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REPORT ON TROPICAL FORESTS AND BIODIVERSITY IN THE DOMINICAN REPUBLIC

Foreign Assistance Act 118 & 119

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REPORT ON TROPICAL FORESTS AND BIODIVERSITY IN THE DOMINICAN REPUBLIC

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ACRONYMS

CDCS	Country Development Cooperation Strategy
DO	Development Objective
DR	Dominican Republic
FAO	Food and Agriculture Organization
FEPROBOSUR	Federacion de Productores del Bosque Seco del Suroeste
GIZ	Deutsche Gesellschaft fur Internationale Zusammenarbeit
GNP	Gross National Product
INDRHI	National Institute of Water Resources in the Dominican Republic
KII	Key Informant Interviews
MARN	Ministry of Environment and Natural Resources
NFI	National Forest Inventory
NGO	Non-Governmental Oranization
NRM	Natural Resources Management
PRONATURA	Fondo Pro Naturaleza
SINAP	National System of Protected Areas
TNC	The Nature Conservancy
UNEP	United Nations Environment Programme
USAID	United States Agency for International Development

EXECUTIVE SUMMARY

Introduction

This report has the following purposes:

(1) Identify the **actions needed** in the Dominican Republic to achieve sustainable management of its forests and biodiversity;
(2) Determine the **gaps in the actions needed** in the Dominican Republic to achieve sustainable management of its forests and biodiversity;
(3) Determine the **extent to which United States Agency for International Development's (USAID's) proposed actions correspond to these actions needed** to achieve sustainable management of the Dominican Republic's forests and biodiversity; and
(4) Determine **how the needed natural resources management (NRM) actions could contribute to achieving potential Development Objectives** (DOs) in the USAID/Dominican Republic (USAID/DR) 2020-2025 Country Development Cooperation Strategy (CDCS).

This report was prepared in 2017 during Phase-I (Initial Consultations and Parameters Setting) of preparing the USAID/DR CDCS 2020-2025. As the basis for its analysis, the report uses the hypothetical Development Objectives (DO) for the 2020-2025 CDCS, as follows:

(1) DO 1: Security from Crime
(2) DO 2: Democratic, Effective Governance
(3) DO 3: Widespread Human Health
(4) DO 4: Equitable Economic Prosperity and Stability

Contribution of Biodiversity and Forests to the Dominican Republic's Development

The Dominican Republic's biodiversity and forests contribute goods and services that underlie its economy and thereby the welfare of its people. Watershed ecosystems regulate the quantity, timing, and quality of the water that flows to rivers, lakes, and the ocean and to subterranean aquifers. Tourism, agriculture, and industry all require sufficient, reliable, and high-quality water to prosper. Coastal ecosystems regulate wave and wind erosion of beaches and dunes. Both watersheds and coastal ecosystems temper the potentially devastating effects of tropical storms and hurricanes on economic and social infrastructure, and on human lives. Coastal reefs provide the sediments that create the beaches that draw millions of tourists to the Dominican Republic and the food and shelter for the fishes that feed people and delight tourists. Forests produce fiber and food, provide habitat for wildlife, create fertile soil, and moderate local climates. Given their fundamental, pervasive, and irreplaceable contributions to its economic prosperity and the welfare of its people, conserving the Dominican Republic's biodiversity and forests necessarily plays a central, essential role in its development.

Findings

The Dominican Republic's topographic and climatic diversity have made it one of the most biologically diverse countries in the world for its size. The country contains numerous ecosystems including lowland rainforests, cloud forests, pine forests, dry forests, mangroves, savannah, coastal lagoons, salt lakes, a rift valley, karst land formations, and four mountain ranges – including the highest mountain in the Caribbean. Of the Dominican Republic's 15,669 known species, 4,881 (31 percent) are endemic and 806 (five percent) are considered in some degree of danger of extinction. Speculation, given the lack of data,

suggests high genetic diversity within the terrestrial species, since the Dominican Republic's rugged and diverse topography may have given rise to many isolated genotypes.

The National Forest Inventory classifies the Dominican Republic's forests into eight forest types. The Dry and the Humid Broadleaf forest types are the largest and the Shaded Coffee and Mangrove forest types are the smallest in area. The area of the two Conifer and the Cloud Broadleaf forest types lies between these two extremes. Forest cover increased from 5,882 km2 (12 percent) in 1967 to 19,661 km2 (38 percent) in 2016[1]. Only about 800 km2 of this forest cover are tree plantations, so there are about 11,946 km2 of secondary, naturally regenerated forest. Few data exist on the location, age classes, and species composition of the natural forest or the forest tree plantations.

Four categories of direct threats affect the Dominican Republic's biodiversity and forests. (1) **Loss and degradation of habitat,** mostly within the national parks of the mountains, continues even though the overall area of forest has increased. (2) **Over-exploitation** is depleting the populations of commercially valuable wild species of terrestrial, estuarine, and marine plants and animals. (3) **Pollution**, including agricultural chemicals, sewage, and solid waste, is degrading habitats and directly poisoning or preventing adequate reproduction of some species of plants and animals. (4) **Invasive species** are displacing some native plant and animal species, thereby reducing their numbers and long-term viability as species.

Four factors drive these direct threats. (1) **Population growth and migration** has increased demand for food, housing, and infrastructure and has disrupted rural economies and social structures, thereby increasing the rate of habitat loss, over-exploitation, and pollution. (2) M**arket demand** for wild products is driving the direct threats of loss of habitat, over-exploitation, and pollution. (3) **Tourism** is a major driver of the direct threats, especially those to coastal and marine biodiversity, but the Dominican Republic lacks the land use regulations and infrastructure that would prevent millions of tourists from indirectly causing degradation its reefs, beaches, mangroves, and other coastal and marine ecosystems. (4) **Global climate change** alters the environmental conditions for some species of plants and animals more rapidly than they can adapt.

To conserve the Dominican Republic's biodiversity and forests requires actions to create the **enabling conditions** that would permit successful **direct NRM actions.** This report identifies and discusses five categories of enabling actions: **(1) policies and laws, (2) institutions, (3) education/training, (4) research, and (5) awareness**. Direct actions involve implementing NRM practices in the field. This report identifies and discusses five categories of required direct NRM actions: (1) **watershed management, (2) forest management, (3) agroforestry, (4) protected area management**, and (5) **coastal zone management**.

This report identifies the following "lessons learned" from the five NRM projects that USAID/DR financed between 2007 and 2014:

(1) Decision-makers and the public need to understand the links between NRM and the economy;
(2) Territorial planning underlies both NRM and economic growth;
(3) Businesses often have strong financial reasons to promote and sponsor NRM;
(4) NRM organizations require dynamic, effective leadership to produce results;
(5) Cooperation between institutions creates powerful synergies that further NRM;
(6) Effective NRM efforts require sufficient, well-educated NRM professionals; and
(7) Research and technology provide the tools for effective NRM.

Contribution of Needed NRM Actions to Development Objectives

Tables 1 and 2 indicate the enabling and direct NRM actions that could contribute to the achievement of hypothetical[1] CDCS 2020-2025 DOs of security, democracy, health, and economic growth:

Table 1 Contribution Enabling NRM Actions Contribute to Potential DOs

Enabling NRM Actions	Contribution to USAID/DR 2020-2025 DOs
Policies/Laws	• **Security** increased by policies that create more NRM jobs for at-risk youth • Participatory processes for managing natural resources strengthens **democracy** • NRM policies and laws conserve water supplies needed for **human health** • **Economic growth** fostered by NRM policies that conserve natural resources
Institutions	• NRM policies and laws increase e**ffective governance** • **Human health** improved due to more capable institutions sustainably managing water supplies • Effective NRM institutions conserve natural resources so **reduce risks**
Research & Technology	• NRM research clarifies **governance, health, and economic growth issues**
Awareness	• Awareness of NRM issues increases peoples' **respect for law**
Education/Training	• Increased NRM capacity supports economic growth and helps **stabilize the economy** by supplying sustainable natural resource products and services

Table 2 Contribution of Direct NRM Actions to Potential DOs

Direct Actions	Contribution to USAID/DR 2020-2025 DOs
Watershed Management	• Increased **security** through training and jobs for at-risk youth • **Democracy** furthered by participation in watershed management actions • Reliable, clean water supplies improve **human health** • Reliable supply of water strengthens **economic stability** • Ensure natural resources necessary for **production of food**
Forest Management	• Training and jobs for at-risk youth in tree planting and silvicultural work increases **security** • Participation in forest management strengthens **democracy and governance** • Forest management protects water supplies required for **human health, economic prosperity, and stability** • Reliable flow of forest products increases **economic prosperity and stability**

[1] The hypothetical DOs, used for the purpose of this analysis, are different from the USAID/DR 2014-2018 Development Objectives.

Direct Actions	Contribution to USAID/DR 2020-2025 DOs
Agroforestry	• Training and jobs for at-risk youth in tree planting **increases security** • Protection of watersheds protects water supplies, contributing to **widespread human health** • Increased productivity of coffee and cacao plantations, and improved prices furthers **economic prosperity and stability**
Protected Areas Management	• Training and jobs for at-risk youth in protected areas **increases security** • Improved management of the National System of Protected Areas (SINAP) increases **economic growth and prosperity** by protecting water for agriculture, energy, and human health
Coastal Zone Management	• Training and jobs for at-risk youth in coastal zone management actions increases **security** • Land use regulations protect investments in tourism facilities, contributing to **economic growth and prosperity** • Enforcement of fishing regulations protects supplies of marine products needed for **economic growth and prosperity** • Protection and re-establishment of reef-lagoon-mangrove-beach ecosystems reduces risk to **economic growth and prosperity** from extreme weather events

This report also finds that actions to achieve USAID/DR's potential Development Objectives for 2020 to 2025 could contribute substantially to achieving the enabling and direct NRM actions that are required to conserve the Dominican Republic's biodiversity and forests.

Conclusions

Based on its findings, this report draws the following conclusions:

(1) Within five categories of enabling NRM actions there are 11 actions needed to achieve sustainable management of forests and conservation of biological diversity;
(2) Within five categories of direct NRM actions there are 25 actions needed to achieve sustainable management of forests and conservation of biological diversity;
(3) There are serious gaps in current and future projects that would finance and implement the needed enabling and direct NRM actions;
(4) The needed enabling and direct NRM actions would also contribute substantially to achieving the USAID/DR DOs of security, democracy, health, and economic growth;
(5) Actions to achieve the USAID/DR DOs of security, democracy, health, and economic growth could also contribute to assisting the Dominican Republic to achieve better conservation of its biodiversity and forests;
(6) The development actions USAID/DR may finance could also contribute to sustainable management of the Dominican Republic's forests and conservation of its biodiversity;
(7) Based on seven criteria, six of the needed enabling actions were rate as high priority (Table 4), three were rated as medium priority, and three were rated as low priority for USAID/DR attention; and
(8) Based on the same seven criteria, 10 of the direct actions needed were rated as high priority (Table 5), seven were rated as medium priority, and eight were rated as low priority for USAID/DR attention.

Criteria for Selecting USAID/DR Priority NRM Actions

Table 3 indicates the criteria that were used to rate the priority of USAID/DR for financing the needed NRM actions. Criterion A reflects whether the needed action fills a gap or not. Criteria B through E reflect the degree to which the needed NRM action contributes to one of the four USAID/DR DOs. Criteria F refers to the degree to which the needed NRM action would improve the conserve of biodiversity over a long period and a large geographic scale. Criterion G is concerned with whether or not the needed NRM action falls within USAID/DR's manageable interest and Criterion H reflects whether or not the needed NRM action reflects lessons learned from prior NRM activities in the DR.

Table 3 Selection Criteria for Priority NRM Actions

Label of Criteria	Description of Criteria
A	Gaps in needed NRM actions
B	Contribution to DO 1 Security from crime
C	Contribution to DO 2 Democratic, effective governance
D	Contribution to DO 3 Widespread human health
E	Contribution to DO 4 Equitable economic prosperity & stability
F	Geographic & time scales
G	USAID's manageable interests
H	Lessons learned

(Note that half of these criteria concern the extent to which the needed NRM actions also contribute to four hypothetical DOs for the 2020-2025 CDCS.)

Recommendations for Priority USAID/DR NRM Actions

If the DOs of the USAID/DR continue to be security, democracy, health, and economic growth, this report recommends it incorporate the priority enabling and direct NRM actions indicated in Tables 4 and 5 into its 2020-2025 CDCS. The lower priority enabling NRM actions that resulted from the ranking process described above will not have actions recommended in the table below. For example, institutional strengthening was less of a priority than building the capacity, and increasing the population, of NRM practitioners.

Table 4 Priority Enabling NRM Actions

Policies & Laws
(1) Enforce NRM and biodiversity regulations
Institutions
Education/Training
(2) Educate more NRM practitioners and promote pro-environmental constituencies
Research & Technology
(3) Finance scientific biological and social research

(4) Do research on NRM technologies
Awareness
(5) Increase public awareness of NRM and biodiversity
(6) Increase decision-maker awareness of NRM and biodiversity

Table 5 Priority Direct NRM Actions

Watershed Management
(1) Implement integrated potable water supply, treatment and watershed management systems, focused on small watersheds.
(2) Control soil erosion through soil NRM practices
(3) Promulgate and enforce land use regulations
Forest Management
None
Agroforestry
(4) Increase productivity of coffee and cacao agroforestry plantations
Protected Area Management
(5) Enhance the capacity of key stakeholders to enforce laws and promote sustainable management
Coastal Zone/Marine Management
(6) Enhance the capacity of key stakeholders to enforce land use regulations and promote sustainable management
(7) Install sewage systems, waste water treatment, and sanitary landfills
(8) Protect and re-establish reef, lagoon, mangrove, beach ecosystem
(9) Enforce fishing regulations
(10) Enforce tourism regulations

If the USAID/DR CDCS for 2020-2025 has other DOs, then this report's methodology could be used to identify those needed NRM actions that would most support the achievement of those DOs.

1 INTRODUCTION

1.1 BACKGROUND

1.1.1 Purposes of the Report

This report has the following purposes:

- Identify the actions needed in the Dominican Republic to achieve sustainable management of its forests and biodiversity;
- Determine the gaps in the current and planned actions needed to achieve sustainable management of the Dominican Republic's forests and biodiversity;
- Determine the extent to which USAID's proposed actions correspond to the actions needed to achieve sustainable management of the Dominican Republic's forests and biodiversity; and
- Determine the extent to which the needed NRM actions could contribute to achieving potential DOs in the USAID/DR 2020-2025 CDCS.

1.1.2 Schedule and Methodology

The report was prepared in 2017 during Phase I (Initial Consultations and Parameters Setting) of preparing the USAID/DR CDCS 2020-2025. Table 1 indicates the phases, dates, and methodology for the report's preparation.

Table 6 Schedule and Methodology

Phase	Dates 2017 - 18	Methodology
Work Plan	September 23 – October 6	• Draft schedule for report preparation • Draft itinerary for field work • Draft report outline • Draft bibliography • In-brief meetings with USAID/DR
Field data collection	October 7-20	• Prepare interview guides • Conducted key informant interviews • Transcribe interviews in Word document • Record field observations • Obtain additional documents • Out-brief meeting with USAID/DR
Data Analysis	October 23 – November 17	• Analyze & triangulate data
Preparation draft report	November 20 – 26	• Use data to identify findings • Use findings to draw conclusions • Use conclusions to make recommendations
USAID review draft report	November 27 – March 5	• USAID/DR staff comments on draft
Preparation of final report	January 5 – April 30	• Prepare Final Draft Report

1.1.3 Limitations of the Data

Time and logistical constraints prevented interviews with the direct users of the Dominican Republics's natural resources, such as farmers, fishermen, charcoal makers, and Haitian immigrants. Documentary and key informant interview (KII) data partially compensated for this limitation.

When the report was prepared, USAID/DR had not yet identified its DOs for its CDCS for 2020-2025.

1.2 USAID/DR COUNTY DEVELOPMENT COOPERATION STRATEGIES

1.2.1 USAID/DR CDCS 2013-2018

Table 7 indicates the USAID/DR CDCS 2014 to 2018 Results Framework:

Table 7 USAID/DR CDCS 2014-2018 Results Framework

GOAL: The Dominican Republic Improves Citizen Security to Promote Economic Growth
DO 1: Crime Prevention Strengthened • IR 1.1: Youth Involvement in Criminal Activities Reduced • IR 1.2: Increased Reading Skills of Primary School Students in Targeted Areas • IR 1.3: Criminal Justice Institutions Strengthened
DO 2: Increased Resilience of People to the Impact of Climate Change • IR 2.1: Land Use Planning Reduces Negative Impact from Climate Change • IR 2.2: Climate-Related Risk Reduction Measures Implemented
DO 3: AIDS-Free Generation Advanced • IR 3.1: Quality of HIV Response Improved

Source: USAID 2014

Figure 20 in Appendix A indicates that the education activities which USAID/DR is currently financing under DO 1 are occurring in the Northeast Corridor (Puerto Plata, Santiago, Valverde and in and close to Santo Domingo. The Youth-at-Risk Activities, also associated with DO 1, are more dispersed, although still largely occurring in the Northeast Corridor as well. USAID/DR-financed activates under DO 2 are concentrated entirely just to the north of La Vega, except for one activity in Duarte, one in Sanchez Ramirez, one in Samana and one in San Pedro de Macoris. The HIV Clinics USAID/DR and Zika prevention and treatment activities USAID/R is financing under DO 3 are scattered over most of the country except for the far south.

1.2.2 USAID/DR CDCS 2020-2025

USAID/DR will begin the preparation of its new CDCS 2020-2025 in January 2018, so its goal, DO and intermediate results (IR) remained to be determined.[2] This report uses the following hypothetical DOs for analysis:[3]

- DO 1: Security from Crime
- DO 2: Democratic, Effective Governance
- DO 3: Widespread Human Health
- DO 4: Equitable Economic Prosperity and Stability

1.3 CONTRIBUTION OF BIODIVERSITY AND FORESTS TO THE DOMINICAN REPUBLIC'S ECONOMIC PROSPERITY

Figure 1 indicates the close links between ecosystem products and services and any country's economy. Qualitative data obtained for this report leave no doubt that the Dominican Republic's economy conforms to the links with ecosystem goods and services indicated in this diagram. It follows that the Dominican Republic's economic prosperity and growth is as highly dependent on the protection and wise, long-term management of its ecosystems and the biodiversity and forests which they encompass.

Figure 1 Ecosystem Structures (tan) and Processes (multi-colored circles)

Source: Spalding et al. 2016

The Dominican Republic has not established a National System for Environmental and Economic Accounts, which would permit it to account for the overall contribution of the different components of its natural capital to the well-being of its population and its sustainable economic growth.[4] Moreover, the methodologies for calculating the economic value of ecosystem regulatory services is still largely experimental.[5] It is not possible, therefore, to provide accurate and detailed quantitative data on the economic contribution of biodiversity and forests to the Dominican Republic's economic prosperity and growth.

Table 8, nonetheless, indicates some estimates of how ecosystem goods and services contribute to the Dominican Republic's economic growth and prosperity.

Table 8 Estimates of economic value of Dominican Republic's ecosystem goods and services

Terrestrial	Ecosystem Goods	Ecosystem Services
Urban Trees (in colonial zone)	No data	Study of 206 trees: pollution removal; 77.49 kg./yr. ($561/yr.); carbon storage: 83.14 t./yr.($11.9 thousand); carbon sequestration: 3.424 t./yr. ($490/yr.); oxygen production: 5.352 t./yr.; avoided runoff: 29.33 m3/yr. ($69.2/yr. [6]
Natural & Plantation Forests	Wood for 1,600 wood industries; charcoal, no data[7]	Regulate water flows; reduce level of peak flooding[8]
Agroforestry	Fodder, fuelwood, live fences, wood	Shade for cocoa, coffee and cattle; roots and litter increase soil productivity and retain water
Agriculture	$1.6 billion/yr. agricultural exports[9]	No data. However, agriculture is expected to generate natural resource costs (e.g., soil loss, water pollution, and damage to reefs)
Pasture	3 million cattle[10]	Soil protection, regulation of water flows[11]
Fresh Water		
Rivers	Fish, no data	Aquatic biodiversity; 0.6 million kW[12]; irrigation water on 270,000 ha
Ponds & Lakes	400 mt./yr fish[13]	Habitat for freshwater biodiversity
Aquifers	Industrial water, no data Drinking water- about 8 million people [14]	No data
Coastal		
Estuaries	No data	No data
Rocky	No data	No data
Dunes	No data	No data
Mangroves	Fish: 110-1000 kg/ha/yr. $2,000/ha/yr. Fish[15]	Carbon sequestration; fisheries enhancement, 2-5 X cheaper than concrete coastal defense; nature tourism[16]
Sea Grass	Fish:1 kg/m2/yr. or 30,000 fish/yr. = $24,000/yr.[17]	Fisheries enhancement; coastal protection[18]
Beaches	No data	Tourism: US$6.7 billion; 6 million tourists, 1 in 20 DR jobs[19]
Coral Reefs	Fish:5-10 tons/km2/yr.[20]	Fisheries enhancement; coastal defense; reduces waves 97%; nature tourism[21]
Marine		
Ocean	Fish: 54 million tons/yr.; 11,500 jobs[22]	Fisheries enhancement, nature tourism[23]

Watershed ecosystems, mostly in the Dominican Republic's mountain ranges, regulate surface water flows and quality and recharge of aquifers.[24] They not only reduce the extent of damage to economic infrastructure from flooding and save human lives, but also provide the water supplies that much of the Dominican Republic's economic activity requires and the water its population needs to stay healthy. Hydropower plants produce over 18 percent of the Dominican Republic's electricity, essential for the industrial and service sectors of the economy, agricultural production, and for good education and

health.[25] Water irrigates over 270,000 hectares of farmland, where much of the Dominican Republic's agricultural export crops are grown, in 2015 already worth over US$1.633 billion and growing in value at over 12 percent a year. The Dominican Republic's exports of over US$200 million of organic agricultural products per year require clean and abundant supplies of water.[26] The Dominican Republic's three million head of cattle require plentiful supplies of water.[27]

The economic value of the Dominican Republic's coastal ecosystem services was calculated to be US$1,199 million in 2014. The annual economic loss due to degradation and poor use of its coastal resources was calculated to be US$434.22 million. Coastal-marine ecosystems contribute 21 percent of gross national product (GNP) and the economic losses due to degradation and inappropriate use have been calculated to be 7.61 percent of the Dominican Republic's annual GNP. In the Dominican Republic's reef ecosystems, parrot fish eat coral and defecate the sand grains that contribute to forming dazzling white beaches. Such beaches literally underlie its massive beach tourism industry, which in 2017 attracted over six million tourists, earned US$6.7 billion dollars, contributed over 17 percent of its GNP and created one in twenty of its jobs. Most but not all tourists are foreign, but Dominicans themselves spend over US$1 million per year in visits to the Biosphere Reserve of Jaragua, Sierra de Bahoruco, and Lago Enriquillo in southwest Dominican Republic.[28] The Ministry of Tourism has plans to increase international tourist visits to ten million per year by 2020, which has the potential for large economic benefits, as well as costs.

The Dominican Republic's forestry plantations produce about 20 percent of the wood its 1,600 wood-based industries use. Its mangrove forest, lagoons, reefs, and open marine water ecosystems provide habitat for economically valuable marine organisms. An older source of data reports that fishing activity in the Domincan Repubic has a long history, and has developed rapidly during the last two decades. The number of fishing boats, fishers and catches has grown since the beginning of the 1980s (FAO, 2001). The fleet, which is comprised of more than 3 361 boats (98% of them artisanal), 8 399 fishers and an average annual production of 11 000 tonnes, generates significant pressure on the traditional coastal and marine fishing resources (SERCM, 2004).

Figure 2 Pine Forest in the Dominican Republic

This implies the Dominican Republic's current and future economic growth and prosperity and the welfare of its population require that it effectively manage and conserve its biological diversity.

The greatest economic value of the Dominican Republic's coastal-marine ecosystems may be the protection and mitigation they provide from the effects of its frequent tropical storms and hurricanes. Hurricanes San Zenon (1930), David (1979), George (1998), for examples, killed and injured people, ruined crops, destroyed homes and wrecked road and communication infrastructure. Hurricane Jeanne (2004), although only a Category 1 hurricane, severely affected tourism on the east coast by making access impossible.[29] In 2017, Hurricanes Maria and Irma, although they did not hit the Dominican Republic directly, caused over $63 million of damage to roads, $300 million in losses to businesses and families, and flooded 5,400 ha of banana plantations.[30] Hurricanes also impose

enormous replacement costs. Rebuilding Puerto Rico's infrastructure after Hurricane Maria, for example, may cost over US$94 billion.[31] If Maria had crossed the Dominican Republic, it probably would have caused similar damage, required huge re-investments in infrastructure, and set the economy back decades. Investments in creating and maintaining healthy ecosystems, with intact biodiversity and thriving forests, would increase resilience in the Dominican Republic to the devastating effects of such tropical storms and hurricanes.

2 FINDINGS

2.1 STATUS OF DOMINICAN BIODIVERSITY AND FORESTS

2.1.1 Ecosystem Biodiversity

Ecosystem diversity is the variety of ecosystems in a given region. The Dominican Republic's ecosystem diversity derives from its extremely varied topographies and climates. Although small (49,020 km2), the Dominican Republic's territory ranges from 40 meters below to 3,000 meters above sea level and includes eight mountain ranges, four large interior valleys, three coastal plains, and 141 islands. Its 1,668-kilometer-long coastline has 226 beaches, 41 rocky cliffs, 25 sand dunes, 141 lagoons, and 49 estuaries. Shallow shelves and deep canyons lie under its 138,000 km2 marine territory. The continental shelf, averages 7.5 km wide and covers 8,130 km^2. Eleven percent of its coastline, or 166 km., has coral reefs. There are two submerged offshore banks, two barrier reefs, as well as many fringing reefs (see Fig. 9, Annex A, Location of Coral Reefs in the Dominican Republic).[32]

Table 9 Hispaniola Ecoregions

Ecoregion	Original (Km^2)	Remaining (Km^2)	%
Terrestrial Ecoregions			
Forested Ecoregions			
Hispaniolan Moist Forest	28,839	4,340	15
Hispaniolan Dry Forest	9,582	2,967	31
Hispaniolan Pine Forest	8,334	4,064	49
Greater Antilles Mangrove	422	245	58
Subtotal	47,177	11,616	25
Wetland Ecoregions			
Enriquillo Wetland	421	152	36
TOTAL TERRESTRIAL	47,176	11,768	25
Freshwater Ecoregions			
Hispaniola Freshwater	350	350	100
Marine Ecoregions			
Greater Antillean Marine	138,000	138,000	100

Source: Kernan et al 2016 based on CATIE's analysis of GIS System and analysis

It rains as much as 2,540 mm/year in the mountainous northeast. Rainfall in the western and southwestern valleys rainfall is only 760 mm/year. On the coastal plains it falls to 400 mm/year. On the northern coast rain falls from September to June; in the in the rest of the country from May to

November. El Niño-induced droughts occur periodically. Tropical storms and hurricanes frequently batter the island.

