USAID | CENTRAL AMERICA
FROM THE AMERICAN PEOPLE

CENTRAL AMERICA REGIONAL ENVIRONMENT AND CLIMATE CHANGE ANALYSIS

Final Regional Climate Change Vulnerability Assessment

June 21, 2016

This document was produced for review by the United States Agency for International Development. It was prepared by ECODIT under the El Salvador Regional Environment and Climate Change Analysis Task Order under the REPLACE IDIQ.

CENTRAL AMERICA REGIONAL ENVIRONMENT AND CLIMATE CHANGE ANALYSIS

Final Regional Climate Change Vulnerability Assessment

June 21, 2016

Task Order Contract: AID-596-TO-16-00001 (REPLACE IDIQ: AID-OAA-I-14-00016)

Cover photo: Jiquilisco Bay, El Salvador, November 2015
Photo credit: Zulma Medoza

ACRONYMS AND ABBREVIATIONS

AbD	Adaption Based Mitigation
AECID	Spanish International Agency for Development Cooperation
CA/DR	Central America and the Dominican Republic
CAFTA-DR	Dominican Republic-Central America Free Trade Agreement
CATIE	Tropical Agricultural Research and Higher Education Center
CCAD	Central American Commission on Environment and Development
CCVA	Climate Change Vulnerability Assessment
CEPREDENAC	Centro de Coordinación para la Prevención de los Desastres Naturales en América Central (Coordination Centre for the Prevention of Natural Disasters in Central America)
CNS	Carbon Neutrality Strategy
CSA	Climate-Smart Agriculture
EGI-CAD	Integrated Strategy for Prevention and Control of Dengue in Central America and Dominican Republic
EMSA	Mesoamerican Strategy for Environmental Sustainability
ENSO	El Niño-Southern Oscillation
ERAM	The Regional Environmental Strategy Framework
ERCC	The Regional Climate Change Strategy
FAO	Food and Agriculture Organization
GCM	Global Climate Models
GDP	Gross Domestic Product
GHG	Greenhouse Gas Emissions
GIZ	The German Cooperation Agency for Development (GIZ)
INDCs	Intended Nationally Determined Contributions
IPCC	Intergovernmental Panel on Climate Change
KI	Key Informant
LAI	Leaf Area Index
MAS	Mitigation-Adaptation Synergies
NAMAs	Nationally Appropriate Mitigation Actions
PCGIR	The Central American Policy for Integrated Risk Management
PES	Payment for Environmental Services
PIAAG	Guanacaste Integrated Plan for Water Supply
PREP	Ecological Landscapes Restoration Program
RCP	Representative Concentration Pathway
RDCS	Regional Development Cooperation Strategy
REDD	Reducing Emissions from Deforestation and Degradation
REDD+	REDD *plus* conservation of existing forest carbon stocks, sustainable forest management and enhancement of forest carbon stocks
SICA	Central American Integration System
SIEPAC	The Central American Electrical Interconnection System
SNA	UN System of National Accounts
SST	Sea Surface Temperatures
TFBA	Regional Tropical Forest and Biodiversity Assessment
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
USAID/CAM	USAID/El Salvador's Central America Regional Program

TABLE OF CONTENTS

LIST OF ANNEXES

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

Central America is one of the regions in the world most vulnerable to the impacts of climate change. Changing rainfall patterns, increasing land and water temperatures, and rising sea levels will exacerbate current challenges associated with economic reliance on agriculture, fishing, and natural resources; its high levels of poverty and inequity; and weak governance and susceptibility to natural disasters. Germanwatch's Global Climate Risk Index 2016 shows that three of all Central American countries are among the top 10 countries most vulnerable to climate change. Honduras is ranked No. 1, followed by Nicaragua at No. 4, and Guatemala No. 10. The Dominican Republic comes in at No. 11, followed by El Salvador, No. 14 and Belize at No. 23. Costa Rica is ranked at No. 75 and Panama at No. 107.

USAID/El Salvador's Central America Regional Program (USAID/CAM) new Regional Development Cooperation Strategy (RDCS) for 2015 to 2019 includes activities to assist the region to avoid, mitigate, and adapt to these climate trends so they do not detract from the attainment of the region's development goals. The purpose of this regional Climate Change Vulnerability Assessment (CCVA) is to inform USAID/CAM's strategic decisions about how to effectively reduce risks that changes in climatic conditions may cause. The geographic scope of this CCVA broadly covers the seven Central America countries and the Dominican Republic (CA/DR). The main limitation in the assessment is that the lack of sufficient and consistent quantitative data, making it impractical to uniformly map vulnerabilities throughout the region.

DEVELOPMENT CONTEXT

Based on CA/DR Country Development Plans, the countries seek economic growth, employment, reduced poverty, and environmental protection. USAID/CAM's regional development objectives are: increased economic integration, climate-smart economic growth, improved human rights and citizen security, and reduced HIV prevalence. With respect to CA/DR's social context, Panama and Costa Rica have poverty rates below 27 percent, El Salvador has a poverty rate of 36 percent, and the remaining countries all have poverty rates above 40 percent. Only in Nicaragua does less than 90 percent of the population have access to improved water sources, but Guatemala and Nicaragua are lagging in providing improved sanitation to all of their population. Infant mortality is strikingly lower in Costa Rica than in any of the other countries.

The sectors in CA/DR countries that are likely to be most directly affected by changes in climatic conditions are agriculture and forestry, fisheries, tourism, manufacturing, water supply and energy and transportation. Although not reflected in national accounts, ecosystem services, especially from forests, are economically important in the CA/DR region. Non-climate and social factors that affect achieving CA/DR's development goals include population growth, urbanization and poverty, violence, crime and poor governance, pollution, and natural disasters. Indirect links do exist between climate change, poverty and violence, especially in urban settings, which could affect achieving development goals.

CLIMATE CHANGE IMPACTS AND VULNERABILITY

Changes in air temperature, rainfall, sea surface temperature and sea level rise were the climate conditions or stressors that were projected from the present to 2100. Their changes were used to evaluate CA/DR's capability to attain its development goals under future climate scenarios. Changes in air temperature include an increase in the number of warm and a decrease in the number of cold days and nights and an increase in the number of heat waves. Climate models project that CA will become drier in the long term and will have more extreme seasonal rainfall anomalies. Historic trends of increased sea surface temperatures are projected to continue as are historic increases in sea level.

Trends in temperature and rainfall are projected to threaten crop production, especially that of subsistence farmers. Decreased or more irregular rainfall may affect crop production and supplies of water used for irrigation. Increases in sea surface temperatures are projected to affect the habitat for some commercial species of marine organisms and perhaps freshwater commercial fish. Temperature increases may directly cause a decrease in tourism during some months of the year and impact the biodiversity that many tourists come to CA to observe. Hurricanes and cyclones may increase in frequency, which could pose an increased risk to tourism and its infrastructure. Rising sea levels also threaten infrastructure and livelihoods. The effects of changes in climatic conditions on manufacturing are secondary, mostly through decreased stability of energy supplies due to a decrease in the amount or reliability of water supplies for hydropower production. Transportation is already a significant business cost in CA/DR, but more severe rainfall may incur additional costs by causing more numerous and larger landslides and floods that block roads. Temperature increases and reduced water supplies are projected to affect negatively the health of some people, while an increase in floods may also cause outbreaks of some diseases. Emergencies caused by extreme climate events may increase forced migration and changes in climatic conditions may also decrease employment opportunities in some regions, which could further increase migration. A principal effect of higher temperatures and reduced rainfall may be increased human-caused and natural wild fires, which could affect forest ecosystems. As discussed throughout this document, most immediate and likely devastating climate change impacts are related to an increase in the number or intensity of hurricanes and cyclones that have so often ravaged the region.

Vulnerability to changes in climatic conditions is determined by identifying a combination of exposure to changing climatic conditions, sensitivity to their changes, and adaptive capacity to deal with them. Adaptive capacity is lower in relatively less developed countries of Guatemala, Honduras, El Salvador, and Nicaragua compared to Costa Rica and Panama. Within each country, patterns generally reveal lowest adaptive capacity for areas distant from main urban centers and in areas where the population has a large fraction of indigenous groups. The Dry Corridor that extends from Guatemala, through El Salvador and Honduras, and into Nicaragua and Costa Rica contains areas that are most vulnerable to changes in air temperature and rainfall. Likewise, coastal urban areas and areas of mangrove forests in Honduras, El Salvador, Guatemala, and Nicaragua are also most vulnerable to changes in temperatures and sea level rise.

EXISTING ADAPTATION EFFORTS AND REMAINING GAPS

The "Declaration of San Pedro Sula," the Regional Climate Change Strategy (ERCC), the Central American Policy for Integrated Risk Management (PCGIR), and the Regional Environmental Strategy Framework (ERAM) are the four main regional CA/DR policy instruments for addressing climate change. All the CA/DR countries have prepared a National Climate Change Policy; a Climate Change Action Plan and Strategy and/or a Second National Communication to United Nations Framework Convention on Climate Change (UNFCCC); and an Intended Nationally Determined Contributions (INDCs).

Policy documents for disaster preparation and management include the: Hyogo Framework for Action and the Central American Policy for the Management of Risks from Disaster 2014–2018; Strategic Framework for Reducing Vulnerability and Disasters in Central America; Strategic Framework to Face Food and Nutritional Insecurity Associated with Drought and Climate Change; Regional Agriculture Action Plan against Climate Change; Regional Plan for the Health Sector in the Face of Climate Change; Central American Integrated Risk Management Policy; Central American Fund for the Promotion of Disaster Risk Management; and the Integral Management of Climate Risks. As of 2012, 166 early warning systems for floods, landslides, and fire were operational in many communities and cities have become better prepared to detect and react quickly and effectively to natural disasters.

National climate change policies in CA/DR countries support both adaptation and mitigation. These priorities are reflected in the growing emphasis on implementing Adaption-based Mitigation (AbM)

actions that concurrently reduce vulnerability to climate change and increase sequestration of atmospheric carbon. Within the context of AbM, many regional and national projects consider water availability as a development issue, providing access to water for production, and aim to provide a promising response to recurrent droughts. For CA/DR to adopt the AbM paradigm, its countries must commit to adopting the policy and institutional changes that are required and to sustain these commitments over a long period of time.

CA/DR countries participate in the UNFCCC mechanisms to reduce emissions from forests and other landscapes. The main mechanisms under development in CA/DR are REDD+ and Nationally Appropriate Mitigation Actions (NAMAs), with INDCs. All countries have submitted their Readiness Preparation Package, but only Costa Rica has submitted its Readiness Package. Tropical Agricultural Research and Higher Education Center (CATIE) has been the principal institution conducting research and education related to the carbon emissions from coastal/marine ecosystems in CA/DR.

OPPORTUNITIES

Following the review of literature, our regional spatial analyses, and interviews of key informants, the analysis of our findings identified eight categories of recommendations to strengthen CA/DR resilience to climate change. These recommendations are at the regional scale, and directly focus on the RDCS's DO 2 and indirectly on its DO 1 and DO 3. Emphasis has been placed on IR 2.2 (Resiliency of humans and the environments to climate change impacts increased) and IR 2.3 (Transboundary natural resource management strengthened). Recommendations are for USAID/CAM to:

1. Support advanced watershed and coastal zone management to assist CA to strengthen its resilience to climate change.
2. Build on and coordinate with the adaptation projects being implemented in the region by
    - Evaluating the extent to which Feed the Future projects in CA are contributing to increasing resilience to climate change of small farmers in the Dry Corridor;
    - Supporting an evaluation of lessons learned in past and current climate change, soil/water conservation, and agricultural projects and programs in priority areas;
    - Supporting continuous monitoring and adaptive management of adaptation projects being implemented in the region;
    - Sharing results and coordinate with other donors working in the region;
    - Continuing to support activities that reduce barriers to and the inclusion of AbM and CSA actions in programs that facilitate the management and conservation of productive landscapes;
    - Supporting technical and financial assistance for countries to implement their REDD+ readiness packages and their REDD+ Measurement Reporting and Verification (MRV) systems;
    - Analyzing the social, financial and economic benefits to small farmers from conservation practices (e.g. mulching, terracing, live barriers, agroforestry, integrated pest management);
    - Strengthening the implementation of reforestation, adaptive forest management, and water use management to ensure better retention of the aquifer levels during the longer dry seasons and absorption of water into the aquifer during intense rainfall; and
    - Incorporating links with climate change concerns and environmental risk management to strengthen climate resiliency programs.
3. Integrate resilience activities with biodiversity and tropical forest activities.
4. Provide technical and capacity building support for CCAD by
    - Supporting the monitoring and evaluation of CCAD programs with emphasis on changes in biodiversity and resilience to climate changes;
    - Supporting a targeted NAMA mechanism to initiate the design and implementation of its actions; and

- Supporting for an assessment of the type and degree of technical assistance required by NAMA developers across the region.

5. Support activities that will increase the capabilities of municipal governments to plan for and manage climate change impacts by
- Assisting municipalities to identify and leverage new sources of financing for watershed management and the ecosystem services and resilience watersheds help provide;
- Identifying and supporting municipal leaders through technical assistance, capacity building activities, and study tours; and
- Providing technical and capacity building support to local conservation NGOs that support municipal planning.

6. Focus assistance in the Dry Corridor by
- Providing technology transfer grants channeled through CA universities and other organizations to support the demonstration and implementation of new technologies on the ecological, social and economic aspects of the impacts of climate change;
- Supporting the coordination of climate resilient land use planning between Dry Corridor and Coastal areas to facilitate effective implementation on program actions; and
- Providing pilot demonstrations of conservation technologies that can be applied most effectively on small farms for increasing resilience to climate change in the Dry Corridor.

7. Focus its activities to increase resilience in the most vulnerable coastal and marine areas of CA's Pacific and Atlantic Coasts by
- Assessing and documenting the adaptive capacity of municipalities within the coastal areas exposed to sea level rise;
- Convening a regional workshop with national governments and CCAD to identify activities to support municipal governments in strengthening resilience in the coastal zones;
- Supporting climate resilient land use planning in the coastal areas with emphasis placed on mangrove areas;
- Supporting the implementation of pilot studies and policies that quantify and conserve the dynamics of carbon stocks and emissions in mangrove, sea grass and coastal marsh ecosystems;
- Supporting the restoration of areas previously covered by mangroves that have experienced encroachment from land-use change agents; and
- Supporting interactions between and training of individuals and organizations involved in blue carbon activities.

8. Support climate services and data rescue activities by
- Conducting an audit of digital and paper data holdings by meteorological departments in all the CA countries;
- "Data rescue" activities by locating and recovering data that is at risk of being lost due to deterioration;
- Supporting the introduction and implementation of technologies to achieve country-level GHG emissions accounting; and
- Supporting training and capacity building programs for meteorological staff in the CA countries.

Overall, USAID/CAM has an opportunity to design and implement efficient and effective programs that coordinate activities to address climate change and conservation issues. This would reinforce implementation of the region's existing climate change and conservation strategies and would develop synergies with other programs to be implemented under USAID/CAM's RDCS.

RESUMEN EJECUTIVO

Centroamérica es una de las regiones del mundo más vulnerables a los impactos del cambio climático. Estos cambios se reflejan en los patrones de precipitación, aumento de temperaturas tanto en terrestres como acuáticas, al igual que el aumento en el nivel del mar lo cual exacerbará los actuales desafíos que se enfrentan, vinculados con la dependencia económica en la agricultura, la pesca y los recursos naturales aumentando los niveles de pobreza y desigualdad y una débil gobernabilidad y la susceptibilidad a los desastres naturales. El Índice Global de Riesgo Climático de Germanwatch 2016, muestra que tres de todos los países de América Central, se encuentran entre los 10 países más vulnerables al cambio climático. Honduras ocupa el puesto No. 1, seguido por Nicaragua en el No. 4, y Guatemala ocupando el No.10. La República Dominicana está en el puesto No. 11, seguido por El Salvador, No. 14 y Belice en el No. 23. Costa Rica se sitúa en el lugar No. 75 y Panamá en el No. 107.

El Programa Regional de América Central de USAID/El Salvador (USAID/CAM) ha lanzado una nueva Estrategia de Cooperación para el Desarrollo Regional (RDCS) 2015-2019 que incluye actividades para ayudar a la región a evitar, mitigar y adaptarse a estas tendencias climáticas con el fin de no menoscabar la consecución de los objetivos de desarrollo de la región. El propósito de esta Evaluación de Vulnerabilidad de Cambio Climático regional (CCVA) es informar sobre las decisiones estratégicas de USAID/CAM para reducir eficazmente los riesgos que los cambios en las condiciones climáticas puedan causar. El ámbito geográfico de esta CCVA abarca aproximadamente los siete países de América Central y República Dominicana (AC/RD). La principal limitante para la evaluación fue contar con datos cuantitativos consistentes, lo cual hace prácticamente imposible uniformizar el mapa de la vulnerabilidad en toda la región.

CONTEXTO DEL DESARROLLO

De acuerdo a lo planes de Desarrollo de País de AC/RD, los países buscan crecimiento económico, empleo, reducción de la pobreza, y protección del medio ambiente. Los Objetivos de Desarrollo regional de USAID/CAM son: mayor integración económica, crecimiento económico inteligente respecto al clima, una mejora en los derechos humanos y seguridad ciudadana, al igual que la reducción de la prevalencia del VIH. Con respecto al contexto social AC/RD, Panamá y Costa Rica tienen tasas de pobreza por debajo del 27% El Salvador posee una tasa de pobreza del 36% y todos los países restantes tienen tasas de pobreza superiores al 40 por ciento. Sólo en Nicaragua menos de un 90%de la población tiene acceso a fuentes de agua mejoradas, sin embargo, Guatemala y Nicaragua están rezagados en la prestación de mejores servicios de saneamiento a toda su población. La mortalidad infantil es notablemente menor en Costa Rica que en cualquiera de los otros países.

Los sectores en los países de AC/RD con mayor probabilidad de ser directamente afectados por los cambios en las condiciones climáticas son la agricultura y silvicultura, pesca, turismo, manufactura, energía, suministro de agua y transporte. Aunque no se refleja en las cuentas nacionales, los servicios ecosistémicos, especialmente el de los bosques, son de importancia económica en la región de AC/RD. Los factores sociales y no-climáticos que influyen en el logro de los Objetivos de Desarrollo de AC/RD incluyen el crecimiento demográfico, la urbanización y la pobreza, la violencia, el crimen, una gobernanza deficiente, la contaminación y los desastres naturales. Existen vínculos indirectos entre el cambio climático, la pobreza y la violencia, especialmente en entornos urbanos, lo cual podría afectar el logro de los Objetivos de Desarrollo.

IMPACTOS DEL CAMBIO CLIMÁTICO Y VULNERABILIDAD

Los cambios en la temperatura del aire, la lluvia, la temperatura superficial del mar y aumento del nivel del mar fueron las condiciones climáticas o los factores de perturbación que se proyectaron desde el presente hasta el 2100. Estos cambios se utilizaron para evaluar la capacidad de AC/RD de alcanzar sus

Objetivos de Desarrollo (OD) en virtud de futuros escenarios climáticos. Los cambios en la temperatura del aire incluyen un aumento en el número de días y noches tibias y una disminución en el número de días y noches frías así como un incremento en el número de olas de calor. Los modelos climáticos proyectan que toda AC se convertirá en más seco a largo plazo y tendrá anomalías de precipitación estacional extremas. Las tendencias históricas de aumento de las temperaturas superficiales del mar están proyectadas a continuar tal como son los aumentos históricos en el nivel del mar.

Las tendencias en temperatura y precipitaciones se proyectan como amenazas en la producción de cultivos, en especial para la agricultura de subsistencia. La disminución o precipitación irregular puede afectar la producción y suministro de agua utilizada para el riego de cultivos. Se prevé que los aumentos en la temperatura superficial del mar afectará el hábitat de algunas especies comerciales de organismos marinos y quizá peces comerciales de agua dulce. Los aumentos de temperatura pueden causar directamente una disminución en el turismo durante algunos meses del año y un impacto en la biodiversidad la cual muchos turistas vienen a observar en AC. Los huracanes y los ciclones pueden incrementar en frecuencia, lo que podría suponer un mayor riesgo para el turismo y su infraestructura. De igual manera el aumento del nivel del mar también amenaza la infraestructura y los medios de vida. Los efectos de los cambios de condiciones climáticas en la industria son secundarios, principalmente a través de la reducida estabilidad de los suministros de energía debido a una disminución en la cantidad o la confiabilidad en los suministros de agua para la producción de energía hidroeléctrica. El transporte tiene ya un costo significativo en AC/RD, pero precipitaciones más severas pueden incurrir en costos adicionales al causar inundaciones y deslizamientos de tierra más grandes y frecuentes bloqueando las carreteras de acceso. El aumento de temperatura y la reducción de los suministros de agua se prevé que afectará negativamente la salud de algunas personas, mientras que un aumento en las inundaciones también puede causar brotes de algunas enfermedades. Las emergencias causadas por eventos climáticos extremos pueden aumentar la migración forzada, al igual que los cambios en las condiciones climáticas también pueden disminuir las oportunidades de empleo en algunas regiones, aumentando así la migración. El efecto principal de altas temperaturas y disminución de las precipitaciones puede aumentar los incendios forestales naturales o causados por humanos, afectando los ecosistemas forestales. Como se ha expuesto a través de este documento, impactos más inmediatos y devastadores del cambio climático están relacionados con un aumento en el número o la intensidad de los huracanes y ciclones que tan a menudo han asolado la región.

La vulnerabilidad a los cambios en condiciones climáticas se determina identificando la combinación entre la exposición a condiciones climáticas cambiantes, la sensibilidad a sus cambios, y la capacidad de adaptación para hacer frente a estos. La capacidad de adaptación es menor en los países de relativamente menos desarrollados como Guatemala, Honduras, El Salvador, Nicaragua y Costa Rica en comparación con Panamá. En cada país, los patrones revelan generalmente menor capacidad de adaptación en las zonas alejadas de los principales centros urbanos y en las zonas donde la población tiene una gran fracción de grupos indígenas. El Corredor Seco que se extiende desde Guatemala, a través de El Salvador y Honduras, y dentro de Nicaragua y Costa Rica contiene áreas que son más vulnerables a los cambios en la temperatura del aire y la lluvia. Del mismo modo, las zonas urbanas costeras y las zonas de manglares en Honduras, El Salvador, Guatemala, y Nicaragua también son más vulnerables a los cambios de temperaturas y al aumento del nivel del mar.

ESFUERZOS DE ADAPTACION EXISTENTES Y VACIOS

La "Declaración de San Pedro Sula," la Estrategia de Cambio Climático Regional (ERCC), la Política Centroamericana de Gestión Integral de Riesgos (PCGIR), y el Marco de Estrategia Regional del Medio Ambiente (ERAM) son los cuatro principales instrumentos regionales de política de AC/RD para hacer frente al cambio climático. Todos los países de AC/RD han preparado una Política Nacional de Cambio Climático; un Plan y Estrategia de Acción de Cambio Climático y/o una Segunda Comunicación Nacional

al Marco de Convención de las Naciones Unidas sobre el Cambio Climático (CMNUCC); y Contribución Nacional Prevista y Determinadas (INDCs).

Los documentos de política para la preparación y gestión de desastres incluyen: el Marco de Acción de Hyogo y la Política Centroamericana para la Manejo de Riesgos de Desastres del 2014 al 2018; Marco Estratégico para la Reducción de la Vulnerabilidad y Desastres en América Central; Marco Estratégico para Enfrentar la Inseguridad Alimentaria y Nutricional Asociada con la Sequía y Cambio Climático; Plan de Acción Regional de Agricultura contra el Cambio Climático; Plan Regional para el Sector Salud frente al cambio climático; Política de Gestión de Riesgos de América Central Integrada; Fondo de América Central para la Promoción de la Gestión del Riesgo de Desastres; y la Gestión Integral de los Riesgos Climáticos. A partir de 2012, 166 sistemas de alerta temprana de inundaciones, deslizamientos de tierra, e incendios estuvieron operando en muchas ciudades y comunidades y están mejor preparados para detectar y reaccionar con rapidez y eficacia ante los desastres naturales.

En las políticas nacionales de cambio climático y los países de AC/RD se apoyan tanto, la adaptación como la mitigación. Estas prioridades se reflejan en el creciente énfasis de la implementación de acciones de Mitigación basadas en Adaptación (AbM) que concurrentemente reducen la vulnerabilidad al cambio climático y aumentan el secuestro de carbono en la atmósfera. En el contexto de AbM, muchos proyectos regionales y nacionales consideran la disponibilidad al agua como un problema de desarrollo, provisionando agua para la producción, por lo que tienen como meta proporcionar una respuesta efectiva a las sequías recurrentes. Para AC/RD adoptar el paradigma de AbM, implica un compromiso de los países a adoptar los cambios de política e institucionales que se requieren y asumir estos compromisos durante un largo período de tiempo.

Los países de AC/RD participan en los mecanismos de la CMNUCC para reducir las emisiones de los bosques y otros paisajes. Los principales mecanismos en fase de desarrollo en AC/RD son REDD+ y Acciones Nacionales de Mitigación Apropiadas (MMAP), con los INDCs. Todos los países han presentado su "Paquete de Preparación a Buena Disposición", sin embargo, sólo Costa Rica ha entregado su Paquete de Preparación. El Centro Agronómico Tropical de Investigación y Enseñanza ha sido la institución principal que conduce la investigación y educación con relación a las emisiones de carbono de los ecosistemas costeros/marinos en AC/RD en la región

OPORTUNIDADES

Tras la revisión de la literatura, nuestros análisis espaciales regionales, y entrevistas a informantes clave, el análisis de nuestros resultados identificó ocho categorías de recomendaciones para fortalecer la resiliencia al cambio climático en AC/RD. Estas recomendaciones son a escala regional y se centran directamente en DO 2 e indirectamente en DO 1 y DO 3 de la RDC. Se ha puesto énfasis en el IR 2.2 (la capacidad de resiliencia de los seres humanos y del medio ambiente a los impactos del cambio climático aumentada y el IR 2.3 (El manejo de recursos naturales transfronterizos fortalecidos). Las recomendaciones para USAID/CAM son las siguientes:

1. Apoyar el mejor manejo de cuencas y gestión de zonas costeras para ayudar a AC a reforzar su resiliencia al cambio climático.
2. Construir y coordinar con los proyectos de adaptación al cambio climático que se están ejecutando en la región mediante:
    - La evaluación del alcance y contribución de los proyectos de la Iniciativa Alimento para el Futuro en AC a aumentar la resiliencia al cambio climático de los pequeños agricultores en el Corredor Seco;
    - El apoyo a una evaluación de las lecciones aprendidas sobre cambio climático en el pasado y actual, conservación de suelo/ agua, y proyectos y programas agrícolas en áreas prioritarias;

- El apoyo al monitoreo continuo y manejo adaptativo de los proyectos de adaptación ejecutados en la región;
- Compartir y coordinar los resultados con otros donantes que trabajan en la región;
- La continuidad de apoyo de las actividades que reducen las barreras y a la inclusión de la ABM y acciones de CSA en los programas que faciliten el manejo y conservación de los paisajes productivos;
- El apoyo de asistencia técnica y financiera a los países para aplicar sus Paquetes de Preparación y los Reportes de Medición y Verificación (MRV) de sus sistemas de REDD+;
- El análisis de los beneficios sociales, económicos y financieros a los pequeños agricultores con relación a las prácticas de conservación (por ejemplo, compostaje, terraceo, barreras vivas, agroforestería, manejo integrado de plagas);
- El fortalecimiento a la reforestación, el manejo forestal adaptativo, el uso del agua y la gestión para asegurar una mejor retención de los niveles de los acuíferos durante las estaciones secas más largas y absorción de agua en el acuífero durante las lluvias intensas; y
- La incorporación de vínculos entre los problemas del cambio climático y la gestión del riesgo ambiental para fortalecer los programas de resiliencia climática.

3. Integrar las actividades de resiliencia con la biodiversidad y las actividades de los bosques tropicales.

4. Proporcionar apoyo técnico y creación de capacidades para la CCAD mediante:
- El apoyo a la supervisión y evaluación de los programas de la CCAD, con énfasis en los cambios en la biodiversidad y resiliencia a los cambios climáticos;
- El apoyo de un mecanismo enfocado al NAMA para iniciar el diseño e implementación de sus acciones; y
- El apoyo a la evaluación del tipo y grado de asistencia técnica requerida por los promotores del NAMA a través de la región.

5. Apoyar a las actividades que aumenten las capacidades de los gobiernos municipales para planificar y gestionar los impactos del cambio climático a través de:
- Asistir a los municipios a identificar y aprovechar nuevas fuentes de financiamiento para la gestión de las cuencas hidrográficas y los servicios ecosistémicos que las cuencas hidrográficas proporcionan;
- Identificar y apoyar a los líderes municipales a través de asistencia técnica, actividades de capacitación y viajes de estudio; y
- Proporcionar apoyo técnico a para la creación de capacidades de las ONG conservacionistas locales que apoyan la planificación municipal.

6. Concentrar la asistencia en el Corredor Seco mediante:
- La proporción subsidios o becas de transferencia tecnológica canalizados a través de universidades de AC y otras organizaciones que apoyan la demostración y aplicación de nuevas tecnologías en los impactos del cambio climático en aspectos ecológicos, sociales y económicos;
- El apoyo a la coordinación para la planificación de uso del suelo resilientes al clima entre el Corredor Seco y las zonas costeras para facilitar la aplicación efectiva de las acciones del programa; y
- Brindar demostraciones piloto en tecnologías de conservación que se pueden aplicar con mayor efectividad en las pequeñas granjas para aumentar la resiliencia al cambio climático en el Corredor Seco.

7. Enfocar sus actividades para aumentar la resiliencia en las áreas costeras y marinas más vulnerables de las costas del Pacífico y del Atlántico de AC mediante:

- La evaluación y documentación de capacidad de adaptación de los municipios de las zonas costeras expuestas al incremento del nivel del mar;
- La organización de un taller regional con los gobiernos nacionales y la CCAD para determinar las actividades de apoyo a los gobiernos municipales y el fortalecimiento de la capacidad de resiliencia de las zonas costeras;
- El apoyo a la planificación al uso de la tierra resiliente al clima en las zonas costeras, con énfasis en las áreas de manglar;
- El apoyo a la implementación de estudios pilotos y políticas que conservan y cuantifican la dinámica de las reservas de carbono y las emisiones en los manglares, pastos marinos y los ecosistemas costeros de humedales;
- El apoyo a la restauración de las áreas previamente cubiertas por manglares que han sufrido la invasión de agentes de cambio de uso del suelo; y,
- El apoyo a las interacciones entre y capacitaciones de individuos y organizaciones que participan en actividades de carbono azul.

8. Apoyar servicios climáticos y actividades de rescate de datos mediante:

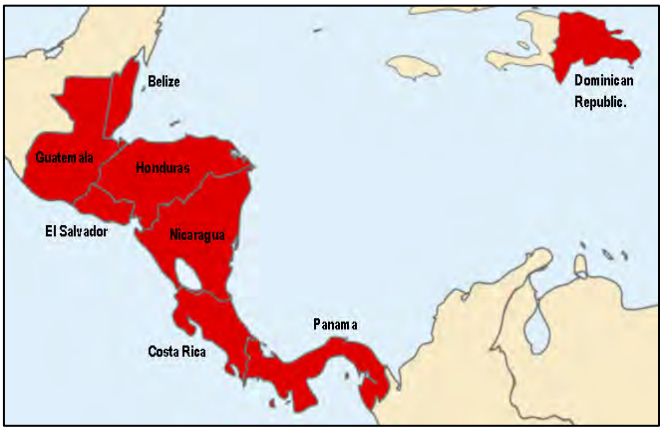
- La realización de una auditoría de los datos digitales y en documentos duros de los valores registrados por los departamentos meteorológicos de todos los países de América Central;
- Las actividades de "rescate de datos" mediante la localización y recuperación de datos que está en riesgo de perderse debido a su deterioro;
- El apoyo a la introducción y aplicación de tecnologías para lograr los registros de las emisiones de GEI a nivel de país; y
- El apoyo a programas de entrenamiento y capacitación para el personal de meteorología en los países de América Central.

En general, la USAID/CAM tiene la oportunidad de diseñar e implementar programas eficientes y eficaces que coordinen las actividades dirigidas al cambio climático y los problemas de conservación. Esto reforzaría la aplicación de las estrategias regionales existentes de cambio climático y conservación y desarrollaría sinergias con otros programas para ser implementados bajo la RDCS de USAID/CAM.

1. INTRODUCTION

1.1 BACKGROUND

The seven countries that comprise Central America plus the Dominican Republic (CA/DR) are among the world's most vulnerable to the impacts of climate change. Based on the 2016 Global Climate Risk Index (CRI) by Germanwatch (Kreft et al., 2016) which analyses the extent that countries have been affected by the impacts of weather-related loss events (storms, floods, heat waves etc.), covering the period 1995–2014, three of the CA/DR countries are ranked in the top 10 (Honduras is ranked No. 1, Nicaragua No. 4, and Guatemala No. 10). The Dominican Republic comes in at 11, El Salvador is at 14, Belize at 23, while Costa Rica is ranked at 75 and Panama at 107.



Changing rainfall patterns, increasing land and water temperatures, and rising sea levels are projected to have complex, negative impacts on agriculture, livelihoods, fishing, and natural resources. These impacts are exacerbated by the region's persistently high levels of poverty and inequity, weak governance, and susceptibility to natural disasters. USAID/El Salvador's Central America Regional Program (USAID/CAM) has developed a new Regional Development Cooperation Strategy (RDCS) for 2015–2019 that includes activities to assist the region to avoid, mitigate, and adapt to these climate trends so they do not affect the attainment of the region's development goals.

1.2 PURPOSE

The purpose of this regional Climate Change Vulnerability Assessment (CCVA) is to inform USAID/CAM's strategic decisions about how to most effectively manage risks from climate change. Since January 2012, USAID Missions have been required to fully consider climate change resilience and mitigation during the country/regional-level strategic planning process. New guidance on the processes for considering climate information will be issued by USAID in late 2016. The CCVA, therefore, is intended to help USAID/CAM: (1) identify climate change adaptation priorities in CA/DR from a development-driven perspective; (2) better understand the landscape of climate change activities already underway in CA/DR; and (3) identify actions USAID/CAM can support to improve CA/DR's capacity to prepare for and respond to climate change. The CCVA is intended to inform strategic-level decisions related to the sectoral and geographic scope of USAID/CAM's programs. It is not intended to inform the design of a portfolio or initiative with specific sectors.

1.3 APPROACH AND METHODS

The geographic scope of this CCVA broadly covers the seven Central America countries and the Dominican Republic. It attempts to focus, however, on issues and activities that include two or more countries and areas or sectors that are not already fully covered by USAID country programs. The CCVA uses available data as the basis for its finding, conclusions, and recommendations. These data were obtained from researching and interpreting various cases and documents, conducting interviews

with key informants, and are supported by field observations made in the El Salvador and Honduras parts of the Gulf of Fonseca, the Guatemala and Honduras sections of the Gulf of Honduras, the Nicaraguan Miskito Coast, and the Salvadorian section of the Trifinio Biosphere Reserve. ***Annex A*** is a bibliography of the hundreds of documents that were consulted. ***Annex D*** provides a list of more than 90 Key Informants (KI), selected for their knowledge of and experience with climate change and conservation issues across the region.

The CCVA's approach is based on a development perspective. First, it summarizes Central America's development goals, selected economic sectors, social factors and cross-sectoral issues. A review of past climate trends and projects future trends was conducted, when possible, for the near-term (through 2020s), middle-term (through 2050s), and long-term (through 2100s). The climate variables discussed are air temperature, rainfall, sea surface temperature, and sea level rise. Next, the CCVA discusses how climate change has effected, and how future trends are likely to affect, the various priority economic sectors, inputs, and cross-sectoral issues, such as those related to forest ecosystem services.

An important caveat is that there are high-levels of uncertainty in the climate models used in the region. The models do not perform as adequately in regional-scale simulations, and availability of important historical weather records and other observational data are limited as discussed throughout this CCVA. With such high-levels of uncertainty, recommendations are based on the best available science, analyses, and expert opinion. Characterizing and quantifying uncertainty in climate change projections is of fundamental importance for purposes of detection and attribution, and for developing strategic approaches to adaptation and mitigation. There are three main sources of uncertainty in future climate change (see box): throughout this document, these interrelated concepts are referred to generally and simply as "uncertainty."

Uncertainty in Climate Change

Uncertainty in future climate change derives from three main sources: forcing, model response, and internal variability (Hawkins and Sutton 2009; Tebaldi and Knutti 2007). Forcing uncertainty arises from incomplete knowledge of external factors influencing the climate system, including future trajectories of anthropogenic emissions of greenhouse gases (GHG), stratospheric ozone concentrations, land use change, etc. Model uncertainty, also termed response uncertainty, occurs because different models may yield different responses to the same external forcing as a result of differences in, for example, physical and numerical formulations. Internal variability is the natural variability of the climate system that occurs in the absence of external forcing, and includes processes intrinsic to the atmosphere, the ocean, and the coupled ocean-atmosphere system.

A series of indicators were identified and used to develop regional spatial analyses related to impacts to: (1) agriculture, (2) water, (3) coastal, and (4) forests and biodiversity resources. These sectors broadly cover the subject matters of concern for USAID climate change programming and have indicators available for them at the municipal level, across the region, and which are comparable for preparing such maps. Similarly, indicators were selected to provide a (5) general adaptive capacity map of the region. All of these maps are depicted at the level of municipal boundaries across the region. Additional information on the detailed methodologies used and their limitations are provided in each respective section in the report and in ***Annex C***. In summary, these regional maps cover the following:

1. Potential impacts of changes in both frequency and intensity of climate stressors, such as longer, drier, hotter growing seasons coupled with more intense rain events and subsequent flooding, on the region's agricultural sector by evaluating changes in the area suitable for the cultivation of main crop (those accounting for more than 5 percent of total cultivated area). We also mapped the fraction of population that depends on the agricultural sector.
2. Estimates of runoff were used to assess potential changes in the availability of water across the region in response to projected changes in precipitation and air temperatures. Runoff, broadly defined as precipitation minus evapotranspiration, also represents water potentially available for human use, and can provide an indication for potential for landslides.

3. A digital elevation model to help map the areas where high concentrations of cities and their infrastructure are exposed to and already experiencing sea level rise impacts.
4. Changes in leaf area index (LAI), evaluated under future climate scenarios, as a means of indicating changes in forests and biodiversity. LAI is related to net primary productivity and evapotranspiration rates, and is reduced when plants are under water stress.
5. Adaptive capacity was mapped across the region based on the fraction of people with access to potable water, level of education, and the ratio of active vs. older population (demographic dependency).

A lack of sufficient and consistent quantitative data made it impractical to uniformly map vulnerabilities throughout the region in a meaningful way. Therefore, a discussion of the vulnerabilities of the key sectors and inputs, in the short, medium and long term, highlighting geographic areas was developed based on the information available. Next, the CCVA summarizes current activities that are intended to assist Central America to avoid, mitigate or adapt to the negative effects of climate change trends and identifies gaps in current climate change activities. The CCVA then formulates recommendations for USAID/CAM's support for activities that will assist the region to reduce its vulnerability to climate change impacts and outlines synergies with other planned development priorities.

2. DEVELOPMENT CONTEXT

In order to assess climate change impacts and vulnerability in relation to economic development goals, this section provides an overview of the CA/DR economies, enabling conditions, and key economic sectors and inputs that are likely to be affected. It also provides an overview of the social context and ecological resources, and discusses key non-climate stressors that also impact development.

2.1 ECONOMIC CONTEXT, DEVELOPMENT GOALS, AND ENABLING CONDITIONS

Central American Integration System's (SICA) regional development goals are to achieve integration and to transform Central America into a region of peace, freedom, democracy, and development through democratic governance, regional security, economic prosperity, and sustainable development, and to protect the environment (CCAD 2010). Based on CA/DR Country Development Plans, the countries seek economic growth, employment, reduced poverty, and environmental protection. USAID/CAM's regional development objectives are: increased economic integration, climate-smart economic growth, improved human rights and citizen security, and reduced HIV prevalence (USAID 2016).

Table 1 indicates selected economic data for the CA/DR countries in 2015. From 2015 to 2019 the economies of the region are expected to have modest rates of growth and low inflation (BCIE 2015). ***Table 2*** indicates the relative contribution to GDP made by a selection of sectors in CA/DR countries that are likely to be most directly affected by climate change, as classified according to the sectors by the UN System of National Accounts (SNA). These selected sectors, related to agriculture, fisheries, tourism, manufacturing, supply of utilities, and road transport, contribute 30–50 percent of the GDP of CA/DR countries. Other sectors that make up most of the remainder of the economies, which are not discussed further in this report, include public administration and defense, wholesale and retail trade, maintenance of transport equipment, storage, communications, education and social work, construction, and financial intermediation. Although climate change can and does affect such secondary and tertiary

level economic sectors, the effects are far more indirect, and can be wide and complex through impacts to labor productivity and financial and product markets (Kumar and Yalew, 2012). We touch on manufacturing throughout this report, however, given its significance to several of the countries, and its high dependence on raw materials and energy. Some other sectors, such as mining and quarrying, do not comprise a large part of the CA/DR economies.

Table 1: Economic Data for CA/DR Countries

Country	GDP US$ Billion	GDP/Capita 2015	GDP Growth Rate 2015	2014 Un-employment Rate	% of Population Below Poverty	GINI Index[1]
Belize	1..6	8,600	2.2	11.5	43	n/a
Costa Rica	45.3	15,500	3.0	8.3	25	50
Dominican Republic	60.6	14,900	5.5	15	41	46
El Salvador	25.6	8,300	2.3	6.2	36	47
Guatemala	63.2	7,900	3.8	2.9	54	55
Honduras	41.0	5,000	3.5	3.9	60	58
Nicaragua	31.2	5,000	4.0	5.3	42.5	40
Panama	82.2	20,900	6.0	4.3	26	52

Source: World Bank Data Bank, 2016

Table 2: Contribution to GDP of Sectors Likely to be More Directly Affected by Climate Change

Selected Sectors (according to NSA)	Belize	Costa Rica	Dominican Republic	El Salvador	Guatemala	Honduras	Nicaragua	Panama
Agriculture and hunting	10.7%	9.2%	n/a	12.0%	12.5%	11.3%	15.5%	2.9%
Fishing	4.8%	0.2%	n/a	0.4%	0.2%	1.3%	1.2%	0.9%
Hotels and restaurants	4.0%	4.3%	6.9%	3.2%	3.2%	2.1%	3.3%	3.2%
Manufacturing	12.3%	23.1%	23.5%	24.4%	18.6%	18.8%	14.7%	5.5%
Electricity, gas, water supply	5.7%	2.8%	1.5%	0.7%	2.8%	2.4%	2.1%	2.8%
Transport	3.6%	7.8%	5.6%	6.0%	2.6%	3.8%	5.0%	15.1%

Source: UN System of National Accounts (NSA) Data – Country Accounts

Since the CA/DR countries depend heavily on the U.S. market for economic growth, they have put competitiveness in international trade at the center of their development agenda and negotiated the Dominican Republic–Central America Free Trade Agreement (CAFTA-DR) with the United States and the Association Agreement (AA) with the European Union. The 2014–2015 World Economic Forum Global Competitiveness Report ranked Panama and Costa Rica at 48 and 51, respectively out of 141 countries, the highest rankings in the CA/DR region. Nicaragua, Honduras, and the Dominican Republic rate the lowest in the region, ranking from 99 to 101. Factors considered in this index include institutions, infrastructure, macroeconomic environment, health, and primary education.

[1] GINI Index is a measurement of the income distribution of a country's residents. This number, which ranges between 0 and 100 and is based on residents' net income, helps define the gap between the rich and the poor, with 0 representing perfect equality and 100 representing perfect inequality.

