmers with larger registered land size and official plot measurements benefited more in negotiations. Communities did not see the Roundtable for Sustainable Palm Oil (RSPO) as a tool for strengthening their position vis-à-vis the company. A participatory assessment for the RSPO was limited to a few local public figures, all men.

[1] Work by CIAT examined the costs of different mitigation options in the agricultural sector in Colombia, although not reported under Theme 3, also contributed to this output.

3.2 Institutional arrangements and incentives for mitigation

3.2.1 Evidence, analysis and trials to support institutional designs, policy and finance that will deliver benefits to poor farmers and women, and reduce GHG emissions

The incentives and institutional arrangements to support a major shift towards mitigation practices among smallholder farmers are still nascent and little information exists in the formal literature. Hence, in 2011, CCAFS coordinated 38 chapters by experts in agricultural mitigation to produce a book on the state of agriculture and climate change mitigation. To strengthen the community of practice, a workshop was held jointly with FAO on incentives for mitigation, and four background papers produced. Gender implications were examined. A panel at the Durban COP reported on the main conclusion from this meeting that mitigation is more likely to be practiced where synergies with increased yields and farm production are possible than from C markets, and that the costs of making transitions to new practices need support for widespread adoption to occur. Participatory action research with carbon projects (see EcoAgriculture below) and research on payments for ecosystem services (see ICRAF below) drew similar conclusions.

Due to the current momentum on REDD+ in negotiations, several publications on the implications of REDD+ for food security and agricultural mitigation were also produced, with research by Kissinger on REDD+ readiness plans showing that agricultural expansion and impacts on agriculture and food production required more attention in RED+ planning. Agrawal et al. conducted a review of institutional arrangements affecting governance of agricultural expansion in forest areas and commissioned five related papers, finding that legal enforcement and land tenure were primary explanatory factors. Results were presented in a seminar for policy makers and will be published in a special issue of Global Environmental Change in 2012.

Because of the importance of creating incentives within current agricultural finance and corporate supply chain, Kissinger completed a scoping report on corporate social responsibility and agricultural finance programs supporting mitigation and suggestions for further research made. The Munden Project worked with data from CCAFS benchmark sites to investigate how to make investment in smallholder mitigation practices more profitable.

On the ground, EcoAgriculture Partners facilitated participatory action research (PAR) with carbon market projects in Africa. A report comparing systems for project management, finance, benefit distribution and monitoring across six projects was completed and presented in the 2011 Earth Systems Governance meeting. This included a gender analysis. A second phase of PAR research was initiated with four projects for more in-depth study of institutional arrangements that communities to sustain the projects and workshop held.

Theme 3 collaborated with Theme 1 in designing pilots for the social return on investments research, which contributed to the development of a proposal for national economic assessments of the costs and benefits of mitigation options for East Africa by ENR Associates. This work will begin in 2012.

ICRAF, under the project, Rewards for, Use of and Shared Investment in Pro-poor Environmental Services (RUPES) Phase II, developed new frameworks for the paradigm for 'Payments for Ecosystem Services,' and reported on PES experiences in a book chapter and various workshops and training events in Asia and E Africa. A major conclusion was that per capita financial flows from PES remain small and co-investment and shared responsibility for stewardship, with a

focus on integrative livelihood assets (natural + human + social capital) rather than only financial assets can be expected to provide future flows of ecosystem services. Collective action, social mobilization and secure land access were major benefits from ecosystem service projects.

CIMMYT scientists in the Cereal System Initiative South Asia (CSISA) project completed baseline farm household data collection on adoption of zero and minimum tillage in the IGP was completed (n = 2592 households) and is being analysed to provide adoption history of zero tillage and reduced tillage in the hubs of India, Nepal and Bangladesh.

In 2012 CCAFS will continue to explore alternate incentives and institutional options, with an emphasis on support for innovation and adoption and incentives from within the agricultural sector. A new scientist position at IFPRI will be created to further investigate climate finance and the role of agribusiness. We will develop frameworks for consistent data collection and comparison.

3.2.2 Improved capacity to increase the uptake and improve the design of incentives mechanisms and institutional arrangements to deliver benefits to poor farmers and women

CCAFS efforts to build a partnership for this output were not successful and a new partner has been identified for 2012. The focus will be on developing a framework for assessing women's innovations that can be applied by partners and at CCAFS benchmark sites. Modeling gender and social differentiation of different pathways will require more data and detailed modeling than currently available. Results should be available by 2013 from the household IMPACT model survey by CCAFS.

ICRAF held workshops based on the manual on Estimating the Opportunity Costs of REDD+ at regional, national and sub-national levels for researchers and other stakeholders: Regional - Africa: 50 participants, Asia : 25 participants, Latin America: 25 participants. National and subnational– *Cameroon:* 25 participants, *Vietnam* 20 participants, *Indonesia* (2 workshops): 53 participants; *Peru*: 50 participants expected.

3.3 On-farm mitigation practices and landscape implications

3.3.1 Analysis of mitigation biophysical and socioeconomic feasibility for different agricultural practices and regions, and impacts on emissions, livelihoods and food security

The largest research effort in 2011, as expected given CG technical expertise, was towards understanding the effects of different farm management options on GHG emissions, as well as economic implications. Options were tested for grasses, agroforestry and fruit trees, soil management, and rice. Supporting more complete understanding of emissions, all GHG analyses were conducted for soils and agroforestry, and lifecycle assessments were completed for tropical perennial fruit systems, N2O in sweet sorghum and aquatic systems. Promising approaches include use of digestible and nitrogen inhibiting *Brachiaria* species, planting of timber agroforestry, and use of rice straw to reduce GHG emissions. CIAT, IITA and ICRAF began to link their efforts on perennial tree crops. In 2012 we will begin systematic synthesis of emissions factors and activity data as input to the IPCC fifth assessment AR5. Highlights from 2011 included:

Grasses and grasslands

- Evaluated 42 hybrids of *Brachiaria humidicola*, 5 had higher biological nitrogen inhibition.
- Assessment of *Brachiaria* and *Canavalia* in-vitro dry matter digestibility indicated these are potential candidates to reduce GHG emissions per unit livestock product.
- Rangeland in Central Asia was estimated to have lost 50 Tg soil organic carbon due to land use change and degradation (observed on 4.9 Mha), but recuperation of rangelands offset around 42 % of losses, resulting in little loss in response to land use.

Agroforestry and fruit trees

- A review of agroforestry in Africa found high biophysical potentials, but low potential for C market revenues.
- In Western Kenya, ICRAF assessed tree-planting interventions for 362 households and found the nearly 160 additional timber (and fruit) trees provided the highest sequestration rates of about 10-15 kg C/tree. The value of carbon from all new trees, if valued at $4 per ton of CO2, was about $23 /yr/ household. For all 4,451 project households, the estimated net present value would be $751,946 for timber and fruit and $431,768 for fodder and soil fertility trees.
- In East Africa, IITA scientists classified seven E. African coffee production systems and assessed their adaptation and mitigation potential. Shaded, intercropped coffee-banana production systems most successfully combined adaptive capacity with mitigation.
- Potential benefits and strategies for equitable benefit sharing from a CARE carbon finance project were identified with different groups, including women.
- Data for 'IMPACT' household model was collected (n=40), after incorporation of an agroforestry component.
- CIAT scientists generated field and secondary data for 8 tropical fruit species to quantify the life cycle emissions and sequestration in fruit-based production systems. Ground quantification and verification of inputs used on fruit farms, and production strategies that contribute to energy footprint were started.
- In India, under the National Agricultural Innovation Project (NAIP), smallholders adopted emission reducing and carbon sequestering farming practices, including agroforestry in a grid of a thousand ha and started savings on energy use (lighting); fuelwood, irrigation pumps, and inputs in farming.
- In Indonesia, research was conducted on palm oil emissions to understand the effects of intensification and land conversion.
- All GHG analysis of soils under agroforestry in W. Kenya using photoacoustic measurements, started by ICRAF.
- Review paper on mitigation for smallholder coffee systems completed and policy brief produced.

Conservation Agriculture, soil C and crop-soil management

- CIMMYT conducted research on conservation agriculture in E. Africa, India and Mexico. Plot- and household- level data were collected to characterize conservation agriculture practices and technologies (in Ethiopia, Kenya, and Tanzania; Haryana and W. Bengal India) and analyse economic, social (gender) and environmental benefits. A review was produced of the potential of CA to mitigate and adapt to climate change for two contrasting agro-ecological environments in Mexico and related economic benefits. Management effects tested included:
    - CH4, NO2 and CO2 monitored under contrasting tillage, residue and nutrient management practices in rice-wheat rotation in Haryana, India.
    - Economic and environmental effects of zero tillage were conducted for 340 households of West Bengal and Haryana.
    - Productivity indicators and total soil carbon were monitored in over 120 on-station and on-farm trials under different CA options in E Africa.
    - In IGP and Mexico, scientists tested management effects on GHG emissions, especially nitrous oxide

- Other soil carbon and soil conservation efforts included:
  - Programme to Support Smallholder Conservation Agriculture Promotion in Western (Nigeria) and Central Africa (Cameroon, Congo D.R) completed by ICRAF, including farmer innovation networks, locally adapted conservation agriculture and upscaling of CA.
  - Sites established and protocols implemented for agricultural mitigation options for high value market crops study by IFPRI.For the test sites, the soil organic carbon initial conditions were recorded, the baseline for soil organic carbon for the period 2010-2050 was determined, and a portfolio of mitigation practices identified. A cost-benefit analysis that simulates the adoption of these practices was carried out for Ghana, Morocco, and it's almost completed for Mozambique. The implicit cost of a mitigated ton of carbon was also determined.
  - Research published by ICRISAT on C sequestration in Indian soils of tropical and subtropical environments: Assessment and Potential.
  - Evaluation of nitrous oxide emissions from a long-term Conservation Agriculture experiment at Patancheru was in progress, and on-going C-seq. & NO2 measurements were made in cropping systems and in long-term on-station experiments by ICRISAT, including life-cycle analysis of nitrogen losses in sweet sorghum at different N-rates.

Livestock

- ILRI developed emission factors for livestock that are in use by the IPCC (see also Output 3.3.2)

Biofuels

- Feasibility of smallholder production of biofuels was conducted by ICRAF. Evaluation of feedstocks and their environmental suitability, production and yields analyzed. Sweet sorghum and castor were the most environmentally suitable bioethanol and biodiesel feedstock respectively. Sweet sorghum had the highest gross margin, followed by sugarcane and cassava for bioethanol feedstocks. For biodiesel feedstocks, sunflower has the highest gross margin per hectare. Experimental design and pot tests for effect of biochar on gas fluxes completed. Studies on biofuel value chain potential* and *Jatropha** in Mali for oil production are underway.

Rice

- IRRI produced region-specific mitigation potentials in rice production associated with improved irrigation and fertilizer management and tested emissions in farmers' fields for different management options in different rice growing regions. Specific research completed in 2011 included:
  - Testing net GHG emission reduction from water saving strategies in farmers' fields in the Philippines, Indonesia and Vietnam to examine whether experiment stations results from the last decade were practicable and could be considered options for the Clean Development Mechanism (CDM). In the Philippines, a comprehensive database of emission, soil and agronomic data on alternate wetting and drying was compiled, and collection will be continued in 2012 and 2013. In Indonesia, ongoing measurements addressed the impact of direct seeding. In Vietnam field measurements started in 2011.
  - Regional assessment of LUCCi (Land Use and Climate Change Interaction) to develop strategies for sustainable land use in Vietnam considering the regional socio-economic development, national planning elements as well as regional climate change projections. The project focuses on analyzing the impacts of different land use systems and crop management on GHG emissions as well as climate change impacts (Links to Objective 3.1)
  - Two case studies on alternative uses to burning of rice straw in Vietnam and Philippines. Farmers were asked to describe their perception about alternative uses of rice straw such as rapid composting and mushroom culture and to name factors that may affect their adoption of these alternative uses. The study also recorded GHGs of alternative uses of rice straw and identified policy options to enhance adoption.

- A quantitive analysis of published methodologies for chamber measurements and an environmental impact assessment of mitigation technologies.
- In Vietnam, IFPRI assessed alternative paddy mitigation practices for 2 seasons of paddy rice in the Red River Delta in Vietnam. One season included measurements for CH4 and N2O.

Aquatic systems

- World Fish completed Guideline on Life Cycle Analysis (LCA) and aquaculture products completed and working paper on Lifecycle Inventory and Lifecycle Assessment methodology relevant to Bangladesh integrated aquatic-agricultural systems completed

Other

- Assessments of emissions from the agricultural sector and lifecycle analysis for major food products were conducted for Bangladesh.

3.3.2 Methods developed and validated for GHG monitoring and accounting at farm and landscape level to contribute to compliance and voluntary market standards

Although methods exist for GHG quantification, studies are usually based on sector specific interventions and activities. This output seeks to develop methods that enable a systems analysis of net emissions at the whole farm and landscape level. To that end, two review papers were commissioned and a workshop (40 participants) with FAO was held to assess the state of the art of such approaches and create a road map for future work. A research group was formed and proposal written to develop and apply a common protocol for the CG and partners to conduct a major data GHG data collection effort for smallholder systems in 2012. The Copenhagen University-initiated Climate Food and Farming Network (CLIFF see http://www.cliff.life.ku.dk/), which links researchers and doctoral students working on climate change mitigation and adaptation in small-scale farming and food systems, gave eight grants and held a workshop in 2011. This network should support additional data collection and protocol development.

These efforts will build on existing tools and initiatives also produced in 2011:

- A protocol for Measuring and Monitoring Soil Carbon Stocks in Agricultural Landscapes that was produced by ICRAF and made available under the Carbon Benefits Project toolkit. A proposal to extend this work was produced with the aim to quantify the uncertainties in soil carbon estimates and improve guidelines for planning soil carbon measurements.
- ILRI researchers developed an intermediate scale rangeland model for climate change and carbon sequestration studies. Carbon sequestration measurement protocols were established and field data collection has begun in Mali, Burkina Faso and in southern Ethiopia. Datasets for validating the models for different regions are being collated.
- Papers, policy briefs and presentations in SBSTA and COP meetings by the Alternatives to Slash-and-burn and ICRAF's Architecture of REALU: Reducing Emissions for All Land Use (Phase II) projects on landscape approaches to mitigation.
- Links to 3.1 activities related to Tools for REDD+

Case Study 1: Investment mechanisms for low climate-impact agriculture

Case type: Non-research partnerships

Brief description of the activity

One of the major constraints to intensifying agriculture sustainably while also reducing net greenhouse gas emissions is capital investment. Farmers usually require additional capital to transition to new practices such as soil conservation or agroforestry. While international capital exists, the high risk of variability in agricultural production in developing countries, especially under climate change, has discouraged investment. The scale of smallholder operations has also made it difficult for them to compete with larger agricultural operations for funds. hannel for funds.

The purpose of the partnership with the Munden Project is to investigate and test investment mechanisms for delivering capital to sustainable agriculture that helps sequester carbon and reduces potential future impacts on the climate. The Munden Project is using data from the CCAFS benchmark sites to identify how to enable smallholder farmers to compete for finance with larger agricultural operations by achieving scale and overcoming risks through the development of international portfolios. The development of the mechanisms has involved consultations with investor experts, including bilateral donors, development banks, private sector groups with corporate social responsibility approaches, as well as development expert judgment, including CCAFS researchers, partners at CCAFS benchmark sites.

Result of activity

The project is working with bilateral donors to establish practicable mechanisms that can be used by the Munden Project and others to guide climate or agricultural investments. In 2012, The Munden Project will establish and test a real investment mechanism. The partner is creating a new non-profit arm to manage this work.

Partners involved and their role

The Munden Project, a US-based consulting firm, leads the investigation.

Bilateral donors, development banks, private sector groups with corporate social responsibility approaches have supported development of the mechanism and will collaborate in its implementation.

Development experts, including CCAFS researchers, partners at CCAFS benchmark sites have informed the development of the mechanism.

Research on which the activity is based

CCAFS benchmark sites

Web address for further information

http://www.mundenproject.com (but no project results posted yet)

Case Study 2: Governing Mitigation Trade-offs in Agriculture-Forestry Landscapes

Case Type: Communications

Brief description of the activity

Forest conversion due to agricultural expansion is a major contributor to greenhouse gases. While intensifying agricultural production can reduce these pressures, institutional measures can help provide incentives for forest protection as well as enforcement of protected areas and property rights. Research by the University of Michigan's International Forestry Resources and Institutions Program and five partners examined the institutional dynamics and mechanisms for forest conservation due to agriculture. They sought to identify how institutional arrangements and agricultural technologies can enable improvements in both livelihoods and net emissions reductions.

Due to the relevance of these findings to the development of REDD+ policies, the authors of each of the papers presented their findings at a policy meeting hosted by the International Food Policy Research Institute in Washington DC in August 2011. About 15 policy, advocacy and research organizations were represented, including the World Bank, Oxfam and the World Resources Institute. The papers were then made available the following week as five CCAFS working papers. A summary was shared in print and web form the next month in a Rights and Resources Initiative meeting on agriculture and REDD+ in the Hague that was attended by a mostly European policy makers and advocates, including the the Dutch Foreign Ministry, BothEnds, representatives of several African national governments and the World Wide Fund for Nature.

Result of activity

The immediate sharing of research results in two key policy forums created rapid awareness of the role of legal enforcement and tenure arrangements on reducing forest conversion due to agriculture, without having to wait for the long process of publishing a scientific journal issue. Revised versions will be published in a special issue of Global Environmental Change.
Working papers (titles of article will be the same):

Robinson BE, Holland MB, Naughton-Treves L. 2011. Does secure land tenure save forests? A review of the relationship between land tenure and tropical deforestation. CCAFS Working Paper no. 7.

Börner J, Wunder S, Wertz-Kanounnikoff S, Hyman G, Nascimento N. 2011. REDD sticks and carrots in the Brazilian Amazon: Assessing costs and livelihood implications. CCAFS Working Paper no. 8.

Fox J, Castella J-C, Ziegler AD. 2011. Swidden, Rubber and Carbon: Can REDD+ work for people and the environment in Montane Mainland Southeast Asia? CCAFS Working Paper no. 9.

Barbier EB and Tesfaw AT. 2011. Overcoming tenurial constraints to carbon forestry projects in Africa. CCAFS Working Paper no. 10.

Cohn A, Bowman M, Zilberman D, O'Neill K. 2011. The Viability of Cattle Ranching Intensification in Brazil as a Strategy to Spare Land and Mitigate Greenhouse Gas Emissions. CCAFS Working Paper no. 11.

Partners involved and their role

Arun Agrawal and Lauren Persha at the University of Michigan International Forestry Resources and Institutions (IFRI) Program commissioned the papers and coordinated the event.
Authors listed above.
IFPRI as host of the policy forum

Research on which the activity is based

U Michigan research project on governing mitigation trade-offs

Web address for further information

http://ccafs.cgiar.org/resources/working-papers

Case Study 3: Building communities of practice: CCAFS-FAO Smallholder Mitigation Workshop Series

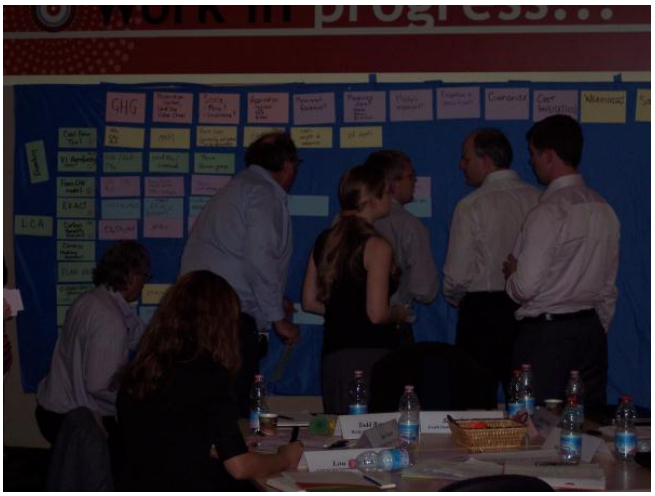
Case Type: Capacity strengthening/Communications

Brief description of the activity

Climate change mitigation in agriculture is a rapidly emerging field that requires collaboration among different entities that have not traditionally worked together, for example investors and extension agents, national negotiators of the UNFCCC and advocates of smallholder farmers. The knowledge needed to develop frameworks for mitigation policies and practice thus has been fragmented and the diverse networks and organizational cultures involved have made it difficult to work towards common goals.

CCAFS and FAO's Mitigation of Climate Change in Agriculture (MICCA) Programme are collaborating in a workshop series intended to overcome these constraints. The workshops are designed to review the state of knowledge, create shared goals for action, and build communities of practice for innovation. Each workshop involves the preparation of at least one major background review paper. Two workshops were held in 2011

- **Mitigation Options and Incentive Mechanisms, July 2011**
- **Whole Farm and Landscape Accounting, October 2011**



The workshop on incentives brought together economists and finance experts, carbon market specialists, gender experts, practioners in technology adoption, sustainable agriculture certifiers and representatives from agri-business, among others. Participants explored mechanisms that jointly support smallholder livelihoods and food security by reviewing (1) the costs and benefits of mitigation options at the farm level and barriers for their adoption, (2) incentive mechanisms and associated institutional arrangements, (3) mechanisms specifically to reach women and the poor. Participants also developed principles for pro-poor incentives for smallholders.

The workshop on systems approaches to greenhouse accounting brought together researchers, practitioners and policy makers with expertise in greenhouse gas quantification to (1) review the state of methods for quantification of net emissions at the whole farm and landscape levels,

(2) explore options for creating protocols and guidelines for methods appropriate to smallholders based on current knowledge, and (3) identify gaps and issues where further work is required.

Additional workshops in 2012 will be on quantification issues for smallholder agriculture and decision making to support national mitigation priorities.

Result of activity
A partnership for research on a GHG protocol for smallholders was initiated and concept note developed among five CG centers, the Global Research Alliance (Canada, Measurement and Monitoring working group) and selected universities.

Input from participants for review papers on whole farm and landscape approaches.

A Google Groups listserv for participants for use as a resource to contact colleagues, pose questions to the group, and share materials.

Partners involved and their role
Workshop participants

Research on which the activity is based
Havemann T and Muccione V. 2011. Mechanisms for aricultural climate change mitigation incentives for smallholders. CCAFS Report no. 6. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark. Available online at: www.ccafs.cgiar.org

Streck C and Burns D. Forthcoming. Harnessing mitigation finance for the benefit of smallholder farmers. *Forthcoming CCAFS Report.*

McCarthy N, Lipper L, Branca G. 2011. Climate-Smart Agriculture: Smallholder Adoption and Implications for Climate Change Adaptation and Mitigation. Food and Agriculture Organization of the United Nations. http://www.fao.org/docrep/015/i2575e/i2575e00.pdf

Branca G, McCarthy N, Lipper L, Jolejole MC. 2011. Climate-Smart Agriculture: A Synthesis of Empirical Evidence of Food Security and Mitigation Benefits from Improved Cropland Management. Food and Agriculture Organization of the United Nations. http://www.fao.org/docrep/015/i2574e/i2574e00.pdf

Milne E. Forthcoming. Methods for the quantification of net emissions at the landscape level for developing countries in smallholder contexts. *Forthcoming CCAFS Report.*

Seebauer M. Forthcoming. Methods for the quantification of net emissions at the farm level for developing countries in smallholder contexts. *Forthcoming CCAFS Report.*

Web address for further information: http://www.fao.org/climatechange/micca/72532/en/
(includes links to presentations and outputs)

2011 Theme 3 Center Publications

Highlighted publications indicate potential mitigation focus

Bioversity

Blogs

1. Cherfas, J. 4 December 2011. Who knows what about climate change? *Available online:* http://www.agriculturedayorg/blog/2011/12/who-knows-what-about-climate-change/
2. Cherfas, J. 9 December 2011. Could climate-smart agriculture help save our forests? *Available online:* http://blog.cifor.org/6185/could-climate-smart-agriculture-save-our-forests/
3. Cherfas, J. 18 July 2011. Climate Change at the Commission on Genetic Resources for Food and Agriculture. *Available online:* http://ccafs.cgiar.org/blog/climate-change-commission-genetic-resources-food-and-agriculture

Books

1. Halewood, M., Louafi, S and Lopez-Noriega, I. Editors. Crop Genetic Resources as a Global Commons: Challenges in International Law and Governance. London: Earthscan. [peer reviewed]. *Manuscript sent in 2011 to Earthscan, for publication in 2012. Available for order on Earthscan website at: http://www.earthscan.co.uk/?tabid=102815*
2. Rudebjer P, van Schagen B, Chakeredza S, Njoroge K, Kamau H, Baena M. 2011. Teaching agrobiodiversity: a curriculum guide for higher education. [peer reviewed] *Available on CD-ROM.*

Book Chapters

1. Padulosi S., V. Heywood, D. Hunter and A. Jarvis (2011). Underutilized Species and Climate Change: Current Status and Outlook. In Shyam S. Yadav, Robert J. Redden and Jerry L. Hatfield Eds. Crop Adaptation to Climate Change, First Edition. Hermann Lotze-Campen and Anthony E. Hall. John Wiley & Sons, Ltd. Published 2011 by Blackwell Publishing Ltd.507-521 pp. [peer reviewed] *Available on CD-ROM.*
2. Ramirez, J., Jarvis, A., Van den Bergh, I., Staver, C. and Turner, D. (2010). Chapter 20: Changing climates: Effects on growing conditions for banana and plantain (*Musa* spp.) and possible responses. In Shyam S. Yadav, Robert J. Redden and Jerry L. Hatfield Eds. Crop Adaptation to Climate Change, First Edition. Hermann Lotze-Campen and Anthony E. Hall. John Wiley & Sons, Ltd. Published 2011 by Blackwell Publishing Ltd. 426-438 pp. [peer reviewed] *Available upon request.*
3. Snook, L., Dulloo, M.E., Jarvis, A., Scheldeman, X., Kneller, M. (2011). Crop Germplasm Diversity - the Role of Gene Bank Collections in Facilitating Adaptation to Climate Change. In Shyam S. Yadav, Robert J. Redden and Jerry L. Hatfield Eds. Crop Adaptation to Climate Change, First Edition. Hermann Lotze-Campen and Anthony E. Hall. John Wiley & Sons, Ltd. Published 2011 by Blackwell Publishing Ltd.495-506 pp. [peer reviewed] *Available on CD-ROM.*

Discussions

1. Discussion among experts on participatory monitoring; Solutions Exchange e-mails, October – November 2011. *Available on CD-ROM.*
2. Fadda, C. 1 September 2011. Seeds for needs approach was proposed as one option to mitigate drought-induced food crisis.
3. Fadda, C. 5-9 October 2011. Seeds for needs approach as an example on how science can help policy to adapt to climate change. Pre-Meeting for the IPBES second multi-stakeholder meeting. Nairobi, Kenya.

Events

1. Agrobiodiversity to address climate change, agriculture and food security. 19 July 2011. Thirteenth Regular Session of the Commission on Genetic Resources for Food and Agriculture. Food and Agriculture Organization of the United Nations, *Available on CD-ROM and online:* http://ccafs.cgiar.org/events/19/jul/2011/agrobiodiversity-address-climate-change-agriculture-and-food-security
2. The CGIAR Centres' experiences implementing their Article 15 agreements with the Governing Body of the International Treaty. 14 March, 2011. Fourth Session of the Governing Body of the International Treaty on Plant Genetic Resources for Food and Agriculture. Bali, Indonesia. *Available online:* http://www.sgrp.cgiar.org/sites/default/files/CGIAR_Experiences_SideEvent140311_flyer.pdf

Journal Articles

1. Bellon, M.R., D. Hodson and J. Hellin. 2011. Assessing the vulnerability of traditional maize seed systems in Mexico to climate change. *Proceedings of the National Academy of Sciences USA*. 108 (33): 13432-13437. [peer reviewed] *Available on CD-ROM and online:* www.pnas.org/cgi/doi/10.1073/pnas.1103373108
2. Bonham, C.A. and Dulloo, E. and Mathur, P. and Brahmi, P. and Tyagi, V. and Tyagi, R.K. and Upadhyaya, H.D. (2010) *Plant genetic resources and germplasm use in India.* Asian Biotechnology and Development Review, 12 (3). pp. 17-34. [peer reviewed] *Available on CD-ROM.*
3. Ford-Lloyd BV, Schmidt M, Armstrong SJ, Barazani O, Engels J, Hadas R, Hammer K, Kell SP, Kang D, Khoshbakht K, Li Y, Long C, Lu B-R, Ma K, Nguyen VT, Qiu L, Ge S, Wei W, Zhang Z, Maxted N. Crop Wild Relatives—Undervalued, Underutilized and under Threat? BioScience 2011, 61(7): 559-565. [peer reviewed] Available online: http://www.jstor.org/pss/10.1525/bio.2011.61.7.10
4. Halewood, M. 2011. Options for governing the microbial commons. In P. F. Uhlir (Ed.), *Designing the Microbial Research Commons: Proceedings of an International Workshop*. (pp. 191-200). Washington: National Academy of Science. [peer reviewed] *Available online:* http://www.nap.edu/openbook.php?record_id=13245&page=191

5. Pascual, U., Narloch, U., Nordhagen, S. and Drucker, A. G. 2011. The economics of agrobiodiversity conservation for food security under climate change. *Economía Agraria y Recursos Naturales*. Vol. 11 (1): pp. 191-220. [peer reviewed] *Available online:* http://aeea.webs.upv.es/aeea/ficheros/Revistas/EARN_11_1/11_1_09_Pascual.pdf
6. Ramírez, R., A. Jarvis, I. Van den Bergh, C. Staver and D. Turner. Climate change in the subtropics: The impacts of projected averages and variability on banana productivity. ProMusa symposium – "Cultivation of bananas and other tropical fruits under sub-tropical conditions – Special problems and innovative solutions" Acta Horticulturae. *In press.*

Maps

1. Arnaud, E. and team. 2011. Maps of georeferenced accessions. *Available on CD-ROM.*
2. Platform for Agrobiodiversity Research. Mapping of agrobiodiversity as an adaptation strategy on the AMKN website. *Available online:* http://amkn.org/#/bm=1/ctr=4628280.715140242;968867.446404513/lvl=1/pts=biodiv_cases

Meeting Proceedings

1. On farm conservation of neglected and underutilized species: status, trends and novel approaches to cope with climate change; Frankfurt, Germany, 14 – 16 June 2011. *In press.*
2. Proceedings of three national workshops on fine tuning of participatory approaches to national contexts; Kathmandu, Nepal, 1-2 September, Chennai, India, 5-6 September, La Paz, Bolivia, 21-22 September. *In press.*
3. Staver, C. 14 October 2011. Proceedings of Workshop ProMusa 2011 Pests and diseases in bananas – projecting the effects of climate change; Salvador de Bahia, Brazil. *Available on CD-ROM.*

Presentations

1. Bonham, C. 9 May 2011. Climate Change and Policy: Access and use of agrobiodiversity in India. CRP7 Seminar. Bioversity International, Rome, Italy. *Available online:* http://player.vimeo.com/video/23631561
2. Cadima, X. Foundation for the Promotion and Investigation of Andean Products (PROINPA), Bolivia, presented on the role of agrobiodiversity in coping with climate change and the experience of rural communities and indigenous peoples. Available on CD-ROM and online: http://www.fao.org/fileadmin/templates/nr/documents/CGRFA/Local_Perspective_Cadima.pdf
3. Dulloo, M.E., Van Zonnevald, M., Thormann, I., Drucker, A., Marandu, W., and Gaisberger, H. 13 May 2011. Seeds for Needs: Adaptation to climate change; Progress to date in Ethiopia. CRP7 Seminar. Bioversity International, Rome, Italy. Available on CD-ROM and online: http://www.slideshare.net/slideshow/embed_code/8336241

4. Lopez Noriega, I., 13 May 2011. CRP7 and Policy Research and Support Unit. . CRP7 Seminar. Bioversity International, Rome, Italy. Available on CD-ROM and online: http://www.slideshare.net/slideshow/embed_code/8335107
5. Rudebjer, P. 17 June 2011. Capacity enhancement in CCAFS - Bioversity's contribution. CRP7 Seminar. Bioversity International, Rome, Italy. *Available online:* http://www.slideshare.net/slideshow/embed_code/8376437
6. Staver, C. y J. Ramirez. 22 – 24 June 2011. Bananeros frente al cambio climatico: Adaptacion al incertidumbre, variabilidad y eventos extremos. International Congress - Cambio Climático en el Sector Platanero y Bananero, Piura, Perú. *Available upon request.*
7. Perez Vicente, L. 22 – 24 June 2011. Expectativas y desafíos para el manejo sostenible de plagas en musáceas frente a la variabilidad climática. 1st International Latin American Congress on Banana and Plantain - Cambio Climático en el Sector Platanero y Bananero. *Available upon request.*
8. Jarvis, A. and J. Ramirez. 22 – 24 June 2011. Impactos e implicaciones del cambio climático para la banana en Latinoamérica y el Caribe. 1st International Latin American Congress on Banana and Plantain - Cambio Climático en el Sector Platanero y Bananero. *Available upon request.*

Public Awareness Materials

1. Farmers and genebanks: creating alliances to help rural communities cope with climate change. Platform for Agrobiodiversity Research. Rome, Italy. 2011. *Available on CD-ROM and online:* http://agrobiodiversityplatform.org/climatechange/files/2011/08/Prova6-corretto6-LOWRES.pdf

Statements

1. Platform for Agrobiodiversity Research – Statement made at the 13th Regular Session of the Commission on Genetic Resources for Food and Agriculture (CGRFA): Agenda Item 2.2 Climate change and genetic resources for food and agriculture. *Available on CD-ROM and online:* http://agrobiodiversityplatform.org/climatechange/files/2011/07/PAR_Statement.pdf

Surveys

1. Standardized survey questionnaire developed jointly with partners to include also role of gender in conserving genetic diversity and indigenous knowledge and their value within climate change copying strategies. *Available on CD-ROM.*

Technical Reports & Background Papers

1. Experiences of international institutions with the implementation of the agreements with the Governing Body under Article 15 of the Treaty, with particular reference to the use of the Standard Material Transfer Agreement for Annex I and non-Annex I crops. Fourth Session of the Governing Body of the International Treaty, Bali, Indonesia, 14-18

March 2011. *Available on CD-ROM and online:* http://www.planttreaty.org/sites/default/files/gb4i05e.pdf

2. Report of the Thirteenth Regular Session of the Commission on Genetic Resources for Food and Agriculture. Food and Agriculture Organization of the United Nations, Rome. July 2011. *Available on CD-ROM and online:* http://www.fao.org/nr/cgrfa/cgrfa-meetings/cgrfa-comm/thirteenth-reg/en/
3. Report from the international agriculture research centres of the consultative group on international agricultural research to the intergovernmental technical working group on plant genetic resources for food and agriculture. Food and Agriculture Organization of the United Nations, Rome. April 2011. *Available on CD-ROM and online:* http://typo3.fao.org/fileadmin/templates/agphome/documents/PGR/ITWG/ITWG5/ITWG5_INF8ReportfromCGIARFINALUpton_01.pdf
4. Beed, F, Halewood M. et al. May 2011 Climate Change and Micro-Organism Genetic Resources for Food and Agriculture: State of Knowledge, Risks and Opportunities. Background Study Paper No. 57. CGRFA, Food and Agriculture Organization of the United Nations, Rome. *Available on CD-ROM and online:* http://www.fao.org/docrep/meeting/022/mb392e.pdf
5. Fujisaka, S., Williams, D and Halewood, M. (Eds). April 2011. Background Paper No. 48: The impact of climate change on countries' interdependence on genetic resources for food and agriculture. Food and Agriculture Organization of the United Nations, Rome. April 2011. *Available on CD-ROM and online:* ftp://ftp.fao.org/docrep/fao/meeting/017/ak532e.pdf
6. Ling, Li. 2011. Climatic stresses at pea collection sites in China; final technical report for the Vavilov Frankel Fellowship. Liaoning Academy of Agricultural Science, Liaoning, China. *Full text available upon request.*

Videos

1. Cherfas, J. 18 July 2011. Climate Change at the Commission on Genetic Resources for Food and Agriculture. Jeremy Cherfas. *Available online:* http://ccafs.cgiar.org/blog/climate-change-commission-genetic-resources-food-and-agriculture
2. Seeds for needs project update – helping women farmers in Ethiopia adapt to climate change. August 2011. *Available online:* http://www.youtube.com/watch?v=Ye8yUUNXnxE&list=UUGIRaI1_FpiN271fRnaFimA&index=8&feature=plcp
3. Seeds for Needs, Papua New Guinea Mid-term Report. November 2011. *Available online:* http://www.youtube.com/watch?v=LsyaDyYlwpo&feature=player_embedded

CIAT

PEER-REVIEWED PAPERS

Butare, L., I. M**. Rao,** P. Lepoivre, J. Polania, C. Cajiao, J. B. Cuasquer and S. **Beebe.** 2011. New sources of resistance in *Phaseolus* species to individual and combined aluminium toxicity and progressive soil drying stresses. Euphytica 181: 385-404.

Blair, M. W., C. H. Galeano, E. Tovar, M. C. Muñoz Torres, A. Velasco, **S. Beebe and I. M. Rao**. 2011. Development of a Mesoamerican intra-genepool genetic map for QTL detection in a drought tolerant x susceptible common bean (*Phaseolus vulgaris* L.) cross. Molecular Breeding (published online).

Graefe, S; Dufour, D; Giraldo, A; Muñoz, L.A; Mora, P; Solís, H; Garcés, H; Gonzalez, A. 2011. Energy and carbon footprints of ethanol production using banana and cooking banana discard: A case study from Costa Rica and Ecuador. Biomass and Bioenergy. DOI: 10.1016/j.biombioe.2011.02.051 [Artículo aprobado]

Herrera-Campo, B.; **Hyman, G**.; Bellotti, A.; 2011. Threats to cassava production: known and potential geographic distribution of four key biotic constraints, *Food Sec.*DOI 10.1007/s12571-011-0141-4

Jarvis, A., **Ramirez-Villegas, J**., Herrera Campo, B.V., Navarro-Racines, C.E. 2011. Is Cassava the Answer to African Climate Change Adaptation. *Tropical Plant Biology*, accepted for publication.

Jarvis, A.; **Lau, C**.; **Cook, S.E**.; Wollenberg, E.; Hansen, J.; **Bonilla, O**.; Challinor, A. 2011. An integrated adaptation and mitigation framework for developing agricultural reserch: synergies and trade-offs. *Experimental Agriculture* 47:185-203. [Artículo aprobado]

Maxted, N.; Kell, S.; Toledo, Á.; Dullo, E.; Heywood, V.; Hodgkin, T.; Hunter, D.; Guarino, L.; **Jarvis, A**. & Ford-Lloyd, B. 2011. A global approach to crop wild relative conservation: securing the gene pool for food and agriculture. *KEW BULLETIN* VOL. 65: 561–576 .

