



# Assessing Climate Change Vulnerability and Building Resilience in the Agricultural Sector

to Promote Economic Development and Food Security in Central America



AdaptationPartnership

March 2012  
An Adaptation Partnership Workshop





# About the Adaptation Partnership

**A**t the Petersberg Ministerial Climate Dialogue in May 2010, Costa Rica, Spain, and the United States identified a need for development practitioners to share information and lessons on adaptation efforts. The three countries took on the role of chairing a global Adaptation Partnership. Since then, over 50 developing and developed countries have participated in the Partnership to identify common adaptation priorities and improve coordination of efforts to scale up action and financing for adaptation.

For more information please visit

[www.adaptationpartnership.org](http://www.adaptationpartnership.org)

# Introduction

**F**rom March 27-29, 2012, the US Agency for International Development (USAID), the US Department of State, and the Costa Rican Ministry of Environment, Energy and Telecommunications (MINAET) and its Climate Change Division hosted an Adaptation Partnership workshop in San José, Costa Rica. The workshop focused on assessing vulnerability and exploring ways to build resilience in some of the region's key agricultural products – including beans, rice, corn, bananas, coffee, sugarcane, and livestock. The 78 participants represented public and private sector institutions in the Central American countries and the Dominican Republic; a number of these participants are also involved in research, education and communication efforts. The workshop involved two days of panel presentations and small group exercises, followed by a one-day field trip to EARTH University to observe the implementation of mitigation and adaptation measures in the production of bananas and livestock.

As the workshop came to a close, participants expressed a desire to find new ways to exchange information and strengthen cooperation, and make information about climate change and resilient practices more accessible and useful for farmers and agricultural sector decisionmakers. Topics of particular interest for future work and knowledge exchange included improved agricultural technologies and adaptive practices, collective efforts at the territorial or watershed level, and adapted silvopastoral systems. A final session explored the need for a regional community of practice around adaptation issues in the agricultural sector, while using and building upon existing platforms as much as possible. Participants also highlighted the importance of more face-to-face exchanges and opportunities to directly observe and learn from existing efforts to build resiliency in key agricultural value chains, to facilitate replication.



**Photo:** Day 1 of the Adaptation Partnership Workshop in Costa Rica March 27-29th, 2012

In the opening session, Minister René Castro of MINAET highlighted Costa Rica's commitment to reducing its environmental footprint and sharing lessons learned, and the Ministry's efforts to raise climate change issues with partners in the region. Vice Minister Tania López of the Ministry of Agriculture and Livestock stressed that adaptation efforts would benefit from regional cooperation, as all of Central America and the Caribbean are experiencing serious changes. A range of actors—from governments to the private sector and research institutions—must work together to effectively respond to these vulnerabilities. William Alpizar, Director of MINAET's Climate Change Division, described the history of the Adaptation Partnership (see page 1) and its achievements to date. Finally, Nora Ferm, on behalf of USAID, shared the objectives of the workshop:

- 1) To offer participants new knowledge that enables them to take action to increase resiliency in the agricultural sector;**
- 2) To discuss the role of a community of practice that can provide ongoing opportunities for learning and exchange; and**
- 3) To explore the ways in which different public and private sector actors can contribute to adaptation efforts.**

The key note address was given by Dr. José J. Campos from the Centro Agronómico Tropical de Investigación y Enseñanza (CATIE), who indicated that all sectors, not just agriculture, need to be climate-smart. Within the agricultural sector, achieving climate resilience will require collective action, effective policies and institutions, and technologies and information. All actors in the value chain need to be involved and carry out actions at all levels, from national to local. Dr. Campos also emphasized the importance of enabling conditions (financing, governance, and innovation) and the relevance of non-climate trends such as migration and population growth.

# Stresses on Agriculture that Threaten Food Security and Economic Growth

This session placed climate change in the context of the region's broader development goals and ongoing trends. It is important to understand how climate change will exacerbate existing problems or undermine gains that have been achieved. The agricultural sector will be affected by both climate and non-climate stresses; panelists described what is already known about these issues, and identified some information gaps.

Jose Emilio Suadi, from the Food and Agriculture Organization of the United Nations (FAO), provided an introduction to the components of food security, which go beyond physical access to food. To achieve food security, the population, household or individual must have access to adequate food at all times. The food security crisis becomes a reality when one of the four pillars (availability, access, use, stability) is severely affected which may put at risk the food security of the population. Keeping in mind that the rural poor are particularly vulnerable to climate change and food insecurity, the FAO has worked regionally to conduct local impact assessments, share information, and provide possible cross cutting solutions in areas like climate smart agricultural practices and biotechnology.