2.2 PRIORITY SECTORS

2.2.1 AGRICULTURE

The land area under agricultural production in CA/DR was estimated to be approximately 21 million hectares (ha) in 2011. As shown in ***Table 2***, agriculture and associated service activities generally contributes to between 10 and 15 percent of CA/DR country GDPs.

Table 3: Land Areas under Agricultural Production and Potentially and Actually Irrigated Areas

Country / Areas	Total Land Area (Ha)	Agricultural (Ha)	Cultivated (Ha)	Pasture (Ha)	Potential Irrigated (Ha)	Actual Irrigated (Ha)	% Irrigated Cultivated Lands
Belize	2,281,000	160,000	110,000	50,000	-	3548	3%
Costa Rica	5,106,000	1,817,000	585,000	1,300,000	430,000	101,500	17%
Dominican Republic	4,832,000	2,352,000	1,300,000	1,197,000	710,000	306,500	24%
El Salvador	2,072,000	1,582,000	930,000	637,000	200,000	45,229	5%
Guatemala	10,716,000	3,720,700	2,479,000	1,950,000	2,620,000	312,100	13%
Honduras	11,189,000	3,235,000	1,475,000	1,760,000	500,000	89,607	6%
Nicaragua	12,034,000	5,065,000	1,796,000	3,275,000	365,120	199,086	11%
Panama	7,434,000	2,257,000	725,000	1,540,000	187,000	32,140	4%

Source: FAO Aquastat, 2016

In Honduras, the agriculture sector employs nearly 900,000 people. In El Salvador and the Dominican Republic, agriculture (and forestry) employs more than 500,000 people in each country (mostly in agriculture). Costa Rica on the other hand employs only about 24,000 people in agriculture (and forestry) (UN/SNA: 2010 - 2013 avg., 2008/2007 ILO Labor force survey). This information excludes subsistence farmers, for which official data are not available.

In 2011, the principal agricultural products were banana and sugar cane, followed by corn, African palm, and pineapple (FAOSTAT, 2016). The region is a net exporter of foods, and a net importer of certain staples such as rice, corn, beans, oils, milk, and meat (FAO-PRESANCA II – PRESISAN, 2013). In terms of the top three exported crops for each country, Costa Rica leads with banana exports (more than $900 million in 2013-2014), followed by Guatemala ($710 million), and Honduras ($450 million). Belize and Panama export less than $100 million of banana. Honduras is the highest coffee exporter (more than $800 million), followed by Guatemala ($670 million), and then Nicaragua and Costa Rica ($400 million and $285 million, respectively). Costa Rica also exports about $850 million in fruits and vegetables, and Guatemala exports more than $950 million in sugar cane. Sugar cane is in the top three exports for Belize, El Salvador, and Nicaragua, but at less than $200 million from each country. (CCAFS, 2016; IICA, 2015)

Agriculture and livestock represents about 11 percent, and including agroindustry, totals close to 18 percent of the region's GDP. CA/DR is also the principal supplier of food and raw materials for industry and contributes to 35 percent of total exports. Agriculture and livestock production also employs an important part of the poorer segment of rural populations (CEPAL, 2010).

2.2.2 FISHERIES

In the territorial marine waters of the CA/DR countries, artisanal and industrial fishing is an important activity worth nearly $1.2 billion and provides direct employment to more than 250,000 people (ERAS, 2008). In Belize and Honduras, exports of crustaceans amounted to $50 million (2013) and $292 million (2014) respectively. In Panama, exports of crustaceans and fish were at $81 and $54 million in 2014

(CCAFS, 2016; IICA, 2015). The fisheries sector employs 29,400 people in Honduras, 18,500 in El Salvador (UN/SNA: 2010–2013 avg.), and 6,600 people in Costa Rica (2008/2007 ILO Labor force survey). ***Table 4*** below shows the fisheries and crustacean catches from inland and marine waters of CA/DR countries over the period 2008–2010.

Table 4: CA/DDR Marine and Inland Fish and Crustacean Catches (in Tons, 2008 – 2012)

Type	Inland					Marine				
Year	2008	2009	2010	2011	2012	2008	2009	2010	2011	2012
Belize	-	-	-	-	-	365,494	303,954	399,033	276,697	149,806
Costa Rica	1,000	1,000	1,000	1,000	1,000	21,305	19,714	20,000	19,500	19,500
DR	1,708	432	350	973	952	696	790	700	664	561
El Salvador	3,980	3,000	2,326	2,355	2,350	39,307	33,224	37,257	51,926	49,650
Guatemala	2,360	2,360	2,360	2,360	2,360	20,466	17,635	19,558	17,343	17,201
Honduras	100	100	100	100	100	12,804	11,202	11,007	9,062	8,331
Nicaragua	988	868	943	971	712	30,177	35,273	37,129	32,582	33,138
Panama	3,143	1,909	2,013	1,594	1,414	225,391	235,815	179,044	166,696	145,535

Source: 2012 FAO Fishery and Aquaculture Statistics Yearbook

The productivity and sustainability of marine fisheries depend greatly on certain habitats within the overall marine territorial waters of the Central American countries. These include the mouths of rivers that empty into gulfs and bays, such as the Gulf of Honduras and Gulf of Fonseca, reefs such as the Mesoamerica Reef and the Miskito Cayo, and mangrove forests.

2.2.3 TOURISM

In 2015, the Dominican Republic had 5.9 million tourists, mostly for beach tourism, and had tourism receipts of about $6 billion; in 2014, Costa Rica had 2.5 million tourists, mostly for nature tourism, who injected $2,636 million to the economy. Tourism is also quite important in the other countries, especially Panama and Guatemala (see ***Table 5***). Hotels and restaurants alone contribute from 2 to 7 percent of the CA/DR countries GDPs (see ***Table 2*).** Tourism in the DR results in well over 220,000 jobs, while in Costa Rica it employs well over 100,000 people (2008/2007 ILO Labor Force Survey).

Table 5: Number of Visitors and Revenues from Tourism in CA/DR

Country	Year	Number of Visitors	Tourism Receipts (US$ million)
Belize	2011	294,000	$351
Costa Rica	2014	2,526,817	$2,636
El Salvador	2015	1,972,854	$1,107
Guatemala	2014	2,142,000	$1,563
Honduras	2012	1,035,000	$1,078
Nicaragua	2014	1,390,338	$445
Panama	2014	2,304,711	$5,476
Dominican Republic	2015	5,899,859	$6,153

Sources: Nicaraguan Tourism Institute; Statistical Institute of Belize; National Bureau of Statistics; Tourism Authority of Panama; Costa Rican Tourism Institute; Honduras National Chamber of Tourism; Salvadoran Tourism Corporation; CentralAmericaData.com

Coastal tourism in CA/DR is concentrated geographically on the Pacific Coast beaches of Panama and Costa Rica, and to some extent Nicaragua, the Bay Islands of Honduras, the more northern beaches of Belize, and the eastern beaches of the Dominican Republic. In Guatemala, tourism is concentrated in the indigenous highlands and Tikal in the Petén.

2.2.4 MANUFACTURING

Manufacturing is an important part of the CA/DR economies, although it contributes as little as 5.5 percent to the GDP of Panama. However, it accounts for greater than 23 percent of the GDP of Costa Rica, Dominican Republic, and El Salvador. Honduras and El Salvador have positive balances of trade in manufactured goods, principally due to exports of textiles, electrical equipment and food products. Panama's principal exports are wood and metal products. Nicaragua exports food products and chemicals. The Dominican Republic exports food products and medicines. Belize exports minerals and chemical products. Costa Rica exports medical equipment and food products. Guatemala and Costa Rica are the largest exporters in the region, exporting more than $8 billion and $6.9 billion in 2015, respectively. Honduras exported $4 billion in 2015, while other CA/DR countries exported less than $2 million, with Belize and Panama at the bottom of the pack with $800 million and $250 million, respectively.[2] Manufacturing employs approximately 400,000 people in each of El Salvador and Honduras (2010 - 2013 average UN/SNA).

2.2.5 WATER AND ENERGY

The region's energy sources in 2008 comprised oil (44%), biomass (mostly firewood) (43%), electricity (12%), and others (1%). Home consumption is the main sector, in particular for Guatemala, Nicaragua, and Honduras, where 85 percent of households use firewood (IARNA, 2010). ***Table 6*** shows data about the sources of electrical energy in megawatts (MW) by country in 2012.

Table 6: Sources of Electrical Energy in CA/DR by Country in 2012

Country	Installed Power MW				Potential Hydro Power MW
	Hydro	Thermal	Other	Total (MW)	
Belize	53	91	-	144	900
Costa Rica	1,700	613	410	2,723	6,474
El Salvador	472	871	204	1,547	2,165
Guatemala	891	1,570	42	2,503	5,000
Honduras	531	1,089	102	1,722	5,000
Nicaragua	105	852	150	1,107	2,000
Panamá	1,468	953	-	2,421	3,282
Dominican Republic	600	2,318	85	3,003	2,095

Source: Regional Strategy for Efficient Lighting in Central America, 2014

In Central America, traditional methods have been used as means of energy production; however, in recent years, countries have experimented with clean energy alternatives such as wind and solar power, and have increased marketing of photovoltaic systems (solar energy) and the development of wind farms.

Table 7 shows information on water availability and use in CA/DR. In total, the region has sufficient water but it is unequally distributed. Two-thirds of CA's population live on the Pacific Coast, where

[2] Central Bank of Nicaragua, 2016; PROCOMER, 2016; Statistical Institute of Belize, 2016; Central Reserve Bank of El Salvador, 2016; Banco de Guatemala, 2016; Central Bank of Honduras, 2016; National Institute of Statistics and Census; 2016

only 30 percent of the regions water is available (GWP, 2016). The rest of the population is on the Caribbean side, where 70 percent of the water is available. Demand has increased sharply due to high population growth rates. ***Table 3*** shown previously, indicates the relatively low proportion of irrigated agricultural areas in some of the CA/DR countries.

Table 7: Water Availability and Use in Central America Million Cubic Meters per Year (MCM/yr)

Country	Renewable Water Resources (MCM/yr)	Total Water Use (MCM/yr)	Total Water Use per Capita (m3/capita/yr)	Percent used by:		
				Agriculture	Industry	Municipal
Belize	21,730	101	385	67.7	21.0	11.3
Costa Rica	113,000	2,350	489	56.6	11.1	32.3
Dominican Republic	23,500	7,156	705	79.9	8.2	12.0
El Salvador	26,270	2,118	354	67.6	10.1	22.4
Guatemala	127,900	3,324	241	56.7	18.1	25.1
Honduras	92,160	1,607	225	73.3	7.1	19.6
Nicaragua	164,500	1,545	263	76.7	4.8	18.5
Panama	139,300	1,037	277	43.0	1.0	56.0

Source: FAO Aquastat 2016

2.2.6 TRANSPORTATION

Climate change and natural disasters is projected to significantly impact road transportation across the region. Road infrastructure provides critical links for people and economies in the region. Transportation is costly in CA because of high fuel prices, raw materials, security costs, returning with empty loads, and excessive travel times. Security costs associated with transportation have increased by 25 percent since 2009, creating deferred maintenance and backlogs for repairs and replacement, thereby increasing risks and costs. Travel times are high, in part, due to poor roads and landslides, particularly on unpaved roads. The World Bank suggests that to lower transportation costs several region-wide solutions must be implemented to harmonize customs systems, invest in roads and continue the fight against crime and violence (WB, 2013). Similarly, major infrastructure, such as hydroelectric dams and flood controls, are also vulnerable, though gaps exist in the climate-infrastructure-connection research literature to draw conclusions on the extent of the risks. Some CA countries that submitted National Contributions listed road transportation as highly vulnerable.

2.3 SOCIAL FACTORS

2.3.1 DEMOGRAPHICS AND HUMAN MIGRATION

Table 8 shows the total population of the CA/DR countries in 2015, their projected population, projected absolute increase, and the percent of rural and urban population. CA/DR countries have become highly urbanized, and urban population growth (8.8% on average) is higher than overall population growth (5.5%). These changes include human migration following hurricanes and other disruptions that have occurred throughout the region.

Table 8: Demographic Statistics for CA/DR Countries

Country	Total Population		Increase	% Increase	% Rural (2015)	% Urban (2015)
	2015	2019				
Belize	359,000	390,000	31,000	8.6	56.0	44.0
Costa Rica	4,808,000	4,999,000	191,000	4.0	23.2	76.8

Country	Total Population		Increase	%	% Rural	% Urban
Dominican Republic	10,528,000	10,996,000	468,000	4.4	21.0	79.0
El Salvador	6,127,000	6,210,000	83,000	1.4	33.3	66.7
Guatemala	16,343,000	17,677,000	1,334,000	8.2	48.4	51.6
Honduras	8,075,000	8,536,000	461,000	5.7	45.3	54.7
Nicaragua	6,082,000	6,352,000	270,000	4.4	41.2	58.8
Panama	3,929,000	4,172,000	243,000	6.2	33.4	66.6
TOTAL	56,251,000	59,332,000	3,081,000	5.5	37.3	62.7

Source: WB 2016

2.3.2 HUMAN SERVICES AND HEALTH

The percentage of public budgets dedicated to investments in education, health care, social security, and housing provides an indication of a government's commitment to social development goals. Last decade, Costa Rica dedicated about 23 percent of its GDP to social investments, while other countries were investing less than 15 percent (CEPAL-CEPALSTAT, 2016). Guatemala was dedicating only 7.6 percent. ***Table 9*** provides some key indicators related to health and access to water and sanitation in CA/DR countries. While 93 percent of the urban population has access to potable water and 78 percent to sewerage, only 60 percent of the rural population has access to potable water and 58 percent to sanitation services.

In the regional Health Plan of Central America and the Dominican Republic for 2010-2015, the principal health care service problems identified is the co-existence of many units or entities that are not integrated into the network of health services. Access to health care services is especially difficult for the poor and for people who live in remote locations. Cultural barriers can limit access to health care (e.g., for indigenous and Afro Caribbean people). Of all deaths, 13.6 percent correspond to transmissible diseases (COMICSA, 2009).

Table 9: Access to Improved Water/Sanitation and Key Health Statistics

Country	Improved Water Source %	Improved Sanitation %	Life expectancy (Years)	Mortality rate /1000 people	Infant mortality rate /1000 children < 1 year old
Belize	99.5	90.5	74	5	16
Costa Rica	97.8	94.5	80	4	9
Dominican Republic	84.7	84.0	72	7	n/a
El Salvador.	93.8	75.0	72	5	18
Guatemala	92.8	63.9	74	5	24
Honduras	91.2	82.6	75	5	21
Nicaragua	87.0	67.9	77	5	14
Panama	94.7	75.0	73	6	26

Sources: Pan American Health Organization, 2012, and WB 2016

2.4 FORESTS AND COASTAL ECOSYSTEMS

In CA/DR, 25.3 million ha of land, or 45.5 percent of terrestrial ecoregion areas, remain as natural habitats. Of its 39 terrestrial ecoregions, only five are considered stable. All 13 freshwater ecoregions are degraded. Of the seven marine ecoregions, four are degraded, one is stable, and the condition of two has not been evaluated.

There are approximately 22.5 million ha of forest land in CA/DR, and they cover about 44 percent of the terrestrial land area. Forestry, logging and associated service activities contribute small amounts to the formal economies (between 0.2 and 1.2% of GDP), and firewood continues to be a principal source of energy for a large percentage of rural people in the region. Forest ecosystem services contribute to the growth and prosperity of CA/DR countries. Forests regulate the quantity, quality, and stability of the water that is used for productive activities and human consumption. The 20,000 gigawatt-hours of hydropower generated a year is worth about $3 billion/year. Forests in the watersheds from which the water flows to generate this electricity provides economically valuable regulatory ecosystems. Similarly, a study in El Salvador estimated the economic value of ecosystem services in its mountainous areas to be more than $14.2 million per year.

There are 847 protected areas (PAs) in CA/DR. Their current terrestrial area is nearly 133,000 km^2, 23.4 percent of the terrestrial area of CA/DR. The marine area within PAs is approximately 72,150 km^2. PA's contribute enormously to its economic growth and prosperity. For example, a study in Costa Rica estimated that tourism in eight PAs contributes more than $1.5 billion annually to its economy. About $100 million, 10 percent of the Panama Canal's yearly income depends on reliable flows of water from PAs within the canal's watershed.

There are five categories of direct threats to CA/DR's tropical forests and biodiversity: habitat loss and degradation, invasive species, over-exploitation, contamination or pollution, and climate change. Of the 42 types of specific threats within these categories, the four main ones to terrestrial ecoregions are logging, cattle grazing, agriculture, and urban expansion/human settlements. The most common threats to marine ecosystems are pollution from industrial sources, siltation, solid waste, tourism developments, overfishing, untreated sewage, agrochemicals runoff from fields, invasive species, and dredge-and-fill operations. The principal drivers of these direct threats to ecosystems in CA/DR are population growth, urbanization, poverty, and insecurity and corruption. In addition to being a direct threat, climate change is expected to exacerbate indirect threats.

Major issues for the conservation of tropical forests and biodiversity in CA/DR concern: (1) better regional integration of conservation activities; (2) strengthening governance of biodiversity and tropical forests; (3) educating more foresters, soil conservationists, and fisheries professionals and providing additional high-quality conservation research, technology, and education; (4) financing for conservation actions far from matches the economic value of the ecosystem services its biodiversity and tropical forests provide; and (5) the need for conservation across large-scale landscapes (TFBA, 2016).

2.5 NON-CLIMATE STRESSORS

Non-climate stressors increase vulnerability to climate change because they harm the functioning of a system and the achievement of development goals. Non-climate and climate stressors usually exacerbate each other as they interact.

2.5.1 POPULATION GROWTH, URBANIZATION, AND POVERTY

As shown previously in ***Table 8***, the total population of CA/DR is expected to increase by 3,081,000 in five years. Populations, therefore, will have social and economic needs and will exert additional pressures on natural resources. As shown in ***Section 2.3.1***, urban population growth indicates that more significantly more people are moving from rural areas to cities. ***Table 1*** shows the large portion of CA/DR people living in poverty. The highest poverty rate, 60 percent, is in Honduras, while Costa Rica has the lowest, 25 percent. The GINI Index indicates a skewed distribution of wealth in all the countries. The range of GDP/capita also varies considerably from lows of $5,000 in Honduras and Nicaragua, to highs of $20,900 in Panama and $15,500 in Costa Rica. Formerly sparsely populated, low-

value coastal land has become densely populated and high-priced. Although part of the local population may benefit, another part may find its access to fishing areas and beaches greatly restricted. These trends of population growth, migration, and urbanization contribute to violence by complicating governance and law enforcement.

2.5.2 VIOLENCE, CRIME, AND POOR GOVERNANCE

Over the last decade, persistent poverty and inequity of income combined with recent armed violence in civil wars, drug trafficking, and underfunded law enforcement agencies, insecurity, and corruption have become rampant in CA. Unemployed young men are particularly susceptible to becoming involved in crime, particularly in organized gangs. Persistent poverty, inequality, and unemployment leave large portions of the population susceptible to crime. (KIs and WB 2011) Poverty, inequality, unemployment and crime can make addressing climate change a lower priority.

Transparency International's 2014 Corruption Perceptions Index indicates that citizens in CA perceive high levels of public sector corruption. Corruption has permeated all levels and parts of government in Central American countries. Corruption may weaken the ability of governments to plan and implement actions to counter the negative effects of climate change. Under-funded law enforcement agencies are also often unable to control the violence associated with drug trafficking,

2.5.3 POLLUTION

Nearly half the population is exposed to contaminated water sources. Pesticides have affected the health of more than 2 percent of the population over 15 years old. Solid waste management requires improvements to municipal institutional capabilities. Puerto Cortez is the only city in CA where all of its wastewater is treated. In addition, increases in projected rainfall intensity combined with drier and longer droughts impact levels and locations of pollution. For example, intense rains wash pollutants downslope towards lowland and coastal areas, while drier conditions and higher temperatures cause an increase in pests and therefore pesticide concentrations.

2.6 NATURAL DISASTER AND EXTREME EVENTS

CA/DR's geographic location makes it prone to severe natural disasters. Natural disasters frequently severely affect CA/DR, costing human lives, social disruption, economic losses and ecological devastation. Based on data available in Maynard-Ford (2009), storms, hurricanes, droughts and extremely high temperatures, cause nearly 70 percent of CA/DR's natural hazards. Earthquakes, volcanoes and landslides, epidemics of diseases and insects cause the remaining 30 percent. Natural disasters due to earthquakes were most common along the western coasts of CA, where the Cocos and Nazca plates are colliding with the South American plate. Extreme tidal events also create natural disasters along the Pacific coast of CA (Maynard-Ford, 2009). The impact of cyclic events such as El Niño-La Niña often produce droughts, excessive rains, and flooding, often leading to landslides and erosion.

In Guatemala, the 2014 eruption of the Pacaya volcano and the impacts of tropical storm Agatha reached upwards of $982 million (2% of GDP; Guatemala 2010). Latin America as a whole, including CA/DR, depends on reconstruction and international assistance to respond to disasters rather than prevention and preparation. Although the human toll taken by disasters has remained fairly stable, it is unlikely to decrease if widespread poverty persists, population grows, and migration towards coasts and large cities continues (Charvériat, 2000).

3. CLIMATE CHANGE IMPACTS AND VULNERABILITY

3.1 CLIMATE STRESSORS

A synthesis was made of the scientific literature on observed historical trends and projected changes in climate variables over terrestrial and marine Central America. The four climate variables discussed are: air temperature, rainfall, sea surface temperature, and sea level rise. Broadly, the United States Global Change Research Program defines a stressor as something that has an effect on people and on natural, managed, and socioeconomic systems. Multiple stressors can have compounded effects, such as when economic or market stress combines with drought to negatively impact farmers. The four variables discussed in this section affect traditional patterns in drought, precipitation events, and water availability. While socioeconomic and other non-climate stressors were not examined in detail as part of this assessment, USAID may want to consider responses to certain trends in CA/DR that affect the region's capacity to manage climate risks:

- Impacts from globalization. Increasing worldwide competition results in migration of skilled workers. This can affect adaptive capacity over time.
- Aging. Younger, able bodied people tend to migrate at faster rates than older generations. This in turn increases vulnerability for the elderly to respond to environmental changes, such as increased heat, access to health care, and other quality of life issues.
- Financial capacity. Lower rates of taxation affect the financial resources for and quality of government services.

Future trends in temperature and rainfall climate stressors are projected when possible for the near-term (through 2020s), middle-term (through 2050s), and long-term (through 2100s) with a spatial resolution of 1 square kilometer. Global Climate Models (GCM) identified in the Intergovernmental Panel on Climate Change (IPCC) are used to assess climate and emission scenarios. These studies allow decision makers to draw conclusions about regional trends, but do not distinguish between specific watersheds or countries. For example, it is broadly agreed in the literature that tropical cyclones (e.g., hurricanes) will increase in intensity and frequency; though cyclone landfall patterns (e.g., storm tracks) are erratic and inconsistent in the models, making adaptation actions at geographic scales difficult for investments. USAID could further explore options such as "no regrets" development approaches, "development first" approaches identified in USAID's 2015 Climate Resilient Development Framework and sector Annexes, and, at the policy levels, whether environmental and climate-related policy responses to future risks includes functional or actionable measures that assist the CA countries prepare for these stressors.

Future emission scenarios were estimated from Potential Development Pathways in the IPCC 4th assessment and Representative Concentration Pathways for its 5th assessment. The analyses did not distinguish differences between climate data from the CMIP3 or CMIP5 (Coupled Model Inter-comparison Projects) experiments used for the 4th and 5th IPCC assessments since there were no discrepancies between them. Mean future changes in temperature and rainfall climate stressors were quantified for 19 bioclimatic variables in projections that utilized a Representative Concentration Pathway (RCP) of 4.5. (A detailed description of these models and procedures are described in worldclim.org and in Hijmans et al., 2005.)

Four limitations make historical and projected changes in climate stressors difficult. First, most of the historical climate records in CA have not been fully or consistently digitized, so data is not currently

used for improving computer projections of historical or future impacts.[3] Few hydro-climatic data are currently being collected. The lack of these data makes it challenging to use up-to-date technologies for projecting the impacts of climate change and variability in CA. For example, seasonal forecasting systems could be greatly improved. CCAFS (2016) reports that weather patterns and other climatic influences and interactions in the region provide high levels of complexity and therefore uncertainty. This makes it difficult for climate models to simulate the *observed* climate, thereby justifying prioritizing investments in data collection methods by the international donor community. Consequently, lack of information makes it more difficult to plan and implement effective mitigation measures for climate change and variability near time horizons. Second, the spatial resolution of global data sets do not sufficiently downscale to permit historical reconstructions of climate trends in the region. In other words, the lack of data prevents models from reconstructing the past, which in turn affects the accuracy of future projections. Third, few regional climate change projections for Central America have been run. Consequently, conclusions about future climate trends are based on global model projections. These projections agree more on temperature than precipitation trends. Finally, global GCM projections show large inter-model disagreement regarding precipitation intensity changes (Biasutti et al., 2012). Nakaegawa et al., (2013) found increased precipitation intensity in the region.

3.1.1 CHANGES IN AIR TEMPERATURE

Though historic records are inconsistent, it is agreed that CA's climate is becoming warmer. Mean air temperatures and the frequency of warm days increased and the number of cold days and nights decreased. . By the 2020s, should worst case scenario conditions prevail, the region will be significantly impacted by climate change. By the medium- and long-term, people, ecosystems, and species of CA/DR may experience a new climatic regime well outside traditional boundaries.

In the near-term, the magnitude of natural climatic variability in Central America will be greater than a trend in the magnitude of global warming (Kirtman et al., 2013). Models indicate, however, that CA will become warmer than its natural variability in the middle-term, i.e., through 2050's (Hawkins and Sutton, 2012; Mora et al., 2013; (Imbach et al., 2012). The temperature trends in CA will likely coincide with the models' projections for global temperature trends. Global trends are for an increase in the number of warm and a decrease in the number of cold days and nights (Seneviratne et al., 2012). Models also project more frequent heat waves (measured as the maximum period with maximum temperature more than 5°C above the 1961–1990 daily norms) in CA in the long-term (Biasutti et al., 2012). These trends could lead to increased incidents of life-threatening dehydration epidemics in tens of thousands of agricultural and other outdoor workers.

3.1.2 CHANGES IN RAINFALL

Historically, rainfall events have increased in intensity in CA for the 1960-2003 period (Aguilar et al., 2005). These intense rain events, however, are not increasing seasonal precipitation. Regional climate models, which include El Niño-Southern Oscillation (ENSO) events, project that CA will become drier in the long-term (Giorgi, 2006). The models project that under mid- to high-global warming scenarios, CA will continue to experience *extreme* seasonal anomalies of rainfall (Diffenbaugh and Giorgi, 2012). The models also project that in the long-term, CA will experience higher numbers of consecutive dry days (Nakaegawa et al., 2013). Importantly, the models project a decreased total annual rainfall from northern to southern CA in the short-term (Imbach et al., 2012). In the long-term models project higher precipitation in eastern regions of Costa Rica and Panama (IPCC, 2013a, 2013b). Higher temperatures, however, will cause more evaporation, so Costa Rica and Panama's climates are projected

[3] Several initiatives are undertaking efforts to address this issue and a Mesoamerican chapter has recently joined the initiative (www.idare-portal.org/data/acre-mesoamerica).

to become drier in the long-term (Hidalgo et al., 2013; Imbach et al., 2012; Nakaegawa et al., 2014). Regional climate models also project reduced precipitation in June, July, and August (Biasutti et al., 2012). The result would be increased length and intensity of the current mid-summer dry seasons (Rauscher et al., 2008). The models also project a period of decreased rain within CA's wet season (Magaña et al., 1999).

3.1.3 CHANGES IN SEA SURFACE TEMPERATURE

Deser et al. (2010) studied sea surface temperature (SST) trends since the 1900s from several data sources and found increased temperature trends for both the Pacific Ocean and the Caribbean Sea between 0.2 and 1°C per century. Historical data for the Caribbean Sea is limited to the last three decades (Nurse and Charlery 2016). These authors show that models of SST project that global warming will cause an increase in SST for both the Caribbean and Eastern Pacific. The magnitudes of these increases, however, depends on the emission scenario and temporal horizon used in the projections (Donner, 2009). Nurse and Charlery (2016) projected SST for the end of the 21st century using downscales projections of the ECHAM4 GCM and found increased temperatures (compared to the 2000-2009 period) between 0.5 and 1.5 for 2050, and >1.5°C for the 2090s.

3.1.4 CHANGES IN SEA LEVEL RISE

Long-term tide-gauge records since 1916 show that the rate of sea level rise (SLR) has been more than 1.44 mm yr^{-1}. Data on SLR from the last few decades collected by altimetry satellites indicate higher rates of SLR than the tide-gauges have shown (BIOMARCC-USAID, 2013). The recent increase in the rate of SLR has likely been driven by both the variability caused by the ENSO and global warming (Bouroncle and Imbach, 2013). Recent data collected from satellite observations indicate increases in the rate of SLR over most of the Caribbean, though there is an observed decrease in the rate of rise for the Pacific (Nicholls and Cazenave, 2010).

Simulations of SLR in the short- and middle-term projected trends are similar to historical trends. They indicate a SLR of 3 mm yr^{-1} on the Caribbean Coast of CA. They project a 2 mm yr^{-1} for the Pacific coast of CA (CEPAL and UC, 2015).

Projections for the long-term indicate an increase in SLR of greater than 0.5 meters for the Caribbean Sea shore of CA. These projections show a greater than 0.4 meters SLR for the Pacific Ocean shore of CA (Church et al., 2013). However, coastal impacts from SLR result from a combination with other climate variables (e.g., wind speed and direction, wave height, tide range, and inter-annual variability of SL), tectonic processes, and coastal morphology, which will impose additional challenges for future impact assessments in CA (Bouroncle and Imbach, 2013). Various approaches to address these issues exist, but there is no "one size fits all" method.

3.2 IMPACTS ON PRIORITY SECTORS AND CROSS-SECTORAL ISSUES

3.2.1 AGRICULTURE

Changes in climate stressors threatens crop production across the region, with implications for food security (Magrin et al., 2014) and malnutrition, which already affects more than 25 million people across Central America and the Caribbean (Lobell et al., 2008). More than 35 percent of the region's children under 5 suffer chronic malnutrition, led by Guatemala, El Salvador, and Honduras (Programa Estado de la Nacion, 2011). Subsistence farmers, who make up 64 percent of the population in the agricultural areas of the region, are also vulnerable to the potential adverse effects of changes in climate stressors (IARNA, 2010). For example, the 2012 coffee rust outbreak, related in part to increased daily temperatures, led to a 10-16 percent decline in production, affecting more than 1.4 million people

across the region (Avelino et al., 2015). Coffee supports the livelihoods of about 2 million people in CA. The epidemic is consistent with a changing climate, and the authors briefly discuss four development actions needed in response: development of resistant coffee cultivars; creation of early warning systems; capacity building of individuals and institutions; and better crop management.

The literature indicates climate-related declines in the production of maize, beans, and rice, which comprise 90 percent of the agricultural production consumed within the region (CEPAL, 2010), though small production increases could occur in the near term (to 2030) in sugarcane, cassava and maize (Lobell et al., 2008). About half of the municipalities in the region could experience declines in the area suitable for coffee, maize, beans, upland rice, sorghum, plantain, and cassava, with average declines of 6, 5, and 1 percent estimated for Nicaragua, El Salvador, and Honduras, respectively (Bouroncle et al., n.d.). Costa Rica, El Salvador, and Nicaragua could lose 40 percent of their current coffee areas (Läderach et al., 2010). Nicaragua and Honduras could lose 14 percent of the area suitable for beans, while Guatemala, with large areas of highlands, could see increases in bean productivity (Eitzinger et al., 2013).

A study by ECLAC (2013), also estimated that the average yield of corn in the region could decrease by 4 percent by 2020 as a result of changes in climate stressors, while the average regional yields of beans could decline by 3 percent and with rice, yields are estimated to decrease by 8 percent. However, there are large uncertainties in these estimates because the potential effects of CO_2 fertilization, increased water use efficiency, and the use of new varieties or management improvements are unknown (Imbach et al., 2012).

Furthermore, the drought caused by El Niño in 2009, caused the loss of 30 percent of the harvest of various grains in Nicaragua and reduced the yields of 1,200 hectares of rice, with total losses of $ 6.25 million in agricultural production (Bonilla, 2014). Due to El Niño in 2015, an estimated 3 million tons of maize harvest across the sub region was 8 percent below 2014's already compromised harvest. Sharp production declines are expected in El Salvador and Honduras in the next few decades as irregular rainfalls impact planting, growth, and harvest. In Guatemala, some 80 percent of crops are estimated to have been lost in 2015, affecting over 150,000 families. Similarly, in Nicaragua, a majority of useable arable land was damaged, with total crop losses in some regions of the country. (FAO, 2015) Hurricane Stan, in 2005, generated damages of 20 percent of the coffee harvest in the Pacific region of Guatemala, amounting to $4 million (Laderach et al, 2013).

While it is agreed that major impacts are projected on water availability and supply, food security, and agricultural incomes, there will be unpredictable shifts in production areas of crops. The increasing frequency and intensity of climatic events is projected to decrease already poor producer's abilities to both grow and sell their yields, but the exact regions are unknowable. USAID could coordinate with meteorological services of countries in CA to generate regional climate scenarios for impact studies, which could assist with better understandings of uncertainties and incomplete information, and other gaps. Training and capacity programs can also be built around these efforts.

3.2.2 FISHERIES

Increased sea surface temperature will cause: (1) coral bleaching (loss of zooxanthellae algae) and potential coral mortality (Fabricius et al. 2007); and (2) seagrass distribution changes, growth rate alterations, changes in sexual reproduction patterns and a general redistribution of existing seagrasses habitats (Short and Neckles, 1999). Increasing atmospheric carbon dioxide will elevate CO_2 levels in coastal waters reducing the amounts of ions available for calcium carbonate to form. This is called climate change related ocean acidification, which slows and stunts skeletal growth in fish, corals, and other invertebrates (Short and Neckles 1999). Impacts to wetlands and mangroves from both increase in sea surface temperature and sea level rise can also impact fisheries; the cumulative impacts of CC

together with human induced habitat destruction could have damaging impacts to the fisheries industry. A recent study in the Gulf of California states that mangroves are used as nursery or feeding areas for many important commercial species for artisanal fisheries, estimating the median value of these fisheries at $37,500 per hectare (Aburto-Oropeza et al., 2008).

Ficke et al. (2007) projected that changes in climate stressors, such as increased air temperatures and changes in precipitation patterns, will increase adverse impacts on freshwater fisheries worldwide as a result of alterations in fish physiology and life histories of fish. The authors explain that general effects of climate change on freshwater systems will likely be increased water temperatures, decreased dissolved oxygen levels, increase toxicity of pollutants, exacerbated eutrophication resulting in more pronounced stratification, and other factors that could change or affect the quality of fish habitat. Given that fish physiology is linked to temperature, and that they have evolved to cope with specific hydrologic regimes and niche habitats, their physiology and life histories will be affected. Such changes in fresh water ecosystems could change the conditions for the growth of species of eatable fish especially for species that are unable to migrate or acclimate, thereby affecting the food supplies of people who depend on freshwater fisheries for food.

3.2.3 TOURISM

CEPAL (2010) analyzed projected temperature changes in 2020 and 2050 for tourist sites in Central America focusing on July and December, the times with the most tourist arrivals. In December 2020, it is projected that Nicaragua will experience temperature increases. In December 2050, the largest projected increases appear in Costa Rica (Guanacaste region in the northwest part of the country). Temperature increases in July 2020 are projected to be highest at tourist sites in Guatemala (Tikal) and Honduras (Copán). The largest temperature increases could occur in July 2050 across the region, and particularly for tourist sites in El Salvador, Guatemala (Tikal), Belize (Punta Gorda), and Honduras (Cusuco). CEPAL (2010) and BID-INTAL (2010) highlight natural resources and biodiversity as main factors that attract tourism to the region and identify sea level rise and increased sea surface temperature as potential threats for tourism infrastructure and coastal biodiversity.

Hurricanes and cyclones are also a threat to tourist sites due to coastal erosion and flood impacts over the Caribbean coast, but future trends are unknown as of this assessment. In a study by ECLAC in 2010, extreme events, such as Hurricane Mitch, caused indirect losses to tourism in Guatemala amounting to $15.5 million, and $8.9 million in El Salvador.

3.2.4 MANUFACTURING

Climate change analyses for the manufacturing and industrial sector are mostly related to the potential role of increased demand for energy and energy efficiency for greenhouse gas emissions reductions. Impacts to these sectors under future climate scenarios are linked to changes in water availability, and indirect relationships with water availability for power generation, impacts to transport, and labor-related health issues, as well as changes to product markets. Mostly, industrial demand for energy will be indirectly impacted by changes in water availability for hydro-power production and impacts to other sectors such as agricultural and forestry, which provide raw material inputs (CEPAL et al., 2015).

3.2.5 WATER AND ENERGY

Reduced water availability is one of the region's main threats affecting drinking water, irrigation and hydropower generation. Increases in aridity are expected for more than 40 percent of the municipalities by 2050 over the "Dry Corridor" close to the Pacific Ocean and expanding towards the Atlantic Coast (CEPAL, 2012). The number of dry months currently do not exceed six months per year over drier areas, but can expand and increase in severity up to more than eight dry months per year over the

Trifinio area shared by El Salvador, Honduras and Guatemala (CEPAL, 2012). Regional studies using complex hydrological models projected increasing or severe drought in the northern part of the region (Hidalgo et al., 2013); decreases runoff in the Mesoamerican region and the highlands of Nicaragua, Honduras, and Guatemala (Imbach et al., 2012); and reduction in electricity generation in the catchments associated with the Lempa and Chixoy rivers (CEPAL, 2012; Maurer et al., 2009).

Cloud forests cover a large fraction of regional highlands (Mulligan and Burke, 2005) and account for up to between 6 and 35 percent of additional water to total rainfall (Bruijnzell, 2005). They also play an important part of the regional hydrological budget (Imbach et al., 2010), in particular with dry season base flows of the Pacific watersheds (Hastenrath, 1966), which can be affected by land use (Lawton et al., 2001) and change in climate stressors.(Karmalkar et al., 2008).

Global-scale studies indicate that 1-27 million people in Mesoamerica could experience water stress by 2025 and 33-70 million by 2055, (Arnell, 2004). A regional study estimated that the percentage of people under water stress could increase from 15 percent to 45 percent by 2050 and 4 percent by 2070 (Imbach et al., 2015a). Stressed catchments under future scenarios cover large areas of Honduras, El Salvador, and Guatemala, as well as the capital cities of other countries (Imbach et al., 2015a). Because many of these catchments cross borders, there is a potential for increased conflict over water resources among countries in the region (Wolf et al., 2003).

The Pacific watershed of northern CA, including north-west of Nicaragua, El Salvador, west Honduras and most of Guatemala have a climate that is relatively drier compared to Costa Rica and Panama (with the exceptions of Guanacaste Province in Costa Rica and Azuero in Panama). In these areas, the effects of reduced water availability are expected to be greatest in large cities and populated areas dominated by rural livelihoods dependent on subsistence agriculture. The significance of these changes depends on current water availability. For example, a 20 percent reduction in runoff over the Atlantic watershed of Costa Rica still leaves large amounts of water available, whereas for Trifinio, or other parts of the Dry Corridor, reductions will occur in an already stressed environment. Furthermore, a rain shadow affects the Pacific side of the mountain range, as most rainfall occurs over the Caribbean watershed. As a result, less humidity moves towards the Pacific. A significant portion of water over the Pacific side comes from underground resources, which recharge during the rainy season. Cloud forests also play an important role for total available water, but conclusions about potential changes in cloud height or frequency are yet available.

Studies accounting for detailed water budgets that include cross-sectorial demands are lacking, as well as the efficiency of adaptation measures. For example, large cities might be the most stressed by access to drinking water but have access to financial resources and institutions to infrastructure measures relative to rural areas where other adaptation measures might be more or less effective (i.e. ecosystem based adaptation). Reduced water availability will likely increase competition between poor producers, industry, mining, urban demand, environmental protection, indigenous groups, and others for resources and require cross-sectoral planning and adaptive management (IARNA, 2010). Reduced rainfall, for example, will increase demand for irrigation water while reducing supply of water for cities and hydropower. Reduced water and biomass availability under future climate change scenarios poses a challenge for the role of renewable electricity sources and household energy (IARNA, 2010). Electricity generation depends on hydropower (40%), where Costa Rica leads production, following fossil fuels (47%) (IARNA, 2010). ***Section 2.2.5*** provided additional information on the use of biomass / firewood in the region.

CEPAL (2012) highlighted how precipitation impacts water availability and how temperature increases evapotranspiration in El Salvador and Guatemala, resulting in significant reductions in water availability for hydropower production. The researchers estimate that by 2020 the hydropower production could be reduced by 20 percent due to decreased water availability. Likely reductions in water availability

across most of the region will reduce energy outputs and seasonal availability requiring investments in improved energy efficiency, additional hydropower facilities or new sources (oil-based thermal plants or other renewable sources).

3.2.6 TRANSPORTATION

Transportation assets tend to be more sensitive to extreme events, such as storm surges, heavy precipitation events, heat waves, and high wind events rather than to incremental changes in the mean of the climate variables (USDOT, 2012). Different climatic change affects, such as extreme events, will likely have a range of diverse impacts on transport infrastructure and services. The IDB-supported Road Sector Support Program: Developing Adaptive Capacity for Climate Change in Nicaragua, states that road infrastructure is increasingly affected by changes in climate stressors, and the economic impacts, especially from severe rainfall events, are often substantial, mainly through loss of access due to damage to roads, culverts, and bridges. In its 2015 INDC, Costa Rica said its road infrastructure has experienced the largest impact from climate change out of all sectors. The highway, which connects San José with the Caribbean Coast, and crosses the central mountain chain, is closed several times a year due to landslides.

3.2.7 HUMAN MIGRATION

Impacts of climate variability on human migrations have been poorly studied in Central America. Hurricane Mitch, for example, drove a large increase in migration from Honduras and Nicaragua (FAO, 2001). More recent studies for Costa Rica and Guatemala showed that hydro-meteorological emergencies increase migration above its average (Robalino et al., 2015). Less severe events can increase migration towards urban areas (Robalino et al., 2015) due to effects on conditions across rural territories, particularly food security issues (Lozano et al., 2014). Expected increased climate variability will likely induce changes in migration rates.

3.2.8 HEALTH

Climate change is expected to affect health directly (e.g., heat waves or hurricanes), indirectly (e.g., through changes in air, food, and water quality or vector ecology), and through social or economic perturbations (CEPAL, 2012). Pathogens, such as soil-transmitted helminths, Leishmaniasis, Chagas, onchocerciasis, cysticercosis, and leptospirosis are of importance for CA, particularly linked to indigenous groups, and linked to the absence of basic needs, deforestation, desertification, and migration (Hotez et al., 2008). Water stress and extreme events are also associated with vector-related diseases such as dengue diarrhea and other health issues (Magrin et al., 2014).

ECLAC (2012) determined that the groups of people most affected by exposure to high temperatures are those over the age of 75, people with previous illnesses or living alone, indigents, and people of low socioeconomic status in general. In Nicaragua, there have been several floods that cause outbreaks of leptospirosis, which in most cases cause mild infections, but can develop complications with a mortality rate of up to 40 percent. Studies by the Ministry of Health of Costa Rica in 2008, found that the diseases associated with climate change can bring about high costs in health care, with diseases like dengue, malaria, asthma, diarrhea, and abdominal angiostrongylosis. Health services are highly vulnerable to extreme events, not only because of existing budget deficits but also because of the characteristics of the environment. Only El Salvador and Costa Rica have national policies that seek to ensure their respective hospitals are safe environments during emergencies. These two countries and Nicaragua also have specific norms for planning hospital responses to disasters (COMISCA, 2010). Otherwise, there are few studies assessing the impact of changes in climate stressors on health in the region.