McClean, P, J. Burridge, **S. Beebe, I. Rao** and T. Porch. 2011. Crop improvement in the era of climate change: An integrated multi-disciplinary approach for common bean (*Phaseolus vulgaris* L.). Functional Plant Biology 38: 927-933

Mulligan, M.; **Fisher, M**.; Sharma, B.; Xu, Z.X.; Ringler, C.; Mahé, G.; **Jarvis, A**.; **Ramírez, J**.; Clanet, J.C.; Ogilvie, A.; Ahmad, M. 2011. The nature and impact of climate change in the challenge program on water and food (CPWF) basins. *Water International* 36 (1): 96-124.

Ramirez-Villegas, J., Jarvis, A., Laderach, P. In press. Empirical approaches to assess the impacts of climate change on agriculture: The EcoCrop model and a case study with grain sorghum. *Agricultural and Forest Meteorology*. http://dx.doi.org/10.1016/j.agrformet.2011.09.005

Ramirez-Villegas, J., Salazar-Villegas, M, Jarvis, A. and Navarro-Racines, C.E. 2011. A way forward on adaptation to climate change in Colombian agriculture: Perspectives towards 2050. *Climatic Change*, accepted for publication.

Vermeulen S.J.; Aggarwal,P.K.; Ainslie,A.; Angelone, C.; Campbell, B.M.; Challinor A.J.; Hansen, J.W.; Ingram, J.S**.; Jarvis, A**.; Kristjanson, P.; **Lau, C**.; Nelson, G.C.; Thornton P.K.; Wollenber, E. 2011. Options for support to agriculture and food security under climate change. *Environmental Science and policy*.

BOOK CHAPTERS

Leal Filho W.; **Laderach, P**.; **Lundy, M**.; **Jarvis, A**.; **Ramírez J**. 2011. The Economic, Social and Political Elements of Climate *Change.Change*: 703–723-723. Available:http://www.springerlink.com/index/10.1007/978-3-642-14776-0.

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Ceballos,H.; **Ramirez,J**.; Bellotti,A.; **Jarvis, A**.; and Alvarez, E.; 2011. Adaptation of Cassava to Changing Climates. Chapter 19. In Crop Adaptation to Climate Change, ISBN: 978-0-8138-2016-3, 632 p.

Jarvis, A.; **Ramirez, J**.; **Bonilla-Findji, O**, and Zapata, E. 2011. Impacts of Climate Change on Crop Production in Latin America, Chapter 3.1. In Crop Adaptation to Climate Change, ISBN: 978-0-8138-2016-3, 632 p.

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Ramirez,J.; **Jarvis, A**.; Van den Bergh, I.; Staver, Ch.; and Turner, D. 2011. Changing Climates: Effects on Crowing Conditions for Banana and Plantain(Musa spp.) and Possible Responses. Chapter 20. In Crop Adaptation to Climate Change, ISBN: 978-0-8138-2016-3, 632 p.

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Van den Bergh, I., **Ramirez-Villegas, J**., Staver, C., Turner, D., Jarvis, A., and Brown, D. 2011. Climate Change in the Subtropics: Impacts of Projected Averages and Variability on Banana Productivity. *Acta Horticulturae, in press.*

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IFPRI – no pubs listed on intranet

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ILRI (from Table C Activity tables by Themes/Objectives)

Comment [AN2]: These are all from the Theme 3 table

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Policy Briefs

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- Workshop report: CCAFS/FAO Expert Workshop on Smallholder Mitigation: Mitigation Options and Incentive Mechanisms. Rome, 7-8 July 2011. Workshop Summary.
- Workshop report: CCAFS/FAO Expert Workshop on Smallholder Mitigation: Whole Farm and Landscape Accounting. Rome, 27-28 October 2011. Workshop Summary.

Book

Wollenberg E, Nihart A, Tapio-Biström M-L, Grieg-Gran M, eds. 2011. 'Climate Change Mitigation and Agriculture.' Routledge, London, 419 pp.

Table of Contents:

2011 Theme 4.1 (Linking Knowledge with Action) Annual Report

Summary of Theme 4.1 Budgeted Activities

Output 4.1.1 **Scenarios**
Activities: EA quantification workshop using GLOBIOM and IMPACT models, in Sept with 30 participants including a mulit-sectoral qualitative/writing team and a quantitative team; WA scenarios development workshop in Oct with 30+ cross-sectoral participants, in conjunction with regional policy organization CORAF/WECARD
Deliverables: EA and WA multi-sectoral scenario teams trained and storylines produced, analyzed and refined. EA modelling/quantification of scenarios underway. Proposal for EA policy workshop submitted and accepted; brief, posters and other communication products under development with PANOS (a communications firm)
Publications: Chaudhury M, Vervoort V, Kristjanson P, Ericksen P, Ainslie A. Multi-Stakeholder Scenarios as a Boundary Process: Improving Food Security, Environments and Livelihoods in East Africa under Conditions of Climate Change. Submitted to *Regional Environmental Change, Dec. 2011.*

Output 4.1.2 **Vulnerability Mapping**
Activities: Analysis with partners; finalization of report; launch and several high-profile media stories
Deliverables: CCAFS report; media stories in BBC, Time and Nature – see: <http://ccafs.cgiar.org/news/category/press-releases>
Publications: Mapping hotspots of climate change and food security in 2030. Available at: <http://ccafs.cgiar.org/resources/climate_hotspots>

Output 4.1.3 **Linking K with A strategies**
Activities: Partner capacity building efforts, data and knowledge sharing activities, communications efforts aimed at linking CCAFS outputs to actions
Deliverables: trainings and workshops held (CARE project, EcoAg collaboration, household and village baseline research teams, regional gender teams, communicating carbon partners)
Publications:

1. Förch W, Kristjanson P, Thornton PK. 2011. Initial Sites in the CCAFS Regions: Eastern Africa, West Africa and Indo-Gangetic Plains. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark. <http://ccafs.cgiar.org/where-we-work>
2. Kristjanson P, Garlick C, Ochieng S, Förch W, Thornton PK. 2011. Global Summary of Baseline Household Survey Results. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark. <http://ccafs.cgiar.org/resources/baseline-surveys>
3. Thirteen CCAFS's sites household baseline result reports (Kenya, Tanzania, Uganda, Ethiopia, Senegal, Mali, Burkina Faso, Ghana, Niger, Bangladesh, India, Nepal) all available at: <http://ccafs.cgiar.org/resources/baseline-surveys>
4. Improving carbon initiatives aimed at smallholders: Addressing opportunities and challenges through better communication. ICRAF Policy Brief 11. With CCAFS, CARE, ECOTRUST, ENR, VEDA, Vi Agroforestry, World Vision. Available at: www.worldagroforestry.org and www.ccafs.cgiar.org/resources
5. Kristjanson P, Neufeld H, Gassner A, Mango J, Kyazze F, Desta S, Sayula G, Thiede B, Förch W, Thornton PK, Coe R. Are food insecure smallholder households making changes in their farming practices? Evidence from East Africa. Re-submitted to *Food Security*, Dec 2011.

Training materials and data: household and village-level surveys, data management, analysis and data available on dataverse, through: http://ccafs.cgiar.org/resources/baseline-surveys

Output 4.1.4 **Methods and improved regional capacity in gender-CC analyses**
Activities: Methods and training materials development, recruitment of regional gender-CC research teams/trainees, training workshops held
Deliverables: Training materials and data; regional gender-CC research teams trained
Publications:

1. Gender and climate change research in agriculture and food security for rural development. FAO/CCAFS/CGIAR brief. <http://ccafs.cgiar.org/blog/gender-climate-change-and-food-security> and <www.fao.org/gender>
2. FAO and CCAFS. Gender and Climate Change Research in Agriculture and Food Security for Rural Development Training Manual. CGIAR Program on Climate Change, Agriculture and Food Security (CCAFS) and The Food and Agriculture Organization of the United Nations (FAO). *Forthcoming on www.fao.org and www.ccafs.cgiar.org (on CCAFS intranet site)*
3. Three draft gender-CC reports (available on CCAFS intranet site)

Publications

Ericksen P J, Thornton P K, Notenbaert A, Cramer L, and Jones P G (2012). Mapping hotspots of climate change and food insecurity in the global tropics. Food Security (forthcoming).

Kristjanson P, Neufeld H, Gassner A, Thornton P K, Förch W, Mango J, Kyazze F, Desta S, Kayula G, Thiede B and Kinyangi J (2012). Are food insecure smallholder households making changes in their farming practices? Evidence from East Africa. Food Security (in press).

Vermeulen S J, Aggarwal P K, Ainslie A, Angelone C, Campbell B M, Challinor A J, Hansen J W, Ingram J S I, Jarvis A, Kristjanson P, Lau C, Nelson G C, Thornton P K and Wollenberg E (2012). Options for support to agriculture and food security under climate change. Environmental Science & Policy 15, 136-144.

Vermeulen S, Zougmoré R, Wollenberg E, Thornton P K, Nelson G, Kristjanson P, Kinyangi J, Jarvis A, Hansen J, Challinor A J, Campbell B and Aggarwal P K (2011). Climate change, agriculture and food security: a global partnership to link research and action for low-income agricultural producers and consumers. Current Opinion in Environmental Sustainability 4, 1-6.

Ashby J, Kristjanson P, Thornton P, Campbell B, Vermeulen S, Wollenberg E (2011). CCAFS Gender Strategy. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark. Available online at: www.ccafs.cgiar.org.

Ericksen P J, Thornton P K, Notenbaert A, Cramer L, Jones P G and Herrero M (2011). Mapping hotspots of climate change and food insecurity in the global tropics. Report to CCAFS, ILRI, Nairobi, 77 pp.

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Desta S, Tezera S, Gebru G, Kristjanson P. 2011. Summary of Baseline Household Survey Results: Borana, Ethiopia. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark. <http://ccafs.cgiar.org/resources/baseline-surveys>

Kyazze F. B, Kristjanson P. 2011. Summary of Baseline Household Survey Results: Rakai, Uganda. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark. <http://ccafs.cgiar.org/resources/baseline-surveys>

Lyamchai C, Yanda P, Sayla G, Kristjanson P. 2011. Summary of Baseline Household Survey Results: Lushoto, Tanzania. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark. <http://ccafs.cgiar.org/resources/baseline-surveys>

Singh RPK, Kristjanson P. 2011. Summary of Baseline Household Survey Results: Bihta, Bihar State, India. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark. <http://ccafs.cgiar.org/resources/baseline-surveys>

BCAS, Kristjanson P. 2011. Summary of Baseline Household Survey Results: Paikgacha, Bangladesh. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark. <http://ccafs.cgiar.org/resources/baseline-surveys>

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Improving carbon initiatives aimed at smallholders: Addressing opportunities and challenges through better communication. ICRAF Policy Brief 11. With CCAFS, CARE, ECOTRUST, ENR, VEDA, Vi Agroforestry, World Vision. Available at: www.worldagroforestry.org and www.ccafs.cgiar.org/resources

Gender and climate change research in agriculture and food security for rural development. FAO/CCAFS/CGIAR brief. <http://ccafs.cgiar.org/blog/gender-climate-change-and-food-security> and <www.fao.org/gender>

Scenarios for socio-economic development under global environmental change: Testing strategies and building networks to improve food security, environments and livelihoods. CCAFS brief <www.ccafs.cgiar.org/resources>

Training materials

P. Kristjanson, W. Förch, C. Barahona, C. Garlick, P. Thornton. CCAFS Baseline Household Level Survey: Manual for Survey Sites. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark. <http://ccafs.cgiar.org/resources/baseline-surveys>

W. Förch, C. Barahona, P. Kristjanson, P. Thornton, J. Mango, L. Onyango, F. Noor. 2011. CCAFS Village-Level Baseline Study - Implementation Manual. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark. <http://ccafs.cgiar.org/resources/baseline-surveys>

FAO and CCAFS. Gender and Climate Change Research in Agriculture and Food Security for Rural Development Training Manual. CGIAR Program on Climate Change, Agriculture and Food Security (CCAFS) and The Food and Agriculture Organization of the United Nations (FAO). *Forthcoming on www.fao.org and www.ccafs.cgiar.org*

Contributions to the Collective Action and Property Rights Program's: CAPRi Sourcebook entitled **Resources, Rights, and Cooperation.** A Sourcebook on Property Rights and Collective Action for Sustainable Development. In addition to hard copy distribution, the full sourcebook has been downloaded over 1500 times in PDF, iPAD, and Kindle versions. <http://www.capri.cgiar.org/sourcebook.asp>

Proposals/funding
EA Knowledge to Action Policy Level Workshop ($100,000) – accepted/funded by USAID

Data sharing
CCAFS Household-level baseline data for 5,040 households in 12 countries and 36 sites available at: www.ccafs.cgiar.org/resources/baseline-data

Blogs
Change and Innovation: climate adaptation practices <http://ccafs.cgiar.org/news/research-highlights/change-and-innovation-climate-adaptation-practices>
Food Security in a Changing Climate message reaches Canada <http://ccafs.cgiar.org/blog/food-security-changing-climate-updates-ccafs-latest-seminar>
Developing regional scenarios for climate change and food security in 2030 http://ccafs.cgiar.org/blog/developing-regional-scenarios-climate-change-and-food-security-2030
Final report: Mapping Hotspots of Climate Change and Food Insecurity in the Global Tropics <http://ccafs.cgiar.org/news/research-highlights/final-report-mapping-hotspots-mapping-hotspots-climate-change-and-food>
How to talk to farmers about carbon <http://ccafs.cgiar.org/blog/category/integration-decision-making/knowledge-action>

Case studies for Theme 4.1

Case Study 1: Supporting regional female scientists and new research on gender-climate change issues
Case type: Social differentiation and gender
Brief description of the activity: CCAFS is supporting female researchers in our 3 regions to undertake climate change, agriculture and food security-related research. Towards this aim, a competitive call was extended and grants were awarded to five female researchers at the postdoctoral level working within our regions. These researchers are based at local agricultural research institutes or universities, and are working closely with CCAFS theme leaders on CCAFS priority research areas. This is first step in building new capacity in local partner institutions in this critical and under-invested area.
Result of activity: 5 grants issued to local institutions where the researchers are based; research underway; theme and regional leaders supervising
Partners involved and their role: 5 local institutions (NGO's, Universities and agricultural ministries) in Senegal, Nepal, Uganda, Burkina, Bangladesh
Research on which the activity is based: Themes 1-3 relating to gender issues
Web address: www.cgiar.ccafs.org/gender

Case Study 2: Improving methods and strengthening regional capacity in gender-climate change analysis
Case type: Social differentiation and gender/capacity building
Brief description of the activity: Working closely with FAO gender and climate change specialists, we brought together research teams from each of our regions and collaboratively reviewed and refined a range of participatory research methods to target them towards addressing key gender-related questions cutting across CCAFS research themes. These new approaches were tested in CCAFS sites in Bangladesh, Uganda and Ghana, and revised further from the lessons learned during the pilot field

testing. Training materials were finalized and made freely available on our websites. The pilot studies have generated interesting results that are informing the design of new action gender-sensitive action research across CCAFS regions and themes.
Result of activity: Gender-CC research teams trained (and will now be trainers themselves) and methods tested in Bangladesh, Uganda and Ghana. Brief on new training materials disseminated at COP17 in Durban and available at: fao.org/gender. 3 pilot study CCAFS reports published. Synthesis report on pilot studies being written. New participatory action research is being designed in our sites, using these results to ensure that it will appropriately incorporate key gender concerns.
Partners involved and their role: FAO and local partner institutions in 3 regions
Research on which the activity is based: Themes 1-3 relating to gender issues
Web address: www.cgiar.ccafs.org/gender and www.fao.org/climatechange/micca/gender

Case Study 3: Scenarios for boundary-spanning and linking to policy
Case type: Innovative non-research partners/Capacity building
Brief description of the activity: Over 50 participants from national and regional institutions and organizations actively involved in defining environmental and food security policies in both East Africa and West Africa, received training in, and co-developed, regional futures scenarios. These are decision-making tools that capture key uncertainties and challenges for regional food security, environment and livelihoods and help inform new strategies and policies to deal with a changing climate.
Result of activity: Enhanced capacity in East and West Africa has been built to create regional environment and socio-economic scenarios in a participatory manner through the training of cross-sectoral public-private scenarios teams that have developed qualitative 'futures' storylines that are also being quantified through modelling. A brief that was disseminated at COP17 and a blog on this activity are available at: ccafs.cgiar.org/scenarios. Radio shows, posters, videos and other communications materials are under development with PANOS. CCAFS has been requested to design a high-level policy workshop together with The East African Community where the scenarios and the CCAFS vulnerability maps will be shared with policymakers as inputs to inform national and regional climate change and food security policies.
Partners involved and their role: Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) and West and Central African Council for Agricultural Research and Development (CORAF/WECARD), along with a wide a range of public and private sector actors.
Research on which the activity is based: This activity is informing ongoing research into identifying potential agricultural adaptation and mitigation activities.
Web address: http://ccafs.cgiar.org/scenarios

Synthesis of Program Participant Activities by Output

Output 4.1.1 *For each region, coherent and plausible futures scenarios to 2030 and looking out to 2050 that examine potential development outcomes under a changing climate and assumptions of differing pathways of economic development; developed for the first time in a participative manner with a diverse team of regional stakeholders.*

Much progress has been made in East and West Africa in 2011 in the scenarios-related activities led by the U of Oxford team, and a summary progress report is available at www.ccafs.cgiar.org/scenarios. Over 50 participants from national and regional institutions and organizations actively involved in defining environmental and food security policies in both East Africa and West Africa, received training in, and co-developed, regional futures scenarios. These are decision-making tools that capture key uncertainties and challenges for regional food security, environment and livelihoods and help inform new adaptation and mitigation strategies and policies to deal with a changing climate.

These qualitative 'futures' storylines for EA and WA are now being quantified through modelling. A brief that was disseminated at COP17 and a blog on this activity are available at: ccafs.cgiar.org/scenarios. Radio shows, posters, videos and other communications materials are under development with PANOS. CCAFS has been requested to design a high-level policy workshop together with The East African Community where the scenarios and the CCAFS vulnerability maps will be shared with policymakers as inputs to inform national and regional climate change and food security policies, and similar policy events are being discussed with CORAF in West Africa.

WorldFish has also been working on global and regional scenarios with a network of partners, including policymakers, in West Africa (ENDA/REPAO) that also has involved building capacity in scenarios methods in Ghana.

Output 4.1.2 *Global and regional maps, tables and associated syntheses, showing current vulnerable agricultural and fishing populations in relation to food security to 2030 and 2050*. This work was done together with Theme 4.2 and led by ILRI and a CCAFS report was published in 2011, entitled "Mapping hotspots of climate change and food security in 2030". It is available at: <http://ccafs.cgiar.org/resources/climate_hotspots>), along with extensive media coverage -see: <http://ccafs.cgiar.org/news/category/press-releases>. This work is now being linked with the scenarios work and communications and policy engagement approaches are being pursued to see that key decision-makers are accessing and using this information to inform food security policies in our regions.

Several centres undertook vulnerability assessments in 2011, including studies on impacts of CC by CIAT in Colombia and Thailand, and food security vulnerability maps in maize and wheat production systems by CIMMYT. Much of this work will be synthesized in 2012 as a background paper for the report on climate change and food security by the High Level Panel of Experts of the UN's Committee on World Food Security (CFS).

A capacity strengthening and training workshop that included 25 participants from across South Asia was held that focused on climate change scenarios and crop modelling.

Output 4.1.3 *Evidence on, testing and communication of, successful strategies, approaches, policies, and investments contributing to improved science-informed climate change-agricultural development-food security policies and decision making.* Numerous partner capacity building efforts (e.g. survey design, data management, survey implementation, data analysis training), data and knowledge sharing activities (e.g. widely sharing all CCAFS baseline survey materials on the web using *dataverse)*, and many engagement and communications efforts aimed at linking CCAFS outputs to actions were carried out in 2011 together with multiple CG centres, NGO partners and policymakers (e.g. scenarios training and development workshops, blogs, briefs, videos see: ccafs.cgiar.org/resources and amkn.org).

While most activities falling under this output are reported elsewhere, one example of centre's activities here is ICRAF's work on knowledge and information sharing products (KISPs) in Central and West Africa as well as East Africa. Partnership workshops were held in 2011 and a communication strategy was developed. An 'evergreen agriculture' web page has been created on the ICRAF website (www.worldagroforestry.org/evergreen_agriculture).

Output 4.1.4 *Analyses providing evidence of the benefits of, strategies for, and enhanced regional capacity in, gender and pro-poor climate change research approaches that will increase the likelihood that CCAFS-related research will benefit women and other vulnerable as well as socially differentiated groups.*
Analyses and evidence. New gender-focused research is underway in our 3 regions, by five female researchers who were awarded CCAFS grants. These researchers are based at local agricultural research institutes or universities, and are working closely with CCAFS theme leaders on CCAFS priority research areas. This is first step in building new capacity in local partner institutions in this critical and under-invested area. Bioversity initiated cross-site studies on the role of gender in conserving genetic diversity and indigenous knowledge in India, Nepal and Bolivia, and its 'Seeds for Needs' project in Ethiopia is doing participatory varietal selection with women.

Improved tools and capacity. Working closely with FAO gender and climate change specialists, we brought together research teams from each of our regions and collaboratively reviewed and refined a range of participatory research methods to target them towards addressing key gender-related questions cutting across CCAFS research themes. These new approaches were tested in CCAFS sites in Bangladesh, Uganda and Ghana (supported by IWMI, ICRISAT and ILRI), and revised further from the lessons learned during the pilot field testing. Training materials were finalized and made freely available on our websites. The pilot studies have generated interesting results that are informing the design of new action gender-sensitive action research across CCAFS regions and themes. <ccafs.cgiar.org/gender and fao.org/climatechange/micca/gender>

CIAT is working closely with NGO's and private-public sector partners in LA and developing gender-sensitive supply chain approaches/tools. ICRAF is looking at institutional arrangements for payments for ecosystem services in East Africa and SE Asia and how they can enhance benefits to women. In South Asia, additional gender and climate change-focused capacity strengthening workshops were held with 20 participants from Nepal, India and Sri Lanka. Some of these trainers then provided training to 35 rural women leaders in Punjab. A training manual on gender and climate change was developed for South Asia. See: <ccafs.cgiar.org/blog/%E2%80%9Cwe-can-change-our-lives-information%E2%80%9D-empowering-rural-women-south-asia-adapt-climate-change>

A new cross-CG gender research committee has been formed, with an objective of stimulating and designing new cross-CRP gender-targeted research across CCAFS/other CRP's 'gender sentinel' sites

Output 4.1.5 *Mainstreaming adaptation strategies into national policies, agricultural development plans, and key regional and global processes related to agriculture and rural development, food security and climate change.*

In East Africa, a regional learning partnership was developed and a learning platform web interface was designed to bring together and share widely CCAFS-related information and knowledge. The information being brought together in this learning platform is providing input to the Thematic Working Group 3 on the National Adaptation Plan in Kenya, which is informing Kenya's National Climate Change Response Strategy. CCAFS regional program leaders and various CG researchers involved in different CRP's have been involved in policy dialogues with farmer's organizations – ROPPA in WA and EAFF in EA, and SACAU in Southern Africa (this is in addition to the scenarios work with these organizations).

Regional dialogues on CCAFS related policy, research and development were initiated with policymakers, civil society, donors and researchers from India, Nepal and Bangladesh. A high level policy meeting with the President of Nepal was held.

ICRAF and ASB supported several events at COP17, including a learning event on landscape approaches, as well as an event at a SBSTA meeting in Bonn; posters and briefs are available at www.worldagroforestry.org).

Output 4.1.6 *Building of capacities to engage in global policy making processes and adopt risk management strategies.*

Various CCAFS-supported partners from West African partner organizations, including CORAF, AGRHMET, ACMAD, FARA, ROPPA, have effectively participated in global events (e.g. global science conference on climate smart agriculture, Ede-Wageningen – www.gscsa2011.org/workinggroups/theme1a.aspx), the CCAFS Science meeting, ARDD and Forest Day-COP17 in Durban (www.agriculturedday.org).

Several CCAFS partners from East Africa also attended COP17, where a SBSTA agricultural working group was agreed upon, and CCAFS began organizing follow-up workshops in early 2012 with COMESA, EAC and SADC partners to help further articulate the African position on agriculture.

2011 Theme 4.2 Technical Reporting

1.1 Outcomes – none achieved yet

1.2 Impact studies – none due yet

1.3 Activity Summary

Output 4.2.1 Integrated assessment framework, toolkits and databases to assess climate change impacts on agricultural systems and their supporting natural resources

4.2.1.1 Regional site and baseline characterisation

Activities: Household baseline data collected at all sites, data collated and analysed, site reports made available on the CCAFS website. Village baseline survey designed and implemented, site reports written up. Organisational baseline survey designed, currently being implemented. Participatory process designed and implemented to select two new target regions for CCAFS, to come on-line in 2012.
Deliverables: Site reports, baseline data, all materials made available on website. First in a series of papers on the baseline surveys written and submitted for publication.
Publications:

- CCAFS reports: Förch W, Kristjanson P, Thornton PK, 2011. Initial Sites in the CCAFS Regions: Eastern Africa, West Africa and Indo-Gangetic Plains. ccafs.cgiar.org/where-we-work
- Kristjanson P, Garlick C, Ochieng S, Förch W, Thornton PK, 2011. Global Summary of Baseline Household Survey Results. ccafs.cgiar.org/resources/baseline-surveys
- Thirteen household baseline result reports at ccafs.cgiar.org/resources/baseline-surveys
- Kristjanson P, Neufeld H, Gassner A, Mango J, Kyazze F, Desta S, Sayula G, Thiede B, Förch W, Thornton PK, Kinyangi J, Coe R, 2012. Are food insecure smallholder households making changes in their farming practices? Evidence from East Africa. Food Security (in press).
- Training materials and data: household and village-level surveys, data management, analysis and data available on dataverse, through ccafs.cgiar.org/resources/baseline-surveys
- Thornton PK, Förch W, 2011. Additional CCAFS Target Regions: Recommendations to the ISP. CCAFS document, 17 pages.
- Roque de Pinho J, Galvin KA, 2011. Maasai Voices On Climate Change: Understanding Climate From the Ground Up. A trailer for a participatory film project in Kenya. To be linked to the CCAFS website.

4.2.1.2 Downscaling needs and methodologies

Activities: Two activities commissioned on new methods: one on reconstructing daily weather data and downscaling, and one on generating synthetic data sequences that capture the statistical properties of observed near-term climate variability, in the absence of reliable model-based forecasts of regional "near-term" climate change.
Deliverables: project reports, workshop report, software, software documentation.
Publications:

- Quiroz R, Posadas A, 2011. Application of nonlinear techniques for daily weather data reconstruction and downscaling coarse climate data for local predictions. CCAFS website.
- Greene AM, Goddard L, Hansen JW, 2012. Toward a rubric for the simulation of regional decadal variability for agricultural and other applications. CCAFS website.
- Greene AM, 2011. The Simgen software package: User guide and notes. CCAFS website.

4.2.1.3 Downscaled climate data and repository

Activities: Suites of downscaled climate data for the 2030s to 2090s from climate models used in IPCC's Fourth Assessment Report generated and archived, for standardised applications. Development and application of a tool, MarkSimGCM, based in Google-Earth, that can generate "plausible" daily weather data in DSSAT format for future climate change scenarios.
Deliverables: report, web-based storage and archiving (ccafs-climate.org), web-based tool (gismap.ciat.cgiar.org/MarkSimGCM/), papers in refereed journals.
Publications:

- Jones PG, Thornton PK, Heinke J, 2011. Generating characteristic daily weather data using downscaled climate model data from the IPCC Fourth Assessment. https://hc.box.net/shared/f2gk053td8
- Jones PG, Thornton PK, 2012. Generating downscaled weather data from a suite of climate models for agricultural modelling applications. Agricultural Systems (submitted).

4.2.1.4 Evaluation of global climate models for the three CCAFS regions

Activities: Completion of reports on the climate of the three CCAFS target regions and the implications of global warming for agriculture, focusing on those aspects of climate change that will have greatest impact on the crops currently grown in each region. This work investigated the ability of models to reproduce the observed climate in each region and the reliability of future climate and associated crop growth projections.
Deliverables: reports on each CCAFS region and a forward-looking paper on prospects for climate modelling in the next 5-10 years.
Publications:

- Climate Change in CCAFS Regions: Recent Trends, Current Projections, Crop-Climate Suitability, and Prospects for Improved Climate Model Information. Part 1, West Africa (R Washington & M Hawcroft); Part 2, East Africa (R Washington & H Pearce); Part 3, The

Indo-Gangetic Plain (M New, M Rahiz & J Karmacharya); Part 4, Progress in Climate Science Modelling: a look forward (R Washington). CCAFS working papers.

4.2.1.6 Databases

Activities: Databases for soils, agricultural systems, and natural resources in the CCAFS regions evaluated, gap-filled, collated and made available. Household data collection tool (IMPACT-Lite) developed and tested at CCAFS sites in Kenya and Bangladesh. Development and implementation of a CCAFS data management policy.
Deliverables: reports, databases on the web, workshop reports and presentations, software tools and documentation.
Publications:

- Chaves B, Hoogenboom G, 2011. Strengthening Soil Databases for Climate Change and Food Security Modeling Applications: WISE Soil Profile Database V3.1 for DSSAT Applications. CCAFS Website.
- Fritz S, See L, 2011. Characterizing and Validating Global Land Cover. A workshop organised by IIASA, CGIAR Consortium for Spatial Information (CSI), Group on Earth Observation (GEO), the Agricultural Monitoring Communities of Practice (COP), GOFC-GOLD, and the Joint Research Centre of the European Commission (JRC). Presentations and summaries at www.iiasa.ac.at/Research/FOR/lc/presentations.html and www.iiasa.ac.at/Research/FOR/lc/breakout.html
- See L, Fritz S, Thornton P, You L, Becker-Reshef I, Justice C, Leo O, Herrero M, 2012. Building a Consolidated Community Global Cropland Map. EarthZine (in press).
- Robinson T, D'Aietti L, 2011. Global Mapping of Intensive Livestock Production Systems, Quarterly Reports. CCAFS website.
- Quiros C, Rufino M, Herrero M, 2012. Developing generic tools for characterising agricultural systems for climate and global change studies. CCAFS Working Paper.

4.2.1.7 Agricultural impact model scoping and documentation

Activities: Two scoping studies undertaken on agricultural impact model gaps and needs: household models and global integrated assessment models. Contributions made to the AgMIP program on crop and livestock model inter-comparison and improvement. Development of an Agricultural Modelling Web Site started, to provide an information and discussion centre for the global agricultural impacts modelling community.
Deliverables: reports, model information web site, peer-reviewed papers.
Publications:

- van Wijk MT, Rufino MC, Enahoro D, Parsons D, Silvestri S, Valdivia RO, Herrero M, 2012. A review on farm household modelling with a focus on climate change adaptation and mitigation. CCAFS Working Paper.
- Havlik P, 2012. A review of global integrated assessment tools. CCAFS Working Paper.

4.2.1.9 Toolkit and toolkit component development

Activities: Assembling toolkit components to evaluate likely effects of specific adaptation and mitigation options in CCAFS target regions. Engagement with key users to build capacity in use of tools and data. Targeted enhancements developed to existing integrated assessment and agricultural impacts models, and better linkages with new and existing data sets to allow local, regional and global impact assessment to be carried out. Contributions to the quantification of the regional scenario exercises undertaken with two global models, IMPACT and Globiom. Contributions to a mapping activity to identify hotspots of food system vulnerability in the global tropics. Contribution to the development of the "E-Atlas of African Agricultural Research and Development" in collaboration with HarvestChoice, CSI and ESRI.
Deliverables: Reports, software and software documentation, tools developed for uptake by users, electronic and hard-copy versions of atlas.
Publications:

- Boone RB, Conant RT, Hilinski TE, 2011. G-Range: Development and Use of a Beta Global Rangeland Model. Report and software available on CCAFS website.

1.4 Activity Reporting

See consolidated spreadsheet.

1.5 Publications

Ericksen P J, Thornton P K, Notenbaert A, Cramer L, and Jones P G (2012). Mapping hotspots of climate change and food insecurity in the global tropics. Food Security (submitted).

Kristjanson P, Neufeld H, Gassner A, Thornton P K, Förch W, Mango J, Kyazze F, Desta S, Kayula G, Thiede B and Kinyangi J (2012). Are food insecure smallholder households making changes in their farming practices? Evidence from East Africa. Food Security (in press).

Vermeulen S J, Aggarwal P K, Ainslie A, Angelone C, Campbell B M, Challinor A J, Hansen J W, Ingram J S I, Jarvis A, Kristjanson P, Lau C, Nelson G C, Thornton P K and Wollenberg E (2012). Options for support to agriculture and food security under climate change. Environmental Science & Policy 15, 136-144.

Vermeulen S, Zougmoré R, Wollenberg E, Thornton P K, Nelson G, Kristjanson P, Kinyangi J, Jarvis A, Hansen J, Challinor A J, Campbell B and Aggarwal P K (2011). Climate change, agriculture and food security: a global partnership to link research and action for low-income agricultural producers and consumers. Current Opinion in Environmental Sustainability 4, 1-6.

Moore N, Alagarswamy G, Pijanowski B, Thornton P K, Lofgren B, Olson J, Andresen J, Yanda P and Qi J (2011). East African food security as influenced by future climate change and land use change at local to regional scales. Climatic Change online, DOI 10.1007/s10584-011-0116-7

Herrero, Gerber P, Vellinga T, Garnett T, Leip A, Opio C, Westhoek H J, Thornton P K, Olesen J, Hutchings N, Montgomery H, Soussana J-F, Steinfeld H and McAllister T (2011).

Livestock and greenhouse gas emissions: the importance of getting the numbers right. Animal Feed Science and Technology 166-167, 779-782.

Boone R B, Galvin K A, BurnSilver S B, Thornton P K, Ojima D A and Jawson J R (2011). Using coupled simulation models to link pastoral decision making and ecosystem services. Ecology and Society 16(2), 6. [online] URL: http://www.ecologyandsociety.org/vol16/iss2/art6/

Thornton PK, Jones P G, Ericksen P J and Challinor A J (2011). Agriculture and food systems in sub-Saharan Africa in a four-plus degree world. Philosophical Transactions of the Royal Society Series A 369, 117-136. doi:10.1098/rsta.2010.0246

Ashby J, Kristjanson P, Thornton P, Campbell B, Vermeulen S, Wollenberg E (2011). CCAFS Gender Strategy. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark. Available online at: www.ccafs.cgiar.org.

Kristjanson P, Garlick C, Ochieng S, Förch W and Thornton P K (2011). Global Summary of Baseline Household Survey Results. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark. Available online at: www.ccafs.cgiar.org.

Thornton P K, Rufino M C, Karanja S, Jones P G, Mutie I, Herrero M (2011). Genesis Reversed: Climate Change Impacts on Agriculture and Livelihoods in Mixed Crop-Livestock Systems of East Africa. Final report to the World Bank. International Livestock Research Institute (ILRI), Nairobi. 162 pp.

Thornton P K (2011). Socioeconomic dimensions of crop modelling. Symposium Honoring James Jones, ASA Annual Meetings, San Antonio, 19 October 2011. Paper 196-3, online at a-c-s.confex.com/crops/2011am/webprogram/ Paper67848.html

Thornton P K and Förch W (2011). Additional CCAFS Target Regions: Recommendations to the ISP. CCAFS document, 17 pages.

See L, Fritz S, Thornton P, Justice C, Becker-Reshef I, Leo O and Herrero M (2011). Building a consolidated community cropland product. Earthzine (www.earthzine.org), in press.

Herrero M, Thornton P K, Havlik P and Rufino M (2011). Livestock and greenhouse gas emissions: mitigation options and trade-offs. In: Climate Change Mitigation and Agriculture (eds E Wollenberg, A Nihart, M L Tapio-Bistrom, M Grieg-Gran). Earthscan, London (in press).

Robinson T P, Thornton P K., Franceschini G, Kruska R L, Chiozza F, Notenbaert A, Cecchi G, Herrero M, Epprecht M, Fritz S, You L, Conchedda G and See L (2011). Global livestock production systems. Rome, Food and Agriculture Organization of the United Nations (FAO) and International Livestock Research Institute (ILRI), 152 pp.

Thornton P K, Herrero M and Jones P G (2011). Adaptation to climate change in mixed crop-livestock farming systems in developing countries. In: Handbook on Climate Change and Agriculture (eds R Mendelsohn and A Dinar). Elgar (in press).

Thornton P K (2011). A framework on addressing climate change adaptation and vulnerabilities. Chapter 15 (pp 205-211) in J Gonsalves, P Mohan (eds), Strengthening Resilience in Post-Disaster Situations: Stories, Experience and Lessons From South Asia. Academic Foundation. Delhi, and IDRC, Ottawa.

Ericksen P J, Thornton P K, Notenbaert A, Cramer L, Jones P G and Herrero M (2011). Mapping hotspots of climate change and food insecurity in the global tropics. Report to CCAFS, ILRI, Nairobi, 77 pp.

New M, Anderson K, Bows A, Fung F and Thornton P K (2011). SR8: The possible impacts of high levels of climate change in 2060 and implications for migration. Report for the UK

Government Foresight Project on Migration and Global Environmental Change, 56 pp. Online at www.bis.gov.uk/assets/bispartners/ foresight/docs/migration/science-reviews/11-1126-sr8-impact-high-levels-climate-change-2060-for-migration.pdf

Förch W, Kristjanson P and Thornton P K (2011). Initial Sites in the CCAFS Regions: Eastern Africa, West Africa and Indo-Gangetic Plains. CCAFS Report, 74 pp.

Herrero M, MacMillan S, Johnson N, Ericksen P, Duncan A, Grace D, and Thornton P K (2011). Improving Food Production from livestock. Chapter 14 (pp 155-163) in State of the World 2011: Innovations that Nourish the Planet. Washington DC, Worldwatch Institute, 155-163.

1.6 Case Studies

1. Title: Baseline surveys at household and village levels in the CCAFS benchmark sites

Case type: Social differentiation and gender

Brief description of the activity: CCAFS is engaged in conducting baseline surveys at the household, village and organizational levels across the target regions. The survey instruments being used adhere to high quality standards so that cross-site comparisons can be made. Households and villages will be revisited in the future to monitor what changes have occurred since the baseline survey was carried out. The goal is assess what kinds of changes have occurred and whether these changes are helping households adapt to, and mitigate, climate change. The baselines are allowing us to explore gender differences in target populations (for example, in access to information and to resources).