Edgar Mata of the Costa Rican Ministry of Agriculture and Livestock described recent economic and social trends in the region's agricultural sector; for example, agriculture's contribution to GDP has decreased in the past ten years in all countries except El Salvador, where it has remained constant. He also pointed out that while there has been a decrease in rural employment overall, women's involvement in rural employment has actually increased in all countries in the region since 2000, providing a reason to ensure that adaptive measures in rural agriculture take on a gender perspective. Other recent changes include increased competition and demand for higher quality products, greater attention to environmental conservation, improvements in sanitary and

phytosanitary practices, and increased use of technological innovation and development.

Johnny Montenegro of the National Institute for Innovation and Transfer in Agricultural Technology (INTA) of the Ministry of Agriculture and Livestock (MAG) and the National Meteorological Institute of Costa Rica, described the results of studies on the impacts of climate change on agricultural yields. For example, in bean production, rising temperatures reduce the number of pollen grains, the viability of the pollen, and the weight of the seeds, with a resulting negative impact on yields. Similarly, in the case of yucca, an increase in the average temperature will have a detrimental impact on productivity. For this reason, more studies and investments in genetic research are needed to identify varieties that are adapted to future climatic conditions, and thereby help ensure adequate production and food security under a changing climate.

Finally, Patricia Ramirez, of the Regional Committee on Hydrological Resources (CRRH), indicated that climate change has both direct effects (such as an increase in the number of hot days, and a decrease in rainfall) and indirect effects (such as changes in pest and disease incidence, and impacts on transportation infrastructure). Looking at long-term national averages for precipitation and temperature is insufficient, however; increased spatial and temporal detail is necessary given topographic differences. Work also needs to be done to identify the upper and lower limits of crops' tolerance ranges. Furthermore, information needs to be communicated in a less abstract way, with greater interaction between those who generate and provide information, and those who need to use it in their decisionmaking.

# Anticipating How Key Agricultural Crops May Perform under Climate Variability and Change

Table 1

**R**oberto Villalobos Flores of the National Meteorological Institute, part of the Ministry of Environment, Energy, and Telecommunications, introduced this working session by providing an example of how bean production has been affected by a variety of stresses in the region. Non-climate factors include changes in input costs, free trade agreements, the high cost of agricultural insurance, and difficulty accessing credit. A successful agricultural industry depends on solutions to these kinds of challenges, as well as on the implementation of adaptation measures that respond to changes in the climate.

Working groups addressed six key agricultural products: bananas, maize, rice, sugarcane, coffee, and livestock. Since each crop has different input and natural resource requirements, each crop can be vulnerable to different climate and non-climate stresses. At the same time, there are overlaps, and interventions which could reduce vulnerability in several different crops. The most commonly identified non-climate stresses were economic factors such as increases in the prices of inputs like seeds, equipment, and gasoline. Climate-related threats included droughts and flooding. The following table summarizes the findings of each group.

Crop Group	Inputs	Non-Climate Threats	Climate Threats	Impact of Climate Threats	Possible Measures to Reduce Impact
Livestock	Feed	Increases in the price of feed	Extreme climate conditions (intense rains or droughts or extended rainy periods)	Low reproductive rates	Capacity building for producers
	Water	High infrastructure and equipment costs (wells, pumps, irrigation systems, etc.)  Poorly adapted breeds of cattle		Livestock deaths  Higher production costs  Higher methane emissions due to slow growth rate  Stress on nutritional calorie intake	Adoption of adaptive technologies  Use of silvopastoral systems (Improved pasture, scattered trees, hedgerows, fodder banks for grazing)  Improved water resources management  Use of genetically adapted breeds
Coffee	Water	Changes in market prices	Variability in climate, change in the time when the rains come	Decreases in production	Varieties that are drought tolerant or better adapted to increased temperatures  Agroforestry systems  Water conservation practices, efficient irrigation, drainage systems
Maize	Seed	Inability to share and transfer local knowledge  Loss of local varieties	Climate variability  Droughts, flooding, strong winds, freezing	Damage to the crop  Erosion  Disease  Food insecurity and decreases in livelihoods	Seed banks  Capacity building  Improved post-harvest technology, storage systems and management practices
Rice	Water  High quality seed	Change in demand for rice, changes in market price  Low genetic diversity	Increased rainfall variability	Harvest loss  Food insecurity	Provision of climate and weather information to producers  Increased water use efficiency  Joint public-private genetic research
Sugarcane	Water and associated infrastructure (canals, equipment, reservoirs, wells)	Increases in gas prices, electricity, lack of manual labor, supply and demand  Trade policies  Decreases in world price of sugar	Drought  Flooding  Strong winds	Decreases in productivity  Increases in water usage and higher production costs  Loss of harvest due to destruction or disease, infrastructure loss  Well contamination	Technological innovation in irrigation  New sugarcane varieties  Early warning system to decrease vulnerabilities  Canals and dikes
Bananas	Water	Workforce migration	Increases in rainfall variability	Reduced yields	Land use policies and planning
	Soil	Strikes at the port	Higher temperatures  Flooding  Droughts	Damaged trees  Difficulty taking product to market	Reforestation of watersheds  Better dissemination of weather forecasts  More advanced irrigation systems, including micro-sprinkling systems (micro-aspersion)  Drainage channels