3.2.9 FORESTS AND COASTAL ECOSYSTEMS

Global studies indicate a potential loss of forest cover and an increase in wildfire frequency due to changes in climate stressors (Scholze et al., 2006). Ongoing processes of landscape degradation result from overexploitation of woody coverage across agricultural fields, forest degradation, and deforestation (Díaz et al., 2013), and could be exacerbated by reductions in vegetation primary productivity and available biomass due to increased water stress as temperatures rise. Reduced biomass under drier conditions would also affect the availability of firewood. Since many rural people depend on firewood, their livelihoods could be threatened and their collection of firewood could threaten remaining forests. In Guatemala, Nicaragua, and Honduras, 85 percent of households use firewood (IARNA, 2010).

Nicaragua has the highest deforestation rates, while Costa Rica and El Salvador seem to be recovering forest cover. Degraded lands cover an estimated 59 percent of Guatemala, 38 percent of Honduras, and 30 percent of Costa Rica (Magrin et al., 2014), which also impact forests via land-use threats. Changes in the ranges of crop production, for example upslope shifts for coffee, will also impose a threat to highland forests and the provision of ecosystem services they currently provide.

Forest dieback under changes in climate stressors similar to that expected for Amazonia (Cox et al., 2004) has been suggested for dry and relatively small areas in Honduras and Guatemala. Plot-level observational studies generally agree with regional studies that show shifts in the composition of highland tree species towards warmer-lowland community assemblages (Feeley et al., 2011). With an increase in deciduous, compound, and canopy species (Enquist and Enquist, 2011), and reduced wood production due to lower precipitation during the dry season and increased minimum temperatures (Clark et al., 2010), conifer species could show improved primary productivity leading to potential benefits (IARNA, 2010).

Assessing changes in climate stressors' effects on biodiversity and ecosystems integrate a range of scales, from genes to biomes, across which spatial, temporal, and individual responses occur (Bellard et al., 2012). Regional studies focused on assessing impacts on potential ecosystems using correlative Holdridge Life Zones system (Holdridge, 1947) and mechanistic (Neilson, 1995) approaches.

Changes in natural ecosystems will affect species migration processes. Large-scale landscape management will be required to establish and improve connectivity pathways for the species that could be affected. Forests fires are part of the natural cycle but in some areas may be modified by human activities and climate variability that is exacerbated by climate change (IARNA, 2010). These changes may develop feedbacks that result in changes in natural ecosystems that cause shifts to or from drier types and exacerbate threats to biodiversity.

Impacts of climate change on the marine-coastal system may affect coral reefs, seagrass, and wetlands biodiversity (Hoegh-Guldberg and Bruno, 2010; BIOMARCC-USAID, 2013). Mangroves also present important and unique biodiversity as well as ecosystem services. Coverage loses associated with diverse uses, including unsustainable aquaculture and infrastructure affect these ecosystems. Their high value to fisheries, as shown in ***Section 3.2.2*** on fisheries, reveals the important value of mangroves. That value is reported to be approximately $37,500 per hectare and does not include other benefits from mangroves such as those related tourism, storm, and flood mitigation (Aburto-Oropeza et al., 2008).

Projected precipitation changes on wetlands will mainly affect the hydrology of individual systems, as freshwater contributions will reduce intertidal wetlands salinity. This, in turn, will affect nutrients and sediments needed to generate favorable habitat conditions for plants survival, affecting species composition, richness, and wetland productivity. Temperature changes will create coastal wetlands loss due to sea level rise and increased shoreline erosion (Erwin, 2009; Lovelock and Ellison, 2007).

3.2.10 NATURAL DISASTER AND EXTREME EVENTS

Impacts of historical climate variability usually relate to natural disasters (CEPAL et al., 2015). During 2000-2009, 39 hurricanes occurred in the Caribbean basin compared to 15 and nine in during the 1980s and 1990s, respectively (UNEP-ECLAC, 2010). The enormous economic and human costs of natural disasters result mostly from extreme vulnerability that originate in CA/DR's population patterns, level of socioeconomic development, and inadequate risk management policies (Charvériat 2000). Maynard-Ford et al. (2009) mapped disasters in CA/DR caused by floods, earthquakes, windstorms, volcanoes and landslides between 1900 and 2007. They found that floods had occurred most frequently on the Atlantic coast and large river basins. Windstorms, mostly hurricanes and tropical storms, affected the DR severely and most of CA moderately. Droughts occurred predominantly in the "drought corridor" of CA along its western coast. Landslide disasters occurred mostly on densely populated, mountainous terrain of CA/DR, especially in El Salvador. ***Table 10*** compares population density against natural disaster density.

Since 1970, the number of natural disasters in CA/DR has increased. Natural disasters disproportionately affect the poor because they usually live in environments and shelters that are more vulnerable to windstorms, earthquakes, landslides, and flooding (Ferris 2009). One study determined that a large portion of the population in CA/DR is at risk from natural disasters: 95 percent of Salvadorians; 92 percent of Guatemalans, 85 percent of Costa Ricans, 69 percent of Nicaraguans and 56 percent of Hondurans.

Table 10: Population Density and Natural Disaster/100 km^2 in CA/DR, 1900-2009

Country	Population/km2	Disasters/100 km2
Belize	13	0.061
Costa Rica	83	0.091
Dominican Republic	197	0.076
El Salvador	341	0.174
Guatemala	120	0.044
Honduras	68	0.046
Nicaragua	48	0.035
Panama	43	0.035

Source: (Maynard-Ford 2009)

The fires that occur in CA/DR during extended droughts are a natural disaster to both humans and ecosystems. A lot of fires are man-made however, caused by burning to clear fields or to facilitate hunting. Between 2003 and 2012, 632,700 ha of forest in CA/DR were burned. Nicaragua, Guatemala and Honduras had the most area burned. The Pacific lowlands, the "Dry Arch" in Panama, the areas of José del Carmen Ramírez, Juan B. Pérez Rancier, Armando Bermúdez, Nalga de Maco, the Haitises National Park, and the Sierra de Bahoruco and Sierra de Neyba of the DR have been the areas most affected by fire (Gomez and Saenz, 2009; FAO, 2015b). CA/DR countries do not have enough trained personnel, equipment, or funds to operate an effective fire control program.

In 1998, Hurricane Mitch caused $4 billion of agricultural losses to Honduras (Telford et al 2004). In 2009, Tropical Storm Ida caused economic losses in El Salvador of $315 million (GES, 2009). In El Salvador, between 1981 and 2007, 30.4 percent of deaths related to natural disasters were due to hydrometeorological events and in 2001, the total economic impact of natural disasters represented 14 percent of its GDP (Cabrera, 2008).

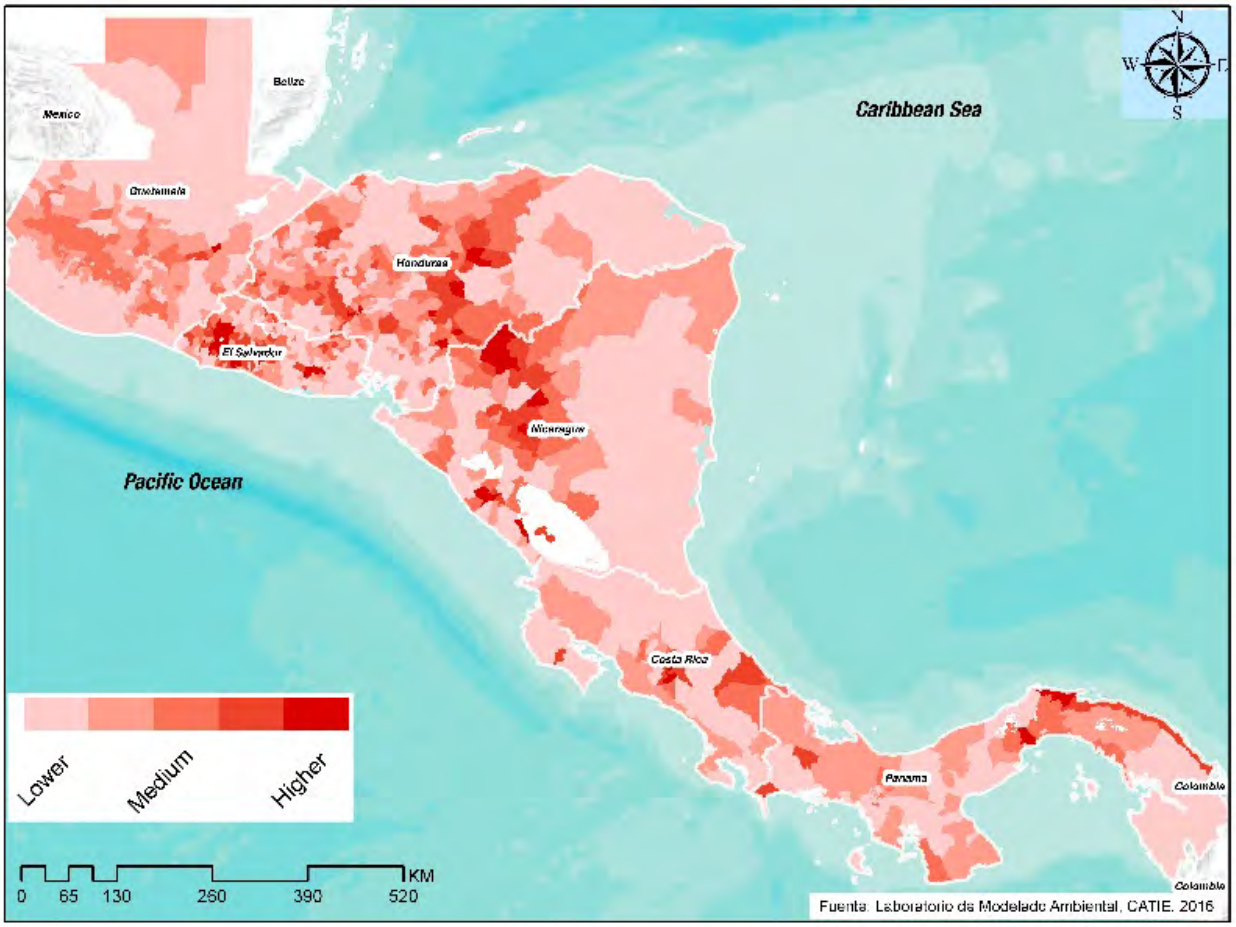
3.3 INDICATORS OF VULNERABILITY AND ADAPTIVE CAPACITY

In this section, we present a selected series of comparable indicators used to develop regional spatial analysis related to impacts to: agriculture, water, coastal, forests, and biodiversity resources. Exposure and sensitivity together describe the potential impact that changes in climate stressors can have on a system (Fellmann, 2012). Similarly, indicators were selected and mapped to provide a general adaptive capacity map of the region. All of these indicators are mapped at the level of municipal boundaries. Although we provide an overview under each section below as to how these maps were developed, important additional details on the methods used and limitations can be found in ***Annex C***.

3.3.1 AGRICULTURE

The potential impact of changes in climate stressors on the region's agricultural sector were identified by evaluating changes in the area suitable for the cultivation of maize, beans, coffee, cassava, and plantain within each municipality for all countries in the region. The area suitable for crop production is commonly used as an indicator of potential agricultural productivity. Crop suitability changes were weighed by the fraction of each crop area of total agricultural area within each municipality.

Figure 1: Average Change in Crop Suitability (absolute values) under Climate Change Scenarios (2050, RCP 4.5 intermediate emissions scenario)

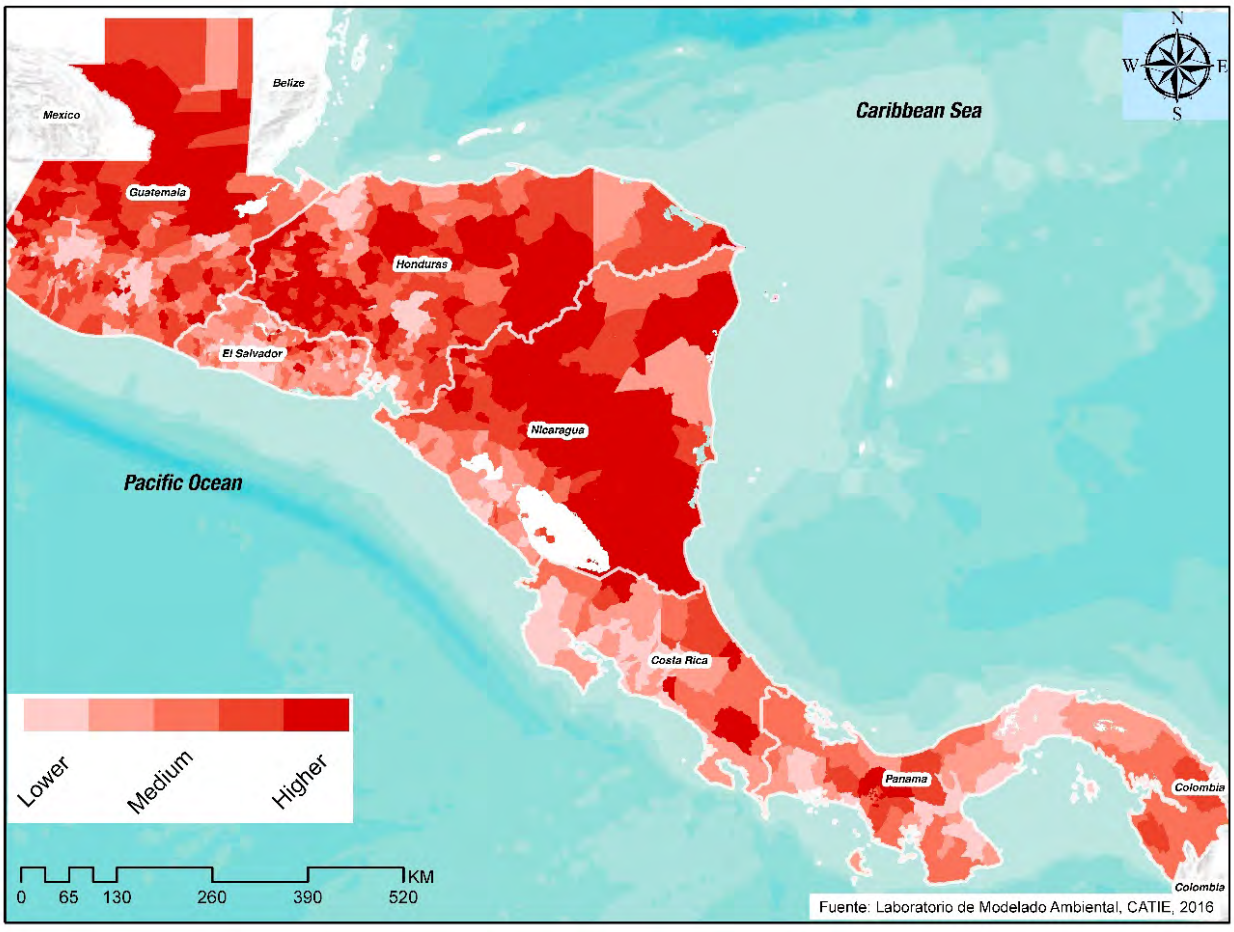


Crops assessed were coffee, maize, beans, upland rice, sorghum, plantain, and cassava. Data from Bouroncle et al., (n.d.). Using absolute (i.e., no positive or negative sign) considers that both increases and decreases in suitability imply changes in rural livelihoods, either by crop productivity loss or increased productivity that can displace other crops, and that both cases require adaptation.

As shown in ***Figure 1***, results indicate that the largest changes in the area suitable for crops are likely to occur over the highlands of Nicaragua, Honduras, Guatemala, and El Salvador. Relatively smaller changes are projected for Costa Rica. This is because Costa Rica cultivates mostly non-traditional and export crops that were not assessed. Costa Rica, El Salvador, and Nicaragua could suffer suitability losses of 40 percent or more of their current coffee areas (Läderach et al., 2010). Honduras and El Salvador expect declines in maize yields across all production areas, and Nicaragua and Honduras expect losses of around 14 percent for beans, whereas Guatemala could see increases in bean productivity given its relatively large highlands (Eitzinger et al., 2013).

Rural livelihoods that are highly dependent on the agricultural sector can be assumed to be more sensitive to changes in crop suitability. Urban areas also rely on agricultural products from rural areas, but income is usually more diversified and relatively higher, and therefore urban areas are assumed to be relatively less sensitive. ***Figure 2*** shows the fraction of the economically active population that depends on the agricultural sector and can be a general proxy for sensitivity to changes in crop suitability. For Guatemala, Nicaragua, and Honduras, sensitive areas correspond to those with largest changes in crop suitability except when they are close to large cities. Although Costa Rica shows sensitive areas there is a larger fractions of crops (non-traditional and for export) that are relatively less subject to change (IARNA, 2010).

Figure 2: Fraction of Economically Active Population that Depend on the Agricultural Sector

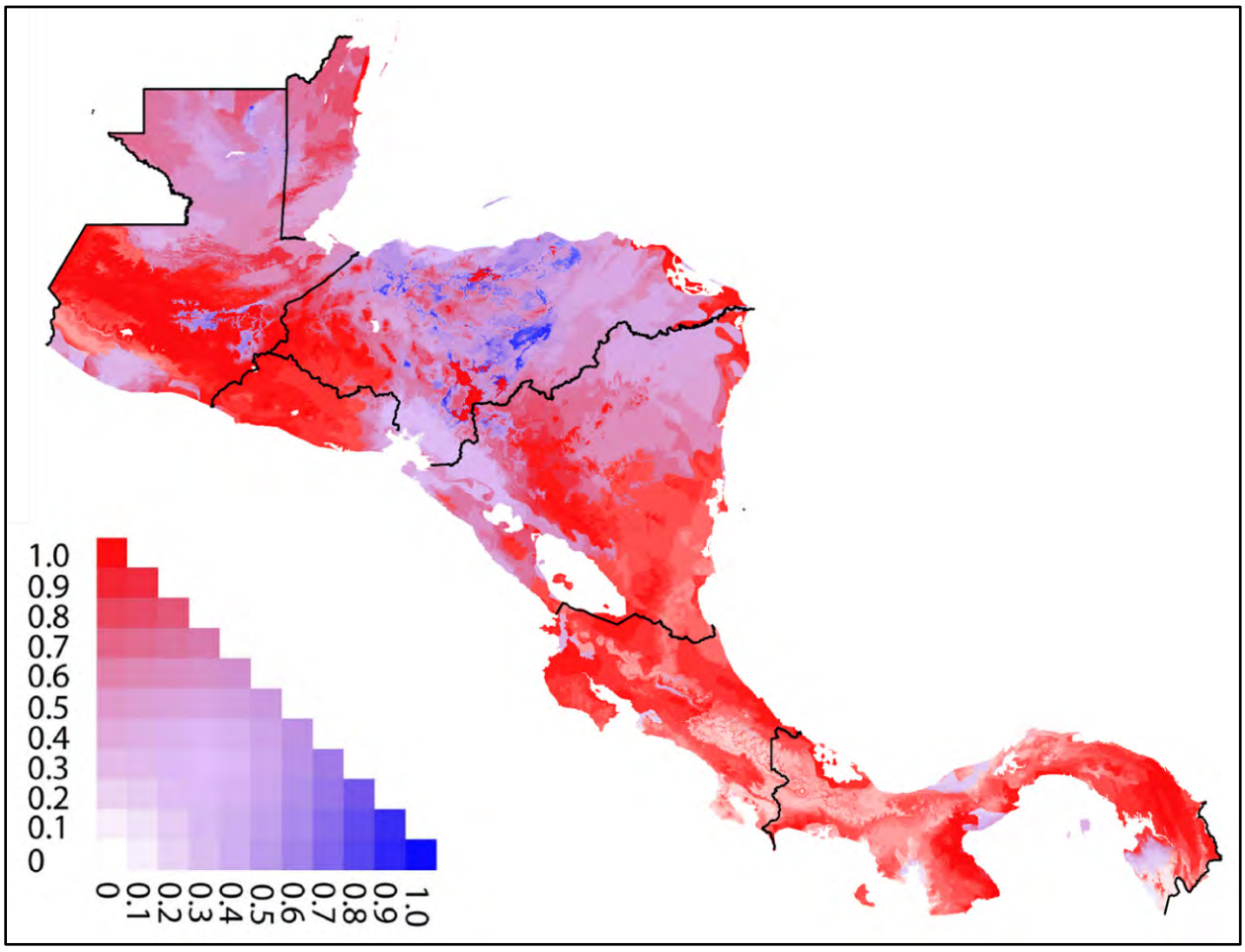


Data from (Bouroncle et al., n.d.)

3.3.2 WATER RESOURCES

Estimates of runoff were used to produce potential changes in the availability of water across the region in response to projected increased future temperatures, resulting in higher evapotranspiration, and reduced precipitation. ***Figure 3*** shows the likelihood of a change in runoff of 20 percent or more in 2050 relative to historical conditions assuming an intermediate emissions scenario (RCP 4.5). Runoff here is broadly defined as precipitation minus evapotranspiration, representing water available for human use (in soil moisture, rivers, percolated to aquifers and surface runoff). Reductions in runoff are most likely: (1) over the highlands of Guatemala, most of El Salvador, and the Trifinio area shared with Honduras; (2) most of Costa Rica and south Caribbean watershed of Nicaragua; and (3) dry areas of Panama and areas east of the canal close to Colombia (Darien). Changes in water availability relate to the use of water resources and are sensitive to areas of high population density because of the human consumption of, and industrial and urban area demands for, water.

Figure 3: Likelihood of Runoff Change of Magnitude Larger than 20% Compared to Present-Day Conditions under 2050 Projected Climate Conditions for the Downscaled CMIP5 Ensemble of 19 GCM Models (all for the RCP 4.5 scenario)

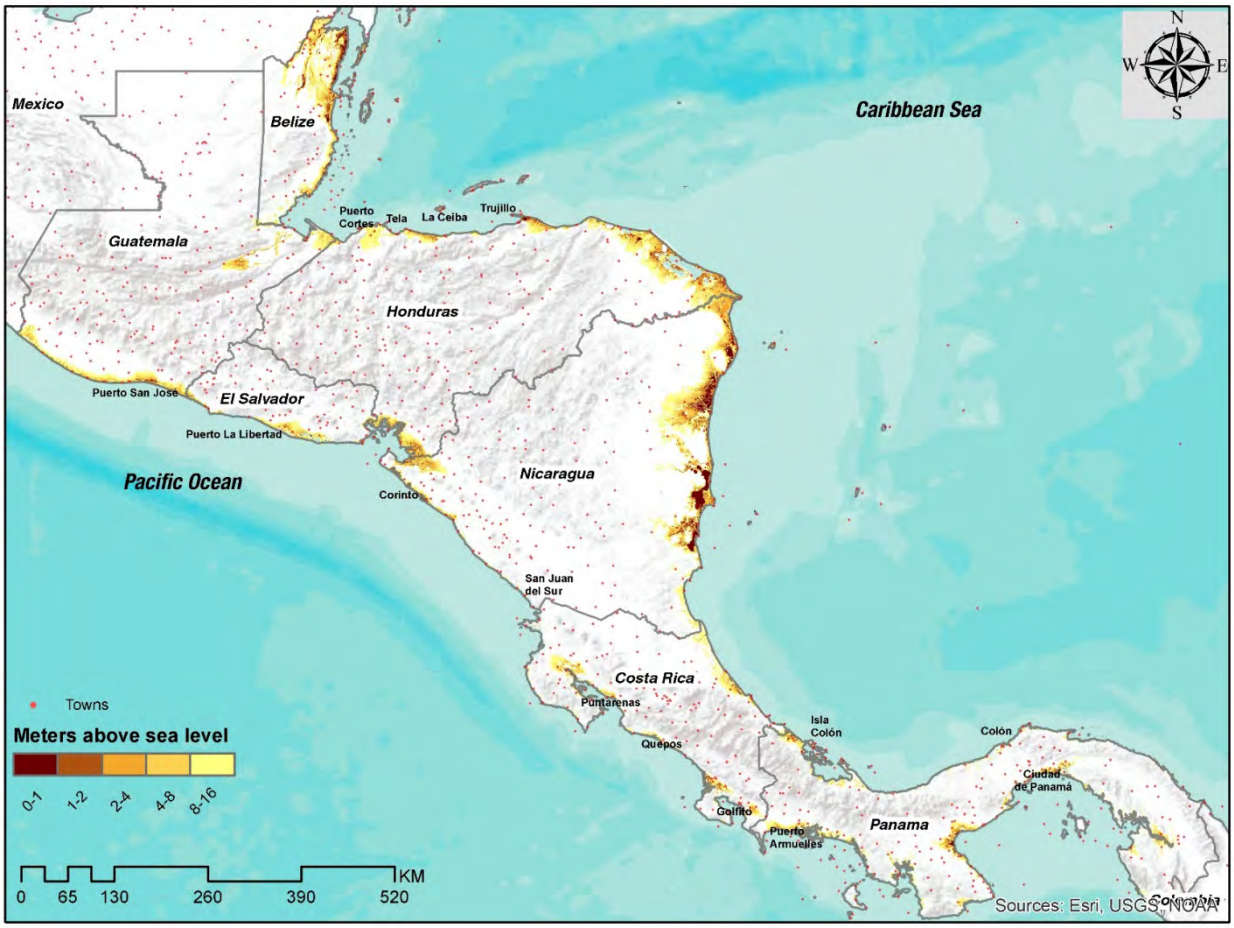


Prepared based on data from Imbach et al.(2015a).
Note: Legend for the Color Grid
Horizontal axis – fraction of scenarios showing an increase in runoff of magnitude >20%
Vertical axis – fraction of scenarios showing a decrease in runoff of magnitude <20%

3.3.3 COASTAL RESOURCES

Sea level rise will affect coastal areas where >30 percent of the total population currently lives (for El Salvador, Nicaragua, Costa Rica, and Panama). Potential impacts include flooding of coastal areas, particularly over the Atlantic, beach erosion, and reduced reliability of ports and coastal infrastructure over the Pacific (Magrin et al., 2014). Sea level rise combined with decrease freshwater availability can increase salt-water intrusion into coastal aquifers (Reyer et al., 2015). Elevation above sea level was mapped for coastal areas across the region using a digital elevation model (Jarvis et al., 2008). ***Figure 4*** indicates that Honduras has the highest concentration of cities exposed to and already experiencing sea level rise impacts in the Caribbean (Puerto Cortéz, Tela, Ceiba and Trujillo) followed by Panama (Isla Colón and Colón). The Pacific coasts have Ciudad de Panamá and Puntarenas, Quepos and Golfito (in order of population size) at low elevations. San Juan del Sur and Corinto in Nicaragua, Puerto La Libertad in El Salvador and Puerto San José in Guatemala could also be potentially impacted by sea level rise.

Figure 4: Cities Exposed to Seal Level Rise in Central America



Coloring indicates meters above sea level of coastal areas of Central America using a digital elevation model (Jarvis et al., 2008). There are no SLR scenarios that could be associated with these contours due to limitations in estimating the effects of rise in sea level to loss of coastline resulting from a combination of factors (coastal geomorphology, wind speed, surge storms, wave size, etc.)

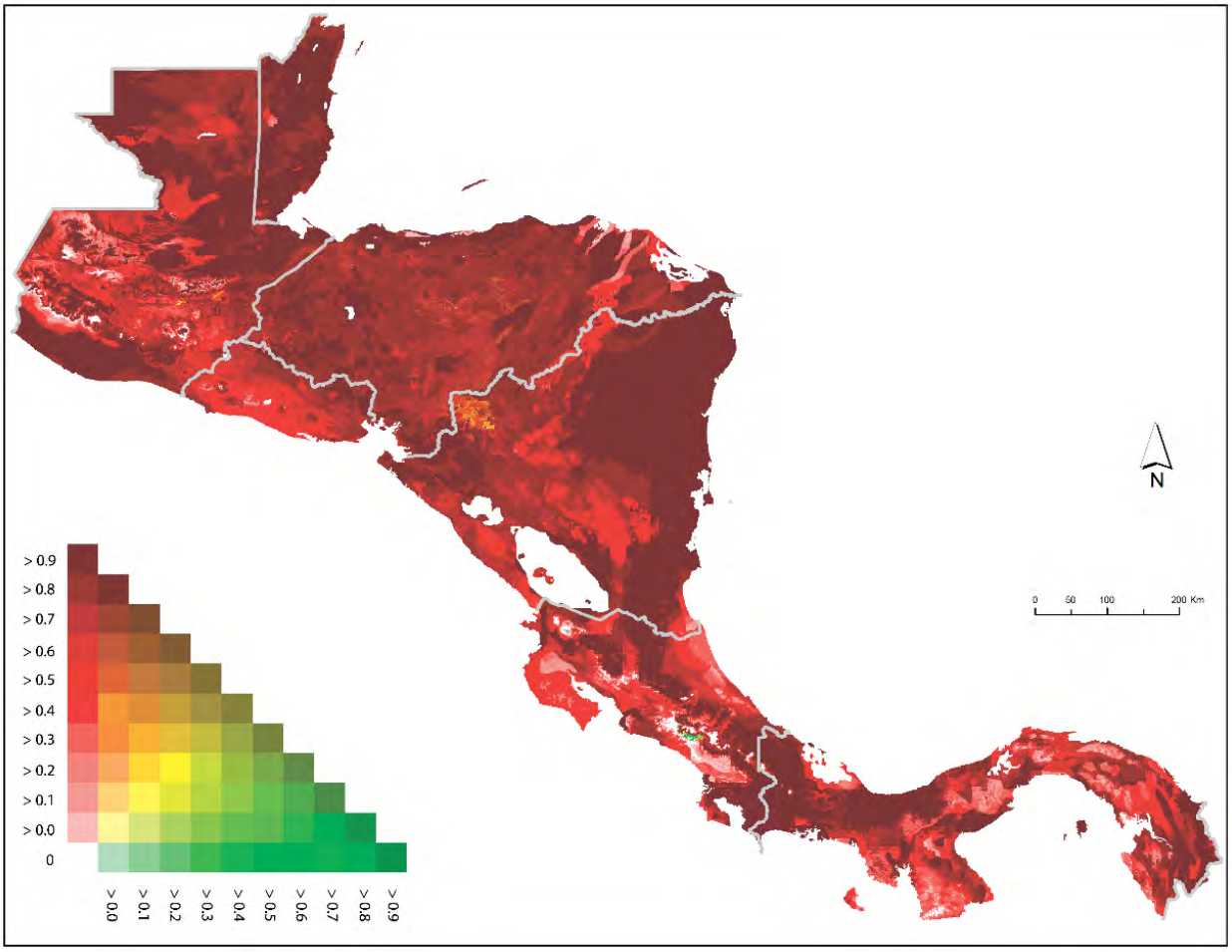
As a result of climate change, countries have implemented measures to reduce its impact on tourism. For example, in Nicaragua, a government proposal was approved that sets a restriction zone to build in

a space of up to 200m from the shore. Likewise, Panama has designed a Master Plan for the Sanitation of the Bay of Panama, covering some 350km^2, five rivers, and 65 watersheds (ECLAC, 2010).

3.3.4 FORESTS AND BIODIVERSITY

Anderson et al., (2008) mapped species richness for birds, mammals and amphibians in the region, showing a range of 22 to 680 species, with higher values over the Caribbean watershed and lowlands of Costa Rica and Panama. Species richness showed lower values for highlands and the drier pacific lowlands of Nicaragua, El Salvador, Honduras, and Guatemala, although they have the highest number of endemic species (2-26 species). Although Anderson et al. (2008) mapped critical areas for biodiversity, their study used few future scenarios and assumed linear responses of biodiversity to climate anomalies, limiting the significance of their results. Land use and climate change are the main threats to the region's biodiversity. Imbach et al. (2012) found a general expansion of drier ecosystem types from the Pacific watershed towards the Atlantic, with likely reductions in Leaf Area Index (LAI) in 77-89 percent of the region across CMIP3 scenarios towards the end of the century. Changes in LAI were evaluated under future climate scenarios as a proxy for changes in forest ecosystems and biodiversity.

Figure 5: Fraction of Simulations in 2050 RC P4.5 Scenarios Showing at Least 40% Change in Leaf Area Index (LAI) across 19 Future Climate Scenarios



Copied with permission from Imbach et al. (2015b)
Note: Legend for the Color Grid:
Horizontal axis – fraction of scenarios showing an increase in LAI of >40%
Vertical axis – fraction of scenarios showing a decrease in LAI of <40%

Figure 5 indicates a higher likelihood of LAI reductions over the: (1) Caribbean watershed in Panama (west of the canal), Nicaragua, Guatemala, and Belize; (2) coastal areas of Honduras; (3) Pacific watershed of Guatemala; and (4) highlands between Costa Rica and Panama. Reduced biomass will affect firewood availability for households over most of Nicaragua, Honduras and Guatemala. Increased water use efficiency could significantly reduce these impacts, but the process is poorly understood for tropical areas at the ecosystem scale.

3.3.5 ADAPTIVE CAPACITY

The indicators used to map adaptive capacity throughout Central America were the fraction of people with access to potable water, level of education, and demographic dependency (ratio of active vs. older population). Each of these indicators is shown in ***Figure 6*** and discussed below.

ACCESS TO POTABLE WATER

Access to potable water is assumed to be related to the capacity to adapt and adjust to changing conditions in one's current location. Weak access to potable water is found in general over the less populated areas with most of the countries forest cover: (1) in northern Guatemala, (2) most of Honduras except for particular municipalities with exceptionally high values, (3) throughout El Salvador except for eastern coastal municipalities and near the capital, (4) Caribbean watershed of Nicaragua, (5) central northern areas of Costa Rica and the great metropolitan area (including the capital), and (6) Caribbean watershed of Panama and west of the Panama canal.

LEVEL OF EDUCATION

Level of education is assumed to be related to the capacity to innovate and adapt. Costa Rica shows high levels of education over most of the country, and Panama shows them closer to large urban areas (e.g., David and Panama City). El Salvador, Nicaragua, and Guatemala concentrate higher levels of education for municipalities closer to the capital city. Honduras follows the same trend with high education dispersed close to the largest cities.

DEMOGRAPHIC DEPENDENCE

The demographic dependency ratio is assumed to be related to the capacity to innovate (e.g., develop and implement adaptation strategies) and can be related to migration of the active population from rural to urban areas or other countries, which also could potentially limit development of rural areas of Central America.

High demographic dependence is found over northern Guatemala, less populated areas of Nicaragua and Honduras, and most of El Salvador. Potential reasons are high migration rates to urban areas or North America and/or large number of children per family compared to the fraction of people within working age. Certain areas in Costa Rica and Panama with high demographic dependency are located in indigenous areas. The region presents a north to south decreasing development gradient that is reflected in its adaptive capacity, with Costa Rica and Panama under relatively better conditions and Nicaragua, El Salvador, Honduras and Guatemala with relatively lower adaptive capacity. Within each country rural areas have relatively lower adaptive capacity than urban areas and their surroundings.

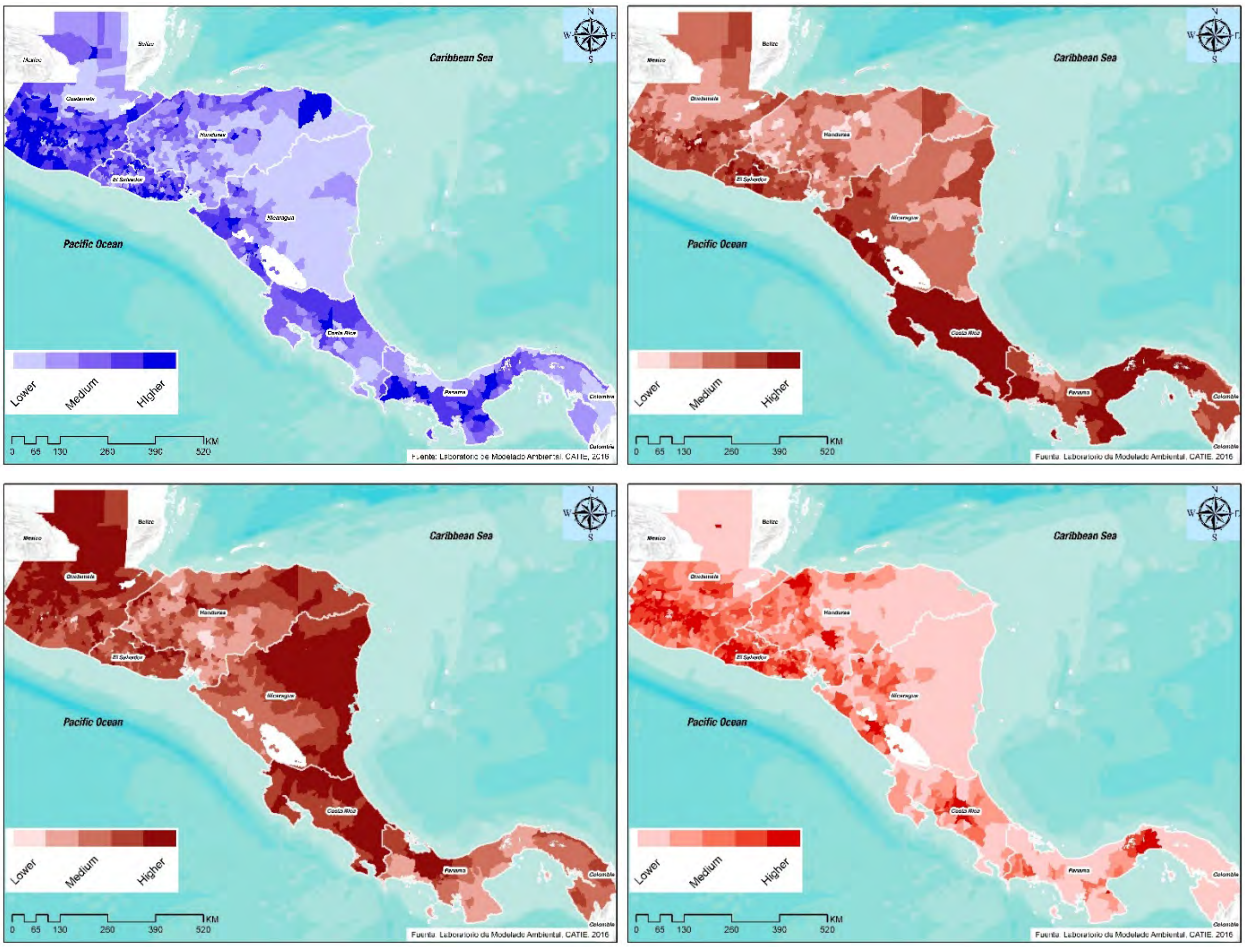
COMBINED

Figure 7 maps the adaptive capacity index, based on mean values for three indicators presented in ***Figure 6***, and assuming equal weights for indicators. Data are standardized for each country in order to account for the north-south development gradient of Central America (Hidalgo and Alfaro, 2012). The adaptive capacity index, and indicators, were rescaled for each country to allow the assessment of

spatial gradients within each country. Population density was also mapped in ***Figure 6***, using data from latest population censuses (2000, 2001, 2002, 2007, 2005, and 2010).

Panama shows relative lower adaptive capacity east of the Panama Canal and over the Caribbean side near the Costa Rica border. Higher values are over municipalities with larger cities. Costa Rica shows the most homogeneous pattern with relatively high values. Nicaragua shows lower values over the less densely populated Caribbean watershed and higher values closer to Managua. Honduras show relatively lower values across most of the country except for smaller municipalities with larger cities. El Salvador shows relatively lower values close to the Guatemala and eastern Honduras border. Guatemala shows lower values for the northern central-highlands and south of the Mayan Reserve Biosphere. Higher values are found within lower adaptive capacity areas on the Caribbean of Nicaragua and Honduras over municipalities mostly covered by forests and low population density.

Figure 6: Maps of Demographic Dependency, Level of Education, Population Density, and Fraction of People with Access to Potable Water

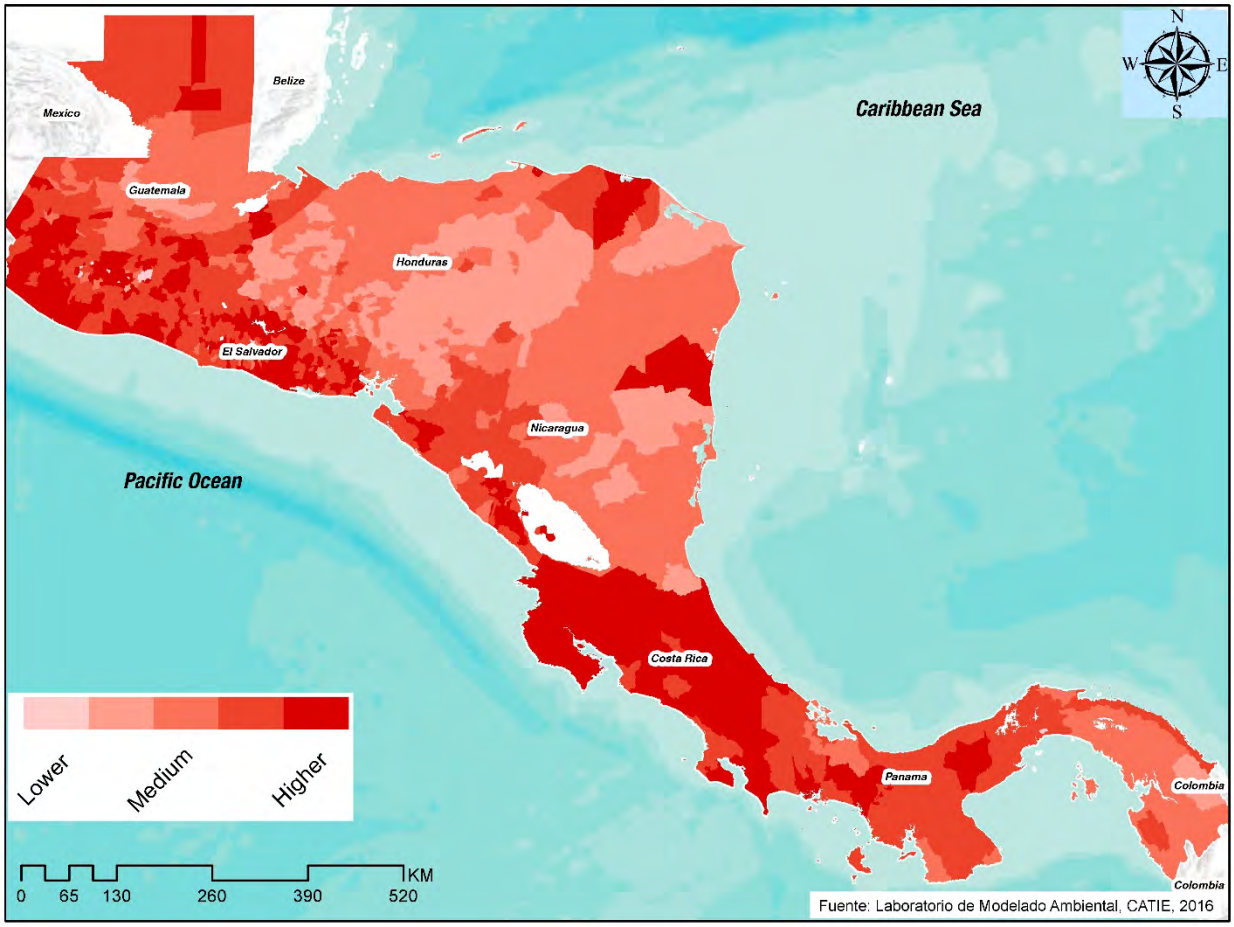


Fraction of people with access to potable water (top-left), level of education (top-right), and demographic dependency (ratio of active vs. older population) (bottom-left). Population density is shown in bottom-right. Data from Bouroncle et al. (n.d.).