Result of activity: Survey manuals, data sets and site reports are available to whomever is interested, through the CCAFS website and stored on Harvard University's DataVerse archiving system. Syntheses and cross-site comparisons are currently being written up for publication in peer-reviewed journals.

Partners involved and their role: the Statistical Services Centre (University of Reading) is playing a key role in design and implementation of the baselines, which are administered through local institutions (NGOs, Universities and agricultural ministries) in all CCAFS sites in Senegal, Burkina Faso, Ghana, Mali, Niger, Uganda, Kenya, Ethiopia, Tanzania, Bangladesh, Nepal and India.

Research on which the activity is based: this activity is providing key information to CCAFS that will be used for monitoring and evaluation purposes in the future.

Web address: ccafs.cgiar.org/resources/baseline-surveys

2. Title: Mapping hotspots of climate change and food insecurity in the global tropics

Case type: Communications

Brief description of the activity: Climate change will have significant consequences for food security, particularly in parts of the global tropics where agriculture is a major activity and/ or many households are currently chronically food insecure. A mapping exercise was carried out to identify "hotspots" of climate change and food insecurity to target CCAFS's research on adaptation, mitigation and risk management. A novel approach was developed using vulnerability domains combining nine different thresholds of climate change exposure with a sensitivity threshold and a threshold for adaptive capacity. Sensitivity was based on percent of area cropped and adaptive capacity was based upon prevalence of stunting among

children under five. The area and population in each of eight vulnerability domains varied considerably among the different climate exposure thresholds, highlighting different parts of the global tropics as highly vulnerable or less vulnerable.
Result of activity: The report was launched with a press release. Subsequent media coverage was very extensive, with the report being picked up by several hundred news websites and publications in more than 15 countries. Several radio interviews were given also. In addition to highlighting the critical links between climate change and food security, the report was also used as one input to a participatory process to select two additional target regions for CCAFS.
Partners involved and their role: the study was led and conducted by scientists at ILRI, in collaboration with Waen Associates (climate modelling) in the UK. Other contributors to the design workshop included the University of KwaZulu Natal, the Food Economy Group, FAO, and Cornell University.
Research on which the activity is based: The activity built on a wide range of previous vulnerability mapping efforts to provide a snapshot for the global tropics. Sub-national vulnerability assessment work is being carried out in the CCAFS regions to add depth to our understanding of the dynamics of vulnerability and food security.
Web address: http://ccafs.cgiar.org/resources/reports-and-policy-briefs

3. Title: Generating downscaled weather data from a suite of climate models for agricultural modelling applications
Case type: Capacity strengthening
Brief description of the activity: In this activity, a generalised downscaling and data generation method was developed, which takes the outputs of a General Circulation Model and allows the stochastic generation of daily weather data that are to some extent characteristic of future climatologies. Such data can then be used to drive any agricultural model that requires daily (or otherwise aggregated) weather data. The method uses an amalgamation of unintelligent empirical downscaling, climate typing and weather generation. A web-based software tool was developed that utilises a subset of the climate models and scenario runs carried out for the 2007 Fourth Assessment Report of the Intergovernmental Panel on Climate Change. This is available on the web as a Google Earth application. The tool will be updated in 2012 with climate model data from the new runs being carried out for the IPCC's Fifth Assessment Report.
Result of activity: Once the software tool was available, it was used as one component of a training course in Nepal in September 2011 on "Using Climate Scenarios and Analogues for Designing Adaptation Strategies in Agriculture", attended by 25 participants from Bangladesh, Bhutan, India, Pakistan, Nepal, Sri Lanka, Kenya, Niger and Senegal. The tool continues to be heavily used on the website, and at least three participants from the training course are currently utilising the tool and methods in their own research.
Partners involved and their role: the software tool was a collaboration between scientists and software developers at Waen Associates in the UK, ILRI in Kenya and CIAT in Colombia.
Research on which the activity is based: The activity builds on previous work on weather generators and downscaling, and puts a tool in the public domain that provides daily weather data with which users can run a wide variety of agricultural impact models.
Web address: http://gismap.ciat.cgiar.org/MarkSimGCM/

1.7 Synthesis of Sub-theme Activities

Output 4.2.1 Integrated assessment framework, toolkits and databases to assess climate change impacts on agricultural systems and their supporting natural resources

Considerable progress was made in designing and implementing baseline data collection activities at the 15 CCAFS core benchmark sites in three regions and 12 countries. The objectives of the baselines were the same at the three levels at which the work is being carried out: to allow the construction and measurement of indicators of behaviour, in relation to climate change adaptation, mitigation and risk management, that can be measured in the future. The goal is assess what kinds of changes have occurred and whether these changes are helping households adapt to, and mitigate, climate change. The baselines, at household, village and organisational level, will allow CCAFS to explore gender and other social differences in target populations (for example, in access to information and to resources). The baselines will be completed in early 2012 for three CCAFS regions (East Africa, West Africa, and the Indo-Gangetic Plain). Site reports, baseline data, and all training materials are available on-line, through the DataVerse archiving system. Results are being analysed and written up for publication. The work has involved a wide range of national partners in the regions, as well as several CG Centres, particularly ILRI, IWMI and ICRISAT. This work will contribute substantially to monitoring and evaluation in CCAFS in the coming years.

Several activities were undertaken in relation to the downscaling of outputs from coarse-resolution climate models to render them more useful for evaluating the impacts of climate change on agriculture and food systems and for assessing adaptation, mitigation and risk management options. CIAT produced data from 24 climate models using two downscaling methods and made these available through a dedicated CCAFS website, www.ccafs-climate.org. Several other organisations have produced downscaled data for the 2030s to the 2090s. These include ILRI (International Livestock Research Institute), IFPRI (International Food Policy Research Institute), PIK (Potsdam Institute for Climate Impact Research), HarvestChoice, and the IPM CRSP (Integrated Pest Management Collaborative Research Support Program). All of them provided their own datasets that were added to the website. A tool was developed, MarkSimGCM, based in Google-Earth, that can generate “plausible” daily weather data in a common crop-modelling format for future climate change scenarios. This tool is available at gismap.ciat.cgiar.org/MarkSimGCM as well as via ccafs-climate.org. This website (ccafs-climate.org) is accessed 150 times per day, and during 2011 it received 16,300 unique visitors. Data from new climate model experiments (CMIP5) are being gathered and processed, and will become available in due course.

At the same time, more investigative research activities were carried out. CIP developed and tested a new method, based on wavelets, multifractals and neural networks, for climate downscaling. Software was developed for carrying out high-resolution downscaling. The method can also be used to fill in missing daily rainfall data in historical records. The IRI developed methods and software to generate synthetic weather data sequences that capture the statistical properties of observed near-term climate variability, in the absence of reliable model-based forecasts of regional “near-term” climate change. Several of these

downscaling methods are being contrasted and compared, and that work will continue in 2012. A cross-theme, multi-year initiative was set up as one outcome of the CCAFS Science Meeting in June 2011, to work on the science of seamless weather prediction over the near term, from 3 months to 20 years into the future (the CCAFS Near-Term Climate Project). That work is being led by the University of Cape Town, and will involve partners working with the Coupled Model Intercomparison 5 (CMIP5) and the Coordinated Regional Downscaling Experiment (CORDEX) and several CG centres (CIAT, CIP, ILRI, and possibly others).

A series of reports was completed by scientists at the University of Oxford on the ability of climate models to reproduce the observed climate in each of the CCAFS regions. The object was to establish how reliable future climate and associated crop growth projections might be. The influences and interactions that control each region's climate are complex and region-specific, and in general the climate models have difficulty in simulating observed climate adequately, particularly rainfall timing and amounts. Projections for changes in crop cultivation limits were carried out for the major crops grown in each region. While the outlook for agriculture in all regions is uncertain, the reports contain a wealth of detail about the possible future distribution and performance of key crops during the rest of this century. Substantial increases in the reliability of projections from climate models are not expected any time soon, so careful evaluation of results will continue to be needed in the CCAFS regions when it comes to designing agricultural adaptation, mitigation and risk management strategies. Similar reports are planned for the two additional CCAFS regions that will come on board during 2012.

Many of the Centres in the CGIAR undertake a considerable amount of work in relation to databases, and the work under this objective contributes to this much larger effort by filling in several key gaps that are of particular importance to climate change and food security work.

ICRAF developed databases for Africa from remotely-sensed information related to land properties such as soil carbon, vegetation cover, and land degradation risk factors at different scales. Work is being done to make these databases accessible on open-source platforms and to develop interactive web-interfaces for map generation. These data will provide users with an archive of recent historical changes in land cover and land properties, as well as providing a monitoring system for the future. This work is being led by AFSIS (the Africa Soil Information Service). Other soils database work has been carried out by partners at Washington State University, which has resulted in a large soil profile database (WISE version 3, see www.isric.org/projects/world-inventory-soil-emission-potentials-wise) being formatted and data-filled for agricultural modelling Applications. This will be available on-line in early 2012.

The collation of more detailed information on the agricultural systems operated by householders in the tropics is a key gap. ILRI has developed a household data collection tool, called IMPACT-Lite (Integrated Modelling Platform for Mixed Animal Crop systems) that can be used to collect detailed information from agricultural households concerning the details of the crop and livestock enterprises that they operate, along with information on labour and input use, food security, and gender differentiation within the household. The tool was tested at CCAFS sites in Kenya and Bangladesh in 2011, and will be used across all CCAFS

regions in 2012. At a more aggregated scale, scientists at FAO worked on the generation of global maps of intensive livestock production systems, with a particular focus on landless monogastric systems, for which spatially-explicit global data are lacking. One key input to the spatial delineation of agricultural systems is more accurate cropland extent maps. IIASA (International Institute for Applied Systems Analysis) is leading a multi-year effort to building a consolidated community global cropland map using crowd-sourcing techniques. This work is being undertaken in collaboration with the CGIAR Consortium for Spatial Information (CSI), the Group on Earth Observation (GEO), the Agricultural Monitoring Communities of Practice (COP), GOFC-GOLD (Global Observation of Forest and Land Cover Dynamics), and the Joint Research Centre of the European Commission (JRC).

Some crop and livestock modelling activities were undertaken in 2011. CIAT, in collaboration with the University of Leeds and the World Bank, developed enhanced niche-based approaches for analysing climate change impacts on major and minor crops. Detailed calibration procedures were developed for the model EcoCrop and the model was used for projecting the impact of climate change on banana (tropical and sub-tropical), potato, dry beans, cassava and sorghum. Work is ongoing on other crops in Africa and South Asia, and collaboration was established with the Global Crop Diversity Trust (GCDT) to produce vulnerability analyses for about 20 more crops. IRRI undertook a study to assess the possible impact of climate variability on rice production in the Philippines using several tools including the rice crop model ORYZA2000. That work found that management effects on rice yield variability outweigh year-to-year weather variability, and no long-term trends were found that explain rice yield patterns. With regard to livestock, colleagues at Colorado State University (CSU) developed G-Range, a moderate-complexity global rangeland model designed to be used for climate change studies. This addresses a direct gap in the current arsenal of tools that can be brought to bear on agricultural impact studies. The model, based on components of CENTURY, DAYCENT and Savanna (well-known soil and ecosystem models developed at CSU also), will be further tested in 2012 and several impact assessments are planned.

Several Centres undertook vulnerability assessments during 2012. CIAT conducted a case study of rice and livestock methane emissions and climate change adaptation strategies in Colombia. Another study was carried out for Thailand, where suitability impacts were assessed for several crops using the EcoCrop model, and economic costs of yield changes estimated. Detailed impact analyses were finalized using niche-based approaches for countries in the Andean region, including Peru, Bolivia, Ecuador and Colombia, and the results incorporated in planning exercises and policy briefs. CIMMYT developed a policy brief based on food security vulnerability maps in maize and wheat production systems, and prototype regional scenarios were developed with a wide range of partners. CIP developed vulnerability maps and data sets for potato and sweet potato systems in several Andean countries. A lot of this work will be synthesised in early 2012 as a background paper for the report on climate change and food security being produced by the High Level Panel of Experts of the UN's Committee on World Food and Security (CFS).

Work was undertaken in relation to assembling integrated assessment frameworks and toolkits that can help users analyze likely effects of specific adaptation and mitigation options. AfricaRice worked with IRRI on mapping actual and potential rice areas in Africa and

modelling the effect of climate change on future production, as well as collaborating with the Global Yield Gap Atlas project (GYGA). ICRAF made available toolboxes for REDD+ (Reducing Emissions from Deforestation and Forest Degradation) and AFOLU (Agriculture, Forestry and Other Land Uses) projects to practitioners and policy makers at various levels, work carried out in collaboration with the ASB (Alternatives to Slash-and-Burn) Partnership for Tropical Forest Margins as well as other international organizations. ILRI worked with IIASA to incorporate livestock issues into the GLOBIOM model (GLOBIOM is a global recursively dynamic partial equilibrium model integrating the agricultural, bioenergy and forestry sectors). The resulting model is being used to estimate the impacts of climate change scenarios on food production, land use change, and greenhouse gas emissions.

Output 4.2.2 Socially-differentiated decision aids and information developed and communicated for different stakeholders

Preparatory work was carried out during 2011 on this output. Most work as done on putting out a call for proposals on "Review of and strategy development for climate change communications and social learning in climate change". The work was awarded to a UK-based consortium of IIED (International Institute for Environment and Development) and IDS (Institute of Development Studies), and will be completed in the first four months of 2012. This will be followed by a workshop and case studies in the CCAFS regions, and a ramping-up of activities under this output to contribute to the outcomes that need to be achieved by 2015.

Objective 4.3 Refine frameworks for policy analysis

Outcome 4.3 New Knowledge on how alternative policy and program options impact agriculture and food security under climate change incorporated into strategy development by national agencies in at least 10 key international and regional agencies

Output 4.3.1 Tools developed and climate change impacts assessed at global and regional levels on agricultural systems (producers, consumers, natural resources), national/regional economies, and international transactions

Center-related activities involved broad-scale modeling tools developed to access climate change impact on agricultural systems, as well as dissemination activities on regional assessments.

IFPRI

This section includes both activities supported by theme 4.3 funds and bilateral funds to IFPRI.

Improvements to the Global Economic Model (IMPACT) suite included better integration with the Decision Support System for Agro-technology Transfer (DSSAT) crop modeling suite, improvements to the DSSAT suite itself (integration of the Oryza model into DSSAT) and development of a metric to represent share of population at risk of hunger.

Two sets of country-specific reports on agricultural vulnerability to climate change were undertaken. In each of these, national authors worked to a common, standard outline and with a standard set of IMPACT results for their countries. National authors then customized the reports to better meet their national needs and in some cases with data more appropriate to their national situations. The first set of studies was for Sub Saharan Africa, in conjunction with a project funded by the German Aid Agency. Country level vulnerability studies in Eastern, Western, and Southern Africa (ASARECA coordinated the East Africa studies, CORAF the West African studies, and FANRPAN the Southern African studies) were completed in 2011. The process of preparing peer-reviewed IFPRI research monographs was begun in 2011. These will be published in 2012. The second set of report was for the BRICS countries plus Indonesia and the US. These reports were prepared for a major conference on food security and climate change coorganized by the Chinese Academy of Agricultural Sciences and IFPRI and supported by CCAFS (see case study section).

In late 2011, a model intercomparison exercise was begun, with support to AgMIP (see case study section). Ten of the world's leading models with significant agricultural components ran a single reference scenario with standardized drivers, and initial results were compiled for discussion in January 2012. The second phase of this activity will be to use scenarios for the IPCC's AR5 scenarios with reports to be completed by end 2012.

CIMMYT

With CCAFS support to the climate change component of the Global Futures project (CIMMYT, CIP, CIAT, ICRISAT, IRRI, ILRI, and ICRAF are the centers currently participating in the Global Futures project) DSSAT-based virtual cultivars have been developed for global wheat crop simulations (using several wheat cultivars adapted to major wheat growing environments) and are being currently validated. The IMPACT model linked to DSSAT and Economic Surplus model (DREAM) is also being validated for wheat and work on maize will continue during 2012.

CIP

A simulation of productivity impacts of climate change with alternative potato and sweet potato crop varieties has been conducted within the Global Futures Project, involving the use of the DSSAT crop modeling system for spatial global simulations. An essential first step was the calibration of modern varieties for DSSAT. Efforts have been made to collect and collate yield trial data available at CIP and to use this data for the calibration of the SUBSTOR potato module of DSSAT (3 cultivars were calibrated). CIP also worked on a report of promising new potato and sweet potato varieties and management technologies systems for eventual inclusion in an edited book, about agronomic characteristics to be improved and the expected contributions to ecosystem services, such as food production, water conservation, soil quality, of greenhouse gas emissions. A first draft of the report was submitted to IFPRI in April 2011.

ICRAF

Results from pilot REDD-, PES-, and carbon payment projects for smallholders were synthesized in several journal articles, and web stories. Two PES papers and three web stories were published from PRESA. Several reports, papers and policy briefs that consider the implications of 2010 climate agreements, legislation on national plans and policies for sustainable development in the tropical forest margins, as well as summarize experience with avoided deforestation, and REDD pilot studies for key policy processes, were also published. A paper was published, addressing the intersection of energy policy, society and environment in the Amazon, in a context of increasing environmental concerns because of climate change. Finally, a meta-analysis of rangeland management impacts on Soil Organic Carbon in China was also published.

ICRISAT

Under the framework of assessing the impact of climate change as part of the Global Futures project, IMPACT runs for groundnut were completed and runs for sorghum are in progress. Two popular and widely adopted sorghum and groundnut cultivars were calibrated for South Asia (India) and WCA. Drought, heat tolerance and yield potential traits were simulated under current climate and future climates. Experiments for model calibration, took place at Patancheru, Gulbarga and Jamnagar with four cultivars each of pigeonpea and groundnut.

Output 4.3.2 Likely effects of specific adaptation and mitigation options, national policies (natural resource, trade, macroeconomic, international agreements) analyzed

IITA

Further progress has been done towards the assessment of cocoa and coffee based agricultural systems for carbon sequestration potential to mitigate risk of climate change and enhance food security. In Cameroon and Nigeria, surveys were conducted on cocoa systems to quantify the relationship between yield and major crop constraints, including shade tree sizes and densities (results will be published in 2012). A chapter was written in the Climate Change Mitigation and Agriculture book edited by Wollenberg et al. and published by Earthscan on agriculture (and cocoa in particular) as a driver of deforestation. A report on climate change adaptation and mitigation in coffee and banana systems was written, followed up by a stakeholder workshop and the writing of a policy brief.

Output 4.3.3 Differential impact on social groups (gender, livelihood category etc) of climate change adaptation and mitigation options identified, evaluated and communicated

No results

Output 4.3.4 Likely effects of special adaptation of specific adaptation and mitigation options and national policies (including for socially differential groups) communicate to key local, national and regional agencies and stakeholders

ILRI

A global review of livestock-related issues in global change has been almost completed, to be published as a PNAS special issue. Several papers are also in the pipeline in PNAS, related to this initiative. A Livestock and Global Change session has been included at the Planet under Pressure 2012 conference as a result of the research emerging from the Global Review.

Worldfish

Messages were prepared to be delivered during the Agricultural and Rural Development Day 2011 at COP17. Furthermore, Worldfish collaborated with FAO to put together a New Partnership for Africa's Development (NEPAD) session on climate change for Oceans Day 2011, at COP17, liaising with Réseau sur les Politiques de Pêche en Afrique de l'Ouest (REPAO). Moreover, a NEPAD combined side event, on African fisheries and climate change was organised with the Global Partnership for Climate, Fisheries and Aquaculture (PaCFA), at COP17. In addition, a major Synthesis Report on 'Green Economy in a Blue World', was launched together with UNEP and other partners in Manila, January 25th, 2012. Finally, a Small Island Developing States green economy report was submitted for the SIDS sub-regional preparatory meetings for Rio+20.

Case Study 1: The Agricultural Model Intercomparison and Improvement Project (AgMIP)- *2011 Global Workshop and Global Model Intercomparison Startup*

Case type

Capacity strengthening, non-research partnerships

Brief description of the activity

AgMIP is a major international effort to assess the state of global agricultural modeling and to understand climate impacts on the agricultural sector. It is a trans-disciplinary project focused on the comparisons of crop and economic models applicable initially to South-Asia and Sub-Saharan Africa, which connects the climate science, crop modeling, and agricultural modeling communities with an emphasis on developing the information technology tools required for probabilistic projections of current and future climate impacts.

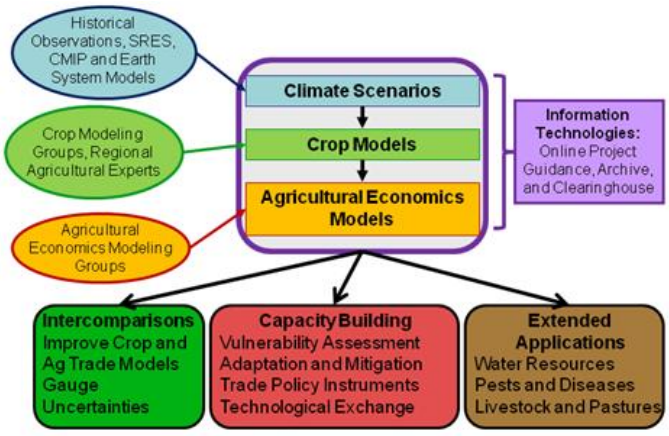

Figure 1. AgMIP components and expected outcomes

The goals of AgMIP are to improve substantially the characterization of risk of hunger and world food security due to climate variability and change, and to enhance adaptation capacity in both developing and developed countries. To achieve these goals, AgMIP is establishing a robust and rigorous international research framework that connects climate, agriculture, economic and information technology communities. This is done through global and regional workshops, capacity building activities, and the establishment of AgMIP-funded research teams initially in Sub-Saharan Africa and South Asia.

Result of activity

CCAFS supported and CCAFS theme leaders participated in the **AgMIP Global Workshop, October 13-15, held in Texas, USA**, which attracted over 100 participants from about 30 countries. Representatives of leading crop modeling, climate, and economics groups from around the world had the chance to meet and review a broad spectrum of research activities for climate scenarios, crop modeling, economics, and information technologies, as well as regional initiatives and crop-specific assessments.

Highlights included advancements among Climate, Crop Modeling, Economics, and IT Teams; the launch of Cross Cutting AgMIP teams to address issues of uncertainty and aggregation; and an opportunity for

Monsanto to announce its support of AgMIP. Additional accomplishments included establishing a new plateau for AgMIP Protocols; steady progress within the Wheat, Maize, and Rice Pilot Teams; methods for providing in-situ climate information in regions where data are scarce; an initial framework for representative agricultural pathways; advancements within the global model intercomparison activity; and developments in application programming interfaces for the AgMIP crop experiment database.

At this meeting plans were developed for the first phase of the global economic model intercomparison exercise. This first phase involved agreement on a single set of drivers to be used by all models, a process for providing model results in a standard framework and a time table leading up to a workshop in Kenya in January 2012 where initial results would be compared.

Partners involved and their role

- Columbia University, NASA Goddard Institute for Space Studies – overall management of the project, co-lead the climate modeling component
- University of Florida – co-lead the crop modeling and IT components
- Oregon State University – co-lead the economics component, focusing on regional modeling intercomparison
- Wageningen UR , Alterra – co-lead the IT component
- IFPRI– co-lead the economics component, focusing on global modeling intercomparison
- US Department of Agriculture, Agriculture Research Service – overall project management
- Commonwealth Scientific and Industrial Research Organization (CSIRO) – co-lead the crop modeling component
- Models included in the global economic model intercomparison component, see table below
- **Table 2.1: Participating Models**
-

Model	Affiliation	Location	Contact	Documentation Link
General Equilibrium Models				
AIM	NIES	Japan	*Shinichiro Fujimori*	http://www-iam.nies.go.jp/aim/infomation.htm
CIM-Earth	University of Chicago	USA	Joshua Elliott *Alison Brizius*	http://www.cimearth.org/cim-earth/about/
ENVISAGE	FAO	Italy	*Dominique van der Mensbrugghe*	http://siteresources.worldbank.org/INTPROSPECTS/.../Envisag
EPPA	MIT	USA	*Elodie Blanc*	http://globalchange.mit.edu/igsm/eppa.html
FARM	USDA-ERS	USA	Ron Sands	
GTEM	ABARES	Australia	Raymond Mi *Edwina Heyhoe*	http://www.daff.gov.au/abares/models

LEITAP	LEI - Wageningen University	Netherlands	*Hans van Meijl* Andrzej Tabeau	
Partial Equilibrium Models				
GCAM	PNNL	USA	*Page Kyle*	http://wiki.umd.edu/gcam/index.php?title=Main_Page
GLOBIOM	IIASA	Austria	*Petr Havlik* *Hugo Valin*	http://www.iiasa.ac.at/Research/FOR/globiom.html
IMPACT	IFPRI	USA	*Gerald Nelson* *Amanda Palazzo* *Sherman Robinson*	http://www.ifpri.org/book-751/ourwork/program/impact-mo
MAGPIE	PIK	Germany	*Hermann Lotze-Campen* *Christoph Schmitz*	http://www.pik-potsdam.de/research/sustainable-solutions/g

Research on which the activity is based
Models developed in partner institutions.
Web address for further information
1. *AGMIP website*
   http://www.agmip.org/

Case Study 2: International Conference on Climate Change and Food Security (ICCCFS)

Case type; Capacity strengthening/ research partnerships

Brief description of the activity
Abstract: "Climate change presents a major threat to sustainable food security. While the general trend of increasing temperatures is clear, major uncertainties remain in the distribution and magnitude of climate change outcomes, the location-specific consequences for agriculture, the possibilities for adapting to a changing climate, and the potential role for agriculture in reducing the amount of greenhouse gasses (GHGs) in the atmosphere."

At a November 2011 conference in Beijing, organized the Chinese Academy of Agricultural Sciences (CAAS) and the International Food Policy Research Institute (IFPRI), leading scientists from around the world gathered to present new research that helps answer these questions.

Result of activity

Leading international scientists and young researchers from the BRICS countries (Brazil, Russia, India, China, and South Africa) plus Indonesia and the United States reported results on the food security and climate change challenges facing their countries. This conference provided a forum for the participants to present their latest research findings, exchange their research ideas, and share their experiences in the field of climate change and food security. The event included technical sessions, poster sessions, and social events. Based on their research, the participants identified two sets of priority actions to address the challenges from climate change (a) strengthening public sector agricultural research and (b) increasing the amount, appropriateness, and accessibility of spatial data.

The recommendations were later presented at the side event "Climate Change and BRICS: Findings from the International Conference on Climate Change and Food Security.", during the 17th Conference of Parties (COP 17), at the United Nations Framework Convention on Climate Change (UNFCCC), hosted in Durban, South Africa. The conference participants urged the negotiators to establish a work program that includes the priorities (a) and (b).

Partners involved and their role

Organizers: Chinese Academy of Agricultural Sciences (CAAS) , International Food Policy Research Institute (IFPRI), CGIAR Research Program on Climate Change, Agriculture and Food Security

Co-sponsors: Adapting to Climate Change in China Project (ACCC), National Major Scientific Research Program of China, Key Project of National Natural Science Foundation of China

Participants: Leading researchers from the BRICS countries, Indonesia, and the United States.

Research on which the activity is based

Accumulated and current research of partnered institutions and of various participants. Country reports based on country-specific results from IMPACT model augmented with national data and analysis.

Web address for further information

1. *Conference website*- http://icccfs.ifpri.info/
2. *Conference information in the CAAS portal*- http://www.caas.net.cn/caas/news/shownews.asp?Id=9054
3. *"Fighting hunger in a changing climate", IFPRI publication*- http://www.ifpri.org/publication/fighting-hunger-changing-climate
4. *Recommendations of CAAS-IFPRI conference in Beijing for UNFCCC negotiators, Video*- http://www.ifpri.org/publication/climate-change-and-food-security http://www.youtube.com/watch?v=1KpnyVpf6qo&feature=youtu.be

Case Study 3: Global Futures for Agriculture Virtual Crop Modeling Workshop, Kenya, 2011

Case type

Capacity strengthening

Brief description of the activity

Global Futures for Agriculture project aims to improve the capacity of the CGIAR centers to evaluate and prioritize research investments, and to support the decision-making of international development partners and national policymakers. The effort is supported with major funding from the Bill and Melinda Gates Foundation. CGIAR researchers and other scientists are developing an enhanced version of IFPRI's International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT), a state-of-the-art economic model that projects the future production, consumption, and trade of key agricultural commodities, and can assess the effects of climate change, water availability and other major trends. The research focuses on regions most vulnerable to global changes in the next 30 to 50 years, with special attention on the rural poor and smallholder farmers.

Global Futures project scientists work with breeders, plant physiologists, and agronomists to identify potentially promising technical traits and develop software (virtual) cultivars with increased productivity in specific environmental conditions (weather, soil quality/composition, limited resources, etc.) today or might occur with climate change. These virtual crops are then fed into IFPRI's IMPACT model to determine the economic benefits. The results will reveal the extent to which new technologies can address food security and climate change challenges.

Scientists associated with the Global Futures project s met in a Virtual Crop Modeling Workshop in Kenya in April 2011, where they had the chance to work together with plant breeders and crop modelers to develop the methodology of creating virtual cultivars. During this process, they discussed promising traits for higher productivity and climate change adaptation (e.g. drought and high temperature, etc.) towards a set of potential technologies for virtual crops.

Result of activity

Project scientists focused on the following 4 main activities: Reporting on Promising Technologies, Developing crop coefficients in consultation with the plant breeders, Collecting and disseminating of crop and country data in collaboration with the Spatial Production Allocation Model (SPAM) experts at IFPRI, Engaging in IMPACT Model activities.

Crop modeling experts discussed practical approaches to creating the virtual crops based on what the plant breeders presented. They worked on setting baselines for the model (identifying target sites, current practices etc.) and preparing a series of protocols. Three categories of technologies were identified – traits to increase yield in current climate conditions, for heat tolerance and for drought tolerance.

Combinations of all the information identified above, including the baseline information, will allow the GF Fellows to simulate runs and calculate the rate of change based on the baseline and the future. List of protocols were decided to be written and distributed to the plant breeders for review. For each crop there will be a baseline variety, a variety with enhanced yield trait, a variety with enhanced heat tolerance, and a variety with enhanced drought tolerance (baseline, and three virtual crops).

Partners involved and their role

IRRI, ILRI, CIP, CIMMYT, ICRISAT, CIAT, ICRAF (technology identification)

IFPRI (coordination, and IMPACT model capacity building)

University of Florida and Washington State Univesity (crop modeling)

Research on which the activity is based

The analysis will improve upon previous research by incorporating: detailed location-specific data; climate, soil type, crop variety, and other critical variables; improved measurement of effects on human welfare; and the impact of potential agricultural investments on economic growth, incomes, and poverty alleviation.

Web address for further information

1. *Global Futures website*
   http://globalfuturesproject.com/

Theme 4.3- Publications, 2011

Peer-Reviewed Articles

- Clark, W.C.; Tomich, P.T.; van Noordwijk, M.; Guston, D.; Catacutan, D.; Dickson, N.M.; McNie, E.. Boundary work for sustainable development: Natural resource management at the Consultative Group on International Agricultural Research (CGIAR). National Academy of Sciences (2011) *Available online:* http://www.pnas.org/content/early/2011/08/11/0900231108.full.pdf+html
- Hoang MH; Do Trong H; Pham MT; Van Noordwijk M and Minang PA.. Benefit distribution across scales to reduce emissions from deforestation and forest degradation (REDD+) in Vietnam. Journal of Land Use Policy (2012): P. 1-15.- *Article in press*
- Jindal, R., et al., Social dimensions of procurement auctions for environmental service contracts: Evaluating trade-offs between cost-effectiveness and participation by the poor in rural Tanzania. Land Use Policy (2011), doi:10.1016/j.landusepol.2011.11.008
- John Kerr; Mamta Vardhan and Rohit Jindal. Pro-social behavior and incentives: Evidence from field experiments in rural Mexico and Tanzania. Ecological Economics 73 (2012): 220–227
- Wang; SP, Wilkes, A; Zhang, ZC; Chang, XF; Lang, R; Wang, YF; Niu, HS, Effects of management and land use change on soil carbon in China's grasslands, in Agriculture, Ecosystems & Environment 142 (2011) 329– 340, doi:10.1016/j.agee.2011.06.002

Book chapter

IITA edited one chapter in: Wollenberg E, Nihart A, Tapio-Biström M-L, Grieg-Gran M, eds. 2011. 'Climate Change Mitigation and Agriculture.' Routledge, London, 419 pp.

Other Publications

Reports

- Synthesis report 'Green Economy in a Blue World', launched in Manila, January 25th, 2012. Full report is in press. *Available online:* http://www.unep.org/pdf/green_economy_blue.pdf
- Small Island Developing States green economy report submitted for SIDS sub-regional preparatory meetings for Rio+20, August 2011. *Available online:* http://www.sidsnet.org/provisional/docs/newsletter/SIDS_Unit_Newsletter-August_2011.pdf

Working Papers

- Country level vulnerability studies in Eastern, Western, and Southern Africa were prepared for review. (IFPRI/ ASARECA- East Africa, CORAF- West Africa, and FANRPAN Southern Africa). Three monographs will appear in 2012.
- Adam, Myriam, Place, Frank, and Edmundo Barrios 2011. Potential contributions of agroforestry for enhancement of models within the Global Futures project. Working Paper, ICRAF, IFPRI and CCAFS, Nairobi, Kenya.
- Adam, Myriam and Frank Place. 2012. Agroforestry as integrated fertilization management practice in southern Africa, Working Paper, Global Futures, ICRAF, IFPRI and CCAFS, Nairobi, Kenya.
- Santos, Ione Vieira; Porro, Noemi Sakiara Miyasaka; Porro, Roberto 2011. Interventions to curb deforestation and stability in access to land: A comparative study between two land regulation modalities in the Transamazon region, Brazil. Roma: International Land Coalision
- *Available online:* http://americalatina.landcoalition.org/sites/default/files/ICRAF PARA_Brazil_web_14.03.11.pdf

Policy Briefs

- Janudianto.; Mulyoutami, E.; Joshi, L.; Wardell, D.A.; van Noordwijk, M. 2011 Recognizing traditional tree tenure as part of conservation and REDD+ strategy
- *Available online:* http://www.asb.cgiar.org/PDFwebdocs/ASB_PB22.pdf
- Magnan Nicholas and Timothy S. Thomas . "Food Security and Climate Change to 2050: Cambodia", Special Report 11, Policy Discussion Paper, Cambodia Development Resource Institute.
- *Available online:* http://www.cdri.org.kh/webdata/download/sr/fscc11e.pdf
- Meyfroidt, P.; van Noordwijk, M.; Minang, P.A.; Dewi, S.; Lambin, E.F. 2011 Drivers and consequences of tropical forest transitions: options to bypass land degradation?
- *Available online:* http://www.asb.cgiar.org/PDFwebdocs/ASB PB_25.pdf

- Minang, P.A.; Bernard, F.; van Noordwijk, M.; Kahurani, E. 2011 Agroforestry in REDD+: Opportunities and Challenges. *Available online:* http://www.asb.cgiar.org/PDFwebdocs/ASB_PB26.pdf)
- Robiglio, V.; Minang, P.A.; Asare, R. 2011 On-farm timber production for emission reduction with sustainable benefits at the tropical forest margins. *Available online:* http://www.asb.cgiar.org/PDFwebdocs/ASB_PB23.pdf
- Santos-Martin, F.; Bertomeu, M.; van Noordwijk, M.; Navarro, R. 2011 Why smallholders plant native timber trees away from the forest margin : Lessons from Leyte, the Philippines. *Available online:* http://www.asb.cgiar.org/PDFwebdocs/ASB -PB24.pdf
- Tata, H.L.; Widayati, A.; Mulyoutami, E.; van Noordwijk, M. 2011 Co-existence of people and orangutan in Sumatra -Stabilising gradients for landscape multifunctionality. *Available online:* http://www.asb.cgiar.org/PDFwebdocs/PolicyBrief%2020.pdf

Other Web posts

- Carbon payments for watershed management. Jun 23, 2011. *Available online:* http://presa.worldagroforestry.org/blog/2011/06/23/carbon-payments-for-watershed-management/
- Carbon project brings new income – and risks – to Uganda farmers. May 9, 2011. *Available online:* http://presa.worldagroforestry.org/blog/2011/05/09/carbon-project-brings-new-income-and-risks-to-uganda-farmers/
- Supporting communities for sustainable ecosystems in western Uganda. Mar 17, 2011. *Available online:* http://presa.worldagroforestry.org/blog/2011/03/17/supporting-communities-for-sustainable-ecosystems-in-western-uganda/

Conference Proceedings

- Country level reports on agricultural vulnerability to climate change in the BRICS countries plus Indonesia and the US. CAAS-IFPRI Food Security and Climate Change conference in Beijing, November 2011. Reports expected to be converted to papers for a special issue of a journal in 2012.
- Adam, Myriam, Barrios, Edmundo, and Frank Place. 2011. Effect of agroforestry on maize productivity in Eastern and Southern Africa: a yield gap analysis, Poster Presented at the World Congress on Conservation Agriculture, 26-29 September, Brisbane Australia.
- Kleinwechter, U. (2012), Global impacts of targeted interventions in food security crops – the case of potatoes in developing countries. Contributed paper submitted for presentation at the 28th International Conference of Agricultural Economists, to be held from August 18 to August 24, 2012, Foz do Iguaçu, Brazil.

CCAFS East Africa Program
Annual Report
2011

February, 2012

Synthesis of 2011 Activities by Output

Key outputs are summarized in relation to 2011 activity plan. The main activities included research in collaboration with the global CCAFS themes, partner engagement, communication and capacity building. Some of the milestones will be completed in early 2012.

Research: Lead the regional synthesis work and ensure the publication of CCAFS research in East Africa.

Theme 1

Output 1.1.1 Development of farming systems and production technologies adapted to climate change conditions in time and space through design of tools for improving crops, livestock, and agronomic and natural resource management practices

In collaboration with theme 1, the program worked with several CGIAR centres in the region to build on the existing Africa Trial Sites project. The project was funded by AgCommons as one of the QuickWin projects, and developed by CIAT, ICRISAT, CIMMYT and IITA. The number of crops was expanded, incorporating livestock and fish data, strengthening its 'analytical capabilities' and broadening its geographical range. When completed, the trials sites project will include performance data and trial protocols in addition to the basic geographic characterisation of trial sites.