# Best Practices and Lessons Learned in the Region

**F**our panelists described ongoing projects in the region that aim to build the resiliency of agricultural systems.

**Honduras:** Hector Tablas from the FAO described efforts to help farmers cope with droughts in Honduras. The technologies highlighted included micro-hydro systems that use water wheels to power pumps, which can carry water a distance of 10km and up 300m, where it is stored in tanks to be used for irrigation. They have also introduced rainwater harvesting systems linked to drip irrigation. These technological innovations have increased water use efficiency, reduced input costs by reducing the need for gasoline, and increased productivity, profitability, and incomes. The project has also increased social capital by increasing cooperation between farmers.

**Nicaragua:** Jefferson Shriver from Catholic Relief Services (CRS) described efforts to increase the resiliency of coffee production in Nicaragua, where coffee farmers are highly dependent on this single crop for their income. He noted that coffee requires regular rainfall and clearly defined seasons, and temperatures between 15 and 24 degrees Celsius. With climate change, the rains are increasingly irregular, and rising temperatures means that the land area suitable for coffee production is shrinking. Whereas today coffee production is possible at 400m above sea level and optimal at 1,200m, by 2050 it is expected that it will only be possible at 700m and optimal at 1,400m. This implies an 85% decrease in the area viable for coffee production in Matagalpa. To respond to these concerns, CRS is working with farmers to diversify into other crops like oranges, banana, and cacao, and to introduce agroforestry systems that can reduce erosion and create a microclimate with lower temperatures. They are also exploring the generation of carbon credits as a way to finance adaptation measures.

**Guatemala:** Alex Guerra from the Private Institute for Climate Change Research (ICC) in Guatemala, an institute founded by the sugar industry, noted that Guatemala is the second largest sugar exporter and the fourth largest sugar producer in Latin America. Sugar constitutes 21% of its agricultural exports and creates 65,000 direct jobs. It is typically grown in the coastal

lowlands, and is vulnerable to flooding. The sugar industry has recognized the value of joint investments in research and technologies to address climate and non-climate stresses, and some of these investments have had broader community benefits. For instance, they have invested in 16 automatic weather stations, and make the data publically available on the web. They have also invested in the development of new sugar varieties, and technologies for increased efficiency. The ICC hopes to expand to include other kinds of producers, outside the sugar industry, and they have plans for increased work on watershed management, water storage, early warning systems, and the development of climate change scenarios. The presentation provided an excellent example of private sector involvement in adaptation, and the benefits of collective action.



**Photo:** Water storage lagoon built by Fundación REDDOM under the Rural Economic Diversification Project, funded by USAID in the Dominican Republic. (Photo credit: Fundación REDDOM)

**Dominican Republic:** Luis Tolentino from Fundación REDDOM described a USAID-funded project that works with farmer clusters, and the interventions that helped livestock producers cope with a prolonged serious drought last year. Activities included building silos to store feed, building and rehabilitating lagoons and reservoirs for water storage and irrigation, and planting improved pastures. After seeing the benefits of these measures, other producers are starting to replicate them on their own. Farmers who did not implement these kinds of risk reduction measures saw a 30% reduction in milk yields, and numerous cow deaths.

# Evaluating Possible Adaptation Measures

Table 2

Participants returned to their working groups and, based on the inputs and vulnerabilities identified previously, brainstormed possible adaptation measures and put them through a critical evaluation process. Participants were encouraged to consider measures in a variety of categories, from on-the-ground infrastructure measures or changes in farming practices to information, governance, and capacity building. Each proposed measure was evaluated based on different criteria such as affordability, technical feasibility, effectiveness, urgency, mitigation co-benefits, broader impact (positive or negative) on the community, and so on. Many groups noted that certain measures are complementary, meaning that they would be far more effective if combined with other interventions. For example, it was discussed that improved land use planning would benefit from improved data and analysis, and from effective enforcement measures. Similarly, capacity building efforts could complement a number of interventions. Measures could also be complementary because they were initiated at different scales; for example, watershed restoration could help address flood risks and benefit the whole community, while individual farms may still need drainage systems to deal with remaining localized impacts.

