USAID FROM THE AMERICAN PEOPLE | Monitoring and Evaluation Program

Guatemala Tropical Forest and Biological Diversity Assessment

March 11, 2016

This publication was produced for review by the United States Agency for International Development. It was prepared by DevTech Systems, Inc. under Contract Number AID-520-C-13-00001.

Photo Credit: Watershed of the Rio Pasabien, Sierra de las Minas Biosphere Reserve. B. Byers/ DevTech, 2016

USAID/Guatemala
Monitoring and Evaluation Program

Guatemala Tropical Forests and Biological Diversity Assessment

Submitted to:
Ángel López, COR
USAID/Guatemala

Authors:
Bruce Byers
César Sandoval
María Mercedes Lopez-Selva

Submitted by:
DevTech Systems, Inc.
Contract: AID-520-C-13-00001

March 11, 2016

Table of Contents

List of Figures and Tables

Acknowledgments

More than 50 people, representing a diverse range of environmental actors and stakeholders, from government agencies to farmers in rural communities, gave their time to talk to the Assessment Team and freely shared their knowledge and opinions. During field site visits, the Team witnessed firsthand both the successes and challenges that some of these people face every day. The Team would like to express our deep appreciation to all of these individuals, even though we cannot acknowledge each one by name. We received much information and heard many viewpoints from the people we met, and if in any way we have misunderstood or misrepresented their views, the fault is ours.

We wish to thank Regina Soto and Teresa Robles of USAID/Guatemala, who facilitated our work through their support of communications with USAID's partners and with USAID/Guatemala Mission staff. We thank the CONAP Regional Office in Flores, Petén, which facilitated our visit to Laguna de Tigre National Park, especially Vinicio Morales, Park Director, and Célica Contreras, Community Relations Specialist, and the members of the cocode of the community of Paso Caballos. Thanks are also due to ACOFOP, the Asociación de Comunidades Forestales de Petén, who arranged a visit to the community forestry concession of the Sociedad Civil "El Esfuerzo," and especially to Jorge Soza, Concessions Coordinator at ACOFOP, and Roberto Esau Soza Chi and Sergio Ortiz of El Esfuerzo. We thank Alejandro Chacón and Eduardo Lopez for a tour of the REPSA oil palm plantation and oil production facility in Petén. We appreciate the help of Danilo Saavedra and Edwin Sosa of Defensores de la Naturaleza, who arranged our visit to the Sierra de las Minas Biosphere Reserve, and Andy Burge, who introduced us to the Reserva Los Tarrales.

Abbreviations and Acronyms

ACOFOP	Asociación de Comunidades Forestales de Petén
ANAM	National Association of Municipalities
BANGUAT	Bank of Guatemala
CBD	Convention on Biological Diversity
CECON	Center for Conservation Studies
CIB	Integrated Forest Account
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CONAP	National Council for Protected Areas
CRH	Water Resources Account
FSC	Forest Stewardship Council
FONCC	National Climate Change Fund
IARNA	Institute of Agriculture, Natural Resources and Environment, Landivar University
IDAEH	Institute of Anthropology and History
INAB	National Forestry Institute
INE	Institute of National Statistics
INGUAT	Institute of Guatemalan Tourism
LEDS	Low Emission Development Strategies
MAGA	Ministry of Agriculture, Livestock and Food
MARN	Ministry of Environment and National Resources
OFM	Municipal Forestry Office
PINFOR	Forestry Incentives Program
PINPEP	Incentive Program for Small Landowners with a Forestry and Agroforestry Potential
SEEA	System of Environmental-Economic Accounting
SEINEF	Forest Enterprises Electronic Information System
SIGAP	Guatemalan Protected Areas System
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations Framework Convention on Climate Change
URL	Rafael Landivar University
USAC	University of San Carlos de Guatemala
WCS	Wildlife Conservation Society

This page is intentionally left blank

Executive Summary

Purpose and Methods

The purpose of this task order was to conduct a countrywide Tropical Forests and Biological Diversity Analysis for USAID/Guatemala, as required by amendments to the U. S. Foreign Assistance Act (FAA) of 1961, Sections 118 and 119, which require USAID to identify actions necessary for conserving biological diversity, including forest ecosystems, and the extent to which USAID programs and projects to be designed under its new CDCS could support Guatemala in meeting those needs. This report (1) summarizes the current state of Guatemala's environment, forests, and biological diversity; (2) describes the direct biophysical threats to Guatemala's biodiversity, forests, and environment, and summarizes the causes of those threats; (3) identifies actions needed to reduce or mitigate the causes of those threats; (4) summarizes contributions that USAID/Guatemala programs are currently making in support of some of the actions necessary to conserve forests and biodiversity; and (5) identifies potential future opportunities to support needed actions. USAID/Guatemala last conducted an FAA 118-119 assessment in 2010. The USAID/Guatemala Country Development Cooperation Strategy (CDCS) currently in use by the Mission covers the period FY2012-2016. This CDCS is likely to be extended for one to two years.

Information needed for the analysis was collected by an independent team of consultants contracted by DevTech Systems, Inc., as a buy-in under its USAID Guatemala Monitoring and Evaluation Program (MEP). Our methodology followed the Agency's most recent "best practice" guidelines for conducting FAA 118-119 analyses. The Assessment Team gathered information through a review of relevant documents and web-based information, interviews and meetings with representatives of key stakeholder groups, and field site visits. We talked with more than 50 people representing key stakeholder groups, including national government agencies, international and national NGOs, private sector representatives, staff of organizations implementing USAID projects, and international donors. We also met with USAID/Guatemala staff from various programs. Our information also came from site visits to the Maya Biosphere Reserve, the Sierra de las Minas Biosphere Reserve, and the Reserva Los Tarrales, a private nature reserve.

State of the Biodiversity and Forests

Although it is a relatively small country, Guatemala's topographic and climatic diversity have created a high level of biological diversity in both its ecosystems and species. We provide an overview of Guatemala's biodiversity at the ecosystem and species levels and a brief discussion of genetic diversity within wild species. This section provides context for understanding the ways humans use and value ecosystems and the threats to biodiversity and forests in Guatemala. About 40% of Guatemala currently supports natural vegetation and ecosystems, with the rest of the landscape dominated by a mix of human uses, mainly pastures and annual and perennial agriculture. We present a topographic and climatic approach to categorizing Guatemala's ecosystems, which we use later to discuss their contributions to ecosystem benefits, especially the ecosystem products and services that are most relevant to Guatemala's economic and social development and resilience to climate change.

Values and Economics of Biodiversity

Biological diversity provides social and economic benefits of three distinct kinds: ecosystem products, ecosystem services, and nonmaterial benefits. In Guatemala, timber and fuelwood are the most valuable forest ecosystem products in monetary terms. Almost 70% of Guatemalan households use wood for cooking and heating, and approximately 70% of the primary energy use in the country is from wood. High-value timber from species such as mahogany, cedro, and

rosul is mostly exported, earning around US $7.6 million per year. Non-timber forest products harvested from natural forests are an important source of income in some communities in Guatemala. Commercial and artisanal fisheries based on wild species contribute significantly to the economy and to food security. Ecosystem services are best defined as the benefits to humans that result from ecosystem functions and processes. Pollination by wild species, mainly bees, is thought to increase yields in Guatemala's coffee sector by 10-20%, representing a significant economic value, for example. Guatemala's forests play a large and valuable role in protecting soils from erosion, contributing to the ecohydrological services of water capture and regulation in watersheds, and providing protection from landslides on steep slopes.

Threats to Biodiversity and Tropical Forests

In this assessment we have used the "threats-based approach" that guides USAID's biodiversity programming as the conceptual framework for our analysis. As presented in Chapter 4, we first identified the direct, biophysical threats to forests and biodiversity in Guatemala, and their immediate and deeper causes or "drivers." The most important direct threat to forests ecosystems in Guatemala, according to our key informants, is habitat loss and degradation. Major causes of this are forest clearing for livestock ranching and for oil palm plantations, and fires started by agricultural burning. Climate change is a potential threat of unknown magnitude, which may accentuate other direct threats, especially habitat loss and degradation. The second-largest category of perceived threats was "overexploitation or overharvesting of particular species," and the third-largest category was pollution or contamination. One important point about these threats is that they differ significantly from place to place and ecosystem to ecosystem. Although these direct threats have diverse and often multiple causes, important categories of drivers are rapid population growth, poverty, economic inequality, lack of livelihood and economic opportunities, and weak governance structures and institutions. We discuss Guatemala's policies, laws, and institutions in with roles in forest and biodiversity conservation and management in Chapter 5. We also summarize the national system of protected areas in that chapter.

Actions Needed to Conserve Forests and Biodiversity

FAA Sections 118 and 119 call for assessments to identify the actions necessary to conserve tropical forests and biological diversity, respectively. To better understand these necessary actions, we analyzed the content of our interviews with key informants, and compiled a list of 157 actions that they suggested were needed. Some of those were mentioned multiple times, by different stakeholders, and we categorized those by as general topic or theme. The proposed "actions necessary" fit into the following ten themes:

1. Create needed policies, laws, strategies, and plans
2. Reform and strengthen institutions with forest and biodiversity responsibilities
3. Stop illegal activities that threaten forests and biodiversity
4. Support community organization, empowerment, and capacity (e.g., community forest concessions)
5. Strengthen climate change resilience through adaptation and mitigation actions
6. Emphasize water as an integrating ecosystem service
7. Provide economic options for the rural poor who depend on natural resources
8. Generate and disseminate scientific information needed for environmental decision-making
9. Fund government institutions with environmental responsibilities at the levels needed
10. Reduce fertility rates and population growth through appropriate initiatives in the health and education sectors

Climate Change Resilience and Adaptation

Climate models of the Intergovernmental Panel on Climate Change (IPCC) predict a warming and drying climate in Guatemala during this century. The IPCC models predict increased temperatures of around +2° C by 2050, and a predicted 10-20 percent decrease in precipitation during the April-September period by mid-century (2046-2065) for eastern Guatemala, and for more of the country by late-century (2081-2100). Guatemala's climate is complex, in part due to the topography of the country, which creates striking differences in precipitation on the windward and leeward sides of mountain ranges, for example in the Sierra de las Minas. This reduces the confidence with which regional projections of climate can be applied at smaller spatial scales within the country. Nevertheless, it is highly likely that Guatemala will face a significantly drier and warmer climate during the coming decades of the century.

The predicted changes in temperature and precipitation in Guatemala would represent a significant shift the climates found at various elevations throughout the country, and would affect species and ecosystems. For example, areas suitable for montane broadleaf forests and cloud forests, which require cooler, wetter conditions, would decrease with warming and drying at higher elevations. Areas with climates suitable for dry forests would increase, as the climate zones they inhabit expand upward in elevation in a warmer, drier climate. These predicted changes would affect ecological functioning, and therefore affect the products and services that ecosystems provide.

Because of the importance of ecosystem products and services to livelihoods and the economy in Guatemala, an ecosystem-based approach to climate change resilience and adaptation is needed. Protecting the ecosystems that provide the eco-hydrological services in watersheds is especially critical, given the likelihood that water supplies will be an increasing challenge in a warming and drying climate.

USAID/Guatemala Contributions to Actions Necessary

The language of FAA Sections 118 and 119 require that after we have identified the actions necessary for conserving tropical forests and biodiversity in Guatemala, we then examine "the extent to which the actions proposed for support by the Agency meet the needs thus identified." We have been told by the Mission that the current CDCS will be extended by one or more years, because of the new administration in Guatemala, and the upcoming U.S. presidential election. Because the development of a new CDCS to replace the current 2012-2016 CDCS is at an early stage, we compared current USAID programs with the actions needed for sustainably managing Guatemala's forests and biodiversity that were presented in Chapter 7.

One of the three Development Objectives in the USAID/Guatemala 2012-2016 CDCS, DO 3, is "Improved Management of Natural Resources to Mitigate Impacts of Global Climate Change." In order to achieve DO 3, USAID/Guatemala is supporting two main projects. The Climate, Nature and Communities in Guatemala (CNCG) Program (2013-2018) and the Low Emissions Development Project (2014-2019). In addition to these main USAID/Guatemala programs, USAID and the U.S. Government are also providing forest- and biodiversity-relevant assistance through the U.S. Forest Service International Programs Office, U.S. Department of the Interior International Technical Assistance Program, and funding through a Tropical Forest Conservation Act (TFCA) debt-for-nature-swap fund. When activities being implemented in support of the Intermediate and Sub-Intermediate Results of DO 3 are mapped against the list of themes for "actions needed" that we developed, it is clear that USAID/Guatemala is currently making contributions through its programs to many of the actions needed to conserve Guatemala's forests and biodiversity.

Opportunities for USAID/Guatemala

Although USAID/Guatemala is currently contributing to meeting some of the actions needed for conserving forests and biodiversity, the list is long and the challenges are difficult and ongoing. This assessment identified thematic and geographic gaps where USAID and other international donors could catalyze needed changes in the natural resources and conservation "landscape" in Guatemala. These general categories of strategic "actions necessary" represent future opportunities for USAID, and the Assessment Team recommends that they be considered when USAID/Guatemala is developing its new CDCS. Because this assessment is being conducted as USAID/Guatemala is extending its current CDCS, detailed recommendations would be premature at this time, but we call attention to four strategic opportunities.

Emphasize Governance and Institutional Capacity

As discussed in Chapter 6 of this report, our key informants emphasized the need for improved governance of natural resources. Among the 157 suggestions for "actions needed" made by these experts and stakeholders, 60% related to governance and institutional capacity. This can be interpreted as strong evidence that there is much work to be done, and that improving governance and strengthening institutional capacity therefore represents a large opportunity for USAID and other international donors to assist Guatemala with its main challenge to environmentally and socially sustainable development. Donors like USAID have several avenues for doing this in their programs. They can support civil society NGOs and private sector associations that can advocate for reform and strengthening of government agencies. Donors can also use diplomatic channels to influence the Government of Guatemala, or conditionality linked to their aid programs to encourage or catalyze needed change in GoG institutions.

Integrate Biodiversity Conservation, Economic Development, and Climate Resilience at a Watershed Scale

In various programs and projects, USAID/Guatemala has moved toward programmatic integration, including in the WHIP, CNCG, and LEDS programs. Our key informants are encouraged by this, but many feel that much more could be done. Through a new Executive Order on "Climate-Resilient International Development" (USAID, 2015) and an Executive Memorandum on "Incorporating Ecosystem Services into Federal Decision Making" (Executive Office of the President, 2015), President Obama has set the stage for integrating climate change and biodiversity conservation in USAID programs. Along with the USAID Climate Change and Development Strategy (USAID, 2012) and USAID Biodiversity Policy (USAID, 2014), these executive directives point USAID strongly in the direction of taking an ***integrated, ecosystem-based approach*** to resilient and sustainable social and economic development. All of these USAID guidance documents and Executive Branch initiatives just cited have been developed since USAID/Guatemala's current CDCS was developed. USAID/Guatemala therefore has an excellent opportunity to take the lessons it has already learned about integration and ecosystem-based approaches to climate change adaptation and mitigation, and use them to integrate their programs even more deeply in the next CDCS.

In Chapter 2 we introduced a topographic perspective on Guatemala's ecoregions, organizing them into five categories that share similar elevational, topographic, and climatic features, and which in turn lead to structural and functional ecological similarities. Each of these five forest ecosystem types makes unique and irreplaceable contributions to ecosystem benefits, and each is facing certain unique kinds of threats. The ecological processes and functions of these five ecosystem types are linked through the ecohydrological processes taking place in watersheds. USAID/Guatemala has an opportunity to use water as the concept for integrating forest and biodiversity conservation, agriculture, economic development, health and sanitation, and climate

change adaptation and mitigation. Using a watershed perspective in planning and management automatically creates a platform for integration of ecological and social systems.

Expand the Geographic Focus of Forest and Biodiversity Investments

Studies suggest that the watersheds of the Pacific Slope have a high potential for water conflicts due to the balance in water supply versus water demand by users of various kinds, and that they are in especially critical need of attention and action. Those watersheds, starting in the high-elevation forests of the Volcanic Chain, and draining steeply to the Pacific plain and coastal mangrove zone, represent prime opportunities for applying an ecosystem-based, watershed-scale approach to biodiversity conservation and climate-resilient development under a future CDCS. In the Western Highlands and Sierra de las Minas, geographic "top-of-watershed" areas where USAID is currently working, the Mission could strengthen the integration of its programs in its new CDCS by deliberate use of an ecosystem-based approach to climate resilience and a watershed focus.

Generate Information to Catalyze Change

Many of our key informants told us about the need for actions to catalyze change in environmental management in Guatemala. Information can often be catalytic. Many kinds of information could potentially inform, if not catalyze, actions needed. There are already examples in Guatemala of how information about hydrology and ecohydrology can inform environmental management, but there is a need for much more decision-relevant, action-oriented applied research. In the area of forest management, one clear need is for better understanding and application of the principles of fire ecology in the fire-prone, and fire tolerant, pine and pine-oak forests, where both too much and too little fire are threats. The pine bark beetle (*gorjojo de pino*) in Guatemala is another example of an issue where accurate and updated ecological information is needed in order to develop prescriptions for managing forest areas in which it is found.

1. Introduction

1.1 Purpose

The purpose of this task order was to conduct a countrywide Tropical Forests and Biological Diversity Analysis for USAID/Guatemala, as required by amendments to the U. S. Foreign Assistance Act (FAA) of 1961, Sections 118 and 119, which require USAID to identify actions necessary for conserving biological diversity, including forest ecosystems, and the extent to which USAID programs and projects to be designed under its new CDCS could support Guatemala in meeting those needs. The main objectives of the assessment were to assist USAID/Guatemala to better integrate environment and conservation considerations in its new CDCS by providing:

- Foreign Assistance Act (FAA) Sections 118-119 compliance ("comply with the law");
- recommendations for linkages and synergies with Mission Development Objectives ("do good if possible"); and
- advance warning of any potential issues with environmental impacts of anticipated programs to avoid future compliance problems ("do no harm").

The Tropical Forests and Biodiversity report (1) summarizes the current state of Guatemala's environment, forests, and biological diversity; (2) describes the direct biophysical threats to Guatemala's biodiversity, forests, and environment, and summarizes the causes of those threats; (3) identifies actions needed to reduce or mitigate the causes of those threats; (4) summarizes contributions that USAID/Guatemala programs are currently making in support of some of the actions necessary to conserve forests and biodiversity; and (5) identifies potential future opportunities to support needed actions.

USAID missions benefit from taking FAA 118-119 assessments seriously because these assessments can help to:

- Fulfill the legal requirements of Section 118 and Section 119 of the FAA;
- Identify potential opportunities for USAID missions to contribute to sustainable development by integrating forest and biodiversity conservation throughout its Country Development Cooperation Strategy;
- Save time and money by giving a USAID mission a "heads up" about possible environmental compliance problems they would face later if they develop a strategy that involves activities that might either directly or indirectly threaten biodiversity, tropical forests, or the environment.

USAID/Guatemala last conducted an FAA 118-119 assessment in 2010 (USAID/Guatemala, 2010), which updated the previous FAA 118-119 assessment that was completed in 2003 (USAID/Guatemala, 2003). The USAID/Guatemala Country Development Cooperation Strategy (CDCS) currently in use by the Mission covers the period FY2012-2016. This CDCS is likely to be extended for one to two years, but planning for the development of a new CDCS is beginning.

It should be noted that although FAA 118-119 assessments are supposed to identify contributions to actions necessary for conserving tropical forests, biodiversity, and the environment that could be made by USAID missions, and to make related recommendations, they are not intended as project or program design documents, and cannot provide the detailed information and analysis needed for sound project design. FAA 118-119 assessments can only

identify opportunities for future programming and suggest where further information may be needed for program or project design.

1.2 Methods

Information needed to meet the above objectives was collected by an independent team of consultants (see Annex B: Biographical Sketches of Assessment Team) contracted by DevTech Systems, Inc., as a task order under its Guatemala Monitoring and Evaluation Project (MEP). The process of information-gathering and analysis followed USAID guidance on a threats-based approach to biodiversity conservation described in *USAID Biodiversity Policy* (USAID, 2014) and *Biodiversity Conservation: A Guide for USAID Staff and Partners* (USAID, 2005a). Our methodology followed the Agency's most recent "best practice" guidelines from *Tropical Forestry and Biodiversity (FAA 118-119) Analyses: Lessons Learned and Best Practices from Recent USAID Experience* (USAID, 2005b). This report provides, to the extent possible, all of the information requested in the assessment Statement of Work (SOW) (see Annex A).

Information was gathered from several sources, and information from one source was validated by, and supplemented with, information from other sources. Sources included the following:

- Review of relevant documents, including the previous USAID/Guatemala FAA 118-119 Assessments of 2003 and 2010; Guatemala's *2014 Fifth National Report to the Convention on Biological Diversity*, and 2011 *National Biodiversity Strategy and Action Plan*; other Government of Guatemala (GoG) documents; donor project documents; reports in the scientific literature; and web-based reports;
- Interviews and meetings with more than 50 people representing key stakeholder groups (see Annex C: Institutions and Persons Contacted), including national government agencies, international and national NGOs, private sector representatives, staff of organizations implementing USAID projects, and international donors;
- Meetings with USAID/Guatemala Development Objectives (DOs) offices; and
- Site visits in Petén to the Maya Biosphere Reserve, including the buffer zone and Laguna de Tigre National Park, the community forest concession of Sociedad Civil "El Esfuerzo," and the REPSA African oil palm plantation and processing plant, The Sierra de las Minas Biosphere Reserve; and the Reserva Los Tarrales, a private nature reserve in Suchitepéquez.

The Assessment Team analyzed the content of its notes from interviews with key informants, and developed a list of the actions necessary for environmental, forest, and biodiversity conservation that they proposed. These proposed actions needed then were organized by theme in order to assess the general types of actions perceived to be most important. All information gathered by the Team was analyzed to identify the extent to which current and future USAID programs could contribute to the needed actions, and to make appropriate recommendations to the Mission about opportunities for mainstreaming biodiversity conservation in its development portfolio, as called for by the Agency's 2014 Biodiversity Policy (USAID, 2014).

2. State of the Biodiversity and Forests in Guatemala

The modern concept of biodiversity encompasses the variety and variability of life at three levels of organization: ecosystems, species, and genes. This section provides an overview of Guatemala's biodiversity at the ecosystem and species levels, and a brief discussion of genetic diversity with wild species. We also discuss agro-biodiversity, the diversity of species and genetic varieties that make up agricultural ecosystems. This section provides context for understanding threats to biodiversity and forests in Guatemala, and actions needed to address them, topics which are discussed in detail in later sections.

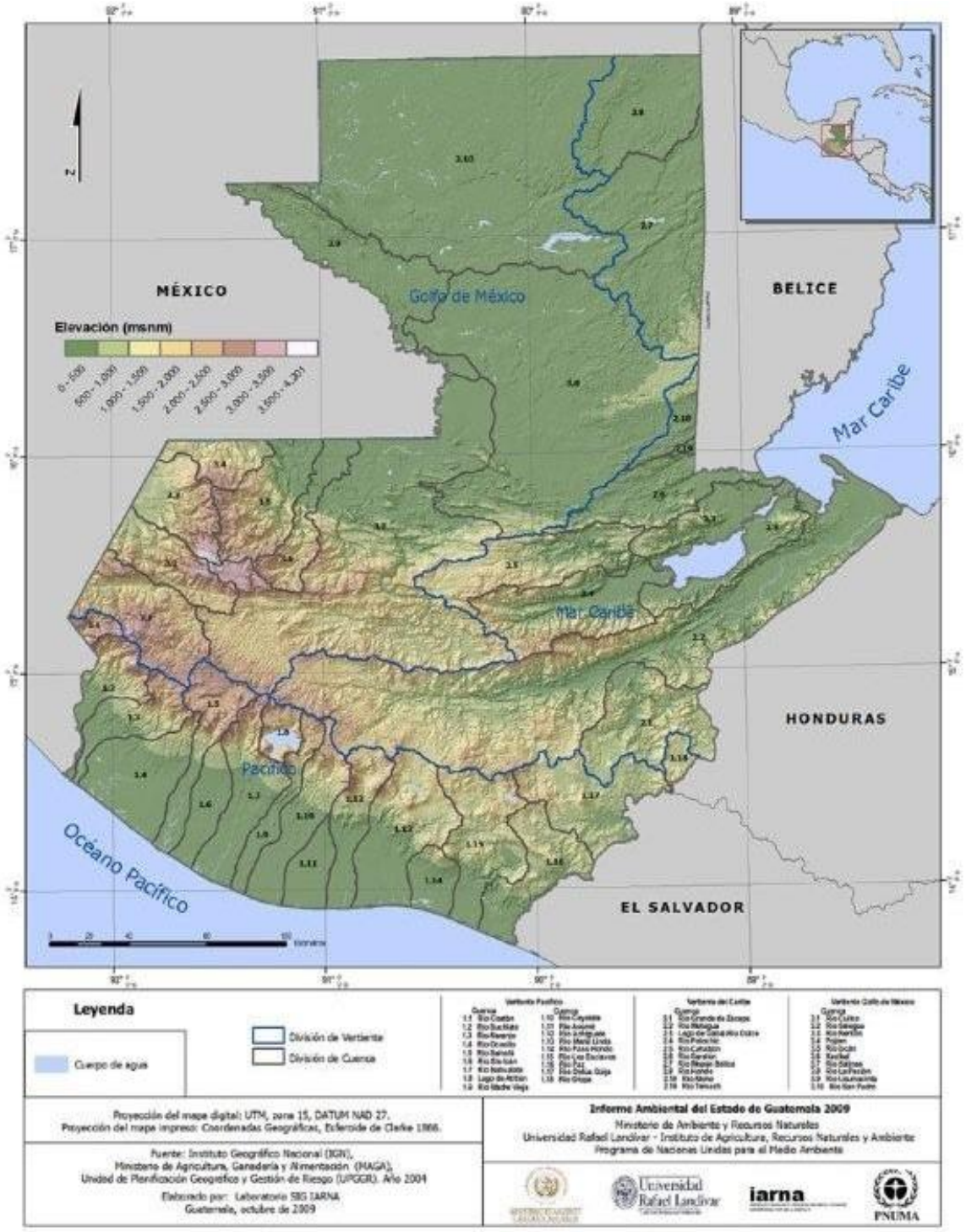
2.1 Biophysical Setting

Guatemala is a Central American country with a land area of about 108,900 km^2, about the size of Cuba or Iceland, or the U.S. state of Pennsylvania. It lies in the tropics between approximately 13°50' and 17°50' north latitude and 88°10' and 92°10' west longitude. It shares borders with Mexico, Belize, Honduras, and El Salvador. Although the average elevation of the country is only around 750 meters above sea level because of its vast limestone lowlands in the northern part of the country, much of the country is mountainous. Guatemala lies on the eastern tectonic plate boundary of the Pacific Ocean, making it part of the Pacific Rim of Fire, and many of its mountains are volcanic in origin. Its 37 volcanoes include the highest peak in Central America, Volcán Tajumulco (4,211 m). The chain of volcanoes, or "*cadena volcánica*," also called the Sierra Madre de Chiapas, extends across southern Guatemala from Mexico in an east-southeast direction toward El Salvador and Honduras.