Output 1.1.2 Building of regional and national capacities to produce and communicate appropriate adaptation and mitigation strategies for progressive climate change at the national level (e.g. through NAPAs)

Together with COMESA, the program initiated a process of documenting the current status of drought and famine in the Horn of Africa. The activity will identify transformative actions on policies and best practices that enhance climate adaptation and mitigation to address current recurring hunger from frequent drought events. The study; Amwata et al, will include a technical report and a DVD documentary that can be shared at policy forums

Output 1.1.3 New knowledge-synthesizing institutional arrangements, policies and mechanisms for improving the adaptive capacity of agricultural sector actors and those involved in managing the food system

National policy priority setting workshops were held in Kenya and Ethiopia. (Linked to 4.3)
Two out of four policy workshops were conducted. For logistical reasons, workshops for Tanzania and Uganda a have been deferred to 2012.

Output 1.3.2 New information, knowledge, guidelines and germplasm are made available to farmers, breeders, local communities and scientists and promoted through knowledge sharing, peer reviewed articles, information systems and media

Theme 1, in partnership with the program organized a crop breeding workshop, in Addis Ababa, Ethiopia. The objective of the workshop was to identify potential improvement scenarios and begin to incorporate them into crop models, and to build a community that will support CCAFS research through the adoption of the developed breeding strategies. The target crops included beans, sorghum, bananas and rice. A total of 40 participants representing the breeding and modelling communities from 16 countries attended the workshop. Several institutions were represented: six CGIAR Centers (AfricaRice, Bioversity, CIAT, ICRISAT, IITA, IRRI); The Global Crop Diversity Trust; 12 NARS partners (INERA, Burkina Faso; EIAR, Ethiopia; Ethiopian National Program; CSIR-Savanna Agricultural Research Institute, Ghana; Crops Research Institute, Ghana; Kenya Agricultural Research Institute, Kenya; Rural Economy Institute, IER, Mali; National Research Institute - NRI, Mali; National Institute for Agronomique Research Of Niger, INRAN, Niger; Zambia Agriculture Research Institute; EMBRAPA, Brazil); Jimma University (Ethiopia); and two regional breeding centres (CARBAP, Cameroon; WACCI, Ghana). A detailed blog story is available at http://ccafs.cgiar.org/blog/mitigating-change-climate-relations-breeders-and-modelers-africa-unite-climate-smart-crops

Theme 2

In partnership with Theme 2, KARI and ICRISAT a project in Wote tested the design and communication of downscaled, probabilistic seasonal forecast. ICRISAT will continue investigating the delivery, evaluation and use of seasonal climate forecasts and forecast-based advisories in 2012. It is anticipated that ICRISAT will work closely with various partners (KARI-Katumani, Kenya Meteorological Department, and University of Nairobi) to facilitate the implementation of the proposed research activities

Output 2.1.5 Identify and evaluate differential impact of agricultural risk management strategies on different social groups, particularly women and men, and communicate findings through technical and policy support activities

Three case studies are being documented at CCAFS learning sites in Uganda, Tanzania and Ethiopia. These studies will document how to reduce vulnerability of smallholder farmers to changing climate through promoting the integration and utilization of indigenous knowledge and scientific weather and climate forecasting for risk management, and will be completed in early 2012. The program is collaborating with Sokoine University of Agriculture (SUA) in Tanzania, NARL, Kawanda in Uganda. In Ethiopia, the program is collaborating with MARIL and ILRI scientists to examine social innovation and rangeland enclosure to adapt to a changing climate in Borana. Five out of the planned 8 small research projects have been commissioned through NARES and CGIAR partners at CCAFS benchmark sites as formulating a call was less feasible given the funding uncertainty that prevailed

Output 2.2.3 Platform and tools for sharing knowledge and fostering improved coordination among food crisis response, the market-based food delivery system, and agricultural research and development

Through partnership with EAC and ICPAC, the program held a workshop on 'Enhancing Climate-Related Information Access for Improved Food System Planning and Coordination in East Africa'. The workshop provided an opportunity to foster critical links between extension services, agro-meteorology and food security communities in terms of planning interventions that address impacts from climate change and climate variability. The workshop proceeding will be available as a publication to engage with the non-research food security and agriculture extension communities on CCAFS research.

Output 2.3.1 Improved climate information tools and products to support management of agricultural and food security risk

In Lower Nyando, the program is partnering with VI agroforestry to develop participatory action research activities, investigating promising adaptation options aimed at enhancing resilience to climate variability/change and to promote food security through actions that build community capacity and strengthen community structures. The emphasis is on a long term presence of skilled and knowledgeable personnel within the local communities. A total of 1,100, people drawn from 220 households participated in this initiative in 2012. Research partners will also capture, learn from and build on local knowledge and practice that has potential to be scaled up and transferred beyond the CCAFS benchmark locations.

Under the Integrative Graduate Education and Research Traineeship (IGERT), fellows were tasked with developing an inventory and critically assessing existing and potential climate change adaptation and local mitigation (CCAM) activities among pastoralist and agro-pastoralist communities in the Borana zone of southern Ethiopia. The report from this exercise highlights potential conflicts and complementarities that may be associated with the implementation of Index-based Livestock Insurance (IBLI) in the region, and is scheduled to be published as a CCAFS working paper.

Theme 3

Working with Theme 3, the program commissioned a study on the status and trends of agricultural adaptation and mitigation project inventory for Eastern Africa. A report has been prepared by Camco Advisory Services (K) Ltd highlighting the current status of projects, policies and other efforts at the national level in East Africa. The report is under review and will be combined with information from two other policy mapping related studies to create a database of climate change, agriculture and food security actors and policies East Africa.

Output 3.3.1 Analysis of mitigation biophysical and socioeconomic feasibility for different agricultural practices and regions, and impacts on emissions, livelihoods and food security

In consultation with Theme3, ICRAF and CIFOR are conducting a study on GHG fluxes from different agroforestry systems at CCAFS sites in lower and middle Nyando, including measurement and modelling results, and an assessment of overall management GHG balances. The study focused on selected farms utilizing different land use practices, ranging from conventional cropping to agroforestry systems (improved fallow; intercropping). Modelling will be done using statistical approaches and the mechanistic DNDC model. This will allow for comparison with a CCAFS commissioned modelling exercise on N_2O fluxes based on national data.

In a second activity, Applied GeoSolutions, LLC (AG, LLC) undertook a baseline study on assessing agricultural emissions. The expected outcomes of the initiative will include: refined methodologies for mapping land cover in support of crop modelling of soil carbon, greenhouse gas emissions and crop yields; acquisition of satellite data for 8-10 benchmark sites in East and West Africa; remote sensing based maps of land cover and cropping systems for 4-5 benchmark sites; and DNDC modelling of GHG emissions and crop yields under current climate conditions and future climate change scenarios.

Theme 4.1

Output 4.1.1 For each region, coherent and plausible futures scenarios to 2030 and looking out to 2050 that examine potential development outcomes under a changing climate and assumptions of differing pathways of economic development; developed for the first time in a participative manner with a diverse team of regional stakeholders

Working with Theme 4.1 and Institute of Resource Assessment (IRA), University of Dar es Salaam, we organised a workshop on "Linking Knowledge with Action through Regional Scenario Building" in Tanzania. This was a follow-up to previous workshops, specifically to develop previous scenario storylines in terms of their ability to engage and communicate to key audiences, together with selected regional media experts (e.g. PANOS) and to link the scenarios with global and regional socio-economic, agricultural and environmental change models to begin to create quantitative outputs for the scenarios that will provide insights into the consequences of each scenario.

After further consultations, the program contracted a senior consultant to undertake an East Africa Scenarios Quantification exercise. The regional scenarios analyses is expected to provide a suitable framework for raising awareness of key regional drivers and concerns, considering the viability of potential adaptation options, and identifying the trade-offs and synergies of different options for climate change, agriculture and food security goals (Katindis work) .There are ongoing discussions to work more closely with USAID and to present the preliminary results at a regional workshop in April of 2012

Output 4.1.5 Mainstreaming adaptation strategies into national policies, agricultural development plans, and key regional and global processes related to agriculture and rural development, food security and climate change

A regional learning partnership was convened to build the capacity of key organizations working on climate change, agriculture and food security to co-generate knowledge and drive the science to policy dialogue in the region. A learning platform web interface – mock-up was designed to aggregate existing climate information sources in order to progress towards an integrated learning and sharing platform, that allows effective dissemination of research and fosters positive collaborations and knowledge exchanges,

At the same time, the program is providing input to the Thematic Working Group 3 on National Adaptation Plan (NAP) under the Ministry of Environment and Mineral Resources in Kenya. The working group is reviewing key national and sectoral strategies, programmes, and policies that will inform National Climate Change Response Strategy.

Theme 4.2

Outcome 4.2.1 Improved frameworks, databases and methods for planning responses to climate change used by national agencies in at least 20 countries and by at least 10 key international and regional agencies

Working with local partners in Uganda, Tanzania, Kenya and Ethiopia, the program compiled a comprehensive household and village baseline data set for five learning sites. The baseline datasets will be used to benchmark the impact of CCAFS long-term research in East Africa. In addition, organizational baseline surveys are on-going in these sites. The household baseline reports have been completed and available on the CCAFS website. http://ccafs.cgiar.org/resources/baseline-surveys

Theme 4.3

Output 4.3.1 Tools developed and climate change impacts assessed at global and regional levels on agricultural systems (producers, consumers, natural resources), national/regional economies, and international transactions

The process of reviewing country papers on agricultural vulnerability to climate change in East Africa with specific focus on the 10 ASARECA countries was completed. The papers which are developed through Theme 4.2 have a location/country specific focus on the direct impacts on crops and livestock productivity domestically; indirect impacts on food prices, income from agricultural production at farm and country level and on reduced farm labor due to escalation of disease like malaria.

A study mapping policies, institutions and actors related to climate change adaptation, food security, food systems and agricultural development in East Africa was initiated in 2011. The objective is to explore, map and assess the adequacy of current climate change-related policies of four countries: Kenya, Uganda, Tanzania and Ethiopia. An expert workshop will be convened in the first quarter of 2012 to review the findings and recommend strategic actors and institutions as well as policy entry points for climate change, agriculture and food security in the region.

Partner Engagement: Design and oversee a strategy for regional as well as Africa-wide engagement and the management of impact pathways

In order to develop strategic partnership for CCAFS research at local, national and regional scales, many scoping missions we undertaken to meet with potential science and policy organizations and to introduce as well as discuss areas for research and collaboration. The specific activities are outlined below:

Regional engagement

For regional engagements, the program initiated visits to the intergovernmental Climate Predictions and Applications Centre (ICPAC), the East Africa Farmers Federation (EAFF), the Southern Africa Confederation of Agricultural Unions (SACAU), Food Policy and Research Network (FANRPAN), Africa Climate Policy Centre (ACPC), East Africa Commission (EAC) and Common Market for East and Southern Africa (COMESA) to establish working relationships within the region.

In partnership with EAFF and SACAU, the program facilitated farmers and their union representatives in the region to arrive at a joint position regarding agriculture and climate change in the UNFCCC negotiations. These positions are now serving as inputs to the submissions on an agriculture work program due in early 2012.

To further expand partnerships, a regional strategy for research, engagement and communication of CCAFS research is being developed and will be completed in 2012. Further presentation of the strategy to the management team and independent scientific panel will be done after inputs from regional partners. A database of key regional partners has been compiled and this will be used regularly to update CCAFS global engagement.

During COP17 in Durban, the program engaged with a number of stakeholders. This included holding meetings with:

- Kenyan delegation to COP17 to introduce CCAFS and its work to Kenyan negotiators. The meeting also provided a platform for representatives of various organizations in Kenya such as government ministries and departments to share their goals and priorities with regard to climate change, agriculture and food security.
- African farmer organizations to update the farmers on the status of the negotiations and expected outcome of COP 17 for African farmers and to deliberate on how to collaborate in 2012. Representatives from farmer organizations in Southern Africa, East Africa and West Africa participated.
- Ethiopian delegation, with representatives from the Ministry of Agriculture, Addis Ababa University, World Food Program, Climate Change Forum Ethiopia and Environmental Protection Agency among others.

The program consulted with the EAFF and co-hosted a two-day Farmer Consultation Workshop on Climate Change, Agriculture and Food Security. The meeting served to consult farmers and farmer union representatives on four thematic areas i) awareness of the linkage between climate change and agriculture, ii) farmer participation in research priority setting, iii) scaling up knowledge generation and dissemination, and iv) enhancing resiliency and capacity. Workshop participants included farmers' and producers' organizations from Ethiopia, Kenya, Tanzania and Uganda. The meeting was undertaken as part of regional learning partnership. We expect in 2012 to work more closely with EAFF to build an action plan for the 4 areas of collaboration.

Working with Addis Ababa University and University of Bayreuth's International Graduate School for African Studies, the program co-hosted the Second International Workshop on Inter-regional Learning and Technology Transfer as a Tool for Adaptation to Climate Change in East African Drylands". The workshop was a follow-up to the first workshop held in Nairobi in March. The workshop focused on clarifying the guiding concepts of adaptation, social learning and technology transfer, the role of local knowledge for the building of adaptive capacities, the translation of knowledge into practice and methodological questions and identification of a future research agenda. A technical team was formed to develop a research proposal that combines social learning processes in climate change adaptation in East Africa with meta-research on how to support and build African scientific capacities in adaptation research through mutual intra-regional learning processes. CCAFS will help build knowledge networks for adaptation learning, leveraging on on-going work with CAREs Adaptive Learning Initiative.

National engagement
We held 2 partner national level consultative meetings in Uganda and Ethiopia. At these meetings, we convened key stakeholders in climate science research in Uganda and Ethiopia. They held discussions on researchable issues and opportunities/approaches for pilot activities at CCAFS sites.

In order to promote the policy dialogue, the program held several national consultative meetings with key decision makers in Kenya, Ethiopia, Tanzania and Uganda:

- Ministry of Agriculture and Meteorological Department in Kenya;
- Ministry of Agriculture, Food Security and Cooperatives, Meteorological Agency, Director of Environment (Vice President's office), Sokoine University and Institute of Resources Assessment (University of Dare salaam) in Tanzania;
- Climate Change Forum, Ethiopian Institute of Agricultural Research (EIAR), CARE, MARIL, and Environmental Protection Authority (EPA) in Ethiopia; and
- Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) in Uganda.

Communication: Develop dissemination outputs (website, rural media bulletins and policy briefs) from partner engagement work on climate change, agriculture and food security

In partnership with the Ministry of Agriculture, Climate Change Forum – Ethiopia (CCF –E), Ethiopian Environmental Protection Agency (EPA), and USAID, and the the programorganised a national conference titled, "Climate change vulnerability and risk assessment of agriculture and food security in Ethiopia: Which way forward?" This event brought together about 150 participants from Regional and Federal governments, experts from research institutions and universities, and practitioners from civil society organizations and the private sector came together for expert presentations and plenary discussions on the impacts that climate change will have on agriculture and food security in the country. Twelve papers which form part of the proceedings are undergoing review and will be published as a volume. A key outcome was that the Ministry of Agriculture has now commissioned an assessment of five vulnerable regions in Ethiopia to inform investments and a policy approach that will ensure food security. Blog story http://ccafs.cgiar.org/blog/raising-awareness-climate-change-and-food-security-ethiopia

In Kenya, the the programin partnership with the Tegemeo Institute hosted the National Level Policy Research Priority Setting Workshop. The objective of the workshop was to share policy status and options for climate change adaptation and mitigation in agriculture in Kenya, identify related research needs and priorities, share CCAFS research, and develop action plans. Thirty participants attended the workshop from government ministries, international research institutions, and civil society organizations.

To communicate risks in dry land agriculture, the program commissioned a project on enhancing learning and dialogue in communities to communicate climate related risks in Eastern Kenya through the use of local language radio programs. This is a partnership with Mbaitu FM and the Kenya National Federation of Agricultural Producers (KENFAP), The Ministry and Agriculture and Kenya Agricultural Research Institute. The goal of this initiative is to strengthen farmers' response to climate change and provide insights and guidance on how to address adaptation, mitigation and risk management to provide food security in Makueni and Machakos districts in Eastern Kenya.

The program participated in a number of climate change exhibitions in 2011:

- Africa Climate Change Resilience Alliance (ACCRA) Knowledge Fair Exhibition. There is need for collaboration between institutions working on development projects and those whose focus is on climate change adaptation and mitigation
- Kenyas' Innovative Response to Climate Change exhibition organized by the Ministry of Environment and Mineral Resources in partnership with the Government of Japan, UNDP and DANIDA. The aim of the exhibition was to create awareness in all sectors and at all levels of society on adaptation initiatives and technologies in Kenya. Innovative climate change technologies and opportunities for enhanced partnerships towards a climate change resilient Kenya were presented.
- First Annual Conference on Climate Change and Development for Africa (CCDA-1). The objective of the CCDA-1 was to establish a forum for dialogue, enhance awareness raising, mobilize effective commitment and actions by bringing together policy makers, academicians and practicing stakeholders with the aim of effectively mainstreaming climate change concerns into development policies, strategies, programmes and practices in Africa.

Capacity development: **Provide support to capacity development through a regional call for projects and national policy dialogue processes**

To explore opportunities for capacity development, CCAFS initiated discussions with Makerere University, University of Dar es Salaam (Institute of Resource Assessment), with strong START links, Sokoine University, Jomo Kenyatta University of Agriculture and Technology and Moi University to examine possible research areas to address climate related risks in the region.

We are also providing inputs to the Thematic Working Group 3 on the Kenya NAP process, which is undertaking review of key Government national and sectoral strategies, programs, policies that feed into the National Climate Change Response Strategy.

One individual gender fellowship was awarded to Dr. Annunciate Nakiganda from the National Livestock Resource Research Institute (NaLIRRI) in Uganda for her project, 'Enhancing the Adaptive Capacity of Men and Women Livestock Farmers to the Effects of Climate Change in Uganda.' The project seeks to understand how men and women livestock farmers at CCAFS research site in Rakai perceive concepts of climate change and to determine how climate change affects crop-livestock production by women and men farmers.

Other individual fellowships and nominations supported NARES scientists and other non-research partners to attend training courses on:-

- Gender and Climate Change, Rome, Italy.
- Statistics in Applied Climatology (e-SIAC), online training.
- Statistics in Applied Climatology Workshop, Egerton, Kenya
- ICCCAD Course and Conference on Community based Adaptation to Climate Change, Bangladesh
- Agricultural Model Intercomparison and Improvement Project (AgMIP) Global Workshop, San Antonio, US.
- Farmer Seasonal Forecast Workshop, Wote, Kenya
- Using Climate Scenarios and Analogues for Designing Adaptation Strategies, Kathmandu, Nepal

Case Study 1: Improving Regional Climate Information and Food System Coordination

Case type: Regional engagement

Brief description of the activity

The activity contributed to Theme 2's objective: to contribute to improved management of the impacts of climate fluctuations on the food system. The aim is to create a platform and tools for sharing knowledge and fostering improved coordination among food crisis response, the market-based food delivery system, and agricultural research and development.

To accomplish this objective, the CCAFS East Africa Regional program co-hosted a two-day conference of stakeholders in agro-meteorology, agricultural research and extension, and food security early warning systems from across the region. The workshop took place 25th – 26th October 2011 in Arusha, Tanzania at the Mount Meru Hotel. The objective of the meeting was to consult key stakeholders from the region on regional agricultural and food security contingency planning processes, current and potential use of climate-related information, and means of improving planning and coordination in East Africa. Co-hosts of the event were two organizations involved in the Regional Learning Partnership: the East African Community (EAC) Secretariat and the IGAD Climate Predication and Application Centre (ICPAC). The regional East Africa program launched the Regional Learning Partnership (RLP) in 2011. The purpose of the RLP platform is to build capacity for knowledge co-generation and sharing to create synergy among partner work programs across institutions working on climate change issues in Eastern and Southern Africa. Sixteen institutions are actively involved in the partnership including COMESA, EAC, SACAU, EAFF and ASARECA. This conference is part of the RLP initiatives among others.

Result of activity

A total of 45 experts in agro-meteorology, agricultural research and extension, and food security early warning systems from Ethiopia, Kenya, Tanzania, Uganda, Rwanda and Burundi gathered to discuss three key areas: Agricultural Research and Extension Needs and Priorities; Agro-Meteorology Products and Services for Enhancing Food Security in East Africa; and Food Security and Early Warning Systems in East Africa. The discussions highlighted possible areas of future CCAFS East Africa regional research and engagement and building connections between stakeholders that had not interacted previously. A consultant is currently engaged in synthesizing the outputs through a continued stakeholder engagements process.

Partners involved and their role

The conference was co-hosted by the IGAD Climate Prediction and Applications Centre (ICPAC) and the East African Community (EAC) Secretariat. These regional institutions assisted in identifying appropriate participants, formulating the agenda, and selecting speakers. The EAC Secretariat also assisted in the identification of relevant participants from the Republic of Burundi and Republic of Rwanda who are EAC Partners States but are not yet included as part of the CCAFS East Africa focus countries. Going forward, these institutes will work more closely with CCAFS to coordinate the development of climate services for agricultural application and as policy hubs for engaging scientists and policy makers in the region

Research on which the activity is based

Stakeholder consultation on regional agricultural and food security contingency planning processes, current and potential use of climate-related information, and strategy for improving planning and coordination in East Africa.

Web address for further information

N/A

Case Study 2: Raising Awareness of Climate Change and Food Security in Ethiopia

Case type: Communication

Brief description of the activity

In July 2011, the CCAFS East Africa regional program co-sponsored a national awareness raising conference at the Ghion Hotel in Addis Ababa, Ethiopia titled "Climate Change Vulnerability and Risk Assessment of Agriculture and Food Security in Ethiopia: Which Way Forward?" The co-hosts of the event were the Ethiopian Ministry of Agriculture (MoA), Climate Change Forum – Ethiopia (CCF-E), and the United States Agency for International Development (USAID).
More than 150 decision makers from Regional and Federal governments, experts from research institutions and universities, and practitioners from civil society organizations and the private sector participated. Expert presentations and plenary discussions focused on the expected impacts of climate change on agriculture and food security in Ethiopia. Journalists from local television and newspaper outlets were also in attendance to cover the event and interview key attendees.

Result of activity

Awareness of the impacts of climate change on agriculture and food security was raised among the participants. Thirteen papers were commissioned for presentation at the conference, and twelve of these will be published in a collected volume in early 2012. The Ethiopian Ministry of Agriculture expressed interest in conducting further vulnerability studies in select regions of the country in conjunction with the Climate Change Forum – Ethiopia (NGO). Discussions are underway for CCAFS to support these more in-depth studies, and to incorporate their findings into the policy planning process in Ethiopia.

Partners involved and their role

The conference was co-hosted by the Ethiopian Ministry of Agriculture (MoA), Climate Change Forum – Ethiopia (CCF-E), and the United States Agency for International Development (USAID). CCF-E provided logistical support by sending invitation letters, arranging participant travel, liaising with the presenters, and booking the venue. The Ministry of Agriculture assisted by providing

strategic direction and helping identify invitees. USAID contributed funding to help bring additional participants from outside of Addis Ababa.

Research on which the activity is based

Communication strategy for the regional East Africa program

Web address for further information

http://ccafs.cgiar.org/blog/raising-awareness-climate-change-and-food-security-ethiopia

Publications; East Africa

Publication of CCAFS work from the region has not commenced yet. In 2012, additional effort will be directed to leading the write up and publication of synthesis work, case studies and policy briefs. During this period, most of the data from work commissioned in 2011 will be available for analyses and syntheses.

Nyberg, G., Bargués Tobella, A., **Kinyangi, J**., and Ilstedt, U.2011: Patterns of water infiltration and soil degradation over a 120-yr chronosequence from forest to agriculture in western Kenya, *Hydrol. Earth Syst. Sci. Discuss*., 8, 6993-7015, doi:10.5194/hessd-8-6993

B.N. Moebius-Clune, H.M. van Es, O.J. Idowu, R.R. Schindelbeck, J.M. Kimetu, S. Ngoze, J. Lehmann, **J.M. Kinyangi**. 2011. Long-term soil quality degradation along a cultivation chronosequence in western Kenya. *Agriculture, Ecosystems & Environment*, 141; Issues 1–2, Pages 86-99

Solomon, D., J. Lehmann, K. Knoth de Zarruk, J. Dathe, **J. Kinyangi**, B. Liang and S. Machado. 2011. Speciation and long- and short-term molecular-level dynamics of soil organic sulfur studied by X-ray absorption near-edge structure spectroscopy. : Journal of. *Environ. Qual*. 40:704-., doi: 10.2134/jeq2010.0061

Sonja Vermeulen, Robert Zougmoré, Eva Wollenberg, Philip Thornton, Gerald Nelson, Patricia Kristjanson, **James Kinyangi**, Andrew Jarvis, James Hansen, Andrew Challinor, Bruce Campbell, Pramod Aggarwal. 2011. Climate change, agriculture and food security: a global partnership to link research and action for low-income agricultural producers and consumers. *Current Opinion in Environmental Sustainability*, 4; Pages 1-6

1.3 ACTIVITY SUMMARY BY OUTPUT

Output 1.1.1. Development of farming systems and production technologies adapted to climate change conditions in time and space through design of tools for improving crops, livestock, and agronomic and natural resource management practices

1.1.1.1. Inventory of Multi-site agricultural trial database to contribute developing a platform for multi-location trials of technologies and genotypes for G x E interaction analysis and the calibration and evaluation of crop models

Three projects signed with NARS (SARI-Ghana, IER-Mali and INERA-Burkina) contributed to establishing a publicly and widely available multi-site agricultural trial database for climate change analysis. This concerns a total of about 200 trials covering areas related to agronomy/soil sciences, weed sciences, entomology, evaluation of varietal performances, farmer field school. This broad database and online repository of multi-site trial on the performance of agricultural technologies will then form the basis for improving models of agricultural production under current and future conditions, and for evaluating the efficacy of tested materials for adaptation.
Deliverables: Three reports describing agricultural databases from countries are available.

Output 1.1.2. Building of regional and national capacities to produce and communicate appropriate adaptation and mitigation strategies for progressive climate change at the national level (e.g. through NAPAs)

1.1.2.1. Capacity development of stakeholders from West Africa on the use and application of the analogue tool

Two experts benefited from training in Nepal (workshop "Using Climate Scenarios and Analogues for designing adaptation strategies in Agriculture"). The two experts have also trained 32 people including representatives from NARS, from National Met offices and NGOs.

Output 1.2.1. Understanding and evaluating the response of different varieties/crops to climate change in time and space, and generating comprehensive strategies for crop improvement through a combination of modelling, expert consultation and stakeholder dialogue

1.2.1.1. Breeding strategies for future climate stresses

Eight West African breeders and modellers representing regional breeding institutions (NARS, WACCI) have engaged with CCAFS to identify potential improvement scenarios in order to cope with future climate stresses.
Deliverables: a research framework and operational plan for CCAFS to support breeders in the design of strategies has been developed during a workshop held in Ethiopia.

1.2.1.2. Collation of crop yields in five West African countries for crop model calibration and validation

Long term yield data (since 1985) of major crops in West Africa (sorghum, millet, rice, maize, cowpea, peanut…) have been collated and structured for each of the following countries: Senegal, Niger, Mali, Ghana and Burkina Faso. Crop modeling (validation or simulation) is an effective tool to predict and inform about climate change impact but also to develop options and strategies to mitigate its effects. The lack or inaccessibility of long-term series of data (crops, soils, weather…) is however of major constraint, particularly in West Africa.

Deliverables: A report on the sources, process, approval/ownership and conditions of use of the yield data as well as a copy of the acquired data.

Output 1.3.2.: New information, knowledge, guidelines and germplasm are made available to farmers, breeders, local communities and scientists and promoted through networking for knowledge sharing, peer-reviewed articles, information systems and media

1.3.2.1. Documenting farmers' traditional knowledge on climate change adaptation and mechanisms for networking among innovative farmers.

An inventory of 60 local and traditional knowledge of adaptation strategies at the farm level and of 125 innovative farmers through surveys in five West African countries has been undertaken in 2011. The aim is to promote and disseminate existing smart climate change adaptation and mitigation options. In addition to compiling, managing and sharing standardized multi-site trial data on the performance of agricultural technologies, it appears also of great importance to identify farmers and communities that have developed significant and uncommon successful innovations/organisations in relation to natural resource management, to improve their livelihoods through crop and livestock production and agroforestry in particular. This concerns farmers that have adopted new behaviours and practices, been able to innovate in the use of either traditional knowledge or introduced technologies (through action research, extension work, trainings, etc.) in order to adapt to or mitigate adverse effects of biotic and abiotic constraints (land degradation, climate variability, soil erosion, poverty, lack of knowledge, poor application of recommended practices, etc.). Identifying these 'innovative' farmers and linking them through a network of farmers could be an asset for sharing knowledge (both from farmers and from research) and for fast dissemination and adoption of practices and technologies across different regions within West Africa to increase adaptive capacity of vulnerable communities in the face of climate change and variability. This is also done through analysing/identifying the most appropriated communication ways/supports that should be used to channel and spread innovative information among the farmers 'network and related communities.
Deliverables: A synthesis report describing about 60 local innovative options for adaptation and mitigation to climate change with illustrative photographs, and defining mechanisms for networking among 125 selected innovative farmers is available for wide dissemination among potential users of this inventory.

1.3.2.2. Participatory M&E to strengthen the adaptive capacity to climate change of farmers and institutions in West African countries: Case study in Burkina Faso, Ghana, Mali and Niger

Country PAR implementation teams' members in each benchmark site have been trained by IUCN on the use of an M&E toolkit (an IDRC-funded project) comprising tools for the planning and tools for the monitoring and evaluation of the adaptive capacity of communities. These tools help to create awareness about the way stakeholders organize themselves to achieve adaptive behaviour, identify individuals, organizations and/or institutions that can help improve adaptive performance. Through assisting actors in identifying opportunities and in specifying proposals to improve adaptive decision making and processes, the toolkit will allow effective application of PAR principles and an iteration of learning circle among all stakeholders during 2012 ground activities in each benchmark site. Indeed, people and organizations (CBOs, NGOs and governmental organisations) adapt better to changing conditions if they are able to anticipate future changes, monitor current changes, as well as observe and assess the effects of efforts to improve their situation. In other words, they can better adapt if they can monitor and evaluate their own adaptation practices and/or strategies, either formally or informally. Monitoring and evaluation (M&E) is therefore a practice that can greatly improve learning from experience. It can be used through adaptive management (learning by doing) to improve adaptation-related decision-making processes and thus in turn, enhance the adaptive capacity of people and organisations to climate change and variability. This is a participatory monitoring that aims to develop a solid understanding about local practices, cultures and strategies against climate change in order to ground local adaptation on a scientific basis.

Deliverables: It is expected from this activity: Four country reports synthesizing the results of the toolkit implementation and recommendations, with particular focus to the documentation of the capacity strengthening of people and institutions involved in each site.

- One special report on identified policy decision from the process across the various levels and providing answer to the four questions above;
- Two policy briefs and one scientific article based on the results obtained.

Output 1.1.4. Testing of participatory methods that are sensitive to gender, livelihoods categories and other social differentiators, to apply globally

1.1.4.1. Production of video testimonials on gender-specific farmer adaptation and mitigation strategies in Ghana and Mali

- One 13 mn documentary film has been produced to capturing gender perspective in climate change, agriculture and food security in a community of the Lawra-Jirapa site in Ghana. The purpose of the documentary is to receive voices from resource poor groups and understand their perceptions of climate change and how it impacts on their daily lives; this will also form part of the baseline and site characterization and testimony that can be used for the purposes of future comparisons.
- One similar document is underway in Mali to capture women perspectives on climate change, agriculture and food security through comparing two periods of agricultural production: dry season and rainy season.

Output 2.1.3. Development and demonstration of the feasibility, acceptability and impacts of innovative risk management strategies and actions for rural communities

2.1.3.1. Diagnosing opportunities and challenges for implementing index-based insurance on the CCAFS benchmark site of Northern Ghana

This exploratory project executed by the University of Kumasi and SARI (Ghana), aimed to carry out the necessary baseline studies towards the introduction of a weather-based insurance scheme to the Lawra (Upper West) farming community. The work consisted in a diagnostic study that includes: identifying key players in the ground (private, government, NGOs, Farmers organizations…), understanding the nature of climate-related risks, and strategies and processes to deal with risk; analysing needs, constraints, and priority interventions; developing a consensus implementation plan and research design; and designing and preparing for ex-post impact evaluation. This has been done in close consideration of the German IBI-project "Innovative Insurance Products for the Adaptation to Climate Change" (IIPACC)" currently on-going in the area. The project is spearheaded and implemented by the National Insurance Commission (NIC) and GIZ-IIPACC, and in close collaboration with the Ghana Insurers Association (GIA).
Deliverables: a final report highlights requirement and information on the introduction and operationalization of a weather Index-based Crop Insurance Scheme in Lawra-Jirapa, Ghana.

Output 2.2.3. Platform and tools for sharing knowledge and fostering improved coordination among food crisis response, the market-based food delivery system, and agricultural research and development

2.2.3.1. Regional food system stakeholder consultation to develop a collaborative strategy for intervention and coordination

This study reviewed relevant background documents and materials to better understand the institutional experience, interests and perspectives of the food system stakeholders; and to introduce regional stakeholders to CCAFS-Theme-2 interests, and potential contributions related to food security management in the face of climate fluctuations. The aim is to build, through a multiple stakeholder perspective, a greater understanding of the constraints and barriers to the effective incorporation of advanced climate information into policy and practice for food system decision-making in the face of climate fluctuations at

the national and regional level (with explicit focus on the food system). The final report constitutes a strategy document for Theme 2 outlining gaps and opportunities, as well as identifying key stakeholders for future collaboration. This activity will be pursued in early 2012 with a workshop that brings together key stakeholders for a discussion based upon findings of the review/bilateral discussions and provides recommendations for CCAFS Theme 2.
Deliverables: a report on strategy for Theme 2, outlining gaps and opportunities, as well as identifying key stakeholders for future collaboration.

Output 2.3.1.: Improved climate information tools and products to support management of agricultural and food security risks

2.3.1.1. Harmonizing methodologies for seasonal forecasting of rainy season characteristics in West Africa

Different approaches to seasonal prediction of the rainy season characteristics were reviewed by experts from the sub-region (Agrhymet, national met agencies), including forecast factors (cumulative rainfall, average water flows), the predictors used (ocean surface temperatures, SST) and the methodological constraints re these forecasts. The introduction of new forecast needs (onset and end of the season, duration of dry spells, maximal flow maxima, starting flow, low flow start) and the use of other forecast factors (wind in altitude, simulated by global models of atmospheric circulation) was also discussed in the perspective to reflect the pressing demands of different users of seasonal forecasts. Working sessions on the Climate Predictability Tool software developed by IRI, were used to assess the feasibility of seasonal forecast of the onset and end of the season based on SST and aloft winds. The southern wind at 850 Hpa has been identified as particularly relevant for seasonal forecasting of the onset of the rainy season in West Africa, therefore recommending more research investigation.
Deliverables: a report discussing methodologies for seasonal forecasting of rainy season characteristics in West Africa

2.3.1.2. Development and evaluation of methodology for combining station observations and remote sensing into gridded daily historic meteorological data sets for use in agricultural and biological threat forecasting and other climate information service interventions

1. Rainfall data quality control training workshop through which: (1) a summary on the climatological data (precipitation and temperature) status in 17 countries was completed, (2) 17 climatologists from national meteorological services have been trained on relevant rainfall data quality control methods and on the merged database initiative
2. Calibration of daily satellite rainfall estimation algorithm: this consisted in a training workshop through which (1) a relevant daily satellite rainfall estimation algorithm was discussed and adopted for West Africa region; (2) Eight experts from AGRHYMET, ACMAD and national meteorological agencies have been trained on satellite rainfall estimation algorithm calibration and use.

Deliverables: workshop report

2.3.1.3. Communicating the probabilistic seasonal forecast for a better farming management and decisions at Kaffrine CCAFS benchmark site, Senegal, West Africa

31 farmers and their organisations including 12 women farmers, NGOs (World Vision), NARS and Universities (ISRA-UCAD), extension services (ANCAR, SDDR), local administration, Journalists, benefited from a communication of a downscaled, probabilistic seasonal forecast provided through ANAMS. The aim was to know how farmers use currently climate information, what kind of forecast they used, and to present and communicate them example of probabilistic seasonal forecasting. A first workshop was designed to expose farmers on probabilistic seasonal forecasting and also to establish dialogue and trust between farmers' organizations and experts working on climate forecasting and farming in general. An emphasis was made to listening the farmers first and better understands their decision system. This was a

first step toward helping small-scale farmers to make appropriate management decisions for improved agricultural based on probabilistic seasonal climate forecast. The second workshop was to deliver the actual seasonal forecast and to ensure they can interpret it. The follow-up work consisted in evaluating the impact of the seasonal forecast products and communication process on farmers' management decision and; in eliciting farmers' perceptions of the seasonal forecast products and communication process, and their management responses to the information.
Deliverables: 1-Report on a common methodology for seasonal forecasting of the rainy season's characteristics in West Africa; 2-Report on the pilot testing of the design and communication of downscaled, probabilistic seasonal forecasts; and evaluating their impact on farmers' management and livelihood outcomes in Senegal;

2.3.1.4. Exploring possibilities for up-scaling Mali Agro-meteorological advisory mechanism in the Sahel: Field and Institutional Assessments study

Mali Meteorological Service (Meteo Mali) began in 1982 an agroclimatological project that provided forecast and climate data to farmers in combination with agricultural extension and agricultural decision support regarding what to plant and when relative to weather forecasts and local precipitation. To explore possibilities for up-scaling this experience in other Sahelian countries, CCAFS, USAID, IRI, IER and AGRHYMET engaged in a thorough assessment study which is currently underway. The objective is to collect detailed information about the institutional context in which the project was set up and run, the scientific information used to inform the forecasts and other information conveyed to participant farmers, the ways in which this project has impacted farming practices related to the targeted crops (millet and sorghum), and how those impacts on farming practice came to pass. A workshop attended by 17 participants from the above-mentioned institutions aimed to discuss the methodology and capacitate the survey team, which will be running the field survey in 21 participating and 21 non-participating villages.

- **Deliverables**: field and institutional assessment study report of the Mali Agro-meteorological advisory mechanism for its scaling-up in the Sahel

Output 3.2.1.: Evidence, analysis and trials to support institutional designs, policy and finance that will deliver benefits to poor farmers and women, and reduce GHG emissions in Ghana, Mali, Senegal and Burkina Faso, West Africa.