Figure 7 indicates the adaptive capacity in CA as estimated from the mean indicator values for access to potable water, level of education and demographic dependency. In other words, if people have more access to potable water, more education and more self-dependence for their livelihoods, they will be

able to adapt to climate change more easily and will be more resilient. Bearing in mind that ***Figure 7*** shows spatial gradients within each country, the darker red areas are where people in general are more resilient to climate change and the light red areas are where people are less resilience to climate change. Almost all of Costa Rica is colored dark red, because most of its population has access to potable water, are well-educated and are economically self-dependent. By contrast, much of Honduras is colored light-pink, because its population has less access to potable water, less education and more commonly dependent on others for their livelihoods.

Figure 7: Adaptive Capacity in Central America Estimated from Mean Indicator Values for Access to Potable Water, Level of Education and Demographic Dependency



3.4 SYNTHESIS OF VULNERABILITY

According to the IPCC, the vulnerability of a system to climate change is a function of its exposure to climate change and variability (including climate extremes), the sensitivity of the system to this exposure, and the system's adaptive capacity (Parry et. al., 2007).

Sufficient consistent quantitative data were not available to make it feasible to map the vulnerability of sectors throughout the Central America region. We have reviewed several country-specific studies, including those covering vulnerability in agriculture and suitable crop areas (see for example: Bouroncle,

et. al, 2014a; 2014b; 2015a; and 2015b). We have used similar approaches to develop indicators to the extent feasible to use across the region in the previous section.

In this section, we therefore provide a qualitative discussion of the vulnerabilities of the sectors described in ***Section 2*** in the short, medium and long term by geographic region. This discussion draws its conclusions from information provided in ***Sections 3*** and ***3.3***, information obtained from interviews, a review of such country-specific studies, and the assessment team's knowledge of the various regions and issues they face. ***Figure 7*** is particularly useful in the qualitative discussion of vulnerability because it shows what countries and regions within CA countries are more or less able to adapt to climate change.

AGRICULTURE

Section 2.2.1 describes how important the agriculture/livestock economic sector is to Central America, because it employs such a large part of the poor, rural population. Of the four climate stressors discussed in ***Section 3.1***, changes in precipitation, and to a lesser extent, changes in air temperature, are the two stressors that are projected to most affect agriculture/livestock. The types of crops that are likely to be most affected will vary by country, depending on the predominant crops and on the resilience of these crops to changes in climate. The resilience of the crops, in turn, is greatly influenced by the crop management practices, such as what varieties of the crop are planted, the quality of the seed, the fertility and structure of the soil and the crop cultivation and protection practices that are used.

Section 3.1 indicates that in the short-term, precipitation and temperature trends will remain within the bounds of the current "envelope" of weather variability. In the medium and long-term the projected trends produce less precipitation, longer dry seasons, and higher temperatures in most of CA. However, the western and southern coasts of CA receive less overall precipitation than the eastern and northern coasts and have a longer and more marked dry season. Changes in air temperature, moreover, greatly affect the quality and quantity of the coffee that is grown at higher elevations in all the Central American countries except Belize. In the short-term, therefore, the Pacific coastal sections of the Central American countries will need to increase their adaptive capacity to year-to-year variations in precipitation and temperature, and in the medium and long-term, to more sustained increases in air temperature and reductions in rainfall.

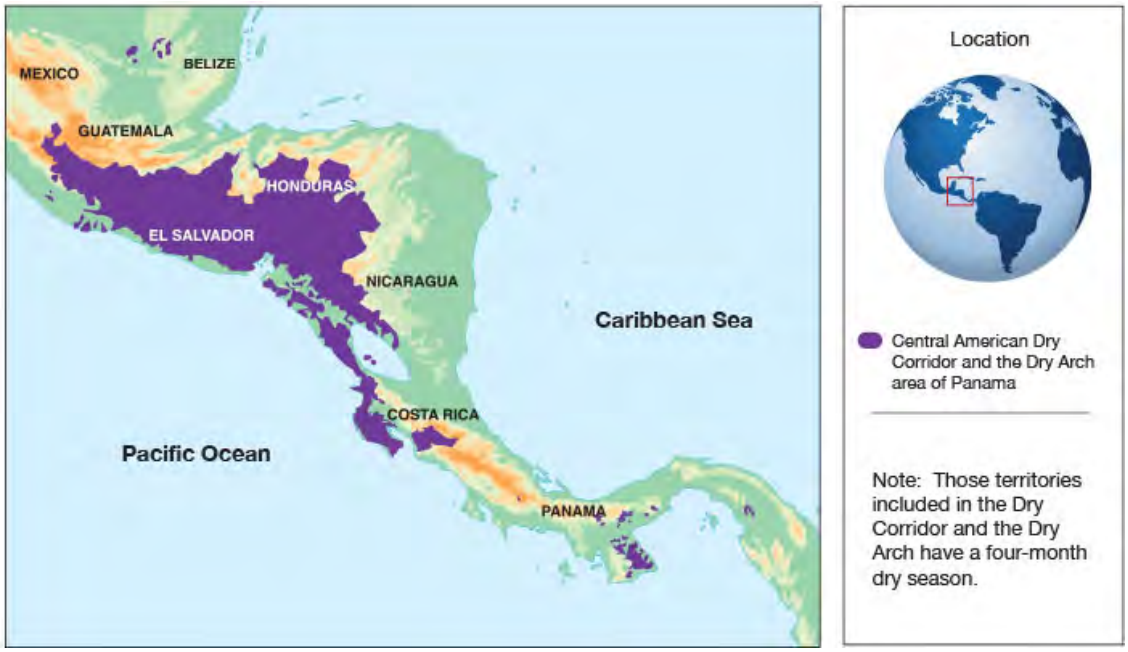
Figure 1 and ***Figure 2*****,** in ***Section 3.3.1***, indicate that while a higher proportion of the populations of El Salvador, Nicaragua, Honduras and Guatemala gain their livelihoods from agriculture than in Panama and Costa Rica, their adaptive capacity to deal with the effects of changes in temperature and rainfall is less. However, within the countries there are variations between regions and municipalities in adaptive capacity. Within Panama and Costa Rica, for example, the adaptive capacity of people living in indigenous territories is lower than people living outside of indigenous territories. In general, the vulnerability of the agriculture and livestock sectors in Central America to the effects of short-term weather variability and medium and long-term effects of changes in temperature and rainfall is greater in El Salvador, Nicaragua, Honduras and Guatemala than in Belize, Panama. In addition, indigenous territories, including in Costa Rica and Panama are also areas where this sector has greater vulnerability.

The "Dry Corridor of Central America" (see ***Figure 8*****)** is probably the part of CA that is most vulnerable to climate variability and change. According to the FAO (FAO 2015) the term Dry Corridor, "…has an ecological basis and defines a group of ecosystems in the eco-region of dry tropical forests in Central America covering the lowlands of the Pacific coastal area, and most of central pre-mountain region (i.e. foothills) of El Salvador, Guatemala, Honduras, Nicaragua, Guanacaste in Costa Rica and Panama's Arco Seco area." The principal risks to human welfare from climate in the Dry Corridor come from the recurrent droughts, excessive rains and severe flooding that affect agricultural production, especially in areas with degraded soils and vegetation. The FAO (2015) estimates that more than 1

million families in the Dry Corridor rely on subsistence farming. Most of these farmers farm subsistence crops, such as maize, beans and sorghum, and most of them farm less than 0.35 ha. Poverty and malnutrition affect a high percentage of these rural and indigenous farmers, since their livelihoods depend on production of basic grains that are significantly affected by climate variability and change.

Figure 8 also indicates that the Dry Corridor extends well up into the mountain ranges on the more western side of the CA isthmus. The Dry Corridor does not, however, include all parts of the Pacific coastline, where the soil and climatic conditions have been conducive to larger-scale mechanized farming, especially for sugar cane. Drought and crop losses effect farmers and communities along the borders shared with El Salvador, Honduras, and Guatemala, known as the Trifinio region. Climate change is expected to exacerbate droughts in the region, creating a threat to food security and rural livelihoods. The maps in ***Figure 8*** shows the Pacific side of Nicaragua is currently very dry, with a more compromised future in terms of water for agriculture. Also within the Dry Corridor, west of El Salvador is quite vulnerable since has the lowest adaptive capacity. Vulnerabilities will persist in North-Central Nicaragua, as it has high dependency on agriculture and low adaptive capacity. Also, in Guatemala and areas near El Salvador, low adaptive capacity increases vulnerability to drought and water resource availability.

Figure 8: Location of the Central American Dry Corridor



Source: IICA, 2015b, Based on the Central American Atlas for Sustainable Development

FISHERIES

Section 2.2.2 describes how important artisanal and industrial fishing is to CA economies, especially the marine fisheries that poor people along the coasts exploit and that depend on habitats in gulfs, reefs, and mangroves. ***Section 3.2.2*** notes how medium and long-term increases in sea surface temperature will negatively affect the growth of marine organisms. These habitats and their ability to allow marine organisms to reproduce and grow are influenced by changes in sea surface temperature. ***Figure 7***, in ***Section 3.2.4***, shows that in general adaptive capacity is higher along the Pacific Coasts than the Caribbean Coasts of Central America, with the exception of Belize. It also indicates that adaptive capacity is more uniformly high in Costa Rica than in the other countries. Overall, the vulnerability of

the Central America fishing sector is highest among the populations who depend on fishing and live in the gulfs of the Caribbean coasts of Honduras, Nicaragua and Panama.

TOURISM

Section 2.2.3 notes how tourism has become an important economic sector in the Dominican Republic, Costa Rica, Panama, and Guatemala, employing hundreds of thousands of people and bringing in millions of dollars of revenue. Tourism is also becoming more important to Belize's relatively small economy. ***Section 3.2.3*** discusses how short-term, catastrophic weather events, and projected medium and long-term increases in temperature and sea level rise (***Section 3.1.4***), could cause economic losses and/or reduced growth in coastal (beach) tourism in specific geographic zones. Catastrophic weather events, such as hurricanes and floods, are likely to continue to affect the tourist sector (infrastructure damage) more than medium or long-term climate trends in temperature, precipitation or sea level rise. ***Figure 7*** indicates that adaptive capacity is highest in general in the tourist areas of Costa Rica and Belize. The adaptive capacity of the Bay Islands of Honduras is low, although it is a major tourist destination. The vulnerability of the tourism sector in Central America is probably highest in the Bay Islands of Honduras.

MANUFACTURING

Section 2 indicates that manufacturing contributes a large percentage of the GDP in Costa Rica, the Dominican Republic, El Salvador, and Honduras and employees many people at relatively high rates of compensation. Flooding and storms can directly affect manufacturing by destroying factories and related infrastructure. ***Section 3.2.4*** points out that changes in climate stressors will mostly affect the manufacturing sector indirectly, particularly by reducing the amounts of water available for power generation and the reliability of transportation. Of the three countries where manufacturing contributes most importantly to the GDP, Costa Rica has the highest adaptive capacity. Adaptive capacity is variable in El Salvador and generally low in Honduras. The manufacturing sector is probably most vulnerable in Honduras, somewhat less vulnerable in El Salvador and least vulnerable in Costa Rica. Data were not available to evaluate the vulnerability of the manufacturing sector in the Dominican Republic.

ENERGY AND WATER

Sufficient and reliable supplies of energy are a basic requirement for economic growth, and ***Section 2.2.5*** emphasizes that hydropower is a predominate source of energy in Costa Rica and Panama, important in El Salvador, Honduras, Belize, and the Dominican Republic and distributed throughout Central America by the Central American Electrical Interconnection System (SIEPAC). However, firewood remains an important source of household energy in Guatemala, Nicaragua, and Honduras. ***Section 3.2.5*** concludes that in the medium and long-term the Pacific watersheds of northern Central America will be impacted more from reduced water availability for rain-fed and irrigated agriculture, energy production, and growth of biomass fuel than the Caribbean and Panama and Costa Rica watersheds, but that the specific impacts will depend on what proportion of the current potential water supply is already being used.

Although Costa Rica has the largest installed hydropower generating capacity, it also has the greatest adaptive capacity and has protected the watersheds of many of its hydropower plants, so its hydroelectric power may be the least likely to be degraded. Quantitative data were not available to assess the vulnerability of hydropower in DR. KIs, however, noted that changes in land use in the upper watersheds of the DR may be reducing the extent of natural vegetation and thereby the water regimes in the watersheds and that municipal governments there are becoming concerned about their supplies of water from these watersheds. Hydropower vulnerability is probably least in countries that are protecting many of its watersheds, such as Costa Rica. Hydropower vulnerability is probably highest in countries, such as Honduras and El Salvador, where watersheds are not being protected and

deforestation of watersheds is still occurring, reducing water availability, increasing variability of supplies, and impacting water quality.

TRANSPORTATION

Reliable, cheap, and secure transportation is another prerequisite for economic growth, and ***Section 2.2.6*** describes how high transportation costs are affecting economic growth negatively in Central American countries. ***Section 3.1.2*** notes that although regional climate models project increased length and intensity of the dry season and decreased rain within Central America's wet season, intensity of rainfall events is likely to increase as it has been during the past. In Central America, intense rainfall events already cause landslides across roads, thereby causing economic damage, and the increases in rainfall intensity, as noted in ***Section 3.2.6*** are projected to increase economic losses due to unreliable transport. Landslides that affect road transportation occur most frequently in areas with extreme rain fall events where roads cross steep, unstable slopes. Slopes tend to be more unstable where natural vegetation has been eliminated or degraded, thereby increasing the rate of water run-off. Such areas probably occur most commonly in the mountainous areas of El Salvador, Honduras and Guatemala, so the short-term weather effects and the short-, medium- and long-term effects of climate change on the transport economic sector are likely to occur mostly in those countries. The adaptive capacity of these countries in general is lower than Costa Rica and Panama, so these countries are the most vulnerable to the effects of weather events and climate change on the road transport sector.

HUMAN MIGRATION

Section 3.2.7 touches on how recent extreme weather events have increased migration in Central America, but concludes that there are insufficient data to project the effect of medium and long-term climate trends on migration.

HEALTH

Section 2.3.2 notes that overall poor, rural populations in Central America have less access to water and sanitation than urban populations but that the populations in Belize and Costa Rica have greater access to water sanitation and health care than the other countries. Changes in average temperature, reduced precipitation, and increased frequency of extreme events and the floods they can cause, are climate stressors that could increase incidence of a number of diseases. Since the impact of weather events, and of short-, medium-, and long-term decreases in precipitation and increases in temperature are projected to be greatest in the Dry Corridor shown in ***Figure 8***. As discussed previously, Costa Rica's adaptive capacity is greater than that of El Salvador, Honduras and Guatemala, so these later three countries can be considered more vulnerable to the effects on human health from natural disasters and trends in climate change.

FORESTS AND ECOSYSTEM SERVICES

Section 2.4 emphasizes the enormous contribution that ecosystem services make to the economies of CA countries. ***Section 3.2.9*** describes the multiple ways that medium- and long-term changes in climate could affect forests, biodiversity and ecosystems, particularly through increasing the number, scale and intensity of fires in natural vegetation and increasing sea temperatures, thereby affecting the ecosystem services and products of reefs, mangroves and gulfs.

Payment of Environmental Services (PSA) in 1996, which evolved from a program of forest incentives (Forestry Law 7575). The PSA program is financed by a percentage of a tax on gasoline, donated funds, and payments by private businesses. Since it started in July 2015, the program has provided incentives that covered 1,052,867 ha and 14,713 contracts, with an investment of US$315.7 million. Payments are

made under different modalities, including forest conservation, reforestation, natural regeneration, and payment for hydraulic services (FONAFIFO, 2016).

More people and economies would likely be affected by changes in ecosystem services in areas where populations are concentrated. ***Figure 6*** indicates that population density is high and generally in the Dry Corridor (***Figure 8***) on the western, Pacific side of the isthmus. Population densities are particularly high in El Salvador and western Guatemala. Population densities are also, of course, high in the large urban areas of CA, such as the Canal Zone of Panama, Guatemala City, Managua, San Salvador and San Jose. The watersheds provide these urban areas with their water supplies, from both surface and underground sources.

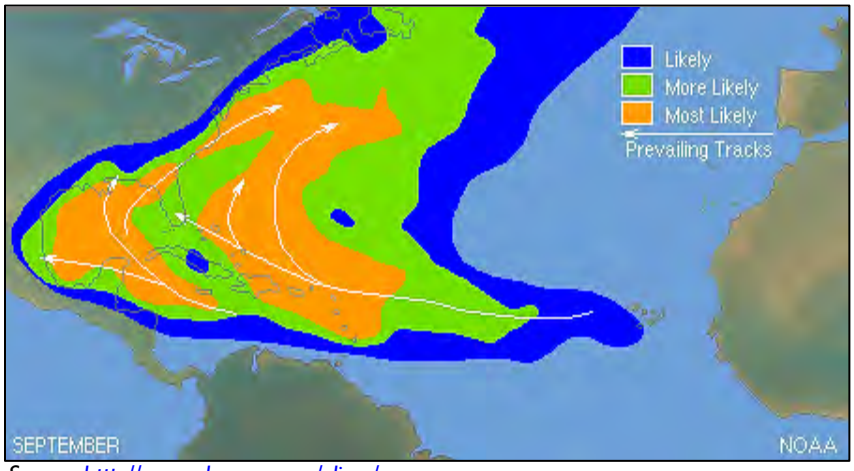
Marine ecosystem services of most importance that are likely to be affected by climate change are those related to reefs, sea grass beds, bays, gulfs, and deltas. Since the adaptive capacities of Honduras, Nicaragua, Guatemala, and El Salvador are lower than Panama or Costa Rica, the most vulnerable ecosystem services, then, are those provided by watersheds and the gulfs, bays, sea grass beds, and reefs in those countries.

NATURAL DISASTER AND EXTREME EVENTS

Section 3.2.10 notes that extreme weather events and cyclical weather patterns, such as droughts, windstorms, and landslides have affected and continue to affect CA/DR's populations and economies. The impact of these extreme weather events has varied from region to region, as a function of topography, climate patterns, population density, and socio-economic status.

Projections show that Central America will experience higher frequencies of intense hurricanes and storms. More reliable hurricane forecasts are needed to better understand and manage vulnerable communities and populations. There is a critical lack of data for models used in forecasting (e.g. upper air soundings) that needs to be closed, while transnational collaboration between weather services in the region needs strengthening (IAI, 2010). ***Figure 9*** indicates the likely tracks of hurricanes that move from the Caribbean towards Central America, on average, during the month of September (other months of the year generally do not get as close to CA). Hurricanes can originate in different locations and travel much different paths from the average however. Hurricanes are most likely to bypass Costa Rican and Panama and more likely to affect Honduras. The areas that are most vulnerable to extreme weather events are those with the least adaptive capacity - El Salvador, Guatemala, Honduras, and Nicaragua. Costa Rica and Panama are exposed to the least amount of tropical storms. Data were not available to evaluate the vulnerability of Dominican Republic to extreme weather events.

Figure 9: Likely Hurricane Tracks in CA/DR during the Month of September



Source: http://www.nhc.noaa.gov/climo/

4. EXISTING ADAPTATION EFFORTS AND REMAINING GAPS

4.1 ADAPTATION

About 52 percent of CA/DR's population is highly dependent of corn and beans for its food supply. These crops are highly vulnerable to climate variations (CCAFS, 2014). Also, conflicts over competing water uses are emerging along the Central American Dry Corridor (IICA, 2015). Countries are also devoting efforts to increasing their resilience by combating land degradation and desertification, promoting energy efficiency, and restoring natural ecosystems and rural landscapes. However, examples of other activities that often dominate a country's priorities are conservation of fisheries and marine resources in Belize and Honduras, addressing UNFCCC losses and damages in El Salvador, and building national institutions in Panama.

4.1.1 REGIONAL AND COUNTRY-LEVEL PLANNING AND PRIORITIES

The Central American countries and the Dominican Republic recognize that adaptation in response to climate change is a regional priority because of their shared vulnerabilities and they have worked to build and consolidate a regional response framework. The "Declaration of San Pedro Sula" (OAS 2009) states that, in the face of the effects of climate change and increasing climate variability, urgent coordinated adaptation and mitigation actions throughout the region are required. This demonstrates the political will and the interest of governments to work together to strengthen the development of integrated adaptation and mitigation actions. Following the Declaration's mandate, the Regional Climate Change Strategy (ERCC), the Central American Policy for Integrated Risk Management (PCGIR), and the Regional Environmental Strategy Framework (ERAM) are the three main policy instruments used by the countries to incorporate climate change as a crosscutting theme, and are a high priority in national development plans and in strategic and operational plans for SICA institutions (OAS, 2009).

- The ERCC is the higher-level framework for SICA's regional work on climate change. It was approved in 2011 and is coordinated by the Central American Commission on Environment and Development (CCAD). The first two of its six strategic areas of action address adaptation and mitigation (CCAD, 2013). Its aim is to prevent and reduce negative impacts of climate change by increasing resilience and adaptive capacity thereby reducing social, ecological, and economic vulnerabilities. Actions to increase adaptive capacity will also help reduce the adverse effects of climate-related natural hazards, such as floods and droughts, which are increasing in intensity. Adaptation-based mitigation such as restoration of mangroves also will voluntarily contribute to the reduction of GHG emissions in accordance with the priorities of national governments (SICA and CCAD, 2010).
- The PCGIR was adopted in 2010 so the Coordination Center for Natural Disaster Prevention in Central America (CEPREDENAC) could implement the ERCC. CEPREDENAC coordinates and supports a network of national institutions to promote climate change adaptation actions based on their territories' vulnerabilities.
- Climate change and risk management is one of six strategic lines of action of the 2015-202 ERAM (CCAD, 2014). The ERAM promotes integrating adaptation and mitigation into national climate change response plans and policies, and focuses on promoting disaster prevention by reducing climate change vulnerability and building adaptive capacity.

Overall, these regional instruments have enabled relevant climate change priorities to guide national policy instruments and further into actions. As a result of the implementation of these national plans and strategies, important progress in adaptation based on risk management has been achieved through national early warning information systems, weather forecasts, and geospatial data. The trend is clearly positive, and the effort to increase national capacities in risk management is noticeable in Costa Rica, Nicaragua and Guatemala. In contrast, Honduras and El Salvador still lack adequate progress in this area. Overall, there is a trend toward risk and disaster management as a priority climate change adaptation in Central America, as shown in INDCs and National Communications (Dominican Republic, 2009; El Salvador, 2013; Honduras, 2013; Costa Rica, 2014; Belize, 2015; Costa Rica, 2015; Guatemala, 2015; Dominican Republic, 2015; El Salvador, 2015; Guatemala, 2015; Honduras, 2015). As climate change impacts continue affecting the economy of the region, support for continuous monitoring and adaptive management of these activities will be necessary.

At the regional level, the focus on mitigation and adaptation in natural resources management is progressively expanding, from traditional carbon sequestration mitigation that prioritized terrestrial areas, particularly forests, to the development of adaptation-based mitigation (AbM) in freshwater and coastal wetlands. AbM leverages mitigation co-benefits generated through synergies with adaptation actions. It involves large-scale transformation of the landscape and seascapes, restoration of degraded ecosystems, and participatory conservation of ecosystems. The extent of the social and political efforts needed to implement them are much broader than traditional approaches (PRISMA 2014) and represent a novel challenge for countries, governments and implementing agencies not familiar with this new way of thinking, designing, and implementing projects.

4.1.2 DISASTER RESPONSE FRAMEWORK

CA/DR countries have taken some important steps to reduce the frequency and severity of natural disasters. In 2005, with assistance from the United Nations Office for the Reduction of Risk from Disasters (UNORRD), they formulated the Hyogo Framework for Action. It established regional objectives for reducing natural disasters by 2015. CA/DR also adopted the Central American Policy for the Management of Risks from Disaster 2014-2018. Each country has formulated national policies and plans for natural hazards and disasters. Between 1998 and 2013, the Program for Preparation for Disasters, financed by the European Commission, financed the preparation of many community plans for responding to natural disasters (CEPREDENAC and UNISDR 2014). Also, CA/DR countries have reached many regional agreements for including aspects of natural disaster preparedness at all levels of their educational systems. As of 2012, 166 early warning systems for floods, landslides, and fire were operational. Many communities and cities have become well-prepared to detect and react quickly and effectively to natural disasters.

The regional response framework for climate change-related disasters has many policy instruments covering mainly disaster management, integrated water resources management, food security, and control of tropical diseases. CCAD relies on the Strategic Framework for Reducing Vulnerability and Disasters in Central America (SICA, 1999), and the Strategic Framework to face food and nutritional insecurity associated with drought and climate change (SICA, 2002). The latter includes a Regional Agriculture Action Plan against Climate Change. CCAD also has a Regional Plan for the Health Sector in the Face of Climate Change (2006). The Central American Integrated Risk Management Policy includes a climate change and environment component, which is dependent of CEPREDENAC for coordination and application within the regional legal frameworks (CEPREDENAC, 2011). To implement risk management actions, the Central American Fund for the Promotion of Disaster Risk Management (FOCEGIR) was created by CEPREDENAC in 2012. In addition, CEPREDENAC and CCAD have conceived the Comprehensive Framework for Climate Risk Management (MEGIRC) as a working instrument that integrates risk management and adaptation to climate change and defines guidelines for

the formulation of projects with a focus on Integral Management of Climate Risks (CCAD, 2013). From this regional level, CEPREDENAC has facilitated SICA countries (except Dominican Republic and Belize, which are not member countries) in developing and implementing their own national frameworks, as follows:

- Costa Rica: National Commission for Risk Prevention and Emergency Response, in charge of the National Policy on Risk Management 2016-2030 and National Emergencies Act and Risk Prevention (Law N° 8488 of 2006)
- El Salvador: National Direction of Civil Protection, Disaster Prevention and Mitigation
- Guatemala: National Coordinator for Disaster Management (CONRED) that implements the National Policy on Risk Management of Disasters, building norms for disaster reduction, and the National Recovery Framework and National Response Plan
- Honduras: Permanent Commission of Contingencies (COPECO)
- Nicaragua: National System for Prevention, Mitigation and Attention to Disasters (SINAPRED)
- Panama: National Civil Protection System (SINAPROC), in charge of the National Human Development Plan for a Risk Management Culture.

Focusing on risk management and adaptation has allowed SICA countries to have updated meteorological online information systems with early warnings and forecasts, and to have emergency procedures to respond to, for example, earthquakes, dengue outbreaks, and volcanic eruptions. Guatemala, specifically, has national plans to reduce risks in high rainfall, hurricane or severe frost events. Nicaragua, has committed to a series of nation-wide disaster simulations and specific hurricane disaster simulations in its Caribbean Autonomous Regions. Their approach is to plan and run the simulations for multiple simultaneous threats, such as forest fires during summers, flooding and landslides in the winter, and earthquakes with tsunamis. Despite the regional frameworks and planning efforts, disasters continue to take a toll on human populations and cause grave economic loss across the region, showing that regional planning does not necessarily translate into local and national interventions that are effective at avoiding or mitigating risk.

SICA's Action Plan for the Integrated Management of Water Resources in the Central American Isthmus (SICA, 1999) is the main response framework for water-related vulnerabilities. One of its goals is to develop and strengthen regional coordination, cooperation, and responses to reduce risks associated with climate variability affecting water resources and related services. The Plan has strengthened and integrated the use of regional information on meteorological events, monitoring and early alert systems into decision-making. Regionally, the Water Center for the Humid Tropics of Latin America and the Caribbean (CATHALAC, an NGO) sought to improve decision-making for water security through its "Water Security and Climate Change in the Region of Central America and the Caribbean" program.

4.1.3 POLICIES TO REDUCE HEALTH EFFECTS OF CLIMATE CHANGE IMPACTS AND DISASTERS

At the regional level, the Regional Agro-environmental and Health Strategy (ERAS) covers health and food security issues and includes climate change and climate variability considerations. ERAS defines and promotes inter-sectoral work under a unified vision and a sustainability, climate change adaptation, equity and citizen participation framework that contributes to reducing poverty and food security (CCAD 2008). Although the effects of increased temperature are mentioned in the ERAS documents, they do not refer to health issues; they refer only to plant and crop effects. This discussion therefore focuses on health issues independently of temperature fluctuations due to climate change. The 2009-2018 Health Agenda for Central America and the Dominican Republic encourages integration through regional policies oriented towards risk reduction, and preparation against health and environmental

damages from natural and human disasters, under the CEPREDENAC framework. Its 10th strategic objective is to reduce vulnerability from natural disasters, human emergencies, and climate change effects (COMISCA 2009).

The Mesoamerican Strategic Plan to Improve Malaria Control Towards its Eradication, the Mesoamerican Strategy for Dengue Prevention and Control, and the Integrated Strategy for Prevention and Control of Dengue in Central America and Dominican Republic (EGI-CAD) do not recognize climate change as a contributor to those diseases (Ministerios de Salud de Centroamérica y República Dominicana 2004). These policies were developed by medical professionals, without an interdisciplinary approach. They address medical and public health perspectives with emphasis on vector biology, epidemiological data, and analysis of the region's laboratory infrastructure for treating diseases (Gómez Dantés y San Martín y OPS, 2004). In contrast when addressing vector-transmitted diseases (VTD), such as Chagas, malaria, Chikungunya and dengue, they are recognized regionally as linked to climate change (COMISCA 2009). This is congruent with national-level guidelines and control programs in Costa Rica (Costa Rica 2010, 2014a), Belize[4], Dominican Republic, Guatemala (Gobierno de Guatemala, n.d.), and Nicaragua. Honduras, Panama ,and El Salvador tend to react to an epidemic after an emergency has been declared. The Zika virus, transmitted by the same vector as dengue, chikungunya, and yellow fever, is currently expanding rapidly across the region. Countries are reacting with prevention and pesticide fumigations campaigns.

Although there are state actions to control disease vectors, recurring epidemics show these efforts are not effective at eradicating the diseases. It is difficult to quantify the success of these efforts and their results because there are no technical reports about the programs' implementation or protocol implementation. The latest information on the subject are the press releases of the ministries of health, which are made for specific cases and do not include an actual analysis of the measures implemented. It is clear that some components of the regional health sector are integrated into other regional policy frameworks and instruments. However, as the general context of public health tends to focus on societal issues, links with climate change notions and environmental risk management are for the most part being ignored.

4.1.4 RAINFALL CAPTURE AND DISTRIBUTION PROJECTS

The most important adaptation initiatives on water harvesting, storage, and management for human needs and production are being implemented in the Dry Central Corridor. PRISMA (2014) and Análisis y Desarrollo Rural Consultores (2015) found residents of the Corridor implement water management solutions based on agroecology, agroforestry, and sustainable agriculture. A regional rainwater harvesting project, financed by the AECID and implemented by ACICAFOC (España, 2014), reached 2,040 poor families in Honduras, Nicaragua, El Salvador, and Guatemala. The project Adaptation of Agriculture to Climate Change through Water Harvesting in Nicaragua is being implemented with Swiss funding. Costa Rica is implementing the Guanacaste Integrated Plan for Water Supply (PIAAG) in the northern dry Pacific area of the country (Zeledón Calderón, 2015), and the Water Harvest as a Mechanism to Strengthen Food Security project in the Chorotega Region.

These regional and national projects consider water availability as a development issue, providing access to water for production, and aim to provide a promising response to recurrent droughts. Such projects are increasingly becoming important since climate change models predict drier and warmer conditions by 2030 (KI). El Salvador and Honduras are working to address contingency measures (food aid for production) and drought responses but, like Belize and the Dominican Republic, do not currently have plans to capture rainwater as an adaptation measure.

[4] http://globalhealth.northwestern.edu/docs/Belize-VectorControlProgram.pdf

USAID can provide regional international cooperation for water management in areas of the dry corridor and elsewhere by promoting the use of SERVIR information and other climate data platforms, including the one being developed by the USAID Regional Climate Change Program, as part of decision-making support systems. Data can be made available to the countries according to their particular needs. Specific areas, where the accuracy of the information is low and the potential impacts should be large, could be prioritized through expert systems and greater attention devoted to them. On the ground know-how and promotion of improved water harvesting and management infrastructure can also be promoted in rural and urban areas alike.

4.2 ADAPTATION-BASED MITIGATION

4.2.1 NATIONAL AND REGIONAL POLICIES

All the CA/DR countries have prepared a National Climate Change Policy, a Climate Change Action Plan and Strategy and/or a Second National Communication to UNFCC and an INDC. ***Annex E*** lists the various CA/DR country statements and national frameworks pertaining to adaptation and mitigation. Although stated in slightly different ways there is general agreement that adaptation is a higher regional priority than mitigation and the objectives of all these plans are to build an economy that is resilient to the impacts of climate change. There are also no significant differences between the sectors or issues that the national climate change documents specifically mention. These sectors include agriculture; forestry; fisheries; coastal and marine resources; water resources; land use and human settlements; human health; energy; tourism; transportation; solid waste; infrastructure; metrics for climate change; technology; finance; and education. Such broad sectors and priorities present a challenge to international cooperation as funding streams cannot be expected to produce large impacts if disaggregated to respond to them all.

ADAPTATION-BASED MITIGATION / MITIGATION-ADAPTATION SYNERGIES

Innovative concepts and interventions are providing the region with robust and alternative adaptation-related tools to respond to climate change. AbM involves actions that concurrently reduce vulnerability to climate change and increase sequestration of atmospheric carbon (Prisma, 2013). In addition, CATIE and USAID's Regional Climate Change Program is making strides promoting Mitigation-Adaptation Synergies (MAS). MAS is a concept that promotes emergent behaviors and simultaneous benefits from mitigation, adaptation and sustainable development and livelihoods across sustainable ecosystems (Vallejo et al 2016). Overall, AbM/MAS respond directly to the needs of the CA/DR countries by reducing the vulnerability of rural populations to the effects of climate change while also contributing to mitigation. They offer a path for the region to participate in global agreements to mitigate climate change while concurrently achieving the shared regional priority of increasing resilience of agricultural production to climate change. So far only El Salvador has officially adopted and implemented AbM/MAS, especially in its their national REDD+ strategy. Honduras and Costa Rica are starting to consider AbM/MAS in their national actions.

El Salvador is especially vulnerable to climate change, so it has given special priority to increasing its resilience to climate change as a main objective and the reduction of GHG emissions as a co-benefit. El Salvador's National Plan on Climate Change includes AbM/MAS in its Ecological Landscapes Restoration Program (PREP). PREP, operating in Southern Ahuachapan, Cinquera, and Montañona departments, restores habitats mostly through actions that establish agroforestry systems, conserve biodiversity, control soil erosion, help form fertile soils that retain water, and other actions to help regulate water flows. PREP also promotes sound agricultural and livestock practices and natural regeneration of mangroves and gallery forests (El Salvador, 2013; KI's). PREP is helping El Salvador learn about managing and conserving productive landscapes. If these lessons were to be documented, they could be applied

across CA/DR. Honduras and Costa Rica have also started to incorporate AbM/MAS into their national climate change policies and programs. Honduras' Human Face of Climate Change Vision includes AbM/MAS and Costa Rica plans to implement MAS through its Carbon Neutrality Strategy (CNS).

CLIMATE-SMART AGRICULTURE

In El Salvador several barriers are complicating the implementation of AbM/MAS and climate-smart agriculture (CSA). CSA develops the technical, policy, and investment conditions to achieve sustainable agricultural development for food security under climate change (FAO 2013). The first barrier results from the government not adequately coordinating its programs to achieve AbM/MAS and CSA so other public rural development programs continue to ignore AbM/MAS and CSA. They are promoting unsound agricultural practices that increase rather than reduce vulnerability to climate change. The second barrier is El Salvador's lack of sufficient data and analytical tools to plan and promote AbM/MAS and CSA effectively. The third barrier is the lack of an adequate number of professionals who are well-trained in AbM/MAS and CSA, mainly due to the relative novelty of both concepts, to promote it to farmers. Although the cost of transitioning to sustainable practices is also a consideration, without effective promotion and training, farmers tend to stick to their traditional production methods that do not include techniques to increase resilience to climate change. The fourth barrier is El Salvador's small-scale farmers lack secure tenure to their land so they are reluctant to adopt AbM/MAS agricultural techniques (KI). The fifth barrier is lack of effective coordination between the national, governments, local governments, and farmers implementing AbM/MAS and CSA strategies (Araya & Madrigal, 2015). For Salvadorian agriculture and other productive sectors to become more resilient to climate change these barriers to AbM/MAS and CSA must be removed (KI).

AbM/MAS and CSA could provide a paradigm for CA/DR to address mitigation and adaptation concurrently (KI). For CA/DR to adopt this paradigm, each country must commit to adopting the policy and institutional changes that are required and to sustain these commitments over a long period of time (PRISMA, 2013). For example, ministries of the environment and agriculture must resolve the long-standing conflict between conservation/preservation measures and the promotion of agriculture. They must also deepen and widen their technical knowledge of AbM/MAS. They must disseminate this knowledge so that it effectively reaches local governments, farmer networks, and rural youth organizations (KI). CATIE's MAS tools are a strong first step to facilitate these processes across CA/DR. Considerably more external technical assistance and long-term funding are necessary for CA/DR to adopt AbM/MAS and CSA on a regional scale. This action could contribute to mitigating global climate change while also significantly augmenting its resilience to the effects of climate change.

COUNTRY PROFILES

Annex G provides an additional discussion on adaptation-based mitigation and provides country profiles. In summary, the mitigation strategies reviewed for the region mostly are linked to the agriculture and forest sectors, despite these sectors not being the main sources of emissions. A majority of the countries will continue to require technical and financial support from international public and private resources to meet their mitigation goals and balance economic growth. REDD+ strategies are well-known, and USAID, GIZ, SilvaCarbon, FAO, and others are providing considerable technical assistance already as part of their coordinated regional intervention strategies.

Continued support for capacity building, forest monitoring, reference levels, finance, and other issues prioritized through the Mesoamerican Strategy for Environmental Sustainability (EMSA) work plan and/or negotiated and agreed upon with individual countries, CCAD, and EMSA should be the focus of assistance for the next few years. As countries move forward into negotiating their emissions reduction packages, more specialized assistance will then be required in finance, legal frameworks and international agreements. The development of Nationally Appropriate Mitigation Actions (NAMA) will require

technical support to design and implement them, as some of them require technological innovations or sectoral transformations seldom explored by the countries. It is still too early to determine the type of assistance that the countries will need to fully implement their Intended INDCs. A current assessment of the type and degree of technical assistance required by NAMA developers across the region is urgently needed, possibly under a broader NAMA-specific technical assistance mechanism.

4.2.2 STATUS OF EFFORTS TO REDUCE EMISSIONS FROM FORESTS AND LANDSCAPE

Central American countries and the Dominican Republic participate in the UNFCCC mechanisms to reduce emissions from forests and other landscapes. The main mechanisms under development in CA/DR are REDD+ and NAMAs, with INDCs gaining relevance since the 21st Conference of Parties (COP21) to the UNFCCC held in Paris in 2015. REDD+ is the mechanism to reduce emissions from deforestation and forest degradation and focuses on the forest sector, while NAMAs are seen as post-2020 alternatives for reducing emissions under the UNFCCC and are being developed in other productive sectors. INDCs are UNFCCC parties' publically outlined post-2020 climate pledges that they intend to make under a new international agreement. These mechanisms include both mitigation and adaptation actions. Technical and financial support for developing these mechanisms comes from international and bilateral cooperation agencies, or from in-country investments. INDCs and REDD+ are the two mechanisms more rapidly advancing in the region. As outlined below, progress is heterogeneous and technical assistance needs will persist for the next five to 10 years.

REDD +

All countries in the region are currently implementing REDD+ readiness processes to reduce forest emissions under the World Bank's Forest Carbon Partnership Facility (FCPF) mostly, the technical assistance of the FAO/UN-REDD Program, and other international technical assistance platforms (including USAID and GIZ). These processes have allowed countries to undergo inclusive and participatory dialogues, and a series of consultations, strategic designs, and activities aimed at constructing the elements of each country's REDD+ strategy. Preparation for REDD+ (a.k.a. "REDD+ readiness") has facilitated stronger dialogues among forest stakeholders and has helped raise the issue of reducing emissions from the forest sector and into the national and regional strategic agendas.

All countries have submitted their Readiness Preparation Package (R-PP; Costa Rica, 2011; El Salvador, 2013; Guatemala, 2013; Nicaragua, 2013; Panama, 2014; Dominican Republic, 2014; Belize, 2015). At least Costa Rica, Dominican Republic, Guatemala, and Nicaragua have prepared and had approved by FCPF their Emissions Reduction Project Idea Notes (ER-PIN; Costa Rica, 2013; Guatemala, 2014; Dominican Republic, 2015; Nicaragua, 2015). Costa Rica is the only country that has completed its Readiness Package and is currently negotiating results-based payments with the World Bank. Individual country responses vary in focus depending on "national conditions" ranging from promoting a carbon neutrality approach and strengthening a country-wide payment for ecosystem services (PES) scheme (Costa Rica, 2011, 2015) to an emphasis on adaptation-based mitigation (El Salvador, 2013). Guatemala and Nicaragua are exploring the potential of REDD+ schemes, strongly associated with reduced vulnerability and adaptation to climate change (Guatemala, 2013; Nicaragua, 2013), while Honduras (2013) is promoting a strong community forestry bias. Targeted technical and finance assistance will continue to be needed for the countries to complete their REDD+ readiness packages and to ensure the countries can adequately negotiate their results-based payments.

Although REDD+ has advanced significantly in the region, some gaps remain. Chief among the gaps are concerns about the participation of forest communities and indigenous people and, fundamentally, about benefit distribution and land and carbon rights (PRISMA, 2010). Also, particular components of the country's REDD+ Measurement Reporting and Verification (MRV) systems still need developing or clarifying. These include developing official definitions and methods to quantify forest degradation,

developing capacities to construct the country's forest reference emissions levels/forest reference levels (FREL/FRL), clarifying the institutionalization and funding streams to sustain these quantification and REDD+ MRV efforts, among others (EMSA 2015). In addition, safeguards and co-benefit information systems are incipient, at best, and except for Guatemala and Costa Rica, finance components of strategies have not been developed at all.

At the national level, the ministries of environment must lead the way in promoting inter-institutional communication, broadening the scope of the discussions, and attracting other sectoral authorities (e.g. ministries of finance, agriculture, etc.) and institutions that play a role in the forest sector to enforce legal frameworks, reduce illegal logging, and contribute to the implementation of REDD + at various scales (KI).

Further investments and technical support are still needed to ensure the targeted consolidation and long-term stability of these efforts. Depending on the topic, this assistance should be negotiated through regional political platforms such as CCAD, or technical ones, such as the EMSA, or negotiated bilaterally depending on country-specific needs. A careful analysis of current and future needs (some of which are already clearly outlined in REDD+ readiness documents) will help narrow down the most advantageous opportunities for programs aimed at promoting the achievement of these mitigation goals. Coordination with CCAD, EMSA regional governance assistance platforms, and other technical assistance suppliers (e.g., GIZ) will be needed.

NATIONALLY APPROPRIATE MITIGATION ACTIONS (NAMAS)

Central American countries have a limited participation in the NAMA mechanism, but momentum is gaining. So far, Costa Rica, Honduras, Dominican Republic and Nicaragua are exploring and working on NAMAs in the energy, forest, and agriculture sectors. NAMAs are designed to guide countries onto low-carbon development trajectories. Overall, Central American countries face a lack of capacities, operational systems, and financial resources to further promote the design and implementation of this mechanism. Only Costa Rica's coffee sector NAMA (Costa Rica, 2015) is being financed (NAMA Facility, 2016). Also, an important challenge for NAMA development is how to harmonize their MRV systems with other national GHG accounting, such as the national GHG inventories, national forest inventories, and REDD+'s MRV. Thus, both considerable technical assistance and investments are urgently required to promote greater development and implementation of these alternative mitigation mechanisms across the region. A large or targeted NAMA-support mechanism could be implemented across the region to kick-start their design and implementation. This mechanism could have both technical and finance components.

