



Proyecto Manejo Integrado "De la Cuenca al Arrecife" de la Ecorregión del Arrecife Mesoamericano -MAR2R-

Regional Strategy for Mangrove Management, Conservation, Restoration and Monitoring in the Mesoamerican Reef 2020-2025



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Development and Integration Chapter 2:

Mangrove Situation in the MAR Region



Proyecto Manejo Integrado "De la Cuenca al Arrecife: de la Ecorregión del Arrecife Mesoamericano -MAR2R-

Preamble

The product of the Regional Strategy for Mangrove Management, Conservation, Restoration, and Monitoring in the Mesoamerican Reef is the outcome of experts and stakeholders working together to promote the mangrove management and conservation in the Mesoamerican Reef ecoregion.

The generous entities such as the Mesoamerican Reef Fund (MAR Fund), the Embassy of Germany in Guatemala, the Smithsonian Institution, and the GEF project Integrated Ridge-to-Reef Management of the Mesoamerican Reef Ecoregion share an interest in good resource management of the ecoregion and are implementing actions at different levels. With their support, a workshop was organized in which 72 experts from the four countries that make up the MAR achieved a groundbreaking goal: a regional strategy for the conservation of the mangrove ecosystem. This effort brought together the ideas, knowledge, and experience of experts in the region, which have been included in a guiding document to be used as a baseline to promote collective actions at regional and national levels, according to interests, in order to coordinate roles, competencies, and potential spaces for collaboration.

The strategy is the first step to building an action plan that enables countries of the MAR to make progress in their own strategies and plans. This valuable input will be widely disseminated as the basis to find comprehensive solutions to conserve this critical ecosystem for biological diversity, human life, and water quality, among others. An important step is reflected among the strategic lines of this document, which is engaging key stakeholders and sectors to optimize resources and achieve collective results that will lead to the sustainability of the ecosystem, including human life.

Regarding the political and institutional aspects, the role and leadership of governments are fundamental. To this end, the first regional task will be precisely to approach the Ministry of Environment of Belize, Guatemala, and Honduras, through the Executive Secretariat of the CCAD, and the Mexican authorities through the SEMARNAT and CONANP. They will be required to support the management processes and all resource mobilization to implement the strategy and its actions. Other interested collaborators, such as research centers and academia, associations of civil society, organizations of indigenous peoples and local communities, the private sector, and others, will also be approached. The strategy seeks to be a guide in draw together committed entities in search of timely solutions to conserve, restore, and monitor this important ecosystem.

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Initials and Acronyms

CAC	Consejo Agropecuario Centroamericano <i>(Central American Farming Council)</i>
CATHALAC	Centro del Agua del Trópico Húmedo para América Latina y el Caribe <i>(Center for Water for the Humid Tropics for Latin America and the Caribbean)</i>
CBD	United Nations Convention on Biological Biodiversity
CC	Climate Change
CCAD	Comisión Centroamericana de Ambiente y Desarrollo <i>(Central American Commission for Environment and Development)</i>
CECC	Coordinación Educativa y Cultural Centroamericana <i>(Central American Education and Cultural Coordination)</i>
CEPREDENAC	Centro de Coordinación para la Prevención de los Desastres Naturales en América Central <i>(Coordination Center for the Prevention of Natural Disasters in Central America)</i>
COMISCA	Consejo de Ministros de Salud de Centroamérica y República Dominicana <i>(Council of Ministers of Health of Central America and the Dominican Republic)</i>
COMMCA	Consejo de Ministras de la Mujer de Centroamérica y República Dominicana <i>(Council of Female Ministers of Women of Central America and the Dominican Republic)</i>
CONPAH	Confederación de Pueblos Autóctonos de Honduras <i>(Confederation of Autochthonous Peoples of Honduras)</i>
CZMAI	Belize Coastal Zone Management Authority and Institute
ENOS	El Niño-Southern Oscillation
FAO	Food and Agriculture Organization of the United Nations
GEF	Global Environmental Facility
IUCN	International Union for Conservation of Nature
MAR	Mesoamerican Reef System
MAR Fund	Mesoamerican Reef Fund
MAR2R	Project “Integrated Ridge-to-Reef Management of the Mesoamerican Reef Ecoregion” (MAR2R/CCAD/WWF)
MARN	Ministerio de Ambiente y Recursos Naturales – Guatemala <i>(Ministry of Environment and Natural Resources – Guatemala)</i>
MiAmbiente+	Secretaría de Energía, Recursos Naturales, Ambiente y Minas de Honduras <i>(Secretariat of Energy, Natural Resources, Environment, and Mines of Honduras)</i>
NDC	Nationally Determined Contributions