3.2.1.1. National level analysis of current climate change adaptation and mitigation efforts in agriculture through stakeholder consultations and expert workshops

Two national policy stakeholder meetings have been organized in Ghana (through CSIR) and Mali (through ICRISAT) to discuss national stakeholder consultations reports on "Status and trends of Climate Change Adaptation and Mitigation Efforts for Agriculture: research needs and priorities". The objective was to document the current status and trends of projects, policies and other efforts at the national level in the two countries as part of a wider CCAFS West Africa pilot countries activities aiming to: (1) Adapt smallholder agriculture to the changing climate and (2) Reduce agriculture's impact on greenhouse gases. In addition, two national stakeholder survey reports on "the Status and trends of climate change adaptation and mitigation efforts for agriculture" have been produced for Senegal and Burkina Faso through an internship hosted by ICRISAT.
Deliverables: four national reports on climate change adaptation and mitigation efforts have been edited and disseminated among country stakeholders to appropriately guide further initiatives of climate change adaptation and mitigation. Also, key country stakeholders for climate change adaptation and mitigation policies, programs and projects were identified to insure efficient country-level engagement in CCAFS program. Recommendations of research needs and priorities were listed for each country for to filling knowledge gaps on mitigation practices effectively adoptable by resource-poor smallholders.

3.2.1.2. Project–level action research on economic and technical feasibility of C-market for smallholders: the case of the biocarbon project in Niger

This study analysed Niger bio-carbon project implementation in order to identify sound mitigation options and incentive mechanisms for agricultural climate change mitigation to benefit the smallholders. This will greatly contribute to understanding the current status and trends of projects, policies and other efforts at the project level to (1) adapt smallholder agriculture to the changing climate and (2) reduce agriculture's impact on greenhouse gases. Drought and famine have had serious effects on human health and the environment in recent years. This biocarbon project is based on the exceptional capacities of *Acacia senegalensis* tree species, an endemic species from the African Sahel superbly adapted to harsh ecological conditions and producing several environmental benefits.
The project is aiming to reforest over 17,000 ha of degraded land throughout Niger with native, drought-resistant *acacia senegalensis*. 32 local communities are involved and it is expected to sequester about 1.8 million tCO2 by 2017. There are also strong local social and environmental benefits:

- Social: Income generation through carbon payments and Arabic gum production (expected to purchase emission reductions of 500,000 tCO2e from the project). The vast majority of the plantations are developed by small local farmers on communal desert lands under partnership agreements with a private company that would also harvest the gum arabic. The project also results in technical transfer of know-how and training to the communities, especially in terms of best practices regarding tree selection, grafting, nursery technology and field monitoring.
- Environmental: Rehabilitation of degraded land and biodiversity; Re-introduce agricultural activities through intercropping with groundnuts and cowpeas.

This is a highly replicable project (already in Mali and starting in Burkina Faso). However, there is a strong need for additional capacity building efforts at the community level
Deliverables: A Report that documents the Niger biocarbon project current status of implementation and an analysis of the mitigation options, including: (1) Framework for to identifying feasible, pro-poor incentives for smallholders and their institutional arrangements (2) Summary of different mitigation options and their costs and benefits; (3) Summary of pros and cons of incentive mechanisms (for audience of practitioners and policy makers); (4) Recommendation of priorities for action in agricultural mitigation community to enhance incentives.

3.2.1.3. Developing community-based climate smart agriculture through participatory action research in five benchmark sites in West Africa

CCAFS has partnered with ICRAF and ICRISAT in West Africa to undertake its participatory action research; the project aims to test and validate in partnership with rural communities and other stakeholders, a scalable climate-smart model for agricultural development that integrates a range of innovative agricultural risk management strategies. To that end, a planning workshop with major stakeholders from countries (NARS, NGOs, ANAMS, AGRHYMET, IUCN) was organized in order to collectively design research tools and methods that will be used by farmers, developers, managers and policy makers to identify, to develop cost-effective options for agricultural mitigation that also concur to strengthening the adaptive capacity of actors while supporting local sustainable development, especially related to food security and climate change adaptation. Lessons learnt from the whole process will be also captured. The workshop provided opportunity for sharing and learning from past and on-going experiences related to the PAR objectives at each of the pilot countries. Each country team came up with a work plan that will be refined and validated at country level with all stakeholders (government, civil society, NGOs, community-based organizations, research and extension services, etc.).
Deliverables: Workshop report including countries' workplans for 2012 and 2013.

Output 3.3.2. Methods developed and validated for GHG monitoring and accounting at farm and landscape level to contribute to compliance and voluntary market standards

3.3.2.1. Regional team for the development of GHG quantification methods

Emissions of GHG are the primary causes of anthropogenic climate change which has severe impacts on agriculture. Spectrums of methods are used nowadays for estimating GHG emissions from various sectors. However, significant gaps and inconsistencies persist in the ways GHG emissions are currently measured and reported, particularly at farm and landscape levels. In West Africa, the main issues on GHG quantification are related to methodologies, data and uncertainty assessment, quality control, technical capacity and greenhouse gas accounting and reporting principles. A regional group of GHG measurement experts from six West African countries have been supported through small grants from CCAFS to implement experiments on GHG quantification methods considering specific land uses in the sub-region. The team is supported by scientists from CGIAR centres (ICRAF & ICRISAT) for regular networking and knowledge sharing among team members. The regional team will be linked with the global technical working group on agricultural GHG to benefit from up-to-date scientific information and progress (http://nicholasinstitute.duke.edu/ecosystem/t-agg/international-project). An initial workshop aimed to start strengthening their capacity through interactions and discussions on their respective proposals, but also to structure the networking among scientists and other beneficiaries at national level (representatives of national policy institutions). This interaction between scientists and policy makers aims to guide the development of sound decision support making tools for the sub-region.
Deliverables: six country projects on carbon measurements.

Output 4.1.1.: Coherent and plausible futures scenarios to 2030 and looking out to 2050 that examine potential development outcomes under a changing climate and assumptions of differing pathways of economic development developed for the first time in a participative manner with a diverse team of stakeholders from West Africa.

4.1.1.1. Supporting scenarios process and regional capacity in scenarios for linking global to regional to national policies.

51 participants from National and regional institutions and organisations actively involved in defining environmental and food security policies (state institutions, NGOs, Farmers organisations, NARS, Universities…) engaged in the development of plausible alternate narratives of the future of West Africa in terms of socio-economic and political change and the effects of these futures on food security, environment and livelihoods. The participatory development of the scenarios by stakeholders from the region aims to linking knowledge with action while developing regional capacity for governance and decision-making in the face of key regional and global uncertainties. Also, the socio-economic scenarios process and functions are used as a platform for the exchange and application of knowledge and experience between CCAFS, researchers and policy makers, private sectors, NGOs and other societal actors. Because scenarios allow for the capturing of uncertainties and systems complexity in a coherent and plausible yet surprising and challenging fashion, scenarios are also a tool for generating shared engagement.
Deliverables: A scenario workshop report developing comprehensively 4 plausible scenarios for the sub-region and how these scenarios can be used to explore how the visions for food security, environments and livelihoods could be realized in each of the alternative futures, what are the major obstacles and what policies and strategies would be effective across the scenarios.

4.1.1.2. Disseminating the household level study results among wider public through communication among sub-regional and national actors.

The five household level-study reports have been validated at country level (validation workshops), and edited both in English and French to insure large dissemination and knowledge sharing while facilitating linkage between research and policy actors. The implementation process of these baseline surveys in West Africa, through NARS and specialized institutions such as INSAH, has contributed to strengthen the capacity of these institutions to harmoniously design, implement and report surveys across countries and regions.
Deliverables: Five household level-study reports produced by NARS under the supervision of a sub-regional specialized institution (INSAH);

Output 4.1.4. Analyses providing evidence of the benefits of, strategies for, and enhanced regional capacity in, gender and pro-poor climate change research approaches that will increase the likelihood that CCAFS-related research will benefit women and other vulnerable as well as socially differentiated groups.

4.1.4.1. Testing tools and methodologies for research on gender and climate change, agriculture, food security and rural development in northern Ghana

Two participants from West Africa have been capacitated through a training workshop and ground testing of training materials (FAO/CCAFS) to develop gender-related tools and methods and to implement regional gender-climate change case studies. Through the training, the concept of climate analogues was introduced to participants. Other tools were used to communicate uncertainty given the uncertainty inherent in climate projections. Using institutional analysis, Venn diagrams and guided questions as tools, institutional arrangements allowing women to take advantage of opportunities for 'climate smart' agricultural activities, (e.g. carbon projects to mitigate emissions and improve livelihoods by adopting improved adaptation practices) were examined. Food security, income and expenditure calendars drawn in male and female focus groups and guided questions were used to examine how women and men manage risks related to food insecurity and loss of income and explored gender differentiated coping strategies and household decision making when natural disasters occurs. A weather forecast session was held to inform design of action research to reach women, men and youths with weather and climate-related information that they can use it in making 'climate smart agricultural' decisions.
From the ground testing of tools with communities, specific recommendations were made to insure sound implementation of climate smart agriculture, taking into consideration gender and social differentiation.
Deliverables: A report on models, tools and approaches to collect information on climate analogues, climate information, institutions and mitigation, and adaptation strategies and risk.

Output 4.1.5. Mainstreaming adaptation strategies into national policies, agricultural development plans, and key regional and global processes related to agriculture and rural development, food security and climate change.

4.1.5.1. Strengthen the capacity of people and their institutions through participation to global levels events.

- Through their effective participation to global level events, various sub-regional and national stakeholders have been supported to engage with CCAFS program and to communicate and share their experiences at global level: Global Science Conference on Climate-Smart Agriculture, Ede-Wageningen (representative from CORAF, AGRHYMET, ACMAD, FARA, ROPPA)
- CCAFS Science meeting, Bonn (representative from CORAF, AGRHYMET, ACMAD, FARA)
- ARDD and Forest day5-COP17, Durban (ROPPA, INRAN)

CCAFS regional program leaders for West and East Africa have undertaken during 2011fruitful dialogues with farmer's organizations in Africa, namely ROPPA in West Africa, EAFF in East Africa and SACAU in Southern Africa. The purpose is to support these organizations with useful knowledge going forward, to plan future positions and actions around climate change. Taking advantage of the presence of these organizations as well as key supporters such as COMESA and FANRPAN in Durban for COP17, regional program leaders, with the support from CCAFS coordination Unit organized with them a strategy meeting to plan the way forward for 2012. One of the key recommendations on how to collaborate in 2012 to push ahead the agenda for small-scale farmers dealing with climate change is to scale-up the engagement started in 2011 in the various regions (East Africa, Southern Africa, West Africa), with continued support from CCAFS program and FANRPAN. It is also recommended to explore on how farmers and their organizations will be effectively involved in the development of policies and in the validation of a work program on agriculture. Regional program leaders of CCAFS and representatives of farmers' organizations

agreed to pursue exchanges and ideas on possible ways to move forwards in 2012 with concrete collaborative actions in respective regions.
Deliverables: Global Science Conference on Climate-Smart Agriculture (http://www.gscsa2011.org/Workinggroups/Theme1a.aspx), CCAFS Science meeting, ARDD and Forest day5-COP17 (http://www.agriculturedday.org/learning-events-details#levent3).

Output 4.2.1.: Integrated assessment framework, toolkits and databases to assess climate change impacts on agricultural systems and their supporting natural resources in West Africa.

4.2.1.1. Implementing village-level baseline surveys in five CCAFS pilot benchmark sites in West Africa.

INSAH, NARS, NGOs, countries' departments of Agriculture and Environment, other state and non-state organisations actively intervening in the five benchmark sites in West Africa have engaged with CCAFS for the implementation of the village-level baseline survey. Data were collected, analysed and reported across the five countries through a collaborative work between a regional team and country teams, both supervised by INSAH, a regional specialised institution for food security studies. Relevant baseline information on villages about natural resources (soil, land, water, livestock, fisheries and agroforestry management…), adaptive and mitigative capacity, access to climate and agricultural information and services, as well as mitigation information, have been compiled in reports and widely used by partners to inform on strategies for adapting to a changing climate. The study process in West Africa has allowed strengthening the capacity of scientists and technicians from sub-regional level (INSAH) to national levels (NARS, NGOs). The process has also allowed local engagement with CCAFS for subsequent participatory action research.
Deliverables: Reports collating and analysing for each village: resources, adaptive and mitigative capacity, access to climate and agricultural information and services.

4.2.1.2. Country sites characterisation through detailed, qualitative and quantitative description of the five CCAFS sites of Burkina Faso, Ghana, Mali, Niger and Senegal.

A detailed qualitative and quantitative description of the five CCAFS sites of Burkina Faso, Ghana, Mali, Niger and Senegal has been done in order to provide scientists and other CCAFS stakeholders with concise information that can support the development of partnerships and research activities on the ground. It also includes a collection of primary data at the sites and the compilation of secondary (legacy) data, mostly in tabular and GIS formats. Research stakeholders at site and their activities, potential research partners at site, as well as reflections and analyses on CCAFS research possibilities at each site (risk, adaptation, mitigation), value that CCAFS research can add to the site, Climate change related issues that CCAFS research can change at each site, are also provided through this study.
Deliverables: Five site characterisation reports produced and edited in French and English for wide dissemination.

1.4. ACTIVITY REPORTING SUMMAR

See intranet Excel document.

1.5. PUBLICATIONS

Abdou et Al., 2011. Methodology for the Calibration of daily satellite rainfall estimation algorithm for West Africa. Synthesis report, Agrhymet.

Adiku et al., 2011. A diagnosis study on the introduction and operationalization of weather Index-based Crop Insurance Scheme in Ghana. University of Kumasi-SARI, Ghana.

Bougouna S. et Al., 2011. Documenting local innovative options for adaptation and mitigation to climate change, and mechanisms for networking among innovative farmers in West Africa. Synthesis report.

CCAFS, 2011. Qualitative and quantitative description of CCAFS benchmark sites in West Africa.
CCAFS, 2011. Village-level baseline study of Kaffrine (Senegal), Fakara (Niger), Lawra-jirapa (Ghana), Cinzana (Mali), Tougou (Burkina Faso).
Diakité et Al., 2011. Household-level baseline study of Cinzana, Mali. Reports CCAFS-INSAH-IER.
Naab and Koranteng, 2011. Gender and CC-related tools to mainstreaming gender and social differentiation into regional/national strategies for climate change, agriculture and food security, Lawra-Jirapa Site, Ghana. 25p.
Joost et al., 2011. Scenario development workshop for food security, environments and livelihoods in West Africa. 65p.
Koné et Al., 2011. Collation of regional yield data for crop model calibration and validation for five countries in West Africa.
Ndiaye et Al., 2011. Communicating the probabilistic seasonal forecast for a better farming management and decisions at Kaffrine, Senegal. Synthesis report, 17 pages.
Ndour et Al., 2011. Household-level baseline study of Kaffrine, Senegal. Reports CCAFS-INSAH-ISRA. Naab et Al., 2011. Household-level baseline study of Lawra-Jirapa, Ghana. Reports CCAFS-INSAH-SARI. Boureima et Al., 2011. Household-level baseline study of Fakara, Niger. Reports CCAFS-INSAH-INRAN. Somé et Al., 2011. Household-level baseline study of Tougou, Burkina Faso. Reports CCAFS-INSAH-INERA.
Priti et al., 2011. Status & trends of Climate change adaptation and mitigation policy for agriculture in Ghana. Synthesis Report, 66p.
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Somda et Al., 2012. Documentation of the M&E toolkit implementation and the capacity strengthening of people and institutions in the CCAFS benchmark site of Cinzana, Mali. Country report, IUCN/CCAFS.
Somda et Al., 2012. Documentation of the M&E toolkit implementation and the capacity strengthening of people and institutions in the CCAFS benchmark site of Fakara, Niger. Country report, IUCN/CCAFS.
Somda et Al., 2012. Documentation of the M&E toolkit implementation and the capacity strengthening of people and institutions in the benchmark CCAFS site of Tougou, Burkina Faso. Country report, IUCN/CCAFS.
Somda et Al., 2012. Documentation of the M&E toolkit implementation and the capacity strengthening of people and institutions in the benchmark CCAFS site of Lawra-jirapa, Ghana. Country report, IUCN/CCAFS.
Somda et Al., 2012. Policy decision recommendations from the M&E toolkit implementation process across administrative levels. Synthesis report, IUCN/CCAFS.
Traoré et Al., 2011. Harmonizing methodologies for seasonal forecasting of the characteristics of the rainy season in West Africa. Synthesis report, Agrhymet.
Traoré et al., 2011. A field and institutional assessment study report of the Mali Agro-meteorological advisory mechanism for its scaling-up in the Sahel. IER Mali.
Zakou et al., 2011. Mitigation Options and Incentive Mechanisms for agricultural climate change mitigation to benefit the smallholders: case study on the Niger bio-carbon project on acacia Senegal plantation. Synthesis report.

1.6. CASE STUDIES

Case study 1:
Engaging farmers organisations, regional economic institutions and national sectorial policy institutions with CCAFS through strategic partnerships with ROPPA, ECOWAS and state agricultural and environmental specialised institutions in West Africa

Case type: Non-research partnerships

Brief description of the activity: CCAFS West Africa Program has developed strategic non-research partnerships with key organisations which have engaged with the program for climate change, agriculture and food security related issues. Indeed, Introduction of CCAFS program during ROPPA-led meeting where immediate areas of interest have been identified and further implemented through ROPPA capacitation to attend global level meetings on climate change (International conference on Climate Smart Agriculture, ARDD, COP17-Africa pavilion events…)
Result of activity: This partnership allowed ROPPA to interact and express a unified voice with sister organisations from East Africa (EAFF) and Southern Africa (SACAU) to advocate for a specific work program of agriculture under the SBSTA and the AWG-LCA. ECOWAS department on agriculture and ROPPA support and promote climate smart agriculture as a triple wins approach (enhanced productivity, improved resilience and reduced GHG emissions) that should guide regional agricultural policy frameworks and initiatives (ex: ECOWAP). They are interested in pursuing the partnership with CCAFS to benefit from up-to-date technologies, tools and measures for an effective implementation of climate smart agriculture in West Africa and to be capacitated to advocate for their positions at international level. The National Environmental Council for Sustainable Development (CNEDD) and the National Institute for Agricultural Research (INRAN) of Niger organised a successful learning event during the ARDD in Durban on how the Niger Republic is building resilience of farmers to climate change and increasing food security through Farmer-Managed Natural Regeneration.
Partners involved and their role: ROPPA: participated in various global events re climate smart agriculture; also organised meetings among its national platforms to explain (through CCAFS) and promote climate smart agriculture. ECOWAS, ROPPA and diverse national actors are engaged with CCAFS in the process of scenarios development for agriculture and food security. INRAN and CNEDD form an example of research-policy institutions partnership for allowing uptake of proven technologies.
Web address for further information: http://ccafs.cgiar.org/blog/climate-smart-agriculture-offers-triple-win

Case study 2:
Strengthening capacity of farmers and local institutions to reduce climate risk through seasonal forecast communication and evaluation at Kaffrine

Case type: Capacity strengthening

Brief description of the activity: A series of workshops were organised at Kaffrine CCAFS benchmark site, Senegal, to communicate the probabilistic seasonal forecast and to evaluate the impact of the forecast products and communication process on farmers' management decision. Farmers and local partners (NGOs, Agricultural extension services, farmers' organisations) were exposed to the probabilistic seasonal forecast to help them make management decisions that can reduce climate risks. Their respective management options were monitored along the rainy season and a final evaluation informs on the effectiveness or impact of the forecast products on farmers' decision making. The whole process was accompanied by a communication process through national TV and village radios coverage.
Result of activity: Farmers listed empirical/Indigenous knowledge on weather and climate, including indicators for imminent onset of the rainy season, empirical sign of a major rainy event, sign for a good rainy season, sign of a good cropping season, and signs of the end of the season. These were crossed against possible scientific facts and explanation for a better understanding. Farmers were also trained to getting used to rainfall amount, its variability, being able to recognize normal year, wet years and dry years and to explore hypothetical forecasts for management decision making. This knowledge capacitated them to decide and plan more confidently their cropping season activities. The communication coverage led to a widespread dissemination and interest of the forecast products and process across the country.
Partners involved and their role:

- ANAMS: Senegalese National Weather Agency, delivered the probabilistic forecasts to farmers and led the whole process;

- ISRA: National Agricultural Research Institute of Senegal, developed the evaluation survey and its implementation;
- SDDR-Kaffrine: Local governmental agricultural extension service-Kaffrine, mobilized farmers organizations at Kaffrine;
- ANCAR: National Agency for Agricultural and Rural Advice, mobilized farmers and women's groups;
- World Vision: An international NGO working to improve health, education, clean water, food, and income generation activities, especially for women; involved local experts in the process.

Research on which the activity is based: research under objective 1 of CCAFS theme 2 "identify and test innovations that enable rural communities to better manage climate-related risk and build more resilient livelihoods"

Web address for further information: http://ccafs.cgiar.org/blog/putting-climate-forecasts-farmers-hands

Case study 3:
Using participatory M&E to strengthen the adaptive capacity to climate change of farmers and institutions in West African countries: Case study in Burkina Faso, Ghana, Mali and Niger

- **Case type**: Capacity strengthening
- **Brief description of the activity**: People and organizations (CBOs, NGOs and state organisations) adapt better to changing conditions if they are able to anticipate future changes, monitor current changes, as well as observe and assess the effects of efforts to improve their situation. In other words, they can better adapt if they can monitor and evaluate their own adaptation practices and/or strategies, either formally or informally. Monitoring and evaluation (M&E) is therefore a practice that can greatly improve learning from experience. It can be used through adaptive management (learning by doing) to improve adaptation-related decision-making processes and thus in turn, enhance the adaptive capacity of people and organisations to climate change and variability. Through a partnership with IUCN, CCAFS West Africa Program is promoting the use of a planning and M&E toolkit by country multi-disciplinary teams in charge of implementing the community-level participatory action research at the five benchmark sites (currently implemented in Mali, Niger, Ghana and Burkina Faso). The toolkit harmoniously combines several existing tools (11) and approaches and multi-scale interventions in order to define a vision and behavioural changes required to increase the adaptive capacity. This allows a participatory planning and monitoring that result into a solid understanding about local practices, cultures and strategies against climate change in order to ground local adaptation on a scientific basis. The ultimate output expected by the end of the process is a model allowing the mainstreaming of climate change adaptation into development plans, at various administrative levels, and contributing to increase the adaptive capacity of people and institutions, in preparation to widely support national planning and policy making and to reduce vulnerability at local levels.
- **Result of activity**: As a key requirement, four country multidisciplinary teams (Experts on agricultural resources management, on social science, on climate) have been formed and have been trained/capacitated to the use of the climate change adaptive capacity M&E toolkit developed through the IDRC/DFID funded CCAA program in CCAFS benchmark sites; The country teams have then applied the set of planning tools to inform the CCAFS's Participatory Action Research programme and other adaptation initiatives from local to sub-national in support to decentralized management of natural resources. A documentation of the process and the lessons learned along the implementation is underway while preparing to initiate the M&E of participatory-defined adaptation options.
- **Partners involved and their role**: Local communities, the most key partners, are involved in data collection and analysis during the community level and districts workshops. IUCN-PACO is leading the implementation of the M&E project in close collaboration with ICRAF Sahel node, which is facilitating the whole PAR work of CCAFS in West Africa. ICRISAT/CCAFS regional program is providing guidance and inputs on the CCAFS program and the PAR approach. NARS and University scientists form the core members of the country teams that implement the project. The Sub-national and National level authorities in charge of rural development participate in field-tests to ensure that farmers perspectives vis-à-vis of climate change adaptation are well understood and taken into account in national policies.

Through the learning by doing process that will be put in place, local NGOs enhance their capacity to better design, implement, monitor and evaluate their adaptation actions at community level.

- **Web address for further information**:

1.7. SYNTHESIS OF REGIONAL ACTIVITIES

1. Synthesis of research activities

During year 2011, a number of research activities have been initiated in West Africa to characterize CCAFS' benchmark sites, to collate agricultural trials data with NARS and Universities, to document current status of climate change adaptation and mitigation efforts for agriculture in countries, to inventory existing knowledge and information re adaptation and mitigation practices, to diagnosis baseline conditions towards the introduction of a weather-based insurance scheme to the Lawra farming community in Northern Ghana, to test climate risk management tools, as well as tools and methodologies for research on gender and climate change, agriculture, food security and rural development. The outputs from these activities are the basis for the development of transformational adaption strategies with low carbon emissions that could contribute improving the adaptive capacity of communities and food security.
The participatory action research has been also initiated through partnering with ICRAF Sahel-node and ICRISAT, the aim being to develop in the five CCAFS benchmark sites, community-based climate smart agriculture options that are up-scalable across the sub-region. ICRISAT has also been actively involved in the assessment study on the Up-scaling Potential of Mali's Innovative Agrometeorology Advisory program, and has also contributed (through bilateral funds) to the participatory identification of climate-proof crop varieties for the sahelian zone.
Training activities have been also undertaken to strengthen the capacity of sub-regional and national experts to use relevant research approaches, methodologies and tools for the implementation of CCAFS-related activities in the sub-region, including analogue methods, regional breeding strategies, gender-related tools and methods, methodologies for seasonal forecasting of rainy season characteristics in West Africa, rainfall data quality control, calibration of daily satellite rainfall estimation algorithm.

- **AfricaRice:** Activities conducted through 3 projects: (1) RISOCAS: Developing rice and sorghum crop adaptation strategies for climate change in vulnerable environments in Africa, focusing on development of crop adaptation strategies for irrigated rice, rainfed sorghum, and rainfed upland rice to cope with climate change. This is done through cultivating a broad range of varietal types of rice and sorghum will be cultivated along longitudinal and altitudinal gradients in West Africa and Madagascar. (2) ESCAPE: assessing the vulnerability of rural societies in sub-Saharan Africa to climate and environmental changes and to explore adaptation pathways to reduce this vulnerability. This will be achieved by fostering inter-disciplinary research, through both retrospective and prospective studies, on the evolution of different agricultural, ecological, and social systems interacting together under the global environmental changes. The AfricaRice subproject is executed in collaboration with CIRAD (France), ISRA and SAED (Senegal) and IER and ON (Mali). (3) PARASITE: aims to prepare the rice sector in threatened areas of Sub-Saharan Africa against projected increases in infestation levels of parasitic weeds. Vulnerable locations will are investigated, with emphasis on the effects of climate variability and extremes on parasitic-weed survival, reproduction and virulence, direct and indirect economic impacts, and sustainable management strategies for resource-poor farmers. The project is executed in a collaborative effort with AfricaRice, CNRA (Cote d'Ivoire), INRAB (Benin) and MARI (Tanzania).
- **BIOVERSITY:** organised a workshop in Frankfurt on 14-16 June, 2011, on approaches to cope with climate change" where CCAFS Regional program leader West Africa presented a synthesis on "the use of indigenous knowledge and participatory plant breeding to improve crop production and regenerate crops and tree species in West Africa. The workshop covered methods, approaches and tools regarding participatory monitoring of agrobiodiversity on farm, including a novel method for Red Listing of cultivated species. Proceedings of the workshop are in press. Also, participants from the sub-region attended a workshop on climate change and banana growth and pests and diseases, where 40 banana

scientists generated a state of the art on parameters for moving forward with climate change projections on banana growth for three cultivar groups, considering Fusarium wilt, black leaf streak and weevils/nematodes. The participatory banana mapping editor is being reprogrammed for more speed and with links to CCAFS functions. Scientists from the sub-region also benefited from a training on tools and methods for research on underutilized species.

- **ICRAF**: Increasing small-scale farmer benefits from agroforestry tree products in West and Central Africa; Promoting Development of Economically Viable Rubber Smallholdings in West Africa; Domestication of *Jatropha curcas* for oil production on smallholder farms in the Sudano-Sahelian region with focus on Mali; Adaptation of Land use to Climate Change in Sub-Saharan Africa (ALUCCSA); Parkland Trees and Livelihoods: Adapting to Climate Change in West African Sahel; Promoting Rural Innovations through Participatory Tree Domestication in West and Central Africa; Program to Support Smallholder Conservation Agriculture Promotion in Western and Central Africa;
- **ICRISAT:** has run IMPACT model for groundnut and sorghum. Two popular and widely adopted sorghum and groundnut cultivars were calibrated for South Asia (India) and WCA and drought, heat tolerance and yield potential traits simulated under current climate and future climates.
- **IFPRI**: Cost-benefit analysis that simulates the adoption of mitigation practices carried out for Ghana, and Morocco.
- **IITA**: Framework for cassava catalogues developed and GxE databases identified for upload to Agtrials; Framework developed and applied to identify and monitor significant new biotic threats in cassava and banana throughout Africa wide; Tools developed to evaluate the carbon footprint of coffee and cocoa systems at plot and regional level; Report produced on the assessment approach and intermediate results of carbon sequestration potential of various cocoa and coffee based system arrangements and implication to food security.
- **ILRI**: Supporting the vulnerable: Increasing the adaptive capacity of Agro pastoralists to Climatic change in West and Southern Africa using a transdisciplinary research approach; Documentation of how agro-pastoralists are coping with climate risk in West and Southern Africa,
- **IWMI**: Re-Thinking Water Storage for Climate Change Adaptation in Sub-Saharan Africa; Engagement of local communities and stakeholders to identify, enhance and test future adaptation scenarios and agricultural risk management strategies in Volta and Nile Basins. Basin water allocation modelling and economic analyses for improved water allocation under CC scenarios- Volta, Blue Nile, Ganga and Nepal
- **WorldFish**: Methodologies developed to assess dynamic vulnerability in fisheries and aquaculture sector; synthesized for different scales from the global, regional and national level to sectoral vulnerability. This includes foresight studies methods. Global Scenario for 2050 for fisheries and aquaculture. Finalize regional scenarios developed in Quest (Ghana, West Africa) and link with CCAFS; organised scenario methods training in Ghana

2. Synthesis of regional engagement activities

The engagement with sub-regional level partners such as CORAF, AGRHYMET, ACMAD, INSAH, ROPPA, has been strengthened through concrete actions implemented collaboratively with CCAFS (e.g. scenario workshops, exchange platform between researchers and policy makers) and through their active involvement in major international events (International conference on Climate Smart Agriculture, ARDD, COP17-Africa pavilion events). Also, through presentations in major regional meetings, CCAFS has been more exposed to other potential partners such as IRD, CIRAD, FARA, ENDA-TM, and networks (e.g.: RIPIECSA-AMMA-Net).

Similarly at country level, CCAFS working partnership with NARS, universities, national met services, NGOs, has been reinforced through the implementation by them of diverse research activities as listed in the above synthesis. A regional team of scientists for the development of GHG quantification methods has been established and benefits from the support of CGIAR scientists (ICRAF and ICRISAT). The regional team scientists share experiences from their own research and with the global level technical working group on agricultural greenhouse gases. It is envisaged to link-up this scientific team with a technical team composed of representatives from national departments and institutions in charge of Agricultural, Environmental and

Food security policy orientation (e.g. EPA-Ghana, CNEDD-Niger, CONEDD-SP/CPSA, SE/CNSA-Burkina Faso, AEDD-Mali, CSE-Senegal, NAPAs, and UNFCCC focal points). This technical group should be regularly up-dated by the regional quantification team on existing approaches and tools that could be used to define intervention priorities at country level in order to inform decision making. In addition to the above mentioned stakeholders, civil society and private sector have also engaged with CCAFS program through the process of regional development scenarios where diverse stakeholders discuss and develop plausible future development scenarios for the sub-region.

Various meetings attended at sub-regional level (RIPIECSA in Cotonou, USAID/ACMAD/AGRHYMET/CCAFS in Dakar, AGRHYMET/UNECA in Bamako…) and international level (AfDB in Lisbon, Climate Smart Agriculture Conference in Ede-Wageningen, ARDD and Forest Day in Durban…) offered opportunities to communicate and promote CCAFS objectives and current work in West Africa. ICRISAT newsletter "*happening*" is also used by CCAFS West Africa to promote its work in the sub-region. The RPL has been invited in two TV programs by the Senegalese TV broadcast to explain to the wide public what CCAFS program is doing in Senegal and how these activities could impact national agriculture and food security and livelihoods of farmers.

CCAFS South Asia: Annual Report 2011

1.3Activity Summary

In 2011, CCAFS South Asia continued to focus on the Indo-Gangetic Plains (IGP), where widespread rural poverty, depleting resource base, rapid population growth and climate change threaten to alter the fragile balance between production and consumption. Our main activity areas included climate and research models to improve data availability, analyses of vulnerability hotspots, social science research on local knowledge networks and innovation pathways, and capacity enhancement interventions. The following were notable among our 2011 outputs:

Output 1.1.1 Development of farming systems…
Milestone 1.1.1.1 Platform established for:

Multi site agricultural database (2004/05-2009/10) consisting of results of the breeding trials from South Asia (Pakistan, India, Nepal, and Bangladesh) was established for climate change analysis. This included trails related to bread wheat, durum wheat, barley, chickpea, lentil, faba bean, and grass pea. The data have been converted into a standard format for uploading to the AgTrials database.

Output 1.1.2 Building of regional…
Milestone 1.1.2.3 Training workshops:

Capacity in the South Asian region was enhanced (25 participants from NARS, universities, NGOs, and government institutions) with the newly developed Climate Analogue tool and its possible applications in understanding future adaptation strategies. A case study on using climatic analogues for global wheat adaptation strategies has been started.

Output 1.1.4 Testing of participatory models…
Milestone 1.1.4.2 Video Testimonials:

Together with local farming communities across IGP, several climate resilient technologies have been tested and videos uploaded to AMKN. Roles of cooperatives in sustaining livelihoods in Bihar, India; importance of education in coping with climate change issues; farmers' realization about decreasing water table and its future consequences, particularly on agriculture; and efforts from stakeholders such as universities to breed crops and varieties requiring less water, were the issues covered in these videos.

Output 1.3.1 New knowledge…
Milestone 1.3.1.2Approaches, Methods:

Farmer's network, initiated in 2010 to evaluate varietal and germplasm adaptation strategies in rice and wheat, was strengthened at few sites in IGP in collaboration with Bioversity International. Participatory assessment of biodiversity through the farmer's network created awareness among farmers across the IGP regarding opportunities for genetic adaptation to climate change.

Output 1.3.2 New information, knowledge…
Milestone 1.3.2.2 Farmers' traditional:

Survey of indigenous and traditional knowledge of adaptation strategies at the farm level was completed. These reviews and surveys highlight the available indigenous knowledge that local communities possess and their specific roles to future adaptation strategies at the farm, regional and national levels. These surveys also document farmer's knowledge on climate change, their specific roles to adaptation and dynamism of indigenous knowledge evolved over time in IGP.

Output 2.1.3 Development; and demonstration…
Milestone 2.1.3.1 Participatory pilot:

Participatory pilot demonstrations have been established to test and validate a scalable climate-smart village model for agricultural development at Sangrur (north-western India), Vaishali (eastern India) and Rupandehi (Terai, Nepal) in partnership with rural communities and other stakeholders. The model consists of a portfolio of risk-management strategies including designed diversification, climate information services, insurance schemes, and community-based management of resources that build more resilient livelihoods.

Output 2.3.3 Improved knowledge, tools, datasets…
Milestone 2.3.3.2 Predictability of crop:

A study conducted in collaboration with World Food Program to understand the impact of past weather on various food security indicators showed that crop yields, food prices and livestock products are influenced by recent climatic trends, particularly in the most vulnerable districts in the far western and western development regions of Nepal. The buffering impact of technological interventions was not clear.

Output 3.1.1and Output 3.2.1
Milestone 3.1.1.1& Milestone 3.2.1.1:

The agriculture sector contributes almost 20% of total emissions in India. A study conducted in collaboration with Indian Agricultural Research Institute to analyze options for mitigating these emissions in rice-wheat systems of IGP showed that minimum tillage, use of nitrification inhibitors, water management, and site specific nutrient management technologies were able to reduce GHG emissions without compromising productivity and at no significant additional cost. Policies and incentives are however, needed to encourage farmers to adopt these options.

Output 3.3.2 Methods developed & validated…
Milestone 3.3.2.1 Expert and stakeholder:

Expert and stakeholder consultations on methods appropriate for measuring GHG emission from smallholder farming in South Asia was completed. The baseline study focuses on how agricultural greenhouse gas emissions can be reduced and sequestration enhanced while maintaining and even increasing food supply. The largest amount of GHG emissions was found to be from the livestock sector, mostly methane from enteric fermentation, followed by emissions from rice cultivation and N fertilizer application.

Output 4.1.2 Global & regional maps…
Milestone 4.1.2.1 Vulnerability assessment& maps:

A capacity strengthening and training workshop focusing on NARS scientists (25 participants) from South Asia was completed. It focused on crop modeling and climate change scenarios for vulnerability assessment.

Output 4.1.4 Analyses providing evidence of…
Milestone 4.1.4.1 Drawing on Theme3:

Capacities strengthening training workshops on gender and climate change were completed. The participants (20 in all) were from Nepal, India and Sri Lanka. Some of these trainers provided training to rural women (35 village *panchs* and *sarpanchs* from Sangrur, Punjab) in India. A training manual on 'Gender& Climate Change' was developed for South Asia. This layered approach aimed to foster new partnerships between CCAFS and regional on-the-ground practitioners, as well as ensure that the rural capacity enhancement workshops are eventually led by local people with in-depth knowledge of local issues.

Output 4.1.5 Mainstreaming adaptation strategies…
Milestone 4.1.5.1 Twenty scenario:

Policy makers, civil society, researchers in India, Nepal and Bangladesh, as well as donors from World Bank and DFID were engaged in discussion around climate change policy, research and development. The South Asia brochure of CCAFS was published, regional email distribution list was prepared, and research papers were produced. In addition, several seminars were given, and blogs written. Similarly, a high level meeting with the President of Nepal was organized where he was briefed about CCAFS South Asia's programs.

1.4 Activity Reporting: on intranet

1.5 Publications

1. Naresh Kumar, S., Aggarwal, P.K., Swaroopa Rani, Jain, S., Saxena, R., Chauhan, N. 2011. Impact of climate change on crop productivity in Western Ghats, coastal and northeastern regions of India. Current Science. 101(3): 332-341.
2. Varshney RK, Bansal KC, Aggarwal PK, Datta SK, Craufurd PQ. 2011. Agricultural biotechnology for crop improvement in a variable climate: hope or hype? Trends Plant Sci.;16 (7):363-71.
3. Vermeulen, S.J.; Aggarwal, P.K.; Ainslie, A.; Angelone, C.; Campbell, B.M.; Challinor, A.J.; Hansen, J.W.; Ingram, J.S.I.; Jarvis, A.; Kristjanson, P.; Lau, C.; Nelson, G.C.; Thornton, P.K.; Wollenberg, E. 2010. Outlook for knowledge, tools and action. Climate change, agriculture and food security, report No. 3. P. 16.