These topographic and climatic characteristics have produced the distribution and types of ecoregions shown in the map in Figure 8, Appendix A. Table 9 shows the names, original areas and remaining areas of these ecoregions for the island of Hispaniola,[33] This map indicates that the Dominican Republic has five terrestrial ecoregions, one freshwater ecoregion, and one marine ecoregion. The freshwater ecoregion occurs within the terrestrial ecoregions. Table 9 indicates that 15 percent of the Hispaniolan Moist Forest, 31 percent of the Hispaniolan Dry Forest, 49 percent of the Hispaniolan Pine Forest, 36 percent of the Enriquillo Wetland, and 58 percent of the Greater Antilles Mangrove ecoregion remain on Hispaniola. The areas of the Hispaniola Freshwater and the Greater Antillean Marine Ecoregions have not changed.

2.1.2 Species Biodiversity

Species diversity is the variety and abundance of different types of organisms that inhabit a given area. The Dominican Republic is one of the most species-diverse countries in the Caribbean.[34] Table 10 indicates the number of native and endemic species.[35] Note the high percentage of endemic amphibians and plants. The map in Figure 10, Appendix A, shows that the centers (beige) of species endemism are the Samana Peninsula, Los Haitises National Park, the Parque del Este and Saona Island, national parks of the Cordillera Central, and the southeastern mountains and Isla Beata.

Table 10 Number of Species, Endemic and Red List Species in the Dominican Republic

Category	No Species	Endemic Species	Red List
Plants	6,000	2,050	547
Birds	306	32	41
Mammals	53	4	14
Amphibians	74	71	37
Reptiles	166	147	72
Fish	540	8	52
Invertebrates	8,529	2,569	43
TOTAL	15,668	4,881	806

Source: MARN 2014

In 2011, the Ministry of Environment and Natural Resources's (MARN) Red List of Species in Danger of Extinction, Endangered, or Protected in the Dominican Republic listed 547 plants and 223 animals in Critical Danger of Extinction, Danger of Extinction, or Vulnerable to Extinction.[36] Many species have not been studied, however, so more plants and animals than this may be at risk. Based on new botanical studies, for example, the National Botanical Garden recently increased its estimate of the number of plant species in danger of extinction to 1,396.[37] Similarly, recent studies have provided data that increased the number of amphibian species in danger from 27 to 33, of reptiles from 11 to 59, of birds

from 6 to 22, and of mammals from 4 to 14.[38] Amphibians are the most threatened group of animal species in the Dominican Republic, due to the destruction of their habitat.[39]

2.1.3 Genetic Biodiversity

Genetic diversity is the combination of different genes found in individuals within a population of single species and the pattern of variation found across different populations of the same species. Few data are available about the genetic diversity of wild organisms in the Dominican Republic. The country, however, is relatively small but geographically diverse. Therefore, speculation suggests it may have numerous isolated ecosystems where genetically un-diverse endemic species, sub-species, or races, have evolved.

Table 11 Dominican Forest Types by Area and Percentage

Forest Type	Area (Km^2)	%
Dense Conifer	1,603	8
Open Conifer	716	4
Cloud Broadleaf	1,093	6
Humid Broadleaf	5,989	30
Semi-Humid Broadleaf	2,325	12
Dry	6,701	34
Mangrove	296	2
Shaded Coffee	939	5
TOTAL	19,661	100

Source: MARN 2016

2.1.4 Status of DR's Forests

According to the Global Forest Assessment prepared by the Food and Agriculture Organization (FAO) in 2015 forest covers 1,983,000 ha (41 percent), other wooded land covers 302,000 ha (6.3 percent), and other land with tree covers 36,100 ha of the Dominican Republic."[40] The FAO definition of forest "excludes tree stands in agricultural production systems, such as fruit tree plantations, oil palm plantations, olive orchards, and agroforestry systems when crops are grown under tree cover."[41]

Table 11 shows the types and areas of the forest types into which MARN has classified the Dominican Republic's forest. The Dry Broadleaf forest type covers the largest area, followed by the Humid Broadleaf forest type, and then the Semi-Humid Broadleaf type. The Dense Conifer and Open Conifer types together are only 12 percent of the entire forest area. Note that in its statistics, MARN has included 939 km2 of shaded coffee as a forest type, although it is not a forest according to the FAO's definition of forest. Without the shaded coffee forest type, MARN's area of forest in the Dominican Republic would be not 19,661 km2 but 18,722 km2. Figure 16 in Appendix A shows the location of these forest types and other land uses.

Forest cover increased from 5,882 km2 (12 percent) in 1967 to nearly 18,628 km2 (38 percent) in 2016[42]. Only about 800 km2 of this additional forest cover are tree plantations, so 11,946 km2 is a secondary forest, and reforestation evidently has played a small role in the increase in the Dominican Republic's forest cover. Reliable data are unavailable regarding the location, age classes, and species composition for both the natural forest and the forest tree plantations.[43]

Several factors contributed to the regeneration and spread of forest in the Dominican Republic. In 1967, logging in natural forest was banned. Many farmers have migrated to urban areas, leaving crop and pastures uncultivated and, therefore, susceptible to natural regeneration. Other rural people live from remittances from relatives who have migrated, so they no longer need to farm. Dominicans are cutting fewer trees for fuel since they have mostly switched to using subsidized and more convenient propane gas for cooking. Cheap imported food has undercut the profitability of farming, driving some farmers to abandon farmland. Finally, the government issued certificates of reforestation and offered tax breaks that made landowners and businesses more willing to plant forest tree plantations.[44]

2.2 DIRECT THREATS TO DOMINICAN BIODIVERSITY AND FORESTS

2.2.1 Loss and Degradation of Habitat

Deforestation has continued to degrade and eliminate terrestrial habitat in the Dominican Republic, although its overall area of forest has increased. Figure 11 in Appendix A indicates that in 2016 deforestation occurred mostly within national parks of the Cordillera Central,[45] the Hispaniolan Moist Forests of Saltos de la Jalda, and Los Haitises National Park, in the northeast mountains, in the Hispaniolan Pine Forests of the Sierra de Bahoruco in the southwest mountains, and on the northeast coast, adjacent to the Via Panoramic Costa Azul. The deforestation data do not distinguish conversion of young, secondary forest to cropland, as part of cyclical "slash-and-burn" agricultural practices, from the elimination of older "primary" forests where agricultural has not been practiced previously. Thus, the data may not indicate that the deforestation caused by "slash-and-burn" agriculture could be offset by forest regeneration on fallow land. Likewise, although between 2001-2016, Dominican Republic lost less than 1 percent of the overall mangrove forest, [46] in some places mangrove forest has been eliminated, while in other places it has become established.[47]

The freshwater ecoregion has not changed in total area, but soil erosion, dams, road construction, and pollution have degraded parts of it, by changing their water volumes, flow patterns, and chemical qualities.[48] No quantitative data, however, were available on these changes.

The marine ecoregions also have not changed in area, but some of its specific marine habitats have lost area or been degraded. For example, 70 to 90 percent of Dominican reefs have died or been severely degraded.[49] Construction and roads have modified coastal marine habitats such as lagoons and beaches,[50] especially along the northern, eastern, and southeastern coasts where most tourism development is concentrated. For example, the vegetation of seaside sand dunes has been destroyed when the dunes have been flattened to allow tourists easier access to beaches. Sedimentation is damaging some of the DR's existing coral reefs and preventing the establishment and growth of new coral reefs.[51]

Loss of one type of habitat may cause changes in other habitats. Clearing of highland forests, for example, may increase sediment deposits in coastal wetlands, mangroves, lagoons, and reefs, making them less suitable for the reproduction and growth of some species. Likewise, mangrove forest provides habitat that is vital to the life cycle of some marine species. The loss of even small areas of mangroves,

therefore, may decimate a marine species' population. The decline of populations of some marine species may alter the functioning of huge areas of marine ecosystems.

Loss and degradation of the habitats in the Dominican Republic's ecoregions may affect migratory species. Many North Atlantic humpback whales breed and raise young in Samana Bay, and some North American migratory birds spend winter months in the Dominican Republic's forests. If the area or quality of these habitats decline, then fewer birds and humpback whales may return to New England or the North Atlantic. Lower populations of these migratory animals may affect the functioning and species composition of these distant ecosystems.

2.2.2 Over-Exploitation

Over-exploitation is depleting the populations of some of the Dominican Republic's wild commercially valuable species. In some cases, known management practices could avoid over-exploitation of a species while meeting its market's demand. The silvicultural practices required to regenerate and grow mahogany *(Swietenia mahagoni),* generally considered the world's finest wood and once an important Dominican export product, have been known for decades. Nonetheless, its over-exploitation has almost eliminated mahogany as a commercial species in the Dominican Republic.[52] Silvicultural practices could also maintain commercially viable populations of the tree guaconejo (*Amyris* sp.), from which an essence is currently being extracted for making perfume. Over-exploitation similarly threatens many of the Dominican Republic's commercially valuable marine species. Catches of spiny lobster, king mackerel, southern red snapper, and yellowtail snapper increased from 1982 to 1986 and 1992 to 1996, then fell drastically between 2002 and 2006 and have never recovered.[53] With proper fisheries management, these species could have been exploited without destroying their populations.

Over-exploitation ripples through the Dominican Republic's ecosystems, society, and economy. When mahogany became rare, for example, not only was an important tree species lost to the Dominican Republic's ecosystems, but Dominicans lost jobs and the Dominican Republic economy lost a valuable economic asset. More recently, when populations of commercially valuable carnivorous fish collapsed, Dominican Republic fishermen looked for other work or turned to catching low-value, algae-feeding parrot fish. Fewer parrot fish permitted reefs algae populations to spread rapidly and smother juvenile corrals. Consequently, the Dominican Republic's reefs have declined in area and diversity. Since reefs produce the white, carbonate sand beaches that attract most tourists to the Dominican Republic, the decline of Dominican reefs could badly affect its tourism industry.[54]

2.2.3 Pollution

Pollution from solid and liquid waste and soil erosion threatens the Dominican Republic's freshwater and marine biodiversity.[55] Soil erosion differs between watersheds, depending on soil characteristics, land use, sequence and frequency of precipitation events, and the stage of the vegetation canopy. In general, however, less vegetation cover results in increases sedimentation.[56]

Most business and residents discharge wastewater into the ground or connect their sanitary discharge pipes to storm drainage systems. Plastics and other wastes have severely polluted the Ozama, Jimenoa, and Las Palmas rivers. In 2009, the Dominican Republic was producing more than 6,000 tons of solid waste per day and to 2017 more than 10,000 tons per day, much of it dumped in the open.[57] One key informant (KI) said,

> "Trash is the biggest threat to NRM here. It's not just plastic but also fecal and medical waste. Las Terrenas beach is covered with trash every time it rains and Samana Bay stinks with trash…The trash washes into the mangroves which are the nursery for fish.[58]

The Cosón River carries about 3,000 m3/year of sewage and 60 tons/year per year of solid waste to the ocean. Similarly, the Terrenas River carries 40,000 m3/year of sewage and 540 tons/year of solid waste to Samana Bay.[59] Excessive use of agricultural chemicals can result in pollution of freshwater, coastal, and marine ecosystems and affect the reproduction and regeneration of organisms, as well as being directly and indirectly harmful to human health – including over 1.1 million tourists per year from the United States.[60]

2.2.4 Invasive Species

There are at least 192 species of invasive plants in the Dominican Republic. On a relatively small, but mountainous island, such as Hispaniola, invasive exotic species, introduced accidently or purposefully, can severely affect populations of native species. Endemic species especially tend to lack defenses against introduced diseases and insects. They may also occur in small, isolated populations that have little genetic variability and so have little chance to adapt and successfully compete with introduced species. Introduced species, by contrast, may find growing conditions ideal and lack natural predators that would otherwise keep their populations under control.

Figure 2 Invasive Scaly-Breasted Munia

Especially aggressive exotic plants are the trees acacia (*Acacia mangium*), leucaena (*Leucaena leucocephala*) and caliandra (*Calliandra calothyrsus*).[61] Similarly, there are large populations of the introduced birds, the village weaver (*Ploceus cuculatus*), scaly-breasted munia (*Lonchura punctulate*), and tricolored muni (*Lonchura malaca*). A bullfrog species (*Rana catesbeiana*) occurs in most of the lowlands.[62] The lionfish (*Pterios* species) are an invasive species in the carribean and a grave threat to local marine ecosystems.

2.3 DRIVERS OF DIRECT THREATS TO DOMINICAN BIODIVERSITY AND TROPICAL FORESTS

2.3.1 Population Growth and Migration

Between 1980 and 2017, the Dominican Republic's population doubled and grew richer. Twice as many people demand about twice as much food, water, energy, and shelter - even more if they become wealthier individually. Exploiting natural resources to meet these demands without proper technology and management practices, drives loss, and degradation of habitat, over-exploitation, pollution, and invasive species.

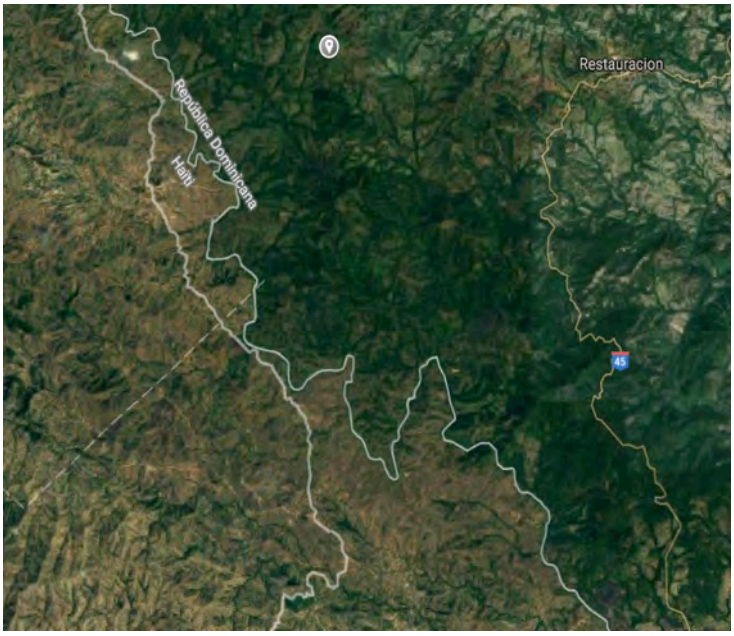
Rural Dominicans have migrated massively to urban areas. The Dominican Republic is now 80 percent urban.[63] Cities and towns require roads, pipelines, power lines, and sewers. Building and operating such infrastructure also drives the direct threats to biodiversity and tropical forests.

Haitians, driven in part because of the depleted forest cover in Haiti (see Figure 4), are migrating to some of the depopulated Dominican rural areas.[64] The analysis team did not locate quantitative data on their numbers or locations. One KI described the situation:

> "Dominicans are leaving the area near the border and coming to the cities to work in tourism and Haitians are moving in to take their place in the rural areas…They do not have the skills to manage the land. And have not vested interest in protecting it"[65]

The analysis team did not identify quantitative data on whether Haitian immigrants to rural areas are increasing the rate of deforestation or other direct threats to biodiversity and forests.

Figure 4 Forests in the Border Area, Haiti at left



Dominicans also migrate to other countries. Nearly a million Dominicans have migrated to the United States. In 2008, their remittances were US$2 billion. Although only 14 percent (US$280 million) of these remittances went to the poorest, rural families,[66] several KIs commented that they think these remittances sometimes affect land use, by permitting rural people to live without working and stop farming. Fishermen have recently been temporarily migrating to Puerto Rico to look for work in reconstruction from Hurricane Irma.[67] Data are unavailable, but less fishermen may reduce the threat of over-exploitation of fish.

2.3.2 Skewed and Insecure Land Tenure

Skewed land ownership and land tenure insecurity is a driver of the direct threats to the Dominican Republic's biodiversity and forests. Agriculture is the fourth-largest economic sector in the country, and the sector employs 15 percent of the economically active population. Yet land ownership in the Dominican Republic is extremely concentrated. Government expropriation of land, weak law enforcement, and public support for land invasions and squatting contribute to insecurity of land ownership.[68] Most land in the Dominican Republic is not registered and, even if land rights are registered, tenure is not assured. Unregistered land may be expropriated for development without notice or compensation. Provisional titles and fraud have confused property rights and land records.[69]

2.3.3 Market Demand

Market demand for wild and cultivated products drives the direct threats of habitat loss and degradation and over-exploitation to the Dominican Republic's biodiversity and forests. Demand for agricultural crops stimulated deforestation mostly in flatter, lowland areas. After deforestation, the effects of market demand can continue to drive ecosystem degradation. For example, recently a collapse in coffee prices (along with a fungus infestation) has caused coffee growers to eliminate shade trees and plant short-cycle crops.[70] Responding to market demand, farmers on the steep hills that surround Jarabacoa are

eliminating coffee and trees and planting plant green squash, Chayote (*Sechium edule*) instead. Consequently, soil erosion and sedimentation into freshwater ecosystems around Jarabacoa has probably increased.[71] Likewise, international demand is driving a conversion from genetically diverse varieties of native avocados to the genetically uniform, non-native Haas variety.[72]

Market demand also has driven or continues to drive the over-exploitation of the wild plants and animals. International market demand, for example, drove the over-exploitation of West Indian mahogany (*Swietenia mahagoni*) to commercial extinction. The tourist industries demand for fish drives over-exploitation of fish.[73] Perfume makers' demand for the oils in the guaconejo tree (*Amyris balsamifera* L.) and from tourists for an aphrodisiac drink made from the plant canelilla (*Pimenta haitiensis*) drives their over-exploitation.[74]

In spite of a prohibition on cutting native trees, charcoal production continues in the Dominican Republic. Between 1982 and 2005, the Dominican Republic's consumption of charcoal and firewood fell from 596,877 75-pound sacks to 48,973 sacks per year, mostly because the government subsidized the market price of propane gas.[75] Now fewer than 10 percent of Dominicans use firewood or charcoal. Charcoal, however, still supplies 75 percent of Haitian energy for cooking and exports it to other Caribbean islands and the United States[76] [77] and part of its charcoal comes from the Dominican Republic.

Figure 5 Charcoal Production in the Dominican Republic

A 2009 study identified 23 communities in the provinces of Independencia and Baoruco where 200 people, mostly Haitians, were producing 37,000 sacks of charcoal per month, worth about US$205,350. Twelve trucks, owned by Dominicans, collected the charcoal from the roadside and transported it to Tierra Nueva, Boca de Cachón y Puerto Escondido from where it was transported to Haiti, mostly by boat across Lake Azuéi and then taken to the market in Puerto Principe. Annually, the production of these communities would be 445,788 sacks worth US$2.4 million in Puerto Principe. The 200 producers received 50 percent of this value (US1.2 million), the truckers received 25 percent (US$600,000), and the intermediaries 13 percent (US$312,000). The remaining 12 percent (US$288,000) went to pay various charges during transport of the charcoal. To produce this quantity of charcoal required cutting wood on 2,108 ha annually, so the production per hectares of charcoal was 211 sacks. The study concluded that the charcoal makers would continue their activity regardless of any attempt to control them.[78]

Data were unavailable to identify all the places in the Dominican Republic where charcoal is being produced. One KI reported production inside the boundaries of the Sierra de Barahuco National Park.[79] A 2015 report identified six companies or associations in the southwest that produce charcoal. This study reports that 16 percent of the energy Haitians use is from charcoal and that 86 percent of this charcoal originates in the Dominican Republic, although export of charcoal to Haiti is illegal. MARN makes some futile attempts to stop transport of charcoal to Haiti. [80]

It is nearly impossible to curb or eliminate the drive to satisfy market demand for plants or animals by enforcement of regulations alone. When the price of the product become too high, market demand may diminish. By that time, however, the population of the plant or animal may be so depleted that its

recovery has become impossible. Moreover, an economic product that could support the welfare of rural people has been destroyed. Domestication of a wild product, therefore, is the most feasible way to stop its over-exploitation. Research, technology, training, administrative ability, and capital are required to domesticate and market a wild product. Enforcement of regulations against exploitation of wild populations may give an additional incentive for domestication of these wild plants and animals.

2.3.4 Tourism

Tourism is a major driver of the threats to the Dominican Republic's marine biodiversity. In 2016, 6.1 million tourists visited the Dominican Republic.[81] Most of them came for the "sun-and-sand" tourism that is concentrated on beaches. The tourist industry stimulates demand for seafood, requires infrastructure, increases the chances that invasive species are introduced, and creates wastes that can pollute fresh and marine water habitat. It also increases demand for beef and vegetables, which may stimulate conversion of some forest land to pasture and cropland, although no data were available on the extent of this impact from tourism. The construction of tourist facilities on the eastern coast, for example, destroyed and filled in mangrove forests.[82] The demand for fish to eat, created in part by the tourism industry, has driven the over-exploitation of carnivorous fish and now is threatening even parrot fish, with grave consequences to some of the Dominican Republic's reefs.[83] Since the Ministry of Tourism has set a goal of attracting two million additional international tourists to the Dominican Republic by 2020,[84] tourism will continue to drive the threats to the Dominican Republic's marine biodiversity.

2.3.5 Global Climate Change

The USAID Climate Change Vulnerability Assessment Report of 2013 for the Dominican Republic projects medium and long-term decreases in rainfall in May and an increase in December and average atmospheric temperature increases for 2030 and 2050 of 0.5-1.0 °C and 1.0-2.5 °C respectively. It predicts that the changes in temperature will increase evaporation and induce additional water stress on plants. The report also projects that sea-level rise will be likely to exacerbate coastal flooding and beach erosion and that a rise in ocean and global temperatures will increase the intensity of tropical storms and their accompanying precipitation.[85] With respect to the historical records, another study based on five climate change projections showed an increase in annual temperature from 1 to 3.5 degrees Celsius and an average annual percent change in precipitation from about -40 percent to +20 percent for the Yaque del Norte, Ozama, Haina and Nizao watersheds.

The USAID Regional Climate Tropical Forests and Biodiversity Assessment, which includes the Dominican Republic, identified five threats climate change can cause to biodiversity, although it notes that insufficient scientific data exists to analyze their specific impacts on biodiversity and forests within particular ecoregions and protected areas. These threats are: higher air temperatures, incidence of climate extreme events, incidence of fires (terrestrial and freshwater only), changes in rain regimes (terrestrial only), and changes in species' occurrence ranges. The report anticipates that marine, coastal, and high-elevation ecosystems are most likely to suffer the initial impacts on biodiversity of climate change and notes that the "apparent decrease and possible disappearance of amphibian species, particularly frogs, in moist and montane forests of Central America and the Dominican Republic may be related directly to climate change".[86]

Another study, using the Soil and Water Assessment Tool, indicates that projected climate changes in the Dominican Republic will interact with different land uses through complex hydrological processes that will affect the volumes and patterns of freshwater water flow and sedimentation.[87] Such changes in

water flow patterns and volumes are likely to affect freshwater biodiversity. If average temperature increases and sea level rises, the Dominican Republic's reefs, coastal and Lake Enriquillo may be the most affected ecosystems.[88] Climate change possibly caused Lake Enriquillo's level to rise, its salinity to fall and its aquatic biota to change between 2001 and 2011.[89]

As sea levels rise, Caribbean reefs will become more submerged and higher waves are likelier to reach areas behind the reefs, which is changing sedimentation and ecological processes and increasing shore erosion and turbidity. Increased turbidity might reduce or kill off species of corals that are sensitive to sediments.[90] Reduced area of coral, or changes in their species composition and growth patterns, could be expected to affect reef ecosystems and species and genetic biodiversity. Even low greenhouse gas emission scenarios are likely to degrade and/or eliminate most warm-water coral reefs by 2040–2050, since little evidence exists to show that coral reefs can adapt at rates that are sufficient for them to keep up with rapid ocean warming and acidification or migrate north.[91]

If climate change were to cause more frequent and/or stronger tropical storms and/or hurricanes, it would be reasonable to predict more of the same effects on terrestrial, coastal, and marine biodiversity as they have caused in the past. Hurricanes and tropical storms, for example, may be the most important factor controlling species composition and some aspects of ecosystem dynamics in Caribbean forests. Tanner, V. et al. found the following:

> "Effects of hurricanes on Caribbean forest ecosystems include: defoliation, felling of trees by uprooting and snapping, and tree mortality. Hurricanes cause direct effects on animal populations and indirect effects through reductions in supplies of food. Frugivorous and nectarivores birds appear to be more severely affected than insectivorous species. The effect of hurricanes on insect populations varies by species and the age of individuals. Effects of hurricanes on the physical environment include modified microclimates due to increased light penetration through defoliated canopies and landslides triggered by rainfall. Increased litterfall can lead to increases in some soil nutrients and reduce fine root biomass. Recovery of forest ecosystems from hurricanes depends on a combination of seedling growth and re-sprouting of canopy trees. Higher light and temperature can increase seed germination but also seedling mortality. The abundance of pioneer and intolerant tree species increases after a hurricane and then decreases over time. The few long-term studies of adult trees show the expected decline in the proportion of pioneer and intolerant species with time after disturbance."[92]

2.4 ENABLING ACTIONS

2.4.1 Policies, Laws and Strategies

The Dominican Republic is signatory to all the international NRM treaties and conventions[93] and has met its obligations to submit reports and strategies under these treaties.[94] The Haitian Dominican Bilateral Mixed Commission, although not entirely a NRM treaty, channels "resources of international cooperation in favor of the development of both countries" (HDBMC 20170).

The Dominican Republic's emissions of the greenhouse gases are so small that its actions to reduce them will have miniscule effect on global climate change. Nonetheless, the Dominican Republic has signed the United Nations Framework Convention on Climate Change and committed to reducing its carbon emissions by 25 percent before 2030. Its principal policy response to global climate change, however, is to adapt by strengthening the country's resilience. Many of the measures in the Dominican Republic's National Strategy for Adaptation to Climate Change 2011-2030[95] and National Strategy for

Adaptation to Climate Change in the Agricultural Sector[96] are the same as the enabling and direct NRM actions that are needed to reduce the threats to the Dominican Republic's biodiversity and forests. If SINAP is managed well in its entirety, for example, it will serve as a refuge for organisms affected by local climate change. Reducing sedimentation and pollution in the Dominican Republic's freshwater and marine ecosystem will increase their capacity to adjust to a change in water temperature.