The following table summarizes some of the adaptation measures and some of the evaluation criteria discussed in the groups. Participants also discussed necessary resources for each measure (in terms of information, policies, technical assistance, or financing) and the public and private sector actors who would need to be involved in order for it to be successful.

Proposed measures	Criteria				Achievable in the short term or long term?
	Low cost?	Technically feasible?	Additional positive benefits (social, economic, environmental)?	Likely to be effective?	
Provide forecasts and information on water availability	Variable	Yes	Yes	Yes, if information is used for decision-making	Short
Develop improved varieties and genetic seed banks	No	Yes	Depends	Yes, though testing will be needed	Long
Create public-private partnerships to coordinate and mobilize resources	Variable	Yes	Yes	Not all the time	Medium
Introduce agroforestry systems	Yes	Yes	Yes, positive environmental impacts	Yes	Medium
Improve post-harvest storage and management	Variable	Yes	Yes	Somewhat, has to be done in conjunction with resilient seed	Short-Medium
Strengthen local technical capacities (e.g., best practices)	No	Yes	Yes	Yes, if designed appropriately	Short-Medium
State-led public policy on agriculture, nutrition, food security	No	Yes	Possible positive health benefits	No, not most of the time	Long
Improve water resources management	Variable	Yes	Yes	Yes, if done correctly	Short-Medium
Improved irrigation	Yes	Yes	Yes, for example could reduce conflict over water by increasing efficiency of use	Yes, but depends on how much is done	Medium
Better land use planning	Yes	Yes, with data and proper analysis	Yes, if considering other factors	Yes, if enforced	Long

# Public and Private Support for Adaptation in Agriculture

In this session, representatives from a variety of sectors described the roles that their institutions can and do play to support adaptation efforts.

Representing the public sector, Tania López, Costa Rica's Acting Minister of Agriculture and Livestock, indicated that governments can both promote and incentivize sustainable production. For example, in the case of Costa Rica, this has been done through incentives like payments for ecosystem services, recognition of environmental benefits, differentiating products with lower emissions, and seeking markets that recognize the ecological value of sustainable production systems. The Ministry of Agriculture and its institutions are engaged in efforts to adapt to climate change through, for example, monitoring new pests and diseases; preserving germplasm, germ banks, promoting innovative production systems (controlled environments, precision farming, organic production, and integrated management practices), and using meteorological data to inform planting and fertilizing decisions, to cite a few examples. These efforts are all being undertaken by the public sector, but in close collaboration with private sector companies.

Julio Flores from the Nicaraguan Association of Microfinance Institutions (ASOMIF) discussed the role that can be played by financial institutions. He noted that some institutions subscribe to the idea of "microfinance plus", which provides additional benefits to farmers and small business owners besides simply giving them loans, in order to make a greater contribution to rural development. Microfinance institutions can partner with other organizations that are specialized in providing the right kind of technical assistance. Training alone won't change behavior, but by combining credit and technical assistance, microfinance institutions can show producers that it is profitable to make certain changes or invest in risk reduction measures. Long term credit will be needed for certain risk reduction measures, not just short term credit directed at the annual harvest.

Representing the perspective of private agribusiness, Rudy Amador described changes that Dole has undertaken in

its banana production practices, which reduce negative environmental impacts and have adaptation benefits. For example, Dole uses a new method for applying herbicides that does not require removing all of the vegetation under the trees, only the harmful weeds – leaving some ground cover to help reduce erosion and retain soil moisture. Dole is also introducing systems to reuse or even eliminate the use of water in packing plants, which will also increase the ability of the company and nearby communities to cope with drought. At the same time, Mr. Amador noted that there are barriers to increased private sector investment in adaptation, even for a relatively large company like Dole. Commodities have a tight profit margin, and companies tend to have a short term focus and not see the urgency of adapting to longer-term changes. Markets are not incentivizing investments in mitigation or adaptation, because consumer awareness is low and externalities are not incorporated into pricing. These kinds of challenges will have to be overcome in order to see a dramatic increase in adaptation efforts by agribusinesses.

Finally, to describe the role of the donor community, Michelle Jennings from USAID's Central America regional office noted that USAID dramatically increased its support for climate change adaptation efforts in 2010, investing in activities such as information generation and dissemination, capacity building, governance, and the implementation of on-the-ground measures to reduce vulnerability. In Central America, USAID also prioritizes work on food security, and has made strategic partnerships with big companies such as Coca Cola and supermarket chains to support sustainable agriculture. USAID also works with NASA to support programs that increase access to information. One example is SERVIR, a Regional Visualization and Monitoring System that integrates earth observations (e.g. satellite imagery) and forecast models together with on-the-ground data and knowledge to inform decisionmaking around disasters, ecosystems, biodiversity, weather, water, climate change, health, agriculture, and energy. In Central America and the Caribbean, SERVIR has provided real time monitoring of over 50 natural disasters, and developed a geospatial portal which provides access to regional data and metadata, helping governments in the region to act quickly.