1.6 CCAFS South Asia Case Studies 2011

Case 1: ***Capacity Enhancement Workshops on Gender and Climate Change Adaptation***

Case Type: Social differentiation and gender; Capacity strengthening; Non-research partnerships

Description: With the understanding that targeted knowledge can provide the basis for adaptive change, and as points of influence, female community leaders can be powerful agents of that change, CCAFS piloted a training of local partners (via a 'Training of Trainers,' or ToT) on how to conduct Capacity Enhancement Workshops (CEWs) for women farmers and local female legislators in South Asia.

Result: The result of the first ToT and CEW has been dual capacity building of 21 local partners (from India, Nepal, and Sri Lanka) to be able to pass on climate change knowledge in a gender-sensitive way (ToT), and35 rural Indian women legislators to better understand climate change and how to adapt, both for their own households and for their fellow village members (CEW).Other outputs include new relationships with on-the-ground NGOs and small research entities across South Asia, a training manual and various communications outputs like workshop report, blog, photos, videos and press clippings.

Partners included IFFCO Foundation (logistics), Kulima Integrated Development Solutions (draft training manual, lead the ToT), Punjab Agricultural University, Punjab (resource persons for CEW in Sangrur), and all the ToT participants, who came from a range of organizations.

Research upon which activity was based: While climate change will likely affect all rural livelihoods, it will have larger and more devastating implications for women who comprise about 40% of the agricultural workforce in South Asia. It is therefore crucial that women be also more conscious about the connections between climate change, agriculture, water, food, farm incomes, and their family's food security.

Web address: N/A**Reporting format**: Blog, workshop report, photos and video.

Case 2: ***Building Climate-Smart Villages***

Case Type: Non-research partnerships; Capacity strengthening

Description: Over the course of several years, CCAFS South Asia will be helping to build "Climate-smart Villages" (CSV) as a participatory action research project in several villages of India (Bihar& Punjab), Nepal (Terai), and Bangladesh (southern coast). The project will partner with rural communities and other stakeholders to test and validate a scalable climate-smart model for agricultural development. The model will include a portfolio of risk management strategies including designed

diversification, climate information services, insurance schemes, and community-based management of resources that build more resilient livelihoods and sequester more carbon.

Result: A scalable model has already been implemented at Vaishali (Bihar), Sangrur (Punjab), and Rupandehi (Nepal) involving 9 villages and around 500 households to test interventions related to dissemination of climate information services, index-based insurance, and water and carbon management.

Partners include IFFCO Foundation, IFFCO Kinas Sanchar Limited, IFFCO Tokio, Indian Meteorology Department, Nepal Agricultural Research Council, Department of Hydrology and Meteorology, Nepal, and WorldFish Center, Bangladesh.

Research on which activity was based: The interventions are based on past research of several CG centers, NARS &Meteorology departments, where individually these interventions proved useful in adapting to climate stresses.

Web address: N/A **Reporting format:** Blog, and forthcoming report, journal article, photos, and video.

Case 3: ***Farmers' Networks for Experiments with Germplasm based Adaptation Strategies***

Case Type: Capacity strengthening

Description:CCAFS has established a 'farmer-based experimentation network' in the IGP region (Haryana, Punjab, Bihar and Utter Pradesh) to explore means of strengthening the link between genebanks of wheat and local farmers in the context of adaptation to climate risks, understand the role of seed systems in enabling adaptation under changing production constraints and understand social and cultural barriers to adoption of adapted landraces and varieties.

Result: Following participatory approach, the project encourages farmers to freely experiment with the supplied crop diversity during the on-farm trials, according to their own preferences and needs. Farmer visits across different sites in order to promote knowledge-sharing that enables farmers to learn from one another's experience in adapting to climate change. For researchers, the project provides on-farm data and visualization of how different varieties perform.

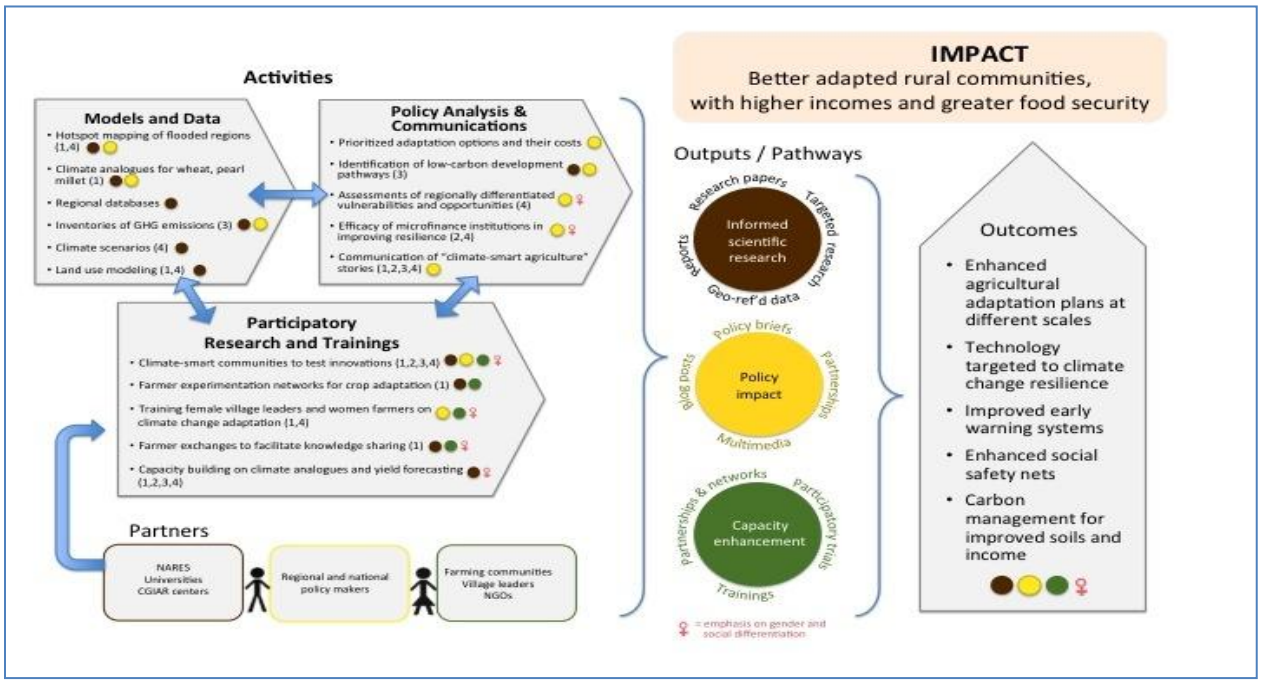
Partners include Bioversity International (research coordination), Indian Council of Agricultural Research (research collaboration), State Agricultural Universities in Punjab, Uttar Pradesh, and Bihar (research collaboration), and various local NGOs and farmer organizations.

Research on which activity was based: Climate change may cause a considerable fraction of the wheat-producing areas in IGP to be classified as wheat stressed, threatening the food security of ~200 million people. More resilient seeds may be a crucial part of the solution.
Web address: N/A **Reporting format:** Blog, Reports (interim ones received) and journal article (to come).

3.1 Synthesis of Regional Activities

Synthesis of Research Activities:

Our regional research strategy aims to support development of climate smart farming communities to be attained through formulation of enhanced adaptation and mitigation plans, technology targeted to increased climatic resilience, improved early warning systems, enhanced social safety nets, and carbon management for improved soils, productivity and income. The key pathways to achieve these outputs are more informed scientific research, policy impact, and capacity enhancement measurable by research reports, targeted research, policy briefs, geo-referenced databases, innovative partnerships and networks, blogs, and trainings as shown in the figure below.



In 2011, RPL and several CG centres undertook initiatives on analyses of vulnerability hotspots, breeding strategies for improved climate resilience, social science research on local knowledge networks and innovation pathways, implementing participatory action research on climate smart villages/farms, quantification of GHG emissions and their mitigation, policy discussions on low carbon development pathways, and development of tools for decision support. To illustrate, IRRI used spatial analysis of past climate data to identify hot spots across South Asia to test a wide range of diverse rice germplasm produced in different abiotic stress breeding programs. IWMI did a vulnerability mapping of Sri Lanka; these findings have been included into Sri Lankan National Climate Change Adaptation Strategy for 2011-2016.

Several centres produced excellent results on breeding strategies for addressing climatic stresses. IRRI in an innovative study used ORYZA2000 crop growth simulation model for an ex-ante impact assessment of a hypothetical combination drought- and submergence-tolerant rice variety in the presence of climate change in South Asia. Their analysis indicated that the economic benefits of such a rice variety more than outweigh the cost of developing this new variety, especially in global climate change scenario.

ICRISAT also conducted studies on heat tolerance and specific drought tolerance traits in sorghum, chickpea, groundnut and millets. ICARDA collated data of 52 research sites of the international nursery testing program in South Asia for experiment results between 2005 and 2010 relating to bread wheat, durum wheat, barley, chickpea, lentil, fababean, and grass pea. These results are being uploading on AgTrials website data for use in model development, evaluation and applications.

During 2011, we established participatory pilot demonstrations to test and validate a scalable climate-smart village model for agricultural development at three sites in IGP in partnership with rural communities and other stakeholders. The model consists of a portfolio of risk-management strategies including designed diversification, climate information services, insurance schemes, and community-based management of resources that build more resilient livelihoods. Complementary activities were also done in the region by some CG centres, namely ICRISAT, CIMMYT, and WorldFish. CIMMYT evaluated the effectiveness of the weather and market information being disseminated through small text messages on mobile phones to farmers in local languages. ICRISAT did some work on seasonal forecasting linked with crop management risk analysis in India. It also identified a set of grass-root level adaptation strategies and constraints that the farmers experienced which resulted in formulating a set of policy needs and road map translated into key messages and policy statements in Sri Lanka. WorldFish did a participatory research assessment for participatory action research on climate risk management with rural communities and other local stakeholders in four baseline villages of CCAFS located along a gradient of salinity and identified the key constraints faced by farmers. Water and salinity management, improved seeds, and knowledge of weather were some of the key issues identified for future research and development. Greater coordination among concerned CG centres around the concept of climate smart village is desirable.

We compiled inventories of GHG emissions from agricultural sector for the key countries of South Asia using remote sensing, and regional/IPCC coefficients. Options that can reduce emissions were also identified. ICRAF showcased an innovative agroforestry project that is helping Indian smallholders to improve their livelihoods and reduce emission by enabling them to adopt emission reducing and carbon sequestering farming practices. WorldFish carried out a carbon footprint analysis of rice/fish farming systems in Bangladesh. ICRISAT produced a journal paper identifying carbon sequestration in dryland systems.

Past trends in rainfall using observed data as well as rainfall time series simulated by regional climate models for Upper Ganges basins were anlaysed by IWMI. IWMI also assessed various scenarios of future climate and alternate water management strategies using a planning model in the Upper Ganga river Basin, India. Similar studies are now being done for Nepal. IWMI scientists also developed and disseminated tools for decision support for adaption planning in rice-producing regions of Godavari, Krishna and Cauvery river basins in India.

Results of all these activities in the region have led to the development of more focused workplan for 2012 aiming to attain impact of research in understanding and implementing climate smart agriculture in South Asia.

Synthesis of Engagement Activities:

With the aim to build climate smart farming and livelihoods, CCAFS South Asia in 2011 sought to engage farmers, policy makers, donors, NGOs, and other such stakeholders, integrating their knowledge to build partnerships and adaptation/mitigation approaches. Our key engagement efforts comprised meetings and dialogues with various senior officials from World Bank, FAO, DFID, and national policy planners, as well as a number of civil society research organizations to publicize CCAFS' tools, techniques and climate change adaptation strategies; inform them about our research &development activities; and explore potential collaborations in South Asia. With the objective to learn about the key issues & approaches needed for climate smart agriculture from farmers, policymakers and other stakeholders, as well as to sensitize them about climate change, agriculture & food security, several seminars were delivered; while workshops were organized to empower stakeholders by increasing regional partnerships.

Our major communications efforts in 2011 revolved around raising regional awareness of CCAFS' South Asia's work in the IGP, whereby a range of research literature was developed and publicized. Among them was a detailed CCAFS-South Asia brochure, as well as the commissioning of next two editions of the 2 Degrees Up photo-films, whose previous editions were widely circulated and well received. In addition, there were several blog posts focusing on CCAFS work in the region, low-carbon development pathways, the gender-side of climate change, and local traditional knowledge. A regional training-of-trainers manual on "Gender, Climate Change, Agriculture, and Food Security" was also published, and an accompanying training session was held, during which CCAFS made many beneficial connections with potential on-the-ground partners for 2012 and beyond. Bioversity conducted a course for scientist trainers and others in Nepal in tools for agrobiodiversity assessment and monitoring. A National Conference was organized by the IWMI to focus on the various issues related to climate change, water and food security in Nepal. This resulted in requests by various NGO's and Government officials to partner in projects and activities, some of which have materialised in Projects since then. IWMI also organized stakeholder workshops to disseminate the various tools in adaptation planning. A newsletter "Climarice" was also circulated to all stakeholders. ICRISAT assessed the grass root level adaptation strategies and constraints in Sri Lanka which resulted in formulating a set of policy needs and road map translated into key messages and policy statements. These were echoed in the stakeholder consultation and "Policy Dialogue" amongst the apex policy makers including ministers, planners and development practitioners.

MILESTONES (OUTPUT TARGETS)	PERFORMANCE INDICATOR	WorkplanActivities (2011)	workplan potential partners (2011)	TL	RF IGP	RF WA	RF EA	Status	Explanation (WA)	Explanation (EA)	Explanation (IGP)	Consolidated explanation Theme Leaders
Theme 1. Adaptation to Progressive Climate Change												
Objective 1.1 Analyze and design processes to support adaptation of farming systems in the face of future uncertainties of climate in space and time												
Outcome 1.1: Agricultural and food security strategies that are adapted towards predicted conditions of climate change promoted and communicated by the key development and funding agencies (national and international), civil society organizations and private sector in at least 20 countries												
Output 1.1.1 Development of farming systems and production technologies adapted to climate change conditions in time and space through design of tools for improving crops, livestock, and agronomic and natural resource management practices												
Milestone 1.1.1.1 Platform established for multi-location trials of technologies and genotypes for GxE interaction analysis and the calibration and evaluation of crop models. (2011)	Number of unique geographic locations, where individual and multi site trials are carried out; assessment of related information and metadata collected; and exchange of derived information	Phase 2: Compilation of multi-site trial data (databases and online repository) to be used in year 2 and 3 as the basis for improving models, and analyzing efficacy of potential adaptation options (part funded with regional funds) (continuation of 2010 activities)	CIAT, CIP, ICRISAT, CIMMYT, IWMI, ILRI, NARS	70	40	80	80	Completed	03 Agtrials projects signed with NARS (IER-Univ. Bamako, INERA-Burkina, SARI-Ghana)	CIP and Bioversity undertaking research on AgTrials Database in multi-locations; One scientist supported to attend workshop on 'Using Climate Scenarios and Analogues for Designing Adaptation Strategies' in Kathmandu, Nepal	IRRI and ICARDA have compiled multi-location datasets and have loaded some of them on Agtrials.org	Platform established and available online at www.agtrials.org with > 3,000 trials available spanning 16 crops.
		CIMMYT Validation trials of best-bet CA systems in East Africa and IGP- Data on the yield and other benefits (e.g. labour, fuel/animal use) of CA options compared to conventional tilled agriculture- Doubts on including it.	Ethiopian Institute of Agricultural Research (EIAR); Kenyan Agricultural Research Institute (KARI); Sustainable Intensification on Maize-Legume Systems in Eastern and Southern Africa (SIMLESA) project.									
		CIMMYT: Collation of data of CA trials in East Africa. Output: Data available for use with crop models on the effects of CA on system productivity.										
		CIMMYT: Trials to evaluate the effects of crop rotations under CA conditions in East Africa and IGP. Output: Data on the effects of crop rotations on system productivity and production risks.										
		ICARDA: Testing potential agricultural adaptation strategies for rainfed agriculture in the semi-arid and dry sub-humid tropics using a combination of model-based ex ante analyses and iterative field-based research on station and in farmers' fields. ESA. Output expected in 2011 : Analogue locations for four important crop growing areas in Kenya and Zimbabwe which comprise (i) cool/dry, (ii) cool/wet, (iii) warm/dry and (iv) warm/wet growing conditions identified and fully characterized	NARES: Kenya, Zimbabwe, GermanyKenyan Meteorological Dept (KMD). Kenya; Kenyan Agricultural Research Institute (KARI), Kenya; Zimbabwe Meteorological Department (ZMD). Zimbabwe; Midlands State University, (MSU) ZimbabweARI: Hamburg University, Faculty of Life Sciences, Germany									
		ICARDA: Compilation and analyses of existing databases to collate multi-site trial data on cereals and food legume crops to characterize target environments and establish evaluation and testing sites. Output: Target environments defined and pilot testing sites established.	NARS in the developing and developed world.									
		ICARDA through CO-FUNDING (50% restricted): Compilation of existing databases on crop performance related to climate from multiple sources (i.e. multi-site trial data of a range of crop varieties: Wheat, barley, lentil, chickpea, fababean and grasspea)	BIGM; IWLMP									
		CIP: Compilation of existing databases on potato & sweet potato performance related to climate from multiple sources	Latinpapa –Latinamerican network of potato breeding programs. CAAS- Chinese Academy of Agricultural Sciences. CPRI –Central Potato Research Institute, India. Key NARIS in AfricaMP3 – RTB – Root, tubers and banana.IRRI, CIRAD, JIRCAS, Egypt									
		AfricaRice: Collation of existing multi-site trial data for calibration and validation of crop simulation models. Output: First version of comprehensive multi-site dataset on rice-based systems from multiple sources available	IRRI, CIRAD, JIRCAS, Egyp									
		Establishment of FACE/FATE experiment in the humid sub tropics (CCAFS grant for the equipment and 2 years of operations funding)	National programs across Africa (invited call to a few), Indian's expertise for support, Open call in EA and WA to start in June (for 1 year)	100								
Milestone 1.1.1.2 Robust methods developed for calculating spatial and temporal analogues of climate. Partner co-authored peer-reviewable method(s) developed and tested codes using pattern-scaled HadCM3 climate output. (2011)	Methods developed and made publicly available through developed communication platforms	Phase 2: Interface development and Implementation of the Analogue methodology developed in 2010 for examining both spatial and temporal analogues based on multiple climate projections (Theme 1 science funds).	Consultancy contract for interface development implementation of phase 2 (managed by CIAT), plus University of Reading methodology input,	50				Completed				Method developed and published in CCAFS working paper 12, and models made available online in R software, and through user friendly web-based interface at http://gismap.ciat.cgiar.org/analogues/
		Script development for Analogue training workshop (G x E methodology)	Consultancy contract (Universidad de Segovia)	20								
Milestone 1.1.1.3* One to five flagship technologies identified, developed and demonstrated in each of the 3 initial target regions which would directly enhance the adaptive capacity of the farming systems to the climate change conditions. Launch through high level engagement with key stakeholders at a key international meeting (2015)	Technologies developed and made publicly available. Positive feedback and increased demand of new technologies by the clientele. Field validation and assessment during field visits by different stakeholders made as a part of 2015 visits	**ICARDA** through CO-FUNDING (50% CRP7, 50% restricted): Development and testing of zero tillage and conservation agriculture technologies in cereal and legume-based cropping systems	CGIAR centers in collaboration with other themes in the MP, NARES, ARIs, CIRAD, NGOs, national governments, Farmers' organisations ICARDA with NARS					Partially completed				

Milestone 1.1.1.6*Tools and guidelines developed to support the selection (and / or maintenance) of the most appropriate water storage options and/ or their combinations for river basin development planning under conditions of increasing climate variability; Reviews of tools and guidelines, including links to individual guidelines and access to tools (2013)	Tools and guidelines developed, reviewed and made publicly available	**IWMI:** A combination of GCM downscaling to the basin level, hydrological modeling, literature review, engagement of local communities and other local stakeholders to identify, enhance and test future adaptation scenarios and agricultural risk management strategies	IWMI,WRI-Ghana,PIK,ZEF, MRC					Partially completed				
		IWMI: A combination of surveys, modelling, inventory of storage types, economic analyses, and conceptualisation.										
		IWMI: Basin water allocation modelling and economic analyses for improved water allocation under CC scenarios- Volta ,– Blue Nile , Ganga and Nepal	WRI- Ghana, PIK, ZEF, AMU, WWF-India, IITM-Kanpur									
		IWMI: Inventory of water storage types	WRI, AMU, Dept Irrigation of Nepal-									
		IWMI: Regional trend analysis. Outputs: Replicable tools, models, methods and data supporting agricultural water management and access to water in river basins under changing climates and existing climate variability	WRI-Ghana, NBI, WWF-India, IHE- Delft, IITM-India, PIK- Potsdam									
Milestone 1.1.1.7*(2012) Assessment of the potential for exploitation of ground water for crop production in at least three basins	Maps demonstrating the potential for groundwater exploitation, which take adequate account of uncertainty	**IWMI:** Inventory, evaluation of previous studies on hydro-geology of the region, socio-economic surveys , geo-physical surveys, hydrogeological modeling, RS/GIS analysis, field measurements and surveys. Outout: Improved understanding of groundwater recharge and management under existing and projected climate variability and land management – with recommendation for improved groundwater management as adaptation measure to climate change	A number of local universities and NARES in 12 countries in sub-Saharan Africa					Partially completed				
Output 1.1.2 Building of regional and national capacities to produce and communicate appropriate adaptation and mitigation strategies for progressive climate change at the national level (e.g. through NAPAs)												
Milestone 1.1.2.1*New knowledge developed on (1) the potential application domains for agricultural practices, technologies and policies (including maps), and (2) best means of transferring these technologies and ensuring their adoption; findings synthesized and presented in report and journal articles (2012)	Synthesis report and journal articles completed and disseminated	**ICRAF**: Outputs: 1) Workshop report on Agroforestry species for farming systems and reduced soil erosion under climate change ; 2) Paper on adaptation potential of agroforestry species under climate change; 3) Guidebook for smallholders with candidate adaptation practices	UNDP-GEF,University of Göttingen, BMZ, ZALF, WWF; UNEP; VAAS					Partially completed				
		ICRAF: Characterization of climate adaptation options in target regions. Output: Interactive, web-based digital vegetation maps as decision-support tool for present and future climates based on ecological suitability and	WWF; UNEP									
		ICRAF: Improved understanding of vegetation responses to climate. Output: Journal paper on a method for evaluation of climate responses of trees from long-term datasets (under review)	No partners									
		ICRAF: Farmers' preferences for tree functions and species in regions of low, intermediate and higher rainfall in the Sahel (journal article published)	INRAN; INERA; IER; IFAD									
		CIMMYT (2011): Identifying coping and adaptation strategies of farmers and the poor to manage future climate outcomes	IFPRI (Global Futures Project), SIMLESA Project (Africa) CSISA project (IGP-Asia), IITA, ICARDA, ICAR, EIAR, KARI, UMB-USA, UMB-Norway									
		CIMMYT : Analysis of future technology options for maize and wheat and ex-ante analysis of their likely future impacts in terms of the economic, social and cultural benefits expected										
		IRRI: Identifying climate change impacts and adaptation pathways in major rice growing areas with specific vulnerabilities	NARES in India, Bangladesh, Indonesia, Vietnam, and the Philippines and ARI in Japan, Germany, USA, Australia									
		ICARDA: Using production environment descriptors as predictors for adaptive traits of small ruminants	FAO, NARS									
Milestone 1.1.2.3 Training workshop(s) organized and and videos produced on the use of the Analogue methodology ((for examining both spatial and temporal analogues based on multiple climate projections; see 1.1.1.2). Engagement of key IGP stakeholders such as national universities, NARC, ICAR (DWR), BARC, NGOs; Farmer exchanges convened among analogue sites (2011, 2012)	Two trainings (2011, 2012) delivered engaging 25 participants; min 2 videos produced; exchanges convened engaging farmers in 2 regions	Application pilot of the Analogue tool in at least two regions (regional funds) Case studies. Characterization of sites in IGP and validation EA: characterization between the different systems * Capacity development on the method (IGP regional funds)	WA: Collaboration with ICRAF IGP: CIAT, BARC, Pramod sub-contract to Indian partner coming to Cali by April. Sept: training NARC, ICAR, NGOs		150	80	80	Partially completed	02 persons from the region trained on the use/application of the analogue tool	Interviews and workshops conducted in Kochiel, Kenya to test the Social Return of Investment approach (SROI)	25 persons trained in the use of climate analogues,; a case study on using analogues for global wheat adaptation underway	Training workshops held and a number of stakeholders now capable of using the analogue methodology. Initial application in farmer exchange ongoing.
Milestone 1.1.2.4 Regional training workshop on approaches and methods for evaluating cost/benefit of adaptation strategies on a national scale (2013)	Two trainings delivered engaging 25 participants total	Costing Adaptation (Case studies and testing of the SROI approach - Kenya, Senegal) . Output: Development of a novel methodology for interdisciplinary resilience and adaptation research and Social Return On Investment costing.	Oxford University	50				Partially completed				
Output 1.1.3 New knowledge-synthesizing institutional arrangements, policies and mechanisms for improving the adaptive capacity of agricultural sector actors and those involved in managing the food system												
		Analyses of rural institutions in enabling adaptation to develop a more profound understanding of how local rural institutional actors respond to the upheavals in livelihood systems that are being triggered by climate change.	Danish Institute for International Studies									
		CIMMYT: Scoping study for characterization of climate-adaptation options in maize and wheat production systems in target regions. Output 2011: Synthesis of institutional arrangements, policies and mechanisms for improving the adaptive capacity of agricultural sector actors; what is working where, how and why (Research paper).	IFPRI (Global Futures Project), SIMLESA Project (Africa) CSISA project (IGP-Asia), IITA, ICARDA, ICAR, EIAR, KARI, UMB-USA, UMB-Norway									
		ICRAF: Understanding of institutional arrangements, policies and mechanisms that enhance the adaptive capacity of resource-poor households to adopt new farming practices, strategies and behaviours that reduce their vulnerability to CC: synthesis paper.	Harvard, CCAFS, KARI; MONRE; CERED; COMART									
		Policy review of adaptation in target countries	Regional partners to be determined			-	15					

Milestone 1.1.3.1*Document produced that synthesizes institutional arrangements, policies and mechanisms for improving the adaptive capacity of agricultural sector actors (addresses what is working where, how and why, with disaggregation by gender and other social strata) (2011)	Document completed and disseminated	**CIMMYT**: Characterization of institutional arrangements and policies that enhance the adaptive capacity of the resource-poor to adopt new maize and wheat farming practices, strategies and behaviors to reduce their vulnerability • Scoping study for characterization of climate-adaptation options in maize and wheat production systems in target regions • Identify coping and adaptation strategies of farmers and the poor to manage future climate outcomes	SIMLESA Project (Africa); CSISA project (IGP-Asia), MasAgro (INIFAP, SAGARPA; IITA, ICARDA, ICAR, EIAR, KARI, UMB-USA, UMB-Norway					Partially completed		Regional policy mapping and scenarios quantification excercise initiated		Completed for selected farming systems (maize and wheat systems). General framework for institutional arrangements and their role in adaptation being finalised in early 2012.
		ICRAF: Understanding of institutional arrangements, policies and mechanisms that enhance the adaptive capacity of resource-poor households to adopt new farming practices, strategies and behaviours that reduce their vulnerability to CC	*Harvard, CCAFS, KARI; MONRE; CERED; COMART*									
		ICRAF: Characterization of climate adaptation options in target regions. Output: Paper on the Role of Local Institutions in Adaptation to Climate Extremes in Mountain Yunnan	*WWF; UNEP; VAAS*									
		ICRISAT:Mini-core/reference/ association panels of ICRISAT mandate crops phenotyped for heat and oher climate change adaptive traits	ARI: University Western Australia									
		ICARDA: Identify and promote strategies and methods of drought mitigation and preparedness for progressive climate change conditions. Output: Guidelines and methods	NARS, ARI, Development organizations,Policy makers, Other CG Centers									
		ILRI: Data assembly (including systems and the analytical framework), analysis and synthesis. Output: Documentation of future vulnerability of livestock systems globally to target interventions	INRA-led consortium of 27 partners									
Milestone 1.1.3.2 Web-based platform established (Adaptation and Mitigation Knowledge Network) to share and exchange knowledge, linking farmers' realities and experiences on the ground with multiple and combined research outputs (2011)	Platform developed and made publicly available (cf http://www.sac.ac.uk/climatechange/farmingforabetterclimate/) Number of unique geographic locations, where individual and multi site trials are carried out; assessment of related information and metadata collected; and exchange of derived information	Adaptation and Mitigation Knowledge Network (AMKN) officially launched; completion of the proof of concept as a georeferenced aggregator of climate change adaptation and mitigation information. Deliverables: Training of CCAFS staff for its maintenance and content curation, and design of a roadmap for the further development of the platform.	ICT-KM					Completed				
Milestone 1.1.3.3 *Adaptation option portfolio (tool box) for aquaculture systems, options identified and disseminated in Vietnam, tool box disseminated in Bangladesh. Building capacity by creating information and working in partnerships. (2011)	Toolbox available and disseminated	**Word Fish**: Identification and appraisal of adaptation options in Vietnam aquatic agricultural systems, including economic analysis and trade off analysis (2011 output). The methods developed here will be used in Bangladesh and Mali (2012)	WorldFish, MCD Vietnam, Cantho University, ESSP partners IHDP/ZEF University of Bonn or/and SEA START RC					Completed				
		Word Fish : Review of adaptation experiences and options in coastal and aquatic food production systems. Output (2012): Draft Book chapters for Earthscan (publication in 2012). Improve understanding and knowledge of existing and potential adaptation strategies in coastal and aquatic food production systems	ESSP/ CCAFS, UEA									
Output 1.1.4 Testing of participatory methods that are sensitive to gender, livelihoods categories and other social differentiators, to apply globally												
Milestone 1.1.4.1 Socially disaggregated participatory methods tested for grounding climate change model results to community-level decision making processes that address food security issues (2014)	Methods tested and disseminated	Building pathways for impact in the IGP – seconded staff member to facilitate connections to major development activities for testing and upscaling technologies and practices	World Bank					Partially completed	Contract signed with Aghrymet to train regional stakeholders and support testing and implementation of the FoTF in at least 2 villages in WA	Identification of model farmers for collaboration on the MICCA initiative; 4 regional partners supported to participate in the ICCCAD Course and Conference on Community based Adaptation to Climate Change held in Dhaka, Bangladesh	Contract signed with University of Adelaide to study social and cultural barriers to adapting through farmer exchanges based on analogous in Nepal	Partner organizations contracted (Greenwich University and Oxford university/Adelaide University); initial sites selected; potential local partners identified and preliminary field visits planned for April in Nepal, Ghana and Tanzania.
		Study of social and cultural barriers to adapting through farmer exchanges based on analogous climates; understanding social and cultural perceptions of future climates (through regional funds)	Open competitive call to start by Oct 2011	100	30	30	30					
		Pilot testing of adaptation options for East Africa through system level modelling using biophysical inputs from trial sites database combined with socio-economic models (through EA regional funds)	To be determined				80					
		CIAT: Development of gender-sensitivity participatory methods for grounding climate change model results to community level decision making processes that address food security issues	Oxfam; CRS; Learning Alliance; Sustainable Food Lab									
Milestone 1.1.4.2 Video testimonials produced on gender-specific farmer adaptation and mitigation strategies (including indigenous knowledge, coping mechanisms and current challenges) in 1-3 sites in each of the 3 initial target regions (2011, 2012)	Video testimonials produced and disseminated through the website	Continued development of video testimonials for each region on gender-specific adaptation and mitigation strategies, adaptive capacity, coping mechanisms and indigenous knowledge	ICT/KM and local NGO partners	57,5	20	20	30	Completed	Two video production underway in Ghana and Mali	Participatory Action Research initiated in Eastern Province and Nyando, Kenya	Video testimonials and field photographs uploaded on website	Further population of the platform and officially launched after completion of the proof of concept. Training of CCAFS staff for its maintenance and content curation, and design of a roadmap for the further development of the platform as a
		Developing and testing climate adaptation tools in smallholder agriculture through community based action research	Competitive call targeting national and local level actors; selection criteria to be developed				40					
Objective 1.2 Develop breeding strategies for addressing abiotic and biotic stresses induced by future climatic conditions, variability and extremes, including novel climates												
Outcome 1.2: Strategies for addressing abiotic and biotic stresses induced by future climate change, variability and extremes, including novel climates mainstreamed among the majority of the international research agencies who engage with CCAFS, and by national agencies in at least 12 countries												
Output 1.2.1 Understanding and evaluating the response of different varieties/crops to climate change in time and space, and generating comprehensive strategies for crop improvement through a combination of modelling, expert consultation and stakeholder dialogue												

Milestone 1.2.1.1 Research and policy organizations actively engaged in setting research priorities; one regional breeding strategy workshop involving regional decision-making and priority setting bodies delivered in each of 3 initial target regions (2011)	Workshops held engaging 10-15 participants representing major regional and international breeding organizations and decision-making and priority setting bodies. List of research and policy organisations that have commented on, and contributed to, the research design	Engagement with regional crop improvement institutions to identify potential improvement scenarios and begin to incorporate into models (regional workshops funded with regional funds)	Local partners in three regions; IGP: ICAR, ICRISAT, CIAT and IITA in EA			40	20	Completed	One regional breeding strategy workshop organised in Ehtiopia	One regional crop breeding 'workshop held in Ethiopia		Engagement with breeding institutions for four crops (banana, beans, rice and sorghum) completed through a workshop I Ethiopia, including researchers from all target regions.
Milestone 1.2.1.3 Range of crop modeling approaches (to inform breeding) developed and evaluated for biotic and abiotic constraints for the period 2020 to 2050; findings presented in summary report and at key stakeholders' meetings ; *including modelling approaches to evaluate the impacts of climate change and the effects of adaptation technologies such as supplemental irrigation and water harvesting on water availability for crops and their productivity under decadal futures from 2020 to 2050 (2013)	Report completed and disseminated	Continued development of crop modelling approaches for major crops to evaluate impacts and run scenario analysis (e.g. crop improvement scenarios). To include initial work on combining niche-based modelling with crop modelling. Development of niche-based modelling for other major crops of the regions of importance to regional food security (in coordination with Themes 4 and 1)	University of Leeds and CIAT	40	20			Partially completed	Regional yield data collation underway for five countries;	Participation in the Multinational CGIAR – Support to Agricultural Research: Formulation Workshop held in Ibadan, Nigeria	Partners could not start this due to technical and admin issues	New version for ccafs-climate.org portal ready including data produced at ILRI/IFPRI and outputs from PRECIS; CMIP3 projections ready to be added to the portal (infrastructure issue); CMIP5 climate data downloaded and ready to be processed (i.e. downscaled). EcoCrop model calibrated and used to predict the impacts of climate change on sorghum, barley and cassava. GLAM crop model runs for Indian Wheat.
		ICARDA through CO-FUNDING: Develop modelling approaches to evaluate the impacts of climate change and the effects of adaptation technologies such as supplemental irrigation and water harvesting on water availability for crops and their productivity under decadal futures from 2020 to 2050. Output: a validated crop model .	NARS, ARI, Meteo. Organizations, Other CG Centers									
		Cofinancing CGIAR-AfDB adaptation research work on 4 commodity crops, rice, cassava, wheat and maize in regional member countries	IITA, ICARDA, AfricaRice and local partners TBD			30	30					
		Improved understanding of temperature thresholds used in crop models	University of Leeds	160								
		Collation of regional yield data for crop model calibration and validation for three regions (through regional funds and in collaboration with Theme 4)	National partners to be identified by Regional Facilitators			20	20					
		Continued development of climate projections, with other themes, including the identification of GCM data for use in CCAFS and the consolidation of downscaled climate surfaces (esp. Theme 4)	Equip, AgMIP, UoL, CIAT, ILRI, IFPRI, CIP	10								
		(Incorporation of pest and disease models into other crop and cropping systems models	TBD pending results of white paper December 2010	60								
		CIMMYT: Understanding the distribution, prevalence and epidemiology of maize and wheat insect-pests and diseases and develop tools to forecast changes in range and severity of climate-induced biotic stresses.										
		Africarice: Updating RIDEV, which is a rice physiology model for (1) on-farm decision support, (2) regional risk scenario mapping and (3) study of genotypic differences	WUR, MARI									
		CIP: User-friendly geospatial potato & Sweet potato models. Output: Software containing CIP-developed routines for daily climate generators (temperature & rainfall), and for correcting daily rainfall estimated by TRMM downloadable from the MP7 web-site (an advanced beta version); Preliminary suitability maps for selected potato and sweet potato varieties and cultivars	**SENAMHI** – National meteorology & Hydrology services Peru & Bolivia **EMBRAPA.** Brasilian **CAAS** MP3-RTB ; NARIS in Target countries MP3-RTB									
		Co-leadership Michael Dingkhun + (MoU with CIRAD)		45								
Milestone 1.2.1.4 Detailed crop-by-crop strategies and plans of action for crop improvement developed, incorporating portfolio of national, regional and global priorities; findings presented in summary report (2015)	Report completed and disseminated	**CIMMYT:** Analysis of the effects of climate change on growth and yield of maize & wheat; Wheat areas/ countries vulnerable to increased climate variability and climate change mapped Maize areas/ countries highly vulnerable to increased frequency of extreme climate events and ecosystem disturbance mapped	CIMMYT, ARIs (USDA-ARS, Swiss Federal Institute of Technology, Texas A & M University, Univ. of Bologna, Italy), NARES in SSA, Asia [Chinese Academy of Agricultural Sciences (CAAS), Yunnan Academy of Agricultural Sciences (YAAS), Indian Council of Agricultural Research (ICAR), Indonesian					Partially completed				
		[illegible] wheat; initiation of heat tolerance screening (IGP) ; Knowledge of the effects of high CO2 and heat stress on wheat crop phenology, plant functions and yields Characterization of heat stress tolerance mechanism(s) in wheat and identification of morpho-physiological traits suitable as selection criteria in breeding for heat stress tolerance										
		CIMMYT: Analysis of the effects of climate change on growth and yields of maize; Knowledge of the effects of high CO2 and heat stress on maize crop phenology, plant functions and yields Characterization of heat stress tolerance mechanism(s) in maize and identification of morpho-physiological traits suitable as selection criteria in breeding for heat stress	CIMMYT, ARIs (USDA-ARS, NARES in SSA (Ethiopia, Kenya, Zimbabwe), Asia (India, Nepal, Bangladesh, Pakistan, southern China), and LAC (Mexico)									
		ICARDA: Selecting salt-tolerant forages and rangeland species. Output by 2015!	NARs									
Output 1.2.2 Breeding strategies disseminated to key national agencies and research partners												
Output 1.2.3 Differential impact on different social groups of strategies for addressing abiotic and biotic stresses induced by future climate change, variability and extremes are identified, evaluated and disseminated												
		CIMMYT: Understanding the distribution, prevalence and epidemiology of maize insect-pests and diseases and develop tools to forecast changes in range and severity of climate-induced biotic stresses	CIMMYT, ARIs (USDA-ARS, NARES in SSA (Ethiopia, Kenya, Zimbabwe), Asia (India, Nepal, Bangladesh, Pakistan, southern China), and LAC (Mexico)									