Initials and Acronyms

OPEV	Oficina Presidencial de Economía Verde <i>(Presidential Office of Green Economy)</i>
OSPESCA	Organización del Sector Pesquero y Acuícola del Istmo Centroamericano <i>(Organization of the Fisheries and Aquaculture Sector of the Central American Isthmus)</i>
REP	Rehabilitación de Ecosistemas y Paisajes <i>(Ecosystem and Landscape Rehabilitation)</i>
SDG	Sustainable Development Goals
SE-CCAD	Secretaría Ejecutiva de la Comisión Centroamericana de Ambiente y Desarrollo <i>(Executive Secretariat of the Central American Commission for Environment and Development)</i>
SEMARNAT	Secretaría de Ambiente y Recursos Naturales – México <i>(Secretariat of Environment and Natural Resources – Mexico)</i>
SER	Sociedad Ecológica de Restauración
SICA	<i>(Ecological Society for Restoration)</i> Sistema de la Integración Centroamericana
SI	Smithsonian Institution
SITCA	Secretaría de Integración Turística Centroamericana <i>(Central American Secretariat of Tourism Integration)</i>
UNFCC	United Nations Framework Convention on Climate Change
WWF	World Wildlife Fund





1. Introduction

The four countries comprising the Mesoamerican Reef System (MAR ecoregion), which include Mexico, Belize, Guatemala, and Honduras, have taken measures in recent years to conserve mangrove ecosystems through a legislation aimed at its preservation and a sustainable development by strengthening government agencies, declaring protected areas, and extended conservation work with a basin approach. Different stakeholders and sectors have also developed actions and interventions to improve the interinstitutional coordination and partnerships in order to optimize resources and to make progress in mitigating threats to ecosystems, including mangroves. Despite these efforts, the region continues losing mangrove cover. According to Canty *et al.*, (2018), the MAR region has lost over 110,000 hectares in the last 20 years..

After the Tulum Declaration in 1997, the MAR region has become a global leader in adaptative management and active implementation of management actions showing results at a regional scale. Regional strategies that address the threat of climate change, conservation of biological diversity, illegal trade of species, desertification, among others, already exist. However, the region lacks a unified strategy for conservation, restoration, monitoring, and sustainable use of mangrove resources, which is of critical importance in order to guide actions aimed at ensuring the health of mangrove ecosystems and the continuity of environmental goods and services that they provide.

Based on the above, the Mesoamerican Reef Fund (MAR Fund) and the Smithsonian Institution, with the support of the Embassy of Germany in Guatemala and the project “Integrated Ridge-to-Reef Management of the Mesoamerican Reef Ecoregion” (MAR2R), started the process for the participatory design of a Regional Strategy for Mangrove Management, Conservation, Restoration, and Monitoring (the strategy) in the MAR.

As input to the preparation process of this strategy, analysis and data systematization were conducted on the current situation of mangroves in the MAR ecoregion. In addition, with the goal of identifying threats and strategies for mangrove management, conservation, restoration, and monitoring in the MAR, in September 2019, a regional workshop was held with the attendance of 72 key stakeholders who represented 44 government agencies, community organizations, indigenous peoples and afro-Honduran peoples, and non-governmental organizations of the region.

As a result of the participatory process, the strategy has come up with a comprehensive perspective for the implementation of long-term actions, with a ridge-to-reef approach and strategic objectives for five years, six strategic lines, 19 strategies, and 54 actions, with which to address and mitigate the main threats that affect the MAR mangrove cover and the ecosystems' health.

This strategy is a dynamic instrument agreed upon between multiple stakeholders and sectors, which will contribute to the coordination of management actions, conservation, restoration, and monitoring of the mangrove ecosystem to reduce its vulnerability and that of coastal communities affected by climate change in the MAR ecoregion, engaging the support of those stakeholders involved in the management of such an important ecosystem.

Recommendations are presented at the end of this document to generate favorable conditions for the governance and structure that enable a smoother process for the implementation of the strategy and its sustainability actions.





2. Reference Framework: Mangrove situation in the Mesoamerican Reef ecoregion

2.1. The Mesoamerican Reef ecoregion

The Mesoamerican Reef ecoregion (MAR ecoregion) is the most extensive cross-border coral reef system in the world and the largest barrier reef in the Atlantic Ocean. The system stretches more than 1,000 km along the coasts of four countries (Mexico, Belize, Guatemala, and Honduras). It constitutes a vital habitat for biodiversity protection, including marine turtles, more than 60 types of corals, and over 500 fish species, many of which are endangered.