The country's climate is complex because of the topographic diversity, with mountains intercepting moisture-bearing winds from the Caribbean and creating areas of extremely high precipitation on the windward sides, and dry "rain shadow" areas on the leeward sides of the mountains, modified by the high altitudes in mountains and volcano peaks and the two adjacent seas that carry winds and clouds filled with moisture. The average temperature is 24 °C, but ranges from below freezing at high elevations to more than 40 degrees C. Average annual precipitation is 1,996 mm per year for the country as a whole, but ranges from 500 mm to 6,000 mm per year. Most rainfall occurs in the wet season from approximately May to October, with a pronounced dry season from November to April.

Guatemala has 38 major river basins, which drain in three directions (Fig. 2.1). Eighteen steep watersheds flow south from the volcanic chain to the Pacific Coast, draining 22% of the area of the country and carrying approximately 15% of the total water flow from Guatemala. Ten rivers, whose watersheds cover approximately 31% of the country and carry about 23% of the water, flow east to the Caribbean Sea. Ten major watersheds originating in the mountains of the southern half of the country flow north toward the Gulf of Mexico, covering around 47% of the country and carrying 62% of the total flow. (IARNA, 2005).

Figure 2.1: Watersheds of Guatemala



Source: MARN, 2009

2.2 *Ecosystems*

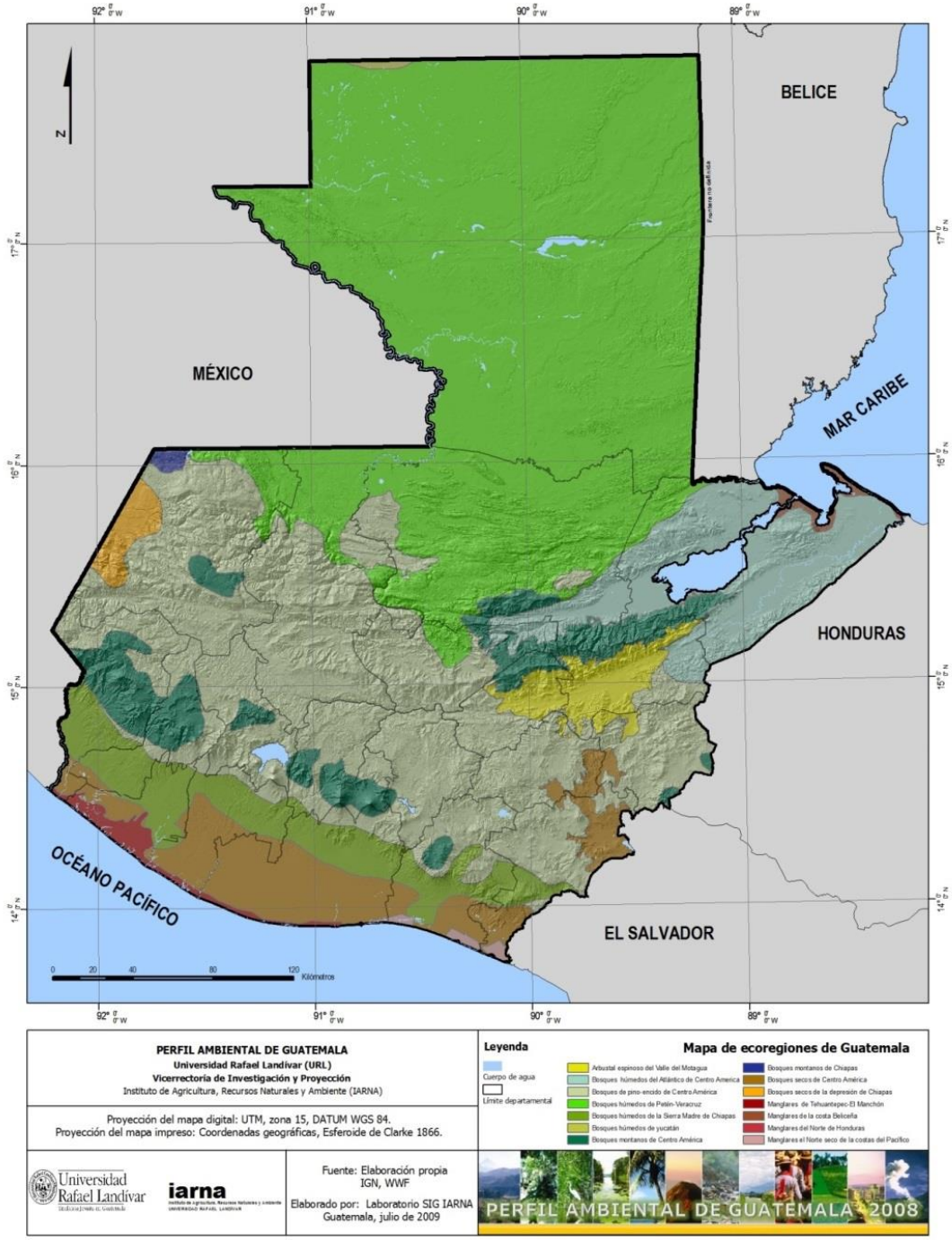
Although it is a relatively small country, Guatemala's topographic diversity has created a high level of biological diversity in both its ecosystems and species.

2.2.1 Terrestrial Ecosystems

A study and map by WWF of Terrestrial Ecoregions of the World published in 2001 (Olson *et al*., 2001) has often been used as the basis for describing and discussing the diversity of Guatemala's ecosystems. Figure 2.2 is a map of the potential natural vegetation of Guatemala categorized into 14 ecoregions according to Olson *et al*. 2001. This WWF ecoregions study categorized the potential natural vegetation of Guatemala into 14 "ecoregions," The study was based on a conservation biology perspective common in the late 1990s that focused primarily on species diversity, richness, and endemism, and the ecoregions are based mainly on species composition and biogeographical relationships, rather than their structural or functional ecological characteristics. The approach is generally fine-grained – that is, tending to split vegetation types into more categories, rather than lump them into fewer.

Thorn scrub (*monte espinoso*) ecoregion in the Motagua Valley, lower watershed of the Río Teculután, Zacapa. Photo: B. Byers/DevTech, February 2016.

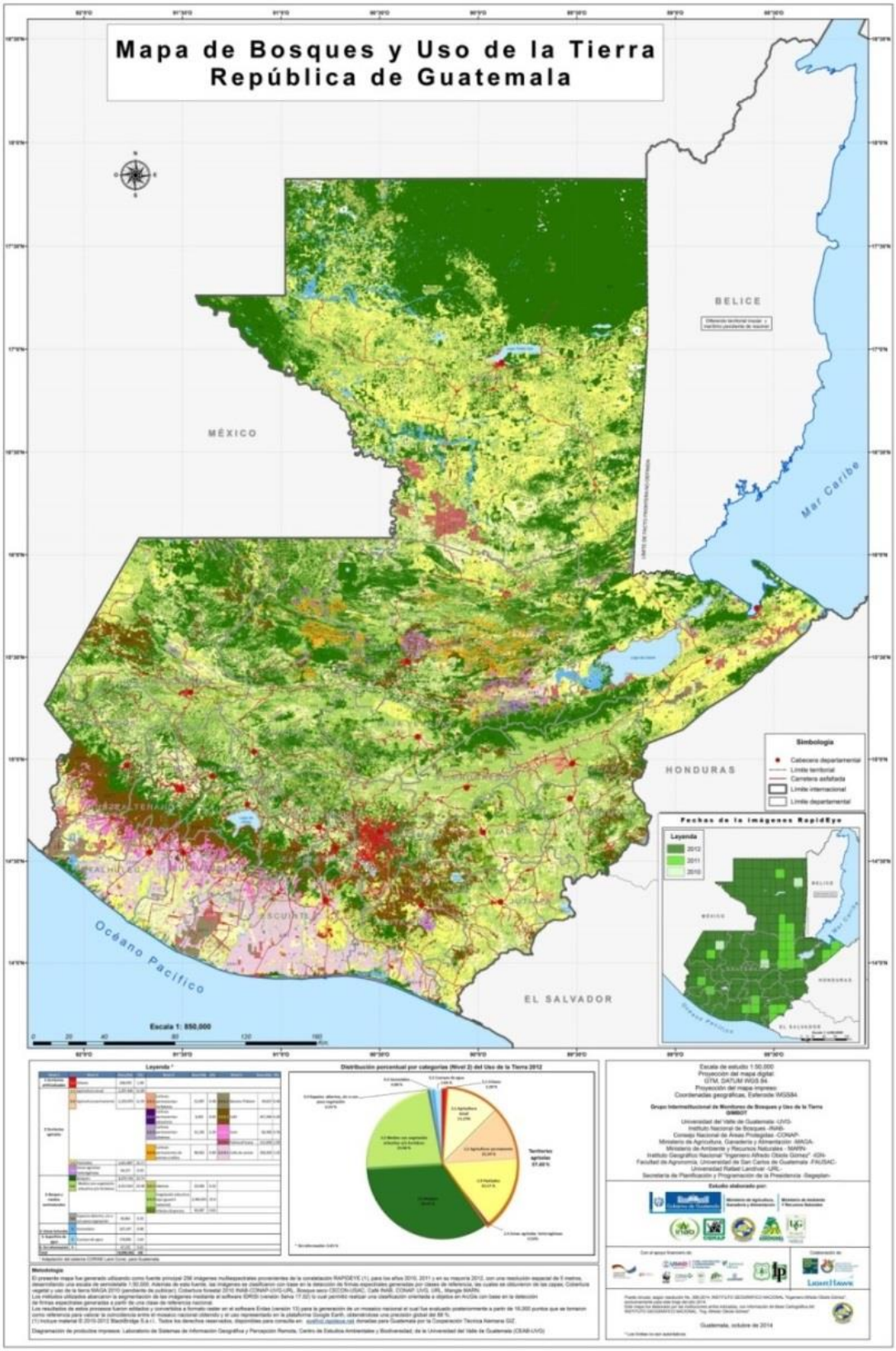
Figure 2.2: Potential Natural Vegetation by Ecoregion



Source: IARNA, 2008, based on Olson *et al.*, 2001.

In Guatemala, as everywhere, large areas of natural ecosystems have been converted to human-managed agricultural ecosystems. The most recent map of actual land cover and land use was produced in 2014 (Fig. 2.3) from images mostly taken in 2012 using the RAPIDEYE system at 5-meter spatial resolution (GIMBUT, 2014). The breakdown of land cover by category is given in Table 2.1.

Figure 2.3: Forests and Land Use



Source: GIMBUT, 2014

Table 2.1: Land Cover/Land Use

Land Cover/Land Use	Percent of total area
Forest	34.7
Shrubs or herbaceous vegetation	23.5
Pasture	15.2
Permanent agriculture (coffee, fruit trees, etc.)	11.3
Annual agriculture	11.2
Lakes and wetlands	2.6
Urban areas and other	1.5
Total	100.0

Source: GIMBUT, 2014

In contrast to the fine-grained, species-focused approach that is reflected in WWF ecoregions (Olson *et al*., 2001), national forest planning by the U.S. Forest Service over that past two decades has tended toward more of a course-filter approach for conservation planning at a large, landscape-scale. Such an approach was used in developing the landmark Northwest Forest Plan, for example (Thomas et al., 2005; Franklin, 1993). Franklin (1993) argued that "larger-scale approaches – at the levels of ecosystems and landscapes – are the only way to conserve the overwhelming mass – millions of species – of existing biodiversity," and Thomas et al. (2005) stated that "… we generally advocate a course-filter approach in which we rely on ecosystem diversity to provide for maintenance of species diversity."

For the purposes of this 2016 analysis of tropical forests and biodiversity in Guatemala we have attempted to apply a more coarse-filter approach to the ecoregions data. We have organized the list of 14 ecoregions into five categories that share similar elevational, topographic, and climatic features, and which in turn lead to structural and functional ecological similarities: 1) montane humid broadleaf forests (e.g. cloud forests); 2) pine and pine-oak forests; 3) humid broadleaf forests; 4) dry deciduous forests and thorn scrub; and 5) mangroves. Each of these five forest ecosystem types makes unique and irreplaceable contributions to ecosystem benefits, especially the ecosystem products and services that are most relevant to Guatemala's economic and social development, and resilience to climate change. This topic will be discussed in more detail in Chapter 3. Each of these five forest ecosystem types also is facing certain unique kinds of threats, a subject to be discussed in Chapter 5.

Table 2.2 gives the areas of potential natural vegetation by forest ecosystem type and by ecoregion. The actual area of the remaining natural vegetation of each ecoregion, as interpreted from the 2014 land cover/land use map of Guatemala (GIMBOT, 2014), is also given in this table. The table shows that in general dry forests and mangrove forests have been lost to a greater degree than the other three forest types. Looking at details, however, it is apparent that Chiapas montane forests, and Sierra Madre of Chiapas humid forests have been converted to a greater degree than some of the other humid forest types; that Central American dry forests have been decimated; and that Pacific Coast mangroves have been lost to a much greater degree than Caribbean mangroves.

Table 2.2: Change in Potential Natural Vegetation by Ecosystem Type and Ecoregion

Ecosystem Type	**Ecoregion** (Olson et al. 2001)	**Area of Potential Natural Vegetation (ha)** (Olson et al. 2001)	**Area of actual vegetation in 2012 (ha)** (IARNA 2016)	**Remaining area of PNV in 2012 (%)** (IARNA 2016)
Montane humid broadleaf forests (e.g. cloud forest)	Central American Montane Forests	593,900	285,200	48.0
	Chiapas Montane Forests	18,700	5,200	28.1
Total *		**612,600**	**290,400**	**47.4**
Pine and pine-oak forests	Central American Pine-Oak Forests	2,933,500	1,153,000	39.3
Total *		**2,933,500**	**1,153,000**	**39.3**
Humid broadleaf forests	Central American Atlantic Humid Forest	774,500	235,200	30.4
	Petén-Veracruz Humid Forests	4,773,700	2,231,100	46.7
	Sierra Madre of Chiapas Humid Forests	573,200	107,200	18.7
	Yucatan Humid Forests	12,100	8,400	69.6
Total *		**6,133,500**	**2, 581,900**	**42.1**
Dry deciduous forest and thorn scrub	Central American Dry Forests	660,700	76,300	11.5
	Chiapas Depression Dry Forests	89,600	23,400	26.1
	Motagua Valley Thornshrub	232,800	129,000	55.4
Total *		**983,100**	**228,700**	**23.3**
Mangroves	Mangroves of the Belizean Coast	35,100	20,200	57.5
	Mangroves of the Dry Forests of the Pacific Coast	26,100	3,700	14.2
	Tehuantepec-El Manchon Mangroves	87,300	13,600	15.6
	Northern Honduras Mangroves	1,900	200	10.5
Total *	**140,000**	**150,400**	**37,700**	**25.1**
Total Guatemala *		10,813,100	4,291,700	39.7

***** calculated for this 2016 USAID/Guatemala FAA 118-119 analysis by IARNA using the 2014 land cover/land use source map (GIMBUT, 2014)

2.2.2 Freshwater Ecosystems

Freshwater ecosystems include streams, rivers, inland wetlands, and lakes, which according to the most recent land cover map (GIMBUT, 2014) cover an area of around 283,000 hectares, or 2.6% of the country. Threats to freshwater ecosystems, including pollution and overharvesting of fish and other freshwater species, will be discussed in Chapter 5.

2.2.3 Coastal and Marine Ecosystems

Guatemala has 255 km of coastline on the Pacific Ocean and 148 km of coastline on the Caribbean Sea. On the Pacific Coast, mangrove forest still stands in the areas of Manchón-Guamuchal, Monterrico-Hawaii and La Barrona-Las Lisas. Within the Sipacate-Naranjo National Park , the Poza del Nance is an estuary were sea turtles feed and rest throughout the year, said to be one of only two places worldwide where this occurs.

Coastal and marine ecosystems of the Caribbean Coast include mangrove forests, estuaries, sandy beaches, and coral reefs and seagrass beds. Like terrestrial ecosystems, coastal and marine ecosystems make important contributions to the ecosystem products and services that contribute to Guatemala's economic and social development and resilience to climate change, a topic to be discussed further in Chapter 3. Coastal and marine ecosystems face their own kinds of threats, as will be discussed in Chapter 5.

2.3 Species

The diverse coastal, marine, freshwater, and terrestrial ecosystems of Guatemala support an exceptional number of species. The latest data on species and taxonomic diversity in Guatemala is summarized in Table 2.3 (CONAP, 2013).

Table 2.3: Species and Taxonomic Diversity of Guatemala

Taxon		Families	Genus	Species
Protista		10	14	20
Fungi				324
Bryophytes				514
Vascular plants		352	2,344	11,350
Invertebrate Fauna		*156*	*1,334*	*3,601*
	Mollusca	69	133	123
	Arachnida	12	49	87
	Hymenoptera	6	141	407
	Siphonaptera	6	13	26
	Hemiptera	1	12	39
	Odonata	15	72	213
	Diptera	1	15	40
	Lepidoptera	8	554	1561
	Coleoptera	38	345	1105
Vertebrate Fauna		*284*	*1158*	*2524*
	Fish	156	473	1061
	Amphibia	12	36	164
	Reptilia	28	110	273
	Birds	85	402	780
	Mammalia	3	137	246

Source: CONAP, 2013

The Orchidaceae family is the most diverse plant family in Guatemala, with 819 described species and probably more undescribed ones. Alta Verapaz and Baja Verapaz are the departments with the highest recorded orchid diversity, and together have 60% of the species that have been described (Dix and Dix, 2006). Forty-one orchid species are endemic to Guatemala.

The greatest diversity of fauna is found in the mountains of Sierra del Lacandón, Sierra de Chamá, Sierra de Santa Cruz and part of the Mayan Mountains (Méndez, 2008). Guatemala is the world center of diversity of lungless salamanders of the family Plethodontidae, with 41 species, 19 of which are endemic.

Guatemala's mountainous topography has provided refugia for both plant and animals species during changing climates over long evolutionary time periods, generating relatively high levels of endemic species. 832 species of plants are regionally endemic, and 538 are endemic to Guatemala. Mountain areas, including Sierra de las Minas, Sierra de los Cuchumatanes, Montaña de Xalapán, Cerro San Gil- Sierra Santa Cruz, Trifinio, and the Arco Húmedo del Norte (from Izabal to Huehuetenango), have the most endemic plants, but the thorn scrub (*monte espinoso*) ecoregion also has its share of endemic plants (Véliz, 2008).

CONAP publishes and updates the national list of threatened and endangered species, the *Lista de Especies Amenazadas de Flora y Fauna de Guatemala*, or LEA as it is known. The most recent LEA (CONAP, 2009) includes 2,343 species. Table 2.4 shows

Table 2.4: Endangered Species by Taxon

Taxon	Number
Fungi	22
Ferns	31
Gymnosperms (conifers)	18
Angiosperms (flowering plants)	1522
Mollusks	3
Arthropods	138
Freshwater fish	29
Marine fish	2
Amphibians	93
Reptiles	160
Birds	194
Mammals	73

Source: CONAP, 2013

The plant family with the most number of species included in the Guatemalan *Lista de Especies Amenazadas* (LEA) is the family Orchidaceae, which makes up the vast majority of the listed plants. The list includes 12 species of conifers and 238 species of flowering trees that are threatened or endangered because of their high-value timber. For animals, the LEA includes all five species of cats, three species of monkeys and five species of sea turtles. Birds such as the harpy eagle, horned guan, and resplendent quetzal are considered endangered and can only be seen rarely in isolated forest fragments.

The term "landscape" species has been used by ecologists and conservationists to refer to species that move widely and thus link widely-separated features of an ecosystem. Marine turtles would be an example. The term "flagship" species has generally been used by conservationists for charismatic species, such as the scarlet macaw or jaguar, which serve as the "mascot" for wider conservation campaigns. Flagship species that could potentially be used to protect large marine habitats in Guatemala are humpback whales (*Megaptera novaeangliae*) and Bryde's whales (*Balaenoptera edeni*), large fish such as sailfish (*Istiophorus platypterus*) and blue marlin (*Makaira mazara*), and marine turtles.

2.4 Genetic Diversity

Genetic diversity within a single species is always present, and it allows species to tolerate a range of environments and adapt to environmental changes over evolutionary time. Such intra-specific genetic diversity is often reflected in partial genetic differentiation of populations throughout the range of a species. Subspecies of a single species are one example of this. Population genetic studies are often needed to reveal such underlying genetic diversity. To

conserve biodiversity, especially in the face of possible environmental changes such as those likely to occur due to global warming, it is important to conserve the full array of genetic diversity within a species. This will provide the species with the genetic diversity necessary to survive, adapt, and evolve.

Guatemala is part of the Central American land bridge, where flora and fauna from North America, the Nearctic biogeographical realm, and South America, the Neotropics, came together. It is a place where many species of plants and animals are at the edges of their biogeographic ranges. One example is *Acer saccharum skutchii*, the cloud forest sugar maple, found in the Sierra de las Minas (Vargas-Rodríguez, 2005; 2010). This is a subspecies of the North American sugar maple, which can be found to about 50º N latitude in southeastern Canada, the sap of which is valuable for making maple syrup.

Other northern hemisphere tree species found at the southern edge of their ranges in Guatemala are *Taxus globosa*, Mexican yew; *Acer negundo*, box elder; and ten species of pines, *Pinus* spp.. *Abies guatemalensis*, the Guatemalan fir, is an edemic species of a widely distributed North American genus. Southern hemisphere species or genera found in Guatemala at the northern limit of their ranges include *Podocarpus guatemalensis*, *P. matudae* and *P. oleifolius*. Among the birds, the harpy eagle and the scarlet macaw can only be found from Guatemala and further south.

The populations of these species, at the southern or northern edges of their biogeographic ranges, undoubtedly contain unique genes that have evolved, in their Guatemalan environments, and which may enable the species to adapt to new conditions resulting from global climate change. Conserving populations of these species in Guatemala is very important.

Cloud forest sugar maple (*Acer saccharum skutchii*), upper watershed of the Río Teculután, Zacapa. Photo: B. Byers/DevTech, February 2016.

The beaded lizard, *Heloderma horridum*, one of only four species of venomous lizards in the world, was thought to be distributed in Guatemala and southern Mexico. The population found in

Guatemala has now been classified as a different species, *Heloderma charlesbogerti*, making it now an endemic to the dry forests of the Motagua Valley. Other species that are endemic to the area are cacti such as *Pachycereus lepidanthus*, *Myrtillocactus eichlamii* and *M. schenkii*, all three with very restricted distributions.

2.5 Agro-biodiversity

Agro-biodiversity can be defined as the diversity of cultivated plants and livestock species and their genetically distinct varieties, as well as wild and semi-domesticated food and medicinal plants. Mexico and Central America is considered one of eight worldwide centers of origin of domesticated plants. This region is thought to be the area where maize (*Zea mays L*), teocintle (*Euchlaena mexicana*), beans (*Phaseolus vulgaris*), lima beans (*Phaseolus acutifolius*), papaya (*Papaya carica*), vanilla (*Vanilla planifolia*) and guisquil (*Sechium edule*) originated. Wild relatives of the two latter species can be found. Agricultural statistics show that about 130 species are cultivated in Guatemala, about one-third of which are traditional crops. Maize and beans are the two most important of these (IARNA/URL, 2014). Other important agro-biodiversity in the country includes varieties of cocoa, squashes, avocado and yuca.

3.0 Values and Economics of Biodiversity

Biological diversity provides social and economic benefits of three distinct kinds: ecosystem products, ecosystem services, and nonmaterial benefits (USAID, 2005a; 2014). This section will highlight the most important of these benefits in Guatemala. Table 3.1 lists some of the most important ecosystem services and products produced by Guatemala's terrestrial ecosystems. The course-filter aggregation of Guatemala's 14 ecoregions that was explained in Chapter 2 (Table 2.2) has been used again in this table.