INTENDED NATIONALLY DETERMINED CONTRIBUTIONS (INDCS)

Except for Nicaragua and Panama, countries in the region are committed to complying with UNFCCC requirements and have submitted their INDCs to the UNFCCC[5]. Because this is a new mechanism, and countries made their submissions during the last three months, there are limited inferences to be made about their success. Final emissions reduction will be determined by available funding and technical support for both Honduras and Guatemala (Guatemala 2015, Honduras 2015). Guatemala's INDC is part of its National Development Plan, KATUN 2032, which focuses on achieving Sustainable Development Goals by 2030 with an emphasis on low emissions. Costa Rica reaffirms its goal to achieve carbon neutrality by 2021 (Costa Rica 2015). El Salvador promotes renewable energy and greater energy efficiency (El Salvador 2015). Dominican Republic will strengthen human resources in synchrony with other national strategies (Dominican Republic 2015). Belize's INDCs is possibly the most technologically-oriented with its focus is on clean power from agriculture and forestry bi-products used

[5] http://www4.unfccc.int/submissions/INDC/Submission%20Pages/submissions.aspx

to co-produce bio-fuels and/or electricity, and to promote appropriate processing technologies to convert biomass from waste, forestry, agriculture and microbial production into food, feed, chemicals and energy (electricity, heat and bio-fuels; Belize 2015). Through their INDCs most countries in the region are committed to reducing their emissions, mainly through work in the energy, transportation, and the land-use and land-use change sectors. INDC development and implementation will need to be supported with targeted technical and financial assistance to ensure proper technologies are adopted, and country-level GHG emissions accounting achieved.

Few national-scale data are available to objectively analyze the country's overall contributions to reducing their GHG emissions. As shown before, there are many policy documents and technical plans, but only ER-PINs and INDC statements go as far as to propose somewhat clear emissions reduction targets, albeit very aggregated and with little supporting information. Based on available information on the INDC statements, emissions reduction contributions in the region should amount to at least 6055 Mt CO2e by 2030. ***Annex E*** lists country statements and national frameworks to reduce emissions. Despite on-going technical assistance, some countries do not have robust emissions reduction estimates, which shows considerable work still remains to be done to achieve their country goals.

4.2.3 STATUS OF COASTAL-MARINE EFFORTS AT EMISSIONS REDUCTIONS

Both inland and coastal wetlands are important in the global carbon cycle, including as carbon stores. Such wetland systems in CA/DR include tropical peatlands and vegetated intertidal wetlands such as salt marshes and mangroves. It is difficult to assess and measure carbon in wetlands because much of their carbon is underground in soils and many wetlands function as 'open' systems with respect to carbon (DFN 2010). CATIE has been the principal institution conducting research and education related to the carbon emissions from coastal/marine ecosystems in CA/DR. CATIE's studies, developed under the international "blue carbon" concept[6], have focused on enhancing regional capacities to quantify the dynamics of carbon stocks and emissions in mangrove ecosystems. No equivalent studies have been undertaken on carbon in sea grass or coastal marsh ecosystems. CATIE is also facilitating the design of policy instruments and more-broadly promoting the importance of conserving and managing the flow of coastal-marine ecosystem services as a means of reducing the vulnerability of coastal communities to climate change.

CATIE undertook the first studies of mangrove carbon in CA/DR, in the Térraba-Sierpe National Wetland in southern Costa Rica (BIOMARCC 2012). CATIE subsequently undertook blue carbon studies in the mangroves of the Gulf of Chiriquí, Panama, on the Pacific Coast of Costa Rica, in the Gulf of Fonseca and in the Bay Islands in Honduras. CATIE has since broadened its blue carbon research. In the last few years, it has studied the history of carbon emissions in mangrove forests and associated land uses, such as African palm and rice plantations, the economic value of mangroves, especially for the livelihoods of rural poor, and the vulnerability of coastal communities to climate change. While implementing these various studies, CATIE has trained numerous people in the methodologies for blue carbon inventories (Howard et al 2015). CATIE also assisted the Government of Costa Rica to formulate strategic principles for reducing emissions of blue carbon that will be included in Costa Rica's National Wetlands Policy Statement. Similarly, CATIE has assisted the Government of Honduras to formulate specific actions for promoting blue carbon research and formulating blue carbon policies.

Two other projects have financed research on blue carbon. In 2013, the United Nations Environmental Programme (UNEP) financed a study of carbon and ecosystem services in the Jeannette Kawas National Park of Honduras (Rivera-Monroy and Catañeda-Moya, 2013). This study was undertaken as part of

[6] Blue Carbon is understood as addressing restoration of degraded coastal areas, and promoting mitigation, and adaptation to climate change while strengthening local sustainable livelihoods

Integrated Management of Costal Zones and Sustainable Management of Mangroves Project being implemented on the Caribbean coasts of Guatemala, Honduras and Nicaragua. The same UNEP project also restored mangroves in Utila and provided training on mangroves to government staff and local people. In 2015, the United Nations Development Program (UNDP) started a blue carbon project in Panama[7] that is studying mangrove ecosystems to determine their ability to reduce risks to coastal settlements from climate change, clarify how carbon is stored in mangroves, and demonstrate ways to manage mangroves.

CATIE's quantification of carbon emissions along coastal land-use gradients provides estimates of the magnitude of historical carbon loss from mangrove conversion into other land uses (BIOMARCC 2012; Cifuentes-Jara et al 2014). Land-use conversions have taken place to establish production mostly of shrimp, salt, oil palm, rice, and cattle. In Costa Rica, for example, CATIE determined that between 1992 and 2014 almost 14,000 ha of land mangroves were converted to other uses. This amount of destroyed mangrove released at least 18-20 million tons of carbon dioxide. That amount is 2.1 times the entire country's emissions reported for 2005 (IMN 2009; Cifuentes-Jara et al., 2014). In El Salvador, CATIE is making a similar study of mangrove forests and adjacent land uses. Quantitative data about the emissions of carbon that occur when mangrove forests are eliminated serve important ends. These data:

- Document the urgency of including mangroves in GHG accounting;
- Provide the basis for including mangroves in REDD+ programs;
- Highlight the inefficacy of the laws and regulations whose purpose was to protect mangroves;
- Permit estimates of the potential of mangroves to sequester atmospheric CO2;
- Support policies to encourage measures to restore and manage mangroves; and
- Provide the basis for PES to communities located in mangroves.

The various studies on blue carbon have greatly expanded the understanding of mangrove deforestation's contribution to carbon emissions. Much, however, remains yet unstudied and unknown about blue carbon. Additional research is needed on historical and current mangrove carbon stocks including permanent study plots and research on carbon in sea grasses and coastal marshes (KI). A blue carbon regional network of scientists, professionals and policy makers should be established. Further training for people involved in some way with mangroves is required so the enhanced local capacities can be applied to better manage mangroves and other coastal ecosystems. Stakeholders who live in or use mangroves should be involved in their management (KIs).

Restoration of mangroves is currently restricted to El Salvador. Mangrove restoration should be expanded throughout the region (KI) so that historical carbon losses can be reverted and countries benefit from these mitigation actions. Coastal ecosystems and land uses adjacent to mangroves need to be mapped, and their historical evolution tracked, because these data are key for calculating local, national, and regional carbon stocks and how they change over time due to land-use change. The results of such research activities would help to promote local capacities and governance, as well as national-level interventions, to ensure long-term mangrove stability to enhance local livelihoods (KI).

Research and training should occur in the following priority regions because these contain large remaining areas of mangroves and their land-use dynamics threaten the current storage of massive amounts of carbon stocks:

- Honduras, El Salvador, Nicaragua: Gulf of Fonseca - Jiquilisco Bay to Jiquilillo;

[7] UNDP Project: Protección de las Reservas y Sumideros de Carbono en Manglares y Áreas Protegidas de Panamá

- Guatemala: Río Paz to Monte Rico
- El Salvador: Bola de Monte, Barra de Santiafo, and Garita Palmera
- Panama: Gulf of Chiriqui and Panama Bay
- Costa Rica: Gulf of Nicoya, Humedal Terraba-Sierpe; and Gandoca-Manzanillo;
- Honduras: Bay Islands and Caribbean Coast.

Pilot projects are needed all across CA/DR; these can be designed based on current data, policy efforts, and national interest that are already available (KI). Future blue carbon projects should focus on stopping degradation of coastal wetland ecosystems and promoting alternative livelihood options for coastal communities. Restoration and management will need to take into account surrounding freshwater ecosystems and upper watersheds as well (KI) because it is recognized that the stability of coastal ecosystems depends on the direct and indirect inland pressures. Proponents of blue carbon projects need to clearly indicate to decision makers how blue carbon interventions complement valuation of ecosystem services and other mitigation, adaptation, and mitigation-based adaptation actions already in process (KI). They must work at the national policy level to address social conflicts and coastal management holistically. Blue carbon projects can provide innovative financial mechanisms to be reinvested in implementing solutions to the core problems causing coastal-marine degradation. For example, PES schemes, credit and micro-credits, and supporting sustainable business ventures would complement these projects and provide much needed strengthening of local livelihoods and capacities (KI).

4.2.4 LOCATION, NUMBER, AND DESCRIPTIONS OF ADAPTATION PROJECTS

Figure 10 shows the location and number of municipal and national-scale adaptation projects in Central America since 2010. ***Annex F*** provides a database of the various mitigation and adaptation projects used to populate this figure.

Figure 10: Climate adaptation projects in Central America (since 2010)

Note on Legends: Red dot labels denote municipalities with adaptation projects. National scale adaptation projects count is shown next to the capital city of each country (yellow star)

5. OPPORTUNITIES

5.1 OPPORTUNITIES AND RECOMMENDATIONS

The following presents recommendations to USAID/CAM to build resilience in CA/DR. Recommendations are at the regional scale, which, as noted in the March 2016 USAID/CAM RDCS (see ***Annex H***), results can be enhanced when regional programs compliment bilateral efforts. Our recommendations focus on DO 2 with particular focus on IR 2.2 and IR 2.3 and indirectly address DO 1 and DO 3. Increasing low-carbon development in IR 2.1 is not addressed in this assessment, though several of our recommendations can produce co-benefits for USAID/CAM. For example, protecting mangroves both improves natural buffers for sea level rise and storm surge while at the same time provide important, measurable carbon sinks. These sinks can assist the CA/DR countries meet their climate pledges in their respective INDCs.

In brief, ***Section 2*** identified CA/DR's regional development goals and described the principal economic, social and ecological sectors that climate change is projected to affect. ***Section 3*** described past and projected climate trends, the impacts of those trends on development goals and the vulnerabilities of CA/DR to those trends. ***Section 4*** described many current efforts in Central America to adapt to climate change and implement adaptation-based mitigation measure efforts, gaps in these efforts and opportunities to fill those gaps. Our recommendations also focus on leveraging local knowledge; lessons learned from past and present programs, with particular emphasis on partnerships; and investing in and supporting science, technology, innovation, and partnerships (STIPs) that will benefit the people of CA/DR for decades to come.

1. We recommend that USAID/CAM **support advanced watershed and coastal zone management to assist CA to strengthen its resilience to climate change**. USAID has supported several projects that have strengthened watershed management in CA. Responding to IR 2.2, USAID/CAM can build on these successes by including climate adaptation activities in new watershed and coastal zone management activities and indirectly address transportation networks issues associated with IR 1.1.2. ***Section 3*** discusses how climate change could impact water supplies and coastal infrastructure utilized by key sectors of CA's economies, as well as the regions forest and coastal ecosystems. In addition, numerous KIs expressed concerns about insufficient water quantity and quality, and the degradation of coastal resources. USAID/CAM could address these concerns by supporting programs that capture rainwater and improve water harvesting and water management as adaptive measures in both urban and rural areas. Also, the concepts of watershed and coastal zone management can be used to encompass building resilient landscapes, since they can encompass large geographic scales.

2. Relatedly, we recommend that USAID/CAM **build on and coordinate with the adaptation projects being implemented in the region.** ***Figure 10*** shows the numerous adaptation projects in Central America, many of them in the Dry Corridor. International conservation NGOs, such as TNC, WWF, IUCN, and the Rainforest Alliance, have successful, experienced programs in CA related to watershed management that USAID/CAM could coordinate with. Responding to IR 2.3 and Sub IR 2.3.1, coordination with international, national, and local conservation NGOs can expand the region's resilience-implementation and support capabilities. New climate resilient development programs are being developed by the American Red Cross and FUNDAECO, for example, and these and similar organizations could be effective partners with USAID/CAM in implementing climate resilient watershed management in priority geographic areas. Previous USAID regional and country projects have already provided considerable assistance for many years in resolving the

problems that are degrading the regions coastal resources. Much experience already exists as a basis for USAID/CAM to design and implement coastal resource management activities.

We recommend that USAID/CAM:

- Evaluate the extent to which Feed the Future projects in CA are contributing to increasing resilience to climate change of small farmers in the Dry Corridor;
- Support an evaluation of lessons learned in past and current climate change, soil/water conservation, and agricultural projects and programs in priority areas;
- Support continuous monitoring and adaptive management of adaptation projects being implemented in the region;
- Share results and coordinate with other donors working in the region;
- Continue to support activities that reduce barriers to and the inclusion of AbM and CSA actions in programs that facilitate the management and conservation of productive landscapes;
- Support technical and financial assistance for countries to implement their REDD+ readiness packages and their REDD+ Measurement Reporting and Verification (MRV) systems;
- Analyze the social, financial and economic benefits to small farmers from conservation practices (e.g. mulching, terracing, live barriers, agroforestry, integrated pest management);
- Strengthen the implementation of reforestation, adaptive forest management, and water use management to ensure better retention of the aquifer levels during the longer dry seasons and absorption of water into the aquifer during intense rainfall; and
- Incorporate links with climate change concerns and environmental risk management to strengthen climate resiliency programs because public health issues tend to focus on societal issues.

3. We recommend that USAID/CAM **integrate resilience activities with biodiversity and tropical forest activities**. Actions to build CA's resilience are needed to conserve the region's biodiversity and tropical forests. ***Section 3.2.1***, for example, discusses vulnerability of subsistence farmers to irregular rainfall, and ***Section 3.2.2***, notes the strong effect climate change can have on the productivity of fisheries. Actions to build resilience of farmers include conservation of the natural vegetation in relevant watersheds. Natural vegetation is floral biodiversity, and it provides habitat for faunal biodiversity. Thus, actions to increase resilience also conserve biodiversity. Likewise, actions to conserve reefs and mangroves both conserve marine biodiversity and augment the resilience of people who depend on fishing, responding to IR 2.1 and Sub-IR 2.1.1, as well as transboundary development issues in IR 2.3 and Sub-IR 2.3.1. Mangroves are also important sinks for carbon, providing co-benefits. Through integration, USAID/CAM can achieve results that would increase both resilience and conservation in CA more effectively and efficiently than it would with two separate sets of activities.

4. We recommend USAID/CAM **provide technical and capacity building support for CCAD** to implement the Regional Climate Change Strategy (ERCC), the Central American Policy for Integrated Risk Management (PCGIR), the Regional Environmental Strategy Framework (ERAM), the Mesoamerican Strategy for Environmental Sustainability (EMSA) and the National Appropriate Mitigation Actions NAMA). In support of IR 2.3.1: Regional environmental governance improved, we recommend that USAID/CAM:

- Support the monitoring and evaluation of CCAD programs with emphasis on changes in biodiversity and resilience to climate changes;
- Support a targeted NAMA mechanism to initiate the design and implementation of its actions; and
- Support for an assessment of the type and degree of technical assistance required by NAMA developers across the region.

5. We recommend that that USAID/CAM **support activities that will increase the capabilities of municipal governments to plan for and manage climate change impacts**. Municipalities in CA/DR already play an important role in reconstruction, disaster mitigation, and economic and social transformation in ways that ensure greater participation of all segments of society. Citizens look to municipal leaders to resolve local and regional issues that impact their livelihoods and quality of life. Training and capacity building programs can assist leaders implement a variety of climate adaptation activities aimed to build resilience at appropriate scales. Some municipalities work independently, while others coordinate with their neighbors for efficiency. The below recommendations primarily link to IR 2.2 and IR 2.3. Improving local governance can also provide co-benefits linked to IR 3.1 on security and coordinated governance systems improvements. Municipal governments in CA are responsible for land-use planning and USAID can provide levels of assistance required to build municipal-level resilience to climate change. Municipal officials, especially mayors, understand their constituents. Therefore, mayors can become effective champions for USAID to partner with. Additionally, the lack of financial resources and shortages of trained staff constrains development of good land use planning and conservation management, which are needed by the municipalities to improve resilience. Poor municipal financial systems are also a major constraint.

To strengthen the capabilities of municipal governments, we recommend USAID/CAM:

- Assist municipalities to identify and leverage new sources of financing for watershed management and the ecosystem services and resilience watersheds help provide;
- Identify and support municipal leaders through technical assistance, capacity building activities, and study tours; and
- Provide technical and capacity building support to local conservation NGOs that support municipal planning.

Focus areas can be strengthening financial capacity and transparency, support GIS activities for the development of flood plain mapping, and surveys of infrastructure to help communities prioritize capital investments.

6. We recommend that USAID/CAM **focus assistance in the Dry Corridor**. ***Section 3*** identifies several reasons to consider the Dry Corridor as the terrestrial area of CA that is most vulnerable to the effects of climate variability and change and our recommendations directly link to IR 2.1.1. The area's climate is already the driest part of CA, as shown in ***Figure 8***, and climate models project the region will likely become drier in coming decades. As discussed in ***Section 3***, and shown in ***Figure 6***, the Dry Corridor is one of the most more heavily populated regions of CA, exposing people, resources, and economies to the negative impacts of climate change. Poor, subsistence farmers, generally with few economic alternatives, make up a large proportion of the population in the Dry Corridor. As shown in ***Figure 7***, the Dry Corridor region shows that Honduras and parts of Guatemala have low adaptive capacity. In ***Section 3***, we discussed the types of intensive, profitable, export-oriented agriculture central to economic growth and prosperity of El Salvador,

Honduras, and Nicaragua. Agriculture in these areas is concentrated on the Pacific Coast and derives irrigation water from watersheds in the easterly mountains. These watersheds are already degraded, which has reduced the quantity and reliability of the water supplies for various sectors, including for coastal agriculture. Conservation of these watersheds, therefore, is an important measure for strengthening the overall resilience of the economies of Honduras, El Salvador, and Nicaragua to climate variability and change. In addition to considering the above strategic priorities, we recommend USAID/CAM support:

- Technology transfer grants channeled through CA universities and other organizations to support the demonstration and implementation of new technologies on the ecological, social and economic aspects of the impacts of climate change;
- Support the coordination of climate resilient land use planning between Dry Corridor and Coastal areas to facilitate effective implementation on program actions; and
- Provide pilot demonstrations of conservation technologies (e.g. soil conservation; integrated pest management; silvics and silviculture, biodiversity conservation) that can be applied most effectively on small farms for increasing resilience to climate change in the Dry Corridor.

7. We recommend that USAID/CAM **focus its activities to increase resilience in the most vulnerable coastal and marine areas of CA's Pacific and Atlantic Coasts**. These respond to transboundary management outcomes from IR 2.3. ***Section 3.3.3*** and ***Figure 4*** indicate the several CA cities that are particularly vulnerable to sea level rise. The vulnerable Pacific Coast areas are adjacent and linked to the Dry Corridor, thus programmatic linkages and efficiencies can be identified. For example, USAID/CAM can support community leaders, such as mayors, who can share their experiences, tools, and techniques with their neighbors who are developing new plans and processes. ***Section 3.4*** explains that the priority geographic areas for coastal resource management in CA are its gulfs, bays, islands and reefs. Tourism and other economic activities, such as fishing, are concentrated in these geographic areas. Gulfs and bays are nutrient rich and are prime habitats for marine commercial species and biodiversity. They are also more protected from storms, and provide harbors, so they are favored for the location of urban areas.

We recommend USAID/CAM support:

- Assessing and documenting the adaptive capacity of municipalities within the coastal areas shown as exposed to sea level rise in ***Figure 4***. Assessments can serve as baselines for USAID/CAM to understand where to focus activities;
- Convene a regional workshop with national governments and CCAD to identify activities to support municipal governments in strengthening resilience in the coastal zones;
- Support climate resilient land use planning in the coastal areas. This includes development of accurate maps of exposed and vulnerable areas; training and building capacity of municipal planners and support staff to understand and implement climate resilient planning activities; and support the strengthening of land use and town planning laws and permit systems. Emphasis should be placed on mangrove areas as referenced in ***Section 4.2.3***;
- Give special attention to the conservation of the large stocks of carbon stored in mangroves by supporting the implementation of pilot studies and policies that quantify and conserve the dynamics of carbon stocks and emissions in mangrove, sea grass and coastal marsh ecosystems;
- Support the restoration of areas previously covered by mangroves that have experienced encroachment from land-use change agents; and

- Support interactions between and training of individuals and organizations involved in blue carbon activities.

8. We recommend USAID/CAM **support climate services and data rescue activities**. More reliable climate data is needed in CA/DR, and USAID/CAM has made data integration a priority in IR 2.2. As noted in ***Section 3.1***, there are several limitations that make climate stressors difficult to analyze and plan for. Changes in precipitation patterns, drought, and storm patterns are needed by governments in CA to plan for resilience. Most of the historical climate and weather records in CA have not been fully or consistently digitized. Additionally, few hydro-climatic data are being collected. Up-to-date technologies are not being utilized, which would help with understanding local impacts, climate variability, and change in CA. The lack of this important data provides many challenges and opportunities in climate resilient development in the region. USAID/CAM can seek the advice of the International Environmental Data Rescue Organization (IEDRO), who can provide more preliminary information about such matters.

We recommend USAID/CAM support:

- Conducting an audit of digital and paper data holdings by meteorological departments in all the CA countries. This audit will create an inventory for CA governments to share and USAID/CAM to help identify needs;

- "Data rescue" activities by locating data that is at risk of being lost due to deterioration of the medium (e.g., paper, microfiche, magnetic ribbon, etc.) Recovered data can be digitized and used to assist researchers create accurate historical trends, which in turn can be used for more accurate climate projections and identification of stressors;

- Support the introduction and implementation of technologies to achieve country-level GHG emissions accounting; and

- Development of training and capacity building programs for meteorological staff in the CA countries.

ANNEXES

ANNEX A: BIBLIOGRAPHY

Aburto-Oropeza, O., E. Ezcurra, G. Denemann, V. Valdez, J. Murray and E. Sala. 2008. Mangroves in the Gulf of California increase fishery yields. Proc. Natl. Acad. USA, 105 (30): 10465-10459, doi: 10.1073/pnas.0804601105

Aguilar, E., Peterson, T. C., Obando, P. R., Frutos, R., Retana, J. a., Solera, M., Soley, J., García, I. G., Araujo, R. M., Santos, a. R., Valle, V. E., Brunet, M., Aguilar, L., Álvarez, L., Bautista, M., Castañón, C., Herrera, L., Ruano, E., Sinay, J. J., Sánchez, E., Oviedo, G. I. H., Obed, F., Salgado, J. E., Vázquez, J. L., Baca, M., Gutiérrez, M., Centella, C., Espinosa, J., Martínez, D., Olmedo, B., Espinoza, C. E. O., Núñez, R., Haylock, M., Benavides, H. and Mayorga, R. 2005. Changes in precipitation and temperature extremes in Central America and northern South America, 1961–2003, J. Geophys. Res., 110(D23), 1–15, doi:10.1029/2005JD006119

Anderson, E.R., Cherrington, E.A., Flores, A.I., Perez, J.B., Carrillo R., and E. Sempris. 2008. Potential Impacts of Climate Change on Biodiversity in Central America, Mexico, and the Dominican Republic. CATHALAC / USAID. Panama City, Panama. 105 pp.

Arnell, N. W.. 2004. Climate change and global water resources: SRES emissions and socio-economic scenarios, Glob. Environ. Chang., 14(1), 31–52, doi:10.1016/j.gloenvcha.2003.10.006

Autoridad Nacional del Ambiente, Panamá. 2011. Segunda comunicación nacional: ante la convención marco de las Naciones Unidas sobre el cambio climático. Panamá: Autoridad Nacional del Ambiente, 170p.

Avelino, J., Cristancho, M., Georgiou, S., Imbach, P., Aguilar, L., Bornemann, G., Läderach, P., Anzueto, F., Hruska, A. and Morales, C. 2015. The coffee rust crises in Colombia and Central America (2008–2013): impacts, plausible causes and proposed solutions, Food Secur., 1–19, doi:10.1007/s12571-015-0446-9

Belize. 2015. INDC submitted to the UNFCCC. Belize. 9p.

Belize Ministry of Natural Resources and Environment. 2012. *Belize Second National Communication to the Conference of the Parties of the United Nations Framework Convention on Climate Change,* Belize

Bellard, C., Bertelsmeier, C., Leadley, P., Thuiller, W. and Courchamp, F. 2012. Impacts of climate change on the future of biodiversity, Ecol. Lett., 15(4), 365–377, doi:10.1111/j.1461-0248.2011.01736.x

Biasutti, M., Sobel, A., Camargo, S. and Creyts, T. 2012. Projected changes in the physical climate of the Gulf Coast and Caribbean, Clim. Change, 112(3), 819–845 [online] Available from: http://dx.doi.org/10.1007/s10584-011-0254-y

BID, SINAC, DCC and CATIE. 2014. Actualización y rediseño de dos medidas de conservación para la adaptación del Sector biodiversidad ante el cambio climático. Final Report., Turrialba, Costa Rica.

BID-INTAL. 2010. Turismo, cambio climático e iniciativas regionales en América Central y El Caribe. Carta Mensual INTAL N°167, Buenos Aires, Argentina

BIOMARCC-USAID 2013. Vulnerabilidad y escenarios bioclimáticos de los sistemas marino-costeros a nivel del caribe centroamericano. San José, Costa Rica. 80pp.

Bouroncle C, Imbach P, Läderach P, Rodríguez B, Medellín C, Fung E, Martínez-Rodríguez MR, Donatti CI. 2015a. La agricultura de Guatemala y el cambio climático: ¿Dónde están las prioridades para la adaptación? Copenhagen, Denmark: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).

Bouroncle C, Imbach P, Läderach P, Rodríguez B, Medellín C, Fung E, Martínez-Rodríguez MR, Donatti CI. 2015b. La agricultura de Honduras y el cambio climático: ¿Dónde están las prioridades para la adaptación? Copenhagen, Denmark: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).

Bouroncle C, Imbach P, Läderach P, Rodríguez B, Medellín C, Fung E. 2014a. La agricultura de El Salvador y el cambio climático: ¿Dónde están las prioridades para la adaptación? Copenhagen, Denmark: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).

Bouroncle C, Imbach P, Läderach P, Rodríguez B, Medellín C, Fung E. 2014b. La agricultura de Nicaragua y el cambio climático: ¿Dónde están las prioridades para la adaptación? Copenhagen, Denmark: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)

Bouroncle, C. and Imbach, P. 2013. Análisis de vulnerabilidad de las zonas oceánicas y marino-costeras de Costa Rica frente al cambio climático: informe final – nivel distrital, Turrialba, Costa Rica.

Bouroncle, C., Imbach, P., Läderach, P., Rodríguez, B., Medellín, C. and Martinez, A. Mapping climate change impacts and adaptive capacity of smallholder agricultural livelihoods in Central America: ranking and descriptive approaches to support adaptation strategies, Under Rev. by Clim. Chang., n.d.

Bruijnzell, L.. 2005. Tropical Montane Cloud Forests: a unique hydrological case, in Forests, Water and People in the Humid Tropics: Past, Present and Future Hydrological Research for Integrated Land and Water Management, edited by M. Bonell and L. Bruijnzeel, p. 944, Cambridge University Press

Caffrey, P et. al. 2013. *Dominican Republic Climate Change Vulnerability Report*. USAID, Washington, D.C.

Cambers, G., Claro, R., Juman R., and Scott, S. 2007. *Working Group Report, Climate Change Impacts on Coastal and Marine Biodiversity. University of Puerto Rico Sea Grant College Program, Puerto Rico* (Institute of Oceanology, Cuba/Institute of Marine Affairs, Trinidad and Tobago/Fisheries Department, St Lucia.

Cañada, E. 2010. Tourism in Central America, Social conflict in a new setting. Available at: http://www.albasud.org/publ/docs/32.en.pdf

CCAD-SICA 2010. Regional Strategy on Climate Change, Executive document. 91p.

CCAFS. (Programa de Investigación de CGIAR en Cambio Climático, Agricultura y Seguridad Alimentaria). Reviewed February at 23th, 2016. Available at: at: https://ccafs.cgiar.org/es/blog/%C2%BFcentroam%C3%A9rica-est%C3%A1-preparada-para-el-cambio-clim%C3%A1tico#.Vs3Zn_nhBD-

CEPAL. 2015. Estado de la Región. Energía en Centroamérica: Reflexiones para la transición hacia economías bajas en carbono. México DF.

CEPAL. 2010a. La economía del cambio climático en Centroamerica: síntesis 2010, Ministerio Británico para el Desarrollo Internacional y la Comisión Económica para América Latina y el Caribe, Naciones Unidas, Mexico D.F.

CEPAL 2010b. Cambio Climático y retos para el sector turismo de Centroamérica. Serie Estudios y Perspectivas 123. Méxio D.F. 73 p.

CEPAL. 2012. La economía del cambio climático en Centroamérica: Síntesis, United Nations, México D.F., México

CEPAL-CEPALSTAT 2016. Available at: http://estadisticas.cepal.org/cepalstat/WEB_CEPALSTAT/Portada.asp

CEPAL and UC. 2015. Efectos del Cambio Climático en la costa de América Latina y el Caribe: dinámicas, tendencias y variabilidad climática, Santiago de Chile, Chile

CEPAL, CCAD, COSEFIN, SIECA, UKAID and DANIDA. 2015. Cambio climático en Centroamérica: Impactos potenciales y opciones de política pública, Mexico D.F.

Charvériat, C. 2000. Natural disasters in Latin America and the Caribbean : an overview of risk / by Céline Charvériat. p. cm. (Research Department Working papers series ; 434) Includes bibliographical references, 104 p.

Chassot, O, Valverde, A., Jiménez, V., Müller, E., Moreno, T. 2011. Regional report for Mesoamerica http://www.uncsd2012.org/content/documents/400Mesoamerica%20Mountains%20Report%202011.pdf

Church, J. A., Clark, P. U., Cazenave, A., Gregory, J. M., Jevrejeva, S., Levermann, A., Merrifield, M. A., Milne, G. A., Nerem, R. S., Nunn, P. D., Payne, A. J., Pfeffer, W. T., Stammer, D. and Unnikrishnan, A. S. 2013. Sea Level Change, in Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, edited by T. F. Stocker, D. Qin, G.-K. Plattner, M. Tignor, S. K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex, and P. M. Midgley, pp. 1137–1177, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Cifuentes-Jara, M.; Brenes, C.; Manrow, M.; Torres, D. 2014. Los manglares del Golfo de Nicoya, Costa Rica: Dinámica de uso del suelo y potencial de mitigación. Serie Técnica. Informe Técnico. Conservación Internacional. San José, Costa Rica. 42p.

Clark, D. B., Clark, D. A. and Oberbauer, S. F. 2010. Annual wood production in a tropical rain forest in NE Costa Rica linked to climatic variation but not to increasing CO2, Glob. Chang. Biol., 16(2), 747–759, doi:10.1111/j.1365-2486.2009.02004.x

Colwell, R. K., Brehm, G., Cardelús, C. L., Gilman, A. C. and Longino, J. T. 2008. Global warming, elevational range shifts, and lowland biotic attrition in the wet tropics., Science, 322(5899), 258–61, doi:10.1126/science.1162547

Comisión Centroamericana de Ambiente y Desarrollo (CCAD). 2014. Estrategia Regional Ambiental Marco 2015-2020. CCAD/SICA. Accessed: 11th January, 2016. Available at: http://www.sica.int/ccad/eram/index.aspx?Idm=1

Corrales, L., Bouroncle, C. and Zamora, J.C. 2015. An overview of forest biomes and ecoregions of Central America. In: Chiabai, A. (Ed). Climate change impacts on tropical forests in Central America. New York, Estados Unidos. The Earthscan Forest Library Series. p. 17-38

Costa Rica. 2015. Contribución prevista y determinada a nivel nacional de Costa Rica. Gobierno de Costa Rica. Ministerio de Ambiente y Energía. San José. 19p.

Costa Rica. Ministerio del Ambiente y Energía. Instituto Meteorológico Nacional. 2014. *Tercera comunicación nacional a la Convención Marco de las Naciones Unidas sobre cambio climático* /MINAE, IMN. San José, Costa Rica: MINAE, IMN, GEF, PNUD. 112p

Cox, P. M., Betts, R. a., Collins, M., Harris, P. P., Huntingford, C. and Jones, C. D.. 2004. Amazonian forest dieback under climate-carbon cycle projections for the 21st century, Theor. Appl. Climatol., 78(1-3), 137–156, doi:10.1007/s00704-004-0049-4

De Loma-Ossorio, E.; García Ruiz, A.; Córdoba Salinas, M.; Ribalaygua Batalla, J. 2014. "Estrategias de adaptación al cambio climático en municipios de Nicaragua del Golfo de Fonseca", Instituto de Estudios del Hambre, Madrid, España

Deser, C., Phillips, A. S. and Alexander, M. A. 2010. Twentieth century tropical sea surface temperature trends revisited, Geophys. Res. Lett., 37(10), n/a–n/a, doi:10.1029/2010GL043321

DFN (Danone Fund for Nature). 2010. Achieving Carbon Offsets through Mangroves and Other Wetlands. November 2009 Expert Workshop Meeting Report, ed. Nick Davidson. Danone Group/IUCN/ Ramsar Convention Secretariat, Gland, Switzerland. 87pp.

Díaz, R., Asturias, J. and Chiliquinga, B.: Uso racional y sostenible de la leña en los países de SICA., 2013.

Diffenbaugh, N. S. and Giorgi, F. 2012. Climate change hotspots in the CMIP5 global climate model ensemble, Clim. Change, 114(3), 813–822, doi:10.1007/s10584-012-0570-x

Dominican Republic. 2015. Contribución prevista y determinada a nivel nacional INDC-RD. 4p.

Dominican Republic. 2009. Segunda comunicación nacional sobre cambio climático. Gobierno de Secretaría de Medio Ambiente y Recursos Naturales (SEMARENA), Programa de Naciones Unidas para el Desarrollo (PNUD), Proyecto Cambio Climático 2009. 318p.

Donner, S. D. 2009. Coping with Commitment: Projected Thermal Stress on Coral Reefs under Different Future Scenarios, PLoS One, 4(6), e5712 [online] Available from: http://dx.doi.org/10.1371%2Fjournal.pone.0005712

Draft Internal Technical Report for the CASCADE Project.

Eitzinger, A., Läderach, P., Sonder, KSchmidt, A., Sain, G., Beebe, S., Rodríguez, B., Fisher, M., Hicks, P., Navarrete-Frías, C. and Nowak, A. 2013. Tortillas on the roaster: Central America's maize–bean systems and the changing climate. CIAT Policy Brief No. 6., Cali, Colombia.

El Salvador. 2015. Contribución prevista y determinada a nivel nacional. Gobierno de El Salvador. Ministerio del Ambiente y Recursos Naturales. 14p.

El Salvador Ministerio de Recursos Naturales y Medio Ambiente. 2013. Comunicación Nacional sobre Cambio Climático, 133p

Enquist, B. J. and Enquist, C. A. F. 2011. Long-term change within a Neotropical forest: assessing differential functional and floristic responses to disturbance and drought, Glob. Chang. Biol., 17(3), 1408–1424, doi:10.1111/j.1365-2486.2010.02326.x

ERAS. 2008. Regional Agroenvironmental and Health Strategy (Estrategia Regional Agroambiental y de Salud de Centroamérica) 2009-2024

Erwin, K. L. 2008. Wetlands and global climate change: the role of wetland restoration in a changing world, Wetl. Ecol. Manag., 17(1), 71–84, doi:10.1007/s11273-008-9119-1

ES-COMISCA (Executive Secretary for the Council of Ministers of Health of Central America). 2010. Health Plan for Central America and the Dominican Republic 2010 – 2015, 128 p.

Estrategia Centroamericana de Desarrollo Rural Territorial 2010-2030: ECADERT -CAC, ECADERT-SICA, San José. Costa Rica. IICA. 2010.

Fabricius KE, Hoegh-Guldberg O, Johnson J, McCook L, Lough J. 2007. Vulnerability of coral reefs of the Great Barrier Reef to climate change. Climate change and the Great Barrier Reef Great Barrier Reef Marine Park Authority and Australian Greenhouse Office, Australia, pp 515–554.

FAO (Food and Agricultural Organization of the United Nations). 2016 Aquastat http://www.fao.org/countryprofiles

FAO, 2015. Major crop losses in Central America due to El Niño (http://www.fao.org/news/story/en/item/328614/icode/)

FAO 2015b. Disaster Risk Programme to strengthen resilience in the Dry Corridor in Central America. http://www.fao.org/emergencies/resources/documents/resources-detail/en/c/330164/

FAO. 2013. Climate-Smart Agriculture Sourcebook, Rome, Italy. 570p.

FAO. 2001. Analysis of the Medium-term Effects of Hurricane Mitch on Food Security in Central America, Rome, Italy

Feeley, K. J., Davies, S. J., Perez, R., Hubbell, S. P. and Foster, R. B.. 2011. Directional changes in the species composition of a tropical forest., Ecology, 92(4), 871–82 [online] Available from: http://www.ncbi.nlm.nih.gov/pubmed/21661550

Fellmann, T. (2012). The assessment of climate change-related vulnerability in the agricultural sector: reviewing conceptual frameworks, in A. Meybeck, J. Lankoski, S. Redfern, N. Azzu, and V. Gitz (eds.) Building resilience for adaptation to climate change in the agriculture sector – Proceedings of a Joint FAO/OECD Workshop, Rome, 23-24 April, 2012

Ferris, Elizabeth. 2010. Natural Disasters, Conflict, and Human Rights: Tracing the Connections, Speechat Brookings Institute UNDP AND THE HYOGO FRAMEWORK FOR ACTION

Ficke, A.D., Myrick, C.A. and Hansen, L.J. 2007. Potential impacts of global climate change on freshwater fisheries. Reviews in Fish Biology and Fisheries, 17(4), 581-613

Fung, E., Imbach, P., Corrales, L., Vilchez, S., Zamora, N., Hannah, L. and Ramos, Z. Mapping conservation priorities and connectivity pathways under climate change for tropical ecosystems, Under Rev. by Clim. Chang.

Game, E. T., Lipsett-Moore, G., Saxon, E., Peterson, N. and Sheppard, S. 2011. Incorporating climate change adaptation into national conservation assessments, Glob. Chang. Biol., 17, 3150–3160, doi:10.1111/j.1365-2486.2011.02457.x

Giorgi, F. 2006. Climate change hot-spots. Geographical Research Letters 33(8), 1–4, doi:10.1029/2006GL025734

Gobierno de Nicaragua. No date. Primera *Comunicación Nacional del Gobierno de Honduras ante la Convención Marco de las Naciones Unidas sobre Cambio Climático,* 124p.

GWP (Global Water Partnership). 2016. http://www.gwp.org/en/gwp-in-action/Central-America

Guasch, J.L, Rojas-Suarez, L. and Gonzales, V. 2012. Competitiveness in Central America The Road to Sustained Growth and Poverty Reduction. Available at: http://www.cgdev.org/sites/default/files/1426258_file_Competitiveness_Central_America_FINAL_0.pdf

Guatemala 2015. Contribución prevista y determinada a nivel nacional. República de Guatemala. Ministerio del Ambiente y Recursos Naturales. 15p.

Guatemala Ministerio de Ambiente y Recursos Naturales. 2001. Available at: http://unfccc.int/resource/docs/natc/guanc1.pdf *Primera Comunicación Nacional Sobre Cambio Climático.*

Hastenrath, S. and Polzin, D. 2013. Climatic variations in Central America and the Caribbean, Int. J. Climatol., 33(6), 1348–1356, doi:10.1002/joc.3515

Hastenrath, S. and Polzin, D. 2012. Climatic variations in Central America and the Caribbean INTERNATIONAL JOURNAL OF CLIMATOLOGY *Int. J. Climatol.* 33: 1348–1356 (2013) Published online 13 June 2012 in Wiley Online Library (wileyonlinelibrary.com) DOI: 10.1002/joc.3515

Hastenrath, S. L. 1967. Rainfall Distribution and Regime in Central America, Archiv für Meteorologie, Geophysik und Bioklimatologie, Serie B, 15 (3), 201-241

Hastenrath, Stefan L. 1966. Rainfall Distribution and Regime in Central America, Theoretical and Applied Climatololgy, 15, 201–241

Hawkins, E. and Sutton, R. 2012. Time of emergence of climate signals, Geophys. Res. Lett., 39(1), 1–6, doi:10.1029/2011GL050087

Hidalgo, H.G., and Alfaro, E.J. 2014. *Skill of CMIP5 climate models in reproducing 20th century basic climate features in Central America*, INTERNATIONAL JOURNAL OF CLIMATOLOGY *Int. J. Climatol.* (2014) Published online in Wiley Online Library (wileyonlinelibrary.com) DOI: 10.1002/joc.4216

Hidalgo, H. G., Amador, J. A., Alfaro, E. J. and Quesada, B 2013. Hydrological climate change projections for Central America, J. Hydrol., 495(0), 94–112, doi:http://dx.doi.org/10.1016/j.jhydrol.2013.05.004

Hidalgo, H. G. and Alfaro, E. J. 2012. Some physical and socio-economic aspects of climate change in Central America, Prog. Phys. Geogr., 36(3), 379–399, doi:10.1177/0309133312438906

Hijmans, R. J., Cameron, S. E., Parra, J. L., Jones, P. G. and Jarvis, A. 2005. Very high resolution interpolated climate surfaces for global land areas, Int. J. Climatol., 25(15), 1965–1978 [online] Available from: http://dx.doi.org/10.1002/joc.1276

Hoegh-Guldberg, O. and Bruno, J. F. 2010: The Impact of Climate Change on the World's Marine Ecosystems, Science (80-.)., 328(5985), 1523–1528 [online] Available from: http://science.sciencemag.org/content/328/5985/1523.abstract.

Holdridge, L. R.. 1947. Determination of world plant formations from simple climatic data, Science (80-.)., 105, 367–368

Honduras. 2013. Segunda comunicación nacional del Gobierno de Honduras ante la Convención Marco de las Naciones Unidas sobre Cambio Climático. 294p.

Honduras. 2015. Contribución prevista y determinada a nivel nacional. Gobierno de la República de Honduras. 8p.

Hotez, P. J., Bottazzi, M. E., Franco-Paredes, C., Ault, S. K. and Periago, M. R. 2008: The Neglected Tropical Diseases of Latin America and the Caribbean: A Review of Disease Burden and Distribution and a Roadmap for Control and Elimination, PLoS Negl. Trop. Dis., 2(9), e300 [online] Available from: http://dx.doi.org/10.1371%2Fjournal.pntd.0000300

Howard, J., Hoyt, S., Isensee, K., Telszewski, M., Pidgeon, E. (eds.) 2014. Coastal Blue Carbon: Methods for assessing carbon stocks and emissions factors in mangroves, tidal salt marshes, and seagrasses. Conservation International, Intergovernmental Oceanographic Commission of UNESCO, International Union for Conservation of Nature. Arlington, Virginia, USA.