Table 12 NRM Laws & Regulations

General Law for the Environment and Natural Resources (Law 64-00.2000)
Sectoral Law of Protected Areas (Law 202-04.2004)
Law of Fishing and Aquaculture 307
Laws: 5856, 67-74; 118-99; 64-00, Dominican Penal Code Art 434
Decree 303
Forestry Regulations
Numeral 12 del Artículo 41 de la Ley 64-00.

Source: MARN 2014

The National Development Strategy 2030 includes strategies for the protecting the environment, adapting to climate change, and promoting forest management and reforestation.[97] Dominican Republic's principal policy for conserving biodiversity has been to establish SINAP. No document articulates the Dominican Republic's forestry policy but in practice it is to promote and subsidize reforestation in degraded watersheds.[98]

Table 13 Dominican Approved and Pending NRM Policy Documents

Approved Documents
National Constitution, Article 14-17
National Development Strategy to 2030
Voluntary Commitments for Marine Areas.
National Strategy for Invasive Exotic Species
National Strategy for Forest Fire Prevention and Control
Pending Documents
Strategy for Watershed Management

Source: MARN 2014

The General Law for the Environment and Natural Resources (Law 64-00) was passed in 2000. It superseded previous NRM laws.[99] Law 64-00 requires the preparation of sectorial laws for protected areas, forestry, territorial planning, coastal and marine resources, and fire control (see Tables 12 and 13). It also requires municipalities to establish Municipal Environmental Units, which a few have done,[100] as well as to prepare, promulgate, and enforce land use plans. The Dominican Republic does not have an urban planning and development law that would provide the legal basis for regulating land use in watersheds and prevent their degradation due to disorganized urban expansion.[101] However, the Ministry of Planning and Development has been working for over a year on the development of a law to regulate the land use in the country. The Sectorial Law of Protected Areas (202-04) aims to conserve

and preserve representative samples of the different ecosystems and the natural and cultural patrimony.[102] MARN has established a process for environmental impact assessment and issues permits for environmental permits.[103] Legislators are currently discussing drafts of the other sectorial laws that Law 64-00 requires.

Actions Needed:

- Approve and implement territorial planning and coastal resources laws
- Approve and implement a water law
- Establish legal, clear land ownership within the SINAP

2.4.2 Institutions

The MARN provides an institutional structure for imposing consistency and order on public NRM actions, inserting NRM into national economic policies, and coordinate NRM policies and actions with other national government institutions, private sector for-profit and non-profit institutions.

MARN has many vice-ministries,[104] all of them with important functions related to NRM. The Vice-Ministry for Protected Areas, the Vice-Ministry of Marine and Coastal Resources and the Vice-Ministry for Forest Resources are the most directly concerned with conserving biodiversity and forests. The National Service for Environmental Protection investigates and the Attorney General for the Defense of the Environment and Natural Resources prosecutes violations of environmental and natural resource laws and regulations.[105] The National Botanical Garden, the National Zoological Park, the National Aquarium, the National Museum of Natural History, and the National Institute of Hydraulic Resources are affiliated with MARN.

Many other national public institutions besides MARN formulate, implement or influence policies and actions that affect biodiversity and forests. The policies and actions of the Ministry of Tourism, the National Hotels and Restaurants Association and hotel operators and associations affect biodiversity, particularly coastal and marine biodiversity, given the predominance of beach tourism. The National Maritime Affairs Authority and the Dominican Council of Fisheries and Aquaculture are legally required to regulate exploitation of natural resources, such as fish, so as to conserve them.

Municipal governments provide a local institutional structure for resolving NRM threats, such as pollution and destruction of habitat, in ways that respond to the collective local interest in economic growth and stability. Community organizations, especially those organized by women, exist and sometimes can be powerful institutions for multiplying NRM practices across landscapes and watersheds. Businesses which seek to add a reputation for social responsibility to their assets and NRM non-governmental organizations (NGOs) add to the Dominican Republic's institutional structure for NRM.

Nonetheless, the capabilities of these institutions, individually and collectively, are still insufficient to eliminate, or even substantially reduce, the threats to the Dominican Republic's biodiversity and forests. Institutional constraints hamper MARNs effectiveness in enforcing NRM regulations, advocating NRM policies, and promoting local NRM actions. MARN has commented that "the greatest difficulty the Dominican Republic faces in conserving its biodiversity… lies in the implementation on the ground of the existing instruments for the protection, NRM, and sustainable use of biodiversity."[106,107] MARN's weaknesses stem from being overly-centralized in some aspects and over-decentralized in others;[108] personalized administration and policy-making;[109] overlap and/or duplication of responsibilities with

other public institutions;[110] lack of personnel and equipment;[111] and insufficient financing for field activities at a large-scale.

Some of the Dominican Republic's 60 or so NRM NGOs (see Table 13), have greatly influenced its NRM policies, especially establishing protected areas as its principal method for conserving biodiversity and forests.[112] Their principal problems concern lack of reliable financing and competition among themselves. Networks of community organizations have capably implemented field NRM actions.[113]

Table 14 Principal Dominican NRM Non-Governmental Organizations

Name of NGO	Thematic Focus	Geographic Focus
Fondo Pro Naturaleza (PRONATURA)	Watershed management, protected areas, forest fire planning & training, planning for natural risks.	Cordillera Central, Ozama watershed and northwest Haiti border.
Reef Check	Reef research & monitoring	Marine & coastal especially reefs
Consorcio Ambiental Dominicano (CAD)	NRM of biodiversity, protected areas, environmental education, sustainable agriculture, ecotourism & coastal-marine ecosystems.	National with focus on protected areas and buffer zones.
Grupo Jaragua, Inc.	Research and projects to solve local NRM problems.	Jaragua National Park & Jaragua-Bahoruco-Enriquillo Biosphere Reserve.
Centro para la Conservación y Ecodesarrollo de la Bahía de Samaná y su Entorno (CEBSE)	Activities aimed at achieving the NRM and sustainable use of natural and cultural resources in the area of the Bay of Samaná	Peninsula of Samaná, Bajo Yuna, the karstic massif of Los Haitises and the Coastal Plain Sabana de la Mar - Miches, the Bay of Samaná and the adjacent territorial sea.
Fundación Moscoso Puello	Scientific research and NRM of natural resources	National system of protected areas "with a marked emphasis in the Cordillera Central"
Fundación Dominicana de Estudios Marinos	NRM of marine-coastal ecosystems and resources, from research to the education of the communities and their integration in the different programs and projects	National level, with emphasis on the eastern coastal area of the country
Centro de Desarrollo Agropecuario y Forestal (CEDAF)	Agricultural and forestry training, information, institutional strengthening, analysis & development of policies & strategies	National scope and Las Neblinas Scientific Reserve (co-management)

Sociedad Ecológica del Cibao (SOECI)	Human-nature inter-relationships	Province of Santiago, emphasis on Pico Diego de Ocampo.
Sociedad Ecológica de Barahona (SOEBA)	Environmental education & reporting, NRM projects	Barahona and Enriquillo Region.
Fundación Sur Futuro	Promotes the development and social welfare of communities through the sustainable management of the environment and natural resources.	Southern Region of the Dominican Republic
SOH NRM	Study & education about endemic & native species	Sierra de Bahoruco National Park & Loma Charco Azul Biological Reserve (co-management).

Sources: Documents of the organizations and KIs

The Nature Conservancy (TNC) has been the most influential and constant presence of international environmental NGOs in the Dominican Republic. It has provided Dominican NGOs with training, financing, and technical support.

The National Network of Business Support for Protection of the Environment has 90 members. It promotes public-private alliances "to create a balance between environmental protection, social responsibility, and economic growth."[114] Table 15 indicates the principal businesses and business foundations that have supported NRM activities. The analysis team did not encounter any financial data for these organizations' NRM projects.[115]

Table 15 Business Sponsored NRM Organization

Foundation	Business Sponsor	Thematic Focus	Geographic Focus
No foundation	Universal Group	Watershed reforestation	Bao, Ocoa, Haina & Ozama watersheds
No foundation	Cibao Savings and Loan Association	Reforestation, training of fishermen	National
Brugal Foundation	Brugal Group	Prizes for environmental projects	National
Foundation Propa-Gas	Propa-Gas	Environmental education; reef research; subsidized natural gas; national parks	Co-management of the Valle Nuevo National Park and coral reefs NRM.
Popular Foundation	Popular Banking Group	NRM projects; Administration & fundraising training	Bao & Ozama watersheds.
Foundation ADEMI	ADEMI Bank	NRM/environmental projects to benefit families	Haina, Nizao, Blanco & Maimón watersheds.

Foundation	Business Sponsor	Thematic Focus	Geographic Focus
Punta Cana Group Foundation	Punta Cana Group	Protect and restore the natural resources of the Punta Cana region, while contributing to the sustainable development of the Dominican Republic.	Zone of development of Punta Cana and its terrestrial, coastal and marine environment
Tropigas Foundation	Marti Group	Training, watershed reforestation, NGO administration; volunteers in collection of solid waste; monitoring of reefs.	Ozama & Isabela watersheds; coral reefs, Sierra de Bahoruco National Park

Sources: ACAP 2017; Brugal 2017; FPG 2017; ADEMI 2017; Tropigás 2016; Punta Cana 2017

A KI noted that donors to the Dominican Republic have been reducing their funding for NRM activities and that lack of consistent funding has affected the financial stability of NRM NGOs. An important NGO, Consorcio Dominicano de Competitividad Turística has just closed due to lack of funding.[116] A KI from MARN noted that as bilateral funds are being reduced, MARN is depending more on regional collaboration projects for financing.[117]

Actions Needed:

- Improve inter-institutional relations
- Improve MARN efficiency
- Increase business involvement in NRM
- Establish MARN offices for all SINAP areas

2.4.3 Education/Training

The most recent study of the Dominican Republic's professional and technical NRM capabilities was prepared in 2008. The study concluded that although the country had the basic capacity required to conserve its biodiversity, more training and education in NRM fields was required at the technical, professional, and research levels. Data were unavailable to evaluate current NRM capabilities.

Table 15 indicates that the Dominican Republic has post high-school educational institutions that could educate NRM practitioners in the areas, such as environmental engineering and ecology, peripheral to NRM practices. However, there are no four-year programs in subject areas that are central to NRM practices, such as forestry, soil conservation, and watershed, fisheries, wildlife, protected area, and coastal zone management. The National Environment and Natural Resources School in Jarabacoa has a technician program in environment and natural resources.[118] Only four of the 2017 graduates have found NRM jobs.[119] Currently no institution trains masters or PhD students in any field of NRM. There are no inter-disciplinary NRM educational programs.

Table 16 Dominican Higher Education Institutions Offering Degrees Related to NRM

Institution	Location	Bachelors	No. of Students 2017	Masters	No. of Students 2017
Universidad Nacional Pedro Henríquez Ureña (UNPHU)	Santo Domingo	Education (Natural Sciences)	0	Environmental Engineering; Ecology & Environmental Engineering	0
Universidad Autónoma de Santo Domingo (UASD)	Santo Domingo	Biology, Geography with a mention in Natural Resources and Ecotourism	No data	Environmental Protection Engineering and Sanitary and Environmental Engineering	No data
Pontificia Universidad Católica Madre y Maestra (PCMM)	Santo Domingo	Ecology & Environmental Management	0	Sustainable Management of Water; Environmental Management	0
Universidad Central del Este (UCE)	San Pedro de Macorís	Education with specific mentions in branches of natural sciences	No data	Environmental Engineering	No data
Universidad ISA (ISA)	Santiago	Environmental Engineering; Ecology & Environmental Management	0	Crop Protection; Natural Sciences for Teachers	0
Universidad Tecnológica de Santiago (UTESA)	Santiago	Drug-Biochemistry	No data	Environmental management	No data
Instituto Tecnológico de Santo Domingo (INTEC)	Santo Domingo	Biotechnology	No data	Environmental Sciences Renewable Energy Technology Doctorate in Environmental Sciences Doctorate in Energy Management for Sustainable Development	No data

Institution	Location	Bachelors	No. of Students 2017	Masters	No. of Students 2017
Universidad Agroforestal Fernando Arturo de Meriño (UAFAM)	Jarabacoa	Tourism - Mention in Ecotourism & Agroforestry Engineering	15	None	No data
Escuela Nacional de Medio Ambiente y Recursos Naturales	Jarabocoa	Natural Resource & Environmental Management Technicians	43	N/A	N/A

Sources: UASD 2017; INTEC 2017; UTESA 2017; UNPHU 2017; PCMM 2017, UCE 2017; ISA 2017; UAFAM 2017; Diario Libre 2016)

Table 16 indicates that only the National Environmental and Natural Resources School in Jarabacoa currently has any students in NRM fields. There are a number of reasons for the scarcity of NRM students and jobs. There are few job opportunities outside of government jobs for NRM practitioners. Government NRM jobs are also scarce;[120] NRM jobs tend to offer lower-paying jobs in more difficult rural conditions than other types of employment. The Autonomous University of Santo Domingo, which has no NRM education, attracts many students who might otherwise go to a private university because it does not charge tuition, but it does not have NRM programs.[121] Children receive almost no education about their surrounding environment in primary and high school, so they typically do not become interested or they are unaware in NRM work. Agronomist occupy many NRM jobs reducing the number of jobs available to NRM practitioners.

Actions Needed:

- Increase formal NRM education
- Give students incentives to study NRM
- Include environmental education in school curricula

2.4.4 Research

Long-term scientifically rigorous studies are required to accumulate reliable knowledge about the social, economic, and biological aspects of the Dominican Republic's NRM problems and solutions. Table 17 indicates that the Dominican Republic has some institutions that do NRM research. Their research has increased knowledge of its biodiversity and forests and technological knowledge about how to conserve them. The National Botanical Garden is capable of preparing detailed botanical studies. NRM NGOs are monitoring the status of the Dominican Republic's reefs and fish stocks.

Table 17 Dominican NRM Research Institutions

Punta Cana Center for Sustainability
Dominican Foundation of Marine Studies
Grupo Jaragua
National Museum of Natural History
National Botanical Garden
UASD: Botanical and Zoological Institute
UASD: Marine Biology Research Center (CIBIMA)
Awas Botanical Institute
University Madre Maestra
National Institute of Technology (INTEC)

Source: Areneman

The conservation status of many plants and animals, however, remain unknown. Little knowledge exists about the silvics and silviculture of most native tree species. Feasible technologies for controlling the spread of invasive species are needed. Little is known about thevariability of the Dominican Republic's commercial and non-commercial organisms. Data have not been collected about how tree plantations have affected surface and ground water. No data are available on the growth rates of tree plantations in relation to site characteristics.

Actions Needed:

- Provide financing for more NRM research projects
- Attract more students to do research in NRM fields
- Apply technical management to wild populations of commercial species
- Domesticate and establish manageable populations wild species

2.4.5 Public Awareness

MARN has stated that to conserve the Dominican Republic's biodiversity "all citizens but especially decision-makers need to develop a greater understanding" of its importance (MARN 2014). Dominicans, in general, and decision-makers specifically, have shown some awareness of NRM issues. National presidents, legislators, municipal officials, business people, communities, and their leaders sometimes have supported needed NRM actions, such as approved NRM policies and laws, financing, and implementing reforestation programs, and protecting beaches and reefs.

Most Dominican citizens and decision-makers, however, are paying only marginal, or no, attention to NRM issues or are opposed to measures that they believe might harm financial interests. NRM is not part of the primary or secondary school curriculum. Even rural people, who live close to the forest or the ocean, generally know little about NRM issues. One KI, for example, said, "the books that rural children read have photos only of urban life…they learn nothing about their surroundings." Similarly, the

administrator of the La Gina and La Limon Wildlife Sanctuaries said "children in Miches never visit these wildlife sanctuaries and know nothing about the coast and ocean"[122],[123]

At the national level, decision-makers generally view NRM as an obstacle to their development plans, rather than understanding that NRM underlies economic growth and stability. Thus, needed NRM laws, such as the forestry, water, territorial planning, and coastal and marine resources laws sometimes have been under consideration in the legislature for a long time. The national government's policy of promoting massive tourism reflects such incomprehension.[124] Several KIs agreed with what one NRM leader said, "without environmental education I do not think that an environmental policy is possible."[125] Without public awareness and support for needed NRM actions, it will remain unlikely that they will ever be financed, implemented, and put into practice by the public.

Actions Needed:

- Educate decision-makers on the need for NRM actions
- Educate the Dominican public about NRM problems and solutions

2.5 DIRECT ACTIONS

2.5.1 Watershed Management

The principal objective of watershed management is to ensure reliable, clean, and abundant water supplies for human needs, but it also protect forests and terrestrial biodiversity and reduces sedimentation into fresh water and coastal waters, thereby helping to preserve aquatic biodiversity and increasing resilience to the impacts of climate change. The Dominican Republic's largest sources of surface water are in the watersheds of the Yaque del Norte, Una, Yuna Yaque del Sur, Ozama, Artibonito, Nizao, and Soco Rivers. The Naguibié, Barrero Rivers, Soliette River, and Artibonito Rivers cross from the Dominican Republic into Haiti. Subterranean aquifers, which are recharged from watersheds, provide 60 percent of DR's water needs.

Table 34 in Appendix B indicates that there are currently 12 watershed management projects in the Dominican Republic. No data, however, were available on the results of these projects, measured in terms of reductions in soil erosion, increased vegetation, improved water quality or reliability, or increased protection for biodiversity and forests. Nor, up to now, has the Dominican Republic had an overall, technically sound plan for the overall management of its watersheds.

Objective 4.1.4 of the National Development Strategy, however, did establish the national government's intention to plan and manage the Dominican Republic's water resources based on watershed management. Decree 265-16 of October 3, 2016 established the Coordinating Unit for Water Resources. It has the responsibility to prepare a strategy for the management of water in the country. It has defined a preliminary strategy and has formed five working groups: (1) legislation and regulation, (2) governance and water security, (3) environmental sanitation, (4) construction and infrastructure improvements, and (5) management of climatic risks. The Executive Director of the Water Unit is currently coordinating the different institutions whose responsibilities includes water to achieve the objectives.

MARN, with technical assistance from the Inter-American Institute for Agricultural Cooperation, currently is designing a new watershed management project called Integrated Management of Natural Resources and Resilient Agriculture for the Yaque del Norte and Ozama-Isabela Basins. The project will

have four components: 1) soil and forest NRM in the basin and rural environmental sanitation and pollution control; 2) response to extreme climate events, 3) improvement of productive capacity and market connectivity, and 4) the strengthening of basin governance structures.[126]

Actions Needed:

- Maintain forest cover on steep slopes
- Produce threatened wild products more efficiently using best practices
- Install sewage, waste water treatment, and sanitary landfills
- Control invasive species
- Control soil erosion through soil NRM practices
- Establish and manage forest tree plantations
- Promulgate and enforce land use regulations
- Increase economic diversification

2.5.2 Forest Management

Forest management is a principal direct NRM action. One aspect of forest management concerns the management of natural forests. Article 157 of the General Law for Environment and Natural Resources (64-00) requires that forestry regulations be established by a Sectorial Law and prohibits cutting of native trees until the completion of a national forest inventory (NFI). MARN is currently making the NFI.[127] For lack of funds, the inventory is not collecting social data or establishing permanent plots.[128] The NFI will provide the data that are needed to prepare a map of forest cover; determine the area of forest cover by forest type; calculate volumes, biomass, and carbon storage by forest type; establish a baseline for forest loss, recuperation, and degradation; monitor, report, and verify (MRV) for the National REDD+ Strategy; and plan land use and forest management.[129]

In the Dominican Institute of Agrarian Reform has given title and use rights to six associations of local communities and MARN has approved their forest management plans for approximately 11,000 ha. The largest of these associations is the Federation of Producers of the Dry Forest of the South (FEPROBOSUR). FEPROBOSUR was formed in 1980 and has 80 members. MARN gives five year permits for charcoal production to these associations and renews the permission yearly, if inspections indicate that the producers are following technical guidelines.

The Forest Management Department of MARN has established a system of control over forest tree plantations on private land. The owner of a property is required to contract with a Forest Consultant (called a "regente") to implement a Forest Management Plan that is prepared according to a standard format. MARN gives the landowner a Forestry Authorization for five-year periods. If MARN judges that the Forest Management Plan has not been followed it will suspend the authorization for cutting trees until the landowner has complied with its provisions. No data were available on the total number of forest management plants or the total area they cover.[130]

Forestry plantations are another aspect of forest management. In 1987, the national government stimulated the establishment of forest tree plantations by revising its strict regulations over the cutting and sale of trees on private land and by issuing a "Certificate of Plantation with the Right to Cut" to landowners who established forest tree plantations.[131] In 1997, the Dominican Republic started the Quisqueya Verde reforestation program, which finances reforestation through grants to private property owners, NGOs, public institutions, and provincial directorates. Between 1997 and 2016 the

Quisqueya Verde program planted 132,764 ha or nearly 7,000 ha/year. In 2008, the Dominican Republic and Haiti, with funding frm the EU, started the Green Frontier reforestation program in cooperation with Haiti. In 2016, the government adopted a policy of concentrating public support for forest tree plantations in degraded and poverty zones and set a goal of planting 20,000 ha by 2020.[132] Few data are available about the total area, location, species, ownership, condition, and growth rates of forest tree plantations in the Dominican Republic. Although the MARN central office has a computer program for monitoring the plantations, MARN provincial offices have not been using the program. MARN provincial offices operate about 50 forest tree nurseries. Public, rather than community, forest tree nurseries are used in the Domican Republic to produce seedlings. Non-native tree species, mostly Caribbean pine (*Pinus caribaea*) and black wattle (*Acacia mangium*) comprise about two thirds of the plantations. No data were available on the species of the other third of the plantations.

Protecting forests, natural and planted, from fire, insects, and diseases, is a third aspect of forest management. Severe outbreaks of pine bark beetle (*Coleoptera: Scolytidae*) have attacked the Dominican Republic's native West Indian pines (*Pinus occidentalis*). Small-leaf mahogany (*Sweitenia mahogoni*) is severely attacked by a shoot borer (*Hypsipyla grandella*).[133] It is probable that a wide range of insects and diseases attack other species of Dominican trees. The U.S. Forest Serice has provided some support to insects and diseases that attack forest trees.

The Dominican Republic does make an effort to control forest fires. Few quantitative data are available on forest fires' location, years, size, and ecological effects. It is known, however, that farmers who practice slash-and-burn cultivation start almost all of the forest fires. The farmers use fire to prepare fields for planting and renovate pastures, expand their fields, and demonstrate their control over land to government officials and neighbors. Fires occur in the dry season from February to September, although most frequently in March.[134] Most fires occur within the more remote and mountainous areas of where pine (*Pinus occidentalis*) and yaragua (*Melinis minutiflora*) predominate, frequently within national protected areas.[135] Heavy growth of understory vegetation after high rainfall, infestations of pine bark beetles, and long drought periods increase the risk of large-scale forest fires.[136]

Currently, provincial Forest Firefighter Brigades fight most forest fires. The Vice-Ministry of Forestry Resources sends its reforestation brigades (21 brigades with six people each) to fight forest fires when needed. Sometimes the Ministry of Defense, which has a specialized forest fire unit, assists them with troops and water-dropping helicopters. Municipal governments, the Red Cross, NGOs, Civil Defense, volunteer groups and guide associations assist in fighting forest fires.

A National Program for the Prevention and Control of Forest Fires, under the Vice-Minister of Forest Resources, exists, including a Center for Detection and Monitoring of Forest Fires. This program, however, lacks sufficient trained staff, infrastructure, equipment, and materials to operate. Currently, it plays no role in actually controlling forest fires. In 2016 MARN, in collaboration with PRONATURA and funding from the Office of U.S. Foreign Disaster Assistance, prepared a Strategy for Management of Forest Fires. The strategy calls for creating a National Directorate, directly under the Minister, which would coordinate the Vice-Ministries of Forest Resources and of Protected Areas and Biodiversity. Resistance within MARN to creating this coordinating Directorate has so far prevented implementation of this strategy.[137]

Actions Needed:

- Manage natural forest to obtain regeneration and products, while conserving genetic diversity and biodiversity
- Implement silvicultural practices to regenerate threatened species
- Establish and manage forest tree plantations
- Conserve riparian vegetation and threatened forest types
- Protect natural forests from fire, insects, and diseases

2.5.3 Agroforestry

Agroforestry is an important conservation tool in the Dominican Republic. Agroforestry is "based on the concept of associating trees with crops on the same piece of land simultaneously or sequentially for increased, diversified, and sustained benefits, and for environment preservation."[138] The trees produce some combination of fuel wood, fruits and nuts, poles and timber, animal fodder, and medicines while also benefiting agricultural crops and animals with increased shade, soil fertility and humidity, and control of weeds and pests. The trees may also increase the variety of habitats and sources of food for animals, thereby sometimes increasing species diversity compared to production systems without trees.[139]

Section 2.1.4 notes that the FAO has classified 302,000 or 6.3 percent of the Dominican Republic's land surface as "other wood land." Speculation suggests that part of this area may be under agroforestry system. Few data are available about the overall extent and character of the Dominican Republic's existing agroforestry systems. In general, its agroforestry systems are more suitable for farmers with medium-size plots of land than those with either tiny or very large ones. The former lack space on their land for trees. The latter prefer either extensive land uses that require relatively little capital investment, such as cattle ranching, or mono-culture, commercial plantations, such as sugar cane.[140]

Many agroforestry systems have been recorded in the Dominican Republic, including ones involving macadamia, cattle, and other crops.[141] Coffee and cacao, however, are the two commercial crops that are commonly grown under the shade of trees.[142] In 2015, the Dominican Republic had about 22,400 ha of coffee and 40,000 to 50,000 coffee farmers.[143] In 2014, between 36,000 to 40,000 farmers were producing cacao on about approximately 152,000 ha.[144]

Figure 6 Shade Trees Over a Coffee Plantation, Monte Plata

The analysis team did not identify any data about agroforestry practices for cacao or coffee in the Dominican Republic. The Smithsonian Migratory Bird Center, however, has reported the results of more than 50 studies on the biodiversity in shade-grown coffee farms in regions ranging from Central and South America to Indonesia. The studies concurred in the benefits of shade-grown coffee plantations for biodiversity and ecosystem functions compared to coffee plantations without shade. These benefits of shade on coffee quality vary by altitude and coffee variety so the spacing and species of trees in coffee agroforestry systems vary from country to country and site to site. In general, however, the higher

species and structural diversity of shaded coffee systems creates more forest-like conditions than unshaded coffee and there contain more biodiversity. Shaded coffee plantations do not replace the biodiversity of natural forests. By providing habitat for some faunal and floral species, however, they do maintain more biodiversity on landscapes than would unshaded coffee plantations. Agroforestry coffee plantations also help to stabilize slopes and reduce soil erosion, increase natural control of pests and pollination, sequester atmospheric carbon, and improve soil fertility and infiltration. Farmers are also more likely to be able to sell their products to niche, specialty coffee markets.