Table 3.1: Ecosystem Products and Services by Type of Forest and Elevation

Ecosystem Type	Elevation & Topography	Ecosystem Services and Products
Montane humid broadleaf forests (e.g. cloud forest)	Top of watersheds	- Eco-hydrological services, water capture and infiltration
Pine and pine-oak forests	Middle of watersheds	- Eco-hydrological services, water capture and infiltration - Soil protection, erosion control - Wood products, timber and firewood
Humid broadleaf forests	Lower watersheds	- Carbon sequestration, long and short term climate regulation - High value timber - Unique non-timber forest products
Dry deciduous forest and thornscrub	Lower watersheds and rain shadows of mountains	- Soil protection and erosion control - Building materials and firewood
Mangroves	Coastal zone	- Eco-hydrological services, prevention of saltwater intrusion in coastal aquifers - Protection from coastal storms - Sediment trapping, land building - Carbon sequestration - Fish and shellfish nurseries and production - Timber and firewood

3.1 Ecosystem Products

Ecosystem products are direct material benefits derived from species harvested for such things as food, fiber, fuel, building materials, and medicines.

Timber and fuelwood are the most valuable forest ecosystem products in monetary terms. Household firewood and industrial fuel accounts for approximately 75% of the wood harvested from Guatemala's forests annually; in 2010 wood fuel consumption was estimated at 26.3 million m^3 (INE, BANGUAT and IARNA-URL, 2013a). Almost 70% of Guatemalan households use wood for cooking and heating (INAB, IARNA-URL and FAO, 2012), and approximately 70% of the primary energy use in the country is from wood (INE, BANGUAT and IARNA-URL, 2013a).

ACOFOP Concessions Coordinator Jorge Soza explaining how mahogany is measured to determine growth rate and develop sustainable management plans. Photo: B. Byers/DevTech, January 2016.

Timber products for construction and wood for furniture manufacturing accounted for about 3.1 million m^3 in 2010 (INE, BANGUAT and IARNA-URL, 2013a).

Table 3.2: Selected Ecosystem Products Values Estimates

Ecosystem Products		Annual Value
Timber and wood products (INE, BANGUAT, and IARNA, 2013a)	Wood fuel/firewood	1,423,000 Q $185,000 USD
	Wood for construction and furniture making	355,750 Q $46,250 USD
	High-value timber (e.g. mahogany, cedro, rosul)	$7,600,000 USD
Non-timber forest products (CONAP, 2014)	Ponytail palm	$1,800,000 USD
	Airplants	$1,300,000 USD
	Spineless yucca	$385,000 USD
	Xate leaves	$882,000 USD
	Allspice	$256,000 USD
	Ramon	Unknown
Fish and shellfish (INE, BANGUAT, and IARNA, 2013b)	Fish	292,000,000 Q $37,960,000 USD
	Shrimp and lobster	163,000,000 Q $21,190,000 USD
	Mollusks, crabs, other	8,000,000 Q $1,040,000 USD

Note: Quetzales converted to USD at 0.13 $/Q

Non-timber forest products harvested from natural forests are an important source of income in some communities in Guatemala. CONAP estimated that non-timber forest products with a value of US $3.8 million were exported in 2014. The most valuable of these were exports of live wild decorative plants, especially ponytail palms, *Beucarnea* spp.; "airplants," bromeliads of the genus *Tillandsia*; and spineless yucca, *Yucca gigantea (*synonym *Y. guatemalensis*). Wild-harvested leaves or fruits for export were estimated to be worth US $1.2 million during the same year, with the most exported species being *xate* (*Chamaedorea* spp.) palm leaves used by florists, and allspice, the fruit of *Pimenta dioica*.

The threat of illegal trade of wildlife species has been documented through a network of animal traffickers, which operates clandestinely in the country and has international contacts. Among the species illegally traded in Petén are the scarlet macaw, spider monkey, and jaguar. The Guatemalan beaded lizard, *Heloderma charlesbogerti*, from the dry ecosystems of the Motagua Valley, is also illegally traded (Batres, 2015). In the Western Highlands, nine species of the avian family Psittacidae, the macaws, parrots, and parakeets, are threatened by the illegal wildlife trade. Fish and shellfish are another major category of ecosystem products, with an average production from 2001-2010 of 22.6 million tons/year, and total average value of about 53.5 million Quetzales/year, approximately $7 million USD (INE, BANGUAT and IARNA-URL, 2013b). About half of the marine and coastal ecosystem products come from the Pacific, and half from the Caribbean (IARNA-URL, 2012).

Shrimp aquaculture, primarily found in the mangrove ecosystem zone of the Pacific Coast, produced about 9.8 million tons/year as an average between 2001-2010, with a value of 174 million Quetzales/year, comparison to only 1.5 million tons/year of wild shrimp and lobster (INE, BANGUAT and IARNA-URL; 2013b). This shrimp aquaculture should be seen in part as taking advantage of the ecosystem services values of mangroves, such as freshwater inflow and flushing, tidal flushing, and nutrient cycling.

Artisanal fisheries continue to contribute significantly to food security programs and to the economic activity of many Guatemalans. Artisanal fishing employs approximately 11,500 fishermen on the Pacific Coast, 2,600 in the Caribbean and 5,600 in inland waters. Approximately 5,500 vessels are engaged in artisanal fishing on the Pacific Coast (Marroquin, 2012).

3.2 Ecosystem Services

Ecosystem services are best defined as the benefits to humans that result from ecosystem functions and processes, such as:

- major biogeochemical and nutrient cycles (e.g., of water, carbon, nitrogen, phosphorus);
- natural pest control by predators in food webs;
- pollination by insects, bats, and birds;
- decomposition of biomass, wastes, and pollution;
- soil formation, retention, erosion prevention, and maintenance of soil fertility; and
- climate regulation.

In a 2015 study of ecosystem benefits (IARNA-URL, 2015), it was estimated that of Guatemala's remaining 4.2 million hectares of forest lands, 65% of those forests were contributing to protecting soils from erosion, 25% were contributing to the ecohydrological

services of water capture and regulation in watersheds, and 10% were providing protection from landslides on steep slopes. This same study estimated that the value of the soil erosion control provided by forests was 1,300 Quetzales per hectare over the period from 1991-2003, which would provide an estimated value of around US $47 million dollars for that ecosystem service.

Guatemala's climate, despite the pronounced seasonality of precipitation, provides it with enough water to meet its current needs. The average annual availability of water exceeds 90 billion m^3, representing an annual availability per inhabitant of more than 6,000 m3, above the level generally considered adequate for meeting human needs. Manufacturing is currently the largest water use sector, with irrigated agriculture the second biggest user of water. Sugar cane, oil palm, bananas, melons, and plantains used the most water for irrigation, in that order (IARNA-URL, 2015).

A study conducted in the watershed of the Río Teculután, a tributary of the Río Motagua arising on the southern slope of the Sierra de las Minas, showed that the forests there play an important role in regulating the water cycle (Tuna and Dimas, 2007). This study estimated that for every hectare of forest lost, runoff is increased by about 16,600 m^3 per year. Incer (2012) studied the water balance in the same watershed, and demonstrated the important and strategic role played by cloud forests (montane humid broadleaf forests) in increasing water capture and infiltration, reducing evapotranspiration, and stabilizing stream flow during the dry season.

Another important ecosystem service is pollination. Pollinators such as bees, wasps, butterflies, moths, flies, beetles, bats, and hummingbirds facilitate the reproduction of many plant species and help maintain the diversity and stability of ecosystems. Examples of pollinators are being the main pollinators of crops (CDB, 2008). About one-third of agricultural crops are pollinated by insects, including coffee, over 90% by bees (Estaban, 2013). Ricketts *et al*., 2004 demonstrated that conserving tropical forest fragments on coffee farms in Costa Rica increased coffee yields by 20% within a km of the natural forest, and also improved coffee quality by reducing the frequency of "peaberries" (i.e., small misshapen seeds) by 27%, because of increased pollination by wild native bees living in the forest fragments. A study on the presence of bees in coffee plantations in San Lucas Tolimán, Guatemala reported a 13% increase in coffee production (Esteban, E., 2013). According to the National Coffee Association of Guatemala (Anacafé) the value of coffee produced in the 2009-2010 season was US $691 million. If we take the value of 13% to 20% yield increases due to pollinators, coffee pollination as an ecosystem service in Guatemala could be estimated to be worth around US $100 million per year. For coffee producers, this value should be a sufficient incentive to set aside areas of native forest within their farms (Ricketts *et al*., 2004).

Coffee growing under shade of native trees, Reserva Los Tarrales.
Photo: B, Byers/DevTech, January 2016.

Mangrove ecosystems provide a range of ecosystem services, including:

- protection from tropical storms;
- sediment trapping and land building, resulting in protection against sea-level rise caused by global warming;
- filtration and nutrient cycling of water carrying nutrients, sediment, and contamination from inland agriculture, resulting in improved offshore water quality and benefits to coral reefs and other nearshore marine ecosystems;
- carbon sequestration; and
- fish and crustacean nurseries, providing shelter and food to larvae and young that will return to the sea as adults.

The latter service is directly linked to the values given earlier for fish, crustaceans, and mollusks as ecosystem products of the coastal-marine zone.

3.3 Nonmaterial Benefits

Besides providing direct material benefits to humans in the form of ecosystem products, and indirect material benefits in terms of ecosystem services, natural ecosystems and species also provide a range of nonmaterial benefits that are important to human well-being and development. These include historical, cultural, spiritual, recreational, educational, and scientific benefits (USAID, 2005a; USAID, 2014). Some examples from Guatemala are summarized below.

Nature-based tourism, a form of recreation, is an example of a non-material benefit of ecosystems and biodiversity. Tourism ranks second in foreign exchange earnings for Guatemala and protected areas are one of the main tourist destinations (CONAP, 2014b). Four of the five most visited tourist sites in the country are protected areas. Nature-based tourism, like birdwatching or whale watching, is directly biodiversity-related. Since many Guatemalan

national parks are archaeological sites, it is difficult to separate the “nature” and “culture” aspects of tourism.

Sport fishing is another example of biodiversity-dependent recreation. The Pacific Coast of Guatemala is an important destination for sport fishing seeking black marlin, blue marlin, sailfish and tuna.

Education and scientific research are also non-material uses of nature and natural ecosystems. In Guatemala, an example of this is type of benefit is the Sistema Universitario de Áreas Protegidas, or SUAP, a network of protected areas within the SIGAP that is administered by the Centro de Estudios Conservacionistas (CECON) of the Universidad de San Carlos de Guatemala.

Finally, we must mention the cultural and spiritual values associated with nature and with specific wild species found among the diverse indigenous communities of Guatemala. Like many other ecosystem benefits, it is difficult or impossible to assign a monetary value to them. In many ways it could be said that these are among the most valuable of all ecosystem benefits – they are simply irreplaceable and invaluable.

4.0 Threats to Biodiversity and Tropical Forests

In this assessment we have used the "threats-based approach" that guides USAID's biodiversity programming as the conceptual framework for our analysis (USAID, 2005a; USAID, 2014). Using this logical framework, we first identify the direct, biophysical threats to biodiversity in Guatemala. Conservation biologists recognize five main categories of direct threats to biodiversity:

- Conversion, loss, degradation, and fragmentation of natural habitats
- Overharvesting or overexploitation of particular species
- Invasive non-native species that harm native ecosystems or species
- Pollution or contamination that harms natural habitats or species
- Climate change effects that harm natural habitats or species

Climate change is a potential threat of unknown magnitude, which may accentuate other direct threats already discussed above, especially habitat loss, degradation, and fragmentation, and the threat from invasive species. In some ways, it falls into a gray area between cause and threat, being itself a cause of some of the other direct biophysical threats to ecosystems and species.

According to the USAID Biodiversity Policy (USAID, 2014), the immediate, proximate causes, and the long-term "root" causes or "drivers" of all of these direct threats generally fit into one of five categories:

- Demographic factors
- Economic factors
- Sociopolitical factors
- Cultural and religious factors
- Scientific and technological factors

Once the causes of the direct threats to biodiversity and the environment have been identified, the actions needed to address, reduce, or remove them can be determined (USAID, 2005a; USAID, 2014).

4.1 Direct Threats

Table 4.1 summarizes the perceptions of our large and diverse group of key informants about the main direct biophysical threats and their main causes, as revealed by content analysis of our interview notes. In some cases, many informants listed the same or similar threats, such as "forest loss from clearing for livestock ranching" or "illegal cutting of high-value timber species." We analyzed these responses and identified common categories of perceived threats. The largest category, by far, was the loss and/or degradation of forest ecosystems (28/48 responses, 58%), mainly from three activities:

1. Fires started by agricultural burning (7/28 responses, 25%)
2. Forest loss from clearing for livestock ranching (6/28 responses, 21%)
3. Forest loss from clearing for oil palm plantations (5/28, 18%)

Table 4.1: Direct Threats from Content Analysis of Key Informant Interviews

Threats by Category
Habitat loss/degradation N = 28 Fires started by agricultural burning N = 7 Forest loss from clearing for livestock ranching (*ganaderia*) N = 6 Forest loss from clearing for oil palm plantations N = 5 Tree cutting in forest for firewood, timber N = 3 Infrastructure development—dams, roads, petroleum development N = 3 Forest loss in the *cadena volcánica* N = 1 Mangrove loss in the coastal zone N = 1 Loss of *bosque seco* and *monte espinoso* from clearing for melon production N = 1 Fire prevention and fuel loading in fire-dependent pine forests N = 1
Overexploitation or Overharvesting of Particular Species N = 11 Illegal cutting of mahogany (*caoba*), cedro, rosewood, and other high-value timber species N = 4 Overfishing of some fish species N = 2 Overharvesting of *xate* palm N = 1 Capture and trade in parrots N = 1 Capture and trade in monkeys N = 1 Capture and trade in reptiles N = 1 Harm to whales from unregulated whale watching tourism N = 1
Pollution N = 6 Discharge of liquid waste from oil palm processing N = 4 Pesticides and nutrient runoff into Caribbean/Mesoamerican Reef N = 2
Climate Change N= 3 Climate change N = 3
Invasive Species N = 0 Total N = 48

Cattle pasture in the buffer zone of the Maya Biosphere Reserve.
Photo: B. Byers/DevTech, January 2016.

The second-largest category of perceived threats was "overexploitation or overharvesting of particular species," mentioned 11 times by our informants. The third-largest category of direct threats, mentioned six times, was pollution or contamination, mainly from the discharge of liquid wastes from oil palm processing.

The summary of threats identified by our key informants presented in Table 4.1 misses a very important point that we heard over and over in our interviews: threats to Guatemala's forests and biodiversity differ significantly from place to place, ecosystem to ecosystem, and ecoregion to ecoregion. Table 4.2 illustrates the differences in threats from ecosystem to ecosystem; for terrestrial ecosystems, the course-filter aggregation of Guatemala's 14 ecoregions that was explained in Chapter 2 (Table 2.2) has been used again.

Table 4.2: Direct Threats by Ecosystem Type

Ecosystem Type	Threats
Montane humid broadleaf forests (e.g. cloud forests)	- Clearing for coffee and other high-elevation specialty agriculture - Climate change (required climate zone shrinking)
Pine and pine-oak forests	- Wildfires escaped from agricultural burning - Fire suppression resulting in over dense, fire-prone forests - Clearing for agriculture - Tree cutting for firewood - Pine bark beetle - Climate change

Humid broadleaf forests	- Clearing and subsequent burning to create pastures for livestock ranching - Clearing for oil palm plantations - Tree cutting for firewood - Subsistence hunting - Illegal logging of high-value species such as mahogany, cedar, rosewood and other species - Overharvesting of xate palm - Illegal capture and trade of parrots, monkeys, felines, and reptiles - Water pollution from liquid waste from oil palm processing
Dry deciduous forest and thornscrub	- Clearing for irrigated agriculture (e.g., melons, sugar) - Tree cutting for firewood
Mangroves	- Clearing for commercial shrimp aquaculture and salt ponds - Clearing for commercial agriculture (e.g. sugar cane) and small-scale agriculture - Clearing for coastal zone development for tourism or other coastal infrastructure - Upstream diversion and extraction of water for all purposes, reducing flows to mangrove zone - Overexploitation for firewood and timber - Overfishing - Pesticide and nutrient runoff - Solid waste discharges into estuaries
Freshwater Ecosystems	- Conversion to agricultural uses (crops, pastures) - Sedimentation - Nutrient runoff and pollution (e.g. sewage, fertilizer and pesticide runoff from agriculture)
Marine Ecosystems	- Overfishing of particular species (e.g., shrimp, dolphin-fish and shark) - Destructive fishing practices - Harm to whales from unregulated whale watching tourism - Sedimentation, nutrient and pesticide pollution from onshore activities - Climate change (coral bleaching and loss from warmer ocean temperatures, sea level rise, and ocean acidification)

Conversion, loss, degradation, and fragmentation of natural habitats are a result of demands for land, timber and firewood. The demand for land translates into land use changes. African oil palm cultivation is increasing at an annual rate of 20%. By 2012, the crop was already covering 1.02% of the country (GIMBUT, 2014). At least 15% of the country's soils are under intensive use for agriculture. Erosion has been measured at 148 million tons of soil per year, and there are no national soil conservation programs.

The illegal harvest of timber and extensive use of firewood is another cause of forest loss and degradation. Illegal timber cutting is now being addressed by INAB through implementation of the new SEINEF system (Sistema de Información de Empresas Forestales), an effort to control

the industrial timber stock and prevent the trade of illegal timber. Firewood is the main source of domestic energy throughout Guatemala.

Fires were frequently mentioned by our key informants as a threat to forests, but without further qualification this can be misleading. Fires in the lowland humid broadleaf forests, such in the Petén are very different in their causes, and actions needed to address them, than in the mid-elevation pine and pine-oak forests of the country. In Petén these fires, which have mainly affected the western part of the Maya Biosphere Reserve (CONAP and WCS, 2014), are generally deliberately set to burn stumps and trees that have been cut to convert forest to pasture land for livestock ranching. These deliberately-set fires cannot be stopped with a public awareness and prevention campaign. In the pine and pine-oak forests, which are naturally fire-prone and fire-tolerant, fires are generally either caused by natural ignition such as lightning strikes, or by fires set for agricultural purposes by small-scale farmers that escape from control. Unwanted fires in this ecoregion could be reduced by a public awareness and prevention campaign. In the pine and pine-oak ecoregion¸ lack of fire is a long-term threat also, so a careful balance between permitting or encouraging fire, and preventing or controlling it, is needed.

The use of firewood was described as a threat to forests by many of our key informants. Although statistics show that 70% of Guatemalan households use wood for cooking and heating, we were not able to find any studies that showed that this level of use exceeds sustainable levels, or that it is really damaging forests. If wood fuel use were shown to be within the productive capacity of Guatemala's forests, and if managed for sustainable production, wood fuel could be a carbon-neutral, renewable energy source for Guatemala.

Degradation of aquatic ecosystems in the country can be explained as a result of the lack of a national water authority to regulate water extraction and use. Water extraction and diversion takes place without investment in water storage, water distribution, and the recharge of basins and underground reservoirs. Only 2.5% of the water that is currently used for human consumption is under some type of management in Guatemala. Water sources are polluted mainly due to the lack of sewage treatment; only 11% of rural areas and 44.3% of urban areas have adequate sewage systems. Over 10 billion cubic meters of untreated waste water are discharged into rivers and lakes from agriculture, industries, and homes.

Some rural communities in Petén and in other forested parts of the country still depend on subsistence hunting to obtain protein for their families. Some birds, such as chachalacas, guans, and curassows (family Cracidae) are under great pressure from hunting. Other mammal and avian species such as howler monkeys, spider monkeys, several species of parrots (*Amazona autumnalis, A. auropalliata, A.farinosa*), and the scarlet macaw (*Ara macao*) are caught for sale on the illegal market. CONAP's data showed that more than 1,400 individual animals were confiscated from this illegal trade in 2012.

Marine and coastal wildlife, including fish stocks which are important for rural food security, are being harvested without adequate management by national authorities, and some stocks are showing signs of depletion. Several species of sharks are now being harvested at increasingly smaller sizes than when the shark fishery began. The Pacific wild shrimp fishery, which was important during the 1990s, has collapsed because of overharvesting.

Invasive species pose a major threat in some terrestrial ecosystems, but we did not hear about clear examples of major threats from such species in Guatemala. During our field site visits for this assessment we did learn about an introduced non-native species, *Elaedobius kamarunicus*,

a weevil introduced from West Africa to increase pollination rates in oil palm plantations. Reports from palm plantations from around the world show that weevil increases fruit production by 20%-30%. We found no information regarding potential effects of this deliberately-introduced species on native palms in Guatemala or elsewhere.

African oil palm fruits being unloaded at a processing facility.
Photo: B. Byer/DevTech, January 2016.

Two invasive marine species are of concern for the Mesoamerican Coral Reef: the lionfish, (*Pterois volitans* and *P. milens)* and the tiger shrimp (*Panaeus monodon*). Guatemala participated in the regional workshops to develop a lionfish strategy. There have been no actions to develop a strategy regarding the invasion of the tiger shrimp although the Comisión de Pesca y Acuacultura from AGEXPORT has issued a warning that implicates the giant shrimp as the reason behind the reduced sizes recently seen in local shrimp species.

4.2 Causes and Drivers of Direct Threats

Guatemala has a population of approximately 15 million people, making it the most populous country in Central America. It also has the highest population growth rate in Latin America, estimated at about 1.8% per year (CIA World Factbook, 2016). That rate of growth would result in a doubling of the population in less than 40 years. Almost half of Guatemala's population is under age 19, making it the youngest population in Latin America, and this age structure means that population growth may continue for at least another generation. According to the CIA World Factbook, “Guatemala's total fertility rate has slowly declined during the last few decades due in part to limited government-funded health programs. However, the birth rate is still more than three children per woman and is markedly higher among its rural and indigenous populations.”

Although it is sometimes stated that population growth is a threat to biodiversity and forests, this claim is not technically correct. Population growth is not a direct cause of these biophysical threats, although it acts as a “root cause” or “driver” underlying other social, political, and

economic causes of direct threats to biodiversity. If it is not addressed and the population not ultimately stabilized, actions necessary to address the social, political, and economic causes of threats to biodiversity will be all the more difficult to carry out.

With the largest population in Central America and a Gross Domestic Product (GDP) per capita of an estimated $7,900 per year, roughly one-half that of the average for Latin America and the Caribbean, Guatemala is a poor country. It ranks 149 of 230 countries in GDP per capita.

According to the 2014 “Encuesta Nacional de Condiciones de Vida,” the latest national survey of living conditions, about 59% of Guatemalans live below the poverty line, and about 23% live in extreme poverty. The survey by the National Statistics Institute (INE, 2014) showed that poverty increased by 2.9% between 2000 and 2014, and extreme poverty levels rose from about 16% to 23%. Children are the most affected, with an estimated 70% of children under 10 years old living in poverty. These levels of poverty explain the high levels of chronic malnutrition found in Guatemalan children. Poverty among indigenous groups, which make up more than 40% of the population, averages 73%, with 22% of the indigenous population living in extreme poverty (CIA World Factbook, 2016).

Although the GDP has been increasingly growing for the past ten years, and with 4% growth projected for 2016, the distribution of income remains highly unequal. The richest 20% of the population accounts for more than 50% of Guatemala's overall consumption (CIA World Factbook, 2014). Remittances from Guatemalans living abroad, estimated at $6 billion USD in 2015, represent an important flow of income into the country.

Economic inequality and the concentration of wealth, rather than poverty, can also be a cause or a driver of direct threats to biodiversity. In Petén we were told by most of our key informants that demand for land from wealthy people for cattle ranching was the main threat to forests there, and that much of the wealth being used to acquire land for that purpose was from narco-trafficking. “Narco-ganaderia,” it was explained, was a way of laundering money acquired through illegal activities.

The credibility of, and public respect for, government institutions have suffered greatly from the recent discoveries of corruption at the highest levels. The public tend to see government institutions as incapable of resolving environmental and other problems. As will be described in Chapter 5, the few government agencies responsible for the conservation and management of Guatemala’s forests and biodiversity have overlapping and sometimes unclear responsibilities, which complicates decision making and efficient investment of financial and human resources. The budgets of these agencies are not adequate for carrying out the responsibilities with which they are charged, so conservation and environmental management suffers.

5.0 Policies, Laws and Institutions

5.1 Policies

The **Forest Policy** (1999) aims to increase the socioeconomic benefits of goods and services of forest ecosystems and contributes to land management in rural areas. It also emphasizes forest resources, biodiversity resources, water and soil, and it incorporates forestry into the national economy for the benefit of the Guatemalan society. Forest policy in Guatemala can be divided into three main aspects: i) conservation of protected areas, ii) provision and maintenance of environmental services (such as watershed management, soil protection, etc.); and iii) productive development that links the forest to industry. The implementation of the policy has been through two instruments: Incentive Program for Reforestation and forest licensing. However, the policy guidelines have not been able to stop forest loss in Guatemala. The country continues to lose natural forests in strategic ecosystems and protected areas that provide water services for society.

The **National Policy and Strategy for the Development of Guatemalan Protected Areas System** (1999) poses to improve the protection and sustainable use of the country's natural and cultural heritage to help to increase the quality of life of present and future generations. The policy strives for biodiversity conservation and economic revaluation of natural resources through actions such as bioregional management, restoration of land for forestry, protection of national heritage, and promotion of investment in protected areas under effective public administration of the conservation sector. The policy has the weakness of not having enough tools and resources to adequately address all the areas within SIGAP.