Milestone 1.2.3.1 Policy recommendations provided to national agencies, policy makers and key actors in the agricultural sector on how to target strategies to enable equitable access to breeding materials and strategies by different social groups (e.g. pastoralists, fishers, urban farmers) and by women and men (2015)	Report completed and disseminated at 3 major international meetings; Report and policy briefs downloaded 200 times from web portal	**ICARDA** (through CO-FUNDING): Assessment of the impact of climate change on cropping patterns, rural income and food security in in dry areas with priority given to most vulnerable countries	IFPRI, NARS`					Partially completed				
		CIAT: PVS/PPB; Testing field selection and data collection. Differentiating among female and male bean variety preferences in a range of dynamic scenarios (low/high stress; market-driven/subsistence)	Pan African Bean Research Alliance (PABRA) Kenya, Rwanda, Burundi and Malawi									
		CIAT: Development of detailed priorities and strategies for breeding of at least 4 crops	CIP; Bioversity International; NARs; regional breeding bodies; GIPB									
Objective 1.3 Identify and enhance deployment and conservation of species and genetic diversity for increased resilience and productivity under conditions resulting from climate change												
Outcome 1.3: Portfolio of information sources, guidelines and germplasm available for using genetic and species diversity to enhance adaptation and resilience to changing climate are adopted and up-scaled by national agencies in at least 20 countries and by international organization for the benefits of resource poor farmers												
Output 1.3.1 New knowledge, guidelines and access to germplasm are provided for using genetic and species diversity to enhance adaptation, productivity and resilience to changing climate												
Milestone 1.3.1.1*Accessions identified with potential adaptive traits for climate change adaptation for at least 5 priority crops using innovative methods. Methodology to select genebank material adapted to local current climate conditions and future climate shifts developed and tested and crop suitability atlases for priority crops (as defined by fraction of total production accounted for) produced; findings presented in reports and journal articles (2011, 2014)	Reports completed and disseminated. Journal articles published. Lists produced (e.g., adapted local varieties conserved in genebanks; newly and already collected domesticated and wild germplasm adapted to climate change). Methodology developed and made publicly available	**ICRISAT**: Phenotyping mini-core/reference germplasm collections for adaptive traits and virtual crop modelling of traits. Output: Core/reference collections of one mandate species phenotyped under/at analogue environment/locations as an exemplar	International Center for Tropical Agriculture (CIAT), Colombia; Institute of Biodiversity and Conservation, Ethiopia; National Agricultural Research Institute, Papua new Guinea (PNG); Institut d'Economie Rurale, Mali; Indian Council Agricultural Research, India; Millennium Seed Bank, UK; Botanic Garden Conservation International (BGCI), UK; members of the Musa Taxonomy Advisory Group; University of Philippines Los Banos (UPLB), Philippines; KULeuven, Belgium; CIALCA partners; Semongok Agriculture Research Centre (ARC), Sarawak Malaysia; PROINPA, Bolivia					Partially completed				Evaluation work of genetic resources identified germplasm with novel traits likely to be of importance for climate change adaptation, including heat tolerant potato, chickpea, groundnut, pearl millet accessions, drought tolerant bean genotypes, and water-logging tolerant forage germplasm.
		ICARDA: Gene mining in cereals and food legumes gene pools for resistance to drought and heat	NARS in drought and heat prone areas, ARI									
		ICARDA: Develop molecular tools and methodologies to rapidly identify candidate germplasm with traits useful for climate change adaptation	NARS, ARI, Other CG centers									
		ICARDA : Analyzing functional genomic markers related to the tolerance of indigenous sheep to heat stress under arid conditions	APRI-Egypt, ILRI, FAO/IAEA joint division, University of Goettingen									
		ICARDA: Develop crop suitability atlas of identified local varieties conserved in genebanks based on genebank information and environmental conditions using Geographic Information system (GIS)	IFPRI; BIGM/GRU									
		ICARDA: Development of the focused Identification germplasm Strategy (FIGS) to select best bets for adaptation to CC	Breeders, crop physiologists collaborators inside and outside ICARDA									
		CIP: Development of efficient screening methods for heat tolerant potato	Rural Development Authority of Korea									
		Bioversity: Identification of genetic material conserved in genebanks with potential adaptive traits for climate change adaptation for barley, wheat, sweet potato, taro and rice	Institute of Biodiversity and Conservation, Ethiopia; National Agricultural Research Instutute, PNG; Indian Council Agricultural Research, India; Semongok Agriculture Research Centre (ARC), Sarawak Malaysia;PROINPA, Bolivia									
		Bioversity: Crop suitability maps for 5 crops in East Africa, Indo Gangetic Plains, South America and South East Asia	Institute of Biodiversity and Conservation, Ethiopia; National Agricultural Research Instutute, PNG; Indian Council Agricultural Research, India; Semongok Agriculture Research Centre (ARC), Sarawak Malaysia;PROINPA, Bolivia									
		CIP: Testing of drought and heat tolerant potato and sweetpotato germplasm										
Milestone 1.3.1.2*Approaches, methods and tools for participatory assessment of where and when biodiversity rich practices facilitate	Consultation workshops; report completed and disseminated. number of communities and individuals surveyed, number of methods and tools tested	Continuation of farmer based experimentation network in IGP depending on progress, and possible out scaling to other regions (theme 1 core funds)	Bioversity International, ICAR, CIAT, PAU, other local partners in other regions.		50							

adaptation to climate change reviewed ; findings summarized in report (2011)		**Bioversity:** General strategic framework of participatory approaches and methods to assess where and when bioversity rich practices facilitate adaptation to climate change developed through international expert consultation	International Union for Conservation of Nature (IUCN), Switzerland; PROINPA, Bolivia; LI-BIRD, Nepal; MS Swaminathan Research Foundation, India; German experts (incl. Prof. K. Hammer); FAO, the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), Italy; University of Perugia, Italy; University of Suaceva, Romania; NGO Peliti, Greece; NGO ProSpecieRara, Switzerland; R. Zougmore-CCAFS, Niger; University Goettingen, Germany; GIZ, Germany; LUGV, Branderburg, Germany; AGPM/FAO, Italy; OriGIn, Switzerland; Slow Food, Germany; IITA, Nigeria).					Partially completed			Farmer experimentation network to test varietal and germplasm adaptation established at few places in India and Nepal	Workshops held with experts and proceedings published. Generation of a framework underway and to be completed during 2012.
		Bioversity: Tailoring general methodological framework for testing out in national contexts carried out through multi-stakeholder workshops held in Bolivia, India and Nepal	PROINPA, Bolivia; Ministry of Agriculture, Bolivia,; Ministry of Environment, Bolivia; LI-BIRD, Nepal; Ministry of Agriculture, Nepal; MS Swaminathan Research Foundation, India; ICAR, India; The International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), Italy; AGPM/FAO, Italy; OriGIn, Switzerland).								
Milestone 1.3.1.3.*Evaluation of germplasm of cereals and food legumes for resistance to insect pests and diseases under variable temperature regime; strategy for targeted collection for sampling landraces and wild relatives in dry and hot areas (ICARDA) (2012)	Evaluation and strategy published	**ICARDA:** Evaluation of germplasm of cereals and food legumes for resistance to insect pests and diseases under variable temperature regimes	IPM researchers and breeders at ICARDA					Partially completed				
		CIAT: Evaluation of drought-selected bean genotypes in contrasting environments in Africa,	Ethiopian Institute of Agricultural Research (EIAR); Kenyan Agricultural Research Institute (KARI); Department of Agricultural Research and Technology of Malawi (DART); Agricultural Research In Tanzania (ART); Dept.								
		CIAT: Evaluation of *Brachiaria* forage grass hybrids for their tolerance to water logging.	CORPOICA-Colombia; INTA-Nicaragua; IDIAP-Panama								
		CIAT: Evaluation of herbaceous forage legumes for their tolerance to water logging	Embrapa								
Milestone 1.3.1.4. Methods and tools for participatory monitoring of deployment of biodiversity and knowledge by communities for climate change adaptation tested out in at least 5 countries (including community surveys); findings synthesized in report (2012) Multi location trials of identified local varieties carried out (2014)		**Bioversity :** Multilocation trials of over 300 local varieties of 5 priority crops carried out in at least 3 different climatic zones in East Africa and Indogangetic Plains and in PNG, with participation of local farmers	Institute of Biodiversity and Conservation, Ethiopia; Indian Council Agricultural Research, India; National Agricultural Research Institute, PNG					Partially completed				
		Bioversity: Initiation of community-based participatory documentation/ monitoring of target species/NUS and their deployment to cope with climate change in project sites across India, Nepal and Bolivia;	PROINPA, Bolivia; Ministry of Agriculture, Bolivia,; Ministry of Environment, Bolivia; LI-BIRD, Nepal; Ministry of Agriculture, Nepal; MS Swaminathan Research Foundation, India; ICAR, India; and possibly: International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), Italy; AGPM/FAO, Italy					Partially completed				
Milestone 1.3.1.5. Knowledge developed on distribution of local seed material (seed systems) and its effectiveness in climate change adaptation strategies; findings summarized in reports, case study narratives and seed system maps. (2013)		**Bioversity** : Knowledge on distribution of local seed material (seed systems) gathered and its effectiveness in climate change adaptation strategies documented	Institute of Biodiversity and Conservation, Ethiopia; National Agricultural Research Instutute, PNG; Indian Council Agricultural Research, India; Semongok Agriculture Research Centre (ARC), Sarawak Malaysia;PROINPA, Bolivia					Partially completed				
Milestone 1.3.1.7 Climate change impact on key global commodities (major Musa groups, cocoa, coconut) and selected pest and diseases modelled and reviewed by commodity network country partners and possible response strategies identified (2015)	Base model available and adapted to specific commodities; findings verified by stakeholders	**Bioversity**: Musa AAB x climate change modeled in Latin America using modified ECOCROP and climate change scenarios; maps of banana production areas in Asia and Africa based on participatory banana editor; options for modeling Musa pest and disease response to climate change reviewed; parameters synthesized for 3 pests and diseases for modeling effect of climate on incidence	MUSALAC, BARNESA, BAPNET (including participating countries by region: LAC -Costa Rica, Brazil, Colombia, Panama; ESA - Uganda, Rwanda, Kenya; WCA Ghana, Nigeria, Cote d'Ivoire, Cameroon; APO - India, China, Taiwan, Australia, Indonesia); CIRAD; International Center for Tropical Agriculture (IITA), Nigeria; CIAT, Colombia; University of Western Australia; Queensland Department of Primary Industries, Australia; CacaoNet, COGENT (including participating countries by region: LAC - Costa Rica, Brazil, Trinidad, Mexico; SSA - Cote d'Ivoire, Ghana, Nigeria, Cameroon, Tanzania; APO - India, Sri Lanka, Indonesia, Philippines, Malaysia), Centre de coopération internationale en recherche agronomique pour le développement (CIRAD), France; IITA, Nigeria; CIAT, Colombia; Centro Agronómico Tropical de Investigación y Enseñanza (CATIE), Costa Rica; South Pacific Commission (SPC), Fiji; United States Department of Agriculture (USDA), USA; University of Queensland, Australia; Reading University, UK;					Partially completed				

			(CATIE), Costa Rica; South Pacific Commission (SPC), Fiji; United States Department of Agriculture (USDA), USA; University of Queensland, Australia; Reading University, UK; World Cocoa Foundation; APCC									
		Bioversity: Identifying areas for future collecting missions, assessing drought tolerance and incorporating evaluation data in the Musa Germplasm Information System (MGIS)	International Centre for Tropical Agriculture (CIAT), Colombia; Institute of Biodiversity and Conservation, Ethiopia; National Agricultural Research Instutute, Papua new Guinea (PNG); Institut d'Economie Rurale, Mali; Indian Council Agricultural Research, India; Millenium Seed Bank, UK; Botanic Garden Conservation International (BGCI), UK; members of the Musa Taxonomy Advisory Group; University of Philippines Los Banos (UPLB), Philippines; KULeuven, Belgium; CIALCA partners;									
		ICARDA: Monitoring of population changes and adaptation of insect pests and diseases of cereals and food legumes	NARS									
Output 1.3.2 New information, knowledge, guidelines and germplasm are made available to farmers, breeders, local communities and scientists and promoted through knowledge sharing, peer reviewed articles, information systems and media												
Milestone 1.3.2.2. Farmers' traditional knowledge on use of diversity and climate change adaptation documented and made available in at least 3 countries; findings presented in databases, reports and peer- reviewed article (2013)	Databases produced and made publicly available; reports completed and disseminated; journal articles published	Survey of local and traditional knowledge of adaptation strategies at the farm level through surveys in target regions	Consultant (IGP) and local partners (EA/WA)		70	50	50	Partially completed	(1) Survey of LTK underway; (2) A contract with IUCN on using M & E to strengthen the adaptive capacity to CC of farmers and institutions in West African countries (Burkina Faso, Ghana, Mali, Niger)	One regional farmers consultative workshop held by EAFF in Nairobi, Kenya; Sokoine University of Agriculture contracted to undertake IK study in Lushoto;	Two studies documenting local traditional knowledge on climate risk management completed in IGP	3 years agreement signed with CIRAD (collaboration with IRRI) aimed to implement part of the agenda of CCAFS (MD co-lidership objective 1.2)
		Establishment of a monitoring system of varietal selection under varying climates, initially in West Africa	Potentially CIRAD, possibly DIVERSITAS and other partners to be identified during Cancun Science Meeting.									
		IITA: Develop new germplasm catalogues on released cassava germplasm. Output: Catalogue on IITA developed and released cassava germoplasm available	NCRRI in Nigeria, SARRNET in Southern Africa									
		Bioversity: Socio economic survey of local farmers undertaken in at least 3 countries to document indigenous knowledge on crop diversity and adapation to climate change.	Institute of Biodiversity and Conservation, Ethiopia; National Agricultural Research Instutute, PNG; Indian Council Agricultural Research, India; Semongok Agriculture Research Centre (ARC), Sarawak									
Milestone 1.3.2.3 Research and development partners (especially young scientists) in at least 11 countries trained in using new monitoring and modelling tools for climate change adaptation for different crops including underutilized species; outcomes summarized in report (2013)		**Bioversity:** Training of scientists and community members on tools and methods for research on underutilized species	Regional Universities Forum for Capacity Building in Agriculture (RUFORUM), Uganda; International Foundation for Science (IFS), Sweden; African Network for Agriculture, Agroforestry and Natural Resources Education (ANAFE), Kenya; Institut de Recherché et de Développment sur la Biodiversité des Plantes Cultivées, Aromatiques et Médicinales (IRDCAM), Benin; Plant Genetic					Partially completed				
Milestone 1.3.2.5. Germplasm information integrated in global information systems including: (1) Databases of priority collections augmented with georeferenced passport data and trait information useful to the diversity analysis for climate change impacts and adaptation effectively linked to global system, (2) Accession level information with quality georeferences, (3) Data on duplication to global collection and important trait information published in GENESYS, (4) complementary data sources on wild species identified through GBIF, (5) training materials, (6) list of and information on newly and already collected germplasm (domesticated and wild) adapted to climate change; Materials of interest safely duplicated in Global Collection and made available (2015)		**Bioversity:** Quality checking of the georeferences in GENESYS, SINGER, EURISCO that contribute to crop suitability Atlas and diversity analysis	AfricaRice, AVRDC, University California Berkeley					Partially completed				
		Bioversity: Develop tools and linkages to AgTrials website for GENESYS, and improved crop ontology (metadata, trait names, etc) and define collaboration with ICT-KM for the use of the ESRI & CIAT resources on the cloud for GENESYS	GCP-IBP;CIAT;ICT-KM									
		Bioversity: Establish strategic partnerships to access data for diversity analyses of CWR and NUS with GBIF and Sud Experts Plantes; test and application of GBIf tools to genebank data, extension of DarwinCore	GBIF, SEP,BGCI									
Output 1.3.3 Policies to enable access to and use of genetic resources for climate change adaptation research, and diffusion of adapted germplasm												
Milestone 1.3.3.1* Baseline survey and analysis of centers' and partners' acquisitions, and distributions of adapted germplasm carried out; Comparative survey and analysis conducted; findings summarized in reports (2011, 2014)	Reports completed and disseminated. Survey documents developed, Data collected, Draft reports circulated or approval/comment, Publication of reports	**Bioversity:** Collection and analysis of information on CGIAR centres' and their partners' acquisitions, uses and distributions of germplasm in the context of climate change, and of the policy factors affecting germplasm flows.	CGIAR Centers; Institute of Biodiversity and Conservation, Ethiopia; National Agricultural Research Institute, PNG; Institut d'Economie Rurale, Mali; Indian Council Agricultural Research, India					Partially completed				Initial 2011 milestone fully completed with a baseline data collected and initial analysis completed. Further analysis and publication is ongoing and pending for delivery of the 2014 milestone.
		ICARDA: Develop strategies for fast track testing and release of varieties and rapid multiplication and dissemination of adapted varieties to climate change. Output: Constraints of seed systems identified and appropriate policies formulated .	Public and local private seed sector									
		ICARDA: Organize targeted collection for sampling landraces and wild relatives in dry and hot areas	NARS									

Milestone 1.3.3.2. Policy guidelines produced for centers and partners to address challenges associated with obtaining, using and distributing germplasm as part of climate change related research (with particular focus on addressing challenges associated with access and benefit sharing, IPR, biosafety policies and laws) (2012	Guidelines finalized and distributed to centers and partners	**Bioversity**: Survey of centres' practices in germplasm acquisitons and distributions and how policies affect them. Literature review on Centre's diffusion strategies for improved germplasm and the conditions for success or failure.						Partially completed				
Milestone 1.3.3.3 Case studies documented of potential role of informal seed systems for diffusion of adapted germplasm; Analysis of institutions and policies that impact on the flow of adapted materials through those seed systems; National strategies developed to implement the International Treaty's Multilateral system on Access and Benefit-Sharing in 4 countries; Policy options produced at national, provincial and community levels to improve existing policies, local management and seed systems to facilitate diffusion and uptake of adapted germplasm (2013, 2015)	Case studies, analysis, national strategies and policy options developed and disseminated	**Bioversity**: Selection of country partners that will be involved in Treaty implementation work. Inception visits and initial workshops. Preparation of template/s for partners to conduct stock-taking studies on PGRFA and the implementation of the Treaty's MLS.	EMBRAPA, Brazil; Kenyan Agricultural Research Institute (KARI), Kenya; University of Malaya, Malaysia; Instituto Nacional de Investigaciones Agricola (INIA), Peru; MS Swaminathan Research Foundation, India; Local Initiative for Biodiversity, Research and Development (LI-BIRD), Nepal; PROINPA, Bolivia; Institute of Biodiversity and Conservation, Ethiopia; National Agricultural Research Institute, PNG; Institut d'Economie Rurale, Mali; Indian Council Agricultural Research, India					Partially completed				
Milestone 1.3.3.4*Technical contributions to international processes support the development of international policies enabling access to and use of genetic resources in climate change research and adaptation strategies; Background papers and policy briefs developed for intergovernmental meetings including the CGRFA, ITPGRFA, CBD; journal article published on options to reform international policies to reflect increased interdependence of countries on GRFA as a result of climate change; Book published on assessing international policy options to support collective pooling and facilitated use of GRFA published (2011, 2013, 2015)	Papers, policy briefs, Journal article and book published	**Bioversity**: Providing technical inputs to relevant international processes enabling access to and use of germplasm for climate change adaptation	CGIAR Centers; representatives of regional groups attending intergovernmental fora, secretariats of relevant international agreements					Partially completed				Policy briefs and background documents generated for ITPGRFA and the Commission on PGRFA, and special sessions held with key policy makers at international level. (2011 Milestone completed)
Output 1.3.4 Identification and evaluation of the differential roles of women and men, and other social groups, in strategies for conservation and use of species and genetic diversity; and the impact of those strategies on those different groups, are integrated into knowledge sharing and other activities to achieve outcomes												
Theme 2. Adaptation through Managing Climate Risk												
Objective 2.1 Identify and test innovations that enable rural communities to better manage climate-related risk and build more resilient livelihoods												
Outcome 2.1: Systematic technical and policy support by development agencies for farm- to community-level agricultural risk management strategies and actions that buffer against climate shocks and enhance livelihood resilience in at least 20 countries												
Output 2.1.1 Synthesized knowledge and evidence on innovative risk management strategies that foster resilient rural livelihoods and sustain a food secure environment												
Milestone 2.1.1.1 Report of priority knowledge and methodology gaps produced for index-based risk transfer products; and Program value-addition and partnership strategy (2011)	Report and journal article completed and disseminated	Report on priority knowledge and methodology gaps for index-based risk transfer products; as well as Program value-addition and partnership strategy	Senior Economist(s) Working on Index Based Insurance (TBD)	30				Completed				An expert workshop held, and a report produced on "Index Insurance for Managing Climate-Related Agricultural Risk: Toward a Strategic Research Agenda." The PI is doing final formatting before publishing through IFPRI.

Milestone 2.1.1.2 Synthesis report produced on options and approaches for reducing risk and enhancing livelihood resilience through cultivar, farm and livelihood diversification; modeling tool developed. *Documentation of how agro-pastoralists are coping with climate risk in West and Southern Africa, and piloting options as to how they may cope with increased climate risk in the future (ILRI) *Review of adaptation experiences and options in coastal and aquatic food production systems (WorldFish) * Characterization of climate-related risk, and survey of current formal and informal responses to risk with potential for transfer and up scaling; Upgrade to the ICARDA Agroclimate Tool (ICARDA) (2012)	One report and functional modeling tool completed and disseminated; Earthscan book chapters (WorldFish)	Critical review of knowledge on livelihood diversification strategies for climate-resilience	Bioversity, WorldFish., other CG Centers					Partially completed				Reports completed on how agro-pastoralists are coping with climate risk in West and Southern Africa (ILRI). Risk management and adaptation experiences and options in coastal and aquatic food production systems assessed and documented (WorldFish). Climate-related risks and risk responses studied and documented, and Agroclimate Tool upgraded to support risk responses (ICARDA). Bioversity was contracted late 2011 for a systematic review on diversification strategies to build climate resilience, which will produce a report and engage a broader community in a planned workshop, but delayed hiring process within Bioversity delayed the start of the review.
Milestone 2.1.1.3 Synthesis of ongoing work on agronomic and NRM technologies for enhancing resilience of agriculture to climate variability (2012)		Climate Change Adaptation and Mitigation in Agriculture Science Workshop, Playa del Carmen, Mexico, 1-2 December 2010	Logistics and facilitation by CIAT. Co-funded with Theme 3.	54				Completed				The workshop was completed, all funds were spent, and report disseminated in 2010. However, a delay in CIAT invoicing Columbia University caused funds to carry over into 2011.
Output 2.1.2 Analytical framework and tools to target and evaluate risk management innovations for resilient rural livelihoods and improved food security												
Milestone 2.1.2.1 Framework report produced and prototype farm household modeling tools developed for evaluating impacts of climate risk and risk management interventions on livelihood resilience (2011)	Framework report and prototype tools completed and disseminated	Develop a framework and methodology for modeling risk and resilience at the farm/household level	In collaboration with Theme 4.2 and multiple CG centers	25				Uncompleted				Theme 2 is collaborating closely with 4.1 on household modeling. T2 collaborated with 4.1 on a review ("A review of farm household models with a focus on food security, climate change adaptation, risk management and mitigation") that took longer than anticipated, and that will inform collaborative household modeling tool and framework development in 2012.
Output 2.1.3 Development; and demonstration of the feasibility, acceptability and impacts; of innovative risk management strategies and actions for rural communities												
Milestone 2.1.3.1 Participatory pilot demonstrations initiated to develop and evaluate current and improved risk management strategies and actions with rural communities at benchmark locations in 2 countries each in EA, WA and IGP (2011)	Pilot demonstration sites and partners in 6 countries	IGP, EA, WA: Establish a network of participatory pilot demonstration projects with rural communities to develop and evaluate risk management interventions	IGP: BARC, NARC, ICAR, Columbia water centre, IRI, State agricultural universities WA, EA: Others TBD with Regional Facilitators (inc. competitive calls in East Africa)		200	150	100	Completed	One diagnosis study on the introduction and operationalization of a weather Index-based Crop Insurance Scheme in Ghana; One field and institutional assessment	Participatory Action Research on crop and livestock interventions initiated in Nyando, Borana, Lushoto, Rakai and Hoima;ICRISAT contracted to undertake project on testing the design and communication of downscaled, probabilistic	Three sites in Punjab, Bihar and in plains of Nepal established for participatory evaluation of risk management interventions	Participatory pilot demonstrations have been initiated in Kenya (led by ICRISAT), Senegal (led by ANAMS) focused on communication and use of climate informatio; and in Punjab, Bihar and Nepal under the "Climate-Smart Village" model. Participatory evaluation of agrometeorological advisory services initiated in Mali, cosponsored by USAID. Participatory diagnosis and preparatory activities started in Ghana, Ethiopia and Bangladesh.
Milestone 2.1.3.2 Current strategies and actions for managing climate-related risk documented for rural communities at benchmark locations in EA, WA and IGP (2011)	Documentation completed and disseminated	as part of 2.3.3.1	See 2.1.3.1					Partially completed		Gender study grant awarded to Dr. Annunciate Nakiganda from the National Livestock Resource Research Institute		Policynetnxa has been contracted to synthesisize what is known about risk management knowledge and strategies at benchmark sites, based on baseline data and literature. The ongoing study was delayed due to a stalled effort to contract it through Bioversity. Available reports document current risk management strategies at the Kuhlna and Borana sites
		Developing and testing climate risk management tools in smallholder agriculture through community based action research	Competitive call targeting national and local level actors such as women groups, farmers and CBOs; selection criteria to be developed				50					
Output 2.1.4 Tailor and disseminate research results for evidence-based policy and technical support for farm- to community-level risk management strategies												
Output 2.1.5 Identify and evaluate differential impact of agricultural risk management strategies on different social groups, particularly women and men, and communicate findings through technical and policy support activities												
Milestone 2.1.5.1 Guidelines developed for ensuring equitable participation of women and other socially disadvantaged groups in participatory action research on climate-related risk management. (2011)	Guidelines completed and disseminated	Consultation on identification of gender and social equity issues, and development of research and implementation strategy for climate risk management participatory pilot demonstrations at benchmark locations	FAO, in collaboration with Theme 4.					Completed				Completed through efforts by Theme 4: Gender and climate change research in agriculture and food security for rural development. FAO/CCAFS/CGIAR brief. <http://ccafs.cgiar.org/blog/gender-climate-change-and-food-security> andwww.fao.org/gender; FAO and CCAFS. Gender and Climate Change
Milestone 2.1.5.2 Summary report of gender and social differentiation of current risk management strategies and access to associated information and services at benchmark locations in 2 countries each in EA, WA and IGP (2013)	Report completed and disseminated	Climate risk discourse through rural radio dialogue amongst farmers, scientists policy makers and private sector service providers	Competitive call to local level partners in EA				25	Partially completed		Vernacular radio program launched in collaboration with Mbaitu FM (Eastern Broadcasting Corporation)		
		Analyses of rural institutions in enabling adaptation to develop a more profound understanding of how local rural institutional actors respond to the upheavals in livelihood systems that are being triggered by climate change.	Danish Institute for International Studies									
Objective 2.2 Identify and test tools and strategies to use advance information to better manage climate risk through food delivery, trade and crisis response												
Outcome 2.2: Better climate-informed management by key international, regional and national agencies of food crisis response, post-crisis recovery, and food trade and delivery in at least 12 countries												
Output 2.2.1 Enhanced knowledge of impacts of climate fluctuations on food security, and how to use advance information to best manage climate-related risk through food delivery, trade, crisis response and post-crisis recovery												

Milestone 2.2.1.1 Report and journal article on impacts of climate variability on components (e.g., production, prices, rural incomes, consumption, trade, humanitarian assistance) of food security; and review of policies to mediate impacts in EA, WA and IGP (2011)	Report completed and journal paper published and disseminated	Analyze impacts of climate variability on components (production, prices, rural incomes, consumption, trade, humanitarian assistance) of food security, and policies to mediate impacts	Competitive call	70			25	Partially completed		Draft report on Managing Climate Risks through CCAFS Programmes: A Stakeholder Institutional Capacity Analysis in Eastern Africa Region		A three-country study of relationships between historic climate variability and components of food security (e.g., production, staple food prices, rural incomes, humanitarian assistance), awarded to WFP through a competitive process, produced a report for Nepal (funded by IGP and cross-listed as Milestone 2.3.3.2). Reports in preparation for Senegal and Ethiopia were delayed as partnership and data-sharing agreements were negotiated.
Output 2.2.2 Synthesized knowledge and evidence of the impacts of alternative risk management interventions within the food system on food security and rural livelihoods, to inform policy and practice												
Milestone 2.2.2.1 Report and policy brief on the costs associated with timing and targeting of alternative food crisis interventions (2011)	Report and policy brief completed and disseminated	Assess influence of timing and targeting on costs of food security interventions, to inform investment in improved information and response systems	WFP, IRI	20				Completed				A consultation with international food security stakeholders (Output 2.2.3) led to a shift in focus – from a food security intervention costing study, toward a demand-driven process focused on government food security decision-making in Ethiopia. A preparatory study reviewed decision processes and calendars for government
Output 2.2.3 Platform and tools for sharing knowledge and fostering improved coordination among food crisis response, the market-based food delivery system, and agricultural research and development												
Milestone 2.2.3.1 Report and policy brief of an international food system stakeholder consultation to develop a collaborative strategy for improving intervention, coordination, capacity to respond to improved climate-related information (2011)	Report completed and disseminated	International food security stakeholder consultation to develop a collaborative strategy for improving intervention, coordination, capacity to respond to improved climate-related information	Relevant international food security organizations, Tufts U., Cornell U.	60				Completed				A workshop in Nairobi brought global leaders in food security information and response to identifying priority issues, gaps and opportunities, to inform CCAFS strategy. Outcomes are captured in a workshop report, and a report on promising Objective 2.2 activities and partnerships. The Tufts University study was started in 2010 but wasn't completed until early 2011 due to delays in contracting. Delays in processing within Columbia University caused some funds from the East Africa study -- completed in 2010 -- to carry over into 2011.
	Report completed and disseminated	Scoping study of current state, trends, emerging opportunities to incorporate advance information into management of climate-related food crises and price fluctuations, in preparation for consultation workshop and subsequent work	Tufts U.	42								
	Report Completed	Partial salary (Aug-Dec 2010) and travel (Aug-Sep 2010) toward: Case study of regional food security planning in E. Africa and use of climate information for national-level food security decision making in select countries.	WFP, IRI, Red Cross, FewsNet	6								
Milestone 2.2.3.2 Study and stakeholder consultation on regional agricultural and food security contingency planning processes, current and potential use of climate-related information, and strategy for improving planning and coordination in EA, WA and IGP (2011)	3 workshops each engaging at least 10 participants; Study report completed and disseminated.	IGP, WA, EA: Relevant regional and national food security and trade organizations TBD with Regional Facilitators	-	50	50	50		Partially completed	One synthesis report produced on regional food system stakehoders consultation & one FS stakeholder workshop in preparation		Discussion initiated for this activity but could not be implemented due to lack of consensus on technical details	Consultations with relevant stakeholders were initiated in all three regions, but not completed or reported in the IGP. In EA, it is incorporated into the report on Managing Climate Risks through CCAFS Programmes: A Stakeholder Institutional Capacity Analysis in Eastern Africa Region, reported under milestone 2.2.1.1.
Output 2.2.4 Identify and evaluate differential impact of tools and strategies for climate risk management on different social groups, particularly women and men, and inject findings into support to agencies												
Objective 2.3 Support risk management through enhanced prediction of climate impacts on agriculture, and enhanced climate information and services												
Outcome 2.3 Enhanced uptake and use of improved climate information products and services, and of information about agricultural production and biological threats, by resource-poor farmers, particularly vulnerable groups and women, in at least 12 countries												
Output 2.3.1 Improved climate information tools and products to support management of agricultural and food security risk												
Milestone 2.3.1.1 Historic gridded daily rainfall dataset, combining observations and satellite images, developed and evaluated for 1 country each in EA and WA (2011)	Dataset for 2 countries completed and disseminated; evaluation report completed and disseminated	Develop and evaluate methodology for combining station observations and remote sensing into gridded daily historic meteorological data sets for agricultural modeling applications	competitive call(45), U. Reading (25), IRI (40); coordinated with EA and WA regional partner activities	114		40	50	Partially completed	One workshop on harmonizing methodologies for seasonal forecasting of the rainy season characteristics in West Africa	Report on Improved Daily Rainfall and Temperature Time Series over Ethiopia, study submitted by the Ethiopia National Meteorology Agency (NMA)		CCAFS commissioned a set of partners (Reading, Princeton, IRI, AGRHYMET) to develop methods to reconstruct historic daily weather data needed for agricultural modeling and adaptation interventions. Deliverables include 2 technical reports, prototype software tools and training events. Two reports are still pending and one is preliminary. Participating countries have not yet given permission to develop full data sets for public release.
	Report Completed	Travel for Dinku (Aug-Sep 2010) and Lyon (Nov-Dec 2010) toward: Initiate development of historic meteorological data set in East and West Africa, for use in agricultural and biological threat forecasting and other climate	IRI, Ethiopian NMA, AGHRYMET	9								
Milestone 2.3.1.2 Prototype seasonal forecast information products tailored and evaluated for local agricultural decision-making in 2 countries each in EA, WA (2011)	Tailored products developed for benchmark locations in 2 countries and made publicly available	Methodology and capacity development to tailor seasonal forecasts to crop forecasting and local agricultural decision-making	IRI, Senegal Met. Dep., relevant national and regional climate institutions	30	30	35		Completed	One Seasonal Forecast Communication Workshop and Evaluation implemented in Senegal;		Discussion initiated for this activity; activities finalised to be implemented in 2012	Locally-downscaled probabilistic seasonal forecasts were developed and presented in training workshops in Senegal and Kenya, and are available in training workshop reports. Instead of 2 countries each in EA and WA, seasonal forecast development was expanded into the IFP, for which a set of web-based analytical "maprooms" were developed to visualize and analyze agriculturally important rainfall statistics
Output 2.3.2 Synthesized knowledge and evidence on institutional arrangements and processes for enhancing climate services for agriculture and food security												
Milestone 2.3.2.1 Report and journal article produced on synthesis and program strategy for needs, constraints and opportunities for enhancing climate services, and institutional and ICT-based information delivery mechanisms for agricultural risk management (2011)	Report completed and journal paper published	Climate services and delivery mechanisms synthesis and program strategy formulation	ACMAD, IGP consultants, IRI	20				Uncompleted				A study was commissioned with a consultant, through ILRI, to synthesize information about current climate services and inform strategy in the three focus regions. The synthesis builds five previous regional reports. Contracting problems within ILRI delayed work on the synthesis report.
Output 2.3.3 Improved knowledge, tools, data sets and platforms for monitoring and predicting agricultural production and biological threats, and informing management, in response to climate fluctuations												
Milestone 2.3.3.1 Proof-of-concept on remote sensing data assimilation for crop and rangeland production forecasting reported (2011)	Report completed and disseminated	Develop and evaluate methodology and tools for forecasting climate impacts on crop production	NASA-JPL	51				Completed				The IRI completed the proof-of-concept study and prototype tool development and report.
Milestone 2.3.3.2 Predictability of crop production and prices from climate information in the IGP reported (2011)	Report completed and disseminated	IGP: Exploratory study of the predictability of regional crop production and prices from climate information	Co-funded with T2 under Milestone 2.2.1.1.		50			Completed			A report by the World Food Program explaining	This was incorporated into the Nepal report and draft manuscript on impacts of climate variability on components of food security, reported under Milestone 2.2.1.1