Worldwide, however, cacao and coffee are grown in a rustic and three types of planted shade systems. In **rustic systems**, cacao is planted under thinned primary or older secondary forests, so its habitat resembles and has flora and fauna similarly to degraded tropical forests. Of the planted systems, the **traditional** systems have a range of planted shade trees with occasional remnant forest species. The **commercial** systems have other crop trees interspersed amongst planted shade trees and the cacao. In the monocultural systems one or a few tree species, usually fast growing, nitrogen-fixing legumes, such as *Erythrina* spp., *Gliricidia sepium*, *Cassia*spp. and *Inga* spp., dominate.[145] The biodiversity within cocoa plantations has been studied at only a few sites anywhere in the world, none of them, so far as could be determined, in the Dominican Republic. Nonetheless, based on research in coffee agroforestry systems and on inference from ecological principles, it is reasonable to assume that the overall biological diversity and the diversity in cacao plantations is higher than for pasture or cropland, and increases when there are more different species and sizes of shade trees and when the plantation is closer to tract of natural forest.[146] The World Cocoa Foundation's Cacao Forest project has found that in the Dominican Republic cocoa is generally grown in diversified agroforestry systems that in addition to the cacao also include bananas, plantains, avocados, mangos, citrus fruits, and many tuber species.[147]

Cacao and coffee plantations in Dominican Republic, as in the rest of the tropics, have typically been established at the expense of tropical forest. When the soil under existing plantations has been degraded, or when the price for cacao and coffee beans rises sufficiently, farmers clear more tropical forest to plant new cacao and coffee plantations. Yet many cacao and coffee plantations in the Dominican Republic are less productive than they could be if they were to improve their genetic material and production practices. If the productivity of existing plantations were to rise sufficiently, and if the productive capacity of their soils were to be maintained or enhanced, then the existing plantations rather than new plantations, created at the expense of tropical forest, could at least partially satisfy increased demand for coffee and cacao. Agroforestry practices could be an important part of increasing productivity in the Dominican Republic.[148] The mission suggests that that the traditional Domincan grazing systems contribute to deforestation and the integration of wood and fodder could reduce deforestation.

Actions Needed:

- Increase productivity of coffee and cacao agroforestry plantations
- Increase integration of silvopastoral systems in traditional grazing systems

2.5.4 Protected Area Management

Protected areas are a fourth principal category of direct NRM action. Table 18 indicates the protected areas in the Dominican Republic by category.[149] Their total terrestrial area is 60.067 km2. Terrestrial areas have a total area of 12,035 km2 and marine areas of 48,032 km2. The total protected terrestrial area is about 25 percent of the Dominican Republic's total terrestrial area.

Figure 8 in Appendix A indicates the location of the protected areas within SINAP. Terrestrial protected areas are mostly in the mountains. The marine areas are off the southwestern, southeastern, and northwestern coasts and at the western end of the Samana Bay. With the exception of the Parque del Este National Park, the southeastern lowlands and central Cibao Valley have almost no protected areas.

Table 18 Protected Areas in the Dominican Republic

Categories & Sub-Categories	Units	Terrestrial Area (Km²)	Marine Area (Km²)	Total Area (Km²)
I. Strict Protection	12	422	35,263	35,685
A. Scientific Reserves	8	223	0	223
B. Marine Mammal Sanctuaries	2	21	35,263	35,284
C. Biological Reserves	2	178	0	178
II. National Parks	31	8,964	1,811	10,776
A. Terrestrial	29	8,963	1,556	10,519
B. Marine	2	1	255	256
III. Natural Monuments	30	663	24	687
A. Natural Monuments	28	629	24	653
B. Wildlife Refuges	2	35	0	35
IV. Habitat & Species Management Areas	19	305	10,885	11,190
A. Wildlife Refuges	17	303	319	438
B. Marne Sanctuaries	2	2	10,566	10,567
V. Natural Reserves	15	1,358	1,358	1,650
A. Forest Reserves	15	1,358	0	1,650
VI. Protected Landscapes	16	323	49	372
A. Panoramic Highways	9	191	12	203
B. Natural Recreation Areas	4	108	37	145
C. Ecological Corridors	3	24	0	24
Total	**123**	**12,035**	**48,032**	**60,067**
Jaragua-Bahoruco-Enriquillo Biosphere Reserve[150]		476	1	477

Source: MARN 2012

Most protected areas were super-imposed by government decree on private properties. The national government has never compensated the private land owners. In 2012 and 2013, MARN attempted to

mark the boundaries of the protected areas on the ground, but completed only a few of the more accessible boundary lines.[151]

People living in or around the protected areas may not even know they exist. A survey made in 2013 while preparing a management plan for Montaña La Humedora National Park, for example, found that more than 90 percent of the people living in the 18 communities inside the park and the 17 communities near it, were unaware of the park's existence. Nonetheless, in 2016, 3,675,000 tourists, mostly foreigners, visited a protected area in the Dominican Republic.[152]

Table 19 indicates that SINAP's total area of 558,756 ha is about half of all the remaining area of relatively unmodified terrestrial ecoregions in the Dominican Republic. A higher percent of the Hispaniolan Pine Forest, Enriquillo Wetland, and the Greater Antilles Mangrove Ecoregions is within the SINAP than of the Hispaniolan Moist Forest or the Hispaniolan Dry Forest. This disparity is probably due to the Hispaniolan Moist Forest Ecoregion being located mostly at lower elevation where land is flatter and more suitable for agricultural crops.

Table 19 Area of Ecoregions within Dominican's Protected Areas

Ecoregion	Remaining (ha)	%	Within PA (ha)	% Within PA
Hispaniolan Moist Forest	433,998	16	142,182	33
Hispaniolan Dry Forest	296,748	31	108,801	37
Hispaniolan Pine Forest	406,368	49	293,436	72
Enriquillo Wetland	15,246	36	14,337	94
Greater Antilles Mangrove	24,171			90
TOTAL	1,176,531		558,756	

Source: Kernan et al 2016

No evaluations have been made of how effectively the SINAP as a whole has protected the Dominican Republic's biodiversity and forests. Only 76 of the 126 protected areas, however, are under effective administration.[153] Parque del Este, for example, receives MARN's (and TNC's) attention because so many international tourists visit it. Currently, MARN is concentrating its attention on only three national parks: Valle Nuevo, the source of water for hydroelectric plants, Los Haitiensis, and the highly biodiverse Bahoruco.

Co-managed protected areas have been shown to be more effectively managed than MARN-managed protected areas.[154] The Saltos de Damajagua Natural Monument provides an example of successful co-management. Since 2005, the monument has been co-managed by MARN, the Association of Guides of the Damajagua River and a co-management council. However, no study appears to have evaluated how effective co-management in this protected area has been for the NRM of biodiversity and forest.[155]

Actions Needed:

- Manage and protect all of SINAP
- Mark boundary lines and formalize land tenure
- Foment ecotourism to increase income
- Enforce laws and regulations
- Promote creation and sustainable management of private reserves

2.5.5 Coastal/Marine Zone Management

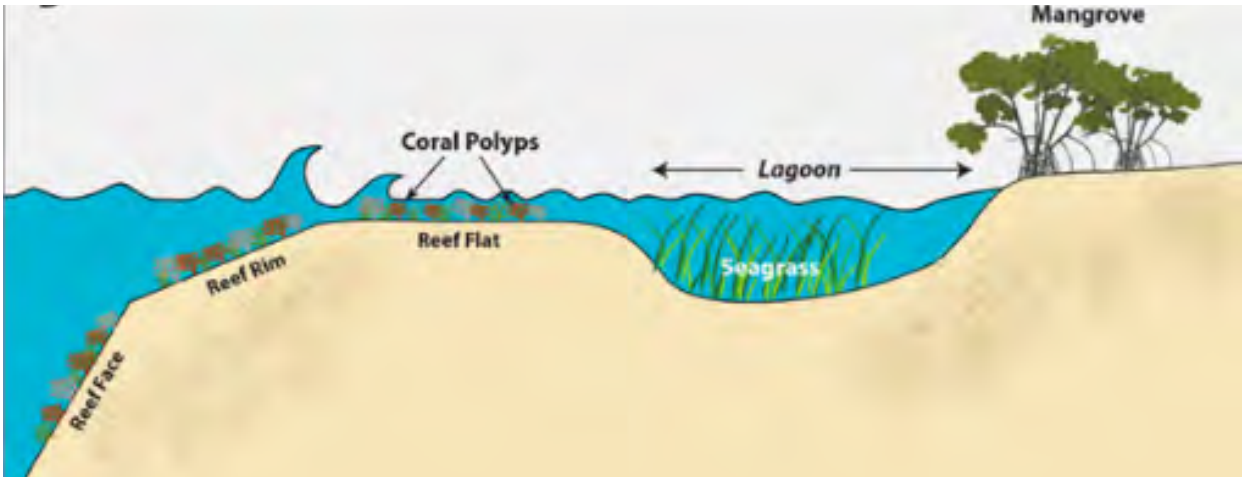
Coastal/marine management is a fifth category of direct NRM. The main coastal management problems are: congestion of tourism areas, superficial and ground water pollution, water management, beach erosion, degradation of mangroves, destruction of coral reefs, growth of slums, and pollution from solid wastes. The Dominican Republic's economy is extremely vulnerable to the effects of tropical storms and hurricanes on its coastal natural (e.g., beaches, sea grass, and reefs) and man-made infrastructure (e.g., roads and water systems), because coastal tourism contributes significantly to the economy. Coastal ecosystems (e.g., reefs, lagoons, sea grass beds, and mangroves) also are the habitats where commercial varieties of marine organisms reproduce and grow. The Dominican Republic's reefs provide habitat to most of its marine biodiversity.

A recent study by the World Bank found that

> "Coastal and marine habitats, particularly coral reefs and mangroves, can substantially reduce exposure and vulnerability, providing natural protection from risk [of extreme weather events]. Yet the value of these systems as "green infrastructure" is still not fully recognized, and they continue to be lost and degraded."[156]

Figure 7 indicates the coral reef, sea grass and mangrove "natural infrastructure," that provides natural protection for parts of the Dominican Republic's coastline by reducing the force of waves and so reducing beach erosion.

Figure 7 Cross-section of coral reef, sea grass, and mangrove natural protection of coast



Source: Wielgus et al 2010

Since the 1990's, when there was a coastal management project in the Dominican Republic, there has been a gap in attention to coastal zone management. There have been a few coastal NRM projects but they have been for short periods and limited in their geographic scope. The projects that USAID/DR financed from 2007 to 2014 addressed specific coastal NRM issues, but were not integrated coastal resource management projects.

MARN and the Ministry of Tourism are now jointly coordinating the Coastal Biodiversity and Tourism Project: An Opportunity for Sustainable Development. The Vice-Ministry of Coastal Resources has submitted to the Congress a Draft Law for Coastal Marine Resources.[157] MARN has published documents about coastal resources management that establishes a system of monitoring NRM of coastal

and marine resources. This tool permits MARN to collect standardized data on coastal resources and coastal zone management activities. [158]

Globally, 400 times more is spent on coastal infrastructure, which often damages ecosystems, than on conservation or re-establishment of the existing, cheaper, more durable and more effective "natural infrastructure" of coastal reef and mangrove ecosystems. Some insurance companies are considering incorporating the presence of "natural infrastructure" into their insurance models. If insurance companies were to reduce their rates when "natural infrastructure" is protecting man-made infrastructure, then perhaps policy-makers and business people will give its conservation the importance it deserves.[159]

Actions Needed:

- Enforce land use regulations
- Install sewage systems, waste water treatment, and sanitary landfills
- Protect and re-establish reef, lagoon, mangrove, beach ecosystems, and vegetation
- Control invasive species
- Enforce fishing regulations
- Enforce tourism regulations
- Incorporate "natural infrastructure" into insurance rates for coastal tourism infrascture

2.6 LESSONS FROM PAST USAID/DR NRM PROJECTS

In 2012, a performance evaluation of five NRM project that USAID/DR financed between 2007 and 2014 identified the lessons learned in Table 20.[160]

Table 20 Lessons Learned from Prior USAID/DR NRM Projects

Lessons Learned by Needed Enabling NRM Action
Policies/Laws/Strategies
(1) Failure resulted from insufficient awareness of NRM and economic links
(2) Territorial planning required for large-scale, permanent NRM
(3) Businesses have self-interest in NRM
(4) Large-scale, permanent NRM requires participation of business
Institutions
(5) Successes were due to leadership competence
(6) Successes were due to links between NRM and large financial interests
(7) Failures resulted from an overly centralized and politicized MARN
(8) Failures resulted from overemphasis on administrative needs
(9) Failures resulted from insufficient collaboration with local people and institutions
(10) Technical solutions need to solve people's problems
(11) Synergies between projects & sectors increase effectiveness & reduce costs.
Education
(12) Failures resulted from under-emphasis on technically sound field activities
Research & Technology

Lessons Learned by Needed Enabling NRM Action	
(13)	Successes were due to technical competence
(14)	NRM matched to biological & socioeconomic situations;
(15)	Research on NRM problems required to achieve NRM solutions;
(16)	Gender issues affect NRM adoption & sustainability

3 CONCLUSIONS

3.1 ACTIONS NEEDED

3.1.1 Enabling NRM Actions

Table 21, derived from Findings 2.4.1 to 2.4.5, indicates the principal needed enabling NRM actions for reducing the five direct threats to the Dominican Republic's biodiversity and tropical forests.

Table 21 Needed Enabling NRM Actions

Categories Enabling Actions	Actions
Policies/Laws /Strategies	(1) Approve and implement laws: territorial planning, water, fire control, and coastal resources
Institutions	(2) Increase inter-institutional coordination (3) Increase institutional effectiveness & efficiency (4) Provide incentives to business to practice more appropriate NRM and sustainable development
Education	(5) Educate more NRM practitioners (6) Give students incentives to study NRM
Research & Technology	(7) Do more scientific biological & social research (8) Do more research on NRM technologies (9) Develop more effective NRM technology
Awareness	(10) Increase public awareness of NRM (11) Increase decision-maker awareness of NRM

3.1.2 Direct NRM Actions Needed

Table 22, based on Findings 2.5.1 to 2.5.5, indicates the principal NRM actions needed for conservation. This table is a list of all the "actions needed" that were listed in the Findings sections. They are not in order of priority. The methodology for choosing priority actions is indicated in Section 3.5 below.

Table 22 Direct NRM Actions Needed

Categories Direct Actions	Actions
Watershed Management	(1) Maintain forest cover on steep slopes (2) Produce threatened wild products more efficiently using best practices (3) Install sewage, waste water treatment, and integrated solid waste management facilities & systems (4) Control invasive species (5) Control soil erosion through soil NRM practices (6) Establish and manage forest tree plantations (7) Promulgate and enforce land use regulations (8) Increase economic diversification

Categories Direct Actions	Actions	
Forest Management	(9)	Manage natural forest to obtain regeneration & products
	(10)	Implement silvicultural practices to regenerate threatened species
	(11)	Establish and manage forest tree plantations
	(12)	Conserve riparian vegetation
	(13)	Protect natural forests from fire, insects, and diseases
Agroforestry	(14)	Increase productivity of coffee & cacao agroforestry plantations
Protected Areas Management	(15)	Manage and protect all of SINAP
	(16)	Increase competitive production of threatened species outside of SINAP
	(17)	Mark boundary lines and legalize land tenure
	(18)	Foment ecotourism to increase income
	(19)	Enforce laws and regulations
Coastal Zone Management	(20)	Enforce land use regulations
	(21)	Install sewage systems, waste water treatment and sanitary landfills
	(22)	Protect and re-establish reef, lagoon, mangrove, beach ecosystem
	(23)	Control invasive species
	(24)	Enforce fishing regulations
	(25)	Enforce tourism regulations

3.2 COUNTRY WIDE GAPS IN CURRENT AND PLANNED ACTIONS NEEDED

3.2.1 Gaps in Enabling NRM Actions

Table 23, derived from Tables 34 and 35 in Appendix B, indicates that two projects address needs for policy/law/strategy actions and two address the need for institution actions. By contrast, there are no planned NRM projects for NRM education, research, public awareness, or finances.

Table 23 Analysis of Gaps in Enabling NRM Actions

Need Addressed	No of Projects	
	Current	Planned
Policies/Laws/Strategies	2	1
Institutions	2	0
Education/Training	0	0
Research	0	0
Public Awareness	0	0
TOTAL	4	1

3.2.2 Gaps in Direct NRM Actions

Table 23, also derived from Tables 34 and 35 in Appendix B, indicates that the largest gap in direct NRM actions is in the category of protected area management, which has only one current and no planned projects. Nonetheless, the other four categories of direct NRM actions have only one planned project each.

Table 24 Gaps in Needed NRM Actions

Need Addressed	No of Projects	
	Current	Planned
Watershed Management	11	1
Forest Management	2	1
Agroforestry	0	1
Protected Areas Management	1	0
Coastal/Marine Zone Management	2	0
TOTAL	16	3

3.3 CONTRIBUTIONS OF ACTIONS NEEDED TO USAID/DR DOS

3.3.1 Enabling NRM Actions

Table 25, based on Tables 38 to 39 in Appendix D, summarizes how the needed enabling NRM actions could contribute to the potential USAID/DR CDCS 2020-2025 Development Objectives of security, democracy, health, and economic prosperity.

Table 25 Contribution Enabling NRM Actions Contribute to Potential DOs

Enabling NRM Actions	Contribution to USAID/DR 2020-2025 Development Objectives
Policies/Laws	• **Security** increased by policies that create more NRM jobs for at-risk youth • Participatory processes for managing natural resources strengthens **democracy** • NRM policies and laws conserve water supplies needed for **human health** • **Economic growth** fostered by NRM policies that conserve natural resources
Institutions	• NRM policies & laws increase e**ffective governance** • **Human health** improved due to more capable institutions conserving water supplies • Effective NRM institutions conserve natural resources to **reduce risks**
Research & Technology	• NRM research clarifies **governance, health, and economic growth issues**

Enabling NRM Actions	Contribution to USAID/DR 2020-2025 Development Objectives
Awareness	• Awareness of NRM issues increases peoples' **respect for law**
Education/Training	• NRM **stabilizes economy** by supplying natural resource products

3.3.2 Direct NRM Actions

Table 26, also derived from Tables 38 to 39 in Appendix D, indicates how the **direct** NRM actions needed could contribute to the potential USAID/DR DOs for 2020-2025.

Table 26 Contribution of Direct NRM Actions to Potential DOs

Direct Actions	Contribution to USAID/DR 2019-2023 Development Objectives
Watershed Management	• Increased **security** through training and jobs for at-risk youth • **Democracy** furthered by participation in watershed management actions • Reliable, clean water supplies improve **human health** • Reliable supply of water strengthens **economic stability** • Ensure natural resources required for **production of food**
Forest Management	• Training and jobs for at-risk youth in tree planting and silvicultural work increases **security** • Participation in forest management strengthens **democracy and governance** • Forest management protects water supplies required for **human health, economic prosperity, and stability** • Reliable flow of forest products increases **economic prosperity and stability**
Agroforestry	• Training and jobs for at-risk youth in tree planting **increases security** • Protection of watersheds protects water supplies, contributing to **widespread human health** • Increased productivity of coffee and cacao plantations, and improved prices further **economic prosperity and stability**
Protected Areas Management	• Training and jobs for at-risk youth in protected areas **increases security** • Improved management of SINAP increases **economic growth & prosperity** by protecting water for agriculture, energy, and human health
Coastal Zone Management	• Training and jobs for at-risk youth in coastal zone management actions increases **security** • Land use regulations protect investments in tourism facilities, contributing to **economic growth and prosperity** • Enforcement of fishing regulations protects supplies of marine products needed for **economic growth and prosperity** • Protection and re-establishment of reef-lagoon-mangrove-beach ecosystems reduces risk to **economic growth and prosperity** from extreme weather events

3.4 CONTRIBUTIONS OF USAID/DR DOS TO ACTIONS NEEDED

3.4.1 Enabling NRM Actions

Table 27, derived from Table 36 in Appendix C, summarizes the principal ways that USAID/DR's potential DOs could contribute to achievement of the needed enabling NRM actions.

Table 27 Contribution of Potential Development Objectives to Needed Enabling NRM Actions

Potential Development Objective	Needed Enabling NRM Actions
Security from Crime	(1) Strengthened enforcement of NRM laws (2) Education in NRM laws (3) Identifies research & technology needs (4) Increase public understanding of NRM laws (5) Financing for actions to enforce NRM laws
Democratic, Effective Governance	(6) Improved NRM policies/laws/strategies (7) NRM education includes governance (8) Research clarifies organizational aspects of NRM actions (9) Public participation increases awareness of NRM (10) Transparency increases effectiveness of use of NRM funds
Widespread Human Health	(11) Health regulations require water treatment & sanitary landfills (12) NRM education includes NRM-health links (13) Health research identifies links to NRM (14) Health technology improves water systems, sewage treatment & solid waste disposal (15) Financing for water treatment & sanitary landfills
Equitable Economic Growth & Prosperity	(16) Economic policies/laws/strategies meet NRM needs (17) Land use planning for economic growth favors NRM (18) Business education includes NRM (19) Economic reporting includes NRM aspects (20) Credit & technical assistance for economic growth includes NRM actions

3.4.2 Direct NRM Actions

Table 28, derived from Table 37 in Appendix C, summarizes how the hypothetical potential USAID/DR development objectives for 2020-2025 could contribute to the achievement of the needed direct NRM actions.

Table 28 USAID Potential Development Objectives and Needs for Direct NRM Actions

Potential Development Objective	Needed Direct NRM Actions
Security from Crime	• Enforcement of land use regulations • At-risk youth involved in field NRM action
Democratic, Effective Governance	• Improved governance for direct NRM actions • More participation engenders the public & decision-maker support for land use regulations • SINAP conflicts with inhabitants in protected areas mitigate & resolved

Potential Development Objective	Needed Direct NRM Actions
Widespread Human Health	• Need for water furthers NRM of watersheds, forests & SINAP • Need for sanitation furthers construction of water treatment plants, sewage systems & sanitary landfills
Equitable Economic Growth & Prosperity	• Economic growth provides funds for needed field NRM actions • Economic policies stabilize land use in watersheds and coastal zones • Tourism policies favor sustainable over unsustainable tourism growth

3.5 PRIORITY ACTIONS NEEDED

3.5.1 Criteria for Selecting Priority Actions

Table 29 indicates eight possible criteria, labeled A through H, for selecting from among the needed NRM actions those to include in the 2019-2023 CDCS.

Table 29 Criteria for Rating Needed NRM Actions

Label of Criteria	Description of Criteria
A	Gaps in needed NRM actions
B	Contribution to DO 1 Security from crime
C	Contribution to DO 2 Democratic, effective governance
D	Contribution to DO 3 Widespread human health
E	Contribution to DO 4 Equitable economic prosperity & stability
F	Geographic & time scales
G	USAID's manageable interests
H	Lessons learned

(Note, this table includes four hypothetical DOs for the next CDCS)

Note that these criteria give 50 percent of the weight in the selection of priority actions to the links between the needed NRM actions and the four hypothetical USAID/DR DOs for its 2020-2025 CDCS. Also, note that although the weighting assigned to these criteria is necessarily somewhat subjective, these weightings will reflect the professional experience of the those who assign the weightings.[2]

[2] If several professionals were to each assign weights to each criterion, then the final weighting should provide a reasonable measure of how well the potential action fits USAID/DR's development objectives and goals. In the case of this report, however, only the author assigned the weights. The weighting would be more accurate and useful if the weights were to be assigned also by professionals working with USAID/DR. In any case, we present

3.5.2 Priority Ratings of Needed Enabling Actions

Table 30, derived from Tables 44 and 45 in Appendix E, indicates the priorities among that were determined for the enabling actions based on the application of selection criteria to the 12 needed enabling NRM actions based on a scale of 1 to 3, with 1 being the highest priority and 3 the lowest.

Table 30 Priorities of Needed Enabling Actions

Priorities for Enabling Action	Priority
Policies & Laws	
(1) Formulate & approve new NRM laws & regulations	3
(2) Enforce NRM & biodiversity regulations	1
Institutions	
(3) Increase inter-institutional coordination	3
(4) Increase institutional effectiveness & efficiency	2
(5) Increase business involvement in NRM	3
(6) Use available funds efficiently & effectively	2
Education/Training	
(7) Educate more NRM practitioners	1
(8) Give students incentives to study NRM	2
Research & Technology	
(9) Finance scientific biological & social research	1
(10) Do research on NRM technologies	1
Awareness	
(11) Increase public awareness of NRM & biodiversity	1
(12) Increase decision-maker awareness of NRM & biodiversity	1

Key: High Priority – 1
Medium Priority – 2
Low Priority – 3

3.5.3 Priority Ratings of Needed NRM Direct Actions

Table 31, derived from Tables 46 and 47 in Appendix E, indicates the priorities for the direct needed NRM actions, based on applying the selection criteria.

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these as tentative criteria that could be adjusted, added to or improved by the USAID/DR professional staff and aligned more closely to the goals and DOs of the CDCS.

Table 31 Priorities of Needed NRM Direct Actions

Category of Enabling Action/ Title of Direct NRM Actions	Priority
Watershed Management	
(1) Maintain forest cover on steep slopes	3
(2) Produce threatened wild products more using best practices	2
(3) Install integrated solid waste management facilities & systems	1
(4) Control invasive species	2
(5) Control soil erosion through soil NRM practices	1
(6) Establish & manage forest tree plantations	2
(7) Promulgate & enforce land use regulations	1
(8) Increase economic diversification	3
Forest Management	
(9) Manage natural forest to obtain regeneration & products	2
(10) Implement silvicultural practices to regenerate threatened species	2
(11) Establish & manage forest tree plantations	3
(12) Conserve riparian vegetation	3
(13) Protect natural forests from fire, insects & diseases	3
Agroforestry	
(14) Increase productivity of coffee & cacao agroforestry plantations	1
Protected Area Management	
(15) Manage & protect all of SINAP	3
(16) Increase competitive production of threatened species outside of SINAP	2
(17) Mark boundary lines & legalize land tenure	3
(18) Foment ecotourism to increase income	3
(19) Enforce laws & regulations	1
Coastal Zone/Marine Management	
(20) Enforce land use regulations	1
(21) Install sewage systems, waste water treatment & sanitary landfills	1

Category of Enabling Action/ Title of Direct NRM Actions	Priority
(22) Protect & re-establish reef, lagoon, mangrove, beach ecosystem	1
(23) Control invasive species	2
(24) Enforce fishing regulations	1
(25) Enforce tourism regulations	1

Key: High Priority – 1
Medium Priority – 2
Low Priority – 3

4 RECOMMENDATONS

4.1 FINANCE PRIORITY NRM ENABLING ACTIONS

Table 31, based on the conclusions about their relative priority for USAID/DR, indicates the priority enabling NRM actions this report recommends USAID/DR include in its CDCS 2020-2025.