The **Policy on Biological Diversity** (2011) aims to build a guided, ordered and articulate framework of state and civil society actions to legislate, secure and ensure proper and effective conservation and sustainable use through the definition of the rights, obligations and attributes of each of the actors and sectors involved and the strategic recognition of biological diversity as a collective heritage. The policy aims to promote effective management of Guatemalan biodiversity, emphasizing conservation and sustainable use as a crucial factor in transgenerational integral human development. It is based on the principles of the common good, intergenerational legacy, sustainability, fair and equitable distribution of benefits, equitable sharing of responsibility and participation, prevention, and respect for intellectual property. This policy substitutes the National Strategy for Conservation and Sustainable Use of Biodiversity (2001), which failed to transcend the institutional boundaries of CONAP due to lack of support to make its guidelines appropriate for the institutional network and state organizations. Given the limited relevance of this issue on the national political context, it is expected that the Policy on Biological Diversity will have the same fate.

The **Policy on Conservation, Protection and Improvement of the Environment and Natural Resources** (2011) seeks to harmonize, define and provide guidelines for the different sectors to improve the environment and quality of life of the inhabitants of the country, to maintain ecological balance and for sustainable use of natural resources. The policy defines the guidelines for developing effective management systems to conserve and protect the environment and natural resources, improve environmental quality of life of Guatemalans, and promote the sustainable use of natural resources. Its implementation has been limited by the inability of MARN to fulfill the mandates in the policy.

The **Agricultural Policy** (2011-2015) aims to influence sustainable integral human development in rural areas, contributing to land management and the promotion of agriculture,

forestry and hydrobiological sectors, prioritizing the promotion of the rural, indigenous, farming economy, promoting equitable access to the means of production and sustainable use of natural resources and environmental services in order to achieve food sovereignty, surpluses and their incorporation into the various types of markets.

The **Energy Policy** (2013-2027) contains a dimension regarding the importance of firewood in primary energy production. It also aims to protect biodiversity while respecting SIGAP areas when trying to develop an energy project for proper environmental management of natural resources, especially when trying to develop and implement hydroelectric projects. However, in reality the provision is not met due to socio-environmental conflicts generated by the implementation of hydroelectric projects without taking into account local populations or respecting the process of free and informed prior consultation established by the Convention No. 159 International Labor Organization with regard to works of this nature developed in areas with indigenous populations. This is the case of hydroelectric plant in Xalala, where 58 communities of Quiché and Alta Verapaz oppose its implementation (www.pdh.gob.gt).

5.2 Laws

The Guatemalan Protected Areas System (SIGAP), whose organization and characteristics are established by the **Protected Areas Law**, is the legal instrument for the conservation of biodiversity and tropical forests in Guatemala. SIGAP is administered by the National Council for Protected Areas (CONAP).

The **Forest Law** establishes the guidelines for the management of forests outside protected areas. Its application rests with the National Forest Institute (INAB). To complement the forest law, two other laws were enacted. The **Forestry Incentives Law** applies to owners of small tracts of land used for forestry and agroforestry (PINPEP Decree 51-2010). The preamble of this law mentions the need for forest lands to meet energy demands and to provide environmental services such as the protection of watersheds and carbon sequestration. The new forest law, **PROBOSQUE**, promotes the restoration, management, and protection of forests in Guatemala. It aims to protect existing forests and increase forest cover.

The **Climate Change Law** (Decree 7-2013) governs actions related to climate change vulnerability, adaptation, and mitigation. This law created the National Commission on Climate Change and the National Climate Change Fund (FONCC), and mandated the development of a National Plan for Climate Change Mitigation and Adaptation. Included in this plan are a Low Emission Development Strategy (LEDS), Guatemala Zero-Carbon Footprint (*Guatemala Huella CERO2*), and an initiative to promote a voluntary carbon market in the Maya Biosphere Reserve (*Guatecarbon*).

Although there is no water law in Guatemala, watershed management authorities have been legally proclaimed for Lake Amatitlán, Lake Atitlán, Lake Izabal and Rio Dulce, Pensativo River Sub Basin, and Lake Petén Itzá.

Other Guatemalan laws affect the conservation of forests and biodiversity, including the Electricity Law (Decree 93-96), Mining Law (Decree 48-97), and Hydrocarbons Law (Decree 109-97), which promote activities in areas adjacent to protected areas.

MARN is responsible for the implementation of the law to regulate the reduction of vulnerability, compulsory adaptation to the effects of climate change and mitigation of greenhouse gases (Decree 7-2013).

5.3 Institutions

The **Ministry of Environment and Natural Resources (MARN)** is responsible for protecting the ecosystems and biodiversity of Guatemala. MARN works in collaboration with other governmental and civil society organizations to respond to the following priorities:

- Strengthen and expand the Guatemalan Protected Areas System;
- Address climate change mitigation and adaptation
- Manage watersheds and water resources
- Support the development of renewable energy programs
- Administer environmental permits and licenses for the prevention and mitigation of the environmental impact of projects, works and industries
- Track the legal compliance of the commitments made in the Environmental Management Plans.

Since its inception, budgetary limitations have prevented MARN from meeting the responsibilities assigned to it by law, which exceed its financial and human resources capacity. In 2012, MARN received 0.32% of the national budget.

CONAP, the National Council for Protected Areas, is a secretariat that is administratively dependent on the Presidency of the Republic. The Council is composed of representatives from MARN (which presides), the Center for Conservation Studies at the Universidad de San Carlos (CECON/USAC), the Institute of Anthropology and History (IDAEH), the National Association of Municipalities (ANAM), Guatemalan Institute of Tourism (INGUAT), the Ministry of Agriculture and Livestock (MAGA), and a representative of NGOs registered with CONAP. CONAP is responsible for the approval and monitoring of master plans implemented within the National System of Protected Areas (SIGAP). By 2015, a total of 173 Private Nature Reserves were registered with CONAP; CONAP is responsible for the legal recognition of these areas and INAB has supported them through forest conservation projects. A weakness of CONAP is the administration of its human resources and the need for greater budgetary resources to develop their management. In 2012, CONAP received 0.12% of the national budget.

The **National Forestry Institute (INAB)** is an autonomous institution under the government of a Board of Directors with the participation of government agencies, NGOs, municipalities, academia and the organized private sector. INAB is responsible for the sustainable management and conservation of forests through the adoption of forest management plans in private forests and the recovery of deforested areas through reforestation actions. Since 1996, INAB, through the Forestry Incentives Program (PINFOR), has supported the establishment of 126,000 hectares of plantations, and the protection and management of 216,000 hectares of natural forests. To complement the PINFOR initiative, the Incentive Program for Small Landowners with Forestry and Agroforestry Potential (PINPEP), was developed to encourage small land owners to implement forest protection or reforestation activities. Between 2007 and 2014 PINPEP has supported more than 13,000 projects covering 47,000 hectares (INAB, 2014). As part of the decentralization process, INAB has been implementing the Municipal Forest Administration Program, under which it established 241 Municipal Forestry Offices in municipalities. The program has focused on the transfer of forest management skills to municipal governments. INAB has also made efforts to improve information systems, promote sustainable forest production, reduce deforestation and illegal logging, and improve market linkages for forest products.

One of the strengths of INAB is the stability of its staff. However, as a decentralized government institution, it has not had sufficient funds for its operations. Both PINFOR and PINPEP have struggled to meet their financial obligations.

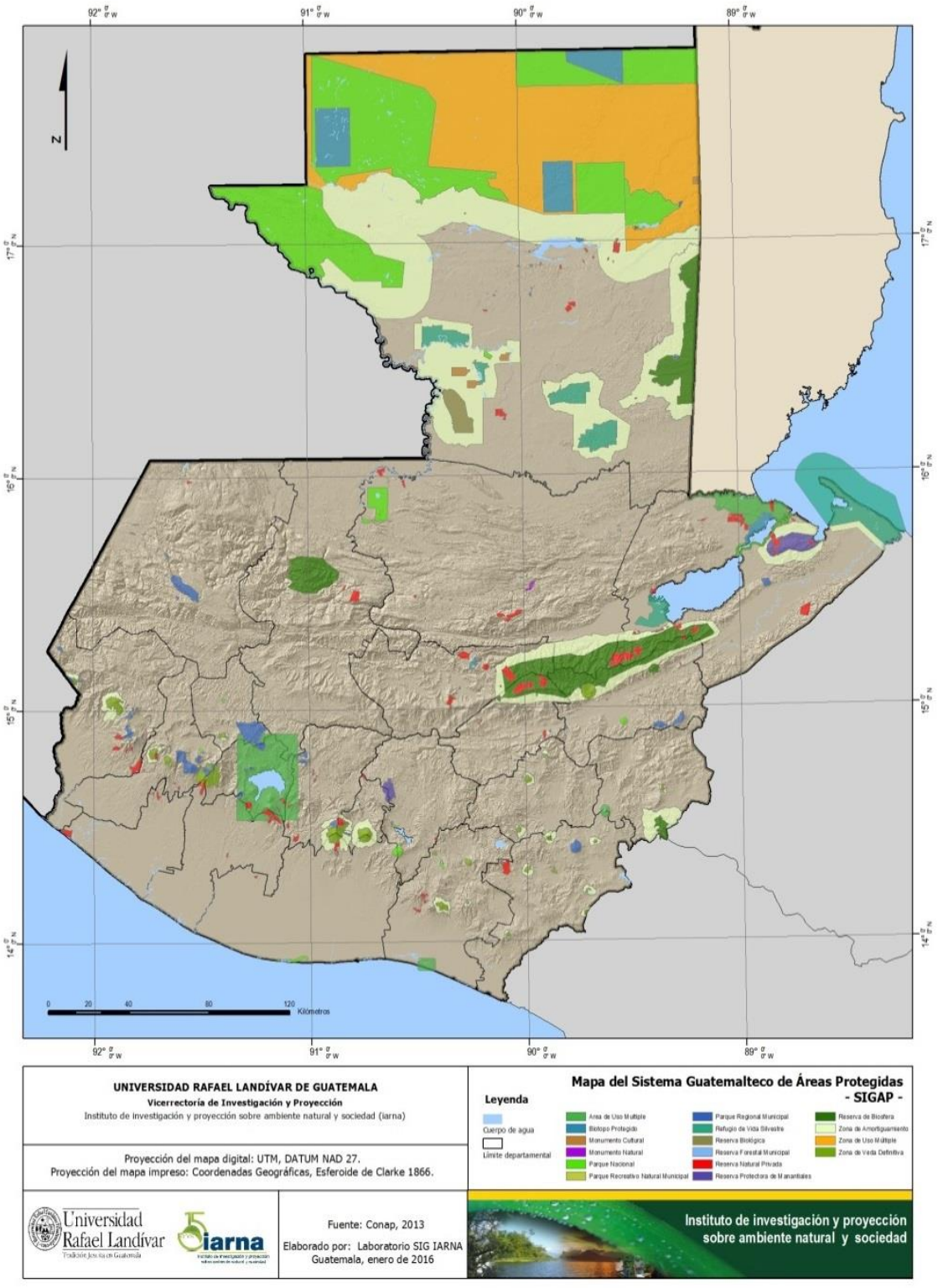
5.4 Non-Governmental Organizations and Academic Institutions

Guatemalan government institutions with responsibilities for forest management and biodiversity conservation rely on non-governmental organizations (NGOs) and academic and research institutions as partners in their work. For example, two NGOs, Defensores de la Naturaleza and Wildlife Conservation Society, and one university, the Universidad de San Carlos de Guatemala, co-manage protected areas in the national protected areas system. Annex D summarizes the relevant activities of these NGOs and academic institutions.

5.5 Protected Areas

As of 2015 the Guatemalan protected areas system (SIGAP) included 328 protected areas with an area of 3,440,000 hectares, or about 31% of the country. Figure 5.1 is a map of the protected areas of Guatemala.

Figure 5.1: Protected Areas of Guatemala



Source: CONAP, 2013

The 2009-2012 report on the management effectiveness of SIGAP areas (CONAP, 2014b) found that of 77 areas representing 58% of the SIGAP area, only 12 were found to be managed at an acceptable level. A recent study by CEMEC and WCS showed that there have been some improvements in monitoring and controlling activities, including illegal activities, in the Maya Biosphere Reserve (CEMEM, 2013; CONAP and WCS, 2014).

The Río San Pedro forms the boundary between the buffer zone and Laguna de Tigre National Park in the Maya Biosphere Reserve.
Photo: B. Byers/DevTech, January 2016.

5.5 International Treaties and Conventions

As a member of the United Nations system, Guatemala is a signatory to many international conventions including the Convention on Biological Diversity (CBD); the Convention on Wetlands of International Importance, known as the Ramsar Convention; the Convention on International Trade in Endangered Species (CITES); the United Nations Framework Convention on Climate Change (UNFCCC); and the United Nations Convention to Combat Desertification (UNCCD).

Guatemala was officially recognized by the CBD as a megadiverse country due to its rich biological and cultural diversity. The Nagoya Protocol of the CBD, ratified by Guatemala in 2014, requires the development of measures to ensure the fair and equitable sharing of benefits arising from the utilization of Guatemalan genetic resources, and the protection of traditional knowledge (CONAP, 2014a).

Guatemala has declared seven Ramsar sites under the Convention on Wetlands of International Importance: 1) Eco región Lachuá; 2) Parque Nacional Laguna el Tigre, Biotopo Laguna del Tigre and Río Escondido; 3) Refugio de Vida Silvestre Bocas del Polochic; 4) Punta de Manabique; 5) Área de Protección Especial Manchón-Guamuchal; 6) Parque Yaxhá-Nakum-

Naranjo; 7) Reserva de Usos Múltiples Río Sarstún. Of these sites, the greatest threats occur in the Parque Nacional Laguna de Tigre.

Guatemala has two World Heritage Sites, Tikal National Park in Petén, and Quirigua Archaeological Park in Izabal. Both conserve areas of natural forest as well as sites of archeological importance.

As a party to the CITES convention Guatemala is obligated to protect species of plants and animals listed in CITES appendices. High-value timber species such as mahogany (*Swietenia macrophylla* and *S. humilis*), Rosul (*Dalbergia retusa* and *D. stevensonii*), and spruce (*Abies guatemalensis*) are listed.

In compliance with UNFCCC, at the institutional level, MARN has a Climate Change Unit, which coordinates national climate change adaptation and mitigation efforts.

6. Actions Needed to Conserve Tropical Forests and Biodiversity

The Assessment Team gathered information about actions necessary to conserve biodiversity and tropical forests from the diverse sources described in the introduction to this report. From an analysis of notes from our interviews and meetings with more than 50 key informants (see Annex D: Persons Contacted), we compiled a list of 157 actions necessary as perceived by those environmental experts and stakeholders. The actions needed for conserving forests and biodiversity are actions that remove or reduce the social, political, and economic causes of the threats.

Our analysis assumes that our diverse group of informants – professionals and experts working on biodiversity conservation and natural resources management in Guatemala – know more about these issues than anyone else. Many of them have contributed to the development of the policies, laws, and institutions discussed in Chapter 5, and the NGO, donor and private sector activities summarized in Chapter 6.

Content analysis of notes from our interviews showed that some actions needed were mentioned many times, by different informants and stakeholders. Similar actions needed that were mentioned repeatedly can be clustered by topic or theme; the 157 proposed actions needed fit into ten general themes (Table 6.1). For a complete list the proposed actions needed and their thematic categories, see Annex E.

This method provides a way of organizing and understanding the many possible "actions needed" according to the key informants. While this approach is not perfect, we believe that it is less biased and more informative than other non-quantitative methods of trying to develop such a list. Although the frequency with which they were mentioned by key informants provides a measure of the perceived importance of the many actions needed, frequency cannot necessarily be equated with priority. In general, prioritization is a very tricky concept because it depends on the values and objectives of those doing the prioritizing, and criteria can vary widely among stakeholders.

Table 6.1: Actions Needed by Theme from Key Informant Interviews

Theme: "Need/Need to…."	# of mentions	% of Total	Cumulative %
1. Create needed policies, laws, strategies, and plans	50	32%	32%
2. Reform and strengthen institutions with forest and biodiversity responsibilities	26	17%	49%
3. Stop illegal activities that threaten forests and biodiversity	17	11%	60%
4. Support community organization, empowerment, and capacity (e.g., community forest concessions)	14	9%	69%
5. Strengthen climate change resilience through adaptation and mitigation actions	14	9%	78%
6. Emphasize water as an integrating ecosystem service	13	8%	86%
7. Provide economic options for the rural poor who depend on natural resources	9	6%	92%
8. Generate and disseminate scientific information needed for environmental decision-making	7	4%	96%
9. Fund government institutions with environmental responsibilities at the levels needed	4	2%	98%
10. Reduce fertility rates and population growth through appropriate initiatives in the health and education sectors	3	2%	100%
Total	**157**		**100%**

For each of the actions needed – the "what" – there is a "who" – that is, which actor or actors can carry out the action necessary, and which have more or less responsibility for doing so? Potential for taking action, and even responsibility for doing so, is often shared, or should be shared, among actors. Depending on the type of action needed, government agencies at all levels are often the responsible and necessary actors. Private sector companies and trade associations often play a key role. Civil society organizations including, of course, national and international NGOs also are key stakeholders and actors. The independent media and press can convey opinions and information that can influence government actors. Universities, depending on their status (private or government) are sometimes positioned to contribute to needed actions, such as generating scientific information needed by decision makers. And finally, international donors, both multilateral donors such as U.N. agencies, or bilateral donors such as USAID, can play a needed and critical role in catalyzing and supporting necessary actions.

Civil society interest groups (NGOs) and private sector trade associations are often needed to "push" government to meet its commitments and responsibilities. In some cases NGO actions can pressure government to regulate private sector activities to protect public interests, or motivate changes in private-sector behavior through corporate social responsibility campaigns.

USAID support can take advantage of different routes for trying to influence the actions of key actors. Sometimes information (studies, reports, monitoring, and media) from civil society organizations supported by USAID can act as leverage on government institutions with legal responsibilities for forests and biodiversity.

The key issues and topics encompassed in these main themes, and the key actors, are discussed below.

6.1 Create Needed Policies, Laws, Strategies, and Plans

The laws and policies that provide the foundation for the sustainable use and management of forests and biodiversity in Guatemala were reviewed in Chapter 5. Our key informants generated more suggestions about policies, laws, strategies, and plans than for any other theme, which can be taken as a strong message that the current legal and policy foundation has gaps and holes that need to be closed, and that even if there are policies and laws already in place, strategies and plans are needed to implement and enforce them. The responsibility at the legal and policy level rests squarely with the Government of Guatemala, but implementation requires coordination and collaboration with other stakeholders – the private sector, and the public, as represented by civil society, non-governmental organizations and associations.

From a review of the specific suggestions under this theme it can be seen that certain topics receive more attention than others. In terms of specific threats that require legal and planning remedies, the expansion of oil palm cultivation and livestock ranching, and the control of forest fires, stand out. Several key informants suggested the need to raise the profile of the environment in public awareness and political debate, at the national level, and provide much better funding for these issues at the national level. Several people also expressed a need to promote a much more integrated, holistic, long-term, big picture strategy for environmental conservation and sustainable development in Guatemala.

Suggestions under this theme were frequently geographically oriented. Undoubtedly because we spoke to many people about actions needed in Petén during our visit to that region, a disproportionate number of suggestions (10 out of 51) were for policies, laws, strategies, or

plans needed there. Interestingly, even more policy and planning actions were aimed specifically at regions other than Petén, with the largest number related to coastal and marine areas, and the second most common being the volcanoes zone, the *Cadena volcánica*. Two key informants specifically urged USAID to change its strategies and plans by supporting more activities outside of Petén than it currently does. One stated that "USAID should diversify its geographic support within Guatemala – to include the *cadena volcánica*, south coast mangroves, etcetera; Petén is important, but doesn't deserve all the funding and focus." Several other key informants also made suggestions for actions needed by USAID, including:

- Increase the profile of environment as a cross-cutting issue within USAID Guatemala, which is quite "sectoral."
- Broaden the interpretation and application of the USAID "Biodiversity Earmark" so that biodiversity funds can be used not only in strictly protected areas (like national parks), but in a range of multiple-use protected areas, including forest concessions.
- Donors, including USAID, need to put more attention and investment toward the root causes and drivers of environmental threats, and less on small, discreet "projects" focused on conservation.

6.2 Reform and Strengthen Institutions with Forest and Biodiversity Responsibilities

Guatemalan government institutions with responsibilities for environmental management were discussed in Chapter 5. Our key informants had a large number of suggestions (25 out of 157 total) about the need to reform or strengthen these institutions, which were often said to be weak and only partly able to carry out their legal and administrative responsibilities. There is a need, one informant said, to "Transform institutions so that they are functional, and can implement the relatively good policies and strategies that are already in place." The responsibility for this list of actions necessary falls squarely on the Government of Guatemala. However, as discussed earlier, other actors and stakeholders have ways of influencing the behavior of the government, so that even under this theme the private sector, NGOs, and donors, including USAID, do have some avenues for taking or supporting some of the actions needed.

For example, civil society NGOs and private sector associations can advocate for reform and strengthening of government agencies that they feel are not performing the duties for which they are legally responsible. Donors, including USAID, can support such NGO and private sector advocacy through their funding. Donors can also use diplomatic channels to influence the Government of Guatemala, or contingencies linked to their aid programs to encourage or catalyze needed change in GoG institutions. One of our informants, for example, stated that "the U.S. Embassy and USAID need to apply diplomatic pressure and provide incentives for needed structural and institutional changes in the GoG, directly and also indirectly related to environmental issues." Another person told us that "Donor funding should emphasize institutional strengthening, because institutional weakness and lack of capacity is the main driver, and root cause, of threats to forests, biodiversity, and environment in Guatemala."

One of reforms most commonly mentioned by our key informants was the need to reform and strengthen CONAP. We heard suggestions, for example, to:

- Combine and merge the perspectives of MARN and CONAP into a more integrated, landscape- and ecosystem-scale vision (with three pillars: ecological, cultural, and economic).
- Combine and merge INAB and CONAP into one institution responsible for biodiversity and forests (and protected areas of all kinds).

- Change and strengthen CONAP into an institution that is actually effective at conserving biodiversity by changing its vision of conservation to include economic incentives and local communities.
- Create a legal framework that gives CONAP administrative and technical autonomy, stable career paths for its staff, and increased institutional stability.

6.3 Stop Illegal Activities That Threaten Forests and Biodiversity

The third most common theme among the suggestions for needed actions was the need to stop illegal activities, mentioned 17 times. Here also the responsibility lies primarily with the Government of Guatemala. Illegal activities were mentioned most frequently as a threat in Petén, with illegal clearing of land for cattle ranching and illegal logging being the most commonly mentioned. Many of our informants described Petén as an area largely without the presence of GoG institutions, and many suggestions suggested that a very strong response was needed to stop illegality, for example:

- Use national institutions and power (army, police, and judicial system) to stop illegal land conversion and other illegal activities in Petén.
- Bring back the presence of the state and the rule of law in Petén (#1 threat is ungovernability because of narco-trafficking).
- The government needs to stop/control the porosity of the border between Petén and Mexico, using the army, police, etc.
- Define and delimit the border between Guatemala and Belize in order to control illegal activities from Belize that are cross-border threats in Guatemala, such as fires, illegal logging, and agricultural expansion.

Several people we talked to suggested that until the presence of the state and rule of law are re-established in Petén, investments in forest and biodiversity conservation there would be wasted. Some of these people proposed that the U.S. Government and USAID could use far stronger diplomatic pressure and aid contingency that they have to stop illegal, drug-related activity in Petén, and suggested that this should be a “national security” issue for the United States.

USAID and the U.S. Department of the Interior’s International Technical Assistance Program have supported the monitoring of illegal activities in the RBM, and efforts to control them, through research to periodically produce a report on “Monitoring of Governability in the Maya Biosphere Reserve,” the last of which was published in 2014 (CEMC, 2013; CONAP and WCS, 2014)

6.4 Support Community Organization, Empowerment, and Capacity

This theme received quite a bit of attention from our key informants, who made 14 suggestions for actions needed. Land and natural resource tenure was mentioned as an area needing attention by several people. Six people stated that it was necessary to continue supporting community forest concessions in the Maya Biosphere Reserve. One informant recommended expanding the decentralized, community-based model of the “48 cantones” in the Western Highlands, which he said was “a success story in how to manage forests well.” Strengthening CONAP’s capacity to interact with and support communities living in protected areas also was seen as a need, in comments like these:

- Improve CONAP’s capacity to work collaboratively with communities (they have too much of a “protected area,” “this is my land” institutional culture and mentality).
- Strengthen and institutionalize within CONAP a view of protected area management through financial and other incentives to local communities, not just through enforcement (control y vigilancia).

Community forest concession plan for sustainable harvest of high-value timber, Concession Sociedad Civil "El Esfuerzo," Maya Biosphere Reserve.
Photo: B. Byers/DevTech, January 2016.

6.5 Strengthen Climate Change Resilience through Adaptation and Mitigation Actions

This group of suggestions for actions needed included seven actions aimed at climate change mitigation, four related to climate change adaptation, and three that mentioned both adaptation and mitigation. The suggested actions for mitigation included:

- Develop a baseline for greenhouse gas emissions for Guatemala.
- Support the development of the Strategy for Reduced Emissions.
- Develop the mechanism for implementing the legal and theoretical framework (strategy, plan) for climate change adaptation and mitigation.

Three mitigation actions suggested reducing the demand for firewood at a national scale, which would allow forests to store more carbon, through the development of more efficient wood cook stoves or renewable energy alternatives.