The MAR is part of the Great Caribbean ecoregion, containing seven coastal ecosystems that have been identified in the Caribbean, according to Sullivan and Bustamante (1999). Of these, four coastal ecosystems were considered a priority, such as (1) systems dominated by reefs, (2) systems dominated by mangroves, (3) systems dominated by seagrass, and (4) mixed systems with reefs-mangroves and seagrass.

Altogether, the MAR ecoregion covers approximately 464 mil km², including 192 mil km² of basins and 272 km² of various marine ecosystems. The topography of the region has vast karstic plains with warm climates and slight surface runoff, particularly in the Yucatan peninsula and the northern region of Belize. In the south, on the other hand, between south Belize, Guatemala, and Honduras, the MAR is dominated by mountain ranges, located very near to the coastal region, producing more rain, primarily associated to the trade winds, and with significant water supply from rivers and coastal lagoons.

Although mangroves contribute to the protection of coastal communities from the adverse effects of climate change, the Caribbean coasts of Mexico, Belize, Guatemala, and Honduras –according to the United Nations Framework Convention on Climate Change (UNFCCC)– are located in one of the most vulnerable regions.

Marine and coastal resources of the MAR ecoregion provide livelihoods to key economic sectors (fisheries and tourism) and more than two million people in the region. For example, it is known that thousands of tourists visit the region every year, allured by the opportunity of diving in secluded locations, swimming with possibly the highest global concentration of whale sharks, and also relaxing on spectacular beaches.

Maritime transportation is another activity economically significant in the MAR ecoregion. The four countries that comprise the region have important ports in the area, and, at least in two cases, these ports are the only way that the Caribbean can commercially communicate with the world. This economic activity is also connected to the ecosystemic service of protecting the coasts provided by mangrove ecosystems.

Regarding the financial contribution from the MAR ecoregion, it is estimated that only in Belize, the MAR generates between USD 395 and USD 559 million in goods and services (Healthy Reefs Initiative, 2010). According to UNEP, ISU, ICRI, and Trucost (2018), the financial benefits of key sectors –tourism, fisheries, and coastal development– of the Mesoamerican Reef for the four countries amounted to approximately USD 6.2 million in 2017, mainly from the tourism sector, equivalent to 70% of the total; that is, approximately USD 4.4 billion. The financial return approximately amounts to USD 4.2 billion, with indirect benefits equal to USD 1.9 billion. Ironically, these activities pose a threat to the same resource on which they depend.

The role that the mangrove ecosystem plays in this economy, highly dependent on the coastal region and its activities, is further explained in this section. Work will be carried out to establish the current role of mangroves in obtaining, directly and indirectly, many of these benefits (fisheries, tourism, others), as well as the risk of losing them due to poor management and other human-induced threats, aggravated by the impact of climate change.

Learning about mangroves in the MAR ecoregion is the first step to better understand their value for biodiversity conservation and contribute to their economic benefits. It is essential to also understand their needs and requirements for their establishment, the implications for their health, and their sensitivity to threats, particularly to the effects of climate change.

2.2. What are mangroves? Their importance to the Mesoamerican Reef ecoregion

2.2.1. General characteristics of mangroves

Mangroves are complex ecological systems. They occur as tropical coastal forests and cover approximately 152,000 km² of the global surface (Spalding *et al.*, 2010).

In terms of evolution, mangroves had its origin and dissemination during the Mesozoic period, approximately 175 million years ago, during Pangea, in the shores of Tetis, just when the continents divided.

As a result, mangroves near the center of origin, in the region known today as Asia-Pacific and part of the Paleotropics (India, Southeast Asia, and Malaysia), are much more diverse than Neotropical mangroves (Chapman, 1970 and Walsh, 1974). These ecosystems in America are limited to five or six genera, according to different authors. The lowest diversity occurs in the Caribbean, dominated by four mangrove genera: *Rhizophora*, *Avicennia*, *Laguncularia*, and *Pelliciera*, and two mangrove genera associated with *Conocarpus* and *Mora* (Table 1).

Discrepancies in the bibliography regarding the diversity of mangrove species and genera are due in part to the controversial taxonomy of various genera, and especially to the different criteria in determining the inner edge in which a transition area is found, where halophilic species coexist with species of brackish environments or freshwater. This ecotone is the result of a salinity gradient and tidal flooding that flows in response to seasonal fluctuations and the intensity of rains, wind, river flow, and tidal range (Brinson *et al.*, 1974).