IAI (Inter-American Institute for Global Change Research). 2010 Hurricanes and coastal zone vulnerability in Central America and the Caribbean, Communiqué 3 – Noviembre 2010 http://www.iai.int/?p=4906

IARNA. 2010. Impactos sociales y económicos del cambio climático con énfasis en los sectores de energía y agricultura, Ciudad de Guatemala, Guatemala.

Imbach, P., Locatelli, B., Zamora, J. C., Fung, E., Calderer, L., Molina, L. and Ciais, P.. 2015a. Impacts of climate change on ecosystems hydrological services of Central America: water availability, in Climate Change Impacts on Tropical Forests in Central America: en Ecosystem Service Perspective, edited by A. Chiabai, pp. 65–90, Routhledge, New York, USA.

Imbach, P., Zamora, J., Georgiou, S., Corrales, L. and Calderer, L. 2015b: Impacts of climate change on the potential vegetation of Central America. Draft Internal Technical Report for the CASCADE Project., Turrialba, Costa Rica..

Imbach, P. A., Locatelli, B., Molina, L. G., Ciais, P. and Leadley, P. W. 2013. Climate change and plant dispersal along corridors in fragmented landscapes of Mesoamerica, Ecol. Evol., 3(9), 2917–2932, doi:10.1002/ece3.672

Imbach, P., Molina, L., Locatelli, B., Roupsard, O., Mahé, G., Neilson, R., Corrales, L., Scholze, M. and Ciais, P. 2012. Modeling potential equilibrium states of vegetation and terrestrial water cycle of Mesoamerica under climate change scenarios, J. Hydrometeorol., 13(2), 665–680, doi:10.1175/jhm-d-11-023.1

Imbach, P., Molina, L., Locatelli, B., Roupsard, O., Ciais, P., Corrales, L. and Mahé, G.. 2010. Climatology-based regional modelling of potential vegetation and average annual long-term runoff for Mesoamerica, Hydrol. Earth Syst. Sci., 14(10), 1801–1817, doi:10.5194/hess-14-1801

INCAE-AECID-SICA. 2009. Plan Estratégico de Desarrollo Turístico Sostenible 2009-2013.

InterAmerican Institute for Agriculture Cooperation (IICA). 2015. Accessed: 14th January, 2016. (online) Available at :http://institutfrancais-ifac.com/wp-content/uploads/2015/12/nota-tecnica-agricultura-y-cambio-climatico.pdf

InterAmerican Institute for Agriculture Cooperation (IICA). 2015b. Technical note - March 2015 Victor M. Villalobos A.: Development of rural territories in Central America to benefit from new geospatial information.

IPCC 2013a: Annex I: Atlas of Global and Regional Climate Change Projections, in Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, edited by G. J. van Oldenborgh, M. Collins, J. Arblaster, J. H. Christensen, J. Marotzke, S. B. Power, M. Rummukainen, and T. Zhouvan, pp. 1311–1393, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

IPCC 2013b: Annex I: Atlas of Global and Regional Climate Projections Supplementary Material RCP8.5, in Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, edited by G. J. van Oldenborgh, M. Collins, J. Arblaster, J. H. Christensen, J. Marotzke, S. B. Power, M. Rummukainen, and T. Zhouvan, p. 159, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Jarvis, A., Reuter, H., Nelson, A. and Guevara, E. 2008: Hole-filled seamless SRTM data, [online] Available from: http://srtm.csi.cgiar.org.

Karmalkar, A. V, Bradley, R. S. and Diaz, H. F. 2008. Climate change scenario for Costa Rican montane forests, Geophys. Res. Lett., 35(11), L11702, doi:10.1029/2008GL033940

Kernan, Bruce, et al. 2014. *Regional Program for the Management of Aquatic Resources and Economic Alternatives (MAREA), Final Performance Evaluation*, USAID, Washington, D.C.

Khatun, K., Imbach, P. and Zamora, J. 2013. An assessment of climate change impacts on the tropical forests of Central America using the Holdridge Life Zone (HLZ) land classification system, iForest - Biogeosciences For., 6(4), 183–189 [online] Available from: http://www.sisef.it/iforest/contents/?id=ifor0743-006

Kirtman, B., Power, S. B., Adedoyin, J. A., Boer, G. J., Bojariu, R., Camilloni, I., Doblas-Reyes, F. J., Fiore, A. M., Kimoto, M., Meehl, G. A., Prather, M., Sarr, A., Schär, C., Sutton, R., Oldenborgh, G. J., van Vecchi, G. and Wang, H. J. 2013. Near-term Climate Change: Projections and Predictability, in Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, edited by T. F. Stocker, D. Qin, G.-K. Plattner, M. Tignor, S. K. Allen, J. Boschung, Y. X. A. Nauels, V. Bex, and P. M. Midgley, pp. 953–1008, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA

Kreft, S., D. Eckstein, L. Dorsch, and L. Fischer. (2016). Global Climate Risk Index 2016. Who suffers most from extreme weather events? Weather-related Loss Events in 2014 and 1995 to 2014. In G. K. Joanne Chapman-Rose, Daniela Baum (Ed.), (pp. 32). Berlin, Germany: Germanwatch.

Läderach, P., Haggar, J., Lau, C., Eitzinger, A., Ovalle, O., Baca, M., Jarvis, A. and Lundy, M. 2010. Mesoamerican coffee: Building a climate change adaptation strategy. Policy Brief no. 2., Cali, Colombia. [online] Available from: http://ciat.cgiar.org/wp-content/uploads/2012/12/policy_brief2_mesoamerican_coffee.pdf

Lawton, R. O., Nair, U. S., Pielke Sr, R. a and Welch, R. M. 2001. Climatic impact of tropical lowland deforestation on nearby montane cloud forests., Science, 294(5542), 584–7, doi:10.1126/science.1062459

Lobell, D. B., Burke, M. B., Tebaldi, C., Mastrandrea, M. D., Falcon, W. P. and Naylor, R. L. 2008. Prioritizing Climate Change Adaptation Needs for Food Security in 2030, Science (80-.)., 319(5863), 607–610 [online] Available from: http://science.sciencemag.org/content/319/5863/607.abstract

Lovelock C.E., and Ellison, J. 2007. Vulnerability of mangroves and tidal wetlands of the Great Barrier Reef to climate change. In: Climate Change and the Great Barrier Reef: A Vulnerability Assessment (eds Johnson J, Marshall P), pp. 237–269. Great Barrier Reef Marine Park Authority and Australian Greenhouse Office, Townsville.

Lozano, D., Chacón, A., Gutierrez, I. and Robalino, J. 2014. Eventos climáticos extremos y migración interna en Guatemala, un análisis basado en percepciones de expertos, Cienc. Ergo Sum, 22(1), 35–44

Lungo, M. 2001. Urban Sprawl and Land Regulation in Latin America. Land Lines: March 2001, Volume 13, Number 2, (Land Lines Article), Lincoln Institute of Land Policy, Cambridge, Mass. 3 p. web site: http://www.lincolninst.edu/pubs/255_Urban-Sprawl-and-Land-Regulation-in-Latin-America

Magaña, V., Amador, J. A. and Medina, S. 1999. The Midsummer Drought over Mexico and Central America, J. Clim., 12(6), 1577–1588 [online] Available from: http://dx.doi.org/10.1175/1520-0442(1999)012<1577:TMDOMA>2.0.CO;2, 1999.

Magrin, G. O., Marengo, J. A., Boulanger, J.-P., Buckeridge, M. S., Castellanos, E., Poveda, G., Scarano, F. R. and Vicuña, S.: Central and South America, in Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, edited by V. R. Barros, C. B. Field, D. J. Dokken, M. D. Mastrandrea, K. J. Mach, T. E. Bilir, M. Chatterjee, K. L. Ebi, Y. O. Estrada, R. C. Genova, B. Girma, E. S. Kissel, A. N. Levy, S. MacCracken, P. R. Mastrandrea, and L. L. White, pp. 1499–1566, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA., 2014.

Malhi and Wright, 2004. Spatial patterns and recent trends in the climate of tropical rainforest regions. Philos Trans R Soc London Ser B 359:311–329

MARN El Salvador Ministerio de Recursos Naturales y Medio Ambiente. 2013. Comunicación Nacional sobre Cambio Climático, 133p

Maurer, E. P., Adam, J. C. and Wood, A. W.: 2009. Climate model based consensus on the hydrologic impacts of climate change to the Rio Lempa basin of Central America, Hydrol. Earth Syst. Sci., 13(2), 183–194, doi:10.5194/hess-13-183-2009, 2009.

Maynard-Ford, M.C., Phillips, E.C. and Chirico, P.G. 2008. Mapping Vulnerability to Disasters in Latin America and the Caribbean, 1900–2007, U.S. Geological Survey, 30 p.

McKinney, M., Scarlett, L. and Kemmi, D.. 2010. Large Landscape Conservation: A Strategic Framework for Policy and Action. Lincoln Institute of Land Policy, Cambridge, Mass

Miller, M. et al. 2011. *Jamaica Climate Change Vulnerability Assessment and Adaptation Prioritization*. USAID/USFS, Washington, D.C.

Mora, C., Frazier, A. G., Longman, R. J., Dacks, R. S., Walton, M. M., Tong, E. J., Sanchez, J. J., Kaiser, L. R., Stender, Y. O., Anderson, J. M., Ambrosino, C. M., Fernandez-Silva, I., Giuseffi, L. M. and Giambelluca, T. W.: The projected timing of climate departure from recent variability, Nature, 502(7470), 183–187 [online] Available from: http://dx.doi.org/10.1038/nature12540, 2013.

Mulligan, M. and Burke, S. M. 2005. Global cloud forests and environmental change in a hydrological context, [online] Available from: http://www.ambiotek.com/cloudforests

Nakaegawa, T., Kitoh, A., Kusunoki, S., Murakami, H. and Arakawa, O. 2014. Hydroclimate changes over Central America and the Caribbean in a global warming climate projected with 20-km and 60-km mesh MRI atmospheric general circulation models, Pap. Meteorol. Geophys., 65, 15–33, doi:10.2467/mripapers.65.15

Nakaegawa, T., Kitoh, A., Murakami, H. and Kusunoki, S. 2013. Annual maximum 5-day rainfall total and maximum number of consecutive dry days over Central America and the Caribbean in the late twenty-first century projected by an atmospheric general circulation model with three different horizontal resolutions, Theor. Appl. Climatol., 1–14, doi:10.1007/s00704-013-0934-9

Nam, V.N.; Sasmito, S.D.; Murdiyarso, D.; Purbopuspito, J.; MacKenzie, R.A. 2016. Carbon stocks in artificially and naturally regenerated mangrove ecosystems in the Mekong Delta. Wetlands Ecol. & Manage. DOI 10.1007/s11273-015-9479-2

Neelin, J. D., Münnich, M., Su, H., Meyerson, J. E. and Holloway, C. E. 2006. Tropical drying trends in global warming models and observations., Proc. Natl. Acad. Sci. U. S. A., 103(16), 6110–5, doi:10.1073/pnas.0601798103.

Neilson, R. P, 1995. A Model for Predicting Continental-Scale Vegetation Distribution and Water Balance, Ecol. Appl., 5(2), 362–385, doi:doi:10.2307/1942028

Nicholls, R. J. and Cazenave, A. 2010. Sea-Level Rise and Its Impact on Coastal Zones, Science (80-.)., 328(5985), 1517–1520 [online] Available from: http://science.sciencemag.org/content/328/5985/1517.abstract

Nurse, L.A. and Charlery, J.L. 2016. Projected SST trends across the Caribbean Sea based on PRECIS downscaling of ECHAM4, under the SRES A2 and B2 scenarios. Theoretical and Applied Climatology, 123(1),199-215

Ojea, Elena, Juan Carlos Zamora, Julia Martin-Ortega and Pablo Imbach. 2015. Climate change economic impacts on water and recreation services in Central American forests

Organization of American States (OAS) 2009. Declaration of San Pedro Sula: toward a culture of non-violence. 8p. Available at: https://www.oas.org/sap/peacefund/resolutions/Declaration_of_San_Pedro_Sula_Culture_of_Non_Violence.pdf

Parry, M.L., Canziani, O.F., Palutikof, J.P., van der Linden, P.J., and Hanson, C.E. 2007. Climate Change 2007: Impacts, Adaptation and Vulnerability. In M. L. Parry, O. F. Canziani, J. P. Palutikof, P. J. v. d. Linden & C. E. Hanson (Eds.), Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (pp. 23-78). Cambridge, UK: IPCC.

Politzer, M.. 2015. *Resilient livelihood strategies in the face of climate change: What works and what doesn't*, Planet Worth, 6p

PRISMA (Programa Salvadoreño de Investigación sobre Desarrollo para el Medio Ambiente). 2014. Cuellar, N.; Luna, F.; Kandel, S.; Diaz, O.; Davis, A. REDD+ Jurisdiccional en Centroamérica: Oportunidades e Implicaciones para Pueblos Indígenas y Comunidades Forestales. Accessed: 13th January, 2016. Available at: https://www.youtube.com/watch?v=60ltHLz5WEA

PRISMA. 2014. Vinculando adaptación y mitigación del cambio climático: Implicaciones para Centroamérica (en línea). San Salvador, ES. 12p. Consultado 09 feb. 2016. Disponible en: http://cdkn.org/wp-content/uploads/2014/08/vinculando_adaptacion_y_mitigacion_del_CC_01.pdf

PRISMA. 2013. Mitigación basada en la Adaptación (MbA), Potencialidades y desafíos para responder al cambio climático en Centroamérica. Available at: http://www.prisma.org.sv/uploads/media/ApD_Mitigacion_basada_en_Adaptacion_02.pdf

PRISMA (2012). Estudios sobre los valores ambientales, económicos y sociales de la biodiversidad, los ecosistemas y los servicios que estos proveen en el área natural La Montaña.

Programa Estado de la Nación en Desarrollo Humano Sostenible. 2014. Estadísticas de Centroamérica 2014 PEN. San José, Costa Rica. 96 páginas.

Programa Estado de la Nacion: Cuarto Informe Estado de la Región en Desarrollo Humano Sostenible, San José, Costa Rica., 2011.

Proyecto Mesoamericano.org 2016 http://www.proyectomesoamerica.org/joomla/index.php?option=com_content&view=article&id=68&Itemid=85

Ramirez, J. and Jarvis, A. 2008. High Resolution Statistically Downscaled Future Climate Surfaces. International Centre for Tropical Agriculture, CIAT.Available from: http://ccafs-climate.org/

Rauscher, S., Giorgi, F., Diffenbaugh, N. and Seth, A. 2008. Extension and Intensification of the Meso-American mid-summer drought in the twenty-first century, Clim. Dyn., 31(5), 551–571 [online] Available from: http://dx.doi.org/10.1007/s00382-007-0359-1.

República Dominicana Secretaría de Estado de Medio Ambiente y Recursos Naturales. 2009. *Cambio Climático 2nda Comunicación Nacional*, pp 317

Reyer, P. O. C., Adams, S., Albrecht, T., Baarsch, F., Boit, A., Canales Trujillo, N., Cartsburg, M., Coumou, D., Eden, A., Fernandes, E., Langerwisch, F., Marcus, R., Mengel, M., Mira-Salama, D., Perette, M., Pereznieto, P., Rammig, A., Reinhardt, J., Robinson, A., Rocha, M., Sakschewski, B., Schaeffer, M., Schleussner, C.-F., Serdeczny, O. and Thonicke, K. 2015. Climate change impacts in Latin America and the Caribbean and their implications for development, Reg. Environ. Chang., 1–21, doi:10.1007/s10113-015-0854-6

Rivera-Monroy, V.; Catañeda-Moya, E. 2013. Análisis de carbono orgánico total en manglares del Parque Nacional Jeannette Kawas. PNUD. Honduras. 29p.

Robalino, J., Jimenez, J. and Chacón, A. 2015. The Effect of Hydro-Meteorological Emergencies on Internal Migration, World Dev., 67, 438–448, doi:http://dx.doi.org/10.1016/j.worlddev.2014.10.031

Rojas, C., Muñiz, I., Pino, J. 2013. Understanding the Urban Sprawl in the Mid-Size Latin American Cities through the Urban Form: Analysis of the Concepción Metropolitan Area (Chile), Journal of Geographic Information System, 2013, 5, 222-234 http://dx.doi.org/10.4236/jgis.2013.53021 Published Online June 2013 (http://www.scirp.org/journal/jgis)

S. Kumar and A. Yalew. 2012. Economic Impacts of Climate Change on Secondary Activities: A Literature Review, Low Carbon Economy, 3(2),39-48, doi: 10.4236/lce.2012.32006

Scholze, M., Knorr, W., Arnell, N. W. and Prentice, I. C. 2006. A climate-change risk analysis for world ecosystems, Proc. Natl. Acad. Sci., 103(35), 13116–13120, doi:10.1073/pnas.0601816103

Selig ER, Turner WR, Troeng S, Wallace BP, Halpern BS, et al. 2014. *Global Priorities for marine biodiversity conservation. PLoS One, 9, e82898*

Seneviratne, S. I., Nicholls, N., Easterling, D., Goodess, C. M., Kanae, S., Kossin, J., Luo, Y., Marengo, J., McInnes, K., Rahimi, M., Reichstein, M., Sorteberg, A., Vera, C. and Zhang, X.. 2012. Changes in climate extremes and their impacts on the natural physical environment, in Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation, edited by C. B. Field, V. Barros, T. F. Stocker, D. Qin, D. J. Dokken, K. L. Ebi, M. D. Mastrandrea, K. J. Mach, G.-K. Plattner, S. K. Allen, M. Tignor, and P. M. Midgley. pp. 109–230, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Short, F. T. and Neckles, H. A. 1999. The effects of global climate change on seagrasses, Aquat. Bot., 63(3–4), 169–196, doi:http://dx.doi.org/10.1016/S0304-3770(98)00117-X

SIECA 2015. Informe Económico Regional 2015. Ciudad de Guatemala, Guatemala.

SITCA-CCT, 2013. http://www.sica.int/cct/

Taylor, M.A., and Alfaro, E.J. 2005. Climate of Central America and the Caribbean, in: J. Oliver (ed), The Encyclopedia of World Climatology, Springer, Dordrecht, Netherlands, pp. 183 – 189.

TNC 2012. Climate Finance Readiness, Lessons learned in developing countries. Ministerio del Ambiente, Perú; Libélula: comunicación, ambiente y desarrollo. 20p

United Nations. 2010. The Economics of Climate Change in Central America: Summary 2010. United Kingdom Department for International Development (DFID) and the Subregional Headquarters of the Economic Commission for Central America and the Caribbean (ECLAC). Mexico City, 144p

UNDP 2015. UNDP and the Hyogo Framework for Action. Available at: http://www.undp.org/content/dam/undp/library/crisis%20prevention/disaster/UNDP%20and%20the%20Hyogo%20Framework%20for%20Action%20-%2010%20years%20of%20reducing%20disaster%20risk.pdf?download

UNEP, ECLAC and GRID Arendal 2010. Vital Climate Change Graphics for Latin America and the Caribbean. Available at http://www.grida.no/_cms/OpenFile.aspx?s=1&id=1441

UN-HABITAT. 2011. Solid Waste Management Technical & Institutional Assistance Initiative for Central America, Nairobi, United Nations Human Settlements Programme

USAID(a). 2007. *Adapting to Climate Change Variability and Change: A Guidance Manual for Development Planning*, USAID, Washington, D.C.

USAID(b) 2008. Potential impacts of Climate change on Biodiversity in Central America, Mexico and Dominican Republic. Cathalac.93p.

USAID(c). 2012. *Climate Change Adaptation Plan*, USAID, Washington, D.C.

USAID(d).2012 Compendio de Legislación Marino Costera centroamericana, convenios internacionales y normativa regional, USAID-MAREA, El Salvador 80 pp.

USAID(e) 2014. Climate Change and Water: An Annex to the USAID Climate-Resilient Development Framework

USAID(f). 2014. *Climate-Resilient Development: A Framework for Understanding and Addressing Climate Change*, USAID, Washington, D.C.

USAID(g). 2014. *Incorporating Global Climate Change in the Country Development Cooperation Strategy Version 1.1*, USAID, Washington, D.C.

USAID(h). 2015. *Governing for Resilience: An Annex to the USAID Climate-Resilient Development Framework,* USAID, Washington, D.C.

USAID(i). 2015. *Climate Change and Coastal Zones: An Annex to the USAID Climate-Resilient Development Framework,* USAID, Washington, D.C.

USDOT, 2012. Impacts of Climate Change and Variability on Transportation Systems and Infrastructure: The Gulf Coast Study, Phase II. A report by the US Department of Transportation Center for Climate Change and Environmental Forecasting [Choate A, W Jaglom, R Miller, B Rodehorst, P Schultz and C Snow (eds.)]. Department of Transportation, Washington, DC, USA, 470 pp

Vallejo, C.; Chacon, M.; Cifuentes, M. 2016. Sinergias entre adaptación y mitigación del cambio climático (SAM) en los sectores agrícola y forestal Concepto y propuesta de acción. Serie Técnica. Informe Técnico. CATIE, Turrialba, Costa Rica. 46p

van Haeften, R. 2010. Urbanization in Latin America and the Caribbean: Trends and Challenges, USAID, Washington, D.C. 13 p

WB (World Bank) 2013. Why is freight transport so expensive in Central America? http://www.worldbank.org/en/news/feature/2013/02/07/costos-del-transporte-en-centroamerica

Williams, J. W., Jackson, S. T. and Kutzbach, J. E. 2007. Projected distributions of novel and disappearing climates by 2100 AD, Proc. Natl. Acad. Sci., 104(14), 5738–5742, doi:10.1073/pnas.0606292104

Wolf, A., Yoffe, S. and Giordano, M 2003. International Waters: identifying basins at risk, Water Policy, 5, 29–60

ANNEX B: BIODATA OF TEAM MEMBERS

BRUCE KERNAN

Team Leader/Tropical Forest Management Specialist

Bruce Kernan has 32 years of professional experience in the design, management, assessment, monitoring, and evaluation of the climate change, environmental, biodiversity, and forestry aspects of international development projects. He has served as a team leader or participant for over 50 short-term consulting assignments in 26 countries, and has accumulated extensive experience in designing and implementing short-term training courses and public consultations. He was team leader for USAID climate change analyses of eight Eastern Caribbean countries, Guyana, Surinam and Bolivia and evaluation of the climate change aspects USAID environmental programs in the Dominican Republic and Central America. He managed several large and complex USAID/Ecuador rural development and natural resource projects, and is fluent in Spanish.

MPS	Natural Resources, Cornell University, USA
MFS	Silviculture and Forestry Economics, Yale University, USA
BA	Geology, Hamilton College, USA

MIGUEL CIFUENTES

Senior Climate Change Specialist

Dr. Miguel Cifuentes is a research professor and climate change specialist at the Tropical Agricultural Research and Higher Education Center (CATIE) in Costa Rica. He has proven scientific research and consulting experience in climate change mitigation and adaptation, forest governance, carbon assessments, forest monitoring, blue carbon, and REDD+. He is leading the conceptual development and construction of analytical tools to promote synergies between adaptation and mitigation to climate change in sustainable landscapes. He has developed analytical indicators to quantify the degree of success of adaptation initiatives at regional, national, and local scales. He has also developed and implemented methodologies to determine the potential of ecosystems (including coastal-marine ecosystems) to mitigate climate change, and leads blue carbon science and policy development in Central America. Dr. Cifuentes currently teaches CATIE graduate programs and 4-10 international courses per year, and has been a speaker, participant or facilitator in many national and international climate change fora. He is a permanent member of the International Blue Carbon Initiative Science Working Group, and IUCN's Commission on Ecosystem Management. Dr. Cifuentes has consulted for FAO, IFAD, the World Bank, IADB, CIRAD, EUROCLIMA, ECLAC, and GIZ. Dr. Cifuentes is a highly effective team member and trainer with excellent interpersonal qualities, strong multi-lingual communication skills, and the ability to work with people from diverse backgrounds in a variety of situations.

PhD	Environmental Sciences, Oregon State University, USA
MS	Forestry, North Carolina State University, USA
BS	Forest Engineering, Instituto Tecnológico de Costa Rica

JUAN PABLO DOMÍNGUEZ MIRANDA

Biological Diversity Specialist

Juan Pablo Miranda has 19 years of experience as an environment and biodiversity specialist in Central America and the Caribbean. He has been a team member and team leader for numerous environmental impact assessments, protected area studies, advisory assignments, and land use planning projects. Mr. Domínguez's expertise includes natural protected areas, biodiversity, biological corridors, ecotourism, sustainable agriculture, land restoration, and climate change. He has worked on a number of international donor projects, for USAID, IDB, IADB, GIZ, UN-HABITAT, and GEF/WB. Mr. Domínguez has strong communication skills in English, Spanish, Portuguese, and German, enabling him to liaise between team members and stakeholders and produce high-quality reports and other deliverables. Mr. Domínguez was the Natural Protected Areas and Biodiversity Specialist within the team that designed the Salvadoran Ministry of Environment's Climate Change Mitigation Strategy based on Adaptation endorsed by the UNFCCC and the German Ministry of Environment. He also led the team that evaluated the impacts and sustainability of projects funded by the Salvadoran Initiative for the America's Fund and designed their 2015 – 2020 territorial intervention strategy based on the principles of the aforementioned Climate Change Mitigation Strategy based on Adaptation. On USAID projects, Mr. Domínguez was responsible for inventories, assessments, technical studies and legislation proposals that lead to the establishment of the first Salvadoran Marine Protected Area. He also conducted a biophysical characterization and proposal for the protection of the southeastern marine area of El Salvador's oceanic coast. With the USFS, Mr. Domínguez conducted an assessment on marine ecosystems of Nicaragua's La Flor – Ostional Marine Refuges, their status and potential uses. He conducted a similar assessment and participated in the design of *La Caleta* Marine Park in the Dominican Republic. As an advanced certified diver, Mr. Domínguez was personally involved in most field activities.

BS	Biology School, Universidad de El Salvador
Licentiate	Biology School, Universidad de El Salvador

ZULMA RICORD DE MENDOZA

Coastal Resource Management/Institutional Development and Gender Specialist

Zulma Ricord de Mendoza has 25 years of professional experience in leading and implementing projects involving biodiversity conservation, biological corridors, biosphere reservations, and protected areas in El Salvador and the Central American region. She has been on regional teams with the CCAD (Central American Commission of Environment) and interacted with OSPESCA, the regional Authority for Fisheries. From 2010 – 2015, she served as the Deputy Chief of Party for the USAID *Regional Program Management of Aquatic Resources and Economic Alternatives*. Mrs. Mendoza has a record of successful interaction with diverse consulting teams and high-level public and private officials. She has a demonstrated facility for fostering and coordinating innovative relationships among government agencies, local communities, and the private sector. She has excellent communication capabilities and is a recognized specialist and regional representative for biodiversity in different countries in the region. Mrs. Mendoza also is a founding member of two National level NGOs that pursue conservation of biodiversity and ecosystems (SalvaNatura) and endangered wildfauna (FUNZEL).

MS	Natural Sciences, Zoology Major, University of Idaho, Moscow, Idaho
BA	Biology, Lewis and Clark College, Portland, Oregon, USA

PABLO IMBACH

Ecosystems/GIS Specialist

Dr. Pablo Imbach has over 15 years of experience working in Latin America, as a GIS specialist working on development-oriented aid, environmental conservation, and scientific research on the biophysical aspects of climate change, biodiversity conservation, and ecosystem services. He has extensively made use of modeling tools at different geographical scales for land use change, hydrology, ecosystem dynamics, atmospheric monitoring, species modeling, and climate change impact assessments on forests and ecosystems. Dr. Imbach has coordinated and participated in several interdisciplinary research groups and capacity building activities, including technical support to institutions and organizations at the national, regional, and local levels. Since 2005, he has worked with CATIE's Climate Change & Watersheds Program, where he coordinates the Environmental Modeling Laboratory, an interdisciplinary group focused on research and technical assistance for ecosystems and global change issues through the use of modeling tools.

PhD Climate and Environmental Sciences, University Pierre Marie Curie, France

- Modeling equilibrium states of vegetation and hydrology in Central America
- Climate change impact assessment on ecosystems and hydrology in Central America
- Assessing species dispersal pathway under climate change for the Mesoamerica Biological Corridor

MS Integrated Watersheds Management, Tropical Agricultural Research and Higher Education Center (CATIE), Costa Rica

BS Agricultural Engineering, emphasis in Plant Science, University of Costa Rica

JOSE ENRIQUE BARRAZA

Regional Coastal Resources Management Specialist Ecosystems/GIS Specialist

Dr. Jose Enrique Barraza has nearly 23 years of experience in marine biodiversity and habitat conservation, and sustainable management of natural resources in El Salvador and Central America. As the Marine Ecology Specialist at the Ministry of Environment and Natural Resources, Dr. Barraza sought to preserve wetland resources, surveyed marine biota and monitored freshwater and coastal pollutants. He was also the Wetlands Unit Chief, and as the Ramsar focal point, helped to successfully oversee Ramsar Convention implementation in El Salvador. He also participated in the implementation and monitoring of other international treaties in the region. He has carried out and published numerous research activities related to marine and coastal resources management, and has lectured in biology and ecology in Central America, the US, and Spain.

Ph.D. Biological Sciences, Ecosystems and Zoological Resources (Spanish Agency for International Cooperation Scholarship), Universidad de Santiago de Compostela, Spain, 2000

MSc Zoology (Fulbright Scholarship), Texas A&M University, USA, 1993

BSc Biology, Universidad de El Salvador, El Salvador, 1988

VIRGINIA REYES

Policy/Economics Specialist & Logistics Support

Virginia Reyes is an economist with 15 years of experience working in Costa Rica and Mesoamerica. She has worked on the development, implementation, and evaluation of environmental projects; design of eco-environmental devices; and studies of natural resource economic assessment, including economic and financial analysis. Ms. Reyes has worked to strengthen public-private alliances, working with governments, local communities, and non-government organizations. She has worked for the IABD, UNDP, the Center for Environmental Law and Natural Resources (CEDARENA), The Nature Conservancy (TNC), International Conservation, World Wildlife Fund (WWF), Global Water Partnership (GWP).

Post Graduate	Economics, emphasis in International Finances, National University of Costa Rica
Masters	Economics and Political Economy, emphasis on Ecological Economy and Sustainable Development, National University of Costa Rica
BA	Economics, National University of Costa Rica

ELIZABETH M. STRANGE

ECODIT Home Office Support: Climate Change Adaptation Specialist / Environmental Scientist

Dr. Elizabeth Strange is an environmental scientist and climate change specialist with MS and PhD degrees in ecology and over 20 of years' experience designing, implementing, managing and evaluating a wide-range of environmental and climate change projects. She is an expert in climate change vulnerability, impacts, and adaptation; natural resource planning and management; ecosystem services; climate resilient development; and the integration of climate change knowledge into development activities. Dr. Strange excels in communicating complex technical information clearly and concisely in a variety of oral and written formats. Her recent experience includes serving as Senior Technical Specialist in the Climate Change and Sustainability Division at ICF International (2009-2013), where her work included providing senior-level technical support to USAID's Climate Change Resilient Development and Asian Regional Environmental Field Support contracts, and serving as team leader and disaster risk specialist for an Asian Development Bank (ADB) project on climate change vulnerability and adaptation in Central and West Asia. As an independent consultant (2014-2015), Dr. Strange developed a primer on subnational approaches to low-emission, climate-resilient development for the USAID-funded CityLinks program; conducted a field visit and desk review on climate change implications for USAID's Food For Peace program in Ethiopia; and provided training to experts from the Ministry of Nature Protection of the Republic of Armenia on climate change vulnerability models and tools for the agriculture and water resource sectors.

PhD	Ecology, University of California, Davis, 1995
M.S.	Ecology, University of California, Davis, 1989
B.A.	Biology, San Francisco State University, 1981

CHARLES HATCH

ECODIT Home Office Support: REPLACEE IDIQ Manager

Dr. Hatch is an experienced educator, researcher, university administrator, and international development professional with more than 35 years of experience. Dr. Hatch has proven experience identifying public policies and market-driven approaches that ensure and sustain the management and conservation of natural resources. He recognizes the importance of integrated, interdisciplinary agriculture and natural resources systems and has developed programs and policies that are sustainable because they capitalized on the interdependencies of these systems. Dr. Hatch has proven experience building the capacity of governments, local communities, and NGOs to manage natural resource systems and to train employees and stakeholders in the use and management of these systems. He served as ECODIT's Chief of Party (COP) for the USAID/ECODIT BSP/NEPA project in Afghanistan, as well as COP for the USAID/Winrock $27.5M Forestry Planning and Development Project in Pakistan and Vice President of the University of Idaho. These positions involved significant project management, program institutional capacity building, HR, performance improvement, project assessment and design, and adult learning methodologies. Dr. Hatch also has a demonstrated commitment to natural resources conservation and strong interpersonal skills with a record of accomplishment by conveying a vision, planning strategically, building collaborative partnerships and alliances, and establishing effective, ongoing working relationships with both internal and external groups.

PhD	Forest Measurements, University of Minnesota
Master of Forestry	Oregon State University

MICHAEL E. COTE

ECODIT Home Office Support: Climate Change Mitigation and Adaptation Specialist

Mr. Michael E. Cote is an international Climate Change Adaptation Specialist with more than 10 years of experience in providing technical support focused on climate change adaptation. He specializes in assisting stakeholders to integrate adaptation options at the local to national levels. He currently supports the USAID/GCC Office's Climate Change Integration Support (CCIS) project, which implements the Agency Adaptation Plan and Executive Order (EO) 13677, "Climate Resilient International Development." He formerly managed parts of the Climate Change Resilient Development (CCRD) project, and supported the CRIS pilot projects in Africa, Dominican Republic, Peru, and Vietnam. He was Technical Lead of the High Mountain Adaptation Partnership in Nepal and Peru and was Director of Communications for the overall project.

Mr. Cote worked with CCRD partners to design, administer, collect, and analyze data collected from surveys and questionnaires from a wide variety of workshops, trainings, "write shops," game pilots, forums, etc. He also served as backstop for the Home Office (HO) team administering the project's Performance Monitoring Plan (PMP) and was a member of the USAID Global Climate Change (GCC) Office's informal National Adaptation Plan (NAP) working group, which supports NAP development in Jamaica, Tanzania, and West Africa. He is currently an editor for The International Journal of Climate Change, and was an Expert Reviewer on the IPCC Fifth Assessment, Working Group II. He also serves as ECODIT's focal point to the UNFCCC Nairobi Work Program on Impacts, Vulnerability, and Adaptation.

MRP	Urban Planning, Cum Laude, University of Massachusetts-Amherst
MELP	Environmental Law and Policy, Vermont Law School
BS	Environmental Design, University of Massachusetts-Amherst

OSAMA A. ABU-RAYYAN

ECODIT Home Office Support: Project Manager

Mr. Abu-Rayyan has managed and/or was the principal coordinator on several different projects during his 17 years of experience in international environmental consulting. After working for ERM International based out of London, he joined ECODIT in 2004 as the Technical Coordinator / Environmental Economist on the Small Communities Project in Jordan. As the de-facto Deputy COP, assuming the role of Acting COP on several occasions during his first 5.5 years on the project, he is also versed in USAID procedures, rules and regulations. In April 2010, he became the COP and took charge of this project, which came to a close in April 2012. Since then, he has been supporting the management of ECODIT's project portfolio, including as Project Manager for the 2015 Uganda ETOA, and was the economic/finance specialists for a project developing National Appropriate Mitigation Action (NAMA) for Lebanon's of GHG emissions. He managed the 1991 Gulf War Environmental Damages Claims for the Government of Jordan, a cost recovery project for the water sector in Scotland, and a World Bank water quality study in the Nile Delta. He was also the principal coordinator on a World Bank reuse strategy for the West Bank-Gaza and was the assistant project manager for a 4-year, 7.5 million USD rural water project for DfID in Hebron. His practical also experience includes conducting and managing several EIAs, including for tourism and industrial master plans, pipelines and roads. He has provided expertise in economics and cost recovery, insights to the operations of water and wastewater utilities, environment, and institutional development and strengthening for local governments, USAID, the ADB, the EC, JICA and oil and gas companies such as BP and Shell.

M.Sc.	Applied Environmental Economics, Imperial College, Wye, UK, 2001
B.Sc.	Resource Conservation, McGill University, Montreal, Canada, 1997

ANNEX C: ADDITIONAL DETAILS ON METHODOLOGIES AND LIMITATIONS FOR REGIONAL INDICATORS AND MAPPING

AGRICULTURE

To assess agriculture crop sensitivity to climate stressors an EcoCrop model was used to estimate crop suitability (http://ecocrop.fao.org/ecocrop/srv/en/home) based on ecological requirements for specific crops. Ecological requirements, computed using 10 temperature and rainfall parameters, were used to develop a suitability index for each crop. More detail on its use can be found at the following website: http://gisweb.ciat.cgiar.org/ClimateChange/EcoCropFB/.

Changes in areas that are suitable for a main crop (those accounting for more than 5 percent of total cultivated area) were estimated across the region. A weighted average suitability change for each municipality was computed as the mean suitability change for each crop weighted by the fraction of its total agricultural area within the municipality. More detail about the methodology can be found in Bouroncle et al. (in press).

Limitations of the agriculture crop sensitivity analysis include the following. First, the future climate scenario used a mean of all GCM projections so there was no measure of uncertainty in crop suitability estimates. Second, the EcoCrop model uses standard global ecological parameters to identify crop suitability for an area. Third, the EcoCrop model does not account for potential effects of CO2 fertilization, management strategies or new crop varieties to identify suitable areas for crops. Finally, climate stressor effects on other aspects important for the agricultural sector, such as transport infrastructure, were not incorporated into the analysis.

WATER

To assess available water sensitivity to climate stressors runoff was estimated using an algorithm associated with the MAPSS equilibrium vegetation model (www.fs.fed.us/pnw/mdr/mapss). This algorithm allows MAPSS to be fully integrated with a model that projects hydrologic processes. Runoff was simulated based on MAPSS projections using climate stressors generated under GCMs. Estimates of changes in runoff occurred if there was at least a 20 percent change in an areas runoff compared to its runoff during the 1950-2000 period.

Limitations of the available water sensitivity analysis include the following. First, the MAPSS model simulates the equilibrium water balance under potential vegetation cover so it is not sensitive to actual changes in vegetative land cover. Second, the MAPSS model does not capture short-term, natural climate variability. Finally, changes in annual runoff projections are assumed to be a proxy for changes in water availability for all sectors but it does not address access, distribution or seasonal availability issues.

FOREST ECOSYSTEMS

To assess forest ecosystem sensitivity to climate stressors a leaf area index (LAI) was estimated using a Mapped Atmosphere Plant Soil System (MAPSS) equilibrium vegetation model (Neilson 1995). The model estimates water balance in equilibrium with vegetation growth and was validated with hydrological and vegetation measurements across Central America under 1950-2000 climate conditions from worldclim.org (Imbach et al. 2010). LAI was simulated based on MAPSS projections using climate stressors generated under GCMs. Estimates of changes in LAI occurred if there was at least a 40 percent change in an ecosystems LAI compared to its level during the 1950-2000 period.

Limitations of the forest ecosystem sensitivity analysis include the following. First, since the MAPSS model was used to simulate potential vegetation across the whole region it considered current natural cover and potential areas identified for restoration in the future. Second, changes in LAI are a proxy for potential changes in biodiversity at the species, community and population levels. Third, changes in LAI were not assessed under higher GHG emissions scenarios (RCP 8.5). Finally, the potential affects of CO2 fertilization on water used efficiency was not considered in the analysis.

ADAPTIVE CAPACITY

To assess the adaptive capacity of sectors and geographic areas to cope with climate stressors complex approaches have been developed (Bouroncle et al. n.d, Baca et al. 2014). Adaptive capacity in this analysis is characterized by indicators that are available by municipality throughout Central America and is limited by available indicators from census data. These are the fraction of people with access to potable water, the level of education, and the demographic dependency (ratio of active vs older population).

These indicators are assumed to represent the adaptive capacity of several sectors and were standardized for each country within the region before an adaptive capacity index was calculated based on an indicators average. Data were standardized for each country to remove the north-south Central America development gradient that would have resulted had a regional standardization been undertaken (Hidalgo and Alfaro, 2012). This procedure produced an analysis that contained a gradient of adaptive capacity within each of the countries and minimized a regional gradient where Costa Rica would have the highest adaptive capacity.