Adaptation actions recommended managing water resources better as an adaptation strategy, expanding the early alert system that warns small and medium sized farmers about predicted climate variability that would affect crop production, and developing a climate adaptation plan for the Pacific Coast.

6.6 Emphasize Water as an Integrating Ecosystem Service

Many of our key informants raised the issue of water in our discussions of forests and biodiversity. Several proposed that water issues were a theme that integrated the protection of forests with societal needs because water is an irreplaceable resource for human health and sanitation, agricultural production, and economic development produced by ecohydrological processes in watersheds. Four people suggested that watershed protection and management

plans were needed to ensure sustainable access to water for a range of uses. Three people proposed that a Water Law needs to be developed, and three saw the need for more research on hydrology and ecohydrology to provide a scientific foundation for sustainable water management. One person mentioned the need to develop a mechanism for valuation of water capture in protected areas, and other forest areas defined in the new forest law, PROBOSQUE, as areas for water capture and recharge. Such valuation could lead to financial mechanisms for supporting the conservation of upland watersheds through payments from downstream water users. One informant recommended working to link upper watershed land owners and managers in the *cadena volcánica* with sugar growers on the south coast. Many of the actions proposed under this theme would require collaboration of various types of actors, including government agencies, NGOs that co-administer protected areas, private landholders, and public and private water users. Donors, including USAID, could catalyze some of these needed actions through their funding.

6.7 Provide Economic Options for the Rural Poor Who Depend On Natural Resources

The nine suggestions for actions needed that fall under this theme are quite consistent in supporting and promoting sustainable production of timber, non-timber forest products, and tourism. Strengthening value chains for forest-based products, and certification and strengthening international markets for non-timber forest products such as *xate*, *ramón*, and *chicle* were mentioned. Comments under this theme proposed that community economic development based on forest products is needed, and that it must measurably and sustainably improve livelihoods and provide basic necessities for health, education, and potable water.

Ramón (*Brosimum alicastrum*) fruits, collected in the Maya Biosphere Reserve, for drying and processing into flour, cookies, and beverages by a women's collective in Ixlú, Flores, Petén.
Photo: B. Byers/DevTech, January 2016.

6.8 Generate and Disseminate Scientific Information Needed For Environmental Decision-Making

A wide range of types of information was included in the suggestions by our key informants under this theme, ranging from monitoring of particular at-risk or indicator species such as guacamayas and jaguars, to increasing the coverage of hydro-meteorological stations in mountain areas. A range of technologies for generating this information were mentioned, including satellite imagery, aerial surveys, and drones. Two people mentioned the need to improve information and practices for treating the liquid waste from oil palm processing.

6.9 Fund Government Institutions with Environmental Responsibilities at the Levels Needed

The several comments under this theme relate closely to an earlier theme, the need for the Government of Guatemala to strengthen institutions with forest and biodiversity responsibilities and provide adequate resources to implement and enforce the laws, policies, strategies, and plans that exist already, including for implementation of the international conventions in which Guatemala participates.

6.10 Reduce Fertility Rates and Population Growth through Appropriate Initiatives in Health and Education

Several of our key informants called attention to population growth as a potential root cause of threats to forests and biodiversity, and they pointed out that actions necessary to address this should aim at improving health and education for women and girls. Basic health, nutrition, and sanitation are related, linked closely to access to water. Reproductive health and access to family planning information and technologies are important. Girls' education and livelihood and economic opportunities for women are also contributing factors to reducing fertility rates.

7. Climate Change Resilience and Adaptation

In this chapter we briefly review climate projections for Guatemala, and discuss ways in which conserving biodiversity and using ecosystem-based approaches to climate change adaptation can address key risks to development, such as in agriculture and food security, flood protection, domestic and industrial water supply, and health.

According to the Economic Commission for Latin America and the Caribbean (ECLAC), Central America is one of the regions that is most vulnerable to climate change (ECLAC, 2010). The 2016 Global Climate Risk Index (Kreft *et al*., 2016) ranks Guatemala number ten in the world in terms of human fatalities and economic losses from extreme weather events such as hurricanes, severe storms, and floods over the period of 1995-2014. Guatemala's neighbor, Honduras, was number one in the world in terms of climate losses, and Nicaragua ranked number five. Extreme weather events are predicted to increase in frequency and severity under global climate warming scenarios, and although the Global Climate Risk Index does not provide an all-encompassing analysis of the risks of climate change, it reflects risk from past climate variability – and to the extent that climate change has already increased extreme weather over the last 20 years, it also may reflect climate change.

Guatemala releases only a very small fraction of global greenhouse gases, estimated at less than 0.04% of global CO2 equivalent (UNISDR, 2009). The country cannot, therefore, reduce its vulnerability to climate change through reductions in greenhouse gas emissions. However, the country's vast forests are a carbon sink, and mitigate some of the CO2 released mainly in large developed countries. Guatemala's forests thus provide carbon sequestration, an ecosystem service, that is a benefit to global climate stability. If they were to be lost, that ecosystem service would be lost, and significant additional amounts of carbon would be released to the global atmosphere.

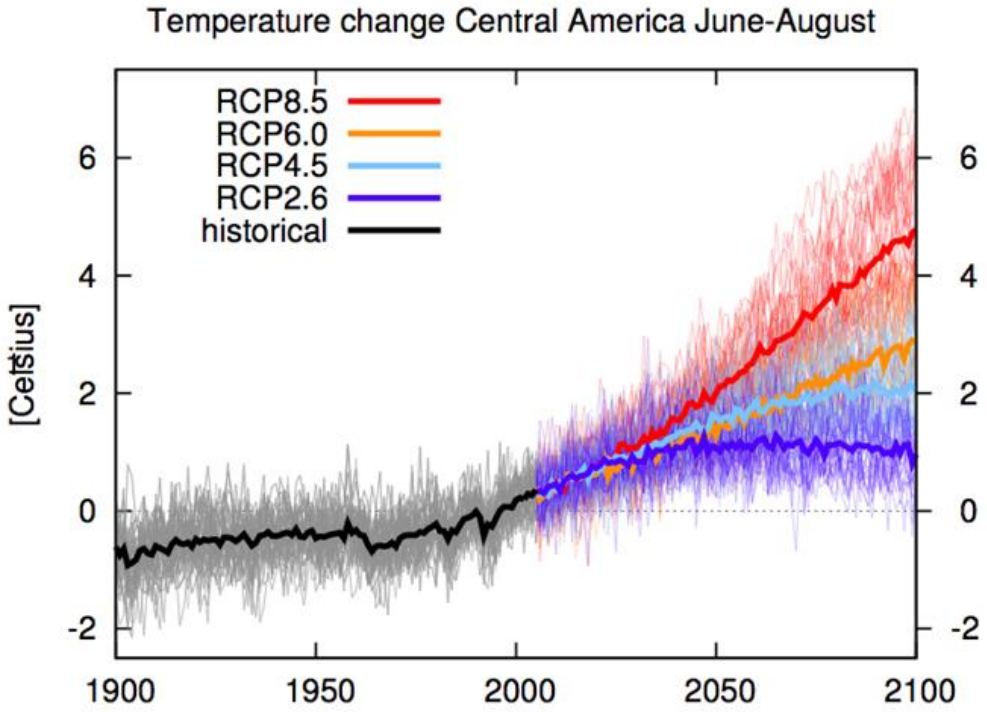
7.1 Climate Projections and Risks

Temperature

Model predictions for Central America from the Intergovernmental Panel on Climate Change (IPCC) published in the Fifth Assessment Report (IPCC, 2013) show warming proportional to the degree of prescribed greenhouse gas forcing (Figure 7.1). By mid-century, models show little difference between predictions developed from the four emissions scenarios, which the IPCC calls Recommended Concentration Pathways (RCPs), labelled RCP 2.6, RCP 4.5, RCP 6.0, and RCP 8.5 in the figure below. The IPCC models predict increased temperatures of around +2° C by 2050 due to greenhouse gas forcing.

The El Niño-Southern Oscillation (ENSO) exerts a strong control on temperatures in Central America at annual and decadal time scales. According to the IPCC, ENSO is likely to remain the main cause of interannual variability throughout this century, so comparable year-to-year temperature variability should continue, superimposed on an overall warming trend driven by greenhouse gas buildup in the global atmosphere (ARCC, 2013).

Figure 7.1: IPCC Temperature Projections for Central America to 2100

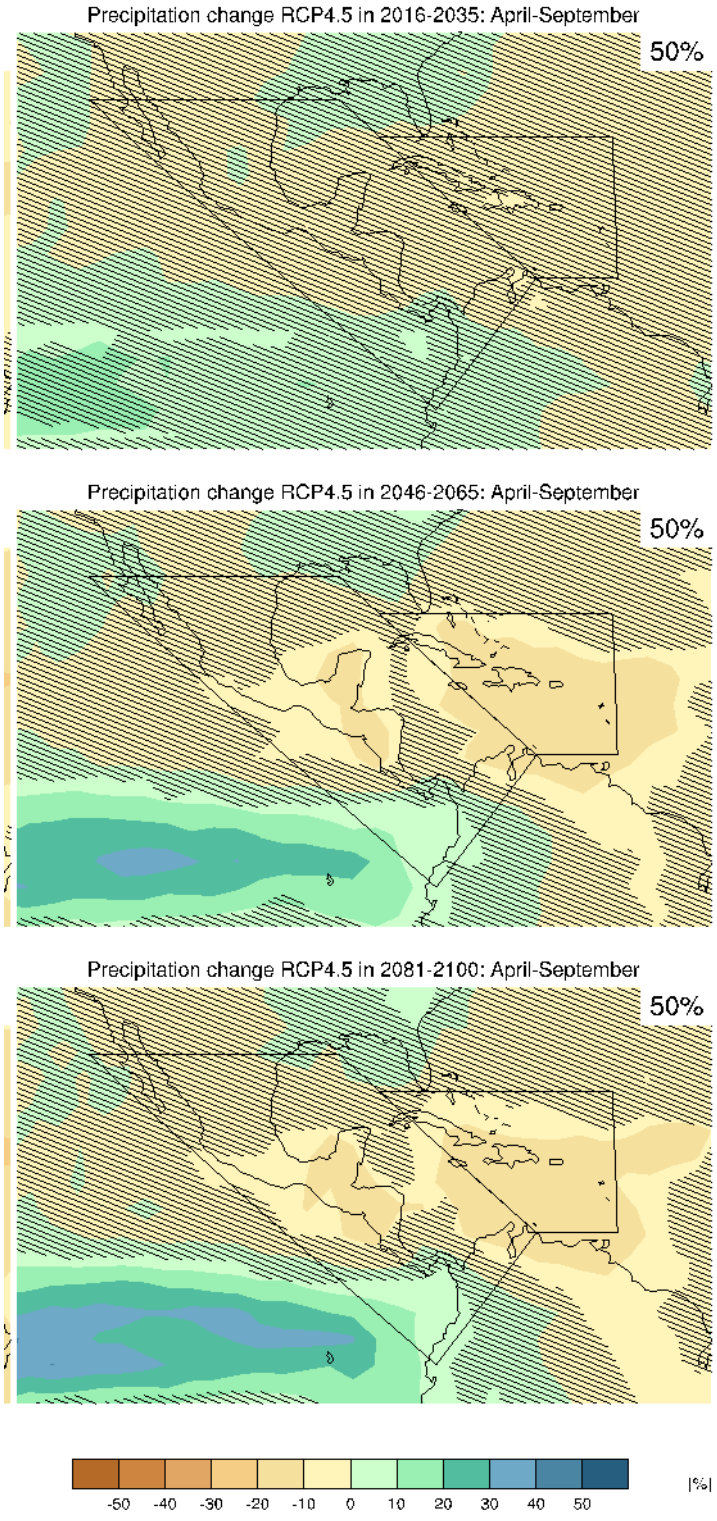


Time series of temperature change relative to 1986–2005 in Central America for June-August under four different RCP greenhouse gas emission trajectories for the 21st century. Thin lines denote model simulations; thick lines the multi-model mean. Source: Reproduced from Figure AI.25 in IPCC (2013) Working Group 1, Annex 1

Precipitation

The IPCC Fifth Assessment Report models (IPCC, 2013) predict a long-term drying trend in Central America, including Guatemala. The maps in Figure 7.2 show modelled precipitation changes for Central America from the IPCC report for 2016–2035 (top), 2046–2065 (middle), and 2081–2100 (bottom) with respect to 1986–2005. These maps represent climate predictions under a moderate scenario (RCP4.5) of anthropogenically-driven climate change. The models show large parts of Guatemala within the zone of maximum reductions in precipitation in both the mid- and late-century. For example, the map in Figure 7.2 shows a predicted 10-20 percent decrease in precipitation during the April-September period by mid-century (2046-2065) for eastern Guatemala, and for more of the country by late-century (2081-2100).

Figure 7.2: Predicted changes in precipitation in Central America to 2100



Source: Reproduced from Figure A1.27 in IPCC (2013) Working Group 1 Annex 1.

Ecological Effects

Guatemala's climate is complex, in part due to the topography of the country, which creates striking differences in precipitation on the windward and leeward sides of mountain ranges, for example in the Sierra de las Minas. This reduces the confidence with which regional projections of climate can be applied at smaller spatial scales within the country (Oglesby and Rowe, no date). Despite some level of local uncertainty, the consensus of models from the IPCC Fifth Assessment Report show at least 2 degrees C increase in average temperature and a 10-20% reduction in average precipitation relative to the present. It is highly likely that Guatemala will face a significantly drier and warmer climate during the coming decades of the century.

Ecologists often use temperature and precipitation to characterize "climate envelopes" for species and ecosystems (Whittaker, 1975). These envelopes outline the combinations of temperature and precipitation within which a species or ecosystem is found. A 2008 study of "Potential Impacts of Climate Change on Biodiversity in Central America" (CATHALAC, 2008) used temperature and precipitation predictions from the IPCC Fourth Assessment Report to model the ecological effects of climate change in the region, for example.

The predicted changes in temperature and precipitation in Guatemala would represent a significant shift the climates found at various elevations throughout the country, and would affect species and ecosystems. Areas suitable for montane broadleaf forests and cloud forests, which require cooler, wetter conditions, would decrease with warming and drying at higher elevations. Areas with climates suitable for dry forests would increase, as the climate zones they inhabit expand upward in elevation in a warmer, drier climate. The climate zone suitable for pine and pine-oak forests would shift upward in elevation, replacing some montane broadleaf forests. These predicted changes would affect ecological functioning, and therefore affect the products and services that ecosystems provide (Grimm *et al*., 2013; Nelson *et al*., 2013). This would in turn affect Guatemalans who depend on those products and services for their livelihoods and economic activities.

Tillandsia sp., a bromeliad "airplant," in the dry thorn scrub (*monte espinoso*) ecoregion in the Motagua Valley, lower watershed of the Río Teculután. Photo: B. Byers/DevTech, February 2016.

7.2 Climate Change and Conservation

The relationship between climate change adaptation and biodiversity conservation goes in two directions: biodiversity might be threatened by climate change, and conserving biodiversity might help societies adapt to the effects of climate change. Addressing the first of these issues could be called ***adaptation for conservation***, while addressing the second could be called ***conservation for adaptation*** (ARCC, 2013a).

Adjusting or adapting biodiversity conservation strategies and activities to take into account the fact that Earth's climate is changing starts with an assessment of the effects of predicted climate changes on species and ecosystems – essentially a vulnerability assessment for biodiversity. Options for adjusting conservation strategies and actions to address these vulnerabilities can then be identified (ARCC, 2013a).

Conserving biodiversity as a way to help human societies adapt to climate change first requires an assessment of how the benefits that biodiversity provide to human societies might be affected by predicted climate changes. Once this has been done, options for maintaining those ecosystem benefits can be incorporated into climate change adaptation strategies. This conservation-for-adaptation approach has been called an ***ecosystem-based approach*** to climate adaptation. Ecosystem-based approaches to adaptation make use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change.

Resilience is the capacity of a system to absorb disturbance and reorganize but still retain essentially the same function and structure. The concept of ecological resilience (Holling, 1973; Walker *et al*., 2004), like that of ecosystem services, is key to integrating climate change adaptation and biodiversity conservation. Many empirical and theoretical studies show that greater species-level biodiversity makes ecosystems more resilient to changes of all kinds, including climate change.

7.3 USAID Biodiversity and Climate Change Context

The concept of ecosystem-based approaches to climate adaptation springs from the fact that "biodiversity…helps people to adapt to climate change through providing the ecosystem services which reduce their vulnerability and enhance their adaptive capacity to change" (IUCN, 2011). The CBD has defined ecosystem-based adaptation as "the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change" (CBD, 2009). Although ecosystem-based adaptation is not a sufficient prescription for climate change adaptation everywhere and in every sector, in a country like Guatemala that is so heavily dependent on ecosystem services such as hydrological benefits in watersheds, and ecosystem products such as wood fuel, ecosystem-based approaches are needed to address key risks to development.

The 2014 USAID *Biodiversity Policy* states that ecosystem-based approaches to climate change adaptation, which take into account the value of biodiversity in providing ecosystems services,

> … can be a cost-effective way to help people adapt to climate change and buffer from climate-related shocks, while providing livelihood benefits that increase social resilience to such shocks. For vulnerable people dependent on ecosystem goods and services, ensuring that the protective and productive functions of ecosystems are maintained is crucial to successfully adapting to climate change. As a result, factoring in climate change and taking more adaptive approaches to conservation is becoming increasingly

> important to achieving conservation results and reducing people's vulnerability. (USAID, 2014)

USAID's *Climate Change and Development Strategy* lists 10 "Guiding Principles" (USAID, 2012), one of which is "value ecosystem services." This principle provides a strong link between biodiversity conservation and climate change because biodiversity is the source of all ecosystem services (Byers, 2012). The *Climate Change and Development Strategy* states that Although these [ecosystem] services are critical to development, they are often not valued appropriately in the marketplace. For example, forests offer more than just timber for harvest… [they store] carbon; … reduce erosion, improve the quantity and quality of water. Strategic investments in ecosystem services can mitigate the impacts of climate change (USAID, 2012). USAID's policies and guidance generally describe both climate change adaptation and biodiversity conservation as cross-cutting, cross-sectoral issues and needs.

An Executive Memorandum from President Obama, "Incorporating Ecosystem Services into Federal Decision Making (Memorandum M-16-01) was released on 7 October, 2015. The memorandum notes that ecosystem services are "benefits that contribute to our economic prosperity, protect the health and safety of vulnerable populations, and help build more resilient communities" but that they are often overlooked" and that "integrating ecosystem services into planning and decision-making can lead to better outcomes, fewer unintended consequences, and more efficient use of taxpayer dollars and other resources.

The Executive Memorandum on Ecosystem Services directs all Federal agencies, including USAID, "to incorporate the value of natural, or "green," infrastructure and ecosystem services into Federal planning and decision making" (Executive Office of the President, 2015).

Recent new guidance to USAID missions is contained in "Climate Change in USAID Strategies, A Mandatory Reference for ADS Chapter 201" (USAID, 2015). This guidance is a first step for USAID in implementing President Obama's Executive Order (EO) 13677 on "Climate-Resilient International Development ," The new guidance notes that "Climate variability and change is a cross-cutting issue that can undermine development progress and increase risk and insecurity throughout developing countries," but "At the same time, climate change challenges offer important opportunities and incentives to take actions that contribute to development. By considering climate risks and opportunities at the strategy, project and/or activity level as part of the planning and design process, USAID can increase the sustainability and impact of its investments." The new ADS 201 Mandatory Reference describes the process through which climate change risks should be screened and addressed, as well as considerations for climate change mitigation in USAID strategies.

Taken as a whole, these USAID strategies, policies, and guidance documents point strongly in the direction of integrating forest and biodiversity conservation and climate change adaptation and mitigation in Guatemala.

7.4 Actions Needed for Adaptation and Resilience

USAID/Guatemala's 2012-2016 CDCS noted that: "In 2010, USAID Guatemala supported the Ministry of Environment's development of two key documents: *Evaluation of Impacts of Climate Change on Biodiversity and Tropical Forests* and *Recommendations for Mitigation and Adaptation for Guatemala*. A number of recommendations pertaining to climate change adaptation and mitigation policies, as well as territorial planning instruments were developed and elaborated upon in these documents. The main recommendations highlight the developing of new and improved protected areas and redesigning of the proposed National Ecological

Corridors; halting deforestation; developing financial mechanisms for biodiversity management and adaptation to climate change; increasing investment in traditional knowledge and technological development; reengineering of the GOG institutional environment sector; and increasing information dissemination and awareness activities."

USAID/Guatemala's CNCG Project has already begun to implement some of the recommendations for needed actions already identified. One study collected traditional knowledge of climate adaptation practices in the Western Highlands, where the diverse indigenous population is a repository of traditional knowledge relevant to adaptation to climate variability and change.

As discussed in Chapter 7, our key informants identified the need to improve climate change resilience as one of the top ten issues facing Guatemala. Actions needed for climate change adaptation from these informants and other sources that we analyzed include the following:

1) Strengthen climate change mitigation actions (but in fact Guatemala is a tiny emitter, and not that big a sink…)

- Forest protection, REDD+ projects
- Forest restoration and agroforestry
- Renewable energy/LEDS, including micro-hydroelectric systems
- Protect the Mesoamerican Reef (corals sequester carbon)

2) Strengthen climate change adaptation actions:

- Emphasize water as an integrating ecosystem service, and forest and watershed management as the key to an ecosystem-based approach to climate change resilience
- Strengthen hydro-meteorological monitoring system, develop water balance and models for all major watersheds, including Guatemala City region
- Develop a Water Law that reflects climate change adaptation needs and provides a foundation for integrated watershed management and PSA/PES mechanisms
- Protect all remaining montane humid broadleaf forests (e.g. cloud forests) (in all areas: *Cadena Volcánica*, Los Cuchumatanes, Sierra de las Minas…)
- Manage upland pine and pine-oak forests to maintain ecohydrological roles
- Manage fire in upland pine and pine-oak forests to increase resilience in a warming, drying climate
- Restore fire as needed to reduce fuel loads and restore natural stand structure in fire-tolerant/dependent *Pinus oocarpa* forests; prevent and/or control wildfires in critical watersheds
- Manage upland pine and pine-oak forests to increase resistance to epidemics of pine bark beetle (*gorgojo de pino*), which may be associated with climate stress

8.0 USAID/Guatemala Contributions to Actions Necessary

In the Introduction, we explained the legal requirement for the FAA 118-119 analyses described in this report. The language of FAA Sections 118 and 119 require that after we have identified the actions necessary for conserving tropical forests and biodiversity in Guatemala, we then examine "the extent to which the actions proposed for support by the Agency meet the needs thus identified." To fulfil this requirement, we now discuss the programs and projects currently being undertaken by USAID/Guatemala. We have been told by the Mission that these ongoing programs should form the basis of our "extent to which" analysis because the current CDCS will be extended by one or more years, because of the new administration in Guatemala, and the upcoming U.S. presidential election. The development of a new CDCS to replace the current 2012-2016 CDCS is at an early stage, so we are not able to assess the future actions to be proposed in the next CDCS. We here compare current USAID programs with the actions needed for sustainably managing Guatemala's forests and biodiversity that were presented in Chapter 7.

It should be noted that FAA Sections 118-119 do not obligate USAID to address any of the "actions necessary" that were identified. To meet the second part of the legal requirement, the Mission essentially has three options. It can:

- Explain why the Mission is not doing anything to meet the "needs thus identified;"
- Explain how activities supporting other Intermediate Results (IRs) and Development Objectives (DOs) in the portfolio will help to meet some of the "needs thus identified;" or
- Propose a Development Objective (DO) that would address some of the "needs thus identified."

USAID/Guatemala has taken the third option; its 2012-2016 CDCS incorporates a DO in support of tropical forest and biodiversity conservation. We assume that there is a high probability that the next CDCS will do so also.

8.1 Overview of USAID/Guatemala Programs

The Assessment Team reviewed the USAID/Guatemala CDCS, covering the period of 2012-2016, and to be extended. The goal of current USAID programming in Guatemala is stated as "A More Secure Guatemala that Fosters Greater Socio-economic Development in the Western Highlands and Sustainably Manages its Natural Resources." Note the geographic emphasis on the Western Highlands of the country, one of the ways in which the Mission is trying to focus and concentrate its development efforts. The three Development Objectives (DOs) of the current CDCS are summarized below, and Figure 8.1 shows a map of the geographic coverage of activities under these DOs.

DO 1: Greater Security and Justice for Citizens

The main focus of this DO has been "citizen security" and violence prevention, but USAID/Guatemala is moving to broaden the focus to what could be called "accountable governance." A local governance program is integrated into the Western Highlands Integrated Program (WHIP) because they are working with municipalities there. One project supporting this DO has been the Security and Justice Sector Reform Project, implemented by Checchi and Company Consulting. This project has done some work on governance in Petén with biodiversity funds. This DO complements work carried out by other U.S. Government agencies, some of which is funded by CARSI. The approach is also aligned with the USG Central America Strategy and the Counter Illicit Trafficking Strategy.

DO 2: Improved Levels of Economic Growth and Social Development in the Western Highlands
The development hypothesis underlying this DO is that improvements in the income, health and nutrition, and education of Guatemala's rural poor will foster the sustainable rural development necessary for social and economic equity. The Western Highlands Integrated Program (WHIP) works in 30 municipalities and integrates DO 2 activities involving three presidential initiatives: Feed the Future (FTF), the Global Health Initiative, and the Global Climate Change Initiative. FTF includes a rural value chains component with three value chains: coffee, handicrafts, and vegetables and cardamom. The project promotes switching from sprinkle to more water-efficient drip irrigation and promotes home gardens for food security. WHIP works mainly with 30 municipalities, but they work some with the Ministry of Agriculture, Livestock, and Food (MAGA) on policy-related issues. Global Climate Change funding for adaptation is used in Western Highlands as part of WHIP, and supports improved climate information, awareness of climate change, and climate-smart agricultural practices.