The trees typical of mangroves, which establish to a large extent the structure of the ecosystem and physical distribution, are characterized by having a series of adaptations that allows them to successfully colonize transition areas between marine and freshwater ecosystems, as well as in regions with very unstable soil. The most characteristic adaptations of mangroves are:

- 1) Vivipary reproduction with propagules. That is, germinated seeds separated from the tree that produces them;
- 2) Mechanisms in leaves to reduce evapotranspiration and water loss;
- 3) Physiological mechanisms for salt excretion;
- 4) Mechanisms to increase or complement respiration in roots;
- 5) Root systems adapted to unstable soils, and
- 6) Most genera are able to reproduce throughout the year, but they share the ability to bloom profusely during the dry season.

Table 1. *Mangrove genera commonly found in Mesoamerica.*

Genus	Local Name
<i>Avicennia</i>	Black mangrove or ixtatén
<i>Conocarpus</i>	Green buttonwood
<i>Laguncularia</i>	White mangrove
<i>Rhizophora</i>	Red mangrove
<i>Pelliciera</i>	Tea mangrove
<i>Mora</i>	Alcornoque or mora

Source: Own preparation based on Windevoxhel (2010) and Jiménez (1994).

Tree mangrove species are highly plastic. They are quite adaptable to a wide range of critical factors that determine their presence. This adaptability allows them to settle in very diverse conditions, thus, be part of an ecosystem that includes multiple ecotones between freshwater and marine ecosystems, which is crucial for keeping an extremely high biological diversity. The ability of mangroves to stay in an optimal development state depends on several factors, including salinity, soil, and nutrients (Table 2).

Table 2. Key factors for optimal development of mangroves in the Neotropics.

Factor	The optimal range for mangrove development
Salinity	0 to 45 ppm. It can be freshwater, brackish, and marine (facultative halophiles)
Light	Require abundant light (obligatory heliophiles)
Temperature	59 to 104 °F, tropical and subtropical
Coastal Physiography	Sedimentary, fluviomarine plains, river and estuary deltas
Soil types	Allocthonous and autochthonous Reduced soils and typically rich in nutrients
Tides	Intertidal zone
Nutrients	Retains nutrients and exports organic matter
Input of freshwater	Maintains appropriate conditions and thus, its productivity
Selective predation ¹	It may be a factor in specific locations and specific conditions

Source: Own preparation based on Windevoxhel (2010).

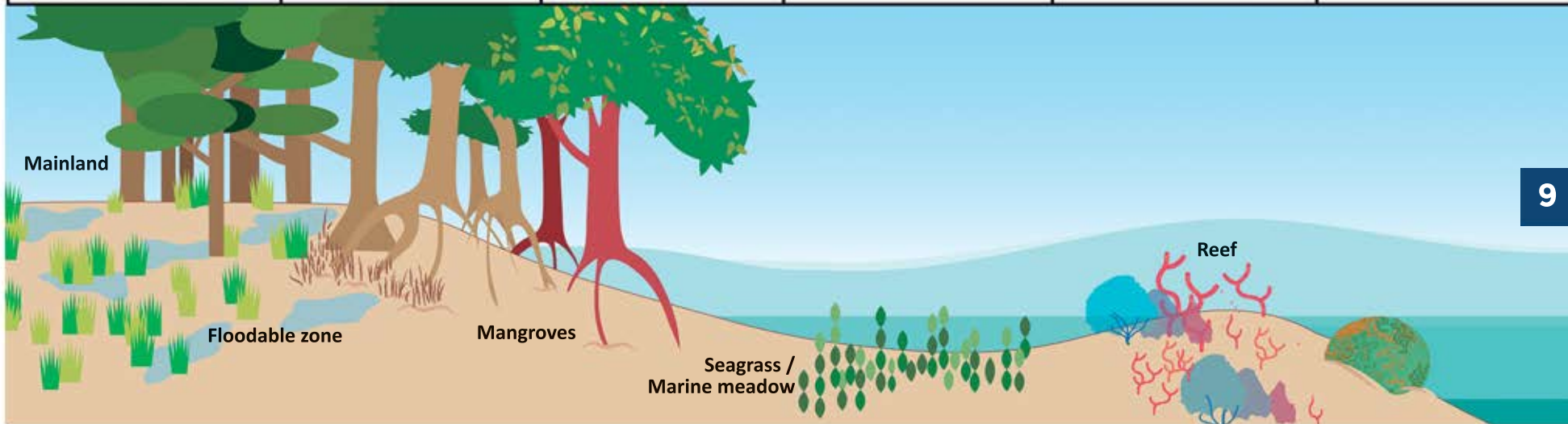
2.3. Characteristics of Caribbean mangroves and their functional relationships

Caribbean mangroves may be characterized in different ways based on their geographic location. Those located in continental coastal areas or large islands, for example, are strongly related to land-based processes and wide basins with greater runoff. Caye mangroves or in small islands are mostly dominated by their internal nutrient activity and the effects of tides and waves, as well as by their relationships with other associated ecosystems such as coral reefs or seagrass meadows.