Milestone 2.3.3.3 Synthesis report on climate-sensitive pest and disease modeling and early warning systems for agricultural and food security risk management (2011)	Report completed and disseminated	Synthesis report on climate-sensitive pest and disease modeling and early warning systems for agricultural and food security risk management	Kansas State U. Co-funded by Theme 2.	30				Completed				The study,produced a journal article submitted to Agricultural and Forest Meteorology, and a report with strategy recommendations. The study, co-funded with Theme 2, was initiated in 2010 but carried into 2011 due to contracting delays.
Milestone 2.3.3.4 Crop and rangeland production forecasting platform, documentation and training materials developed (2013)	Electronic platform publicly available; summary document and training materials completed and disseminated	Crop and rangeland production forecasting methodology development	FAO (35), AGRHYMET & partners (40), NASA-JPL (50), IRI (30)	155			40	Partially completed				Consultation with several experts revealed significant constraints to adapting with what had appeared to be candidate tools, and suggested the need to review existing software tools and approaches before initiating development of a CCAFS crop forecasting
Output 2.3.4 Enhanced capacity of national and regional climate information providers, NARES and communication intermediaries to design and deliver climate information products and services for agriculture and food security management												
Output 2.3.5 Identify and evaluate differential impact of climate information services on different social groups, particularly women and men, and inject findings into support to farmers												
Theme 3. Pro-Poor Climate Change Mitigation												
Objective 3.1 Inform decision makers about the impacts of alternative agricultural development pathways												
Outcome 3.1: Enhanced knowledge about agricultural development pathways that lead to better decisions for climate mitigation, poverty alleviation, food security and environmental health, used by national agencies in at least 20 countries												
Output 3.1.1 Analysis of agricultural development pathways and the trade-offs among mitigation, poverty alleviation, food security and environmental health												
Milestone 3.1.1.1 Report on potential emissions reductions from technical options compatible with maintaining food supply (2011)	Report completed and disseminated	Potential emissions reductions (a) from technical options compatible with maintaining food supply and (b) under alternative intensification scenarios. Two country case studies/region, in collaboration with national agencies; include capacity development (inc IGP regional workshop)	To be selected on a tender basis. WA: IITA IGP: Tender for consultant for status paper; IGP: regional assessments - BARC, NARC, ICAR, NGOs	75	125	70	35	Completed	One PAR activity-planning workshop realised		A workshop organised with stakeholders in India on low carbon development pathways; and reports from IARI, BCAS and BIDS for India and Bangladesh completed on emissions and mitigation opportunities	Potential emissions reductions identified for conditions consistent with maintaining food supply for four countries in E Africa (Brown et al. CCAFS Working Paper 14). Intensification scenario examined for W. Africa cocoa (see below).
Milestone 3.1.1.2*Report on potential emissions reductions from technical options compatible with maintaining food supply under alternative intensification scenarios. (2011)	Report completed and disseminated	WA: Cocoa intensification in West Africa and implications for landscape-level mitigation. IGP: Status paper on potential for carbon sequestration in IGP in agriculture; Regional assessment of low carbon options in agriculture	IFPRI, NARS in Ghana, Senegal, Mali, Uganda, Kenya, India, Nepal, Bangladesh					Completed			see above	Report completed for cocoa intensification in WA (Gockowski et al. CCAFS working paper in progress)
Milestone 3.1.1.5. Assessment report on regional and national agricultural development policies, mitigation policies and mitigation projects and their implications for mitigation, poverty alleviation and food security (2011)	Assessment report completed and disseminated	(a) Global review of low C development strategies to understand linkages to agriculture; (b) Review of mitigation policies and projects in focal regions, with national agencies and with gender lens. (c)Mitigation research planning meetings (1/region)	ASARECA, CORAF and national agencies	28				Completed				B and C completed. Premature to review low carbon development strategies, as agricultural components still few and emerging
Output 3.1.2 Enhanced tools, data and analytic capacity in regional and national policy and research organizations to analyze the implications of different development scenarios and mitigation strategies												
Milestone 3.1.2.1 *Framework for comparison of environmental footprint of agricultural systems (ILRI) (2011)	Framework completed and disseminated	Coordination	Led by ILRI					Completed				
Output 3.1.3 Analysis of the gender and social differentiation implications of alternative agricultural pathways and findings built into communications and capacity building activities												
Objective 3.2 Identify institutional arrangements and incentives that enable smallholder farmers and common-pool resource users to reduce GHGs and improve livelihoods												
Outcome 3.2: Improved knowledge about incentives and institutional arrangements for mitigation practices by resource-poor smallholders (including farmers' organizations), project developers and policy makers in at least 10 countries												

Output 3.2.1 Evidence, analysis and trials to support institutional designs, policy and finance that will deliver benefits to poor farmers and women, and reduce GHG emissions												
Milestone 3.2.1.1 Reviews of promising incentives, institutions, market-based mechanisms and policies at project and national scales, in three initial target regions, including (i) carbon as co-benefit to more productive agricultural practices, (ii) carbon markets, (iii) corporate social responsibility technical assistance, (iv) carbon labelling, summarized in four articles, policy briefs and posted on webpage (2011)	4 policy briefs and scientific articles completed and disseminated. Webpage developed.	Synthesis Book: smallholder mitigation (edited volume, Earthscan),	FAO, IIED, Ecoagriculture					Completed	4 country policy status & research priority reports developed; One report on mitigation options and incentive mechanisms for agricultural climate change mitigation to benefit the smallholders (Niger biocarbon project)	ILRI/CIFOR/ICRAF conducting greenhouse gas fluxes in agroforestry systems of Western Kenya	A study conducted to understand to understand options in India completed IARI	Book published by Earthscan, Ecoagriculture engaged 4 partners in PAR for E. Africa,national workshops held in 4 countries although options not fully identified, landscape special issue ansd policy brief prepared with synthesis article in preparation
		(b) Project–level action research on economic and technical feasibility of C-market for smallholders (E and W. Africa) (no projects identified yet in IGP)	EcoAgriculture, Ecotrust, World Vision, Vi Agroforestry, CARE, Sustainable Food Lab, World Bank, Cacao Carbon Project, NARS	120		35	35					
		(c) National level analysis of options in agriculture either through case studies or expert workshop	Makerere University, BIDS, IIMA, CARE, EPA	15	70	60	90					
		(d) Landscape analysis of Incentives for mitigation at the farm-forest interface (special journal issue, global workshop, synthesis journal article, conference presentation at Earth Systems Governance conference Mar 2011)	Michigan State University	62								
		(e) Analysis of finance channels and resources in smallholder agriculture	Global Carbon	35								
Milestone 3.2.1.2 Experts workshop to identify the design and monitoring requirements of finance and institutional arrangements to better benefit poor farmers and women (2011)	Workshop held; 12-15 participants representing major international and regional organizations dealing with gender issues; Expert consultation completed and summarized; report disseminated	Workshop: incentives for smallholder mitigation (produce review papers and build community of practice) July	FAO	70				Completed				http://www.fao.org/climatechange/micca/72530/en/
Milestone 3.2.1.3 *In-depth analysis of the economic incentives and benefits to farmers for integrated practices (conservation agriculture, sustainable land management, and agroforestry) in three initial target regions, linked to Milestone 3.3.1.1 and 3.3.2.2(CIMMYT, IFPRI) (2012)	Journal article completed and disseminated	Assessment of current incentives at benchmark sites via impact survey (T4 activity)	To be selected on a tender basis;	30				Partially completed				Planning conducted and project expanded. Will take place under T4.
Output 3.2.2 Improved capacity to increase the uptake and improve the design of incentives mechanisms and institutional arrangements to deliver benefits to poor farmers and women												
Milestone 3.2.2.3 Training for project implementers on designing finance and institutional arrangements and safeguards specifically to benefit poor farmers and women (2013)	Workshops provide training to 50 individuals per CCAFS region (3)	Field assessment of role of women and poor in mitigation projects and measures to improve	WOCAN (including national members)	70				Uncompleted				WOCAN in transition (moved to Bangkok)
Objective 3.3 Test and identify desirable on-farm practices and their landscape-level implications												
Outcome 3.3: Key agencies dealing with climate mitigation in at least 10 countries promoting technically and economically feasible agricultural mitigation practices that have co-benefits for resource-poor farmers, particularly vulnerable groups and women												
Output 3.3.1 Analysis of mitigation biophysical and socioeconomic feasibility for different agricultural practices and regions, and impacts on emissions, livelihoods and food security												
Output 3.3.2 Methods developed and validated for GHG monitoring and accounting at farm and landscape level to contribute to compliance and voluntary market standards												
Milestone 3.3.2.1 Expert and stakeholder consultations on methods appropriate for smallholder farmers through one global workshop and workshops in each of the 3 initial target regions (2011)	Workshops engage 25 participants each. Consultations completed and summarized.	(a) Workshop and commissioned synthesis of emissions methods/models and identification of cost effective methods appropriate for smallholders, as basis for regional working groups to develop methods and build a community of practice	Duke University, T-AGG, ILRI, ICRAF, CIP, IRRI, FAO	90				Completed	A report on emission baselines produced (Applied Geosolutions, DNDC Art)	Draft report on the State of Climate Change Adaptation and Mitigation Efforts for Agriculture in Eastern Africa ;	Comparative evaluation of models still to be done; GHG emission baselines from agriculture completed for South Asia.	(a) and (b) completed. ILRI delayed training to 2012. Training by DNDC Art delayed to January-May 2012.
		(b) Scoping study and workshop to assess whole farm and AFOLU /landscape GHG accounting options	FAO-MICCA	70								
		(c) Training in national inventory methods in 2 countries (Nepal)	Global Research Alliance, ILRI, NARS in Nepal	30								
		(d) IGP: Comparative evaluation of field level models for simulating GHG emissions from agriculture in IGP region (report on model suitability);	??????	-	30	30	30					
		(e) IGP, WA, EA: GHG emission baselines for the three study regions and benchmark sites (baseline report) (capacity building component)	Winrock and Applied Geosolutions + local partners; IGP: To be selected on a tender basis		50	50	50					
		Developing and testing GHG mitigation tools in smallholder agriculture through community action research	Competitive calls		-	-	40					
Milestone 3.3.2.2 *Data and methods for carbon measurement and monitoring for integrated agricultural systems (complex landscapes, integrated agriculture, forestry and aquaculture, rangeland and livestock) (ICRAF, WorldFish, ICARDA, ILRI); includes equipment validation for soil carbon field assessments (CIP) (2013)	Data, methodologies, tools and guidelines shared through websites, policy briefs and scientific article	All GHG landscape analysis (inc wetlands/flooded areas)	ICRAF, CIFOR, IWMI	50		40	40	Partially completed	One regional team (8 people) established for GHG quantification methods development; six scientists supported through projects on development of GHG			Wetlands research explored and deferred.
Milestone 3.3.2.3 Field research initiated at benchmark sites to assess trade-offs for different sectors of agricultural mitigation (livestock, soil carbon, agroforestry) based on biophysical and livelihood outcomes (2012)	Field trials in operation in 10 CCAFS benchmark sites across 3 initial target regions	Scoping and contacting prospective partner universities per region Develop a 'pool' of Ph.D. students linked to the network Identify fundraising possibilities for the network50	Copenhagen University, ASARECA, CORAF	-		-	-	Partially completed				See 3.3.2.4. Research not directed to benchmark sites as PhD students already had commitments to other sites
Milestone 3.3.2.4 Network of PhD students launched for studying GHGs in developing country agriculture to test methods and develop further innovations, linked to Milestone 3.3.2.2 and 3.3.2.3 (2011)	20 PhD students engaged in network per CCAFS region							Completed				Climate Food and Farming Network (CLIFF) formed, eight PhD fellow grants given and workshop held in 201; http://www.cliff.life.ku.dk/
Output 3.3.3 Synthesis of understanding about the direct and indirect economic and environmental costs and benefits from agricultural mitigation												

Output 3.3.4 Analysis of impacts of on-farm and landscape level practices on women and poor farmers												
Theme 4. Integration for Decision Making												
Objective 4.1 Explore and jointly apply approaches and methods that enhance knowledge to action linkages with a wide range of partners at local, regional and global levels												
Outcome 4.1: Appropriate adaptation and mitigation strategies mainstreamed into national policies in at least 20 countries, in the development plans of at least five economic areas (e.g. ECOWAS, EAC, South Asia) covering each of the target regions, and in the key global processes related to food security and climate change												
Output 4.1.1 For each region, coherent and plausible futures scenarios to 2030 and looking out to 2050 that examine potential development outcomes under a changing climate and assumptions of differing pathways of economic development; developed for the first time in a participative manner with a diverse team of regional stakeholders												
Milestone 4.1.1.1 Capacity built among three regional teams of diverse stakeholders trained in scenarios approaches and engaging with policymakers in their countries/regions and in global CC processes and with the ESSP community; Methodological briefs, papers (2011)	Regional scenarios partners actively participating in regional food security debates and global CC processes (e.g. UNFCCC negotiations and COP). Number of partners using/citing scenarios; No. of regional partners trained in scenarios participating in regional FS debates and global CC processes	Supporting scenarios process and regional capacity in scenarios for linking to global processes and national policy; synthesis of results and evaluation of value of linking local-regional-global scales through scenarios approach	200k to Oxford for scenarios officer salary and travel	200	40	200	100	Completed	2 scenarios workshops held in WA; storylines produced	2 scenarios workshops held in East Africa; One Regional Learning Partnership consultative meeting held in Durban, South Africa	Scoping work for scenarios completed; further work awaiting quant modeling results from add'l EA work on linked qual-quant methods	EA and WA multi-stakeholder scenarios teams trained and storylines produced. 100K Proposal for EA high level policy workshop accepted by USAID; brief disseminated at COP17; posters and other communication products under development with regional scenarios teams and PANOS
		Implementation with partners of various engagement and communication strategies (policy champions, briefs, website, media outreach) for moving scenarios into policy	PANOS, ILRI, ASARECA, IFPRI, IWMI, ICRISAT, ICRAF	60		135						
		Developing and testing knowledge platforms for communication climate action through community based action research	Competitive call targeting national and local level actors such as women groups, farmers and CBOs; selection criteria to be developed				30					
Milestone 4.1.1.2 Three sets of prototype regional scenarios produced (main regional uncertainties identified, initial regional storylines developed, reports and initial scoping for model analysis). Article on effectiveness of scenarios as a 'boundary object' (2011)	Scenarios reports for EA, WA and IGP available on CCAFS and partners websites; Local media reports from each region	Quantification of regional scenarios in EA, WA, IGP, and initial work on linkage of regional scenarios to the global level and downscaling to the local/household levels	IFPRI, IIASA, AgMIP, others (including regional partners) to be selected					Completed				EA and WA storylines produced, analyzed and refined; modeling teams engaged and quantification work underway. Scenarios approach for S Asia under exploration.Chaudhury M, Vervoort V, Kristjanson P, Ericksen P, Ainslie A. Multi-Stakeholder Scenarios as a Boundary Process: Improving Food Security, Environments and Livelihoods in East Africa under Conditions of Climate Change
Output 4.1.2 Global and regional maps, tables and associated syntheses, showing current vulnerable agricultural and fishing populations in relation to food security to 2030 and 2050												
Milestone 4.1.2.1 Vulnerability assessment and maps from the three CCAFS regions published and widely disseminated in a paper, policy briefs, conference presentations, workshops, web materials, media stories, inputs to the ag work program/ UNFCCC negotiations, global and regional CC conferences (e.g. COP), contributing to strengthening regional climate and agricultural knowledge platforms/networks and improved CCAFS-related science-user information flows (2012-2013)	Rural ag and fishery community concerns included in UNFCCC negotiations. New regional CCAFS-related working groups and gov't units created in at least 3 regions. CCAFS outputs cited by partners at national, and regional levels. Number of downloads and requests from regional partners for CCAFS products. Number of partners/events in the 3 regions applying processes, tools, approaches bringing together CC-Ag-FS communities in dialogue; number of new projects/programs following these approaches	Evaluation of the vulnerability hotspots mapping; further quantification of these to the 2030s and 2050s at different scales, and linkage to the regional scenarios	U of KwaZulu Natal, Food Economy Group, FAO, Cornell U, GECAFS					Partially completed		2 breakfast meetings held with the Adaptation and Mitigation Professional group in Nairobi, Kenya; 3 photo essays and videos disseminated; documentation of the current status of drought and famine in the Horn of Africa ongoing	25 participants from South Asia trained in crop models and climate change scenarios for vulnerability assessment	Vulnerability mapping and analysis with multiple partners undertaken; CCAFS report, launch and media stories in BBC, Time and Nature – see: <http://ccafs.cgiar.org/news/category/press-releases> Ericksen et al. 2011. Mapping hotspots of climate change and food security in 2030. CCAFS Report No. Available at: <http://ccafs.cgiar.org/resources/climate_hotspots>. Paper submitted to the journal Food Security.
		IGP: Capacity building in vulnerability assessment for IGP agricultural sub-regions (including a training workshop)	NARS-India, Bangladesh, Nepal		100							
		EA: Vulnerability and climate risk assessment of the agricultural sector in four countries and mapping policies, institutions and actors related to climate change adaptation, food security, food systems and agricultural development (including a policy dissemination workshop)	National partners TBD. 1 regional consultant to lead the policy mapping study, coordinating 4 national facilitators at EPA (Ethiopia), Ministry of Agriculture, Food and cooperatives (Tanzania), Makerere Univ. (Uganda) and Nairobi University (Kenya)				50					
		Implementation of various engagement, visualization and communication approaches (policy advisory group, maps, films, briefs, website, media outreach) for enhancing use of vulnerability and scenario analyses and maps and other CCAFS outputs in decision making by regional implementing partners and policymakers	USAID, EAC, AU, ASARECA, CORAF	100								
Output 4.1.3 Evidence on, testing and communication of, successful strategies, approaches, policies, and investments contributing to improved science-informed CC-ag development-food security policies and decision making												
NEW Regional capacity strengthened in participatory, gender- and vulnerability-sensitive research on CCAFS issues; research reports from each region (2011)	Training materials and reports available on website, 30 local partners trained	Trainings in participatory, gender & vulnerable groups held	INSAH, CEAPRED, BCAS, AFPRO, NARO, SARI	30			30	Completed		2 regional partners trained on Gender and Climate Change Issues in Agriculture and Food Security Research and Rural Development in Rome, Italy - FAO/CCAFS training		Gender and climate change research in agriculture and food security for rural development. FAO/CCAFS/CGIAR brief. <http://ccafs.cgiar.org/blog/gender-climate-change-and-food-security> and <www.fao.org/gender> FAO and CCAFS. Gender and Climate Change Research in Agriculture and Food Security for Rural Development Training Manual. CGIAR Program on Climate Change, Agriculture and Food Security (CCAFS) and The Food and Agriculture Organization of the United Nations (FAO). <www.fao.org/gender> and
Output 4.1.4 Analyses providing evidence of the benefits of, strategies for, and enhanced regional capacity in, gender and pro-poor climate change research approaches that will increase the likelihood that CCAFS-related research will benefit women and other vulnerable as well as socially differentiated groups												

Milestone 4.1.4.1 Drawing on Theme 3, CARE-CCAFS report on potential impacts on women and vulnerable groups of new carbon payment schemes; FAO/CCAFS report on gender & climate change issues across CCAFS regions, informing new CCAFS gender strategy (2011)	Number of downloads of CCAFS gender-related reports, briefs, blogs; CCAFS gender work cited in partners' reports/strategies and gender highlighted in national/regional climate, ag and food security strategies	Develop gender strategy for CCAFS (with CIAT); Develop gender training materials and design and implement regional gender-CC case studies jointly with FAO to inform FAO's gender mainstreaming strategy	FAO, CIAT	140	50	50	50	Completed	One report on gender-related tools for CC adaptation & mitigation produced (Ghana)	Gender study grant awarded to Dr. Annunciate Nakiganda from the National Livestock Resource Research Institute (NaLIRRI)	Courses for 20 trainers and for 35 rural women leaders conducted; course materials developed for South Asia	CCAFS gender strategy submitted to Consortium
NEW Two research grants to women scientists in each of 3 CCAFS regions, based at Universities or NARS, granted	6 new CCAFS-gender studies initiated in 3 regions	Establish a new competitive small grants program for gender-responsive CCAFS research, and funding going to regional female scientists doing research on CCAFS priorities	Universities, NARS in 3 CCAFS regions	200				Completed				Issued competitive call for proposals and grants given to 5 female scientists now implementing gender-CC research in 3 CCAFS regions
Output 4.1.5 Mainstreaming adaptation strategies into national policies, agricultural development plans, and key regional and global processes related to agriculture and rural development, food security and climate change												
Milestone 4.1.5.1 Twenty scenario and vulnerability-focused food security dialogues and new national and regional agricultural policies incorporating climate change (2013)	Number of new national and regional policies and agricultural sector strategies that incorporate CC concerns	Undertake regional engagement activities	ASARECA, CORAF, Ministries of Ag, CC-units, poverty units		30	30	100	Partially completed	One scenario workshop organised (One scenario communication consultant hired); Preliminary discussions & agreement with CORAF to lead an exchange platform	National level priority planning meetings held in Uganda,Nairobi and Addis; One regional farmers meeting on climate change, agriculture and food security hed in Nairobi;One regional learning partnership workshop held in Nairobi; Design of mock up website for the RLP; one conference on climate change	Policy makers, civil society, researchers in India, Nepal and Bangladesh, as well as donors from World bank and DFID were engaged in discussion around climate change policy, research and development; South	
		Develop communications strategy and implement 2011 activities			15	15	50					
Output 4.1.6 Building of capacities to engage in global policy making processes and adopt risk management strategies												
Milestone 4.1.6.1 Three trainings sessions are held for a wide variety of stakeholders on UNFCCC negotiation process and policy frameworks such as NAPAs and NAMAs (2012)	Numerous stakeholders are trained in at least 20 countries	Develop engagement and training strategy	UNFCCC, UNDP, AMCEN					Uncompleted				Covered in 4.3 and themes1&3
Objective 4.2 Assemble data and tools for analysis and planning												
Outcome 4.2 Improved frameworks, databases and methods for planning responses to climate change used by national agencies in at least 20 countries and by at least 10 key international and regional agencies												
Milestone 4.2.1.1 Regional site characterization and baseline data collection completed and analysed in three target regions at three levels: household, village, and institution; Synthesis report presents results of baseline survey of farming households re: soil, land, water, livestock, fisheries and agroforestry management strategies for adapting to a changing climate, and climate-related information access, needs and uses, implemented across 12 countries in over 200 villages and 5,000 households. Synthesis report of institutional-level baseline work. (2011-2012)	13 site reports from baseline surveys made available on CCAFS and partner websites; baseline data shared widely and available on CCAFS website; synthesis CCAFS report and journal article submitted	IGP, WA, EA: Finalise baseline data collection, collation and analyses, including global synthesis (inc village and organisational baseline)	Consultants, University of Reading Statistical Services Centre, regional partners	224	100	100	100	Partially completed	5 village level baseline study reports produced	Household and village level baseline reports produced for five sites in East Africa; Consultants contracted to undertake organizational surveys in the sites	Household baselines surveys and village surveys completed in IGP	CCAFS reports: Förch W, Kristjanson P, Thornton PK. 2011. Initial Sites in the CCAFS Regions: Eastern Africa, West Africa and Indo-Gangetic Plains. <http://ccafs.cgiar.org/where-we-work> Kristjanson P, Garlick C, Ochieng S, Förch W, Thornton PK. 2011. Global Summary of Baseline Household Survey Results. <http://ccafs.cgiar.org/resources/baseline-surveys> Thirteen household baseline result reports: <http://ccafs.cgiar.org/resources/baseline-surveys>Kristjanson P, Neufeld H, Gassner A, Mango J, Kyazze F, Desta S, Sayula G, Thiede B, Förch W, Thornton PK, Coe R. Are food insecure smallholder households making changes in their farming practices? Evidence from East Africa. Re-submitted to Food Security, Dec 2011. Training materials and data: household and village-level surveys, data management, analysis and data available on dataverse through
		Baseline development and acquisition of satellite imagery										
Milestone 4.2.1.2. Priorities derived for downscaling needs based on an overview of current downscaling initiatives; New products based on innovative methods commissioned and tested, and methods compared and evaluated; Research reports produced on novel downscaling methods and their evaluation; at least one peer-reviewed paper published on comparison of different methods for agricultural impact modelling; * Proof of concept for climate downscaling methodology developed based on wavelets, multifractals and neural networks (CIP) (2012-2013)	Two new products tested and evaluated. Two research reports completed and disseminated. Peer review paper published. Proof-of-concept completed and disseminated	Methodology development for downscaling climate model outputs, daily data reconstruction, daily data generation, for impact evaluation and trade-off analyses;	CIP, U Cape Town, CIAT, ILRI, IRI, Waen Associates	140			30	Partially completed				Two "methodology" reports completed: 1. Application of nonlinear techniques for daily weather data reconstruction and downscaling coarse climate data for local predictions (R Quiroz, A Posadas, CIP). 2. Toward a rubric for the simulation of regional decadal variability for agricultural and other applications (A M Greene, L Goddard, J W Hansen, IRI). Paper underway on comparison of methods of downscaling, for completion in 2012.
		activities for this milestone will be conducted by CIP – see their activity plan under theme 4.2										
Milestone 4.2.1.3 Suite of downscaled climate data for the 2030s to 2090s, first from the AR4 climate models and then from CMIP5, for homogenized applications in the Program. *Online data repository of downscaled 1km present and future climate projections (CIAT) *Climate projection maps to evaluate future crop suitability (Bioversity) (AR4, 2011; CMIP5, 2012)	Datasets available for download via CCAFS website with appropriate documentation	Acquisition of AR5 scenario climate data and downscaling CMIP5 data;	CIAT, ILRI, University of Oxford, University of Leeds, Waen Associates	60				Partially completed				CIAT-based climate data website populated and heavily accessed by users. MarkSimGCM released on the web (Google-Earth based method of generating daily weather data in DSSAT format for future climate change scenarios,using AR4 data. CMIP5 data not available until early 2012.

		activities for this milestone will be conducted by CIAT – see their activity plan under theme 4.2, 1st row	CIAT, Tyndell Center; Stanford University									
Milestone 4.2.1.4 Regional climate characterization and evaluation of global and regional climate model performance for the three initial target regions (2011)	Regional reports that evaluate different climate models, for the three initial target regions, from the perspective of agricultural impacts modelling	Regional climate characterisation and GCM / RCM performance evaluated for all target regions	Oxford University	18				Completed				Reports completed: Climate change in CCAFS Regions: Recent Trends, Current Projections, Crop-climate Suitability, and Prospects for Improved Climate Model Information. Part 1, West Africa (Washington & Hawcroft). Part 2, East Africa (Washington & Pearce). Part 3, The Indo-Gangetic
Milestone 4.2.1.5 Regional climate characterization and evaluation of global and regional climate model performance for additional target regions. *Remote sensing databases and maps of vegetation conditions and recent historical changes in Africa developed (ICRAF) (2013)	Regional reports that evaluate different climate models, for additional target regions, from the perspective of agricultural impacts modelling	Starting up contracts for additional 2 regions	ICRAF, Afsis	60				Uncompleted				New climate reports for SE Asia and Latin America deferred until activities start up in these two new CCAFS regions in late 2012
		activities for this milestone will be conducted by ICRAF – see their activity plan under theme 4.2., 2nd row										
Milestone 4.2.1.6 Databases for soils, historical weather, agricultural systems, and natural resources in the target regions evaluated, gap-filled, collated and made available on the web, following the development and implementation of an appropriate data management policy. *Working version of crop production surfaces developed to model biophysical responses to environmental change (IFPRI). *Enhanced niche-based approaches developed and published for analysis of climate change impacts on major/minor crops (CIAT) *Simulation models on yields and emissions in rice production systems assessed for their use in decision support systems (IRRI) (2012-2014)	Data reports are written up and made available on CCAFS website, for the following: soils profile information; historical daily weather data; global agricultural systems data layers updated and refined; and agricultural systems data collected and collated for several hundred households at the CCAFS sites	Data assembly and provision at different scales, for impact assessment: soils data, cropland extent, agricultural systems classification, agricultural systems data; IGP, WA, EA: Regional site characterisation activities and databases (soils, water, climate, other resources for agriculture)	IIASA, FAO, HarvestChoice, Consortium for Spatial Information. IGP: BARC, NARC, ICAR, NGOs	342	50	30	70	Partially completed	05 sites characterisation reports edited		IWMI contracted to develop, collate databases for south Asia at sub-national scale on soils, climate, agricultural systems, and irrigation	* WISE soil profile database V3.1 data filled and converted to DSSAT format. Report: "Strengthening Soil Databases for Climate Change and Food Security Modeling Applications" (B Chaves & G Hoogenboom, WSU). * Workshop on "Characterizing and Validating Global Land Cover Workshop" (June 2011), involving IIASA (leader), CGIAR Consortium for Spatial Information (CSI), Group on Earth Observation (GEO), the Agricultural Monitoring Communities of Practice (COP), GOFC-GOLD and the Joint Research Centre of the European Commission (JRC). Materials at www.iiasa.ac.at/Research/FOR/lc/presentations.htm l, www.iiasa.ac.at/Research/FOR/lc/breakout.html. Paper, "Building a Consolidated Community Global Cropland Map" (L See, S Fritz, P Thornton, L You, I Becker-Reshef, C Justice, O Leo, M Herrero), EarthZine (in press). * Global Mapping of Intensive Livestock Production Systems (T Robinson & L D'Aietti, FAO), four quarterly reports, to go on web in early 2012. * Report of activities, "Developing generic tools for characterising agricultural systems for climate and global change studies" (C Quiros, M Rufino & M Herrero, ILRI). The tool, the Integrated Modelling
		Development and implementation of a strategy for program data storage, management, and dissemination	U Edinburgh, other partners to be selected on a direct contracting basis.									
		activities for this milestone will be conducted by CIAT – see their activity plan under theme 4.2., 3rd row	CIAT, University of Leeds; World Bank									
		activities for this milestone will be conducted by IRRI – see their activity plan under theme 4.2., 1st row	IRRI, NARES in India									
Milestone 4.2.1.7 Scoping studies undertaken on agricultural impact model gaps and needs, particularly at plot and landscape scales, and development and testing work commissioned and evaluated; Synthesis and research reports developed on key gaps and needs, and model documentation (2012-2013))	Model documentation, synthesis and research reports completed and disseminated	actions arising from crop model meta-analysis (AgMIP) Household modeling review	AgMIP, ILRI	125				Partially completed				* Development started on an "Agricultural Modelling Web Site", a web resource to provide an information and discussion centre for the global agricultural impacts modelling community and others (Hutton Institute, AgMIP). * Support provided for and participating in the AgMIP Global workshop, October 2011 (www.agmip.org/?page_id=977). & Review commissioned and carried out, "A review on farm household modelling with a focus on climate change adaptation and mitigation" (M T van Wijk, M
Milestone 4.2.1.8 Innovative decadal/near-term climate products developed to improve near-term climate prediction and needs and opportunities summarized in research reports (2015)	Model documentation, synthesis and research reports completed and disseminated	Strategy development for decadal & near-term climate inputs, and AR5 scenario climate data acquisition and analysis;	IRI, Oxford U, other partners to be selected	80				Partially completed				Development and initiation of the CCAFS Near-Term Climate Project, a 3-year cross-theme (T1 and T4) initiative based at University of Cape Town with the objectives of building a consortium of international partners, undertaking exploratory research on near-term climate change, and providing preliminary analysis of CMIP5 and CORDEX modelling projections
		IRI expert consultation										
Milestone 4.2.1.9 A loosely-integrated assessment toolkit developed and implemented that can be used to analyze likely effects of specific adaptation and mitigation options in 3 initial target regions; high-level engagement with key users to build capacity in use of tools and data. Reports and meta-databases developed of available models, tools and data. *GLOBIOM-Livestock model used for global integrated assessment of livestock issues (ILRI). *Enhanced/interlinked set of data and quantitative tools including spatial databases, detailed mapping of food system characteristics and human welfare, detailed characterization of impact of changes and uncertainty on global food systems (IFPRI). Integrated assessment framework and toolkit for analyzing likely effects of specific adaptation and mitigation options in three target regions (ICRAF) -2013	Reports and meta-databases completed and made publicly available	Model development and evaluation: rangeland model (G-Range); further model scoping and limited model development, to increase capabilities for trade-off and impact analyses within CRP7 and globally.	Colorado State U, IFPRI, AgMIP, ICASA. Other partners to be selected via direct contracting on basis of scoping work	105	60	40	40	Partially completed	Village level baseline study		Contracted IFPRI to develop approaches for prioritizing adaptation options and conduce case studies at IGP benchmark sites	* Modelling software and report, "G-Range: Development and Use of a Beta Global Rangeland Model" (R B Boone, R T Conant & T E Hilinski, Colorado State University), available on web. * Quantification of the E Africa regional scenarios undertaken with IFPRI's IMPACT model and IIASA's Globiom model.
		Contributions to milestone 4.1.1.2 regional scenarios	U Oxford									
		Contributions to milestone 4.1.2.1 quantification of vulnerability assessment	ILRI									
		activities for this milestone will be conducted by ILRI – see their activity plan under theme 4.2., 1st row	ILRI, IIASA									
		activities for this milestone will be conducted by ICRAF – see their activity plan under theme 4.2., 1st row - Methods and tools made available widely to partners and on website	ICRAF, ZALF; PIK; ASB; UNEP									

		Postdoc IGP and capacity building in WA and EA	????									
Output 4.2.2 Socially-differentiated decision aids and information developed and communicated for different stakeholders												
Milestone 4.2.2.1 Studies completed in selected sites in 3 initial target regions, using different methodologies including visualisation techniques, that outline the perceptions of different stakeholders on climate change and the impacts it has had and may have in the future on the resources that they have control over; Pilot study reports on target groups' perceptions of climate change and other drivers of change in their locations (2011-2012)		Developing and testing decision tools for climate change adaptation in smallholder agriculture through community based action research;	Competitive call targeting national and local level actors such as women groups, farmers and CBOs; selection criteria to be developed;	60			30	Uncompleted		One workshop on Intra-regional learning and technology transfer as a tool for adaptation to climate change in East African Drylands held in Addis, Ethiopia .		
		Strategy development/review for climate change communications;	Competitive calls									
		Review of social science methods and tools related to climate change decision making										
Objective 4.3 Refine frameworks for policy analysis												
Outcome 4.3 New knowledge on how alternative policy and program options impact agriculture and food security under climate change incorporated into strategy development by national agencies in at least 20 countries and by at least 10 key international and regional agencies												
Output 4.3.1 Tools developed and climate change impacts assessed at global and regional levels on agricultural systems (producers, consumers, natural resources), national/regional economies, and international transactions												
Milestone 4.3.1.1 Broad-scale modeling tools developed to assess climate change impacts on yields, production, trade, prices, and various human well-being measures developed or enhanced; models structure design vetted by experts. (2011)	Initial set of modeling tools completed and made publicly available	Develop materials, methods in generating climate change data to be used in regional capacity development activities that will influence policy decisions on climate change. IGP: Workshop and attachment trainings for understanding and modeling biophysical-socio-economic-policy interactions	Global Land Project under ESSP, PBL, Netherlands, MIT Joint Program on the Science and Policy of Global Change, Integrated Assessment Modelling Community. IGP: IFPRI, ESSP, FAO, IIASA, BARC, NARC, ICAR, NGO	170	100		50	Completed		One stakeholder influence mapping workshop held in Nairobi, Kenya	One scientist trained in IMPACT modelling, a draft paper produced on India specific impacts	The model improvement process is ongoing with participation from 7 CGIAR centers. A web version of the IMPACT model was originally supposed to be completed in the 4th quarter but is now expected in the 1st quarter 2012. The model improvements have been used with the East Africa scenarios exercise.
		Enhancements of the IMPACT model (the IMPACT Improvement Task) to include improved demand and the supply systems that incorporate theoretical consistency of underlying parameters, links to GE models to and from IMPACT, and explicit welfare measures and technology adoption modelling	FANRPAN, ASARECA, CORAF CIMMYT, IRRI, ILRI, CIP, ICRAF, ICRISAT, CIAT, National Academy of Agricultural Research Management (NAARM), India, National Centre for Agricultural Economics and Policy Research, India	490								
		Testing policy frameworks that integrate climate change into agriculture and national development through national institutions	Competitive call targeting national and national level actors and institutions				30					
Milestone 4.3.1.2 Global and regional assessments of climate change impacts on agricultural systems, national and international food security completed; Findings included in papers, reports, chapters in global (e.g. IPCC, Biodiversity integrated assessment) and regional (e.g. African Union) assessments (2012)	Papers and reports completed and disseminated. Citations of CCAFS outputs in partners' reports. Chapters of global and regional assessment reports integrate findings	Produce country reports for West and East Africa on assessing the vulnerability of agriculture to climate change	FANRPAN, ASARECA, CORAF					Partially completed				The individual country reports were completed in early 2011. The process of publishing IFPRI research monographs based on the reports was begun in the first quarter of 2011. Delays in the rewriting process meant the monographs were not submitted to the IFPRI review process until 4th quarter. The review process itselft takes 6 months so publication is expected sometime in the 2nd or 3rd quarter of 2012.
Output 4.3.2 Likely effects of specific adaptation and mitigation options, national policies (natural resource, trade, macroeconomic, international agreements) analyzed												
Output 4.3.3 Differential impact on social groups (gender, livelihood category etc) of climate change adaptation and mitigation options identified, evaluated and communicated												
Output 4.3.4 Likely effects of specific adaptation and mitigation options and national policies (including for socially differential groups) communicated to key local, national and regional agencies and stakeholders												
Milestone 4.3.4.1 Set of information products developed and disseminated to key agencies and stakeholders including (1) research monographs and policy briefs on climate change; (2) enhanced, and interlinked datasets and quantitative tools such as spatial databases, detailed mapping of food systems and characterization of likely climate change impacts on agricultural systems, and (3) promising adaptation and mitigation options and tools; Publications and tools delivered to individuals responsible for regional policy programs and interventions that foster climate change adaptation and mitigation (2012)	Research monographs and policy briefs completed and disseminated. Datasets and quantitative tools produced and made publicly available. Information products used in regional programs and policy strategies	Continue enhancement of Statplanet (i.e. display national data with specific indicators, view regional maps, customization to interface and visualization, etc), develop web interface between GAMS and IMPACT model, and country by country policy trend analysis. These tools provide policy makers and others with intuitive and straightforward access to complex modeling results that are otherwise the domain only of experts	GAMS Corp., StatPlanet Developer, Amsterdam Optimization Modeling Group LLC,	190				Partially completed				A beta version of the new Statplanet interface was completed in 2011. The final version is expected to be completed at the end of the first quarter of 2012.

Milestone 4.3.4.4 Major report targeted to COP17, that lays out climate change impacts, adaptation and mitigation options and national policies; Research monographs and policy briefs on climate change adaptation and mitigation developed; Materials disseminated at Ag & Rural Development Day 2011 (2011) .* Input in the MP7 high level report on the agricultural work program; Platform to ensure coastal communities concern are included in UNFCCC negotiations (WorldFish) (2011)	Report, monographs, policy briefs completed and disseminated. Documentation of web traffic (http://webusage.cgnet.com/); citations in press and scholarly articles	Activities for this center will be conducted by CGIAR centers	CIP, CIAT, IFPRI, ICRISAT, CIMMYT, ICRAF, IWMI, ICARDA					Completed				This activity was restructured to be a series of reports on climate change effects on agriculture prepared by the BRICS countries plus the US and Indonesia. These reports were based on a common outline and set of results from the IMPACT model. They were originally presented at the CAAS-IFPRI conference on food security and climate change in Beijing in November 2011. The report authors agreed on a set of recommendations to the climate change negotiators in Durban. The
Milestone 4.3.4.6 To enable rural poor, women and men, to have better access to high value commodity markets for climate change mitigation and other environmental resources, support for up-scaling and follow-up investments including (1) implementation of household surveys, (2) development of modules to assess governance factors from the perspective of different value change actors, (3) identification of interventions to improve access to markets for climate change mitigation, (4) engagement with network or policy advisors, policy researchers and program implementers; (5) highlight the need to act on the climate challenge while supporting other important rural development and environmental goals through policy fora and dialogues (at Regional Fora and Launch Conference) (2015)	Surveys completed, summarized and results shared. Governance factor modules and interventions developed and disseminated. Briefings delivered to 300 individuals representing 30 organizations. CCAFS materials shared through 20 policy events	Analysis of policy issues, in particular those related to improving access by small farmers to new market opportunities in agriculture, especially for high value products, and for climate change mitigation and other environmental services	MoFA (Ghana), Ministry of Agriculture and Water Resource in Nigeria, Nigeria Agricultural Policy Support Facility, Universities in Africa and South Asia, Government Agencies in Africa, Research Institutions					Uncompleted				