DO 3: Improved Management of Natural Resources to Mitigate Impacts of Global Climate Change
The development hypothesis underlying this DO is "that community-based economic incentives for conservation and protection of biodiversity, coupled with improved enforcement of existing environmental regulations and improved national policies, will safeguard the resource base necessary for sustainable rural development and thus contribute to Guatemala's increased prosperity." Global Climate Change adaptation funds are being used in the Western Highlands. Climate Change mitigation funding, aimed at reducing greenhouse gas emissions through Low Emissions Development Strategies (LEDS) or carbon sequestration in forests (REDD+), is used to support activities in the Maya Biosphere Reserve and the Sierra de las Minas.

In order to achieve DO 3, USAID/Guatemala is supporting two main projects. The ***Climate, Nature and Communities in Guatemala (CNCG) Program*** (2013-2018) has five components:

- assisting rural communities to conserve biodiversity by supporting development of small and medium enterprises to sustainably produce timber and non-timber forest products, community forest concessions, strengthening value chains and market mechanisms;
- promoting national strategies to reduce deforestation and forest degradation (REDD+ mechanisms) and establish carbon markets;
- strengthening the resilience and capacity of communities to adapt to the effects of climate change;
- strengthening the capacity of national environmental organizations; and
- supporting steps toward a national low emissions development strategy (LEDS).

The program is working in four regions: the Maya Biosphere Reserve, Western Highlands Las Verapaces, and the Sierra de las Minas Biosphere Reserve. It is being implemented by a consortium of organizations, led by the Rainforest Alliance (RA), and includes also the World Wildlife Fund (WWF), The Nature Conservancy (TNC), Universidad del Valle de Guatemala (UVG), Defensores de la Naturaleza, and AGEXPORT: Asociación Guatemalteca de Exportadores.

Guatemala is a focus country in USAID's EC-LEDS program, and the ***Low Emissions Development Project*** (2014-2019) is being implemented by the International Resources Group (Engility-IRG). Guatemala's 2013 Climate Change Framework Law created the government structure to address climate change priorities, including reducing greenhouse gas emissions or sequestering carbon in forests through REDD+ mitigation measures. Through the Guatemala LEDS Project USAID is:

- working with key private sector counterparts, including industry associations, farmer associations, and cooperatives, to implement practices and technologies that reduce GHG emissions, improve competitiveness, and increase manufacturing efficiencies in the Guatemalan economy.
- engaging communities to advance market-driven conservation strategies that support the development and implementation of national and subnational REDD+ strategies, while enhancing adaptation capacity to the impacts of climate change. – Ongoing
- supporting the Guatemala Zero-Carbon Footprint Initiative.
- updating forest cover and land use maps needed to plan and implement more sustainable forest management practices.

9.0 Opportunities for USAID/Guatemala

This assessment identified thematic and geographic gaps where USAID and other international donors could catalyze needed changes in the natural resources and conservation "landscape" in Guatemala. These general categories of strategic "actions necessary" to conserve forests and biodiversity represent future opportunities for USAID, and the Assessment Team recommends that they be considered when USAID/Guatemala is developing its new CDCS. Because this assessment is being conducted as USAID/Guatemala is extending its current CDCS, detailed recommendations would be premature at this time.

9.1 Emphasize Governance and Institutional Capacity

As discussed in Chapter 6 of this report, our key informants emphasized the need for improved governance of natural resources. Among the 157 suggestions for "actions needed" made by these experts and stakeholders, 50, or 32% of the total, could be summarized as the need to create needed policies, laws, strategies, and plans -- essentially the governance "architecture" for environmental management. Another 26 suggestions, 17% of the total, related to the need to reform and strengthen the capacity of the institutions with forest and biodiversity responsibilities. And another 17 suggestions, 11% of the total, were actions that would stop illegal activities that threaten forests and biodiversity. Taken together, therefore, 60% of the suggestions for "actions necessary" that we heard related to governance and institutional capacity, and this as strong evidence that there is much work to be done. Improving governance and strengthening institutional capacity therefore represents a large opportunity for USAID and other international donors to assist Guatemala with its main challenge to environmentally and socially sustainable development.

One key informant captured this general view that improving governance is the highest priority, stating that "Donor funding should emphasize institutional strengthening, because institutional weakness and lack of capacity is the main driver, and root cause, of threats to forests, biodiversity, and environment in Guatemala." Donors like USAID have several avenues for doing this in their programs. They can support civil society NGOs and private sector associations that can advocate for reform and strengthening of government agencies. Donors can also use diplomatic channels to influence the Government of Guatemala, or conditionality linked to their aid programs to encourage or catalyze needed change in GoG institutions. One of our informants, for example, stated that "the U.S. Embassy and USAID need to apply diplomatic pressure and provide incentives for needed structural and institutional changes in the GoG, directly and also indirectly related to environmental issues."

For long-term sustainability, the Government of Guatemala needs to adequately fund its agencies to carry out the actions they are responsible for. If donors cannot catalyze that, they are at risk of creating donor dependency and wasting their investment in the long run. Several people we talked to suggested that until the presence of the state and the rule of law was re-established in Petén, for example, investments in forest and biodiversity conservation there would be wasted. Some of these people proposed that the U.S. Government and USAID could use far stronger diplomatic pressure and aid conditionality to stop illegal, drug-related activity in Petén, and suggested that this should be a national security issue for the United States.

9.2 Integrate Biodiversity Conservation, Economic Development, and Climate Resilience at a Watershed Scale

In various programs and projects, USAID/Guatemala has moved toward programmatic integration, including in the WHIP, CNCG, and LEDS programs. Our key informants are

encouraged by this, but many feel that much more could be done. Several of these informants suggested that USAID programming sometimes still seems to treat biodiversity conservation as a sector, rather than a cross-cutting topic, to be mainstreamed in all of its sectoral programs. USAID Biodiversity Policy suggests that biodiversity conservation is, like climate change, a cross-sectoral foundation for sustainable development (USAID, 2014).

Through a new Executive Order on "Climate-Resilient International Development" (USAID, 2015) and an Executive Memorandum on "Incorporating Ecosystem Services into Federal Decision Making" (Executive Office of the President, 2015), President Obama has set the stage for integrating climate change and biodiversity conservation in USAID programs. Along with the USAID Climate Change and Development Strategy (USAID, 2012) and USAID Biodiversity Policy (USAID, 2014), these executive directives point USAID strongly in the direction of taking an integrated, ***ecosystem-based approach*** to resilient and sustainable social and economic development. All of these USAID guidance documents and Executive Branch initiatives just cited have been developed since USAID/Guatemala's current CDCS was developed. USAID/Guatemala therefore has an excellent opportunity to take the lessons it has already learned about integration and ecosystem-based approaches to climate change adaptation and mitigation, and use them to integrate their programs even more deeply in the next CDCS.

Many of our key informants raised the issue of water in our discussions of forests and biodiversity. Several proposed that water issues were a theme that integrated the protection of forests with societal needs because water is an irreplaceable resource for human health and sanitation, agricultural production, and economic development produced by ecohydrological processes in watersheds. USAID/Guatemala should use water as the concept for integrating climate change mitigation, adaptation, and forest and biodiversity conservation. The Mission should apply and demonstrate the "ecosystem-based approach" to climate change adaptation in its next CDCS.

In Chapter 2 we introduced a topographic perspective on Guatemala's ecoregions, organizing them into five categories that share similar elevational, topographic, and climatic features, and which in turn lead to structural and functional ecological similarities: 1) montane humid broadleaf forests (e.g. cloud forests); 2) pine and pine-oak forests; 3) humid broadleaf forests; 4) dry deciduous forests and thorn scrub; and 5) mangroves. Each of these five forest ecosystem types makes unique and irreplaceable contributions to ecosystem benefits, as was discussed in Chapter 3, and each is facing certain unique kinds of threats, as discussed in Chapter 5. Generally speaking, ecological processes and functions of these five ecosystem types are linked through the ecohydrological processes taking place in watersheds. Using a watershed perspective in planning and management automatically creates a platform for integration of ecological and social systems.

Figure 9.1 presents a "top-of-watersheds" view of the ecoregions of Guatemala. The water-capturing cloud forests and other montane humid broadleaf forests at the tops of watersheds, and the belts of pine and pine-oak forests that surround them, are circled in red. Top-of-watershed ecosystems such as high-elevation montane humid broadleaf forests and mid-elevation pine and pine-oak forests deserve a great deal of attention and investment because of the role they play in ecohydrology, and are priorities for good forest management. Parts of them are already protected in Guatemala's protected areas system.

Figure 9.1: Top-of-Watersheds Ecoregions (red circles)

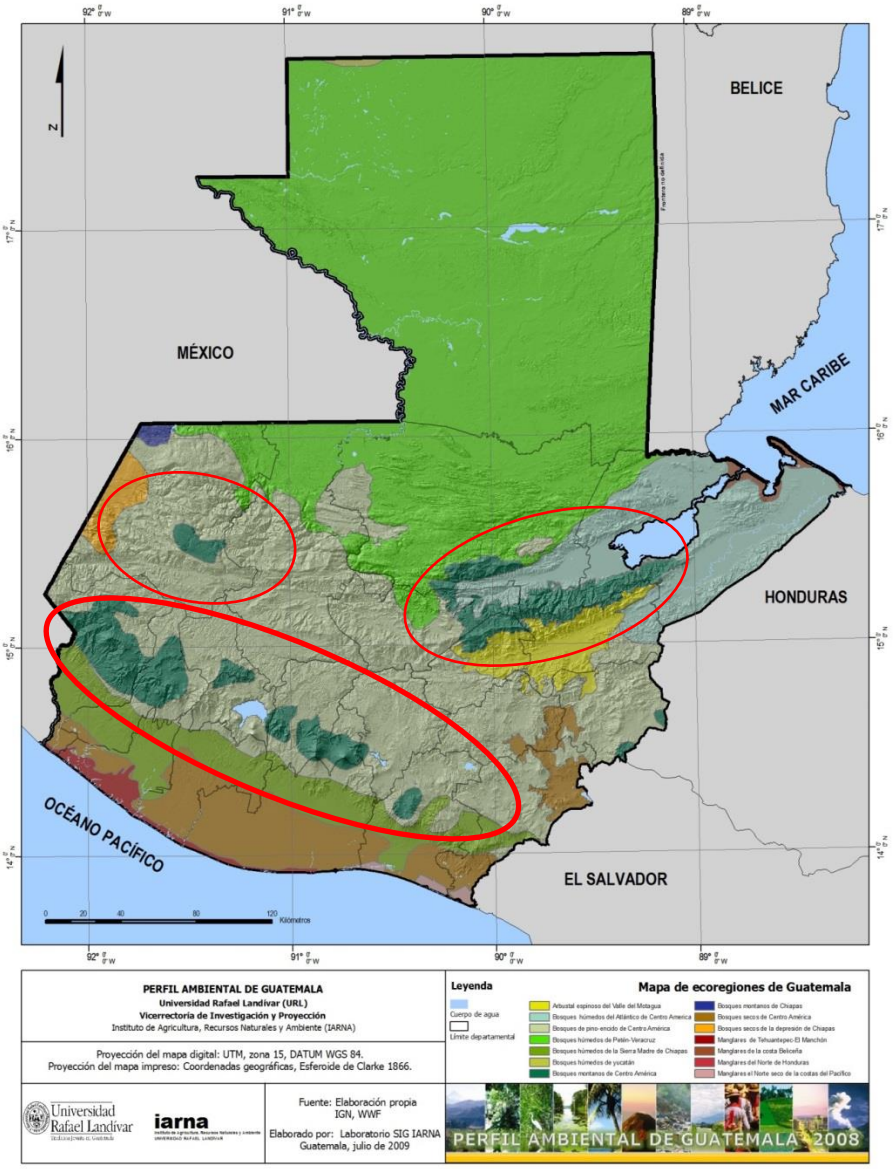
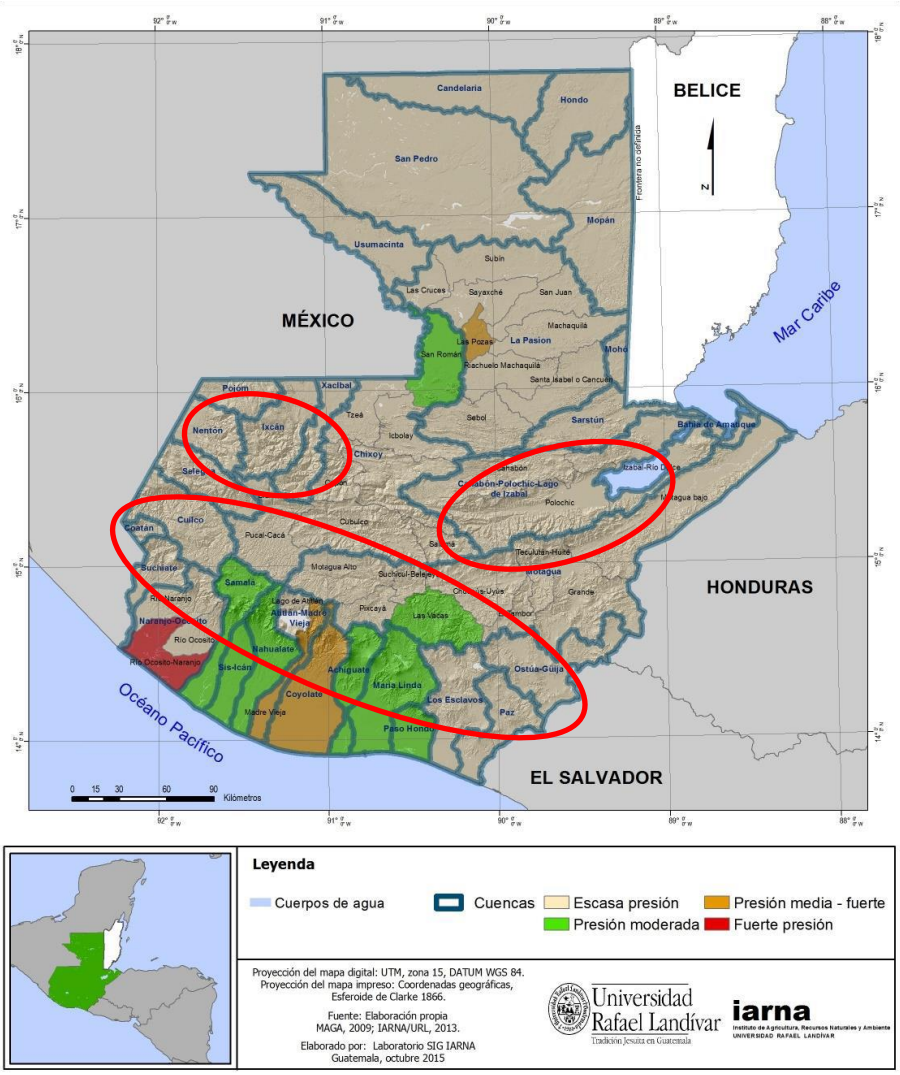


Figure 9.2 presents a map showing hydrological "pressure," or level of potential water conflict due to the balance in water supply versus water demand by users of various kinds. The red lines encircling the tops of the watersheds from Figure 9.1 have been retained on this map. The map suggests that the watersheds of the Pacific Slope are in especially critical need of attention and action. Those watersheds, starting in the high-elevation forests of the Volcanic Chain, and draining steeply to the Pacific plain and coastal mangrove zone, represent prime opportunities for applying a watershed-based approach.

Figure 9.2: Water Stress Index by Watershed



Source: IARNA, 2015

9.3 Expand Geographic Focus of Forest and Biodiversity Investment

The discussion in the previous section suggests that the Volcanic Chain and Pacific Slope, where USAID/Guatemala is currently not very active, represent a new opportunity for supporting ecosystem-based, watershed-scale approach to biodiversity conservation and climate-resilient development. In the Western Highlands and Sierra de las Minas, which do cover geographic "top-of-watershed" areas, the Mission could strengthen the integration of its programs in its new CDCS by the deliberate use of an ecosystem-based approach to climate resilience, and a watershed focus.

9.4 Generate Information to Catalyze Change

Many of our key informants told us about the need for actions to catalyze change in environmental management in Guatemala. Information can often be catalytic. Many kinds of information could potentially inform, if not catalyze, actions needed. A few examples are given below.

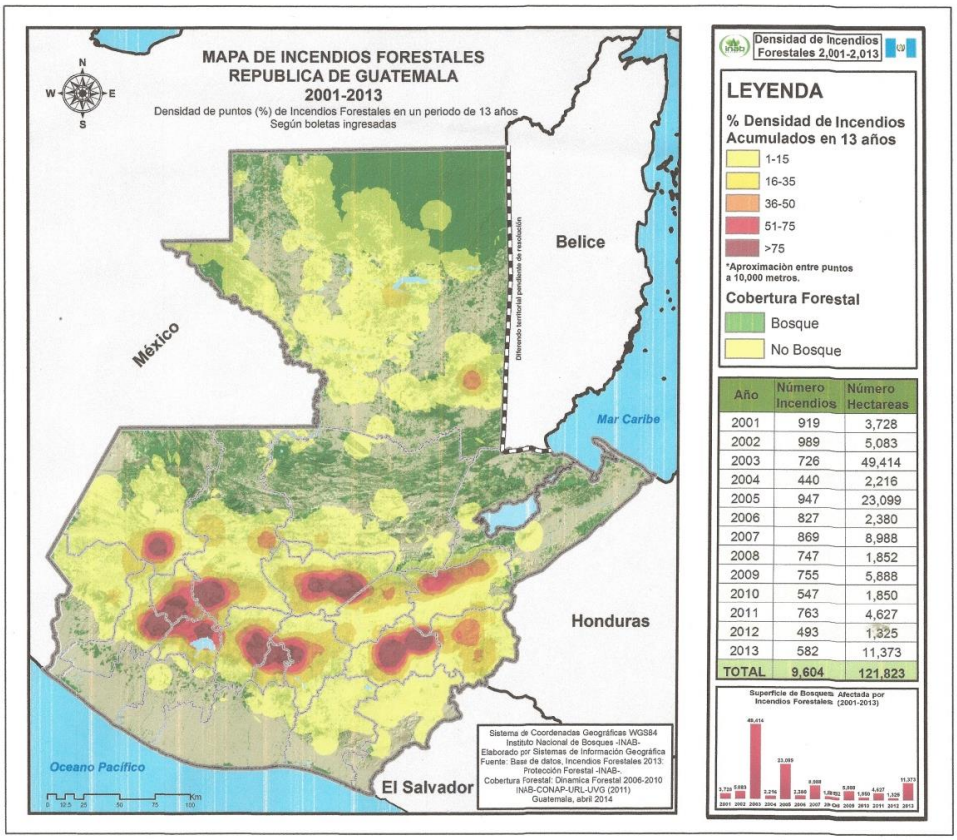
One example related to water and hydrology that we heard about was a study that identified, using stable isotopes of hydrogen and oxygen, critical areas for water recharge of the aquifer of the lower watershed of the Río Pasabien, which flows from the Sierra de las Minas Biosphere Reserve (IARNA and WWF, 2015). Another example is a study of the hydrology of the Guatemala City metropolitan zone (IARNA/URL, 2013), which pointed to serious issues of future water scarcity. Water is now being extracted from aquifers around the city at five times the rate of recharge, so wells are going deeper and deeper. Without regulation, integrated water management, and watershed protection, this situation is clearly unsustainable. This is the kind of information that could potentially catalyze change in water management in the metropolitan zone. Information is not always catalytic, however – other factors such as political or economic ones can block collective action that information shows clearly to be needed.

In the area of forest management, one clear need is for better understanding and application of the principles of fire ecology in the fire-prone, and fire tolerant, pine and pine-oak forests. The highest fire incidence is recorded in these forests, as shown in Figure 9.3

A dominant species in these forests, *Pinus oocarpa*, is very fire-adapted, fire-tolerant, and to an extent fire-dependent for its reproduction. Fire suppression in such forests is a long-term threat to the forests, and could change the fire regime from one of relatively frequent, low-intensity fires to less frequent but much more intense and destructive fires. Good, updated information on the fire ecology, stand condition, and fuel loading in these forests is needed to manage fire, and even restore it as a management tool. A warmer, drier climate is likely to create conditions for more frequent fires. Since these forests play an important role in the ecohydrology of Guatemala's watersheds, water management also must be linked to fire management.

Response to outbreaks of the pine bark beetle (*gorjojo de pino*) in Guatemala is another issue where scientific information is needed for understanding and implementing effective actions (Billings et al., 2004). Since these pine beetles have evolved in Central American pine forests for millions of years, they are not the same kind of "threat" as an invasive species might be. However, climate change may be influencing their ecology, or that of their host trees. Appropriate applied research and information is needed to make decisions about how to respond to and manage these beetles.

Figure 9.3: Fire Incidence in Guatemala 2001-2013



Source: INAB, 2014

Dense pine (*Pinus oocarpa*) forest on steep slopes of the watershed of the Río Pasabien, Zacapa. Tree on the left has an old fire scar at its base, showing that it survived a past fire. Photo: B. Byers/DevTech, February 2016.

References Cited

ARCC (African and Latin American Resilience to Climate Change Project). 2013a. Integrating Climate Change Adaptation into Biodiversity and Forestry Assessments and Programming.

ARCC. 2013b. Vulnerability and Resilience to Climate Change in Southern Honduras.

Barfod, Anders S., Melanie Hagen, and Finn Borchsenius. 2011. Twenty-five years of progress in understanding pollination mechanisms in palms (Arecaceae). Annals of Botany **108** (8): 1503-1516. http://aob.oxfordjournals.org/content/early/2011/08/09/aob.mcr192.full

Batres, Alexis. 2015. Una mirada al tráfico de la vida silvestre en Guatemala. Insigth Crime. Accesado el 26 de febrero de 2016. http://es.insightcrime.org/analisis/mirada-trafico-vida-silvestre-guatemala

Billings, R.F., S.R. Clarke, V. Espino Mendoza, P. Cordón Cabrera, B. Melendez Figueroa, I. Ramon Campos, and G. Baeza. 2004. Bark beetle outbreaks and fire: a devastating combination for Central America's pine forests. Unasylva **217** (55): 15-21.

Byers, B.A. 2012. Defining Ecosystem Services and Designing Mechanisms for Their Conservation. Ecological Society of America presentation, 9 August 2012.

CATHALAC: 2008. Potential Impacts of Climate Change on Biodiversity in Central America, Mexico, and the Dominican Republic.

CBD (Convention on Biological Diversity). 2009. Connecting Biodiversity and Climate Change Mitigation and Adaptation: Report of the Second Ad Hoc Technical Expert Group on Biodiversity and Climate Change. CBD Integrating Climate Change Adaptation into Biodiversity and Forestry Assessments and Programs Technical Series No. 41.

CEMEC (Centro de Monitoreo y Evaluación CONAP). 2013. Monitoreo de la Gobernabilidad en la Reserva de la Biosfera Maya. (Presentation) http://www.marfund.org/wp-content/uploads/2015/07/marfund_cemec_conap.pdf

CONAP. 2014a. V Informe Nacional de cumplimiento a los acuerdos del Convenio sobre Diversidad Biológica en Guatemala. Documento Técnico No. 03-2014.

CONAP. 2014b. Informe de la efectividad de manejo de las áreas protegidas del SIGAP 2009-2012. Editado por Ortiz, GA. Diaz, AG. Utrera LP, Gdoy, CE, Guatemala 204 p.

CONAP and WCS (Consejo Nacional de Áreas Protegidas and Wildlife Conservation Society). 2014. Monitoreo de la Gobernabilidad de la Reserva de la Biosfera Maya. (report)

Dix, M.A and M.W. Dix. 2006. Diversity, Distribution, Ecology and Economic Importance of Guatemalan Orchids. En: Biodiversidad de Guatemala. Cano, E (Ed). Guatemala: Universidad del Valle de Guatemala.

ECLAC (Economic Commission for Latin America and the Caribbean). 2010. The Economics of Climate Change in Central America: Summary 2010. ECLAC, United Nations. November 2010.

Executive Office of the President. 2015. Incorporating Ecosystem Services into Federal Decision Making (Memorandum M-16-01). https://www.whitehouse.gov/sites/default/files/omb/memoranda/2016/m-16-01.pdf

Franklin, J.F. 1993. Preserving biodiversity: species, ecosytems, or landscapes. Ecological Applications 3: 202-205.

GIMBUT (Grupo Interinstitucional de Monitoreo de Bosques y Uso de la Tierra). 2014. Mapa de Bosques y Uso de la Tierra República de Guatemala.

Grimm, N.B., F.S. Chapin III, B. Bierwagen, P. Gonzalez, P.M. Groffman, Y. Luo, F. Melton, K. Nadelhoffer, A. Pairis, P.A. Raymond, J. Schimel, and C.E. Williamson. (2013). The impacts of climate change on ecosystem structure and function. Frontiers in Ecology and the Environment 11(9): 474-482.

Holling, C.S. (1973). "Resilience and stability of ecological systems". *Annual Review of Ecology and Systematics* **4**: 1–23. doi:10.1146/annurev.es.04.110173.000245 Accessed 13 Nov. 2012.

IARNA/URL (Instituto de Agricultura, Recursos Naturales y Ambiente-Universidad Rafael Landívar). 2005. Situación del Recurso Hídrico en Guatemala. Documento Técnico del Perfil Ambiental de Guatemala.