One particular characteristic of mangroves is their close functional relationship with other coastal and land ecosystems and with marine ecosystems. Figure 1 shows the functional relationships of ecosystems in coastal wetlands. It is necessary to recall that this is a conceptual model and that, in particular cases, the location of some ecosystems might change or even some of their functional relationships. Yet it is a very close representation of what can be found in the Caribbean, both on islands and mainland. Mangroves of small cayes or islets with simpler dynamics may be an exception.

¹ Predation refers to a biological interaction between two organisms, a predator and prey, in which one of them becomes the food of the other. They prey may be entirely or partially consumed by the predator.

Functional relationships between ecosystems linked to coastal wetlands					
Swamp Grassland	Swamp Forests	Mangroves	Marine Meadows	Coral Reefs	Sandy Beaches
Sediment retention Nutrient absorption Slow freshwater discharge Export of fish and invertebrate larvae Contribution to infiltration Breeding habitat (birds, reptiles, etc.) Habitat for biodiversity	Sediment retention Nutrient absorption Slow freshwater discharge Export of fish and invertebrate larvae Contribution to infiltration Breeding habitat Wind abatement Habitat for biodiversity	Sediment retention Nutrient absorption Slow freshwater discharge Export of fish and invertebrate larvae Contribution to infiltration Wind and wave abatement Breeding habitat Biomass exporter Habitat for biodiversity	Sediment retention Nutrient absorption Decrease of marine currents Export of fish and invertebrate larvae Wave buffer Habitat for fish and invertebrates Breeding habitat Biomass exporter Habitat for biodiversity	Wave buffer Nutrient absorption Decrease of marine currents Export of fish and invertebrate larvae Key habitat for fish and invertebrates Breeding habitat Habitat for biodiversity Biomass exporter	Abatement of coastal winds Local absorption of nutrients Decrease of marine currents Wave buffer Breeding habitat Habitat for biodiversity



Environmental Services					
Swamp Grassland	Swamp Forests	Mangroves	Marine Meadows	Coral Reefs	Sandy Beaches
Freshwater recharge Retention of suspended sediments Habitat for biodiversity Carbon sequestration	Storm buffer Freshwater recharge Freshwater retention Digestion of organic matter Sediment retention Habitat for biodiversity Carbon sequestration Retention of pollutants	Storm buffer Freshwater recharge Freshwater retention Digestion of organic matter Sediment retention Erosion mitigation Habitat for biodiversity Carbon sequestration Retention of pollutants	Storm buffer Digestion of organic matter Sediment retention Habitat for biodiversity Carbon sequestration Retention of pollutants	Storm buffer Digestion of organic matter Sediment retention Habitat for biodiversity	Storm buffer Habitat for biodiversity

Figure 1. Functional relationships of the ecosystems typically found in coastal wetlands of the Caribbean. Source: Nestor Windevoxhel.



Ecosystems actively interact among themselves, often mixing and providing areas in which components are combined. The conducting element of the connection is water, and, usually, water determines how functional relationships work. Common factors among all floodable terrestrial ecosystems dominated by freshwater are their ability of sediment retention, increased water residence time, and their contribution to infiltration. Generally, all tree systems play an important role by reducing and moderating microclimates and reducing or dissipating wind. It is important to note that these are mainly two-way relationships between adjacent ecosystems.

Marine and coastal-dominated ecosystems have functions associated with the dissipation of energy, waves, and marine currents. Also, their structures keep coasts protected and with low energy. Functional relationships in ecosystems include serving as a habitat for a number of species. Frequently, species from one ecosystem move to and reproduce in another, or spend stages of their life cycle protected in one of the ecosystems adjacent to a coastal wetland.

These functional relationships are essential because the protection of mangrove requires them to remain for a long time. Additionally, these functional relationships determine most of the ecosystemic services that we get from mangroves and their adjacent ecosystems. For example, the effect of wind or current and wave dissipation are determinants as they contribute to the protection against storms.