ANNEX D: LIST OF KEY INFORMANTS

Key Informant:	Country/Place:	Date:	Telephone Numbers:	Email:	Team Member(s):
Alberto Salas , Senior Adviser Forest, Biodiversity and Governance - Oficina Regional para México, América Central y El Caribe – ORMACC	Puerto Cabezas (Bilwi)	02.03.2016	Cel: +506 88445882	Alberto.Salas@iucn.org	Bruce Kernan, Zulma de Mendoza
Amador, Xavier., Director Ejecutivo Nacional de Acuicultores de Honduras ANDAH	Oficina de ANDAH outside of Cholateca in salida a Guasule, Cuidad Balacanes	Jan 26	504 27170410; 504 95031973	jamador@andah.hn	Bruce Kernan, Enrique Barraza, Hector Fuentes
Arias, Ingrid, Local coordinator of FUNDECO	Puerto Barrios, Izabal, Guatemala	1-Feb-16			Bruce Kernan
Augusto Rosales: especialista en medios y alternativas económicas	Guatemala (via Skype)	28 de febrero, 2016	-502	Augusto Rosales <arosalest07@gmail.com>	Zulma Ricord de Mendoza
Ben Schapiro	Marine Biodiversity, USAID/DR	May 20, 2016	829-368-7042	bschapiro@usaid.gov	Bruce Kernan
Bustamante, Nelbin. Protection, Public Use & Ecotourism Coordinator, PROLANSATE	Tela, Honduras	01.29.16	504 + 2448 – 1686 / 2448 – 2042	nelbin76@yahoo.com	J.P. Domínguez
Cajiao, Victoria, Asesora Legal de la Presidencia de la República de Costa Rica.	San José, Costa Rica	1° de febrero 2016	(505) 8323 1645	vicky.cajiao@gmail.com	Zulma Ricord de Mendoza (6-9 de la noche)
Calderon, Osvlado, Director Regional de FUNDAECO, Mirando, Maria de Rosario, Empresa Portuario Santa Tomas, Sandolval, Roderico, Empresa Portuaria Santa Thomas	Santo Tomas, Izabal, Guatemala	1-Feb-16			Bruce Kernan
Calix, Jose Nahun Acalde Municipio de Marcovia	Office of Alcalde en Marcovia	Jan 25, 2016			Bruce Kernan, Enrique Barazza, Hector Fuentes
Carlos Giovanni Rivera, Técnico PREP, MARN	Country/Place:El Salvador/MARN	2/15/2016		crivera@marn.go.sv	Miguel Cifuentes
Carlos Rivas Leclair, Director del Instituto de Capacitacion, Investigación y Desarrollo Ambiental CIDEA	CIDEA, Managua (Universidad Católica)	Feb 29, 2015	(505) 2278 3930	crleclair@ns.uca.edu.ni	Bruce Kernan, Zulma de Mendoza

Key Informant:	Country/Place:	Date:	Telephone Numbers:	Email:	Team Member(s):
Castrillo, Milton: Ex Coordinador de MAREA USAID para la Moskitia Nicaragüense	Puerto Cabezas (Bilwi)	1 March, 2016	(505) 8424 5130	miltonsaulcastrillolopez@gmail.com	Bruce Kernan y Zulma de Mendoza
Coordinador Institucional del Programa Costa Rica por Siempre, SINAC (10:30 a 12:30)	San José, Barrio Escalante Costado Este ULACID/SINAC	Martes 2 de febrero 2016	(506) 2522 6500	marco.araya@sinac.gob.cr	Zulma Ricord de Mendoza (10 a.,m – 1 p.m)
Correa, Leana Correa, Director Ejecitvo de Comité para la Defensa y Desarrollo de la Flora y Fauna del Golfo de Fonseca (CODEFAGOLFO)	San Lorenzo, Honduras	25 Jan 2016			Bruce Kernan
Dennis Mairena / Director Ejecutivo del Centro de Autonomía y Desarrollo de los pueblos indígenas CADPI.	Bilwi, Nicaragua	March 1 2016	(505) 8629 0197	mairena@cadpi.org	Bruce Kernan and Zulma Ricord de Mendoza
Diaz, Mario, Coordinador Correidores Biologicos, MARN		3 Feb 2016			Bruce Kernan
Dr. Guillermo Navarro, Researcher at CATIE's Bosques Program	Costa Rica/CATIE	2/10/2016	+506 2558-		Miguel Cifuentes
Drysdale, Ian. Executive Director, Healthy Reefs	Roatán, Honduras	01.28.16	504+3336-0406		J.P. Domínguez
Dubois, Karen, FUNAECO, Program de Salud	Puerto Barrios, Golfo de Honduras	Feb 1	Tel: 502505580279		Bruce Kernan
Echeverría, José Luis, Director Oficina Técnica de la Biodiversidad	Guatemala City, Consejo Nacional de Areas Protegidas (CONAP)	5 Feb 2016	1518333	echevariatello@gmail.com	Bruce Kernan
Eduardo Rodríguez, International consultant, Chrysina	Costa Rica/ El Salvador	2/15/2016		eduardorh@chrysina.org	Miguel Cifuentes
Espinoso, Su. Investigador en el Centro; Sandoval, Jeritza; Centeno, Anna, U. Catolica de Managua, Laborator d Genetico	Managua, Nicaragua	29-Feb			Bruce Kernan and Zulma Ricord de Mendoza
Fernando Carrera, Researcher at CATIE's Bosques Program	Costa Rica/CATIE	2/10/2016	+506 2558-2619		Miguel Cifuentes
Flores, Merlin. Parks, Monitoring, Education & Communities Coordinator, PROLANSATE	Tela, Honduras	01.29.16	504 + 3208 – 3808	e-mail: daimaufg@gmail.com	J.P. Domínguez
Flores, Victor, Alcalde de Nacaome y Presidente de la Mancommunidad del Golfo	Nacaome, Municipal Building	Jan 25, 2016	504 795 5398; 504 32476972	Email:victorflores1701@gmail.com	Bruce Kernan, Enrique Barazza, Hector Fuentes
Galdames, José Antonio. Minister of	La Ceiba, Honduras	01.29.16	504 + 2235 –	e-mail:	J.P. Domínguez

Key Informant:	Country/Place:	Date:	Telephone Numbers:	Email:	Team Member(s):
Environment, Honduras			7833 / 3192 – 3782 (handy)	joseantoniogaldames@gmail.com	
Galvez, Guillermo, Sub-coordinador de Capitulo costa-marino de FUNDAECO Pacheco, Griselda, Costas técnico de campo Representante de COSTAS y TRIGOH	Puerto Barrios, Golfo de Honduras	1-Feb	42205662	g.galvez@fundaeco.org.gt	Bruce Kernan
Godoy, Juan Carlos, TNC	Guatemala City, Guatemala	2-Feb-16			Bruce Kernan
González, Jose Pablo: Abogado, especialista en derecho ambiental. Director de la Fiscalía Ambiental de Costa Rica. (1:00 p.m – 3 p.,m) Almuerzo de trabajo.	San José, Barrio Escalante	Martes 2 de febrero 2016	(506) 8368 1404	jpgonzalez@poder-judicial.go.cr	Zulma Ricord de Mendoza (10 a.,m – 1 p.m)
González, Mario Director, OPESCA	San Salvador,	Jan 29			Bruce Kernan, Zulma Ricord
Hirezi, Irene Secretaria Ejecutiva, Tri-National Commission Plan Trifinio	San Salvador, Paseo General Escalon 5430, San Salvador	Jan 19, 2016	503 7873 4277; 503 2264 361920	mhirezi@sica.int	BSK, JPD, ZR, EB
Ileana Gomez, PRISMA (Programa Salvadoreño de Investigación sobre Desarrollo para el Medio Ambiente)	San Salvador/ El Salvador	February, 18th			Miguel Cifuentes
Janja Eke, Coordinadora subregional FSC para CA	Managua, Nicaragua / Skype	2/10/2016		Janja Eke <j.eke@fsc.org>	Miguel Cifuentes
Jorge Canales Colindres, Ex Director del Instituto Nacional Forestal INAFOR	Puerto Cabezas, (Bilwi), Nicaragua.	02.03.2016	Tel (505) 84218938	jcanalescolindres@yahoo.es	Bruce Kernan, Zulma de Mendoza
Karina Willis, Berta Mercado: Secretaría de Planificación del gobierno regional, Fesia Wilson: fesiawilson@yahoo.es Institucion para la captación y atracción de la inversión en el sitio. PRONICARIBE – Pronicaragua, apoyan la inversión en la región	Puerto Cabezas, Bilwi, Nicaragua	2 de marzo, 2016			Bruce Kernan, Zulma Ricord de Mendoza
Leinhoff, Andreas, WWF Guatemala	Guatemala City, Guatemala	4-Feb-16			Bruce Kernan
Machano, Deberto, Presidente del Comite de Mergencia Trimineo, Jona, Unidad Ambiental del Municipio	Cedeno, Honduras	martes 26 de enero 2016			Bruce Kernan
Majano, Ana Maria : Ex Ministra de Medio Ambiente y Recursos Naturales, actual COP para el Programa Reigonal CC	El Salvador	March, 2016		Ana.Majano@catie.ac.cr	Bruce Kernan, Zulma de Mendoza
Marco Aurelio Juarez Calderon, Manejo de Recursos Naturales y Ambiente, Geotecnología,	Guatemala City	4-Feb-16	502 23694317	marcojuarez@geotechnologia.com.gt	Bruce Kernan

Key Informant:	Country/Place:	Date:	Telephone Numbers:	Email:	Team Member(s):
Ingeneria Territorial					
Mario Escobedo, Climate Change Programme/ CATIE	San Salvador/ El Salvador	February, 15th	+503 25228700	mescobedo@catie.ac.cr	Miguel Cifuentes
Mario Marroqui, Asistente Tecnico	San Salvador	Jan 19, 2017	503 72565079 (cel); 503 22643619 (tel)	mmarroqin@sica.int	BSK, JPD, ZR, EB
Mary Rodriguez	MEO, USAID El Sal.	20 de mayo 2016	(503) 2501-3422	mrodriguez@usaid.gov	Bruce Kernan
Mayors, Trifinio	El Salvador, El Trficio	Jan 28			Bruce Kernan
Mejia, Susana, Encargado del Escobas		31 Jan 2016			Bruce Kernan
Mendez, Anglica – Coordinadora de Red de Pescadores Ochoa Lopiez, Eustaqiui – Presidente de la Asociacion de Red de Pescadores Ordonez, Edin – Vocal Primero de la Red y Teserero de la Red Representante de Asociacion de Pescadores	Puerto Barrios, Golfo de Honduras	Feb 1	Tel 56166953, 58192288	angyred38@yahoo.es	Bruce Kernan
Miller, Teresa, Busines, Private Sector Officer, Economic Growth Office	USAID/Guatemala	May 24, 2016	503 2501-3310	temiller@usaid.gov	Bruce Kernan
Miriam Hirezi	San Salvador, Paseo General Escalon 5430, San Salvador	Jan 19, 2016	503 7873 4277; 503 2264 361920	mhirezi@sica.int	BSK, JPD, ZR, EB
Moncada, Myrna and Cruz Cortez, Freddy: Presidente biologo	Managua	29/ 02/ 2016	(505) 2268 1087 / cel 8932 2922	Myrna.moncadaf@gmail.com	Bruce Kernan, Zulma Ricord
Monje, Nancy: Miembro del Equipo Técnico de la UICN y encargada del componente de Género.	Costa Rica / Barrio Escalante, San José	Viernes 03 de febrero 2016 – Oficina ORMACC	(506) 2283 8449	Nancy.Arroyo@iucn.org	Zulma Ricord de Mendoza (8:30 a.m – 9:30 a.m)
Mujeres Miskitas / Pikineras, indígenas - Anne Margaret Webster, Presidenta; Gloria Lorena Mergara, Secretaria; Berna Collins Mairena, primer vocal. Angela Zacarías Watson, Secretaria de Actas y Acuerdos. Coordinadora de un centro tecnológico de Acción Médica: Juana Clorinda Medina Morales.	Bilwi, Nicaragua	1° de marzo, 2016			Bruce Kernan y Zulma Ricord de Mendoza
Müller, Eduard y Tania Moreno: Universidad de Cooperación Internacional	Barrio Escalante, San José, Costa Rica	2° de febrero 2016	(506) 8871 7565	emuller@uci.ac.cr ; tmoreno@uci.ac.cr	Zulma Ricord de Mendoza (2:00 a 4:00 p.m)

Key Informant:	Country/Place:	Date:	Telephone Numbers:	Email:	Team Member(s):
Myton, Jenny. Local Manager, Coral Reef Alliance	Roatán, Honduras	01.28.16		jmyton@coral.org	J.P. Domínguez
Nadia Padilla , Ecóloga Coordinadora de INPESCA, Instituto de Pesca en la RAANC	Puerto Cabezas, Bilwi	2 March, 2016		jianayany@gmail.com	Bruce Kernan, Zulma de Mendoza
Nelda Sánchez, Socióloga, consultora independiente. Especialista en cultura miskita.	Puerto Cabezas (Bilwi)	03 March, 2016	(505) 22780062 /Cel. (505) 88227490	neldasahi@yahoo.es	Bruce Kernan y Zulma de Mendoza
Oleas-Montalvo, Julio, El Sistema de Cuentas Ambientales y Económicas (SCAE) 2012: fundamentos conceptuales, CEPAL, Mexico 63 p		2 Feb 2016			Bruce Kernan
Omar Samayoa, Climate Change Programme/ CATIE	Ciudad de Guatemala, Guatemala.	February, 17th		OMARS@iadb.org	Miguel Cifuentes
Oviedo, Machuca Jorge: Gerente General del FIAES[Fondo Iniciativa para las Américas (Fondo fiduciario de condonación de deuda por naturaleza USA)] y miembro del Consejo Asesor de la Red Latinoamericana de Fondos Ambientales y del Caribe REDLAC (10:30 a 12:30)	Country/San Salvador, El Salvador / 75 Ave. Sur #132	Jueves 2 de febrero 2016	(503) 2223 6498 Ext. 102	jorge.oviedo@fiaes.org.sv	Zulma Ricord de Mendoza (5 – 7 p.m)
Paz, Ana. Executive Director, FUCSA	La Ceiba, Honduras	01.28.16	504 + 9836 – 9544 / 3208 – 6130	e-mail: direccioncueroysalado@gmail.com	J.P. Domínguez
Rebolorio, Adelsu,M&E, Director de Planificacion. Monitoreo y Evaluacion Institucional Instituto Nacional de Bosques	Oficina de INAB, Guatemala City, Guatemala	3-Feb-16			Bruce Kernan, Virginia Reyes
Regina Soto	USAID/Guatemala Economic Growth	May 24, 2016	502 2422 4343	rsoto@usaid.gov	Bruce Kernan
Reyes, Wendy, Coordinator de la Unidad Tecnica de la Mancomunidad de Municipios de Sur, NASMA	Centro de Investigacion Aquicultura, San Lorenzo, Empresa Nacional Portuario, Depat. Del Valle	Jan 25, 2016	33759986	Email:wp.reyes72@gmail.com	Bruce Kernan, Enrique Barazza, Hector Fuentes
Robles, Teresa, Asesora en Politicas de Tierra y Recursos Naturales, Oficina de Desarrollo Economico	USAID/Guatemala	May 24, 2016	(*502) 2422 4325	trobles@usaid.gov	Bruce Kernan
Rodríguez, Eduardo Chrysina – Biodiversidad y Bienestar Especialista en desarrollo local y ordenamiento territorial (geógrafo)	San José, Costa Rica	1° de febrero 2016	(506) 8779 1681	eduardorh@chrysina.org	Zulma Ricord de Mendoza

Key Informant:	Country/Place:	Date:	Telephone Numbers:	Email:	Team Member(s):
Ron Savage	CC Chief USAID/DR	May 20, 2016	829-368-7042	rsavage@usaid.gov	Bruce Kernan
Ronnie de Camino, Climate Change Programme/ CATIE	Turrialba, CATIE , Costa Rica	February 15th		rcamino@catie.ac.cr	Miguel Cifuentes
Sandra Liborio: Gender and Development Specialist / Bussiness Adminitration Administration	Country/El Salvador	Viernes 26 de febrero de 2016		sliborio23@gmail.com	Zulma Ricord de Mendoza
Santos, Alejandro, Deputy COP (Subdirector) Clima, Naturaleza y Comunidades en Guatemala, Programa TREES, Rainforest Alliance, Inc.	8 Av. 15-62 zona 10, Ciudad de Guatemala	March 17, 2016	PBX. 2300-6800 Ext	asantos@ra.org	Bruce Kernan
Sevilla, Lesbia: SINAC – Cooperación Internacional	Costado Sur ULACIT, Ave 15, San Francisco, Barrio Escalante	Martes 2 de febrero 2016	(506) 2522 6500	lesbia.sevilla@sinac.go.cr	Zulma Ricord de Mendoza
Shannon Thomas	US Embassy, Costa Rica, Regional Environmental Hub	May 20, 2016	506 251 92392	sthomas@state.gov	Bruce Kernan
Shira Miguel, Coordinadora del Movimiento de Mujeres Nidia White	Puerto Cabezas, Bilwi	2 marzo, 2016			Bruce Kernan, Zulma de Mendoza
Torres, Joe, Regional Environmental Officer	USAID/El Salvador	May 29. 2016	503 2501-3422	jtorres@usaid.gov	Bruce Kernan
Vinicio Cerezo, Marco, Director General, FUNDAECO	Guatemala City, Hotel Barcelo	Feb 5			Bruce Kernan
Yaritza Sandoval, Laboratorio de Biología Molecular, Centeno, Anna y Suyen Espinoza (Bioquímica)	Managua, U. Catolica de Managua, Laboratorio de Genetica	29 feb, 2016			Bruce Kernan, Zulma de Mendoza

ANNEX E: SUMMARY OF COUNTRY STATEMENTS AND NATIONAL FRAMEWORKS PERTAINING TO ADAPTATION AND MITIGATION

Country	Main Documents	Mitigation and adaptation goals/objectives	Key sectors/strategic actions defined in the last national communication or INDC	Mitigation and adaptation strategies, plans, and programs
Belize	National climate change policy Action plan and strategy (2015-2020) 2nd National Communication to UNFCC INDC	Build and economy and citizenship resilient to climate change impacts	Agriculture Forestry Fisheries Coastal marine resources Water resources Land use and human settlements Human health Energy Tourism Transportation Solid Waste Infrastructure	National REDD+ Strategy National adaptation strategy for the agriculture sector National forestry plan Belize integrated plan for coastal zone management Sustainable energy action plan 2014-2033 Climatic resilience national investment plan National plan for vector control (for Chagas, malaria and yellow fever) Solid waste integrated management
Costa Rica	National climate change strategy (ENCC) 3rd National Communication to UNFCC The INDC	Increase society's resilience against climate change impacts and strengthen local capacities for a long term low emissions development	Mitigation Adaptation Metrics Technology Education Finance	National REDD+ Strategy National adaptation plan National action plan against land degradation Carbon neutrality program In the energy sector: VII National energy plan 2015-2030 Institutional environmental management plans Business ecoefficiency plans "Energice" energy efficiency seal Distributed generation program Water for Guanacaste Program Payment for Ecosystem services program Climate change outreach microprogram
El Salvador	National climate change strategy 2nd National Communication to UNFCC The INDC	Transition towards an environmentally friendly economy and society, resilient to climate change	Mechanisms to cope with recurrent losses and damages from climate change Climate change adaptation Climate change mitigation, with co-benefits	National climate change plan National adaptation plan National climate change adaptation and mitigation plan Action plan 2012-2022 for the biological diversity national strategy

Country	Main Documents	Mitigation and adaptation goals/objectives	Key sectors/strategic actions defined in the last national communication or INDC	Mitigation and adaptation strategies, plans, and programs
				Ecosystem and landscape restoration program REDD+ program Critical investment plan to reduce short term losses and damages Mitigation and co-benefits national priorities Public climate change outreach program
Guatemala	National climate change policy Climate Change Framework Law 1st National Communication to UNFCC INDC		Strengthen adaptation in: Human health Coastal marine areas Agriculture, livestock and food security Forest resources Protected areas Conservation and management of strategic ecosystems Infrastructure Integrated management of water resources Quality of productive infrastructure Soil protection Integrated management of disaster risk reduction	REDD+ Strategy Action plan for implementing the national policy for rural development Institutional strategic plan for the Public Health and Social Aid Ministry and the Guatemalan Social Security Institute Forestry Incentives Program (PINFOR) Forestry Incentives for small land holders of forest or agroforest lands (PINPEP)
Honduras	National Climate Change Strategy Climate Change Law 2nd National Communication to UNFCC INDC	Climate change adaptation to reduce the country's vulnerability	Water resources Risk management Agriculture, soils and food security Forests and biodiversity Costal-marine systems Human health Infrastructure (specially hydropower)	Climate change national adaptation plan National climate change strategy action plan Climate change investment plan National action plan to fight against desertification
Nicaragua	National Environment and Climate Change Strategy 1st National Communication to UNFCC (not updated)	Data unavailable	Data unavailable	National Plan for Human development 2012 - 2016 REDD+ Program to Combat Climate Change and Poverty in Nicaragua

Country	Main Documents	Mitigation and adaptation goals/objectives	Key sectors/strategic actions defined in the last national communication or INDC	Mitigation and adaptation strategies, plans, and programs
Panamá	National Climate Change Policy and Action plan 2nd National Communication to UNFCC	Climate change adaptation	Strengthen individual and institutional capacities on environmental challenges and their relationship with climate change adaptation and mitigation Strengthen institutionalisation, increasing public and private interest, as well as political will Overcome interinstitutional coordination among relevant actors Increase follow-up and support for previous actions to ensure sustainable development actions Enhance leadership, communication and coordination with civil society and other actors such as cooperation agencies and non-governmental organisms Strengthen management tools such as the National Environmental Strategy (ENA) Promote programs with integrated and harmonized agendas with the national development policy Promote national science and technology research.	National climate change mitigation strategy National Strategy for Agriculture National plan for Human development for a risk management culture Tourism sector master plan National Integrated water resources management plan (PNGIRH) Plan Nacional de Seguridad Hídrica 2015-2050 (en proceso de elaboración). National climate change program (PNCC) Joint program to incorporate climate change adaptation and mitigation in the integrated management of natural resources in priority watersheds Investment Program for the Restoration of Priority Watersheds Generating Renewable Energy Sources Observations and global learning for environmental benefits program (GLOBE) Watershed guardians program School recycling programs Monitoring Program for the Management Effectiveness of Protected Areas of Panama (PMEMAP)
República Dominicana	National climate change policy 2nd National Communication to UNFCC INDC	Improve adaptive capacity to climate changes, reducing vulnerability, improving human quality of life and ecosystem health, contributing to stabilize GHG and promoting the transition to a low CO2 emissions growth	Ecosystem-based adaptation/ecosystem resilience Increasing adaptive capacity and lowering territorial/sectorial vulnerability Integrated water management Health Food security Infrastructure Flooding and drought Coastal-marine Early alert and Risk management systems	Climate change-compatible economic development plan National adaptation action plan

ANNEX F: MITIGATION AND ADAPTATION PROJECTS IN CENTRAL AMERICA

Name of the project	Country	Start Year	Duration	Scale	Department/ municipality/ other	web-site / document link	executing entity	financer	thematic area
Belize Marine Conservation and Climate Adaptation Project	Belize	2015	5 years	Subnational	Belize Barrier Reef System	https://www.adaptation-fund.org/project/belize-marine-conservation-and-climate-adaptation-project http://www.adaptation-fund.org/wp-content/uploads/2015/01/Belize%20MCCAP%20Project%20Proposal%20June%205%202014.pdf	Protected Areas Conservation Trust (PACT)	Adaptation fund	Coastal management
Climate Change Resilient Productive Landscapes and Socio-Economic Networks Advanced in Guatemala	Guatemala	2013	3.5 years	Subnational	Sololá and Suchitepéquez	https://www.adaptation-fund.org/project/climate-change-resilient-productive-landscapes-and-socio-economic-networks-advanced-in-guatemala/	Guatemalan Ministry of Environment and Natural Resources (MARN)	Adaptation fund	Rural development
Addressing Climate Change Risks on Water Resources in Honduras: Increased Systemic Resilience and Reduced Vulnerability of the Urban Poor	Honduras	2011	2016	Subnational	Francisco Morazán	https://acchonduras.wordpress.com/	Secretariat of Natural Resources and Environment (Miambiente) Autonomous National Service of Aqueducts and Sewers (SANAA)	Adaptation fund	Water-related risks
Reduction of Risks and Vulnerability Based on Flooding and Droughts in the Estero Real River Watershed	Nicaragua	2011	4 years	Subnational	watershed of the Estero Real River	https://www.adaptation-fund.org/project/reduction-of-risks-and-vulnerability-based-on-flooding-and-droughts-in-the-estero-real-river-watershed/ http://www.adaptation-fund.org/wp-content/uploads/2015/01/AFB.EFC_.14.4.Report_of_the_Portfolio%20Monitoring_Mission_in_Honduras%20and%20Nicaragua.pdf	Ministry of Environment and Natural Resources (MARENA).	Adaptation fund	Water-related risks
Reducing the vulnerability by focusing on critical sectors (agriculture, water resources, and coastlines) in order to reduce the negative impacts of climate change and improve the resilience of these sectors	Costa Rica	2014	5 years		Osa peninsula, Matina, Central Region, Puntarenas, Chorotega, and Huetar Norte Region	https://www.adaptation-fund.org/project/reducing-the-vulnerability-by-focusing-on-critical-sectors-agriculture-water-resources-and-coastlines-in-order-to-reduce-the-negative-impacts-of-climate-change-and-improve-the-resilience-of-these/ http://www.adaptation-fund.org/wp-content/uploads/2015/01/AFB.PPRC_.15.10%20Proposal%20for%20Costa%20Rica.pdf	National Ministry of Environment and Energy (MINAE), Ministry of Agriculture (MAG), National Service of Groundwater, Irrigation and Drainage (SENARA)	Adaptation fund	

Name of the project	Country	Start Year	Duration	Scale	Department/ municipality/ other	web-site / document link	executing entity	financer	thematic area
Climate Change Adaptation Program in drinking-water and sanitation sectors Programa de Adaptación al Cambio Climático en el sector agua potable y saneamiento	Nicaragua	2013	3 years	Subnational	Murra- Nueva Segovia, San Juan de Limay- Estelí, Juigalpa-Chontales, San Ramón-Matagalpa, and Corn Island - RACCS	http://www.marena.gob.ni/index.php/programas-ambientales/en-ejecucion/28-cambio-climatico/82-programa-de-adaptacion-al-cambio-climatico-en-el-sector-de-agua-potable-y-saneamiento-fondo-especial-para-el-cambio-climatico-banco-mundial-2013-2016	Ministry of Environment and Natural Resources (MARENA) and Nuevo FISE	WB Special Climate Change Fund (SCCF)	Agriculture and watershed management
Manju intergrade de la Cuenca Amanas- Asturias	Nicaragua	2012	4 years	subnational	San Rafael del Norte- Jinotega and Jinotega - Jinotega	http://www.marena.gob.ni/index.php/programas-ambientales/en-ejecucion/28-cambio-climatico/84-programa-de-manejo-integrado-de-la-cuenca-apanas-asturias-gef-bid-ni-x1005-ni-t111-2012-2016	Ministry of Environment and Natural Resources (MARENA) and INAFOR	GEF-IDB	Agriculture and watershed management
Fortalecimiento de capacidades y entrenamiento en Gestión de Cuencas Hidrográficas y Cambio Climático a los gobiernos locales	Panamá	2013		National	Panamá- Nacional	www.miambiente.gob.pa/index.php/getting-started/101-cambio-climatico/194-proyecto-fortalecimiento-de-capacidades	Ministry of Environment	UNESCO, NASA, NOAA, PNUD, PNUMA, OEA, OIEA, BID, GWP, y USAID.	watershed management
Cuestas – Adaptation al Cambio Climático a travels de cuestas de ague de lluvia	Honduras	2014	3 years	Subnational	Valle and Choluteca	http://www.globalcommunities-hn.org/programas-y-proyectos/cosechas-adaptacion-al-cambio-climatico-a-traves-de-la-comunidad-de-agua-de-lluvia-de-cosecha-embalses/	Agro-Líbano Fundation (FA), Centro Internacional de Agricultura Tropical (CIAT)	USAID	
Cuestas – Adaptation al Cambio Climático a travels de cuestas de ague de lluvia	Honduras	2014	3 years	Subnational		http://www.globalcommunities-hn.org/programas-y-proyectos/cosechas-adaptacion-al-cambio-climatico-a-traves-de-la-comunidad-de-agua-de-lluvia-de-cosecha-embalses/	Agro-Líbano Fundation (FA), Centro Internacional de Agricultura Tropical (CIAT)	USAID	
Transformación de una agricultura de secano a arroz de riego mediante el uso de la cosecha de agua en Nicaragua, México y Costa	Nicaragua	2009 - 2015	3 - 8 years	Subnational	Jalapa-Segovia, Somoto-Madríz, La Paz Centro-León, Malpaisillo- León, Parrita-Puntarenas, Los Chiles- Alajuela, and Nicoya Peninsule-Puntarenas	http://flar.org/cosecha-de-agua-una-oportunidad-estrategica/ http://www.anar.com.ni/index.php/proyectos/cosecha-de-agua https://www.ministeriodesalud.go.cr/index.php/investigacion-y-tecnologia-en-salud/inventarios/inventario-tecn-de-agua-de-consumo-humano/captacion-de-agua-para-consumo-humano/captando-agua-de-la-lluvia/presentacion-power-point/1844-transformacion-de-una-agricultura-de-	Fondo Latinoamericano para Arroz de Riego (FLAR), CIAT and local	Fondo Común para los Productos Básicos	

Name of the project	Country	Start Year	Duration	Scale	Department/ municipality/ other	web-site / document link	executing entity	financer	thematic area
Rica						secano-a-arroz-riego-mediante-el-uso-de-la-cosecha-de-agua/file	institutions	(CFC)	
Ecosystem Based Adaptation Through cultivation of organic cacao in two sub water sheds of the Río Sixaola	Costa Rica y Panamá	2010	n/a	Subnational	Middle Sixaola and the lower Yorkín,	http://www.solutionsforwater.org/solutions/ecosystem-based-adaptation-through-cultivation-of-organic-cacao-in-two-sub-watersheds-of-the-rio-sixaola	UICN		Agriculture and watershed management
Programa Reducción de la Vulnerabilidad y Adaptación al Cambio Climático en la Región Las Segovias	Nicaragua	2013	3-12 years	Subnational	Ocotal-Nueva Segovia, Macuelizo-Nueva Segovia, Santa María-Nueva Segovia; Mozonte-Nueva Segovia, San Lucas-Madriz, Telpaneca-Madriz, Totogalpa -Madriz, Ocotal, Macuelizo, Santa María y Mozonte en Nueva Segovia, Somoto, San Lucas, Telpaneca y Totogalpa en el Departamento de Madriz y Estelí y Condega	http://www.marena.gob.ni/index.php/programas-ambientales/en-ejecucion/28-cambio-climatico/83-programa-reduccion-de-la-vulnerabilidad-y-adaptacion-al-cambio-climatico-en-la-region-de-las-segovias-nicaragua-suiza-pnud-2013-2016	Ministry of Environment and Natural Resources (MARENA).	UNDP-Switzerland	Risk management
Promoting Local Management and Good Governance to Improve Water Supply and Sanitation Services for the Poor (PASOS- III)	Honduras	2006-2011	5 years	Subnational	Departments of the north coast of Honduras: Atlántida, Colón y Yoro	https://www.yumpu.com/es/document/view/30251491/proyecto-pasos-iii-pasos-honduras http://www.careclimatechange.org/files/toolkit/CARE_PASOS_Project.pdf	CARE	Canadian International Development Agency (CIDA)	Water
Environmental Program for Disaster Risk and Climate Change Management Progrma Ambiental de Gestión ante desastres y cambio climático	Nicaragua	2011	4 years	Subnational	Jinotega, Estelí y Matagalpa- Nine municipalities located at Rio Viejo and Apanás Lake watershed	http://www.marena.gob.ni/index.php/programas-ambientales/en-ejecucion/28-cambio-climatico/44-programa-ambiental-de-gestion-ante-desastres-y-cambio-climatico-2415-bl-ni-bid-fnd-us-13-millones-de-dolares-2011-2016 http://www.marena.gob.ni/index.php/publicaciones2/92-programa-ambiental-de-gestion-de-riesgo-de-desastres-y-cambio-climatico	Ministry of Environment and Natural Resources (MARENA).	BID-Nordic Development Fund (NDF)	Agriculture and watershed management
WATERCLIMA – LAC (Programa Regional de	El			Subnation		http://www.waterlac.eu/es_CL/proyecto-piloto-c-bajo-lempa-zona-costera-de-el-salvador-pacifico/	Asociación para el Desarrollo Integral	EUROPEAI	

Name of the project	Country	Start Year	Duration	Scale	Department/ municipality/ other	web-site / document link	executing entity	financer	thematic area
Gestión deCuencas y Áreas Costeras en el contexto del Cambio Climático en América Latina y el Caribe). Proyecto Piloto, Bajo Lempa zona costara de El Salvador	Salvador			al			del Bajo Lempa (ADESCO), MARN, CATIE	D	
Support to the Climate Change Action Plan of Panama	Panamá	2011		Subnational	Chiriquí and San Pablo rivers watersheds	https://www.devex.com/projects/tenders/support-to-the-climate-change-action-plan-of-panama-consulting-services/72128	Ministry of Environment	IDB	watershed management
Integration of Climate Change Adaptation and Mitigation Measures in the Management of Natural Resources in two Priority Watersheds of Panama	Panamá	2008	4 years	Subnational	Tabasará and Chucunaque rivers watersheds (Chiriqui, Veraguas, Comarca Nobe buglé, Darién, Comarca Emberá Wounaan	http://www.mdgfund.org/program/integrationclimatechangeadaptationandmitigationmeasuresmanagementnaturalresourcesfourpriorit http://www.mdgfund.org/sites/default/files/Panama%20-%20Environment%20-%20Final%20Evaluation%20Report.pdf	Ministry of Environment among others	Millenium Development Goals Achievement Fund(MDGF)	watershed management
Integration of Climate Change Adaptation in Twenty Communities in the Darien Region	Panamá	2011	2 years	Subnational	National and in 20 communities in the Cemaco district of the Comarca Embera-Wounaan	http://www.preventionweb.net/files/25767_panama.pdf	Ministry of Environment	USAID	
Alianza para el Corredor Seco	Honduras	2014	5 years	Subnational	departments of La Paz, Intibucá, and Lempira in the dry corridor	http://www.gafspfund.org/sites/gafspfund.org/files/Documents/4.%20Honduras_GAFSP%20proposal.pdf https://www.devex.com/projects/tenders/invest-honduras-project-implementation-dry-corridor-alliance/156538		USAID and Inversión Estratégica de Honduras (INVEST-H)	Rural development
Climate Change, Coastal Community Enterprises, Adaptation, Resilience and Knowledge (CCCCE-ARK)	Belize	2011	2.5 year	Subnational	Coastal communities	http://www.intasave.org/Our-Projects_CCCCE--ARK.html	CARIBSAVE	Multilateral Investment Facility of IDB.	tourism, fisheries and crafts sector
Capacity Development for Policy Makers to Address Climate Change	Honduras, Nicaragua, El Salvador, Costa Rica	2009	2 years	National		http://www.undpcc.org/docs/Project%20Documents/Project%20Flyers/Projekt%20Flyer_Capacity%20Development%20for%20Policy%20Makers.pdf	UNDP		provide technical support to national policy makers and its Country Offices and strengthen capacity on

Name of the project	Country	Start Year	Duration	Scale	Department/ municipality/ other	web-site / document link	executing entity	financer	thematic area
									budgetary issues related to the post-2012 climate regime
Coffee Under Pressure: Climate change and adaptation in Mesoamerica	Costa Rica, El Salvador, Guatemal, Nicaragua	2009	5 years	National	Coffe production areas	https://www.iisd.org/pdf/2011/Central_America-Mexico_Adaptation_Action.pdf	CIAT	Green Mountain Coffee Roaster	Agriculture
Healthy Wells and Latrines Keep Water Drinkable for Vulnerable Communities	El Salvador	2009	2 years	Subnational	Zacatecoluca- La Paz department	https://www.iisd.org/pdf/2011/Central_America-Mexico_Adaptation_Action.pdf	Oxfam, PROVIDA	WB	Freshwater supply
Strengthening Environmental Governance in the face of Climate Change Risks in Guatemala	Guatemala	2008	3 years	Subnational	Jutiapa, Chiquimula, Zacapa, El Progreso, Baja Verapaz, Quiché	http://www.mdgfund.org/program/strengtheningenvironmentalgovernancefaceclimaterisksguatemala http://www.mdgfund.org/sites/default/files/Guatemala%20Joint%20Programmes%20Fact%20Sheet_1.pdf	Guatemalan Ministry of Environment and Natural Resources (MARN) among others	MDG Achievement Fund, UNICEF, UNDP, FAO,	
Empowering Guatemala's Indigenous Communities to Cope with Climate Change	Guatemala	2011	2 years	Subnational		http://www.bancomundial.org/projects/P121137?lang=es	ASOCIACION SOTZ'IL	WB	
Integral disaster risk management capacity strengthening	Guatemala	2011	3 years	National	National	http://www.iadb.org/mobile/projects/project.cfm?lang=en&id=gu-t1135&project=gu-t1135	Government of Guatemala	IDB	Disaster risk management
Program to Support the Climate Change Agenda of Guatemala	Guatemala	2010	2 years	National	National	http://www.iadb.org/en/projects/project-description-title,1303.html?id=GU-L1063	Government of Guatemala	IDB	government capacity building
Community-based Adaptation (CBA) Programme (4 projects)	Guatemala	2009	2 years	subnational	Comitancillo, San Marcos department	http://www.adaptation-undp.org/projects/spa-community-based-adaptation-project	UNDP	GEF	CBA
Community-based Adaptation (CBA) Programme (4 projects)	Guatemala	2009	2 years	subnational	Tacana, San Marcos	http://www.adaptation-undp.org/projects/spa-community-based-adaptation-project	UNDP	GEF	CBA
Integrating climate change into national sustainable development strategies and plans in Latin America and the Caribbean	RIOCC Countries (Belize is not included)	2008	3 years	National	National	http://www.un.org/esa/devaccount/projects/2006/0607AG.html	Economic commission for Latin America and the Caribbean(ECLAC)	UN-development account	government capacity building

Name of the project	Country	Start Year	Duration	Scale	Department/ municipality/ other	web-site / document link	executing entity	financer	thematic area
Partner for resilience	Guatemala and Nicaragua	2011	4 years	Subnational	Sololá department-Guatemala	http://www.partnersforresilience.nl/	Dutch Red Cross, Red Cross Climate Centre, CARE, Cordaid, Wetlands International	Netherlands	Disaster risk management
Partner for resilience	Guatemala and Nicaragua	2011	4 years	Subnational	RAAN- Nicaragua	http://www.partnersforresilience.nl/	Dutch Red Cross, Red Cross Climate Centre, CARE, Cordaid, Wetlands International	Netherlands	Disaster risk management
Integrated Coastal Management with Special Emphasis on the Sustainable Management of Mangrove Forests in Guatemala, Honduras and Nicaragua	Guatemal, Honduras and Nicaragua	2011	2 years	Subnational	Caribbean coast, Guatemala	http://www.pnuma.org/manglares/documentos/FINAL%20Mangrove%20Project%20LFPD%20doc.pdf http://www.pnuma.org/manglares/	Ministries of Environment and Fisheries	UNEP, Spain	Coastal management
Fortalecimiento a la agricultura familiar, aplicando tecnología sostenible ante el CC (FANTEL) fase I	El Salvador	2011-2015	4 years	Subnational	Usulután, San Vicente, La Paz, Unión, San Miguel, Morazán,	Entrevista	CENTA y Dirección de ordenamiento forestal, cuencas y riego del MAG	Fantel	Agriculture
Cliford. Proyecto de forestaría comunitaria	Honduras	2011	5 years	Subnational	El Paraiso, Francisco Morazan, Yoro, Comayagua, Gracias a Dios, Olancho	http://icf.gob.hn/?page_id=87	ICF	GIZ	Forestry
Programa de Resiliencia y Gestión de Riesgo Climático. Proyecto 1.- TCP 3504Apoyo ante emergencia Canícula prolongada 2014.	Honduras	2014		Subnational	Choluteca river	entrevista		FAO	Agriculture
Enhancing Belize's Resilience to Adapt to the Effects of Climate Change	Belize	2012	2 years	National	Belize- National	http://www.bz.undp.org/content/belize/en/home/operations/projects/crisis_prevention_and_recovery/enhancing_belizes_resilience_to_adapt_to_the_effects_of_climate_change.html	Ministry of Finance and Economic Development UNDP	EU	National policies

ANNEX G: ADDITIONAL INFORMATION ON ADAPTATION-BASED MITIGATION AND COUNTRY PROFILES

Although the countries of Central America do not have a binding obligation to the UNFCCC to reduce their emissions of greenhouse gases (GHGs), each country has sought to develop policies appropriate to their contexts, promoting adaptation and mitigation actions, and generating sustainable alternatives compatible with economic, social and environmental development. The promotion of socio-economic programs that will address the problem of poverty and the reversal of climate change, with impacts around adaptation and mitigation, is part of the approach the Central American region has decided to invest in, based on its context and local circumstances. However, it is necessary to seek initiatives that can promote integrated approaches among mitigation, adaptation and development. Since 2014, USAID's Regional Climate Change Program (RCCP) leads the conceptual development and analytical tools to promote these mitigation-adaptation synergies (MAS, or SAM, in Spanish) across the region.

The Adaptation-based Mitigation approach (AbM) defines adaptation at the local/regional and national levels and determines the direction for mitigation strategies. AbM promotes interventions aimed at reducing environmental vulnerability with direct impacts on carbon capture and storage procedures, and it contributes to building a framework of sensible and appropriate policies to meet the challenges of climate change and development in Central America (Prisma, 2013). This approach has only been proposed by El Salvador as of now, which, through its new National Environmental Policy (2012), seeks to reverse environmental degradation and to reduce vulnerability to climate change (R-PP, 2013). The other countries in the region propose, within their programs and REDD+ preparation strategies, mainly the search for a vision of adaptation through the generation of additional co-benefits, as a result of the development of actions to reduce greenhouse gas emissions. However, it is still unclear as to how these visions will be achieved.

El Salvador has some unique features regarding its forest cover that distinguish it in the way that it addresses the issue of REDD+. Their R.-PP (2013) suggests a different and innovative approach in which adaptation is prioritized to be a national problem. Mitigation is regarded as a co-benefit, taking into account the agreements in Cancun (2010) and Durban (2011), which link adaptation and mitigation and seek synergy with the Conservation of Biodiversity. Thus, adaptation is the starting point, while mitigation, through increased capacity of capture and carbon sequestration in vegetation and soil, is seen as a co-benefit of the efforts around adaptation. Within the R-PP special attention is given to the conservation of forests (including mangroves and agroforestry systems), addressing the drivers of deforestation and increased forest carbon stocks. This increase through agroforestry systems (forest, fruit and fodder trees), biodiversity conservation, increased agro-biodiversity, erosion control, the formation of fertile soil, moisture retention in soils and water regulation across the rural landscape are national focal actions for REDD+. Similarly, this focus is complemented with sustainable agriculture and livestock and the restoration and conservation of critical ecosystems (mangroves and gallery forests) through natural and induced regeneration (2nd National Communication, 2013).

Costa Rica, despite not having proposed a direct AbM focus, offers an innovative approach through the formulation of its Carbon Neutrality Strategy (C-Neutral) promoting the development and technology focused on mitigating emissions of greenhouse gas emissions and adaptation to the consequences of climate change. Thus, technologies such as sustainable agricultural production (mitigation), and co-management of watersheds and weather scenarios (adaptation) are prioritized. Efforts respond to two major national objectives: firstly, to achieve the transformation of the development model to a low-

emission one, allowing the country to grow under the paradigm of the "eco-competitiveness"; and secondly, to start the process of adaptation in order to gain resilience to the adverse effects of climate change, which are predicted to be severe for Central America (3rd National Communication, 2014). Costa Rica implicitly considers MAS within what its "climatic justice" concept.

Within the agricultural sector, there is much concern around the impacts of the drought observed during 2014 and 2015. Consequently, the Inter-American Institute for Cooperation on Agriculture (IICA) seeks to use high-level technical dialogue to exchange purposeful ideas, taking into consideration the growing role of agriculture in international climate change negotiations. The goal is to use inter-sectoral coordination to unite efforts with the Intended Nationally Determined Contributions (INDC), and generate institutional and regulatory frameworks to address climate change, simultaneously achieving the regional development goals (IICA, 2015).

It is necessary to emphasize that currently in the Central American region, the mitigation options face many barriers, such as lack of implementation of the policy frameworks, and a clear preference for the approach to adaptation as a vulnerable region. To reduce vulnerability and strengthen resilience to advance adaptation to climate change, innovative efforts like the AbM approach represent significant potential for the region. However, they also require appropriate policy and institutional frameworks based on clear commitments (at different scales) and sustained over time (PRISMA, 2013).

COUNTRY PROFILES

- **Belize** will reduce greenhouse gas emissions from deforestation and forest degradation, conservation of forest carbon stocks, sustainable management of forests, enhancement of forest stocks through the development of a REDD+ strategy (Belice 2015). Its National Climate Change Policy, Strategy and Action Plan 2015- 2020 (NCCPSAP), provides policy guidance for the developing administrative and legal frameworks to pursue a low-carbon development path by 2033 (Belize 2015). Belize's Sustainable Energy Action Plan sets the reduction of Belize's GHG emissions by 24 Mt CO_{2e}, between 2014 and 2033. In addition, Belize expects to increase its share of its renewable energy (RE) in Belize's electricity mix by 85% by 2027 with a 62% carbon dioxide emissions reduction compared to a business as usual scenario (Belize 2015).

- **Costa Rica** made great progress in recovering forest cover due primarily to positive performance of its payment for environmental services mechanism, which is the main component of the REDD+ strategy (TCN, 2014). That strategy is also a key element in the country's carbon neutrality initiative (INDC Costa Rica, 2015) which seeks to maintain and expand PES coverage, increase carbon sequestration (natural regeneration and forest plantations), strengthen institutions and participation, and integrate carbon capture in national parks and biological reserves, as well as other activities. Overall, Costa Rica will seek a reduction of 25% of GHG emissions (relative to 2012), from 12.4 $MtCO_{2e}$ to 9.4 $MtCO_{2e}$ by 2030. There has also been progress in analyzing the suitability of the REDD+ system for the cultural, legal frameworks and the realities of indigenous territories (PRISMA Foundation, 2014). Currently, an evaluation process is being undertaken to identify gaps and congruencies between the VCS-JNR and the proposed REDD+ strategy to decide whether or not to adopt this international standard. Overall, the REDD+ strategy offers reductions close to 29.5 Mt CO_{2e}, with 79% of those reductions coming from forestry and agriculture by 2021 (Costa Rica 2013). The country has pioneered the promotion of a NAMA for the coffee and livestock sectors at the landscape level. The coffee sector NAMA has the technical support and financial platform of the NAMA Facility (2015-2019) (NAMA Facility, Costa Rica 2015). It will address the knowledge gaps of extension personnel on climate mitigation and adaptation, and improve access on existing additional government incentives (e.g. FONAFIFO PES). Under a conservative estimate, it is expected this NAMA will produce 1.8 Mt CO2e in GHG reductions in the next 20 years (Costa Rica 2015). The

bovine livestock NAMA uses a "Climate Smart" livestock approach to produce co-benefits such as soil conservation and ecosystem services, as well as reducing emissions in the order of 6000 Mt CO_{2e} (MINAE 2013, Costa Rica 2015).