IARNA-URL. 2012. Perfil Ambiental de Guatemala 2010-2012. Vulnerabilidad local y creciente construcción de riesgo. Guatemala. Autor.

IARNA-URL. 2013. Bases técnicas para la gestión del agua con visión de largo plazo en la zona metropolitana de Guatemala.

IARNA/URL 2015. Aplicaciones de política de las cuentas de agua: un estudio de caso de Guatemala. En Compilación de notas sobre capital natural (pp. 51-61).

INE (Instituto Nacional de Estadística). 2014. Encuesta Nacional de Condiciones de Vida.

INE, BANGUAT y IARNA-URL (Instituto Nacional de Estadística, Banco de Guatemala e Instituto de Agricultura, Recursos Naturales y Ambiente de la Universidad Rafael Landívar). 2013a. Sistema de Contabilidad Ambiental y Económica para Guatemala 2001-2010: compendio estadístico SCAE 2001-2010. Tomo I.

INE, BANGUAT y IARNA-URL 2013b. Sistema de Contabilidad Ambiental y Económica para Guatemala 2001-2010: compendio estadístico SCAE 2001-2010. Tomo II. Guatemala. Autor.

INAB (Instituto Nacional de Bosques). 2014. Boletín Estadístico 1998-2014. Departamento de Incentivos. Manuscrito no publicado.

INAB. 2014. Mapa de Incendios Forestales Republica de Guatemala 2001-2013. http://www.inab.gob.gt/Imagenes/Mapas/Incendios/2013/Incendios_2001_2013_.pdf

INAB, IARNA-URL, and FAO (Instituto Nacional de Bosques, Instituto de Agricultura, Recursos Naturales y Ambiente-Universidad Rafael Landívar, Programa de las Naciones Unidas para la

Agricultura y la Alimentación). 2012. Oferta y demanda de leña en la República de Guatemala/Woodfuel Interated Supply/Demnad Overview Mapping.

Incer, D.J. 2012. Determinación del balance hidrológico del ecosistema del bosque nuboso de la Sierra de las Minas en la microcuenca de Teculután, Zacapa, Guatemala. Thesis. Facultad de Ciencias Ambientales y Agrícolas, Universidad Rafael Landívar.

Intergovernmental Panel on Climate Change (IPCC). 2013. Working Group I Contribution To The IPCC Fifth Assessment Report (AR5), Climate Change 2013: The Physical Science Basis. IPCC Secretariat, Geneva. Available at: www.ipcc.ch

IPCC Annex I: Intergovernmental Panel on Climate Change. (2013). Atlas of Global and Regional Climate Projections - Final Draft Underlying Scientific- Technical Assessment. IPCC Secretariat, Geneva. Available at: www.ipcc.ch

Kreft, S. D. Eckstein, L. Dorsch, and L. Fischer. 2016. Global Climate Risk Index 2016. https://germanwatch.org/en/download/13503.pdf

López-Selva, M. et al 2008. Biodiversidad acuática. En: Guatemala y su Biodiversidad: Un enfoque histórico, cultural, biológico y económico. CONAP (Ed). Guatemala: CONAP

MARN: Ministerio de Ambiente y Recursos Naturales. 2009. Watersheds of Guatemala (map).

MARN. 2009. Política Nacional de Cambio Climatico. http://www.segeplan.gob.gt/downloads/clearinghouse/politicas_publicas/Recursos%20Naturales/Politica%20Nacional%20de%20Cambio%20Clim%C3%A1tico%20Guatemala.pdf

Méndez, C. 2008. Diversidad faunística de Guatemala. En: Guatemala y su Biodiversidad: Un enfoque histórico, cultural, biológico y económico. CONAP (Ed).

Mitton, J.B., and S.M. Ferrenberg. 2012. Mountain Pine Beetle Develops an Unprecedented Summer Generation in Response to Climate Warming. The American Naturalist, Vol. 179, No. 5 (May 2012), pp. E163-171. http://www.jstor.org/stable/pdfplus/10.1086/665007.pdf?acceptTC=true

Nelson, E.J., P. Kareiva, M. Ruckelshaus, K. Arkema, G. Geller, E. Girvetz, D. Goodrich, V. Matzek, M. Pinsky, W. Reid, M. Saunders, D. Semmens, and H. Tallis. (2013. Climate change's impact on key ecosystem services and the human well-being they support in the US. Frontiers in Ecology and the Environment 11(9): 483-493.

Oglesby, R. and C. Rowe. No date. Climate Change Science for Mesoamerican Decision Makers: A Practical Manual. University of Nebraska-Lincoln. http://www.uncclearn.org/sites/default/files/inventory/idb26.pdf

Oglesby, R. and C. Rowe. No date. Informe Final: Impactos climáticos para Guatemala: Resultados preliminares de los modelos climáticos regionales y globales IPCC AR5. MARN and BID.

Olson, D. M., Dinerstein, E., Wikramanayake, E. D., Burgess, N. D., Powell, G. V. N., Underwood, E. C., D'Amico, J. A., Itoua, I., Strand, H. E., Morrison, J. C., Loucks, C. J., Allnutt, T. F., Ricketts, T. H., Kura, Y., Lamoreux, J. F., Wettengel, W. W., Hedao, P., Kassem, K. R.

2001. Terrestrial ecoregions of the world: a new map of life on Earth. Bioscience 51(11):933-938. http://www.worldwildlife.org/publications/terrestrial-ecoregions-of-the-world

Plan Regional de Pesca y Acuicultura Regional PREPAC. 2005. Inventario de cuerpos de agua de Guatemala con énfasis en la pesca y acuicultura. Guatemala: OSPESCA-MAGA.OIRSA.

The Nature Conservancy. 2015. Conocimientos Tradicionales para la Adaptación al Cambio Climático en el Altiplano Occidental de Guatemala, Guatemala. http://www.usaid-cncg.org/wp-content/uploads/2015/03/Conocimientos_tradicionales_ccl_final.pdf

Thomas, J.W., J.F. Franklin, J. Gordon, and K.N. Johnson. 2005. The Northwest Forest Plan: Origins, Components, Implementation Experience, and Suggestions for Change. Cons. Bio. 20: 277-287.

Tuna M., & Dimas, L. (2007). Valoración económica de Servicios Hidrológicos Sub Cuenca Teculután, Guatemala. Compensación equitativa por servicios hidrológicos.

UICN y IARNA-URL (Unión Mundial para la Conservación de la Naturaleza e Instituto de Agricultura, Recursos Naturales y Ambiente-Universidad Rafael Landívar). 2015. Capítulo Introductorio sobre las Generalidades del Sector Forestal. Manuscrito no publicado.

UNISDR (United Nations International Strategy for Disaster Reduction Secretariat). 2009. Global Assessment Report on Disaster Risk Reduction. http://www.preventionweb.net/english/hyogo/gar/report/index.php?id=9413

USAID. 2012. *Climate Change and Development: Clean Resilient Growth: USAID Climate Change and Development Strategy*. January 2012.

USAID, 2014. USAID Biodiversity Policy.

USAID/Guatemala. 2010. Guatemala Biodiversity and Tropical Forest Assessment. Prepared by the International Resources Group, Environmental Policy and Institutional Strengthening Indefinite Quantity Contract (EPIQ).

USAID/Guatemala. 2010. Guatemala Biodiversity and Tropical Forest Assessment. Prepared by the International Resources Group (IRG) in collaboration with Abt Associates.

USAID-Guatemala. 2012. Guatemala Country Development Cooperation Strategy 2012-2016.

Vargas-Rodríguez, Yalma L. 2010. Una población relicta de *Acer saccharum* subsp. *skutchii* (Aceroideae) en el estado de Guerrero, México. Act. Bot. Mex no.95 Pátzcuaro abr. 2011.

Vargas-Rodriguez, 2005. Ecology of Disjunct Cloud Forest Sugar Maple Populations (*Acer Saccharum* Subsp. *Skutchii*) in North And Central America**.** http://etd.lsu.edu/docs/available/etd-07152005-083738/unrestricted/Vargas-Rodriguez_thesis.pdf

Veliz, M. 2008. Diversidad florística de Guatemala. En: Guatemala y su Biodiversidad: Un enfoque histórico, cultural, biológico y económico. CONAP (Ed).

Walker, B., Holling, C. S., Carpenter, S. R., Kinzig, A. (2004). "Resilience, adaptability and transformability in social–ecological systems". *Ecology and Society* **9** (2): 5. http://www.ecologyandsociety.org/vol9/iss2/art5/

Whittaker, R.H. (1975). Communities and ecosystems. 2nd ed. New York: Macmillan.

WWF-Guatemala. 2015. Resumen de Informe técnico de la investigación: Generación y análisis de Información hidrológica, con énfasis en isótopos estables (2H y 18O), para la determinación de sitios críticos de recarga hídrica del acuífero en parte baja de la cuenca del río Pasabien; Zacapa Guatemala.

This page is intentionally left blank

Annexes:

Annex A: Statement of Work

Annex B: Biographical Sketches of Assessment Team

Annex C: Institutions and Persons Contacted

Annex D: NGOs and Academic Institutions with Biodiversity and Forest Activities

Annex E: Actions Needed Grouped By Theme

This page is intentionally left blank.

Annex A: Statement of Work

Statement of Work

Tropical Forest and Biological Diversity Assessment For USAID/Guatemala's Country Development Cooperation Strategy (*2016-2020*)

I. Background

The USAID/Guatemala Country Development Cooperation Strategy (CDCS), covering the period FY2012-2016, is currently in use by the Mission. USAID/Guatemala is required to carry out an assessment to ensure that its CDCS is in accordance with the conservation of the country's biological diversity and tropical forest resources. This assessment is mandated by the U. S. Foreign Assistance Act (FAA) of 1961 Sections 118 and 119, which requires USAID to analyze national needs for conserving biological diversity and potential USAID contributions in response to these needs in all country strategy plans. Specifically, FAA Section 118(e) and 119(d), Country Analysis Requirements states that: "Each country development strategy statement or other country plan prepared by the Agency for International Development shall include an analysis of: (1) the actions necessary in that country to conserve biological diversity, the actions necessary in that country to achieve conservation and sustainable management of tropical forests and (2) the extent to which the actions proposed for support by the Agency meet the needs thus identified. (FAA, Sections 118 (e) and 119(d)."

This assessment will synthesize information available on the biological and forest resources in Guatemala, the current status of these resources, and the recognized pressures impacting them. It will include the actions and potential actions of the overall Mission program. Particular attention will be paid to developmental plans, specifically large scale plans in other sectors in which the Mission works such as the Plan of the Alliance for Prosperity in the Northern Triangle. The goal should not be to simply list species, but to approach the assessment as a way to prioritize eco-regions and watersheds, to determine common conservation challenges affecting them, and to begin to identify whether other sectors of the Mission program can help to address these issues. Attention should also be given to the quality of the existing data and any critical gaps should be noted.

Guatemala's *c*ountry analysis will mainly be one of compilation, review, analysis and synthesis of existing information, coupled with corroboration and feedback from major players.

Summary of relevant parts of FAA Sec 118 and 119:

From Sec 118 Tropical Forests:

> (e) COUNTRY ANALYSIS REQUIREMENTS.—each country development strategy statement or other country plan prepared by the Agency for International Development shall include an analysis of—
>
> (1) The actions necessary in that country to achieve conservation and sustainable management of tropical forests, and
>
> (2) The extent to which the actions proposed for support by the Agency meet the needs thus identified.

From Sec 119 Endangered Species:

> (d) [85] COUNTRY ANALYSIS REQUIREMENTS.—Each country development strategy, statement or other country plan prepared by the Agency for International Development shall include an analysis of—
>
> (1) The actions necessary in that country to conserve biological diversity, and
>
> (2) The extent to which the actions proposed for support by the Agency meet the needs thus identified.

II. Scope of Work

Under the direction of a team leader, the assessment team will evaluate biodiversity and tropical forest concerns in Guatemala.

The study is conceptualized in two parts. The first part will result in a written report that follows relevant USAID guidance on Section 118-119 analysis. The second part will involve assistance in drafting an analysis of how and to what extent actions proposed in the country strategic plans meet, or could meet, the tropical forest and biodiversity needs thus identified.

The assessment team will need to review the most recent Guatemala Biodiversity and Tropical Forest Assessment (May 2010), an important reference document to guide them in developing the update.

The assessment team will perform the following activities:

A. **Data Collection.** The background assessment will in general follow the illustrative outline presented in the attachment, and will synthesize existing data and information on the status of biodiversity and tropical forests in Guatemala. It will provide an overall description of Guatemala's biodiversity and tropical forestry assets, evaluate their current status, and identify the pressures and threats affecting those resources.

Specifically, the team will:

1. Meet with USAID/Guatemala to understand the Mission's program goals and objectives under its strategy. The Mission will provide the team with advice and protocol on approaching USAID partners and host country organizations with respect to this assignment. The team will be aware of sensitivities related to an assessment exercise (e.g., the potential for raising expectations, and the need to be clear as to the purpose of the assessment) and respect Mission guidance. The team will discuss organizations to be contacted and any planned site visits with the Mission and coordinate as required.

2. The Mission Environment Officer (MEO) will facilitate meetings with other DO Teams at USAID to allow the team to gain a complete understanding of the country program and strategy. The MEO will facilitate an exit briefing with the USAID Mission Director.

3. Obtain, review, synthesize, and analyze existing data and documentation on biodiversity and tropical forest conservation and sustainable management in Guatemala, such as that prepared by government agencies for all sectors considered

under the developing Mission Strategy, bilateral and multilateral donors (e.g., GEF, World Bank, FAO, UN, IDB,), and national and international NGOs active in the country (e.g., Rainforest Alliance, The Nature Conservancy, WWF, FUNDAECO, Fundación Defensores de la Naturaleza). This documentation may include the National Biodiversity Conservation Strategies and Action Plan (NBSAP), the Tropical Forest Conservation Act (TFCA), and materials related to the Climate Change Framework Law and evolving emissions reduction programs.

4. Hold meetings with relevant ministries and agencies, donor organizations, NGOs, and other organizations which are involved in forest and biodiversity conservation, sustainable management or cross-cutting issues, and gather relevant information. The assessment team will also hold two workshops, the first one with Technical Teams of local and international NGOs and USAID (approximately 40 participants) to discuss and obtain feedback on the assessment findings and, the second workshop to communicate final results. The Contractor is responsible to cover the costs of the two workshops. Therefore, the two workshops have to be included in the work plan as well as in the assessment budget.

5. Conduct one to three priority site visits, only if necessary to supplement the understanding gained from interviews, literature, and other second-hand sources. The site visits must be defined with the USAID Environment Team.

B. **Analysis.** Summarize the status of biodiversity and tropical forests in Guatemala, with particular interest in analyzing information from other sector programs that impact tropical forest and biodiversity outcomes. The assessment will compile, summarize, and analyze available information on the following themes:

The Policy, Regulatory, and Institutional Framework for biodiversity and tropical forest resources including: a review of the policy and legislative basis for the protection of biodiversity and tropical forest resources, with attention to decentralization; Guatemala's participation in international treaties and agreements related to conservation; a description and overview of the Government institutions involved in the sector or whose programs directly impact this sector (e.g., Ministry of Agriculture, National Council of Protected Areas, Ministry of Environment and Natural Resources); and an overview of current national level plans to address policy issues related to biodiversity and tropical forest resource conservation (e.g., PINFOR-Programa de Incentivos Forestales-, PINPEP- Programa de Incentivos Forestales para Poseedores de Pequeñas Extensiones de Tierra Vocación Forestal o Agroforestal-, REDD+ - Reducing Emissions from Deforestation and Forest Degradation-, LEDS-Low Emission Development Strategy). Special attention will be given to water resources through general review and analysis of the current status of water resources in the country.

1. An overview of the **Non-Governmental Organization** (NGO) community involved in biodiversity and tropical forest conservation and management activities including a list of the major organizations, the highlights of their program priorities, and an approximate level of financing for their programs.

2. A description of the biodiversity and tropical forest conservation and sustainable management activities and commitments, as well as, descriptions of other major efforts that will impact these resources by other **Donors and Multilateral Organizations** operating in Guatemala, the highlights of their program priorities, and an approximate

level of financing for their programs. Particular emphasis will be placed on plans for environmental impact assessments pursuant to planned large-scale infrastructure investments. If Guatemala has operational partnerships with **other U.S. Government Agencies** related to the environment sector, this section will also list and briefly describe those programs related to or impacting biodiversity and tropical forests (e.g., Tropical Conservation Forest Act-TFCA, U.S. Department of Interior-USDOI, and U.S. Forest Service-USFS).

3. Provide a description of the major biodiversity and tropical forest conservation activities of the **Private Sector** to help identify ways to better foster private sector alliances. Of interest are the norms and standards followed by those commercial entities most engaged in management and use of Guatemala's tropical forests and tracts near protected areas, including, inter alia, major logging companies, tourism developers, and other land development concerns.

4. Provide a description of the **Status and Management of Guatemala's Protected Area System** (SIGAP) including an inventory of all declared and proposed areas (national parks, wildlife reserves and refuges, forest reserves, private reserves, sanctuaries, hunting preserves and other protected areas), including marine and coastal areas. The inventory will identify the institution(s) responsible for the protection and management of each area, its date of establishment, area, and, as much as possible, list the status of each. This section will also include an assessment of the current effectiveness of protection and management and major challenges facing these areas, as well as, their importance to the country's economy (including productive assets, environmental services, and recreation and tourism opportunities). If applicable, include specific climate change impacts that have been identified in the SIGAP area.

5. An assessment of the **Status and Protection of Endangered Species** in Guatemala, including in its territorial waters. This section should identify particularly important habitat conservation areas and issues and evaluate the pressures on those areas and efforts to mitigate pressures, including the participation and compliance with the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

6. An assessment of the **Status of Conservation outside the Protected Area System**, focused on the different natural resources ecosystems common to Guatemala, including forest resources, rangeland resources, arid/semi-arid resources, coastal/marine ecosystems, wetlands and the sustainability of the agricultural landscape. This section will include a general discussion of the economic, ecological and social importance of each of these ecosystems; with particular attention to the critical environmental services they provide (watershed protection, erosion control, soil and water conservation, and amenity and recreation). Emphasis will be placed on the status of wetlands and desert/arid lands in Guatemala and any threats affecting them, including any specific effects of Climate Change. It will also assess the relationship between current land tenure arrangements and effective conservation in the country.

7. An overview and assessment of the **Impacts of Major Development Projects and Plans** on biodiversity and tropical forest conservation, including an analysis of the current policy and regulatory framework for environmental review and permitting of

their projects and plans.

8. An overall assessment of Guatemala programs for **Ex-Situ Conservation and Conservation of Economically Important Species and Germplasm** including as feasible, a list of the programs of natural history museums, zoos, herbariums, botanical gardens, and captive breeding programs and provide a summary of existing conservation databases. It will also provide a description of on-going programs in Guatemala for the conservation of important species and germplasm including gene banks and other efforts to support the sustained production and protection of commercially important wild plant and animal species.

Identify the key direct and indirect threats to biodiversity and tropical forests, water resources, including those considered as specific effects of climate change. Identify the actions necessary to conserve and sustainably manage natural resources and biodiversity and tropical forests in Guatemala in the current context, based on analysis of country donor and NGO responses to meet these needs. Prepare a report on the status of tropical forest and biodiversity conservation and sustainable management efforts in Guatemala and implications for USAID or other donor programming and environmental monitoring which shall define the actions necessary for conservation.

C. **Report.** On the basis of the assessment activities specified above, the team will prepare a summary **Guatemala Tropical Forest and Biodiversity Analysis**. This assessment will follow the attached Agency guidance and include an analysis of the needs for building national capacity, both public and private, and an aware and informed public constituency for biodiversity and tropical forest conservation. It will identify particular issues affecting the protected area system and natural resources protection and management in general. The Consultant(s) will include recommendations regarding USAID's future role in conservation in Guatemala and where U.S. comparative advantages and capabilities are likely to have the greatest impact. As possible, these issues and recommendations will be prioritized to identify those requiring the most immediate attention.

1. Identify the full range of cost effective and implementable actions (including priorities) necessary to achieve sustainable management of tropical forests and the conservation of biological diversity in Guatemala, and

2. Identify the extent to which the actions proposed for support by USAID/Guatemala meet the needs thus identified, and recommend any further actions not described or outlined in the concept papers. Analyze the effects of USAID/Guatemala's entire proposed strategy (FY 2012– FY 2016) on Guatemala's tropical forests and biodiversity. In particular, the proposed strategic objectives of DO3, alternative Development, Food Security, Economic Opportunities, Environment and Natural Resources, and Health should be carefully reviewed.

III. Outline of *Guatemala* Country Analysis of Tropical Forests and Biological Diversity:

The report, approximately 30 to 45 pages in length (excluding appendices), will include sections covering the following topics:

- Title page/ including the date of completion of the analysis report

- Table of contents
- List of appendices
- List of tables and figures
- Executive summary

A. Introduction describing the purpose of the analysis and methods used in conducting it, including the timing of the analysis in relation to the timing of USAID strategy development.

B. A review and summary of legislative and institutional structure affecting biological resources, as well as, donor programs and activities that contribute to conservation and sustainable natural resources management, and an assessment of their effectiveness, strengths, and weaknesses, including:

(1.) Government of Guatemala
(2.) Non-governmental organizations
(3.) International organizations

C. An overview of the status of biodiversity in Guatemala, including terrestrial and aquatic (i.e. coastal/marine) ecosystem (or ecoregion) diversity, species diversity, threatened and endangered species, genetic diversity, agricultural biodiversity, ecological processes and ecosystem services, and values and economics of biodiversity and forests. This overview will include any specific climate change impacts that have been identified. A map of potential natural vegetation and of land use or land/forest cover will be provided if available.

D. Status and management of protected areas and endangered species, water resources and forest resources, including an assessment of the direct and indirect threats, root causes or drivers of direct threats (please specify if any of these threats are climate change-related).

E. A list or description of the actions necessary to conserve biodiversity and forests in Guatemala, logically flowing from the review of the threats, and what is currently being done by government, NGO, and donor programs that address those threats. Recommendations and proposed actions, including review of actions proposed for support by USAID/Guatemala.

F. Conservation outside of protected

areas: (1.) Managed natural systems
(2.) Impacts of development projects
(3.) Ex-situ conservation (e.g., zoos, seed banks)
(4.) Identified impacts caused by effects of Climate Change

G. A review of the current USAID/Guatemala strategy and program, including all DOs, followed by an analysis of the extent to which actions proposed for support by USAID help meet the needs identified in F. This section will also note any threats to biodiversity and forests from activities proposed for USAID support, and suggest mitigating actions. It will also identify opportunities for cross-cutting, cross-sectorial linkages with proposed activities (for all proposed DOs) especially those that would be low cost and/or would

enhance the effectiveness of the proposed activities. And finally, it will note any current or future impacts as a result of climate change.

H. All references used and cited in the report should be listed; web URLs for information resources will also be provided.

I. Appendices to the report will contain, at a minimum, the SOW for the analysis, biographical sketches of analysis team members, a list of persons contacted and their institutional affiliation, and other background or supporting material, as needed.

(1.) Bibliography
(2.) Biodata sketch of team members (3.)
List of persons contacted
(4.) Other appendices as appropriate

IV. Period of performance

This assessment is expected to be completed no later than May 2016.

V. Reporting, Deliverables

- **Work Plan and Schedule:** The Contractor will provide USAID with a Work Plan and Schedule not later than January 15, 2016. The Work Plan and Schedule will be 3-5 pages long, in English, and will include a week-by-week listing of major activities by location (US, Guatemala City, ecoregions and coastal areas, and any other), including any planned site visits, workshops and will highlight planned interaction with USAID on no less than a weekly basis. The Work Plan and Schedule will also include a preliminary report outline.

- **Draft Report:** The Contractor will submit a Draft Report at the end of the fourteenth week of the signature of the modification. The Draft Report will follow the generic outline provided in the attachment to this SOW, as refined during the course of the contract in consultation with USAID. The Report will not exceed forty-five pages, in English, with suitable annexes and pertinent figures (maps, institutional charts, tables) and references. Among the expected appendices is a briefly annotated bibliography of the most important current reference materials related to the topic and a contact list for each of the organizations discussed in the Report. USAID/Guatemala will provide its comments on the Report within 5 working days.

- **Final Analysis Report:** The Contractor will submit a Draft Final Analysis Report for USAID/Guatemala that examines the biodiversity, tropical forestry, water resources, natural resource management, and other related environmental issues, and identifies contributions and/or potential contributions to meeting identified conservation needs by the Mission's current strategy, sixteen weeks after the signature of the modification. This report will be submitted in English. USAID/Guatemala will provide its comments on the Report within ten [10] working days. The Contractor will then have 10 working days to incorporate the comments and submit the Final Report. The final report will then be submitted to USAID/Washington by the Mission for their review. The

Contractor will include in the Consultant LOE a number of days needed to incorporate final comments from USAID/Washington. The Contractor will furnish both electronic file versions of all submissions (first draft, draft final and final report).

Deliverables:

- 50 hard copies of the document in English, and 50 hard copies in Spanish.
- 100 copies of the documents (in English and Spanish) on CDs, to be included in the hard copy.
- Document to include a map of biogeographic regions of Guatemala
- Document to include a map of protected areas of Guatemala

VI. Illustrative Schedule and logistics

The team will coordinate logistical arrangements with DEVTECH, and will be responsible for identifying and obtaining the majority of the reference materials needed for this study with only minimal interventions on the part of the USAID/Guatemala Team.