Table 32 Priority Enabling NRM Actions

Policies & Laws
(1) Enforce NRM & biodiversity regulations
Institutions
Education/Training
(2) Educate more NRM practitioners
Research & Technology
(3) Finance scientific biological & social research
(4) Do research on NRM technologies
Awareness
(5) Increase public awareness of NRM & biodiversity
(6) Increase decision-maker awareness of NRM & biodiversity

4.2 FINANCE PRIORITY NRM DIRECT ACTIONS

Table 32, based on the conclusions about their relative priority for USAID/DR, indicates the priority direct NRM actions this report recommends USAID/DR include in its CDCS 2020-2025.

Table 33 Priority Direct NRM Actions

Watershed Management
(1) Install integrated solid waste management facilities & systems
(2) Control soil erosion through soil NRM practices
(3) Promulgate & enforce land use regulations
Forest Management
None[3]
Agroforestry
(4) Increase productivity of coffee & cacao agroforestry plantations
Protected Area Management
(5) Enforce laws & regulations

[3] Note that the USAID/DR Mission suggests the promotion of sustainable forest management is a priority. This would include forestry and agroforestry as part of watershed management.

Coastal Zone/Marine Management	
(6)	Enforce land use regulations
(7)	Install sewage systems, waste water treatment, and sanitary landfills
(8)	Protect and re-establish reef, lagoon, mangrove, beach ecosystem
(9)	Enforce fishing regulations
(10)	Enforce tourism regulations

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APPENDIX A: MAPS

Figure 3 Terrestrial Ecoregions of the Dominican Republic

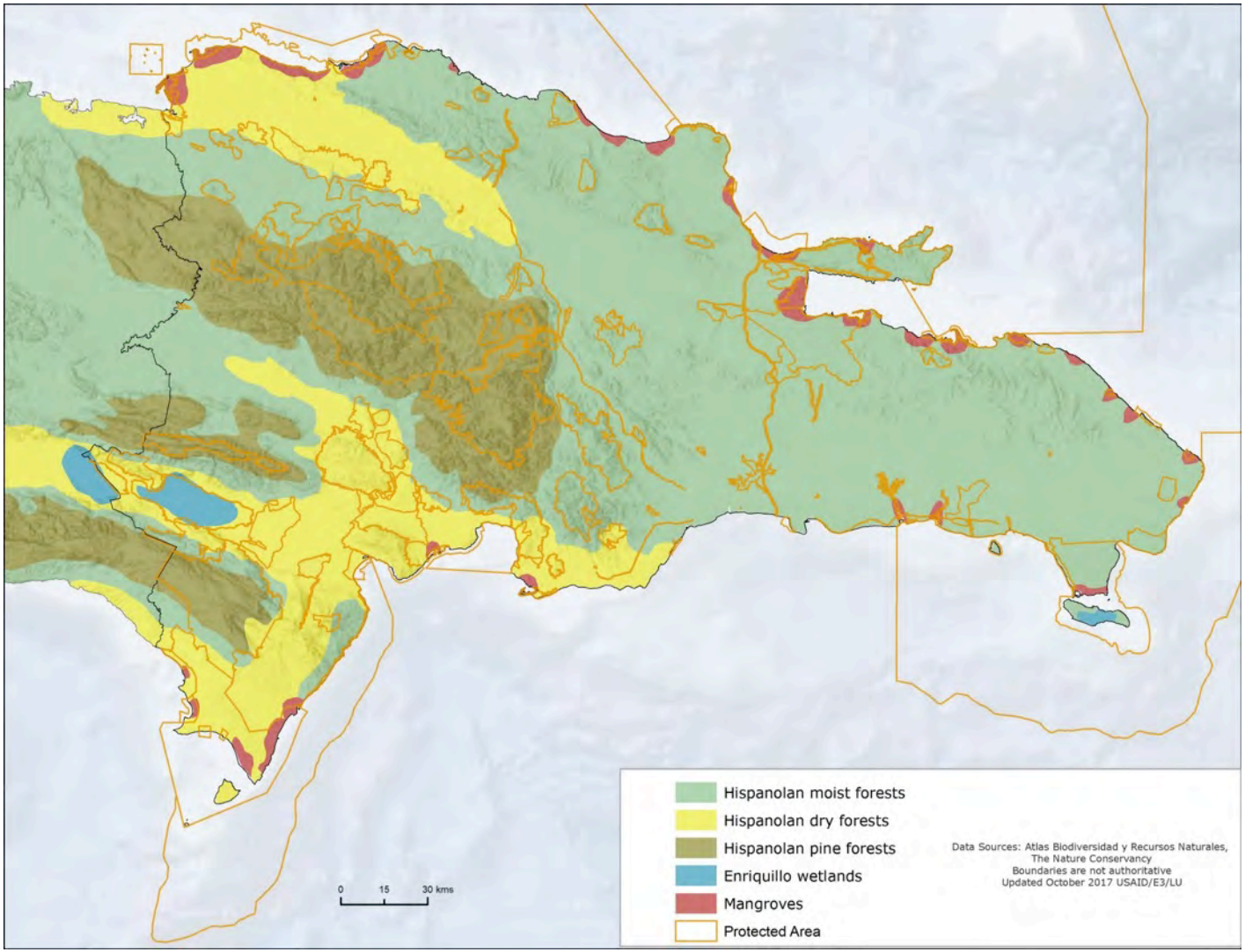


Figure 4 Location of coral reefs in the Dominican Republic

Figure 5 Location of 2001-2016 Deforestation "Hot spots"

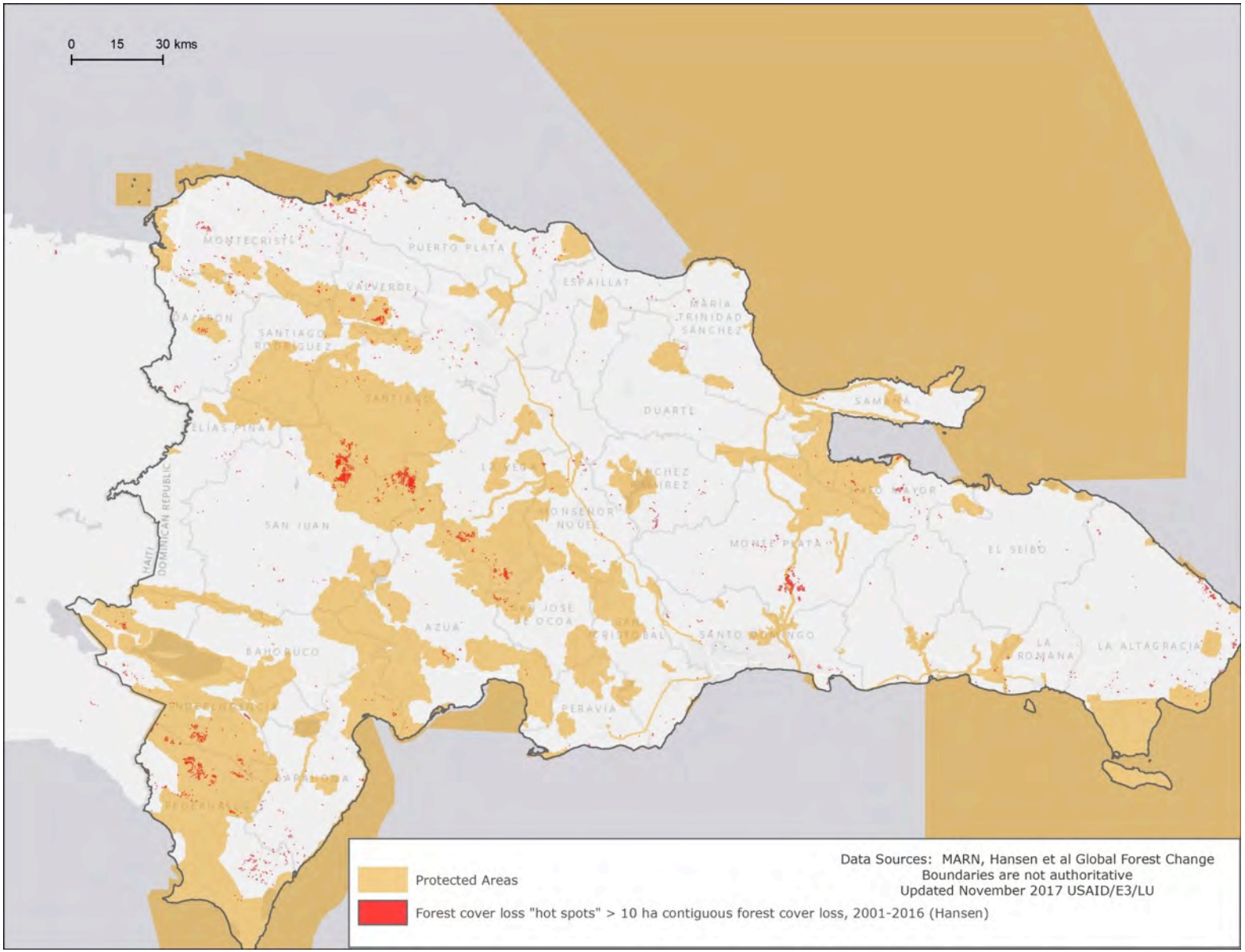


Figure 6 Historical Deforestation Trends in Select Protected Areas

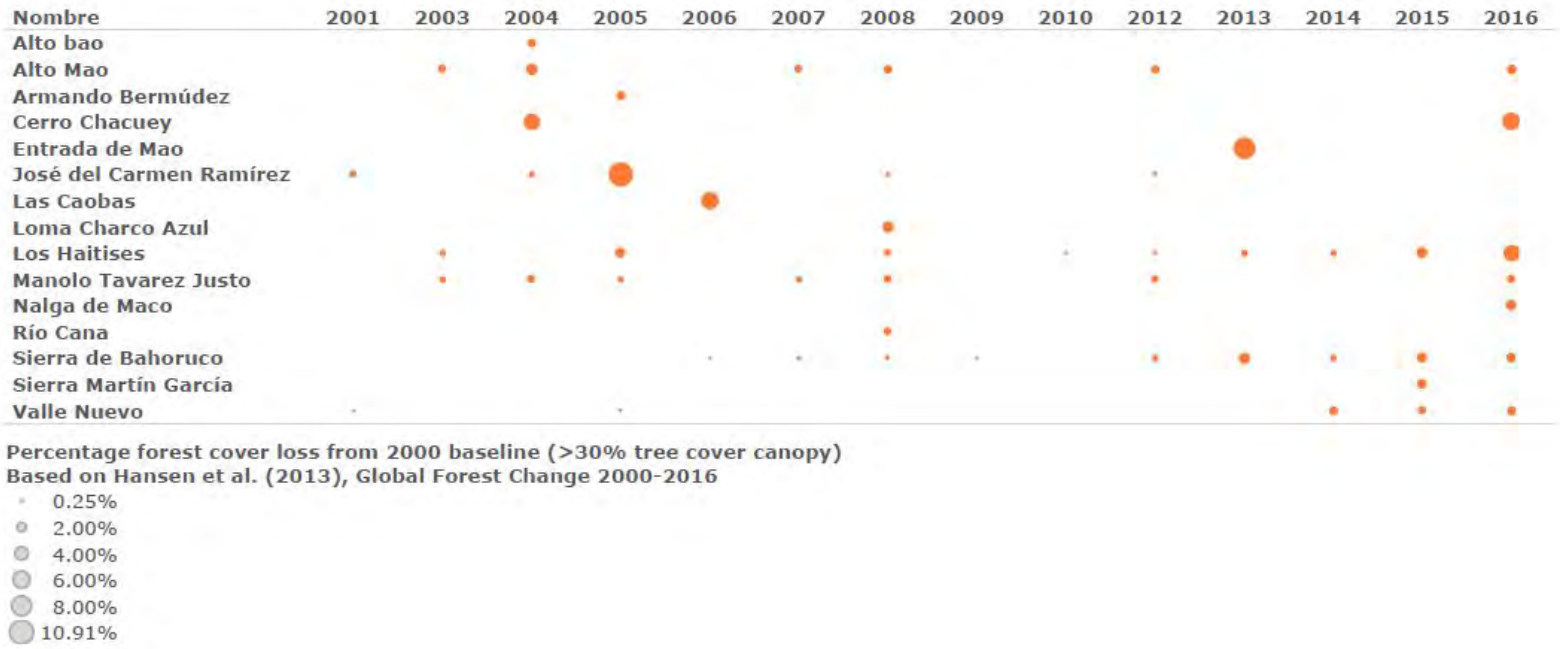


Figure 7 Land Use in the Dominican Republic

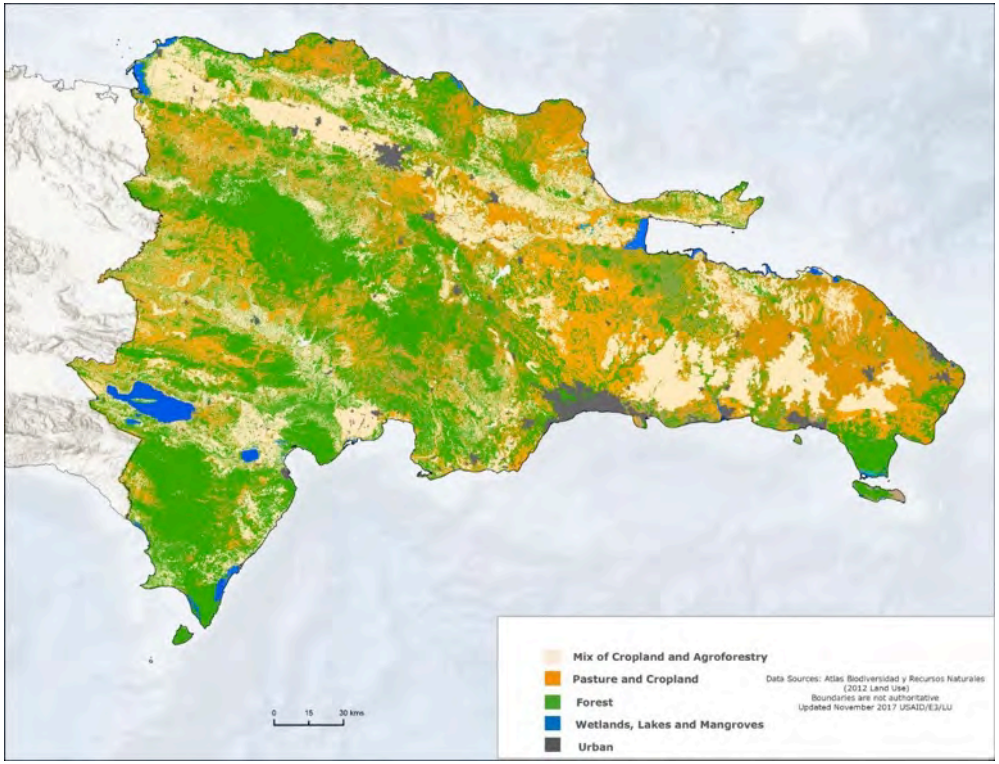


Figure 8 Forest Types and Land Use in the Dominican Republic

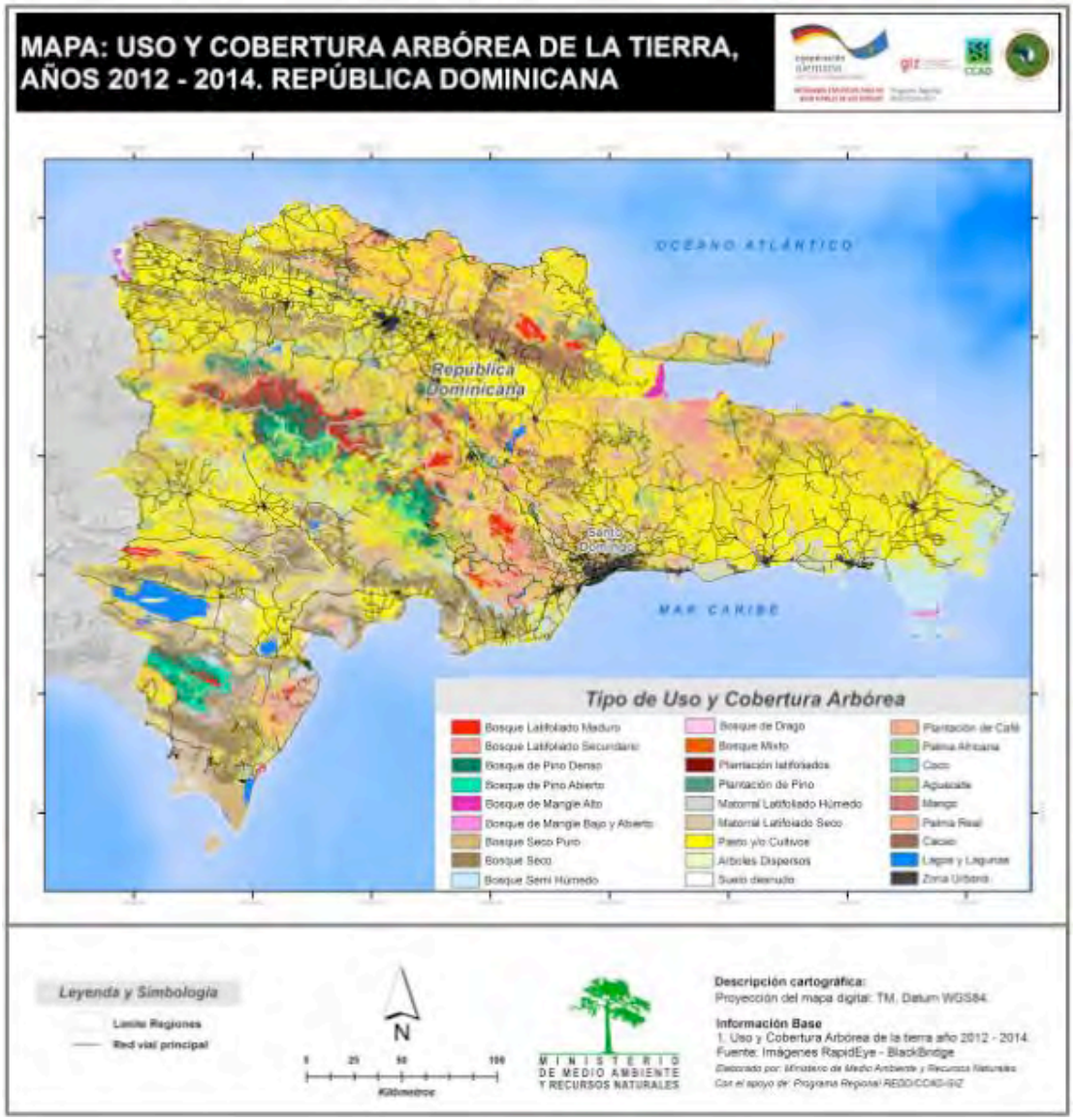


Figure 9 Location of Economic Activities in the Dominican Republic

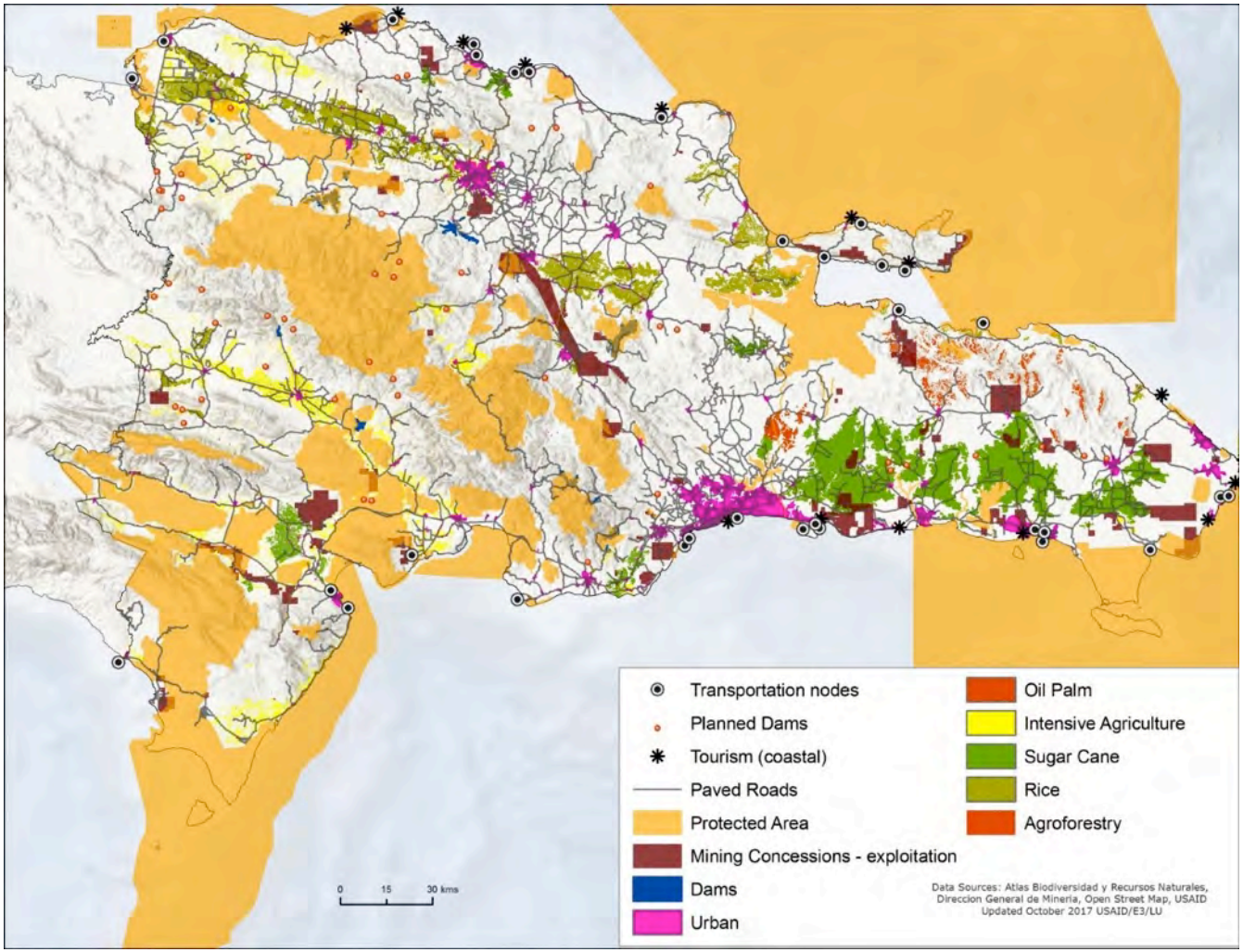


Figure 10 Cacao and Coffee Growing Regions in the Dominican Republic

Figure 11 Locations and Names of Watersheds Shared by Haiti and the Dominican Republic

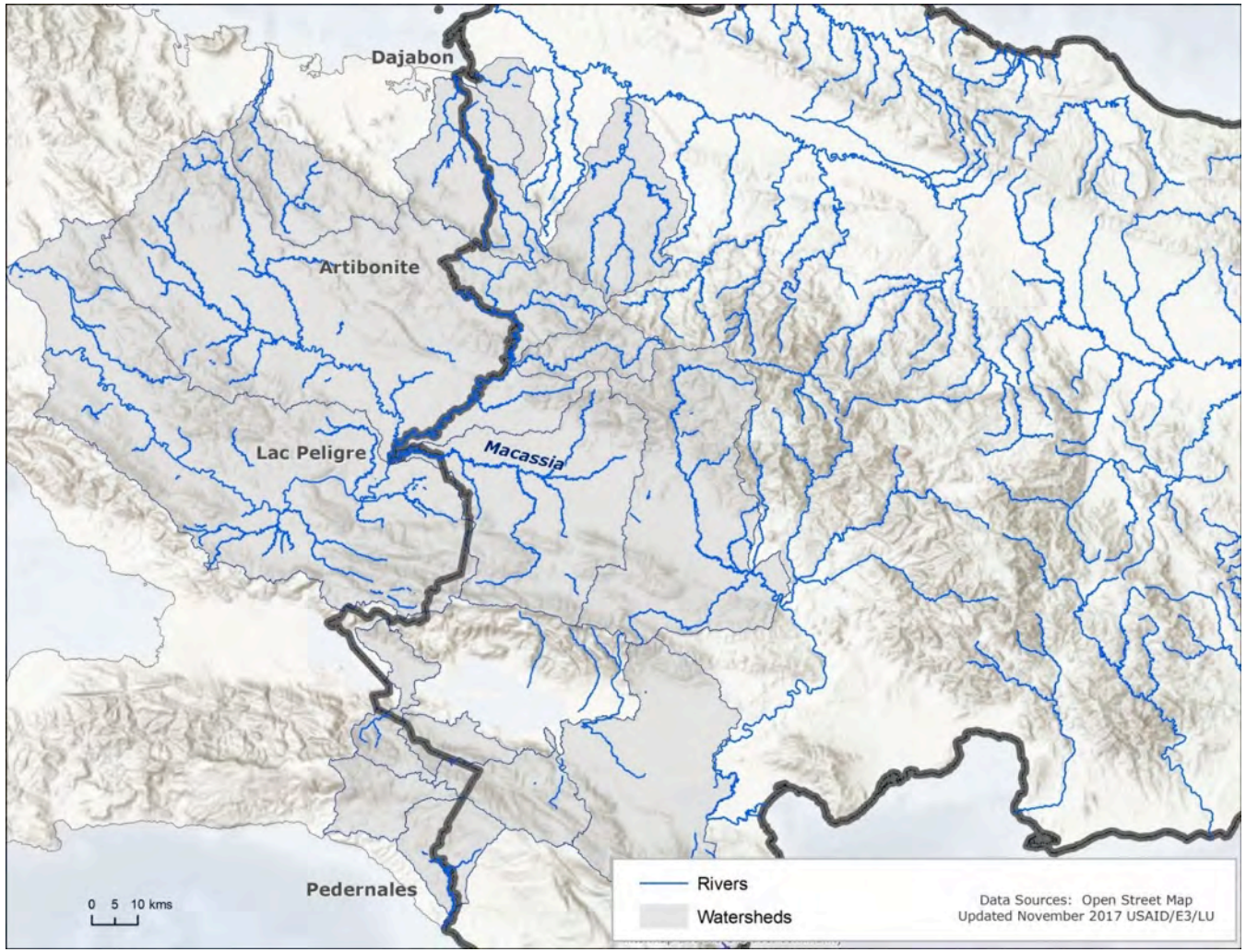
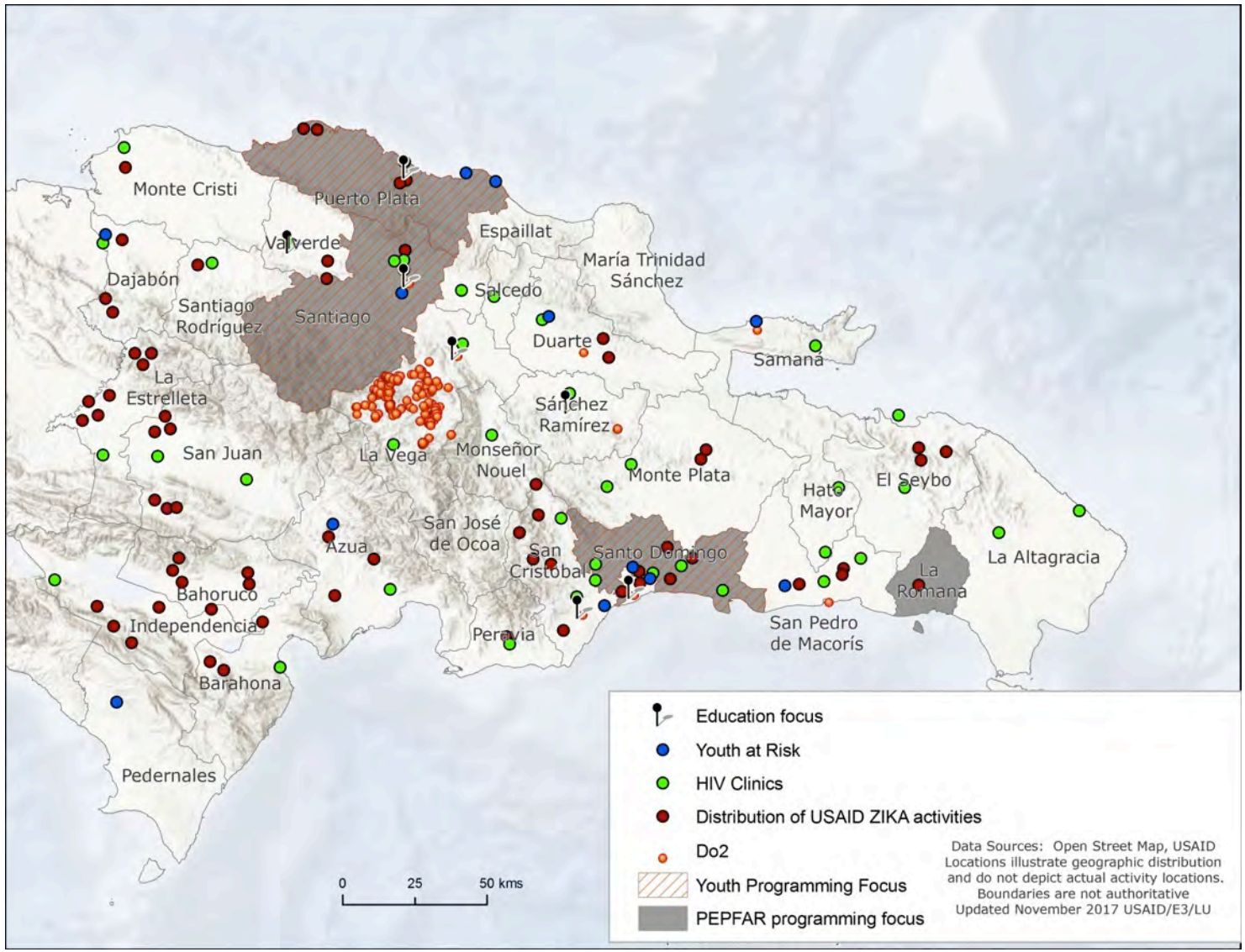