The increase in time of water residence and concentration in mangroves has two effects: the first one serves as a water reservoir and prevents flash or violent floods; the second one collects sediments and nutrients. Also, it contributes to the freshwater retention and infiltration feeding groundwater layers and preventing coastal saline intrusion. Finally, the accumulation of nutrients and sediments allows exporting organic matter that is processed by multiple species as food, contributing to the food chain and providing for the development of organisms that are important to fisheries for direct consumption.

2.3.1. Value of mangroves and their goods and services

Wetlands, in general, and mangroves are characterized particularly for water retention and high accumulation of associated biodiversity. As is usual, species belonging to marine and coastal ecosystems are found in ecotones. These species use the richness and productivity of mangroves during some stages of their life cycle. Thus, mangroves are frequently more diverse than their neighboring ecosystems. Although there are few structural tree species in mangroves, there are many species that use mangroves as a substrate on and off the water, some of them remain permanently and others temporarily.

Paradoxically, wetlands have been considered wasted and useless lands for agriculture, cattle farming, or urban development, for which initiatives have been devised to substitute them for “more productive” activities or rather traditional (Dugan, 1992).

In the MAR ecoregion, goods for direct consumption (Table 3) are significantly important to human communities that are associated with or live within mangrove forests. These communities usually live on a subsistence economy strongly based on goods directly extracted from mangroves, either for their consumption or to sell generally in local markets.

Mangrove ecological functions are strongly related to the services we obtain from them (Windevoxhel, 1992), which can be valued with direct market methods or through indirect methodologies. Often, these valuations may be based on opportunity costs, establishing comparisons justifiable in market methods that may replace the corresponding ecological service (Barbier *et al.*, 1996). On the other hand, there are values related to future (potential) uses and those that Barbier *et al.*, (1996) have referred to as “non-use” values, which represent aesthetic or spiritual values.

There have been many proposals for grouping goods and services under different methodologies, but in the end, all use more or less the same tools, which are applied in similar ways. During the last decades, a broader acknowledgment of the value of wetlands and mangroves, particularly in the economic context, has shown and focused on different types of goods and services offered by mangrove systems. In general, goods and services depend on the ecological functions of ecosystems and their corresponding relationships (Figure 1, Table 3).

Table 3. *Goods, services, and attributes typically valued in mangroves.*

Goods	Services	Attributes
<ul style="list-style-type: none"> • Timber products: <ul style="list-style-type: none"> - Firewood - Wood - Charcoal - Bark • Ornamentals • Fish, mollusks, and shellfish <ul style="list-style-type: none"> - Industrial - Artisanal • Usable species • Mineral materials • Honey • Salt • Other materials 	<ul style="list-style-type: none"> • Mantenimiento del nivel freático • Water quality maintenance • Flood and storm protection • Nutrient retention • Sediment retention • Water transport • Recreation opportunities • Research opportunities • Erosion control • Contribution to external economies • Carbon sequestration • Breeding grounds for aquatic organisms 	<ul style="list-style-type: none"> • Cultural and spiritual values • Ethic or preservation value • Option values

Source: Own preparation based on Windevoxhel, (1994).

According to Table 3, below is a list of the main functions of mangroves in coastal areas:

- 1) Storm and flood buffer,
- 2) Freshwater retention,
- 3) Sediment retention (nutrients and pollutants),
- 4) Freshwater recharge (infiltration),
- 5) Digestion of organic matter,
- 6) Mitigation of coastal erosion or coastal stabilization,
- 7) Habitat for biodiversity (land, tree, and marine species),
- 8) Export of organic matter or support of external biomass (fisheries products and forest non-timber resources, among others) and
- 9) Others, depending on the classification.

Every day, ecosystemic goods and services include more complex levels of classification and division, (Windevoxhel, 1992), even attempting to value intangible services such as cultural and spiritual values of ecosystems. Mangroves are closely associated with cultural values and deities, particularly for fishermen, yet it is difficult to place a financial value on them. Other examples are option values or quasi-option values related to the value of products (goods or services) not estimated with the current technology but that could be relevant in the future, for example, drug precursors (Windevoxhel, 1992).

It is important to mention that regarding coastal wetlands, their economic benefit is usually determined as a whole, without considering the separate contribution from each ecosystem involved, such as the case of the coasts of Belize (UNEP, ISU, ICRI and Trucost, 2018), with reported benefits of USD 6.2 billion for 2017.

Howard *et al.*, (2014) report in the manual on how to measure organic carbon stocks sequestered in the soil of marine ecosystems, that seagrass meadows, marshes, and mangroves are the ecosystems with the highest capacity for sequestering carbon in the soil. Mangroves have an impressive carbon sequestration capability, at least 3 to 4 times greater than tropical or boreal forests (Figure 2).