USAID/Guatemala will provide a letter of introduction to the Government of Guatemala Agencies and other institutions called upon to collaborate in providing information for this study. DEVTECH will assist the team by providing key references and contacts with USAID/Guatemala's Program Office and will also help facilitate meetings with other Mission Team Leaders or their staff to fully brief the team on USAID's program and future vision for their strategy.

VII. Technical Direction

The activity manager for the performance of the above mentioned tasks will be Teresa Robles (Acting Mission Environmental Officer) and, Regina Soto (Mission Environmental Officer) upon her return to the Economic Growth Office (EGO).

Technical and financial approvals for the contract with MEP shall be provided by the official Contracting Officer's Representative for MEP in EGO, Josefina Martínez.

Annex B: Biographical Sketches of Assessment Team

Bruce Byers, **Team Leader**
Dr. Bruce Byers is a practicing ecologist, independent consultant, and writer with more than 30 years of professional experience in more than 40 countries. His work focuses at the interface of ecology and sustainable development, combining his academic background in ecology and evolution with extensive practical experience in applied social sciences. Dr. Byers has served as team leader for many multi-disciplinary and international teams, conducting assessments, evaluations, and strategic planning exercises for USAID and international NGOs, including eleven previous USAID biodiversity and tropical forestry assessments. He was the lead consultant and author of the 2005 USAID publication ***Tropical Forestry and Biodiversity (FAA 118 and 119) Analyses: Lessons Learned from Recent USAID Experience and Guidelines for USAID Staff***. His recent work links biodiversity conservation and climate change adaptation and mitigation.

María Mercedes López-Selva, Biological Diversity Specialist
María Mercedes López-Selva was trained as a biologist and holds a Master's Degree in Sustainable Development and Biological Conservation from the University of Maryland, College Park. She is currently on the staff of IARNA, the Instituto de Agricultura, Recursos Naturales y Ambiente, at Rafael Landívar University. She is currently in charge of *ex situ* orchid conservation there, and conducts research on orchid reproduction and orchids as indicators of ecosystem health. She was a coauthor of the 2010 Guatemala Tropical Forestry and Biodiverssity Assessment.

César Augusto Sandoval García, Tropical Forest Specialist
César Sandoval was trained as a forestry engineer and holds a Master's Degree in Public Administration from the Central American Institute for Public Administration in Costa Rica. He is a doctoral candidate in Political and Social Science in the Guatemala Program of the Universidad Pontificia de Salamanca, Spain. He is currently a research staff member and training coordinator at IARNA, the Instituto de Agricultura, Recursos Naturales y Ambiente, at Rafael Landívar University.

This page is intentionally left blank

Annex C: Institutions and Persons Contacted

Institution	Person(s) Contacted	Contact Information
MARN Dirección de Cambio Climatico	Jacobo Coto, Director Jose Luis Rivera, Technical Assistant	Coto - cclimatico@marn.gob.gt
MARN Jefatura de Ecosistemas	Mario Diaz, Director	mdiazcb@marn.gob.gt
PNUD Guatemala Proyecto Marino Costeras	Raquel Sigüenza	
CONAP Unidad de Conservación	Dafne Domínguez, Director	
CONAP Unidad de Vida Silvestre	Alan Marroquín, Director	amarroquin@conap.gob.gt
INAB	Adelso Revolorio and Josue Morales	arevolorio@inab.gob.gt
Rainforest Alliance & CNCG	Oscar Rojas, COP, and Alejandro Santos, Deputy COP	orojas@ra.org
WWF Guatemala	Maria Victoria Rodríguez, Juan Carlos Rosito, and Sonia Solis	Rodríguez - mporta@wwfca.org
UICN/IUCN	Ursula Parrilla, National Coordinator, Guatemala Office	ursula.parrilla@iucn.org
Defensores de la Naturaleza	Oscar Nuñez, Director	onunez@defensores.org.gt
The Nature Conservancy and FCG	Juan Carlos Godoy, Director	jcgodoy@tnc.org
Engility Proyecto Desarrollo con Bajas Emisiones	Luis Alberto Castañeda, Director	
Universidad Rafael Landívar, VRIP	Juventino Gálvez, Vicerrector	jugalvez@url.edu.gt
FUNDAECO	Rolando Gómez, Coordinador Huehuetenango	
Instituto de Cambio Climático (ICC)	Alex Guerra, Director	
ACOFOP (Flores, Petén)	Teresita Mansilla, Directora Técnica and Jorge Soza, Concessions Coordinator	Mansilla - direccion@acofop.org
Wildlife Conservation Society (WCS) Guatemala	Roan Balas McNab, Director	rmcnab@wcs.org
CONAP Petén Regional Office	Salvador López, Director Regional	
CONAP-CEMEC	Víctor Hugo Ramos, Director	vhramos@conap.gob.gt

CONAP PN Laguna de Tigre	Vinicio Morales, Director PN Laguna de Tigre and Célica Contreras, Community Relations Specialist, and Juan Carlos Rodas, Community Coordinator, Paso Caballos	
Cocode de Paso Caballos	Antonio Xo, Presidente de Cocode; Domingo Pop, Comisión de Salud; Vicente Saquij Tzalan; Ramiro Tzalam; Jesús Bernanrdino Cholón Tec; Jorge Alfredo S. C.; Santiago Pooc Cucl; Carlos Pop Caal; Martín Chub Pop.	
Defensores de la Naturaleza, Flores, Petén, Office	Jorge Soza, Director, Programa de Desarrollo Productivo	
Sociedad Civil El Esfuerzo, Melchor de Menchos	Carlos Humberto Góngora Luna, Presidente y Representate Legal, Roberto Esau Soza Chi, Technico Forestal, and Sergio Ortiz, Tesorero	
REPSA	Alejandro Chacón, Gestión Ambiental y Sostenibilidad and Eduardo Alfredo Lopez, Area Administrator	
Reserva Los Tarrales	Andy Burge, Owner/Manager and Lester Nehemias de Leon Lux, Naturalist	
Defensores de la Naturaleza, RB Sierra de las Minas	Danilo Saavedra and Edwin Sosa	

Annex D: NGOs and Academic Institutions with Biodiversity and Forest Activities

Local NGOs

Name	Activity/Focal Themes
Asociación de Reservas Naturales Privadas de Guatemala	Promotion and management of private natural reserves
Asociación de Comunidades Forestales del Petén – ACOFOP-	Sustainable management of natural forests
Asociación de Silvicultores de Chancol ASILVOCHANCOL	Sustainable forestry management
Asociación para el Rescate y Conservación de Vida Silvestre ARCAS	Wildlife rescue
Asociación de organizaciones de los Cuchumatanes	Sustainable development, environmental and production management
Asociación BALAM	Conservation, policy advocacy, rural development
Centro de Acción Legal, Ambiental y Social de Guatemala -CALAS-	Environmental advocacy
Fundación Defensores de la Naturaleza	Protected area co-management, environmental legislation and policy advocacy
Fundación Solar	Sustainable development, clean technologies
Fundación para el desarrollo integral del hombre y su entorno -CALMECAC-	Environmental education, community organization
Fundación para el eco-desarrollo y la conservación FUNDAECO	Protected area management, environmental advocacy, rural sustainable development, conservation
Federación de Cooperativas de las Verapaces FEDECOVERA	Sustainable forestry management
Fundación Naturaleza para la Vida FNV	Sustainable natural resources management
Fundación para la Conservación de los Recursos Naturales y Ambiente de Guatemala FCG	Tropical forest conservation

International NGOs

Name	Activity/Focal themes
ARGIDIUS	Effective ecosystem building, poverty reduction
Helvetas	Sustainable rural development
Rainforest Alliance	Environmental conservation, sustainable forestry, market based approach conservation
The Nature Conservancy	Environmental conservation, water conservation, PES approach
World Wildlife Fund	Environmental conservation, watershed and freshwater protection, Mesoamerican reef conservation
Wildlife Conservation Society	Protected area co-management, environmental conservation, MBR monitoring,

Academic Institutions and Research Institutes

Name	Activity/Focal theme
Centro de Estudios Conservacionistas CECON, Universidad de San Carlos de Guatemala	Herbarium, seed bank, protected area co-management, environmental research
Centro de Estudios Ambientales y Biodiversidad, Universidad del Valle de Guatemala	Environmental research focused on climate change, herbarium, entomology research,
Instituto de Investigación y Proyección sobre el Ambiente y la Sociedad IARNA, Universidad Rafael Landívar	Environmental research and outreach. Guatemalan Environmental Profile production, orchid conservation
Instituto Privado de Investigación sobre Cambio Climático ICC	Ecological restoration of intervened areas, climate change research

Annex E: Actions Needed Grouped By Theme

1) Create needed policies, laws, strategies, and plans

- Work to restore forest cover in the cadena volcanica so that it becomes a functional ecological corridor, as a part of the larger Mesoamerican Biological Corridor.
- Fill the gap that now exists in coastal and marine conservation with more attention and funding.
- Develop a legal and political framework for coastal zone management; support the implementation of the Coastal-Marine Policy, the Norms and Regulations for the use of Mangroves, the Fisheries Act and other legal tools developed to regulate the use of marine and coastal resources.
- Fill gaps in representation of ecosystems in the SIGAP, especially for bosque seco, monte espinoso, and coastal-marine ecosystems.
- In the Volcanoes Zone, designate the different types of protected areas that are to be managed for different purposes, and develop a master plan for all of the protected areas in the zone that specifies the differences and how they work together for conservation.
- Develop norms and regulations for whale watching tourism.
- Update the marine turtle conservation strategy.
- Support the development and implementation of conservation strategies for endangered endemic species such as: *Dermatemys mawii* (white turtle); *Heloderma charlesbougertii* (beaded lizard), several species of the *Abronia* genus (lizards), *Pharomacrus mocinno* (resplendent quetzal), etc.).
- Review and revise national policies and incentives that promote the expansion of oil palm cultivation.
- Promote more active management of natural regeneration (e.g. in pine-oak forests).
- Broaden the interpretation and application of the USAID “Biodiversity Earmark” so that biodiversity funds can be used not only in strictly protected areas (like national parks), but in a range of multiple-use protected areas, including forest concessions.
- Support a careful balance between agroforestry, which can maintain and restore forest cover, and more strict protection of natural forest areas, which contain more species but may be at risk of being lost because of competition for land uses that generate more direct economic benefits.
- DIPESCA should promote and enforce good fishing practices in Guatemalan Caribbean waters.
- Improve forest administration policies and systems.
- Restore of forest landscapes.
- SIGAP should reduce the number of protected areas they are trying to pretend that they manage, and put their insufficient resources where it is worth the effort; re-define areas and change management categories according to the current potential of an area.
- Direct some attention and investment to Alta Verapaz.
- Regulate tourism development in Petén, which is a threat to forests and biodiversity there if not done carefully and properly.
- Regulate the expansion of oil palm and production practices in the industry.
- Raise the profile of environment and biodiversity as a theme in public policy.
- USAID needs to rethink where it invests biodiversity and forest conservation funds on a geographic basis, and not invest almost all of its funds in Petén.
- Improve solid waste management.
- Reduce and stop the expansion of livestock ranching.
- Reduce and stop the expansion of oil palm.

- Develop and implement a “Plan of Rescue for the PN Laguna de Tigre.”
- Protect the remaining major blocks of natural habitat that act as ecological corridors within the RBM and within the Meso-American Biological Corridor.
- Prevent and control fires, through firebreaks, etc.
- Develop alternative models for archeological tourism to the “megatourism” model, the “Chichen Itza” model of PACAUNAM, with big fancy hotels, roads, high-end tourism.
- Prevent new roads associated with petroleum development in Laguna de Tigre.
- Prevent and control fires crossing the border from Belize.
- Implement the concessions model in the biological corridor areas of the RBM.
- Prevent and control fires.
- Reduce livestock ranching and number of livestock in the RBM.
- Control, manage, stop the expansion of petroleum development in the PN Laguna de Tigre (#2 threat in RBM).
- Develop a strategy to “re-take” the Laguna de Tigre,” especially the wetlands that are a Ramsar Site.
- Give more attention to, and investment in, the buffer zone of the RBM, in order to reduce livestock grazing, the expansion of large-scale commercial farming (e.g. oil palm), and prevent and control fires.
- Register land in the RBM buffer zone through the Registro e Información Catastral (RIC).
- Control porous borders with Mexico in PN Laguna de Tigre.
- Stop expansion of the livestock-agricultural frontier, with clear limits of where these activities are allowed.
- Review and update the Ley del Chicle so that it provides a foundation for chicle-harvesting activities that are being developed through the community concessions in the RBM.
- Integrate environmental protection in mining and energy development.
- Raise the profile of the environment in public awareness and political debate, at the national level, and provide much better funding for these issues at the national level.
- Promote a much more integrated, long-term, big picture strategy for environmental conservation and sustainable development.
- Donors, including USAID, need to put more attention and investment toward the root causes and drivers of environmental threats, and less on small, discreet “projects” focused on conservation.
- Increase the profile of environment as a cross-cutting issue within USAID-Guatemala, which is quite “sectoral.”
- Support private sector initiatives in forest and biodiversity conservation, and the creation of networks of private forest reserves.
- Take stronger action to develop a biological corridor in the coastal mangrove ecosystem of the Costa Sur.
- USAID should diversify its geographic support within Guatemala – to include the cadena volcanica, south coast mangroves, etcetera; Petén is important, but doesn’t deserve all the funding and focus.
- Improve fire prevention and control capacity.
- Use and management of fire to restore fire-dependent forests (e.g. Pinus oocarpa) to a more natural, less-fire prone condition (i.e., fire is a threat, but lack of fire is also a threat to these forests; a fire suppression only policy is not ecologically sustainable).

N = 50

2) Reform and strengthen institutions with forest and biodiversity responsibilities (MARN, CONAP, INAB, etcetera)

- Combine and merge the perspectives of MARN and CONAP into a more integrated, landscape- and ecosystem-scale vision (with three pillars: ecological, cultural, and economic).
- Transform institutions so that they are functional, and can implement the relatively good policies and strategies that are already in place.
- Combine and merge INAB and CONAP into one institution responsible for biodiversity and forests (and protected areas of all kinds).
- Strengthen the presence and capacity of national institutions relevant to coastal and marine management on the Pacific Coast.
- Strengthen human resource capacity in DIPESCA (Dirección General de Pesca) to enhance and improve fisheries management.
- Develop a platform for communication and coordination among relevant actors in coastal-marine management, and develop a clear work plan.
- Strengthen the presence of relevant national institutions in Petén.
- Implement PROBOSQUE, the new Forest Law, through creation of an institutional platform with the capacity to do so. Specific requirements include a are modern equipment to manage data management system; bases and the development of operativeons manuals,and users guides; and, training workshops for INAB´s staff as well as for community groups, private land owners, and other organized groups interested in benefiting from the incentives.
- Strengthen capacity in the forestry sector in general, including in forestry extension, to provide training for new beneficiaries and to perform monitoring and assessment activities.
- Strengthen the prevention and control of wildfires.
- Change and strengthen CONAP into an institution that is actually effective at conserving biodiversity by changing its vision of conservation to include economic incentives and local communities.
- Develop mechanisms to implement the new Forest Law, PROBOSQUE, including the management of watershed forests.
- Promote and support improved forest governance, including safeguards that protect potential REDD+ project areas.
- Support organized forestry alliances.
- Work towards political stability in Guatemala.
- Modernize the institutions of the environment sector within the Government of Guatemala. The management of natural resources and the environment is divided into 6 different agencies that were created in different decades (MARN, INSIVUMEH, CONAP, INAB, DIPESCA, and Autoridades de Lagos). The division of responsibilities has resulted in poor management due to lack of clear responsibilities and poor communication and coordination among the agencies.
- US Embassy and USAID need to apply diplomatic pressure and provide incentives for needed structural and institutional changes in the GoG, directly and also indirectly related to environmental issues.
- Create an Institute for Conservation and Protected Areas, with an Exective Committee with independence from the Office of the President, similar to INAB.
- CONAP needs to develop the capacity to work effectively with private sector and community partners.
- Need political will and action by the GoG to control the porosity of the border beween

Mexico and Laguna de Tigre.

- Create a legal framework that gives CONAP administrative and technical autonomy, stable career paths for its staff, and increased institutional stability.
- Create a legal foundation for CONAP that gives it administrative and technical autonomy.
- Donor funding should emphasize institutional strengthening, because institutional weakness and lack of capacity is the main driver, and root cause, of threats to forests, biodiversity, and environment in Guatemala.
- Increase the presence of the state in many parts of the country, where many state institutions are essentially absent.
- Donors need to develop a coordinated mechanism to promote needed structural and institutional changes in the Government of Guatemala, and move away from a focus on "projects."
- Reform the institutional structure of CONAP; take it out from the President's office, give it an independent board of directors (like INAB), so their is some institutional consistency when administrations change.

N = 26

3) Stop illegal activities that threaten forests and biodiversity (e.g., narco-ganaderia, illegal logging)

- Strengthen forest governance by addressing the drivers of deforestation.
- Reduce or stop illegal trade in wildlife (especially birds such as parrots; reptiles; and mammals such as monkeys).
- Control/reduce illegal logging.
- Control/stop any further conversion of bosque seco for production of melons in the Valle de Motagua.
- Increase funding and human resources and capacity to enforce environmental laws.
- Use national institutions and power (army, police, judicial system) to stop illegal land coversion and other illegal activities in Petén.
- Stop "narco-ganaderia," and the illegal clearing of land for cattle fincas.
- Control illegal synthetic drug factories that are springing up in the RBM.
- The Ministry of External Relations and the Guatemalan Army should take control of strategic resources and borders.
- Bring back the presence of the state and the rule of law in Petén (#1 threat is ungovernability because of narcotrafficking).
- Strengthen the justice system so that it can effectively enforce the law.
- Remove the oil palm plantation just south of the Río Saclúb, or stop their illegal pumping of irrigation water from the river.
- Stop illegal activities in the RBM, including illegal timber extraction, illegal *xate* extraction, illegal palm-leaf harvesting, and stealing of archeological objects.
- Improve surveillance and enforcement in the Sierra del Lacandón.
- Define and delimit the frontier between Guatemals and Belize in order to control illegal activities from Belize that are cross-border threats in Guatemala, such as fires, illegal logging, and agricultural expansion.
- The Ministry of External Relations should address illegal timber trade across the border with Belize.
- The government needs to stop/control the porosity of the border between Petén and Mexico, using the army, police, etc.

N = 17

4) Support community organization, empowerment, and capacity (e.g., community forest concessions)

- Strengthen and institutionalize within CONAP a view of protected area management through financial and other incentives to local communities, not just through enforcement (control y vigilancia).
- Strengthen forest tenure and rights by increasing the organization and capacity of forest communities, working with Government agencies in clarifying land tenure/rights.
- Continue supporting forest concessions to communities.
- Expand the model of the "48 cantones" in the western highlands, which is a success story in how to manage forests well.
- Continue investment in and support for community forests concessions in the RBM.
- Develop a plan for the governance of community concession areas in the RBM. Social leadership and cohesion is needed in community concessions, economic benefits are not enough to motivate conservation and sustainable management.
- Improve CONAP's capacity to work collaboratively with communities (they have too much of a "protected area," "this is my land" institutional culture and mentality).
- Establish clear technical and legal procedures for renewing concessions contracts in the RBM.
- Regularize the tenure of communities living within the PN Laguna de Tigre.
- Develop a plan for the governability of the concessions area of the RBM.
- Develop "acuerdos de cooperación," cooperation agreements, with communities to regulate settlement inside the PA, and build allies and confidence in the communities.
- Develop a strategy to prevent the displacement of communities from the expansion of industrial, large-scale commercial, agriculture.
- Improve GoG agency's capacity to support community-based economic activities, such as community forest concessions.
- Establish clear technical and legal procedures for renewing concessions contracts in the RBM.

N = 14

5) Strengthen Climate Change Resilience through Adaptation and Mitigation

- Develop a baseline for greenhouse gas emissions for Guatemala.
- Develop a national plan for climate change adaptation and mitigation.
- Develop mechanisms and incentives for managing water resources for adaptation to climate
  change.
- Strengthen inter-institutional communication and coordination about climate change (which is
  "trasversal," cross-cutting all sectors). Especially among MARN-INAB-MAGA and CONAP
- Develop the mechanism for implementing the legal and theoretical framework (strategy, plan) for climate change adaptation and mitigation.
- Strengthen human capacity for adaptation regarding health, infrastructure and water resources issues.
- Support the development of the Strategy for Reduced Emissions.
- Develop a climate change adaptation plan for the Pacific Coast.
- Reduce firewood demand at a national scale through more efficient stoves and/or alternative sources of energy (e.g. electricity, gas).

- Expand the early alert system that warns small and medium sized farmers about predicted climate variability that would affect crop production.
- Reduce firewood demand on a national scale through the development of renewable energy alternatives (e.g., micro-hydroelectric plants).
- Develop strategies and technologies for reducing the demand for firewood through fuel-efficient stoves.
- Develop a national strategy for Low Emissions Development.
- Build capacity in the government and private sector for climate change mitigation.

N = 14

6) Emphasize Water as an Integrating Ecosystem Service

- Work to link upper watershed land owners and managers in the cadena volcanica with sugar growers on the south coast.
- Develop a mechanism for valuation of water capture in protected areas, and other forest areas defined by PROBOSQUE as areas for water capture and recharge.
- Develop bi-national mechanisms for managing bi-national watersheds, such as the Río Motagua.
- Support the acquisition of scientific information that can inform decisions – such as the study of isotopic tracing of sources of water in the Sierra de las Minas that are used by downstream water users.
- Support research in watersheds that flow into the Caribbean and therefore affect the Mesoamerican Reef system.
- Support the development of watershed management plans for the Cuenca Pasabien, Cuenca Teculután, and ideally for the Cuenca del Motagua as a whole.
- Support assessments of water catchment and retention areas.
- Promote better agricultural practices in the lower and middle parts of key watersheds.
- Improve watershed management and access to potable water.
- Develop and pass a Water Law.
- Pass a law and develop the institutional structure for water resources management. Create a new Vice-Ministry of Water within MARN. Develop a Water Security Strategy for Guatemala. The modernization of environmental institutions requires the creation of an authority to manage marine ecosystems and an authority to manage freshwater, including both superficial and underground reservoirs.
- Develop integrated water resource management in watersheds to ensure sustainable access to domestic water supplies.
- Develop a water law or regulations to balance uses – for example, domestic, hydropower, agriculture, and environmental flows in Sierra de las Minas watersheds – and provide a legal foundation for PES schemes.

N = 13

7) Provide economic options for the rural poor who depend on natural resources (e.g., community forest concessions, timber and non-timber products value chains, biodiversity-friendly value chains such as coffee, cardamom, cacao)

- Promote agroforestry to restore forest structure and ecological connectivity at a landscape scale.
- Strengthen value chains for forest-based products, including non-timber forest products.
- Diversify livelihood and economic options for local communities living near forests and protected areas.
- Develop opportunities for sustainable businesses based on forest products.

- Develop financial instruments and incentives for sustainable forest management and the restoration of forest landscapes, with the participation of the private sector.
- Support and promote financial mechanisms for sustainable production of timber, non-timber forest products, and tourism in the RBM.
- Need community development projects ("proyectos productivos") that sustainably improve livelihoods and provide basic necessities for health, education, and potable water.
- Develop financing options for implementing local economic development projects.
- Use "fair market" certification mechanisms for certification and strengthening international markets for non-timber forest products such as xate, ramon, pimiento, chicle.

N = 9

8) Generate and disseminate scientific information needed for environmental decision-making (e.g., eco-hydrology, forest inventory, meteorology and climate, pine bark beetle/gorgojo de pino, animal movements and ecological corridors)

- Develop methods, practices, and technologies for reducing nutrient contamination of water from processing of coffee and oil palm.
- Strengthen forest management capacity through the use of new technologies such as satellite imagery, drones, and mobile phones.
- Expand the coverage of hydrometerological stations; most are now located at lower elevations, and there is incomplete coverage in mountain areas.
- Develop practices and technologies to control nutrient pollution from oil palm processing.
- Strengthen the system of monitoring indicators for what is happening "below the canopy," within forests.
- Improve surveillance and enforcement in the RBM; conduct more overflights/aerial surveys for monitoring status and activities, which is important for making decisions.
- Conduct ecological and biological monitoring, such as for guacamayas, jaguars – as flagship or indicator species.

N = 7

9) Fund government institutions with environmental responsibilities at the levels needed (e.g., CONAP, INAB)

- Provide adequate resources to implement and enforce the laws, policies, strategies, and plans that exist already.
- Provide adequate funding to participate in the international conventions of which Guatemala is a member.
- Maintain and/or develop funding sources for traditional biodiversity conservation activities, funding for which has recently been reduced as money has shifted towards climate change adaptation and mitigation.
- Invest in improved natural resource governance.

N = 4

10) Reduce fertility rates and population growth through appropriate initiatives in the health and education sectors (e.g., family planning and reproductive health, maternal-child health, nutrition, water and sanitation, girls education, economic opportunities for women)

- Reduce the fertility and population growth rate by supporting health, family planning, education, and livelihood options for women and girls.

- Reduce the fertility and population growth rate in Guatemala through appropriate policies and investments.
- Provide better access to water for drinking and sanitation in the community of Paso Caballos.

N = 3

N = 157

This page is intentionally left blank

For more information, contact:

DevTech Systems, Inc.
1700 North Moore St.
Suite 1720
Arlington, Virginia 22209
703-312-6038
www.devtechsys.com