Figure 12 Location of Programs Financed by USAID/Dominican Republic



APPENDIX B: NRM PROJECTS IN THE DOMINICAN REPUBLIC

Table 34 Current NRM Projects

Need Addressed	Name of Project	Description	Geographic Focus	Execute	Financing
Watershed Management	Regional Global Climate Change Project	Implemented by the Ministry of Agriculture and the Council for Climate Change and the Clean Development Mechanism to prepare an evaluation of the vulnerability and capacity for adaptation of agriculture in the provinces of San Juan de la Maguana and in Elías Piña , Subzone de Hondo Valle and to prepare the National Strategy for Adaptation to Climate Change for the Agricultural Sector	National	Center for Climate Change of the Caribbean Community	European Union
Watershed Management	USAID/REDDOM Food Security and Sanitation in the El Valle Region (SW) Program	Sustainably raise the standard of living of the people in El Valle Region (SW) through increased income, nutrition, and access to clean water and improved sanitation. Four (4) aqueducts rehabilitated to improve access to potable water and improve sanitation; and, 703 households received water filters to treat drinkable water.	Southwest	Fundacion REDDOM	USAID

Need Addressed	Name of Project	Description	Geographic Focus	Execute	Financing
Watershed Management	Sustainable Cacao Farming in the Dominican Republic Program	Global Development Alliance initiative between USAID and Mondelēz Europe, aimed at increasing the financial and environmental sustainability of small farm members of the National Confederation of Dominican Cacao Farmers (CONACADO) by improving the quality and output of cacao production, and diversifying related income generating opportunities for farmer's families including youth and women. The main results to date are: 48 farmers with increased capacity to adapt to climate change; 105 farmers applying improved farm management techniques to increase cacao farms yield; and, 350 households gaining access to an improved drinking water source.	Yamasa Monte-plata	Fundacion REDDOM	USAID/ Mondelēz Europe

Need Addressed	Name of Project	Description	Geographic Focus	Execute	Financing
Watershed Management	Climate Resiliency and Index Insurance for Small Farmers in the Dominican Republic Program (CRII)	Improves resiliency to climate change, reduce disaster risk, and promote public-private partnerships which will contribute to USAID Feed the Future (FtF)/Food Security (FS) goals. Main results to date for this program include: 1) 529 stakeholders with increased access to climate and weather information, such as impacts across agricultural value chains, early warnings and forecasts, and technical solutions; 2) 298 farmers implementing climate-smart agricultural practices that are informed by weather and climate information; 3) 399 stakeholders with increased understanding of the importance and application of financial and risk management tools; 4) an innovative risk transfer mechanism –index insurance- being launched; 5) an agreement establish with a financial intermediary to market the climate index insurance product; 6) a climate information platform to support decision making in place at REDDOM.	Northwest	Fundacion REDDOM	USAID
Watershed Management	Feed the Future Dominican Republic Climate and Agriculture Program	Increases resilience of people to the impacts of climate change in the farming communities of the Yaque del Norte River upper watershed in the Jarabacoa municipality, which comprises 70% of the upper Yaque del Norte watershed basin. This program pursues the following results: 1) Improved Land Use Planning Enables Reduction of Climate Risk; and 2) Climate-related risk reduction measures implemented. It is expected that this program will benefit 1,000 individuals in farming communities of Jarabacoa municipality.	Yaque del Norte River upper watershed, Jarabacoa area	Fund REDDOM	USAID

Need Addressed	Name of Project	Description	Geographic Focus	Execute	Financing
Watershed Management	Rural Economic Diversification Project (USAID/RED)	supports small-scale producers and processors of agricultural and wood products to diversify and expand their production in order to enable them to become more competitive in global markets. 4,295 hectares under improved natural resource management; 5 investment projects focused on Climate Smart Agriculture, including adaptive and risk reduction measures, and an early alert pilot model for banana farmers;	National	Fund-REDDOM	USAID
Coastal Zone Management	Caribbean Marine Biodiversity Program	reduce threats to marine and coastal biodiversity in priority areas across the Caribbean to achieve sustained biodiversity NRM, maintain critical ecosystem services, and realize tangible improvements in human wellbeing for communities adjacent to marine protected areas.	Samana Bay	The Nature Conservancy	USAID

Need Addressed	Name of Project	Description	Geographic Focus	Execute	Financing
Coastal Zone Management	Management of coastal resources and NRM of marine biodiversity in the Caribbean	The project is supporting numerous activities in the CARICOM region in order to halt the serious impacts of unadapted use of terrestrial and marine areas, as well as the impacts of climate change, on biodiversity, marine and coastal protected areas and their ecosystem services: • capacity development • protection and rehabilitation of marine and coastal geo-ecosystems • protection and sustainable use of terrestrial and marine geo-ecosystems • Securing the drinking water supply and environmentally-friendly sewage disposal • Piloting of innovative approaches as well as up-scaling of the project's best practices and those of other initiatives • Promotion of development partnerships with the private sector • Promotion of gender equality,	Regional	GIZ	GIZ
Watershed management	Climate Compatible Development Plan of the Dominican Republic (CCDP) in the cement and waste sectors	A legal framework and an administrative procedure that cover the use of waste as an energy source and are in line with international standards are being drawn up, brought into force and applied. Actors from the public and private sectors as well as other relevant stakeholders are using a common inter-institutional dialogue platform to facilitate this process.	National		GIZ

Need Addressed	Name of Project	Description	Geographic Focus	Execute	Financing
Watershed management	Reducción de los Usos Conflictivos del Agua en la Cuenca Binacional del Rio Artibonito a través del Desarrollo y Puesta en Práctica de un Programa de Acción Estrategico Multifocal	El proyecto busca establecer un marco binacional para el manejo integrado de la cuenca del río Artibonito para el 2012, que promueva reformas detalladas basadas en el ecosistema, demostraciones e inversiones, y establecer las bases para la funcionalidad ambiental a largo plazo y la estabilidad socioeconómica.	Cuenca Binacional del Rio Artibonito	UNDP	
Protected Area Management	Fortalecimiento de la capacidad de gestión del uso público en el Parque Nacional Lago Enriquillo, Reserva de la Biosfera Jaragua-Bahoruco-Enriquillo	El objetivo de este proyecto es mejorar la gestión y el uso público en el Parque Nacional Lago Enriquillo, zona núcleo de la Reserva de la Biosfera Jaragua-Bahoruco-Enriquillo, mediante la dotación de infraestructura y equipos para la gestión y el desarrollo del uso público en el parque.	Parque Nacional Lago Enriquillo,	UNDP	
Coastal Zone Management	Conservación de la Biodiversidad en las Zonas Costeras Amenazadas por el Turismo Rápido y Desarrollo en la Infraestructura Física	Uno de los objetivos de este proyecto es elaborar un documento de proyecto completo y una solicitud de ratificación CEO para el proyecto que será remitida al GEF Sec dentro del plazo acordado y con toda la documentación de apoyo requerida incluyendo las cartas de confirmación de co-financiamiento.	Project preparation for GEF	UNDP	

Need Addressed	Name of Project	Description	Geographic Focus	Execute	Financing
Policies/laws-Land use planning & zoning	Contribuir a Reducir la Vulnerabilidad de los Hogares Rurales Pobres ante Shocks Climáticos	El proyecto busca lograr la integración de políticas de adaptación a los procesos de planificación y desarrollo, tales como el ordenamiento territorial, y las estrategias de protección social, a fin de reducir la vulnerabilidad de los hogares rurales pobres, aumentando su resiliencia ante shocks climáticos.	National	UNDP	
Protected Area Management	Conservación del Corredor Biológico entre República Dominicana, Cuba y Haití	Contribuir a la integración de las acciones de conservación entre los Estados insulares; teniendo como objetivo común, reducir las pérdidas de la diversidad biológica en la Región del Caribe y el Neo-trópico Americano, teniendo al hombre y el mejoramiento de sus condiciones de vida en el centro de atención.	Incluye en República Dominicana, la Reserva de Biosfera Jaragua-Bahoruco-Enriquillo y la cordillera Central en su macizo de conexión con Haiti.	MARN	
Watershed Management	Programa Manejo Integrado y Uso Sostenible de Cuencas Hidrográficas Prioritarias y sus Franjas Costeras en la Rep. Dom.	Implementación de medidas de recuperación de ecosistemas degradados, de modelos de producción social, económica y ambientalmente sostenibles, integrando a los usuarios de los recursos naturales y a la población residente a la protección y uso sostenible de los bienes y servicios de ecosistemas, la biodiversidad y el patrimonio natural de la cuenca.	Las cuencas de los Ríos Yaque del Norte, Yuna-Camú, Yaque del Sur, Higüamo, Ozama-Isabela, Macasías, Haina, Nizao, Ocoa y Pedernales,	MARN	
Watershed Management	Restauración de la Cobertura Vegetal y Uso Sostenible de Suelos de los Municipios Hondo Valle y Juan Santiago	Contribuir al manejo sostenible del medio ambiente, creando un ambiente favorable para restaurar los ecosistemas forestales, mejorar la calidad del agua y reducir la vulnerabilidad al cambio climático, para mejorar las condiciones de vida de las poblaciones de Hondo Valle y Juan Santiago, especialmente de aquellas que viven en el entorno de sus cuencas hidrográficas.	Abarca 216.76 km2 a nivel de cuenca-municipio (Río Caña-Los Guineos 86.63 km2, Río Caño 70.87 km2, Río Macasías 38.89 km2, Río Sonador 20.32 km2 y Barrero 0.05 km2).	MARN	

Need Addressed	Name of Project	Description	Geographic Focus	Execute	Financing
Watershed Management	Fortalecimiento de la Capacidad Institucional en el Manejo Integral de los Residuos Sólidos a Nivel Nacional en la República Dominicana (FOCIMiRS)	Iniciado en enero de 2014 y concluido en mayo de 2017. Sus resultados fueron, la creación de una mancomunidad modelo para el Manejo Integral de los Residuos Sólidos (MIRS) y la remediación ambiental de su vertedero, además el robustecimiento de la capacidad de los técnicos del Ministerio de Ambiente y de los municipios para abordar la problemática de los desechos sólidos.	Dentro del marco de implementación de este proyecto fueron seleccionados tres municipios modelo, Azua, Moca y Sánchez, con la finalidad de ejecutar un aspecto relacionado a la gestión integral de los residuos sólidos municipales.	MARN	JICA
Forest Management	Programa Reducción de Emisiones de la Deforestación y Degradación de Bosques en Centroamérica y República Dominicana (REDD/CCAD-GIZ)	Su objetivo es crear en los países miembros de la CCAD las bases adecuadas para llevar a cabo las acciones que se requieren para desarrollar mecanismos de compensación sostenibles para reducir la emisión de gases CO2, causada por la deforestación y la degradación forestal.	Los ocho países miembros del Sistema de Integración Centroamericano (SICA): Belice, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panamá y República Dominicana.	MARN	GIZ

Need Addressed	Name of Project	Description	Geographic Focus	Execute	Financing
Watershed Management	Establecimiento de una Red Nacional de Producción más Limpia y Eficiencia en el Uso de los Recursos (RECP) en República Dominicana y una difusión regional en los países del CARIFORUM	El objetivo de este proyecto es mejorar la eficiencia, productividad, competitividad y el desempeño ambiental de las empresas, sobre todo las PYME's, en República Dominicana y los países del CARIFORUM, mediante la aplicación de métodos, prácticas y tecnologías RECP. Su Consejo Directivo está integrado por los ministerios de Medio Ambiente y Recursos Naturales, de Industria y Comercio y, de Agricultura, así como la Junta Agroempresarial Dominicana (JAD) y el Instituto Dominicano de Investigaciones Agropecuarias y Forestales (IDIAF).	El resultado esperado es que la Red Nacional RECP que se establezca en la República Dominicana y las instituciones que intervienen en los países del CARIFORUM[4] operen de manera eficiente a nivel nacional y regional, asegurando que las empresas en la República Dominicana y otros países del CARIFORUM adopten RECP sobre una base sostenible, con un efecto positivo sobre el medio ambiente y la competitividad global.	MARN MIC MA	ONUDI

[4] CARIFORUM Agreement countries: Jamaica, Barbados, Trinidad and Tobago, Guyana, Suriname, Antigua and Barbuda, Belize, Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, the Bahamas, Haiti and the Dominican Republic.

Need Addressed	Name of Project	Description	Geographic Focus	Execute	Financing
Coastal Zone Management	Grandes Ecosistemas Marinas (GEM) del Caribe: Caso Monrecristi.	Proyecto Piloto de Manejo y Conservación de la Pesquería y Biodiversidad Arrecifal – Parque Nacional Montecristi, SNIP 12251.Actividades: (i) la pesca no sostenible, que genera poblaciones de peces sobreexplotadas y reducidas; (ii) la degradación del hábitat y modificación de comunidades; y (iii) la contaminación marina. Duración: 4 años (2014-2017)	Montecristi	MARN	UNDP/FMAM

Sources: MARN. 2017

Table 35 Planned NRM Projects in the Dominican Republic

Need Addressed	Name of Project	Geographic Focus	Ejecute	Financing
Agroforestry	Programa de Desarrollo Agroforestal Sostenible	Región suroeste	MINPRE	BID (Preparación)
Watershed management	Proyecto de Recuperación de la Cobertura Vegetal en Cuencas Hidrográficas en la Republica Dominicana		MARN	
Coastal Zone management	Proyecto de Regeneración de Playas	Los balnearios son: Juan de Bolaños– Costa Verde y El Morro en Monte Cristi; Cofresí en Puerto Plata; Playa Bonita, Punta Popy, Ballena y Cosón en Samaná; Cabeza de Toro, Macao, Arena Gorda – Cortecito y Bayahíbe en La Altagracia; Juan Dolio en San Pedro de Macorís, y Boca Chica y Andrés, en Santo Domingo.	MITUR	
Policies/Laws	Mainstreaming NRM of Biodiversity and Ecosystem Services in Productive Landscapes in Threatened Forested Mountainous Areas	Zones of Madre de las Aguas, vulnerable watersheds and buffer zones of other Protected Areas and target areas of Sierra de Neyba and Ozama.	MARN	GEF/PNUD

Sources: MARN. 2017; DIGEPRES. 2017(a); Hoy. 2017; Listín Diario. 2017; GEF. 2017.

APPENDIX C: NRM ACTIONS NEEDED

Table 36 Needed Enabling NRM Actions

Enabling Action	Direct Threat to Biodiversity and Tropical Forests				
	Habitat Loss	**Over-Exploitation**	**Pollution**	**Invasive Species**	**Climate Change**
Policies/Laws/ Strategies	• Approve & implement Territorial Planning Law & Coastal Resources Law • Legalize land tenure in SINAP	• Approve & implement: laws for: forestry, coastal resources; fire control	• Approve & implement water law	• No enabling action	• No enabling action
Institutions	• Increase inter-institutional coordination & collaboration; • Improve MARN & other institutions' effectiveness & efficiency; • Increase involvement of business in NRM	• Improve & promote production technology for threatened species	• Strengthen municipal capacity to construct sewage treatment & sanitary landfills	• Make National Invasive Species Committee functional	• Make all protected areas in SINAP functional
Education/Training	• Educate sufficient foresters & NRM biologists • Give students incentives to study NRM; • Include NRM in school curriculums	• Educate sufficient foresters, fisheries managers	• Educate sufficient environmental engineers	• Educate sufficient agronomists regarding effect and control of invasive species	• Training for disaster preparedness professionals
Research	• Research habitat loss & degradation problems & solutions	• Research over-exploitation problems & solutions	• Research pollution problems & solutions	• Research invasive species problems & solutions	• Research climate resilience problems & solutions

Enabling Action	Direct Threat to Biodiversity and Tropical Forests				
Awareness	• Increase public & decision-maker awareness about habitat loss	• Increase public & decision-maker awareness about over-exploitation	• Increase public & decision-maker awareness about pollution	• Increase public & decision-maker awareness about invasive species	• Increase public & decision-maker awareness about resilience to climate change
Finance	Finance enabling sufficiently & direct actions & implement them effectively & efficiently				

Table 37 Needed Direct NRM Actions

Direct Actions	Direct Threats to Biodiversity and Tropical Forests				
	Habitat Loss	Over-Exploitation	Pollution	Invasive Species	Climate Change
Watershed Management	• Maintain forest cover on steep slopes & next to water bodies	• Stimulate more efficient & competitive production of commercial endangered species	• Install sewage treatment plants & sanitary landfills • Soil NRM practices	• Train farmers in feasible technology to control invasive species	• Build resilience through economic diversification, land use zoning & increase in vegetation
Forest Management	• Produce forest products while protecting forest ecosystems	• Apply technology to increase competitive production	• Conserve riparian vegetation to reduce sedimentation	• Manage forests, tree plantations & fire to control invasive species	• Maintain & expand forest cover to reduce flooding
Agroforestry	• Increase productivity of existing coffee & cacao plantations	• Use over-exploited forest trees in agroforestry systems	• Include control of waste from coffee & cacao processing in agroforestry projects	• Control invasive species as part of agroforestry techniques	• Increase use of high-yield coffee & cacao agroforestry systems
Protected Areas Management	• Mange all of SINAP	• Increase competitive production of commercial species outside of SINAP	• Maintain vegetation especially near water bodies	• Eliminate/control invasive species when feasible	• Manage all of SINAP

Direct Actions	Direct Threats to Biodiversity and Tropical Forests				
Coastal/Marine Zones	• Protect & re-establish coastal ecosystems • Promulgate & enforce land use regulations	• Promulgate & enforce fishing regulations & no-catch zones • Promulgate & enforce tourism regulations	• Install sewage treatment & sanitary landfills	• Prevent & control invasive species	• Maintain coastal "natural infrastructure"

APPENDIX D: CONTRIBUTION OF POTENTIAL DEVELOPMENT OBJECTIVES TO NRM ACTIONS

Table 38 Contribution of Potential Development Objectives to Needed Enabling NRM Actions

Potential Development Objective	Policies/Laws/Strategies	Institutions	Education/Training	Research & Technology	Awareness
Security from Crime	Effective enforcement of NRM laws	Strengthen enforcement capabilities	Education in NRM laws	Indicates research & technology needs	Public & decision-maker understanding of NRM laws
Democratic, Effective Governance	Additional & improved NRM, policies, laws & strategies	Strengthened institutions more effective in NRM actions	NRM education includes governance & democracy	Social research clarifies organizational aspects of NRM actions	Public participation increases awareness of NRM
Widespread Human Health	Health regulations require water treatment & sanitary landfills	Stronger water & sanitary institutions	NRM education includes human health	Health research identifies links to NRM & improves technology for water & sanitation	Health programs increase awareness of NRM-health links
Equitable Economic Prosperity & Stability	Economic policies/laws/strategies further NRM policies	Land use planning for economic growth favor NRM actions	Business education includes NRM	Research & technology for businesses includes NRM	Reporting on economic policies include NRM

Table 39 Contribution of Potential Development Objectives to Needed Direct NRM Actions

Potential Development Objective	Watershed Management	Forest Management	Protected Area Management	Coastal Zone Management
Security from Crime	Enforcement of watershed management regulations	Enforcement of forest management regulations	Enforcement of SINAP regulations	Enforcement of coastal land use regulations & fishing regulations
Democratic, Effective Governance	Improved governance for watershed management Public participation events increase awareness of NRM Transparency increases efficiency & effectiveness in use of public funds for watershed management	Land use regulations foment forest management	Participation resolves human-SINAP conflicts	Participation re-enforces land use regulations
Widespread Human Health	Build & operate water treatment & sanitary landfills	Requirement for water foments tree plantations & regeneration of natural forest	Requirement for water foments management of SINAP	Build & operate water treatment & sanitary landfills
Equitable Economic Prosperity & Stability	Economic policies stabilize land use in watersheds & coastal zones	Economic policies permit productive & protective forest management	Economic growth permits increase in budget for SINAP so all of Pas' can be managed & legal land tenure established	Tourism policies favor sustainable over unsustainable tourism

APPENDIX E: CONTRIBUTION OF ACTIONS NEEDED TO POTENTIAL DEVELOPMENT OBJECTIVES

Table 40 Contribution of Actions Needed to Security from Crime

	Employment Opportunities for At Risk Male Youth	Enforce Laws Effectively	Self-Esteem of "At-Risk" Male Youth
Enabling Actions			
Policies/Laws	Secure land tenure-economic investment-jobs	Enforce regulations- jobs- enforce laws effectively	-
Institutions	MARN implements SINAP-job	MARN enforces laws-jobs	-
Research/ Technology	New products-economic investment-jobs	Field research - jobs	Field research – training-jobs-self esteem
Awareness	Increased support-maker support-field actions-jobs	Increased support-enforcement-jobs	NRM Education + primary, secondary education-jobs-self-esteem
Education/Training	Education/training-capabilities-jobs	Training- jobs	NRM training – jobs – self-esteem
Direct Actions			
Watershed Management	Field actions-jobs	Field actions-respect for law & jobs	Field training-skills-jobs-self-esteem-
Forest Management	Field action-jobs	Field action-respect for law & jobs	Field training-skills-jobs-self-esteem
Agroforestry	Field action - jobs	none	Field training-skills-jobs-self-esteem
Protected Areas Management	Field actions-jobs	Field actions-respect for law & jobs	Field training-skills-jobs-self-esteem
Coastal Zone Management	Field actions-jobs	Field actions-respect for law & jobs	Field training-skills-jobs-self-esteem

Table 41 Contribution of Actions Needed for Democratic, Effective Governance

	Increase Public Participation in Governance	Reduce Corruption in Public Institutions	Increase effectiveness of Public Institutions
Enabling Actions			
Policies/Laws	NRM policies-clearer choices-more informed electorate-more participation	NRM policies-clear institutional roles & responsibilities-less corruption	NRM policies-clear institutional roles & responsibilities-more effective institutions
Institutions	Stronger institutions-better participation mechanisms-more participation	MARN Budget based planning – clearer budget process - less corruption	Better land use planning –more effective municipalities
Education/Training	NRM capabilities-better land use planning & use-more participation	NRM professionalism-less corruption	NRM professionalism-more effective institutions
Research	Research on social-environment interactions-better planned public participation-more public participation	-	Research on land uses-more effective land use planning-more effective land use plans-more effective municipalities
Awareness	NRM knowledge-public concern-more participation	NRM knowledge-opposition to corruption	NRM knowledge – demand for effective government-more effective institutions
Direct Actions			
Watershed Management	Community-led watershed management-more public participation	Well-managed watersheds-less corruption	Protected water supplies-stronger municipalities
Forest Management	Community-led forest management-more public participation	Community control over forests-knowledge-more transparency-less corruption	Community-led forest management-wider application of forest management-more forest management-more effective MARN
Agroforestry	None	None	None
Protected Areas	Improved park-human relations-more public participation	Improved park management-less corruption related to exploitation of natural resources	Improved park management-stronger MARN

	Increase Public Participation in Governance	Reduce Corruption in Public Institutions	Increase effectiveness of Public Institutions
Coastal/Marine Zone Management	Community led coastal resource management – more public participation	Well-managed coastal zone-less corruption	Well-managed coastal zones-stronger municipalities