# Conclusions and Recommendations

This session's objective was to reflect and identify the possible characteristics and activities of a regional community of practice that would foster ongoing information exchange between workshop participants as well as other relevant stakeholders, around the priority topics and knowledge gaps that were identified. Communities of Practice (CoPs), a concept that emerged in the early 1990s, facilitate informal opportunities for learning, problem solving, collaboration and knowledge sharing by offering a way for people with common concerns, problems or interests to interact with each other on an ongoing basis.

In this context, participants highlighted the need to make information – on weather and climate, best practices for adaptation, and lessons learned -- more accessible, relevant and useful for farmers and other agricultural sector decisionmakers. A community of practice could address this in several ways, such as by:

- **Systematizing** existing information, studies, and project documents through databases and online portals; identifying and inventorying ongoing projects and initiatives.
- **Facilitating** the sharing and exchange of experiences and lessons learned, particularly around the key crops that were part of this workshop (coffee, beans, sugarcane, rice,

bananas, maize) and livestock, and on cross-sector topics like water management and the use of climate and weather information for farm-level decision making. This information sharing could be done virtually, through an online forum, mailing list, virtual library, etc. Participants also emphasized the importance of in-person exchanges, visits to model farms, trainings, or follow-up workshops, which allow for more in-depth conversations and field observation.

- **Sharing** data on weather, climate, agricultural yields, etc.
- **Helping** to identify gaps in each country related to information, policies and regulatory frameworks, and capacity.
- **Advocating** for a stronger commitment by national governments to provide support for adaptation efforts and make information and data accessible.
- **Fostering** cooperative research and more in-depth case studies.



**Photo:** Workshop Participants at the EARTH University field visit

# Building a Community of Practice: Next Steps

**U**SAID and the US Department of State set aside funds to support discrete follow-on efforts to the workshop based on participant recommendations, within the framework of the community of practice. These activities are expected to include the following:

## 1. Systematizing existing information and identifying ongoing projects:

a.) Dissemination of the comprehensive inventory commissioned by the Adaptation Partnership. This *Review of Current and Planned Adaptation Action* seeks to provide a rapid assessment of: priority interests and adaptation needs; efforts by governments to support adaptation through policy and planning; the scope of international support for adaptation efforts in different countries and sectors; and potential gaps in adaptation efforts at the country and regional levels. The Central America section is available at <http://www.adaptationpartnership.org/resource/central-america-and-mexico-current-and-planned-adaptation-action> and the Caribbean summary is at [http://www.adaptationpartnership.org/system/files/resource/The\\_Caribbean\\_Adaptation\\_Action.pdf](http://www.adaptationpartnership.org/system/files/resource/The_Caribbean_Adaptation_Action.pdf).

b.) Compile documents to upload to the Adaptation Learning Mechanism (ALM) site (<http://www.adaptationlearning.net/>), which organizes resources such as project documents and assessments by country. Documents could also be shared through REGATTA, a Latin America-specific web platform that is currently under construction.

## 2. Facilitating the sharing and exchange of experiences and lessons learned, particularly around the key crops that were part of this workshop and on cross-sector topics like water management and the use of climate and weather information:

a.) The Adaptation Partnership website has a dedicated page for follow-up to this workshop, which will be in both Spanish and English, at <http://www.adaptationpartnership.org/communities/central-american-climate-resilient-agriculture-cop>.

b.) We plan to award small grants for projects that will build capacity for climate resilient agriculture at various levels in Central America and the Dominican Republic, in a competition managed by the International Resources Group (IRG). Pending available funding, we anticipate awarding 1-3 small grants totaling up to \$400,000, to non-governmental, regional or international organizations. Eligible activities may include field demonstrations; exchanges between farmers or representatives of farmer organizations from multiple countries in the region, and potentially also including agricultural extension agents; side-by-side technical assistance and dissemination of information on climate impacts and vulnerability; processes for assessing options to address vulnerability at the farm level; and dissemination of information on innovations through case studies or other media. Preference will be given to proposals that include activities and participants in multiple countries, to encourage South-South learning and cooperation and achieve regional impact. Projects should generate tangible and useful communications materials that can be used to share adaptation lessons learned more broadly across the region, and globally through the Adaptation Partnership website. The solicitation will be issued in late June 2012, and will be available at [www.adaptationpartnership.org](http://www.adaptationpartnership.org).