- **The Dominican Republic** has the most NAMAs under development among the region. It has NAMAs for tourism and waste (Dominican Republic 2015a), in the cement/co-processing sector (Dominican Republic 2015b), the energy efficiency sector (Dominican Republic 2015c), and for pig farms (Dominican Republic 2015d). It also submitted a "blue carbon" NAMA focusing on mangroves (Dominican Republic 2015e). The units used in these NAMAs preclude us from aggregating emissions reduction potential, but the country is offering reductions in the range of 0.36 to 0.85 Mt $CO_{2/}$ yr in the hog production and waste sectors, respectively, and up to 2 Mt CO_{2e} in the cement sector, by 2030. The Dominican Republic had its ER-PIN approved by the FCPF Carbon Fund in late 2015 (Dominican Republic 2015), which will be carried out on a national scale and will focus its initial activities on six priority areas. Its FREL/FRL mentions 2.6 Mt CO_{2e} in net emissions reduction from the forestry sector (Dominican Republic 2015f), and the ER Program has the objective of reducing emissions of forest sector by up to 15,6 Mt CO_{2e} between 2018-2030. Overall, the country's UNFCCC commitment (Dominican Republic 2015) reaches 25 Mt CO_{2e} by 2030.

- In **El Salvador**, adaptation to climate change is the national priority and this "adaptation-based mitigation" logic guides the construction of their REDD+ strategy. Interventions are thus designed primarily to restore degraded landscapes and increase tree cover as a way to reduce vulnerability (El Salvador 2013). Mitigation benefits from increased forest cover would subsequently be achieved as co-benefits generated from the adaptation efforts. This approach can be used for planning at the landscape scale, where adaptation determines the location and extent of the mitigation efforts. There are currently no plans for NAMA design. El Salvador has made its commitment to restore 1 million hectares as part of the "20x20 Initiative", an effort led by some Latin-American countries, CIAT, CATIE, and IUCN to restore 20 million hectares of degraded land by 2020. No official national estimates of emissions reductions could be located.

- **Guatemala** emitted 31.45 roughly Mt CO_{2e} in 2005 (Guatemala 2015), roughly 2% of the Latin America's GHG emissions (Vergara et al 2013). It was an early country in preparing for REDD+ through several projects on the voluntary market, focused mostly on protected areas. The FCPF-funded REDD+-readiness process (R-PP) began in 2009 and was revised in 2012 (Guatemala, 2013). Lessons learned from the GuateCarbon project (implemented in 2006), for example, were crucial for establishing the sub-national REDD+ implementation scheme for the country. (PRISMA Foundation, 2014). Projects like the Tropical Forest Conservation and Sustainable Community Development in the Sierra del Lacandon National Park, are starting to support a mechanism to reduce deforestation in the Sierra del Lacandón National Park (2011-2015), promoting the development of national and international regulations that will integrate the conservation of biodiversity and poverty reduction into REDD+ (IKI 2016). In 2014, the Government of Guatemala presented its emissions reduction project idea notes (ER-PIN) to the Carbon Fund for the 2012-2020 period. They propose to achieve emissions reductions of 20.97 Mt CO_{2e} between 2016 and 2020, through avoided deforestation and degradation, and enhancements of carbon stocks. Guatemala is also working on its Low Emissions Strategy, which considers finance and technical assistance for implementing public policies, strategies and programs in all sectors (Guatemala, 2015). According to its INDC, the country will seek a reduction of 11.2% of GHG emissions (relative to 2005), from 53.8 to 47.8 Mt CO_{2e}, with a magnitude of reduction of 6.04 Mt CO_2e by 2030. Guatemala also pledged to restore 1.3 million hectares by 2020 as part of the 20x20 initiative.

- **Honduras'** approach to REDD+ readiness is based on agroforestry, integrating agriculture and forest sectors, avoiding deforestation and forest degradation (Honduras 2013). The readiness proposal frames general guidelines for poverty reduction, sustainable management of forests and the

promotion of community forestry (PRISMA Foundation 2014) through the new Human Face of Climate Change Vision, which has human development using adaptation and mitigation technologies to improve environment and life as its core value. Honduras is receiving technical and financial assistance from the FCPF since 2013 and from the UN-REDD Program since 2014. Honduras is also designing NAMAs specific for the livestock sector (UN, 2015). This NAMA promotes a shift towards alternative livestock practices by increasing agricultural productivity, reducing GHG emissions and contributing to the country's adaptation needs. In addition, the government is considering a coastal NAMA, integrating the "ridge to reef" concept, with an emphasis on their northern coast (M. Cifuentes, KI). Honduras is proposing an additional effort to reforest 1 million hectares by 2030 as part of its INDC (Honduras 2015). In addition, the country will seek a reduction of 15% of GHG emissions by 2030, relative to its BAU (0.03 Mt CO_{2e} in 2030).

- **Nicaragua** has ample participation of indigenous peoples, local governments and local community stakeholders, who will be later called upon to implement the REDD+ strategy. This has helped strengthen dialogue platforms identified in four possible geographic areas emphasized for their forest cover, and highlighting the autonomous regions of the Caribbean coast (RACCN, and RACCS; Nicaragua, 2013). The PRISMA Foundation (2014) concludes that unlike other cases in the region (e.g. Guatemala and Costa Rica), the ENDE-REDD+ development process in Nicaragua has resulted in more significant advances in social issues than in technical decisions. Social spaces have encouraged the participation of indigenous peoples at decision-making levels, forming a space where there is consensus on the current problems like water supply, education and resources management, and the strategic actions required to follow-up. No estimates of national emissions reductions could be documented.

- **Panama** was one of the first countries to start its REDD+ readiness process (2008-2009) with the FCPF, creating a high expectation of rapid advancement. This helped Panama take immediate advantage of a proposal request to the UN-REDD Program (PNC 2013; Prisma 2014). However, a number of communication problems between the government and indigenous people resulted in a momentary lag of labor (UN-REDD and FCPF). After a complaint by the indigenous groups, the UN-REDD Program in Panama was reformulated, and the FCPF renewed their support. This new formulation proposes the definition of new communication strategies and strengthens the consultation and accountability means. It also seeks to broaden the base of stakeholders, and the inclusion of an indigenous environmental agenda (PRISMA Foundation, 2014). No estimates of national emissions reductions could be documented.

ANNEX H: EXCERPTS FROM THE NEW USAID/CAM RDCS

Development Hypothesis

A regional program can both complement and enhance work done by USAID bilateral missions in the region, and through a concerted and coordinated effort, can tackle transnational issues for a more inclusive, prosperous, transparent, and safe Central America region.

Applying the criteria for a regional program, as described above, truly regional interventions will be identified in the various sectors covered by this strategy. Projects and activities will be in alignment with the CEN strategy and USG priorities for the region, and adapt to the ever-changing situation in the region. The RDCS is based on the philosophy that overall region-wide development results can be enhanced when regional programs complement country-specific bilateral efforts.

Specifically, by strengthening regional economic integration, enabling improved movement of goods and services across the borders, while ensuring environmentally conscious and sustainable practices are adhered to, Central America's development will advance and create space for economic growth and increase opportunities for employment. By testing new climate-smart approaches and scaling up proven best practices, USAID/CAM will increase economic growth and good governance across the region that reduces emissions, builds resiliency to climate change, and conserves and strengthens management of Central America's biodiversity. Further, through targeted programming that leverages interagency and intra-agency collaboration, USAID will promote safer communities in which citizens have fewer incentives to leave their communities and can productively contribute to their country. USAID/CAM will also promote a regional learning community among security, legal and judicial practitioners from across the region to inform and provide opportunities for smarter development of crime prevention and human rights related programming. Moreover, by promoting increased transparency in government, USAID/CAM will help generate trust between citizens and their government officials, in addition to creating greater accountability and improved governance. Through enhanced regional cooperation and harmonization of the technical assistance provided, CAM's work in the HIV/AIDS sector will enable governments in the region to effectively contain the epidemic in the future.

DO 1: Regional economic integration increased.

- **IR. 1.1 Regional trade expanded.** Central America will expand trade to create jobs and economic opportunities by improving the movement of goods across borders, by optimizing facilities connectivity and infrastructure, and simplifying international trade controls and procedures. Transparency and simplification in laws, regulations and procedures will allow businesses to formally comply with controls and promote increased access to regional and international markets.

  Illustrative Activities:

  - Improve, through technical assistance, border facilities, traffic flows, power generation and connectivity at border crossings.
  - Improve information technology to allow for interconnectivity and information sharing among border control agencies.
  - Update and modernize import and export procedures, and regulatory or legal national and regional Central America Customs Union (CACU) frameworks if necessary to ensure consistency with the World Trade Organization Trade Facilitation Agreement and international best practices.
  - Develop and promote a regional market information exchange system of certified land

transportation, services, promoting integration of small and medium transport service providers in regional value chains.

Sub-IR 1.1.1 Trade facilitation improved. Central American countries will advance trade facilitation through improved policy formulation; effective coordination of border control agencies, including customs administration, agriculture, immigration, and security; improved procedures and management; and improved quality and border facilities, while ensuring effective controls for citizen security. The RDCS activities under this Sub-IR will consider the large number of women involved in cross-border trade, working in informal trade and as small-volume traders at the border, many of whom suffer from invisibility, stigmatization, violence, harassment, poor working conditions, inadequate transport and funding, and lack of recognition of their economic contribution.

Sub-IR 1.1.2 Transportation modernized and logistics efficiency improved. The modernization of land cargo transportation regulations and standards and the efficiency of operations are necessary to reduce the costs of trading goods across borders, and contribute to streamlining logistics and border controls. Harmonized regulations for transport, including weights and dimensions, technical and mechanical standards, certifications for drivers, regional agreements to promote increased use of cargo capacity, and service information exchange, would promote a more efficient and modern land transportation service supply in Central America. USAID will support host country governments in their efforts to improve the coverage and quality of multi-modal transport infrastructure (roads, ports, airports and railways), focusing on projects that strengthen regional integration.

Sub-IR 1.1.3 Technical barriers to trade reduced. The consolidation of an expanded market and access to global production networks depend on improved quality systems that comply with international standards. An expanded Central American market for goods and services will benefit from industry and science-based standards, certifications and compliance audits that are standardized throughout the region. Sanitary registries, sanitary and phytosanitary standards and other technical requirements for goods and services shall be science-based and standardized, and not constitute unnecessary barriers to trade. With the advent of stricter food safety laws in the U.S. and other key markets for food exports from the region, USAID will support governments and regional production associations to meet food safety standards and maintain vital export markets.

- **IR. 1.2 Regional markets and investment in key sectors increased.** Regional market linkages in key sectors, including but not limited to agriculture value chains will increase through public and private investments in infrastructure, knowledge management, and institutional capacity to support business innovation and compliance with standards to compete in international markets. The rapidly changing international environment has placed greater pressure on producers to introduce technological and management improvements in farming techniques in order to compete. Work under this IR will be cognizant of women who represent small and subsistence farming families, as they are among the least able to benefit from the opening of new market opportunities. Activities will include but are not limited to improved productivity, quality compliance, product innovation and linkages to markets, increased private investment in key value chains for improved processing, product innovation, trade logistics, and well established market linkages that will promote increased economic opportunities and job creation.

  Illustrative Activities:

  - Improve regional producers' capacity through support to producer organizations in complying with international market standards and specifications, through investments in product and packaging innovation, new processing equipment, quality assurance systems and organizational capacity strengthening.

- Establish regional and international producer-buyers alliances; continue promotion of buyer-producer alliances and identification of international market opportunities for agriculture value chains (cacao, red and black beans, plantains, cacao and other horticulture).
- Ensure continued export market access from fruit and vegetable producers in support of the Food Safety Modernization Act.
- Promote private investment through business models that support regional trade logistics, such as short route maritime transport, improved borders, airports, and ports management.

Sub-IR 1.2.1 Agriculture value chains enhanced. USAID will facilitate technical assistance to regional producer organizations to improve compliance with international market standards and specifications. Investments in product and packaging innovation, new processing equipment, quality assurance systems and organizational capacity strengthening are critical for maintaining regional and global competitiveness, and USAID will work with organizations to ensure they are equipped to trade internationally. By focusing on standardization and export readiness, CAM efforts will align with farm-level assistance provided by bilateral missions. CAM will promote buyer-producer alliances and identification of regional and international market opportunities for agriculture value chains, including coffee, cacao, red and black beans, plantains, and other horticulture. Moreover, CAM will support host governments to develop and verify production partnerships across borders and support regional value chains to scale-up production networks.

Recognizing the dependency of agriculture value chains on a healthy climate, this Sub-IR's work in the promotion of value chains will consider regional climate change impacts, looking to the 118, 119 Tropical Forestry and Biodiversity analysis, as guides. Further, CAM will seek information from bilateral counterparts to ensure that programs consider country-specific knowledge and expertise in climate impacts.

Sub-IR 1.2.2 Private sector productive and competitive capabilities strengthened. USAID will support Central American businesses by linking regional goods and services to global value chains and promote greater diversification and value-added elements. Assistance will promote greater innovation and technology in key economic sectors such as textiles and apparel, electronics and other value-added activities. USAID will promote partnerships and introduce best practices in business modeling, and coordinate with activities in the energy and workforce development sectors to foster sustainable economic growth opportunities in the region. Activities will develop public-private investment models that not only create economic opportunities but also expand regional trade through more efficient logistics, such as short route maritime transport, and other interventions that help develop the productive and competitive capabilities in the private sector. Work under this Sub-IR will be closely coordinated with the IR 1.1 focus on USAID technical assistance in trade facilitation and logistics, seeking value chain integration that will support new and innovative business models for profitable and sustainable solutions to existing constraints to growth.

DO 2: Regional climate-smart economic growth enhanced.

- **IR 2.1: Low-carbon development increased.** USAID will continue to work across the region to promote low-carbon growth that stimulates the economy and reduces greenhouse gas emissions, by assisting regional institutions, governments, and key stakeholders to support Central America in making this transition. By promoting sustainable land use practices and policies and continuing support to increase renewable energy and energy efficiency, CAM will help reduce emissions, increase incomes, and diversify economic opportunities that will lead to more sustainable regional development in Central America.

Illustrative Activities:

- Promote and expand the use of climate-smart agricultural practices throughout the region that sequester or reduce emissions, such as expanded agroforestry practices, and provide links to regional markets for these improved practices.
- Build regional capacity on Reducing Emissions from Deforestation and Forest Degradation (REDD+) policies and, where possible, leverage expertise from countries, such as Mexico, that have already developed and are currently implementing similar policies and procedures.
- Support regional and national energy institutions to fully develop the Regional Energy Market and improve the business environment for investment in renewable energy.
- Develop improved regulatory approaches and financial incentives for energy efficiency projects, both public and private.

Sub-IR 2.1.1: Regional climate-smart land use practices scaled-up. In an emerging field like climate change, several climate-smart activities have been piloted and shown to be successful in reducing or sequestering emissions while increasing economic growth. CAM will scale-up these successful, evidence-based approaches across the region and in different landscapes, potentially connecting community-based mangrove conservation to carbon markets. CAM will also continue to support Central American countries in developing and implementing policies at the regional, national, and local level, such as REDD+ strategies, that reduce emissions from deforestation, forest degradation, agriculture, and land use changes.

Sub-IR 2.1.2: Investment in low-emissions solutions expanded. Low-emissions activities will promote investment in renewable energy generation and energy efficiency standards to reduce greenhouse gas emissions in Central America. Noting that women and men play different roles in energy production, distribution, and utilization, CAM's work in this sector will be mindful of the varying ways in which support of renewable energy technologies to reduce greenhouse gas emission affects men and women.

- **IR 2.2: Resiliency of humans and the environment to climate change impacts increased.** USAID will contribute to climate-resilient economic growth in Central America by reducing the vulnerability of people and ecosystems to climate change. Regional institutions, national governments, private sector institutions, and small and medium-sized businesses throughout Central America are at varying stages in terms of their respective access to information, integration of climate change data into multi-sectorial strategic planning, identification of priority actions, and implementation of these actions to effectively become more resilient to climate change. CAM will provide regional institutions, governments, businesses, and individuals with the means to make decisions and implement actions that avoid, adapt to, or better manage climate change impacts.

  Illustrative Activities:

  - Support the development of research, technology, and innovation centers that create solutions to common regional climate change challenges.
  - Facilitate information exchanges and develop tools to help predict, analyze, and prepare end-users, including women, for future climate-related impacts in the region.
  - Identify and disseminate new technologies and innovations for climate-smart practices in agriculture, integrated water resources management, watershed conservation, and biodiversity conservation that reduce the impacts of climate change on economic growth and regional stability.

Sub-IR 2.2.1: Access to quality climate data for decision-making increased. Although climate change data in Central America are currently generated and shared, information that is most needed is not properly disseminated. CAM will provide evidence-based, demand-driven climate change data, analyses, and tools to end users such as government officials, agricultural fishing cooperatives, or civil society groups. USAID/CAM will rely on technology and innovation to ensure activities provide information products that are both accessible and appropriate for the end user. With access to this user-friendly information and better capacity to apply it, Central American institutions, communities, and citizens will be able to make informed decisions in real time that reduces their vulnerability to climate change impacts. Moreover, because women have proven to be a driving force in preserving natural resources and preventing land degradation, activities will promote women as change agents of climate change mitigation, disaster reduction and adaptation strategies.

Sub-IR 2.2.2: Evidence-based climate-resilient practices adopted. USAID will assist regional institutions, businesses, and individuals in identifying and implementing actions that help the region better manage ecosystems, create and enforce climate-smart policies, and become more resilient to economic shocks from climate change impacts. For example, CAM will support climate-smart agriculture that restores soils and is more resilient to droughts and extreme rain events. CAM will stimulate the emergence, development, and implementation of climate-smart practices in many sectors, including agriculture, integrated water resources management, and biodiversity conservation.

- **IR 2.3: Transboundary natural resource management strengthened.** Central America's biodiversity is one of its most abundant and most valuable assets. Biodiversity hot spots, such as forests and coastal marine ecosystems, are often found in transboundary zones shared by two or more countries, and are increasingly under threat by human and natural activities. As a result, conservation and management of these resources is complex and difficult to manage solely through bilateral support. Moreover, illegal, unreported, and unregulated fishing has contributed to ecosystem decline and threatens the livelihoods of many of Central America's poorest citizens. CAM will help build regional capacity to improve sustainable management of natural resources found in these transboundary ecosystems, including improving governance and economic incentives for conservation, to increase regional biodiversity on which many Central Americans depend.

  Illustrative Activities:

  - Establish community-based cooperative management of protected areas or diverse biological resources through community enforcement, for example, women-only patrolling groups or resource management councils, to ensure better management through use of local practices, rights, and buy-in.
  - Create alternative economic and sustainable opportunities for local communities through the diversification of products extracted from transboundary ecoregions, including non-traditional resources and environmentally sustainable aquaculture opportunities.
  - Pilot the development of a seafood traceability system that utilizes technology to improve trade in seafood across the region.

  Sub-IR 2.3.1: Regional environmental governance improved. In Central America, weak institutional management of natural resources can damage the environment and lead to effects on human health and the economy. CAM will support Central American countries to develop, implement, and enforce environmental laws, regulations, and policies. RDCS activities will also

promote improved harmonization of policies and coordination among countries and key stakeholders for successful management of these transboundary natural resources.

Sub-IR 2.3.2: Environmentally sustainable livelihoods expanded. CAM will address threats to biodiversity and decrease illegal and unsustainable trade in natural resources by promotion of safe, legal, and environmentally-friendly alternative livelihoods that reduce poverty. CAM will work in transboundary areas within the region to expand sustainable economic alternatives to improve livelihoods through best management and development practices.

DO 3: Regional human rights and citizen security improved.

- **IR 3.1 Regional capacity to address citizen security through more coordinated governance systems improved.** Crime and violence do not respect borders, and transnational problems require a collaborative, regional approach to ensure consistency and prevent "weak links" that can negatively impact across borders. While myriad site and country-specific approaches and models are underway, as missions tackle these complex problems that have governance implications, a concise, region-specific approach is needed. CAM programming will help share successes across the region to ensure stakeholders have information and are aware of responsive governance practices available to address these challenges.

  Illustrative Activities:

  - Develop regional citizen security indicators that are comparable within the region and disaggregated to be tracked, disseminated and analyzed to inform both national and regional challenges.
  - Develop a clearinghouse for regional information to be made available broadly, including publicly available research, publications, and key citizen security indicators.
  - Assess and promote comparative best practices and approaches across key institutions, including regional exchanges with Colombia, Brazil, Chile, and Mexico, to share lessons learned and expertise in citizen security-related issues.
  - Strengthen regional youth advocacy and networks for crime and violence prevention.
  - Identify, test, and disseminate new and innovative approaches to citizen security strategies and adapt various crime prevention models region wide.
  - Develop youth leadership initiatives, such as forums and trainings, to foster their capacity to advocate on issues most pertinent to their positive development and advancement, such as civic participation and citizen security.

  Sub-IR 3.1.1 Increased regional capacity for citizen security data collection and analysis. The region still lacks comprehensive data collection in the area of citizen security and governance, including sex disaggregated data, due to limited capacity and resources, and a dearth of detail in statistical records. Activities will improve the quality, comparability, reliability, and timeliness of citizen security, governance, and transparency data in the region, followed by increased capacity to undertake comparative analysis that enables informed policy decision-making. They will also seek to strengthen both analysis and institutional capacity of select public institutions and civil society networks at the national and regional levels to provide evidence-based analysis and policy recommendations.

  Regional programming will support governments and civil society organizations, including women-led NGOs, to improve the collection, monitoring, and systematization of crime data,

sex and age disaggregated, at the national and regional level to provide evidence-based analysis and policy recommendations. This programming will further enhance analysis and dialogue of cross-border issues that impact citizen security and governance in the region. Activities will also complement existing studies and conduct further in-depth research on specific citizen security issues.

Sub-IR 3.1.2 Dissemination of citizen security best practices through regional networks expanded. Regional programming will analyze and document successful practices and solutions to systemic, transnational issues affecting the region with respect to crime and violence, including femicides, and gender-based violence. Additionally, programming will disseminate evidence-based approaches, best practices, tools, and successful models throughout the region, sharing information across Central American countries. Best governance practices in crime prevention through municipal crime prevention councils, for example, will be assessed and shared among the community of civic and policy making practitioners to help identify successful interventions that may be applied throughout the region. Activities will encourage replication and scale-up of successes, emphasizing the application of technology and innovation as much as possible. Additionally, trilateral cooperation will be emphasized as a method to share successful regional experiences and knowledge.

Sub-IR. 3.1.3 Sustainable regional capacity for violence prevention and interruption increased. A critical element of USAID's regional citizen security efforts is to enhance the ability of key stakeholders (individuals, groups, organizations) to identify and meet the challenges the region faces in terms of crime, violence, and governance. Capacity is a key determinant of government and organizations performance. Regional programming will develop the region's capacity for the prevention and interruption of violence by promoting assessment of best practices, leadership models, actions planning, evaluation, and learning. In order to foster regional learning and exchange on citizen security and best practices, activities will provide training and exposure on regional and international best practices for policy makers, elected national and local authorities, civil society, private sector, and other stakeholders involved in primary, secondary, and tertiary prevention efforts across the region. Also, activities will promote youth development by providing support to improve the capacity of youth to actively participate in violence prevention initiatives, and enhance regional youth leadership and participation. A key element will be the development of a regional training academy-like network, wherein crime prevention experts and violence interrupters share and learn about international and regional comparative evidence-based practices on citizen security-related topics, providing civil society organizations, social service providers, police, journalists, youth and other stakeholders with enhanced knowledge of what is working internationally and regionally.

- **IR 3.2 Human rights standards and protection systems strengthened.** The Northern Triangle countries of Central America have made efforts to establish elements of national human rights protection systems, such as ratifying core human rights conventions, accepting the jurisdiction of the human rights international and regional mechanisms and adopting constitutions and human rights-specific laws and policies.

  Illustrative Activities:

  - Facilitate a regional advisory network or working group of leading experts in human rights education and awareness-raising to establish goals, standards, protocols, themes, and content for education, training, and strategic communications.
  - Engage with regional networks to adopt and replicate a non-discrimination campaign

especially regarding groups such as LGTBI, youth, migrants, internally displaced persons, women, children and other traditionally excluded groups.

- Generate improved information systems on migrants and internally displaced persons to contribute to decisions involved in the reception, assistance, and reintegration process.
- Provide standardized protocols and best practices to assist in the introduction, and/or management of victim registries related to disappearances, trafficking, migration, and internally displaced persons.
- Provide technical assistance to establish a regional registry to track disappearances as well as genetic database to help identify persons both deceased and living.
- Design special mechanisms to track violations against vulnerable groups regionally, in particular women, LGBTI, children and indigenous groups.

Sub-IR. 3.2.1 Enabling environments for prevention of human rights violations strengthened. USAID will work to improve enabling environments for guaranteeing human rights protections and preventing violations in a manner appropriate to national as well as regional contexts. This will be achieved by improving human rights education and awareness, and public policy research and data collection. To improve the enabling environment, USAID/CAM will work with partners to elevate human rights awareness and increase the understanding of society at large, as well as among government officials and the larger human rights community of practice.

Sub-IR. 3.2.2 Responsive actions to address human rights violations expanded. Because efforts to prevent human rights violations can sometimes be ineffective and unsuccessful, USAID/CAM will provide assistance to improve the ability of human rights institutions and actors, both government and civil society, that make up national human rights protection systems in the region to respond to and mitigate the immediate effect and harm of these violations. Countries in the region share a number of at-risk populations and individuals whose rights have been violated. In addition to human rights defenders and journalists, the rights of migrants and internally displaced persons, of women and youth, labor organizers, of indigenous peoples and ethnic minorities, LGBTI persons, and pre-trial detainees and prisoners are imperiled. Labor and land rights are also tenuous for many throughout the region.

Sub-IR 3.2.3 Sustainable early warning and protection systems for key vulnerable groups developed. Work under this Sub-IR will support partners in the region to develop and institutionalize measures to prevent systematic, along with more individualized and localized, forms of human rights violations in the region and reduce to a minimum the harm they cause through early warning and threat assessment.

DO 4: HIV prevalence in Central America contained.

- **IR 4.1: Effectiveness of comprehensive prevention, care, and treatment services increased.** USAID will strengthen HIV prevention practices and services directed to key populations, including men who have sex with men (MSM), sex workers, and transgender populations, and interventions in Honduras will also target the Garifuna population. The activities will promote behavior change to decrease infection rates and enhance detection, care, and treatment in some specific sub-national units. The geographical focus will allow for saturation of services in each area to have a major impact on the epidemic. The program will support host country governments to effectively and efficiently lead national and regional responses to achieve the national goals set by the countries as part of the continuum of care concept. Under the worldwide

goals of 90-90-90 which lays out an ambitious treatment target that by 2020, 90 percent of all people living with HIV will know their HIV status, 90 percent of all people with diagnosed HIV infection will receive sustained antiretroviral therapy, and 90 percent of all people receiving antiretroviral therapy will have viral suppression. USAID efforts will support the countries' endeavors to accelerate control of the epidemic in the most affected areas and with the most affected populations in future years.

Activities will also support health system strengthening, building the capacity of countries to more effectively reach key populations and monitor and use information to make sustainable evidence-based decisions in close coordination with all key stakeholders in the region.

Illustrative Activities:

- Prevention programs targeted for key populations, including peer outreach, small group prevention activities and prevention activities in "hot spots", mainly focused on promoting behavioral change.
- Service provision related to the procurement, distribution, and marketing of condoms and lubricants.
- Establishment of NGO networks to provide high quality prevention services; build the capacity of local NGOs to support the implementation of evidence-based, quality HIV prevention services for key populations in compliance with new ministry of health (MOH) funding mechanisms.
- Provision of HIV testing and counseling across the range of community and facility-based settings, including mobile units to increase key populations' ability to access the HIV test.
- Support for programs that provide timely entry into medical care and retention, after HIV positive diagnosis.
- Strengthen reference systems between community services, local clinics and HIV Comprehensive Units.

Sub IR 4.1.1 HIV prevention and diagnosis services focused on key populations increased. Activities will include diverse types of modalities to increase the coverage of people tested, such as mobile units, HIV testing days, online references and vouchers, private clinic enrollment, among others. Besides increasing the availability of service offerings, it is important to simultaneously accelerate the sensitization and training of health workers. All of these will result in an enabling environment for key populations that facilitates the diagnosis process, as well as supports an effective system for reference from the places where they are reached to the places where HIV tests are taken. New cases will be tracked through the input of the data collected into the national and homogenous system to track new cases.

Sub IR 4.1.2 Positive populations' enrollment, retention, and treatment in HIV qualified health care centers and community services improved. USAID will help countries to improve the quality, coverage, and linkages to comprehensive HIV services, bringing HIV positive people to viral suppression. These activities will be complemented with health systems strengthening interventions, including capacity building in laboratory services, supply chain management, human resources, and quality improvement.

- **IR 4.2: Health systems strengthened and sustained.** Most countries in the region have supportive legal frameworks and national strategic plans are in place to respond to the HIV epidemic. However, the poor implementation of HIV laws and national policies, as well as the lack of sanctions for non-compliance, greatly reduce the efficacy of these laws. In addition, non-health

sectors are not meaningfully engaged in HIV policy design or implementation, and this greatly constrains the impact of HIV laws and policies.

For example, conservative cultural norms about sexuality and a strong normative preference towards heterosexuality are reflected in the lack of political leadership to implement human rights laws to guarantee the protection and equality of key populations. Reflecting broad public intolerance for sexual diversity, policies do not adequately address gender-based violence against transgender women and MSM.

HIV policies are often not well linked to other larger national policies, such as a country's national development strategy or poverty reduction strategy, which reduces their impact, isolating them as stand-alone policies, with isolated financing. USAID will support NGOs and advocacy groups to play a critical role in holding governments accountable for their policies and financial commitments related to HIV/AIDS.

Illustrative Activities:

- Development and implementation of policy, advocacy, guidelines, and tools (including developing national adherence strategies).
- Capacity building activities that strengthen national, departmental and municipal health systems to increase quality of HIV services for key populations or patients.
- Strengthen the national HIV/AIDS monitoring and evaluation system based on the Joint United Nations Programme on HIV and AIDS (UNAIDS) 12 components model.
- Share among key actors methods, tools, best practices, and lessons learned focused on the HIV cascade to monitor the HIV epidemic.
- Technical assistance to develop and implement HIV and GBV prevention policies.
- Increase the organizational capacity within ministries of health to establish and carry out effective funding mechanisms, management and stewardship of local NGOs to provide HIV prevention services.

Sub IR 4.2.1: Capacity and competency of governmental and non-governmental health organizations to respond to the increased demand built. The strengthening of governmental and non-governmental health organizations is a critical factor for improving uptake of health services to respond to the increased demand. It is important to address the barriers that limit access for vulnerable people, and ensure provision of relevant information and skills, client-friendliness, and accessibility to services. This capacity building will include mapping the locations and capacity of all service organizations working on the HIV response, and developing their capacity through training and tools such as protocols, manuals, and norms. USAID programs will prioritize capacity building and systems strengthening interventions that build strong leadership and governance, particularly those that strengthen the social service workforce and system.

Sub IR 4.2.2: Non-health sector organizations involved in the HIV response increased and strengthened. There is a general consensus that a true multi-sector response is required to achieve more effective implementation of national and regional HIV policies. USAID will work to involve stakeholders from a wide range of sectors and at various levels of government in the policy process to ensure more effective implementation of policies and continuity, particularly during periods of political transition.

Sub IR 4.2.3: Sustainable national investments in HIV increased. Governments in Central America currently finance HIV programs at varying levels. While countries demonstrate increased ownership of specific components of the HIV response (particularly in relation to

treatment, care, and support activities), prevention activities remain quite dependent on international cooperation. USAID will strengthen country capabilities and ownership to establish leadership and improve skills and performance to manage the limited resources available and, in the near future, lead the response to the epidemic.

In a joint effort, the Central American countries and USAID developed a Regional Sustainability Strategy which is being adopted by each country to progressively absorb the cost of the epidemic. USAID will continue to support the development and implementation of the national and regional strategies to ensure the appropriate national investments in combatting the epidemic.

- **IR 4.3: Knowledge management system adopted.** USAID will continue investing in the generation, dissemination, and use of HIV strategic information for evidence-based decision making. Despite the progress made in managing knowledge, it is still a challenge to generate, disseminate, and use the right knowledge at the right time, in the right places. USAID will develop and adopt a comprehensive knowledge management framework in Central America. USAID has the opportunity to be more efficient and effective at improving the strategic information strategy focusing on streamlining processes, increasing external generation, improving knowledge transfer quality, and creating local capacity and sustainability. Overall, this IR will endeavor to strengthen the generation, dissemination and efficient use of strategic information, knowledge about the epidemic, and the registry of national response actions for decision-making.

  Illustrative Activities:

  - Technical assistance to improve key population size estimation in coordination with UNAIDS and the Global Fund.
  - Technical assistance to develop coverage assessments for HIV services among key populations and identify current service provision gaps.
  - Technical assistance to develop local capacity for rigorous evaluation methods; activities may include virtual training on HIV, applied research for local partners, and virtual support to develop research products.

  Sub IR 4.3.1 Geographic and population focused planning strengthened. To improve HIV strategic planning in support of the continuum of care, USAID will strengthen the methodologies for estimating key populations size and the providers of services to key populations to identify gaps in the access of these people to critical HIV services. Priority areas for these interventions are based on the 2013 PEPFAR evaluation in Central America and include strengthening local capacities to perform and use epidemic data on key populations for decision making, and promoting the integration of HIV information systems.

  Sub IR 4.3.2 Innovation and research on interventions for key populations and people living with HIV/AIDS developed. The purpose of this sub-IR is to harmonize reporting methods, frequency, and content, as well as support the identification of barriers and major factors that are preventing the priority areas for these interventions are based on the 2013 PEPFAR evaluation in Central America. Activities under this Sub-IR will strengthen local capacities to improve data collection and use for decision making, and conduct sociological and anthropological studies among key populations and people living with HIV/AIDS.

ANNEX I: TASK ORDER STATEMENT OF WORK (REGIONAL CCVA COMPONENT)

SECTION C – OF THE TASK ORDER

I. Background

USAID/El Salvador's Central America Regional Program (USAID/CAM) is currently developing a new Regional Development Cooperation Strategy (RDCS) to inform its assistance efforts in Central America. As a part of the documentation for the new, five-year RDCS, USAID/CAM is required by Sections 118(e) and 119(d) of the Foreign Assistance Act of 1961, as amended (FAA), and USAID's Automated Directives Systems (ADS) 201.3.4.2(1)(a) to complete an analysis of tropical forests and biological diversity in Central America. Selected text from FAA 118(e), FAA 119(d), and ADS 201 is provided in Annex A. In addition, given Central America's vulnerability to global climate change and the clear links between tropical forests, biological diversity, and climate change, USAID/CAM will also complete a regional climate change vulnerability assessment to better inform its future development activities. Many other documents, studies, and research on Central America's tropical forests, biological diversity, and vulnerability to climate change have been completed by several organizations at both an individual country level as well as at the regional level. This work will primarily consist of an initial compilation, review, and synthesis of existing information on the current state of tropical forests, biological diversity, and climate change throughout Central America. Based on this information, recommendations will be provided on how to direct future funding and efforts in order to conserve biodiversity and to reduce the impacts of climate change. A list of reference documents is included as annexes to the Statement of Work.

II. Statement of Work

The Central America Regional Environment and Climate Change Analysis will include:

1) A regional analysis of tropical forests and biological diversity in Central America, including a review of their current status and incorporation of existing tropical forest and biological diversity analyses in bilateral Missions; and
2) A regional climate change vulnerability assessment, including a review of the impacts of climate change on priority development sectors.

The analysis will be limited to the Central American region, defined as Central American Integration System (SICA) member countries: Belize, Guatemala, Honduras, El Salvador, Nicaragua, Costa Rica, Panama, and the Dominican Republic.

A. Regional Tropical Forest and Biological Diversity Analysis (FAA Sections 118 and 119)

(See Regional Tropical Forest and Biological Diversity Analysis Report Annex)

B. Regional Climate Change Vulnerability Assessment

The overall goal of climate change adaptation activities is to help societies become more resilient to impacts associated with adverse effects of climate change. USAID/CAM's climate change adaptation activities should be based on evidence from vulnerability and adaptation analyses and targeted to successfully address identified adaptation priorities in Central America. This data- driven approach will assist in designing activities to more significantly reduce the region's vulnerability to climate change impacts in order to achieve development results. More broadly, the Mission's development activities in other sectors should be informed relative to possible climate change impacts and potential opportunities to increase resilience in order to reach their sector-specific development goals. Climate change trends

affecting Central America generally include changing rainfall patterns, increasing land and water temperatures, and rising sea levels. Central America has been identified as one of the regions in the world most vulnerable to these impacts, due in part to its reliance on agriculture, fishing, and natural resources, levels of poverty, and susceptibility to natural disasters.

The Contractor will conduct a climate change vulnerability assessment of Central America to help the Mission identify climate change adaptation priorities from a development-driven perspective and better understand the landscape of climate change activities already underway. This assessment should include a desktop study as well as in-country consultations with key stakeholders. The climate change vulnerability assessment should a) start by describing regional development priorities (e.g., agriculture, tourism, etc.); b) identify the critical inputs and enabling conditions necessary to achieve development objectives in these areas; c) discuss climate variability and change trends and projections that affect those inputs and goals over relevant timescales; and d) identify priority geographic areas, economic sectors, and populations that are most vulnerable to the anticipated impacts of climate change based on their exposure, sensitivity, and adaptive capacity. Development sectors of interest include, but are not limited to, biodiversity conservation, agriculture, economic growth, governance, security, sustainable marine/coastal/fisheries management, and health.

The Contractor will summarize the donor landscape in these areas, identify regional climate change adaptation priorities and gaps where action is needed, and identify opportunities for the Mission's future climate change programming, identifying priority sectors, partners, and/or geographic areas of focus. The vulnerability assessment should also identify climate change impacts on tropical forests and biodiversity on a regional scale and recommend regional actions to reduce the impacts or adapt to them. The Contractor should provide a brief, annotated bibliography summary of individual country climate change vulnerability assessments with the primary focus on the Central American region as a whole, with priority given to trans-boundary issues and opportunities as well as potential for integration into other development sectors.

Central American regional institutions and governments have had recent success in utilizing an adaptation-based mitigation approach where climate change mitigation-related activities – land use activities such as REDD+ policies or agroforestry that reduce greenhouse gas emissions – have increased resiliency of ecosystems, landscapes, and/or communities to climate change impacts. This integration of adaptation and mitigation activities can provide co-benefits to a wider range of beneficiaries (e.g., access to carbon funds) and further incentivize adaptation actions. As such, a brief review of current activities and possible future opportunities in mitigation-related sectors, including land use, agriculture, urban planning, and forestry sectors, is necessary to continue providing targeted support to adaptation-based adaptation.

The climate change vulnerability assessment should be guided by the Mission's development priorities as described in the RDCS concept paper, including but not limited to, regional security, trade, economic growth, and HIV/AIDS. The assessment will draw from existing literature, including regional plans and reports and peer-reviewed journals. When useful, information should be synthesized into tables and charts, such as sector-by-sector tables or figures summarizing vulnerability of valued assets to alternative climate impacts or opportunities for targeted adaptation-based mitigation actions.

III. Central America Regional Environment and Climate Change Vulnerability Assessment Outline and Description

A. Regional Tropical Forest and Biological Diversity Analysis (FAA Sections 118 and 119)

(See Regional Tropical Forest and Biological Diversity Analysis Report Annex)

B. Regional Climate Change Vulnerability Assessment

i. Title page

ii. Table of contents

iii. List of appendices

iv. List of tables and figures

v. Executive summary

1. Introduction (1-2 pages)

(a) Background

(b) Purpose

(c) Approach and Methods (including geographic scope)

2. Development Context – Priorities, inputs, and enabling conditions (2-4 pages)

(a) Economic development goals: review key sectors of the Central American economy in terms of GDP, employment, and priorities for economic growth (e.g., manufacturing, agriculture, energy, fisheries, tourism), including inputs and enabling conditions for meeting development goals.

(b) Social: include demographics, trends, and priorities for human development that will factor into future resilience.

(c) Ecological: briefly describe critical ecosystem services, and priorities for sustainable ecological management and conservation.

(d) Non-climate stressors as they affect economic and social development objectives and ecosystem services: poverty, governance, urbanization, pollution, migration, natural hazards

3. Climate Change Impacts and Vulnerability (4-7 pages)

(a) Climate change stresses: observed trends and projected climate change (e.g., land and water temperatures, volume and spatial distribution of precipitation, extreme weather events, glacial melt, sea level rise, etc.) in near-term (2020s), middle-term (2050s), and long-term (2100s)

(b) Impacts on priority sectors: What is at risk?

- Anticipated impacts of climate change to key sectors described above, including cross-sectoral impacts, especially related to biodiversity and tropical forests
- Significance of concern (e.g., magnitude of drought impacts on food security, flood impacts on infrastructure, temperature rise on marine resources)
- Discussion of timing, severity, likelihood, and consequences of adverse impacts

(c) Synthesis of exposure, sensitivity, and adaptive capacity

- Exposure: where and to what extent are people, settlements, economic activities, and ecosystems most exposed to climate stressors and impacts?
- Sensitivity: what makes certain populations, economic activities, and ecosystems particularly susceptible to negative impacts?
- Adaptive capacity: where and to what extent are populations and economic activities able to prepare for, adjust, and/or react to climate stressors? Which locations are most prepared to adapt to climate change-related stressors?

4. Adaptation-based Mitigation

(a) Summarize status of efforts to reduce emissions from forests and other landscapes in Central America (including short country profiles)

(b) Provide status of coastal-marine efforts at emissions reduction (e.g., blue carbon projects)

5. Existing efforts and remaining gaps (5-7 pages)

(a) Regional- and country-level planning and priorities for adaptation and adaptation-based mitigation

(b) Summary of ongoing programs by regional institutions, national governments, other donors, NGOs, universities, multilateral development banks, and the private sector

- Adaptation (e.g., disaster response framework for severe weather events, policies to reduce health effects of increased temperatures, rainfall capture and distribution projects for agriculture and other sectors)
- Adaptation-Based Mitigation (e.g., greenhouse gas emissions reduction/sequestration from REDD+, climate-smart agriculture, improved land use practices activities)

(c) Description and visual tool to illustrate significant gaps in regional climate change activities, including adaptation-based mitigation

6. Opportunities (3-5 pages)

(a) Overall review of potential opportunities for future implementation

(b) Priority sectors and geographic areas

(c) Recommendations for integration

(d) Opportunities for integrated programming and links to activities proposed in USAID/CAM's RDCS concept paper relative to regional security, regional trade, and HIV/AIDS prevalence

7. Appendices

(a) Bibliography

(b) Biodata of team members

(c) List of persons contacted

(d) Visuals and other appendices as appropriate

U.S. Agency for International Development
1300 Pennsylvania Avenue, NW
Washington, DC 20523
Tel: (202) 712-0000
Fax: (202) 216-3524
www.usaid.gov