Table 42 Contribution of Actions Needed to Widespread Human Health

Enabling Actions	Reduce Occurrence of HIV/AIDS	Adequate Public Water Supplies (reliability, volume, quality)	Improve Sanitary Conditions
Policies/Laws	-	Water Law -more watershed management- conserve water supplies	Water Law conserves-conserves water supplies-improves sanitary conditions
Institutions	Municipal capacity-effective local HIA/AIDs programs	Strong MARN & municipalities – more watershed management- conserve water supplies	Stronger MARN & municipalities-better watershed management-less solid waste- conserve water supplies-improved sanitary conditions
Research/ Technology	-	More knowledge & better technology – more effective field work – less soil erosion – conserve water supplies	More knowledge & better technology – watershed management-conserves water supplies
Awareness		NRM knowledge-support for watershed management-conserve water supplies	NRM knowledge-watershed management-support for solid waste disposal-conserves water supplies-improved sanitary conditions
Education/ Training	-	More competent NRMists-more effective watershed management-less soil erosion-conserve water supplies	More competent NRMists-more effective watershed management-conserve water supplies - more sanitary conditions
Direct Actions			
Watershed Management	-	Reduce erosion-conserve water supplies	Better management of solid waste-conserve water supplies-more sanitary conditions

Enabling Actions	Reduce Occurrence of HIV/AIDS	Adequate Public Water Supplies (reliability, volume, quality)	Improve Sanitary Conditions
Forest Management	-	Better managed forests-more protection of soil-less soil erosion-conserve water supplies	Better management of forests-improve water supplies-more sanitary conditions
Agroforestry	-	Reduce erosion- conserve water supplies	Protection of watersheds-improve water supplies-ore sanitary conditions
Protected Areas	-	Reduce erosion- conserve water supplies	Protection of watersheds-improve water supplies-ore sanitary conditions
Coastal/Marine Zone Management	-	Less salt water intrusion- conserve water supplies	Less salt water intrusion-conserve aquifer water supplies- more sanitary conditions

Table 43 Contribution of Actions Needed to Equitable Economic Prosperity and Stability

	Reduced Risks from Extreme Weather Events	Stable, Prosperous Tourism	Reliable Supplies of Renewable Natural Resources
Enabling Actions			
Policies/Laws	NRM policies & laws-order in resource use-less investment risk	NRM policies & laws-order in resource use-more secure & competitive investments-more sustainable tourism	Establish clear, enforceable regulations-less investment risk-more investment-more reliable supplies
Institutions	More effective MARN & municipalities-better resilience actions-less risk	More effective MARN & municipalities-more order in tourist areas-more NRM of beaches & reefs – more competitive tourism-more sustainable tourism	More effective MARN & municipalities-less investment risks-more reliable supplies

	Reduced Risks from Extreme Weather Events	Stable, Prosperous Tourism	Reliable Supplies of Renewable Natural Resources
Research/ Technology	More knowledge & better technology-better resilience actions-less risk	More knowledge-better technology & planning-better use of beaches & reefs-more competitive tourism-more sustainable tourism	More social & biological knowledge of biodiversity & forests-better management-better watershed management-less erosion-more secure irrigation water
Awareness	More support for NRM-more effective field actions-less risk	More decision-maker & public support for NRM-more NRM of beaches & reefs-more competitive tourism-more sustainable tourism	More decision-maker & public support-more NRM-more reliable supplies
Education/Training	More competent NRMists-more effective field actions-less risk	More competent NRMists-better management of beaches & reefs-more competitive tourism-more sustainable tourism	More competent NRMists-better NRM practices-more reliable supplies
Direct Actions			
Watershed Management	More vegetative cover on soil-reduced floods-less risk	More stable water supplies to tourist destination-more competitive tourism-more sustainable tourism	More & better NRM actions-more reliable supplies
Forest Management	Better managed forests-more vegetation cover on soils-reduced floods	Better managed forests-more vegetation cover on watersheds-more stable, higher quality water supplies-more sustainable tourism	Better managed forest
Agroforestry	Higher yields & prices-increase cacao & coffee farmer incomes	Higher yield cacao & coffee plantations-less deforestation & more tree cover in watersheds-more stable & high-quality water supplies- more sustainable tourism	More production of wood products from cacao & coffee plantations
Protected Areas	More vegetation on soils-reduced floods-less risk	More competitive protected areas-more sustainable tourism	-

	Reduced Risks from Extreme Weather Events	Stable, Prosperous Tourism	Reliable Supplies of Renewable Natural Resources
Coastal/Marine Zones	More natural protection-less risk	More competitive protected areas-more sustainable tourism	Reduced over-exploitation-more regeneration & growth-more reliable supplies

APPENDIX F: APPLICATION OF CRITERIA FOR SELECTION OF PRIORITY NRM ACTIONS

Selection Criteria

Table 44 indicates eight possible criteria, labeled A through H, for selecting from among the needed NRM actions those to include in the 2019-2023 CDCS.

Table 44 Criteria for Rating of NRM Actions Needed

Label of Criteria	Description of Criteria
A	Gaps in needed NRM actions
B	Contribution to DO 1 Security from Crime
C	Contribution to DO 2 Democratic, Effective Governance
D	Contribution to DO 3 widespread human health
E	Contribution to DO 4 equitable Economic Prosperity & Stability
F	Geographic & time scales
G	USAID's manageable interests
H	Lessons learned

(Note, this uses the hypothetical 2020-2025 CDCS DOs.)

Criterion A refers to gaps in needed NRM actions. If another project or program is already addressing the NRM need, then we assume it would be unneeded or duplicative for USAID to also finance that NRM need and give this criterion a zero weighting. Contrariwise, the criterion receives a weighting of one.

Criteria B through E refer to the contribution to the potential 2019-2023 DOs the needed NRM measure would be likely to make. If it would contribute, then it is given a weighting of one; if not, a weighting of zero. A needed NRM action that could contribute to more DOs thus receives a higher weighting than one that could contribute to fewer DOs. Criterion F combines the two important criteria of geographic scale and time scale. Needed NRM actions that would be likely to help expand NRM over a large geographic area permanently are given a one rating. Needed NRM actions that that are likely to cause only ephemeral, small-scale NRM results are assigned a zero rating. Quantitative data are unavailable upon which to base this decision. The criterion is so important, however, that a rating, even if based on professional judgement, seems justified.

Criterion G incorporates the idea of USAID/DR's manageable interest. If it seems likely that USAID/DR will be able to achieve the needed NRM result, then that NRM action is within its manageable interest and receives a rating of one. Those needed NRM actions outside of USAID/DR's manageable interests receive a rating on zero.

Criterion H concerns lessons learned. If a needed NRM actions does not contradict a lesson learned, it receives a rating of one. If it does contradict a lesson learned it receives a rating of zero.

Although the weighting assigned to these criteria is inevitably be somewhat subjective, it should reflect professional experience. When a several professionals assign a weight to each criterion, then the final weighting should provide a reasonable measure of how well the potential action fits USAID/DR's development objectives and goals. In any case, we present these as tentative criteria that could be adjusted, added to or improved by the USAID/DR professional staff and aligned more closely to the goals and DOs of the 2019-2023 CDCS.

Table 45 Summary Ratings of Enabling Actions

Category of Enabling Action/ Title of Enabling Action	Rating
Policies & Laws	
(1) Formulate & approve new NRM laws & regulations	1
(2) Enforce NRM regulations	6
Institutions	
(3) Increase inter-institutional coordination	2
(4) Increase institutional effectiveness & efficiency	4
(5) Increase business involvement in NRM	2
(6) Use available funds efficiently & effectively	4
Education/Training	
(7) Educate more NRM practitioners	8
(8) Give students incentives to study NRM	3
Research & Technology	
(9) Do scientific biological & social research	**7**
(10) Do research on NRM technologies	7
Awareness	
(11) Increase public awareness	7
(12) Increase decision-maker awareness	7

Table 46 Application of Selection Criteria to Needed Enabling Actions

Letter of Selection Criterion	Category of Enabling Action/Title of Enabling Action Summary of Reason for Numerical Rating of Needed Action	Rating
	Policies/Laws/Strategies/Action	
	Formulate & approve new NRM laws & regulations	
A	Most required laws & regulations already in place or in process	0
B	Enforcement of NRM laws contributes to overall security	I
C	New NRM laws & regulations are not needed to further DO2	0
D	New NRM laws & regulations will not contribute to human health	0
E	New NRM laws & regulations not required to achieve this DO	0
F	New NRM laws & regulations not required to achieve this DO	0
G	USAID not in a position to influence laws & regulations	0
H	Lessons learned not very relevant	0
	TOTAL	**I**
	Enforce NRM regulations	
A	NRM regulations often not enforced so will fill a gap	**I**
B	Enforcement increases overall security	**I**
C	Enforcement of laws & regulations furthers governance	I
D	Enforcement of anti-pollution laws improves human health	I
E	Enforcement brings stability, a pre-prerequisite for growth & prosperity	I
F	Enforcement required for large-scale permanent NRM	**I**
G	USAID cannot enforce laws & regulations	0
H	No direct relationship to lessons learned	0
	TOTAL	**6**
	Institutions	
	Increase inter-institutional coordination	
A	MARN already working to increase inter-institutional coordination	0
B	Inter-institutional coordination unrelated to security	0
C	Inter-institutional coordination does improve governance	I

Letter of Selection Criterion	Category of Enabling Action/Title of Enabling Action Summary of Reason for Numerical Rating of Needed Action	Rating
D	Inter-institutional coordination not linked to human health	0
E	Inter-institutional coordination marginally linked to growth & prosperity	0
F	Institutional cooperation prerequisite for large-scale permeant NRM	1
G	USAID has little influence on inter-institutional cooperation much	0
H	Not a lesson learned	0
	TOTAL	**2**
	Increase institutional effectiveness & efficiency	
A	DR government already trying to increase effectiveness & efficiency	0
B	Effectiveness & efficiency of NRM institutions unrelated to security	0
C	Increased effectiveness & efficiency prerequisite for improved governance	1
D	Some NRM institutions contribute to improved human health	1
E	Some NRM institutions contribute to economic growth & prosperity	1
F	Effective, efficient NRM institutions prerequisite for large-scale NRM	1
G	USAID exerts little influence on institutional effectiveness & efficiency	0
	TOTAL	**4**
	Increase business involvement in NRM	
A	Business already involved in NRM	0
B	Little or no link between business involvement in NRM & security	0
C	No link between business involvement in NRM & DO2	0
D	Little connection between business involvement in NRM & DO 3	0
E	Businesses depend a lot on NRM	1
F	Businesses need water that flows from large watersheds	1
G	Little USAID influence business decisions	0
	TOTAL	**2**
	Use available funds efficiently & effectively	
A	MARN & GDR already taking measures to use funds efficiently & effectively	0

Letter of Selection Criterion	Category of Enabling Action/Title of Enabling Action Summary of Reason for Numerical Rating of Needed Action	Rating
B	Use of NRM funds not linked to security	0
C	NRM & governance linked closely	1
D	NRM linked to health through provision of water	1
E	NRM linked closely to economic growth & prosperity	**1**
F	Effective, efficient use of funds permits impact over large area	1
G	Little USAID influence on use of funds	0
H	No a lesson learned	0
	TOTAL	**4**
	Education/Training	
	Educate and train more NRM practitioners	
A	DR lacks new generation of NRM practitioners	1
B	NRM offers employment to at-risk youth	1
C	NRM practice contributes to democracy & governance	1
D	NRM improves human health (reduced pollution & assure water supplies)	1
E	NRM underlies economic growth and prosperity (goods & services)	1
F	NRM a prerequisite for large-scale, permanent NRM	1
G	USAID able to provide NRM education/training opportunities	1
H	NRM prerequisite for technically sound field actions	1
	TOTAL	8
	Give students incentives to study NRM	
A	Few incentives to study NRM	1
B	No links to security	0
C	No close links to democracy & governance	0
D	No close links to human health	0
E	NRM practitioners a prerequisite to economic growth & prosperity	1
F	NRM practitioners a prerequisite to large-scale permanent NRM	1

Letter of Selection Criterion	Category of Enabling Action/Title of Enabling Action Summary of Reason for Numerical Rating of Needed Action	Rating
G	USAID has little influence on employment opportunities	0
H	No specific lesson learned	0
	TOTAL	3
	Research & Technology	
	Do scientific biological & social research	
A	Many gaps in scientific knowledge	1
B	No close link to security	0
C	NRM contributes to governance	1
D	NRM contributes to health	1
E	NRM contributes to economic growth & prosperity further DO 4	1
F	Large-scale NRM requires research	1
G	Research within USAID manageable interests	1
H	Need to do research is a lesson learned	1
	TOTAL	7
	Do research on NRM technologies	
A	Much more research on NRM technologies required	1
B	Little applicability to DO 1 (Security)	0
C	Social/organizational research required for NRM	1
D	NRM technologies required to maintain water quality & flow for human use	1
E	NRM a pre-requisite for economic growth & prosperity	1
F	NRM a pre-requisite of large-scale, permanent NRM	1
G	USAID can manage research & show results	1
H	Need for NRM is an important lesson learned	1
	TOTAL	7
	Awareness	
	Increase public awareness	

Letter of Selection Criterion	Category of Enabling Action/Title of Enabling Action Summary of Reason for Numerical Rating of Needed Action	Rating
A	Lack of public awareness of NRM	1
B	No direct link with security	0
C	NRM linked to governance & democracy	1
D	NRM linked to human health through pollution & water supplies	1
E	NRM prerequisite for economic growth & prosperity	1
F	Public awareness needed for large-scale, permanent NRM	1
G	USAID can influence public awareness through educational programs	1
H	Need for public awareness is a lesson learned	1
	TOTAL	**7**
	Increase decision-maker awareness	
A	Decision-makers not entirely aware of need for NRM	1
B	No link to security	0
C	NRM closely linked to governance & democracy	1
D	NRM linked to human health (pollution & water)	1
E	NRM underlies economic growth & prosperity	1
F	Decision-makers affect NRM at large-scale, permanently	1
G	NRM education and training within USAID manageable interest	1
H	Lesson learned: importance of leadership on resolving NRM issues	1
	TOTAL	**7**

Table 47 Summary of Ratings of Direct USAID/DR Actions

Category of Enabling Action/ Title of Direct NRM Actions	No. of Points
Watershed Management	
(1) Maintain forest cover on steep slopes	3
(2) Produce threatened wild products more using best practices	4

Category of Enabling Action/ Title of Direct NRM Actions	No. of Points
(3) Install sewage, waste water treatment & integrated solid waste management facilities & systems	5
(4) Control invasive species	4
(5) Control soil erosion through soil NRM practices	5
(6) Establish & manage forest tree plantations	4
(7) Promulgate & enforce land use regulations	7
(8) Increase economic diversification	3
Forest Management	
(9) Manage natural forest to obtain regeneration & products	4
(10) Implement silvicultural practices to regenerate threatened species	4
(11) Establish & manage forest tree plantations	3
(12) Conserve riparian vegetation	3
(13) Protect natural forests from fire, insects & diseases	1
Agroforestry	
(14) Increase productivity of coffee & cacao agroforestry plantations	7
Protected Area Management	
(15) Manage & protect all of SINAP	3
(16) Increase competitive production of threatened species outside of SINAP	4
(17) Mark boundary lines & legalize land tenure	3
(18) Foment ecotourism to increase income	2
(19) Enforce laws & regulations	6
Coastal Zone/Marine Management	
(20) Enforce land use regulations	6
(21) Install sewage systems, waste water treatment & sanitary landfills	5
(22) Protect & re-establish reef, lagoon, mangrove, beach ecosystem	5
(23) Control invasive species	4
(24) Enforce fishing regulations	5

Category of Enabling Action/ Title of Direct NRM Actions		No. of Points
(25)	Enforce tourism regulations	5

Table 48 Application of Selectin Criteria to Direct Needed NRM Actions

Letter of Selection Criterion	Category of Direct Action/ Title of Direct Action Summary of Reason for Numerical Rating of Action	No. of Points
	Watershed Management	
	(1) Maintain forest cover on steep slopes	**3**
A	Forest cover is returning already naturally & by planting	0
B	Does not further DO 1 (security)	0
C	Does not further DO 2 (democracy & governance)	0
D	Furthers DO 3 (widespread human health) through water supplies	1
E	Furthers DO 4 (more resilience, forest products, ecosystem services)	1
F	Contributes to large-scale permanent NRM	1
G	Beyond USAID manageable interest over long-term	0
H	Does not incorporate lessons learned	0
	(2) Produce threatened wild products using best practices	**4**
A	Yes, little work is being done on producing threatened wild products	1
B	Does not further DO 1 (security)	0
C	Does not further DO 2 (democracy & governance)	0
D	Does not further DO 3 (widespread human health)	0
E	Does further DO 4 (economic growth & prosperity)	1
F	Contributes little to large-scale NRM	0
G	Is within USAID manageable interest	1
H	Does incorporate lesson learned	1
	(3) Install sewage, waste water treatment & integrated solid waste management facilities & systems	**5**
A	Would help fill a large gap	1
B	Does not further DO 1 (security)	0
C	Does not further DO 2 (democracy & governance)	0
D	Furthers DO 3 (widespread human health) by reducing pollution	0
E	Furthers DO 4 (more resilience)	1
F	Does contribute to large-scale, permanent NRM especially coastal/marine	1
G	On a small-scale within USAID manageable interests	1
H	Incorporate lesson learned (technology)	1
	(4) Control invasive species	**4**
A	Would help fill a large gap	1
B	Does not further DO 1 (security)	0
C	Does not further DO 2 (democracy & governance)	0
D	Does not further DO 3 (human health)	0
E	Marginal effect on DO 4 (resilience of crops to invasive species)	0

Letter of Selection Criterion	Category of Direct Action/ Title of Direct Action Summary of Reason for Numerical Rating of Action	No. of Points
F	Does contribute to large-scale, permanent NRM	1
G	On a small-scale within USAID manageable interest	1
H	Lesson learned regarding application of technology & science	1
	(5) Control soil erosion through soil NRM practices	**5**
A	Soil erosion problem resolving through revegetation	0
B	Does not further DO 1 (security)	0
C	Does not further DO 2 (democracy & governance)	0
D	Furthers DO 3 (widespread human health) through water supplies	1
E	Furthers DO 4 (more resilience, forest products, ecosystem services)	1
F	Does contribute to large-scale, permanent NRM	1
G	On a small-scale within USAID/DR manageable interests	1
H	Incorporates lessons learned 10,3	1
	(6) Establish & manage forest tree plantations	**4**
A	Does not fill a gap	0
B	Does not further DO 1 (security)	0
C	Does not further DO 2 (democracy & governance)	0
D	Furthers DO 3 (widespread human health) through water supplies	1
E	Furthers DO 4 (more resilience, forest products, ecosystem services)	1
F	Contributes to large-scale, permanent NRM	1
G	Within USAID manageable interest on small-scale	1
H	No lesson learned	0
	(7) Promulgate & enforce land use regulations	**7**
A	Fills a gap	1
B	Does not further DO1 (Security)	0
C	Furthers DO 2 (Democracy & Governance)	1
D	Furthers DO 3 (Widespread Human Health)	1
E	Furthers DO 4 (Economic Growth & Prosperity)	1
F	Contributes to large-scale, permanent NRM	1
G	Within USAID/DR manageable interests	1
H	Incorporates lessons learned 2	1
	(8) Increase economic diversification	**3**
A	Fills a gap	1
B	Does not further DO 1 (Security)	0
C	Does not further DO 2 (Democracy & Governance)	0
D	Does not further DO 3 (Widespread Human Health)	0
E	Furthers DO 4 (Economic Growth & Prosperity)	1
F	Does not further large-scale, permanent NRM	0
G	Not within USAID/DR manageable interest	0
H	Incorporates lessons learned 4, 6	1
	Forest Management	
	(9) Manage natural forest to obtain regeneration & products	**4**
A	Fills a large gap in natural forest management for valuable products	1

Letter of Selection Criterion	Category of Direct Action/ Title of Direct Action Summary of Reason for Numerical Rating of Action	No. of Points
B	Does not further DO 1 (Security)	0
C	Does not further DO 2 (Democracy & Governance)	0
D	Does not furthers DO 3 (Widespread Human Health)	0
E	Furthers DO 4 (Economic Growth & Prosperity)	1
F	Does further large-scale, permanent NRM	1
G	Not within USAID/DR manageable interest	0
H	Incorporates lessons learned 6,13,	1
	(10) Implement silvicultural practices to regenerate threatened species	**4**
A	Gap in silviculture knowledge & practice	1
B	Does not further DO 1 (Security)	0
C	Does not further DO 2 (Democracy & Governance)	0
D	Does not further DO 3 (Widespread Human Health)	0
E	Furthers DO 4 (Economic Growth & Prosperity)	1
F	Does further large-scale, permanent NRM	1
G	Not within USAID/DR manageable interest	0
H	Incorporates lessons learned 10, 12	1
	(11) Establish & manage forest tree plantations	**3**
A	Already many forest tree plantation projects	0
B	Does not further DO 1 (Security)	0
C	Does not further DO 2 (Democracy & Governance)	0
D	Does not further DO 3 (Widespread Human Health)	0
E	Furthers DO 4 (Economic Growth & Prosperity)	1
F	Does further large-scale, permanent NRM	1
G	Not within USAID/DR manageable interest	0
H	Incorporates lessons learned	1
	(12) Conserve riparian vegetation	**3**
A	Already many reforestation projects including streamside protection	0
B	Does not further DO 1 (Security)	0
C	Does not further DO 2 (Democracy & Governance)	0
D	Does further DO 3 (Widespread Human Health) through water	1
E	Does not further DO 4 (Economic Growth & Prosperity)	0
F	Does further large-scale, permanent NRM	1
G	Not within USAID/DR manageable interest	0
H	Incorporates lessons learned (1)	1
	(13) Protect natural forests from fire, insects & diseases	**1**
A	Fire control plan already made; little to do re insects & diseases	0
B	Does not further DO 1 (Security)	0
C	Does not further DO 2 (Democracy & Governance)	0
D	Does not further DO 3 (Widespread Human Health)	0
E	Furthers DO 4 (Economic Growth & Prosperity)	0
F	Does further large-scale, permanent NRM	0

Letter of Selection Criterion	Category of Direct Action/ Title of Direct Action Summary of Reason for Numerical Rating of Action	No. of Points
G	Not within USAID/DR manageable interest	0
H	Incorporates lessons learned	I
	Agroforestry	
	(14) Increase productivity of coffee & cacao agroforestry plantations	**7**
A	Fills a gap	I
B	Does further DO 1 (Security)	I
C	Does not further DO 2 (Democracy & Governance)	0
D	Does further DO 3 (Widespread Human Health)	I
E	Furthers DO 4 (Economic Growth & Prosperity)	I
F	Does further large-scale, permanent NRM	I
G	Is within USAID/DR manageable interest	I
H	Incorporates lessons learned 12	I
	Protected Area Management	
	(15) Manage & protect all of SINAP	**3**
A	Most protected areas without management	I
B	Does not further DO 1 (Security)	0
C	Does not further DO 2 (Democracy & Governance)	0
D	Does not further DO 3 (Widespread Human Health)	0
E	Furthers DO 4 (Economic Growth & Prosperity)	0
F	Does further large-scale, permanent NRM	I
G	Not within USAID/DR manageable interest	0
H	Incorporates lessons learned 9	I
	(16) Increase competitive production of threatened species outside of SINAP	**4**
A	Field production of threatened species restricted	I
B	Does not further DO 1 (Security)	0
C	Does not further DO 2 (Democracy & Governance)	0
D	Does not further DO 3 (Widespread Human Health)	0
E	Furthers DO 4 (Economic Growth & Prosperity)	I
F	Does further large-scale, permanent NRM	I
G	Not within USAID/DR manageable interest	0
H	Incorporates lessons learned 12,14,15	I
	(17) Mark boundary lines & legalize land tenure	**3**
A	Most protected areas without marked boundaries or legal tenure	I
B	Does not further DO 1 (Security)	0
C	Does not further DO 2 (Democracy & Governance)	0
D	Does not further DO 3 (Widespread Human Health)	0
E	Does not further DO 4 (Economic Growth & Prosperity)	0
F	Does further large-scale, permanent NRM	I
H	Not within USAID/DR manageable interest	0
G	Incorporates lessons learned 9	I

Letter of Selection Criterion	Category of Direct Action/ Title of Direct Action Summary of Reason for Numerical Rating of Action	No. of Points
	(18) Foment ecotourism to increase income	**2**
A	Private sector is fomenting ecotourism	0
B	Does not further DO 1 (Security)	0
C	Does not further DO 2 (Democracy & Governance)	0
D	Does not further DO 3 (Widespread Human Health)	0
E	Does further DO 4 (Economic Growth & Prosperity)	1
F	Does not further large-scale, permanent NRM	0
G	Not within USAID/DR manageable interest	0
H	Incorporates lessons learned 1,3,4	1
	(19) Enforce laws & regulations	**6**
A	Severe lack of enforcement	1
B	Does further DO 1 (Security)	1
C	Does further DO 2 (Democracy & Governance)	1
D	Does further DO 3 (Widespread Human Health)	1
E	Does further DO 4 (Economic Growth & Prosperity)	1
F	Does further large-scale, permanent NRM	1
G	Not within USAID/DR manageable interest	0
H	Incorporates no lessons learned	0
	Coastal Zone/Marine Management	
	(20) Enforce land use regulations	**6**
A	Severe lack of enforcement	1
B	Does further DO 1 (Security)	1
C	Does further DO 2 (Democracy & Governance)	1
D	Does further DO 3 (Widespread Human Health)	1
E	Does further DO 4 (Economic Growth & Prosperity)	1
F	Does further large-scale, permanent NRM	1
G	Not within USAID/DR manageable interest	0
H	Incorporates no lessons learned	0
	(21) Install sewage systems, waste water treatment & sanitary landfills	**5**
A	Severe lack of sewage, waste water treatment, sanitary landfills	1
B	Does not further DO 1 (Security)	0
C	Does not further DO 2 (Democracy & Governance)	0
D	Does further DO 3 (Widespread Human Health)	1
E	Does further DO 4 (Economic Growth & Prosperity)	1
F	Does further large-scale, permanent NRM	1
G	Not within USAID/DR manageable interest	0
H	Incorporates lessons learned 9	1
	(22) Protect & re-establish reef, lagoon, mangrove, beach ecosystem	**5**
A	Severe lack of protection & re-establishment	1
B	Does not further DO 1 (Security)	0

Letter of Selection Criterion	Category of Direct Action/ Title of Direct Action Summary of Reason for Numerical Rating of Action	No. of Points
C	Does not further DO 2 (Democracy & Governance)	0
D	Does not further DO 3 (Widespread Human Health)	0
E	Does further DO 4 (Economic Growth & Prosperity)	1
F	Does further large-scale, permanent NRM	1
G	Within USAID/DR manageable interest on small-scale	1
H	Incorporates lessons learned 6,9,11	1
	(23) Control invasive species	**4**
A	Lack of control of some invasive species	1
B	Does not further DO 1 (Security)	0
C	Does not further DO 2 (Democracy & Governance)	0
D	Does not further DO 3 (Widespread Human Health)	0
E	Does further DO 4 (Economic Growth & Prosperity)	1
F	Does further large-scale, permanent NRM	1
G	Not within USAID/DR manageable interest	0
H	Incorporates lessons learned 1,3,4	1
	(24) Enforce fishing regulations	**5**
A	Severe lack of enforcement	1
B	Does further DO 1 (Security)	1
C	Does further DO 2 (Democracy & Governance)	1
D	Does not further DO 3 (Widespread Human Health)	0
E	Does further DO 4 (Economic Growth & Prosperity)	1
F	Does further large-scale, permanent NRM	1
G	Not within USAID/DR manageable interest	0
H	Incorporates no lessons learned	0
	(25) Enforce tourism regulations	**5**
A	Lack of enforcement	1
B	Does not further DO 1 (Security)	0
C	Does further DO 2 (Democracy & Governance)	1
D	Does further DO 3 (Widespread Human Health)	1
E	Does further DO 4 (Economic Growth & Prosperity)	1
F	Does further large-scale, permanent NRM	1
G	Not within USAID/DR manageable interest	0
H	Does not Incorporate lessons learned	0

APPENDIX G: PRINCIPAL NRM NON-GOVERNMENTAL ORGANIZATIONS

Table 49 Some Principal Dominican NRM NGOs

Name of NGO	Thematic Focus	Geographic Focus
Centro de Desarrollo Agropecuario y Forestal (CEDAF)	Agricultural and forestry training, information, institutional strengthening, analysis & development of policies & strategies	National scope and Las Neblinas Scientific Reserve (co-management)
Consorcio Ambiental Dominicano (CAD)	NRM of biodiversity, protected areas, environmental education, sustainable agriculture, ecotourism & coastal-marine ecosystems.	National with focus on protected areas and buffer zones.
Fondo Pro Naturaleza (PRONATURA)	Watershed management, protected areas, forest fire planning & training, planning for natural risks.	Cordillera Central, Ozama watershed and northwest Haiti border.
Grupo Jaragua, Inc.	Research and projects to solve local NRM problems.	Jaragua National Park & Jaragua-Bahoruco-Enriquillo Biosphere Reserve.
Reef Check	Reef research & monitoring	Marine & coastal especially reefs
Sociedad Ecológica de Barahona (SOEBA)	Environmental education & reporting, NRM projects	Barahona and Enriquillo Region.
Sociedad Ecológica del Cibao (SOECI)	Human-nature inter-relationships	Province of Santiago, emphasis on Pico Diego de Ocampo.
SOH NRM	Study & education about endemic & native species	Sierra de Bahoruco National Park & Loma Charco Azul Biological Reserve (co-management).