Other donors, agencies, and governments are invited to look for additional opportunities to support the ideas that arose from this workshop. Some recommendations may not require outside funding, but rather a strong commitment from relevant actors to contribute their time and make their own information and resources more publically available.

As additional activities are developed by different members of the Community of Practice, they will be publicized on the CoP webpage.

# Annex 1: Field Visit to EARTH University



**Photo:** L: Biodigestors at EARTH University. R: Dr. Edmundo Castro of EARTH University explains some of the adaptation measures undertaken at the banana plantation

On the third day of the workshop, participants went on a field visit to EARTH University to observe activities and technologies used in adaptation for climate change, specifically in banana production and in raising livestock.

EARTH University is currently 75% powered by renewable energy sources, including biogas, solar and hydrological sources. Much of this energy is then converted to electrical energy and used to power the classrooms, the research center, the student dorms, as well as the banana production center and livestock farm. The biogas waste from the livestock and swine production is captured and funneled through large pipes to the agro-industrial biodigester where it rests and will emit gases such as CO<sub>2</sub> (carbon dioxide), CO (carbon monoxide), CH<sub>4</sub> (methane) and H<sub>2</sub>S (hydrogen sulfide). Some of the left over liquid waste is then treated in lagoons through oxidation, while in other cases it is treated with bacteria to create fertile soil. Eventually, much of this waste is eliminated through this type of treatment and helps reduce the amount of greenhouse gases emitted into the atmosphere. While this is an example of climate change mitigation, it also helps make the day to day activities at EARTH University more sustainable.

Examples of climate change adaptation in the livestock activities were observed. To combat rising temperatures, which can negatively affect cattle growth, many trees in the grazing areas, as well as the barn area were left to grow big and provide much shade as opposed to leaving wide open spaces of full direct sunlight. Likewise, the cattle and pigs were fed fruit wastes (such as the banana peel and pineapple husks from production as well as human consumption at EARTH) as a means to reduce total waste, and be more efficient. Much of the manure was treated with bacteria to convert it into fertile soil.

In the case of banana production, EARTH is using a few different methods to adapt to climate change while being faced with rising temperatures and increased risk of fungus and flooding. Canals had been built around the trees, so as to combat flooding and avoid standing water. Furthermore, special fungicides and herbicides are used on the bananas and on the soil around them that will eliminate the pests while not harming the beneficial underbrush that can prevent erosion. To adapt to increasingly extreme weather events, including high gusts of wind, many of the banana trees had string reinforcements preventing the plant from toppling over.

# Annex 2: Participants

Country	First Name	Last Name	Organization
<b>Belize</b>	Andrew Anthony	Harrison	MAF
<b>Costa Rica</b>	Alberto	Chinchilla	ASICAFOC
<b>Costa Rica</b>	Alvaro	Redondo	IDB - Costa Rica
<b>Costa Rica</b>	Ana Laura	Vásquez	Cooperativa Dos Pinos
<b>Costa Rica</b>	Andrea	Schloenvoigt	GIZ
<b>Costa Rica</b>	Arlayne	Alfaro	CNP
<b>Costa Rica</b>	Bastiaan Theodoor	Louman	CATIE
<b>Costa Rica</b>	Damiano	Borgogno	UNDP
<b>Costa Rica</b>	David Edison	Williams	IICA
<b>Costa Rica</b>	Edgar	Mata	MAG
<b>Costa Rica</b>	Iván	Delgado	MINAET
<b>Costa Rica</b>	Johnny	Montenegro	INTA-MAG / IMN-MINAET
<b>Costa Rica</b>	José Emilio	Suadi	FAO
<b>Costa Rica</b>	Juan Carlos	Fallas	IMN
<b>Costa Rica</b>	Kathya	Fajardo	IICA
<b>Costa Rica</b>	Marcos	Chaves	LAICA
<b>Costa Rica</b>	Maricela	Muñoz	American Embassy
<b>Costa Rica</b>	Mario	Arroyo	ICAFE
<b>Costa Rica</b>	Miguel	Gómez	RUTA
<b>Costa Rica</b>	Patricia	Ramírez	CCRH-SICA
<b>Costa Rica</b>	Ricardo Manuel	Ulate	CI
<b>Costa Rica</b>	Robert	Dilger	RUTA-CATIE
<b>Costa Rica</b>	Roberto	Villalobos F.	MINAET - IMN
<b>Costa Rica</b>	Rudy	Amador	DOLE
<b>Costa Rica</b>	Sergio	Laprade	CORBANA
<b>Costa Rica</b>	Sergio	Abarca	INTA / MAG
<b>Costa Rica</b>	María	Guzmán	MINAE
<b>Costa Rica</b>	Tania	López	MAG
<b>Costa Rica</b>	William	Alpizar	MINAET
<b>Costa Rica</b>	Magda	Campos	MINAET - IMN
<b>Costa Rica</b>	Marieke	Veeger	FACILITADOR
<b>El Salvador</b>	Amy	Angel	FUSADES
<b>El Salvador</b>	Ana Patricia	Palma	PRESANCA II
<b>El Salvador</b>	José Agustín	Martínez	CAMAGRO
<b>El Salvador</b>	José Antonio	Peñate	BFA
<b>El Salvador</b>	Mateo Antonio	Rendón	MAG
<b>El Salvador</b>	Miguel Ángel	Martínez	CENTA
<b>El Salvador</b>	Gabriela	Montenegro	USAID/ECAM
<b>El Salvador</b>	Michelle	Jennings	USAID/ECAM
<b>El Salvador</b>	Ruben	Aleman	USAID/ECAM
<b>United States</b>	Jeanne	Chabrier	IRG
<b>United States</b>	María Verónica	Letelier	IRG
<b>United States</b>	Nora	Ferm	USAID
<b>Guatemala</b>	Alex Ali	Guerra	ICC