Seagrass meadows and tidal marshes have higher sequestration capability in addition to having the least amount of organic carbon in living biomass, whereas mangroves have a high storage capability in soil as well as in living biomass. Thus, the sustainable management of mangroves and their conservation represent an important value in both short- and long-term mitigation of climate change, which can also be valued in order to trade in carbon markets.

According to Sanjurro and Whelsh (2005), mangroves had been frequently evaluated for their services and direct consumption goods, such as timber or non-timber products. However, this has changed in the last years. One of the most frequently evaluated services includes shoreline protection, where mangroves serve as shelter against hurricanes (Kabii and Bacon, 1977), as well as a protective barrier for gray infrastructure. Farber and Costanza (1987) reported nearly 30 years ago that a mile-wide reduction of coastal wetlands in Louisiana may increase the material damage caused by storms up to USD 5 million per year. However, mangroves are valued differently across the

world, reporting different ranges depending on the evaluated goods and services, as well as the quality and quantity of the available data.

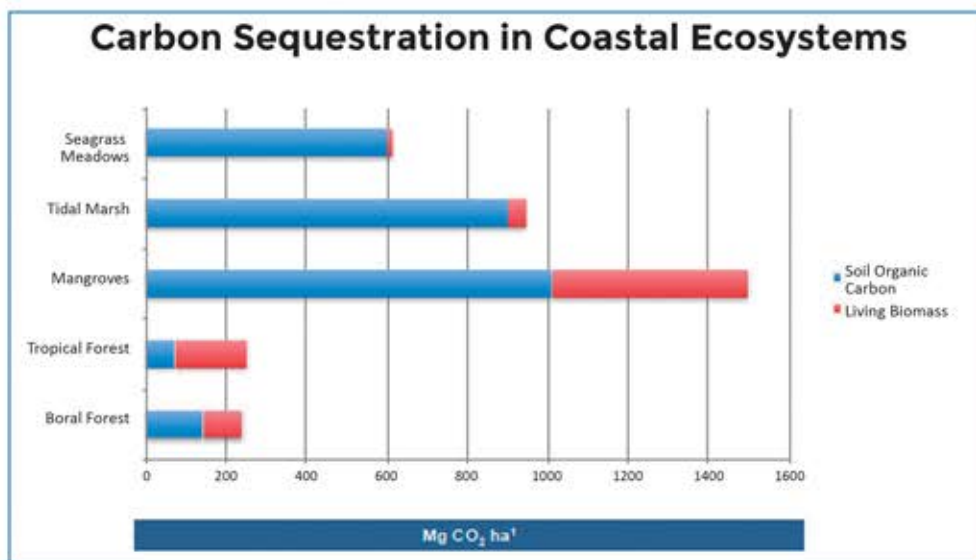


Figure 2. Carbon sequestration in the main coastal ecosystems of the Caribbean .
Source: Adapted from Howard *et al.*, (2014).

There are many estimates of the value of wetlands from total values or partial valuations of some of its ecological goods and services (Table 4). Considering the variation in the valuation of mangroves based on market values, the result presented by Costanza *et al.*, (1997) seems conservative.

Table 4. Estimate of the value of services from mangrove ecosystems in the world

Source	Region	Included ecosystemic services	Value (US\$/ha/year)
Costanza <i>et al.</i> , (1997)	Global	All services	9,900
Sathirathai y Barbier (2001)	Thailand	All services	27,264-35,921
Ronnback (1999)	Global	Fisheries	750-11,280
Windevoxhel (1994)	Nicaragua	Partial evaluation	659-1,260
Aburto-Oropeza <i>et al.</i> , (2008)	Mexico	Fin fish and blue crab fisheries	37,500

Source: Own preparation based on Aburto-Oropeza *et al.*, (2008).

In 2007, mangroves in the MAR stretched approximately 300,000 hectares, distributed in a great number of patches (Arrivillaga and Windevoxhel, 2008). When applying the value estimate per mangrove hectare per year of Costanza *et al.*, (1997) to the area of the MAR ecoregion, it would be equivalent to USD 2,970,000,000/year. Using the most recent estimate of mangrove cover reported by Canty *et al.*, (2018) of 239,176 hectares in the MAR, and supposing that the cover loss does not affect the mangrove functionality, the value is estimated in USD 2,367,842,400/year for all services. This means a drastic decrease of income from mangrove goods and services of approximately USD 602,157,600 per year, in a relatively short period of time.