APPENDIX H: BUSINESS-FINANCED FOUNDATIONS THAT FUND NRM ACTIVITIES

Table 50 Some Principal Business Financed Foundations

Foundation	Business Sponsor	Thematic Focus	Geographic Focus
No foundation	Universal Group	Watershed reforestation	Bao, Ocoa, Haina & Ozama watersheds
No foundation	Cibao Savings and Loan Association	Reforestation, training of fishermen	National
Brugal Foundation	Brugal Group	Prizes for environmental projects	National
Foundation Propa-Gas	Propa-Gas	Environmental education; reef research; subsidized natural gas; national parks	Co-management of the Valle Nuevo National Park and coral reefs NRM
Popular Foundation	Popular Banking Group	NRM projects; Administration & fund-raising training	Bao & Ozama watersheds
Foundation ADEMI	ADEMI	NRM/environmental projects to benefit families	Haina, Nizao, Blanco & Maimón watersheds
Tropigas Foundation	Marti Group	Training, watershed reforestation, NGO administration; Volunteers in collection of solid waste; Monitoring of reefs.	Ozama & Isabela watersheds;, coral reefs, Sierra de Bahoruco National Park

APPENDIX I: KEY INFORMANTS

Table 51 Key Informants

Name	Title	Institution/Organization
USAID/DR		
Savage, Ron	Office Chief	USAID/DR Office of Agriculture & Environment
Pannocchia, Karen		
Schapiro, Benjamin	Regional Environmental Officer	USAID/DR Climate Change Office, United States Embassy in the Dominican Republic, Avenida República de Colombia # 57, Santo Domingo, D.N.
Public Institutions		
Abreu, Patricia* Ruth	Vice Minister Secretary	MARN, Cooperacion Internacional
Villalona, Maribel V	Manager, Coastal Resources Project	Ministerio de Turismo
Serrano, Manuel* Rossy	Vice-Minister, Forest Resources Secretary	MARN
Pending	Pending	La Federación Dominicana de Municipios (FEDOMU)
Gonzalez de Gutierrez, Zoila* Gladys	Vice-Minister Secretary	Gestion Ambiental, MARN
Acevedo, Ydalia* Isabel	Vice-Minister Secretary	MARN, Recursos Costeros
Santana, Daneris* Mirla	Vice-Minister Secretary	MARN, Areas Protegidas
Business Organizations		
Herrera, Roberto	President	Fondo de Agua de S.D.
Dinzey, Elias* Adalgisa	Director Ejecutivo Secretary	Fundacion Popular Banco Popular,Av.27 de Febrero (Plaza Central)
Bonetti, Margarita* Lisette Fernandez	Presidente	Fundacion Propagas Av. Jacobo Majluta, Km. 5 1/2

Name	Title	Institution/Organization
Collado, Rafael	Pending	Dominican Consortium for Tourism Competitiveness (CDCT)
De Moya, José	Presidente	Camara Forestal Dominicana, Santiago
		Instituto
NRM NGOs		
		Pronatura
Arias, Yvonne		Grupo laragua
Inchaustegui, Sixto*		Grupo Jaragua C/El Vergel no.43
Nunez, Francisco *	Project Coordinator, TNC	TNC, Plaza Central Suite 339B, Av. 27 de Febrero Esq. Winston Churchill, Santo Domingo, D.N.
de los Santos, Jesús* Albanidia	Director Secretary	Fundacion REDDOM Av.Romulo Betancourt 1516, Plaza Thalys, 3er. piso
Luther, David* Elizabeth	Executive Director Secretary	Instituto Dominicano de Desarrollo Integral (IDDI) C/Juan Vallenilla no.17, Zona Ind. De Herrera
Sellares, Rita	Director	The Dominican Foundation of Marine Studies, Inc.
Pending		Reef Check Republica Dominicana (RCRD)
Brocca, Jorge	Executive Director	SOH Conservacion
Rodriguez, Sesar*	Executive Director	Consorcio Ambiental Dominicana (CAD) - Reserva Zorzal Av.Rep. de Colombia
Garcia, Ricardo García* Mairelys	Director General Secretary	Jardin Botanica Nacional
Pugibet, Enrique	Director	Centro de Investigaciones de Biología Marina (CIBIMA)
International Institutions		
Lehtonen, Matti	Country Programme Manager	United Nations Environment Programme (UNEP)
Morales, Maria Eugenia*	Director, Environmental Department	United Nations Development Programme (UNDP) Av. Anacaona no.9, Mirador Sur

Name	Title	Institution/Organization
Lamelas, Rosa*	Pending	GIZ Angel Severo Cabral No.5, Ens. Julieta
Educational Institutions		
Paulino, Jose*	Decano, Ecologia y Economia	Pontificia Universidad Católica Madre y Maestra
Contreras, Jose	Director, Centro de Estudios Ambientales	Instituto Tecnológico de Santo Domingo
Espaillat, Jose Rafael*	Vice Rector de Gestion	Universidad Nacional Pedro Henríquez Ureña
Josefina Paulino	Secretary	

APPENDIX J: END NOTES

1 *Rodriguez 2004; KII; FAO, 2010; The REDD Desk 2017, KI8*
2 KI1
3 KI 11 and Out-Briefing discussion
4 U.N. 2018. Gross Domestic Product (GDP) looks at only one part of economic performance—income—but says nothing about wealth and assets that underlie this income. Wealth accounting, including natural capital accounting (NCA), is needed to sustain growth. Long□ term development is a process of accumulation and sound management of a portfolio of assets—manufactured capital, natural capital, and human and social capital. The other major limitation of GDP is the limited representation of natural capital. The full contribution of natural capital like forests, wetlands, and agricultural land does not show up. Forestry is an example—timber resources are counted in national accounts but the other services of forests, like carbon sequestration and air filtration are ignored. So, GDP can give misleading signals about the economic performance and well□being of a country. Partly as a result, ecosystems are deteriorating worldwide, and with them, the capacity to support human wellbeing and sustainable economic growth. Natural capital is a critical asset, especially for developing countries where it makes up a significant share (36%) of total wealth. The concept of accounting for natural capital has been around for more than 30 years. A major step towards achieving this vision came with the adoption by the UN Statistical Commission of the System for Environmental and Economic Accounts (SEEA) in 2012. This provides an internationally□agreed method to account for material natural resources like minerals, timber and fisheries. The System of Environmental-Economic Accounting (SEEA) contains the internationally agreed standard concepts, definitions, classification, accounting rules and tables for producing internationally comparable statistics on the environment and its relationship with the economy. The SEEA framework follows a similar accounting structures as the System of National Accounts (SNA) and uses concepts, definitions and classifications consistent with the SNA in order to facilitate the integration of environmental and economic statistics.
5 World Bank 2016
6 USFS 2017
7 FAO 2015
8 Spalding et al. 2016
9 CIA 2018
10 Koenma. 2018
11 Spalding 2016
12 CNE 2015
13 http://www.fao.org/docrep/005/X0332B/X0332B01.htm
14 CIA 2018
15 Spalding et al. 2016
16 Spalding et al. 2016
17 Spalding 2016
18 Spalding 2016
19 Wielgus J, et al 2010
20 Spalding et al 2016
21 Spalding et al. 2016
22 CODEPESCA 20??
23 Spalding et al 2016
24 Riverside Technologies, no date
25 CNE 2015. Sedimentation has reduced the capacity of reservoirs in the DR by 10 to 25 %, reducing the capacity of hydropower plants by the same range of percentage at a cost of about US$10 million per year in lost electrical power plus the added costs of cleaning irrigation and water supply infrastructure.
26 Berlan & Dr Ame Bergés, 2013
27 Koenma. Acessed 2018. https://knoema.com/atlas/Dominican-Republic/topics/Agriculture/Live-Stock-Production-Stocks/Number-of-cattle-and-buffaloes
28 Wielgus, J. et al. 2010
29 Freshplaza 2018
30 MOP 2017
31 Newton, Creede. 2017.
32 Geraldes, Francisco X. 2003
33 The current forest cover in Haiti to be only 3.5% and that all of the original primary forest of Haiti has been removed or severely altered. Thus, the remaining ecoregion areas in Table 3 occur entirely in the Dominican Republic.
34 TNC 2017
35 Differences exist between the National Red List for the Dominican Republic and the Global Red List of the IUCN. The IUCN list, for example lists only 14 endangered plants while the National List lists 479 species. Similarly, the IUCN Red List has 55 species of invertebrates in danger while the National List has 133. These differences are evidently due to IUCN not having updated its listed recently so as to incorporate the results of more recent studies (MARN 2014).

36 MARN 2016; FishBase 2017
37 KI15
38 MARN 2014
39 MARN 2014, KI 15a, MARN 2016; Juergson et al 2012
40 FAO 2015a and FAO 2015b. The FAO defines forest land as: "Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use." It defines "other wood land as "land not defined as "Forest", spanning more than 0.5 hectares; with trees higher than 5 meters and a canopy cover of 5-10 percent, or trees able to reach these thresholds; or with a combined cover of shrubs, bushes and trees above 10 percent. It does not include land that is predominantly under agricultural or urban land use.". The FAO defines Other Land With Tree Cover as land that is that is predominantly agricultural or urban lands use and has patches of tree cover that span more than 0.5 hectares with a canopy cover of more than 10 percent of trees able to reach a height of 5 meters at maturity. It includes both forest and non-forest tree species."
41 FAO 2015a
42 Rodriguez 2004; KII; FAO, 2010; The REDD Desk 2017, KI8
43 KI22
44 Rodriguez 2004; KII; FAO, 2010; The REDD Desk 2017, KI8, KI24
45 within the Armando Bermudez, Jose del Carmen Ramirez, Picky Lora, Sierra Prieta, Valle Nuevo and Sierra de Bahaoruco and Mirador del Paraiso National Parks.
46 Bouvier, Ioana 2017
47 TNC, 2016. In northern Bajo Yuna, for example, agriculture and buildings are replacing mangroves. At the same time, in southern Bajo Yuna mangrove forest has increased
48 MARN 2014; KIIs, field observations
49 Steneck, R. and R. Torres. 2015; GIZ 2017; ARCC 2013
50 Marte, Domingo. 2016
51 Wikipedia. 2017
52 "Near the tributary streams near the seacoast, are found large quantities of mahogany. Dominican mahogany is said to be excelled by none as to color, quality, and adaptability to fine furniture and cabinet work. Less of this wood is now secured than formerly. Considerable quantity of logwood was previously obtained also, but the supply today is practically exhausted. A fact worthy of note is the effort that is being made to produce a second growth of mahogany. Every farm, both large and small, within the area is protecting in hopes they will bring a profit to their owners" (Durland, 1922).
53 Wielgus, J 2010
54 Wielgus et al 2010; Kis 13b, KI 1, KI 14
55 MARN 2014
56 Riverside Technologies no date
57 http://www.diccionariomedioambiente.org/DiccionarioMedioAmbiente_en/en/cpo_contaminacion_bis.asp; El Dinero 2017
58 KI14.
59 Bautista, José, et al. s/f.
60 Wikipedia. Accessed 2018. https://en.wikipedia.org/wiki/Tourism_in_the_Dominican_Republic
61 Juergens et al 2011; MARN 2012; KII
62 MARN 2012
63 CIA 2017
64 Haitians have been immigrating to the DR looking for work since the early 2th century, when the U.S. controlled both Haiti and the DR and U.S. sugar companies in the DR needed field hands.
65 KI1
66 USAID no date
67 KI11, KI12, KI 13
68 IFAD 2018
69 U.S. State Department. 2017
70 GIZ 2017
71 K3; KI26
72 KI15
73 KI14
74 KI18
75 Ovalles, Pablo U. 2011
76 Lea 2017; K14
77 De La Cruz, O. 2015
78 Mejia, O 2009
79 KI 27
80 De la Cruz, O. 2015
81 Nasda 2017

82 KI23a
83 KI 14, Wielgus,2010
84 KI23
85 USAID. 2017a
86 Kernan, Bruce et al. 2016
87 Riverside Technologies no date
88 MARN 2012
89 MARN 2012
90 Hoegh-Guldberg 2017
91 Hoegh-Guldberg 2017
92 Tanner, V. et al. 1990
93 KI8; MARN 2014
94 MARN 2014, 2012, KI 14, KI15
95 CNCCMDL 2011
96 PLENITUD. 2014
97 GIZ 2017
98 MARN 2014"…land use plans are important to regulate the location and potential impacts of large investments…a national plan for land and marine use is needed in order to avoid conflicts between NRM and the tourist, fishing, mining, agriculture, energy sectors". Several other KIs98 agreed with the Mayor of Jarabacoa that "The municipal government's land use planning…is key to sound investments.98 Unclear division of responsibility for planning and enforcing land use regulation between MARN, the Ministry of Economy and municipalities and limited technical capacity and equipment has impeded effective land use planning and regulation.

Some progress was made at a meeting the GIZ organized two years ago between these three institutions (KI8). Pilot projects have done land use planning in four municipalities, including Las Terrenas and Santo Domingo (KI8). A GEF project is going to make land use maps in 10 municipalities and do pThe strategy for controlling invasive plants and animals and for fire prevention and control might or might not be implemented, for example, depending on the decisions and interests of MARN's top leadershiplanning in three of these municipalities (KI8).
98 Law 64-00 includes regulations concerning payment for ecosystem services, forest land tenure, forestry industry, forest NRM, research and management. The objectives of the law are to:

- *Promote and regulate the protection and sustainable use of forest resources;*
- *Provide rules that allow the incorporation of civil society into the development, management and NRM of forest resources;*
- *Ensure the effective management, NRM and sustainable development of existing forests and forest recovery in areas currently devoid of vegetation;*
- *Promote the restoration and development of forest lands suitable to fulfill the function of soil, water and biodiversity NRM*

Stimulate rural development through the generation of employment.

99 Law 64-00 includes regulations concerning payment for ecosystem services, forest land tenure, forestry industry, forest NRM, research and management. The objectives of the law are to:

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- *Promote the restoration and development of forest lands suitable to fulfill the function of soil, water and biodiversity NRM*
- *Stimulate rural development through the generation of employment.*

100 KI3 The mayor of Jarabacoa noted the difficulties municipalities face in enforcing NRM regulations and the consequences if they do not:

> *"sometimes illegal things are approved through influences…rather than by according to established procedures…Until we have a regime of consequences we cannot hope for much to happen…If we do not establish order now, tomorrow agriculture, housing and the environment will all collapse. Puerto Plata grew so fast in the 1950's that it collapsed. The same thing could happen here. That's why I wanted to be mayor."* …" Before nobody came to the municipality to ask for permissions to construct. We put up Work Stopped" signs…and levied fines up to a million pesos…and they started to come for permissions"

101Riverside Technologies, no date
102 USAID. No date
103 Guzman Ariza 2017
104 It has many vice-ministries and departments, including Forest Resources, Coastal Marine Resources, Environmental Management, Planning and Development, Environmental and Natural Resource Information, Environmental Education and Training, and Social Participation, International Agreements and Treaties and a Program for Prevention and Control of Forest Fires and the Control of Invasive Exotic Species.
105 SENAP 2017, PGS 2017

106 MARN 2014, "We have seasons and prohibited species. Everything has its regulations. The problem is the operative part. There is lack of equipment such as a motor for a boat. There is no office for MARN in Miches, only a guardhouse at the protected area."
107 KI 13
108 MARN has a problem of being over-centralized in its budget and too decentralized in decision making. For example, it has not been able to implement a system for tracking forest tree plantations because the central office of MARN cannot instruct the provincial offices to adopt this system. Yet the provincial offices do not receive budgets that permit them to operate efficiently (KI17a). According to one KI, the "administrative chaos" and general difficulty of accomplishing much in MARN has worn out many of its staff since they think nothing will ever improve (KI17a). Kis in MARN noted this problem of centralization vs decentralization affects the reforestation program: "MARN has 50 tree nurseries that are controlled centrally and the provincial directors want to control them". Another example, "We have software to record where environmental problems have occurred but the provincial directors do not register the problems in the system (KI22a). The idea is to prepare a report where the Vice Mininstries indicate the data they require from the provincial offices and all the data can be seen in one place (KI22a).
109 Berigüete, R. 2016
110 In Miches, for example, the president of a fishing cooperative, the head of CODEPESCA and the local MARN official agreed that enforcing fishing regulations, which is a joint responsibility of these institutions, are not enforced because none of them actually takes on that responsibility (KI10, KI 11, KI 12). At the national level, MARN and CODEPESCA have different objectives and policies, so they coordinate and collaborate with difficulty: for example, MARN found it needed to ban unilaterally fishing for parrot fish when the data indicated that almost all the fishing in the DR is for parrot fish (KI23a). Similar inconsistencies in policies and laws make coordination and collaboration between MARN and the Navy and MARN and ANAMAR (KI23a).
111 One KI, for example, gave two examples of seeing a MARN official refuse to enforce regulations governing the visit of tourist to beaches. The administrator of La Gina Wildlife Sanctuary explained that if he were to try to enforce regulations that prohibit fishing in the La Gina Lagoon, the MARN guard house would probably be burned down by the fishermen (KI 13).
112 Holmes, G. (2015) found that the "extraordinary levels of protection" afforded to biodiversity in the DR "have been achieved by a small network of well-connected individuals, who have been able to shape NRM as they like, while limiting the involvement by the large international NRM NGOs112…" although accepting their methods and models, such as developing close ties to large corporation, for achieving NRM through protected area systems such as SINAP. According to Holmes (2010) in the DR there has been a "…vibrant, powerful national NRM elite that has had "privileged access to political power and the ability to shape public policy discourses on the environment". Dominican NRM NGOs "have rivalries, competition and alliances" … and their links to political parties influence their access to financial and political resources.
113 In San Pedro de Macois, for example, a KI said that Consejo de Operaciones de Emergencies (COE) plays an important role in preparing for an d responding to emergencies such as floods. In Restauracion a KI mentioned the important role that networks of women's organizations play in reforestation and distribution and replication of improved seeds (KI5).
114 PRONATURA 2001; ONEPAGE EPP; De Jesús 2009; ECORED 2017
115 ECORED 2017, KI 9c
116 KI1
117 KI16
118 There was a National Forestry School in Jarabacoa until 2011, when the Minister of MARN changed it into the National Environmental School. By 2013, a shortage of forestry technicians became evident, especially for control of forest fires. In 2015 the school was reorganized so that it now has two-year programs in environmental management and forestry technology. The school does not teach about marine or coastal environments.
119 KI3
120 KI14, KI15
121 KI20a
122 KI13
123 Several KIs, however, noted that many Dominicans do not comprehend that they live on a relatively small island. One KI emphasized "the importance of seeing ourselves as living on an island. We think we live kilometers from the ocean and only notice the sea when there is a wind" (KI23).

Similarly, another KI said, "There is a perception that our natural resources will never run out…and the strongest economic sectors dominate economic planning and policies…most people do not understand that we are a densely populated island nation that has limited natural resources"123). At the local level, unawareness of NRM's benefits has caused destruction of tree plantations. 123
124 KI23; A KI in MARN said
"We've worked with the Ministry of Tourism to make them aware that the model of massive tourism cannot continue with harming the resource upon which tourism depends but there is still an official campaign to bring 2 million more tourists to the DR by 2020. The government is betting on massive tourism to make the economy grow. There is a part of the tourism industry that believes in massive tourism and thinks only of quick profits and another part that realizes the policy of massive tourism should not continue"
125 KI24 She emphasized that the principal role of her foundation Pro Gas has been to raise environmental awareness (KI24). In our own textbooks there is no mention of the DER environment. We made a study in Valle Nuevo and found that out of 300 students only three new anything about the Valle Nuevo National Park (KI24).
126 IICA 2017

127 In 2015 it measured 122 of the planned 424 sample plots and expects to complete the INF in 2018.
128 KI22
129 Díaz Beard, Ramón A.. 2016.
130 KI was Encargado de Manejo Forestal (PMF), el Sr. Francisco Cuevas
131 Rodriguez 2004
132 KI22a, GFFD 2017,KI5
133 Lamb, Bruce. 1966.
134 MARN 2016
135 The national where fires commoly occur are: Jose del Carment Ramirez, Valle Nuevo, Sierra de Bahoruco, Armando Bermudez, Los Haitises, Sierra de Neyba and Sierra Martin Garcia. Outside of natioanl Parks fires occur mostly commonly in Restauracion, Jarabacoa, Constanza San Jose de las Matas, Bonao, Elias Pina, Padre Las Casaas, San Juan de la Maguana, la Vega and El Cercado.
136 For example, droughts in 2014 and early 2015, together with an infestation of bark beetles, created conditions for large forest fires in 2015, especially in the Valle Nueva National Park (Berigüete, R. 2016; KI 22a). High rainfall since then had stimulated understory growth. Thus when droughts occur again large-scale fires would be likely (KI22a).
137 KI22
138 Atangana et al 2014
139 D.H. 2010
140 Ceara 1986
141 Valerio et al, 2017, REDDOM 2017
142 Ceara 1986
143 Café Santo Domingo. Accessed March 21, 2018
144 Berian 2013
145 Greenberg 2018
146 Greenberg 2018
147 Cacao Forest 2016
148 REDDOM 2017
149 United States occupying forces created the first protected areas in the DR to protect the watersheds that provided irrigation water to tobacco and sugar producing valleys. The dictator Trujillo expanded these reserves and converted them into national parks as a means to expropriate land and timber. Joaquin Balaguer, the subsequent dictator, created 36 additional protected areas, using ruthless methods to dispose peasant farmers and charcoal makers (Homes, G. 2010). New protected areas were created in the 19070's (3), 1980's (7), and in the 1990s (40). In 2009, based on an analysis of what ecoregions were not in the SINAP, 24 new protected areas were created, bringing the total number to 123 and the total area to 60,067 km2, or about 15% of the DR terrestrial area (Mateo, J. 2015).
150 "A biosphere reserve is intended to fulfill three complementary conditions: a NRM function, to preserve genetic resources, species, ecosystems and landscapes; a development function, to foster sustainable economic and human development; and a logistic function, to support demonstration projects, environmental education, training, research, and monitoring related to local, national and global issues of NRM and sustainable development" (Posner, S. & J. Toussaint. 2016)
151 KI28
152 Arecoa.com. 2016. The most visited areas are Los Haitises, Parque del Este, Salto del Limón, Salto de Damaguaja, Isla Catalina, Santuario Marinos Banco de Plata y la Navidad, Estero Hondo, Parque Jaragua and Cueva de Los Tres Ojos, Valle Nuevo, Reserva Antropológica Cuevas de Borbón o del Pomier, Saltos de Jima, La Gran Laguna o Perucho, Río Cumayasa, Cueva Las Maravillas y Saltos de Jimenoa.
153 MARN 2016
154 Sobre este tema, añado a lo comentado por Abel, el siguiente comentario, confirmado por los señores Sésar Rodríguez, Director Ejecutivo del Consorcio Ambiental Dominicano (CAD), que patrocina y administra la Reserva Privada El Zorzal, y por Jonathan Deláncer, Director del Programa Turismo y Biodiversidad del MARN, y anterior Director del Programa de Reingeniería de Áreas Protegidas, que las áreas protegidas co-manejadas muestran una mejor condición de conservación, aspecto que no es solamente una percepción de las ONGs y del propio MARN, sino que también se evidencia fisicamente en las propias áreas. Sin embargo, no existe ningún estudio que analice de manera exhaustiva esta situación
155 Data provided by the area's current administrador, Roberto Gómez
156 World Bank 2017
157 KI 23
158 (Ver Nota: Jonathan Delancer y Rita Sellares)
159 Spalding et al 2016
160 Kernan et al 2012. There five projects were: Living Museums in the Sea; Sustainable Fisheries in Miches; Development of Sustainable Tourism Alliance; Participating Agency Program Agreement (PAPA); and Environmental Protection Program.