<b>Guatemala</b>	Ana Victoria	Román	INCAP
<b>Guatemala</b>	Arnoldo	Melgar	ANACAFE
<b>Guatemala</b>	Iván Marcelo	Buitrón	AGEXPORT
<b>Guatemala</b>	José Antonio	López	MAGA
<b>Guatemala</b>	Luis Andrés	Arévalo	UNIV DEL VALLE
<b>Guatemala</b>	Luis Estuardo	Ríos	UNIDSESEQ
<b>Guatemala</b>	Luis Humberto	Mazariegos	ARROZGUA
<b>Guatemala</b>	Marco Antonio	Monzón	SESAN
<b>Guatemala</b>	Luisa Carolina	Siu	INCAP
<b>Guatemala</b>	Manuel Eduardo	Alarcón	ARROZGUA
<b>Honduras</b>	Berta Mireya	Hernández	SAG
<b>Honduras</b>	Claudia Florencia	Vallejo	SERNA-DNCC
<b>Honduras</b>	Héctor Lisandro	Tablas	PACTA- FAO
<b>Honduras</b>	José Mauricio	Rivera	FHIA
<b>Honduras</b>	Kenny Sirey	Nágera	UNAG
<b>Nicaragua</b>	Héctor José	Pérez	EIAG
<b>Nicaragua</b>	Julio Francisco	Flores	ASOCAMIF
<b>Nicaragua</b>	Wilberg Milán	Castillo	PESA-FAO
<b>Nicaragua</b>	Jefferson David	Shriver	CRS
<b>Nicaragua</b>	Mauricio	Peñalba	UE
<b>Panamá</b>	Carlos Justo	Córdoba	MIDA
<b>Panamá</b>	Daris Cecilia del Carmen	Dominguez	ANAM
<b>Panamá</b>	Temilda Yanet	Sierra	FAO
<b>Panamá</b>	Doris	Osterlof	SEGIB
<b>Panamá</b>	Vivienne	Caballero	UNEP
<b>Dominican Republic</b>	Andrea	Gonzalez	CEDAF
<b>Dominican Republic</b>	Juan	Mancebo	MIN AG
<b>Dominican Republic</b>	Leoncio	Duarte	ONAMET
<b>Dominican Republic</b>	Manuel Emilio	González	MIN AG
<b>Dominican Republic</b>	Evaydee	Pérez	IDDI
<b>Dominican Republic</b>	Luis Miguel	Tolentino	Fundación REDDOM
<b>Dominican Republic</b>	Monica	Bansal	USAID/DR

# Annex 3: Agenda

## Assessing Climate Change Vulnerability and Building Resilience in the Agricultural Sector to Promote Economic Development and Food Security

Date: March 27-29, 2012  
San José, Costa Rica

Hotel Corobicí

---

---

### Day 1: Tuesday, March 27, 2012

#### Objectives for Day 1:

- Understand the importance of food security and economic growth to the region's development goals
- Explore the climate and non-climate stressors that threaten to impede those goals
- Identify specific climate change impacts in the region that will affect the viability of key agricultural crops

---

---

<b>8:00 a.m. – 9:00 a.m.</b>	<b>Registration</b>	
<b>9:00 a.m. – 9:30 a.m.</b>	<b>Welcome</b>	María Guzmán, Vice Minister, MINAET Tania López, Vice Minister, MAG
<b>9:30 a.m. – 10:00 a.m.</b>	<b>Overview of the Adaptation Partnership</b>	William Alpizar, Director of Climate Change
	<b>Vision for the Workshop and Agenda</b>	Nora Ferm, USAID
<b>10:00 a.m. – 10:30 a.m.</b>	<b>Keynote address: "Climate Smart Agriculture"</b>	José J. Campos, Director General CATIE
<b>10:30 a.m. – 11:00 a.m.</b>	<b>Break</b>	
<b>11:00 a.m. – 12:30 p.m.</b>	<b>Session 1: An introduction to the stresses on agriculture that threaten food security and economic growth</b>	- José Emilio Suadi, FAO - Edgar Mata, MAG-Costa Rica - Johnny Montenegro, INTA-IMN-Costa Rica  Moderated by Miguel Gómez, RUTA
<b>12:30 p.m. – 1:00 p.m.</b>	<b>Anticipated climate change impacts in Central America</b>	Patricia Ramirez, Comité Regional de Recursos Hidráulicos (CRRH)
	Impacts on water, crops, and livestock.	
<b>1:00 p.m. – 2:00 p.m.</b>	<b>Lunch</b>	

---

---

---

---

**2:00 p.m. – 3:30 p.m.**

**Session 2: Anticipating how key agricultural crops may perform under climate variability and change**

Roberto Villalobos Flores, MINAET-IMN will present an example: beans

Six working groups, divided by ag sector (coffee, banana, rice, sugar cane, corn, and livestock)

Nora Ferm, USAID: Introduction to the small group exercise

---

---

**3:30 p.m. – 4:00 p.m.**

**Break**

---

---

**4:00 p.m. – 5:00 p.m.**

**Continuation of Session 2**

Presentations in plenary

---

---

**5:00 p.m. – 5:30 p.m.**

**Wrap-up**

Marieke Veeger, RUTA

---

---

**Day 2: Wednesday, March 28, 2012**

**Objectives for the second day:**

- Share best practices and lessons learned in different countries
  - Identify how different actors can contribute to adaptation efforts in subsistence and export agriculture
  - Begin to form a community of practice on these issues
- 
- 

**8:30 a.m. – 9:00 a.m.**

**Welcome and Summary of Day 1**

Marieke Veeger

---

---

**9:00 a.m. – 10:15 a.m.**

**Session 3: Best practices and lessons learned from around the region**

- Honduras (irrigation and energy)
- Nicaragua (coffee)
- Guatemala (sugar cane)
- Dominican Republic (livestock)

- Hector Tablas, FAO
  - Jefferson Shriver, Catholic Relief Services
  - Alex Guerra, ICC
  - Luis Tolentino, Fundación REDDOM
- 
- 

**10:15 a.m. – 10:45 a.m.**

**Break**

---

---

**10:45 a.m. – 12:45 p.m.**

**Session 4: Measures to respond to vulnerabilities**

Small group exercise on possible adaptation measures (Information, planning, capacity building, infrastructure, diversification, enabling environment, etc.)

Esther Zeledon, USAID: Introduction to small group exercise

---

---

---

---

**12:45 p.m. – 1:45 p.m.**

**Lunch**

---

---

**1:45 p.m. – 3:15 p.m.**

**Session 5: Public and private support for adaptation in agriculture**

The role of governments, microfinance institutions, the private sector, and donor agencies

- Tania López, Ministry of Agriculture and Livestock, Costa Rica  
- Julio Flores, ASOMIF, Nicaragua  
- Rudy Amador, Dole, Costa Rica  
- Michelle Jennings, USAID/EI Salvador

---

---

**3:15 p.m. – 3:45 p.m.**

**Break**

---

---

**3:45 p.m. – 5:15 p.m.**

**Session 6: Building a Community of Practice**

Discussion to determine the needs and possible formats for a community of practice to follow up on these recommendations and continue the learning process.

Veronica Letelier, IRG

---

---

**5:15 p.m. – 5:30 p.m.**

**Conclusions**

Marieke Veeger

---

---

**Day 3: Thursday, March 29, 2012**

---

---

**7:00 a.m. – 3:30 p.m.**

**Field Visit: Escuela Agronómica del Trópico Húmedo (EARTH)**

EARTH University offers a rigorous four-year undergraduate program in agricultural sciences and natural resources management. It is located in the province of Limón, in the tropical lowlands of north-eastern Costa Rica.

**Objectives:**

- Observe the management of banana trees under an EARTH project, in a tour led by EARTH expert Edmundo Castro. Adaptation measures are being implemented in the banana plantation to reduce the incidence of disease in a warming climate; mitigation measures are also being implemented to reduce emissions.
- Presentation on the benefits of real-time information generated by an automatic meteorological station.
- Final discussions to draw conclusions about the Community of Practice.

---

---

**6:00 p.m. – 8:00 p.m.**

**Dinner:** Fuji Restaurant, Hotel Crowne Plaza Corobici