Costanza *et al.*, (2014) estimated the value of mangroves in USD 33 trillion at a global scale in 1995, USD 46 trillion in 1997, and USD 165 trillion 12 years later, in 2011, taking into consideration different ecosystems and different environmental services. In their study, they also assessed the changes of values for the same ecosystems between 1997 and 2011. In the analysis, mangroves and salt marshes were aggregated, which adds complexity to the analysis of mangroves. Additionally, they assessed the changes in cover and changes in the estimated value of benefits per hectare.

The study shows that values for the mangrove-salt marsh system significantly increased in terms of benefits, from a global average value of USD 20,404/ha/year to USD 140,174/ha/year. That is, between 1997 and 2011, the value per hectare per year increased by USD 119,770 ha/year. During the same period, the authors established that the mangrove-salt marshes ecosystem was reduced from 165 million hectares to 128 million hectares, with a net loss of 37 million hectares and a financial value that varied from USD 2.3 trillion per year to USD 3.2 trillion per year.

These results evidence several important aspects to consider in developing a strategy for mangrove management, and that have been mentioned earlier:

- 1) The importance of being cautious with the results of valuations and recognize their scope and limitations;
- 2) Try to find results that are truly comparable to those of the region from the point of view of the ecosystems, as well as the goods and services to be valued;
- 3) In the case of mangroves-salt marshes, despite the losses in ecosystems, the improved or updated measuring methods show a net increase in the benefits we obtain from mangroves;
- 4) Many ecological services are considered public goods or shared resources, for which traditional markets are often not the best institutional frameworks to manage them. However, these services must be (and are being) valued, and we need to establish innovative arrangements with institutions in order to acknowledge these values.

2.4. Mangrove situation in the MAR ecoregion

The MAR region includes the four structural types of mangroves of the Caribbean (Lugo and Snedaker, 1974). Fringe mangroves stretch along the shoreline, while dwarf mangrove forests are strongly associated with lowlands in the northern part of the ecoregion, mainly in Quintana Roo, Mexico, and northern Belize. Riverine mangroves are associated with coastal lagoons and river mouths, and island mangroves are associated with small cayes and dry coastal areas, sometimes near dwarf mangroves (Arrivillaga and Windevoxhel, 2008). Mangrove forests provide a rich habitat due to the great number of aquatic species associated with their root system and sediments, as well as with the forest canopy and related freshwater flooded ecosystems, on the edge opposite to the sea.

Dwarf mangrove forests, particularly, have a very fragmented distribution, while fringe and riverine mangroves, which have a greater structural development, are massive and occur in big patches. Mangroves associated with karstic systems in the northern part of the ecoregion are less developed compared to similar structural types in the southern part, associated with river mouths and/or coastal lagoons of the ecoregion, between southern Belize, Guatemala, and Honduras (Arrivillaga and Windevoxhel, 2008).

2.4.1. Mexico

Mexico has the greatest stretch of mangroves in any country of the Caribbean, including its Central American neighbors. In fact, Mexico holds the fourth place of total mangrove cover in the world, preceded by Indonesia, Australia, and Brazil. In the Mexican MAR ecoregion, including part of the states of Yucatan and Quintana Roo, mangroves have been estimated to cover a total of 128,049 hectares (Canty *et al.*, 2018). Quintana Roo is the state with the most extensive mangrove area in the country; thus, conservation strategies in the MAR are vital for Mexico (Agráz-Hernández *et al.*, 2006). Many mangroves in Quintana Roo are inside protected areas, and others are also Ramsar sites or UNESCO World Heritage Site.

The direct alteration of landscapes for human development is the main driver of mangrove loss in Mexico, and particularly, in the Yucatan peninsula. In addition, in some areas pollution or changes in hydrology have caused a significant degradation, to the extent that restoration opportunities may now be limited (Zaldivar-Jiménez *et al.*, 2010; Valderrama *et al.*, 2014). The development of tourism-related infrastructure in Cancun and further south has led to a massive loss of mangroves (Spalding *et al.*, 2010). Additionally, these impacts have contributed to a significant, yet the less known negative effect on the underground water system of the peninsula, the anchialine system.

The Yucatan peninsula and its large mangrove extension are also often sensitive to the impact of hurricanes and strong tropical storms. Research suggests that these extreme climatic events can increase in scale and frequency if global temperatures continue to rise (Bender *et al.*, 2010). The investigation conducted by Calderón-Aguilera *et al.*, (2012) shows that hurricanes have an impact

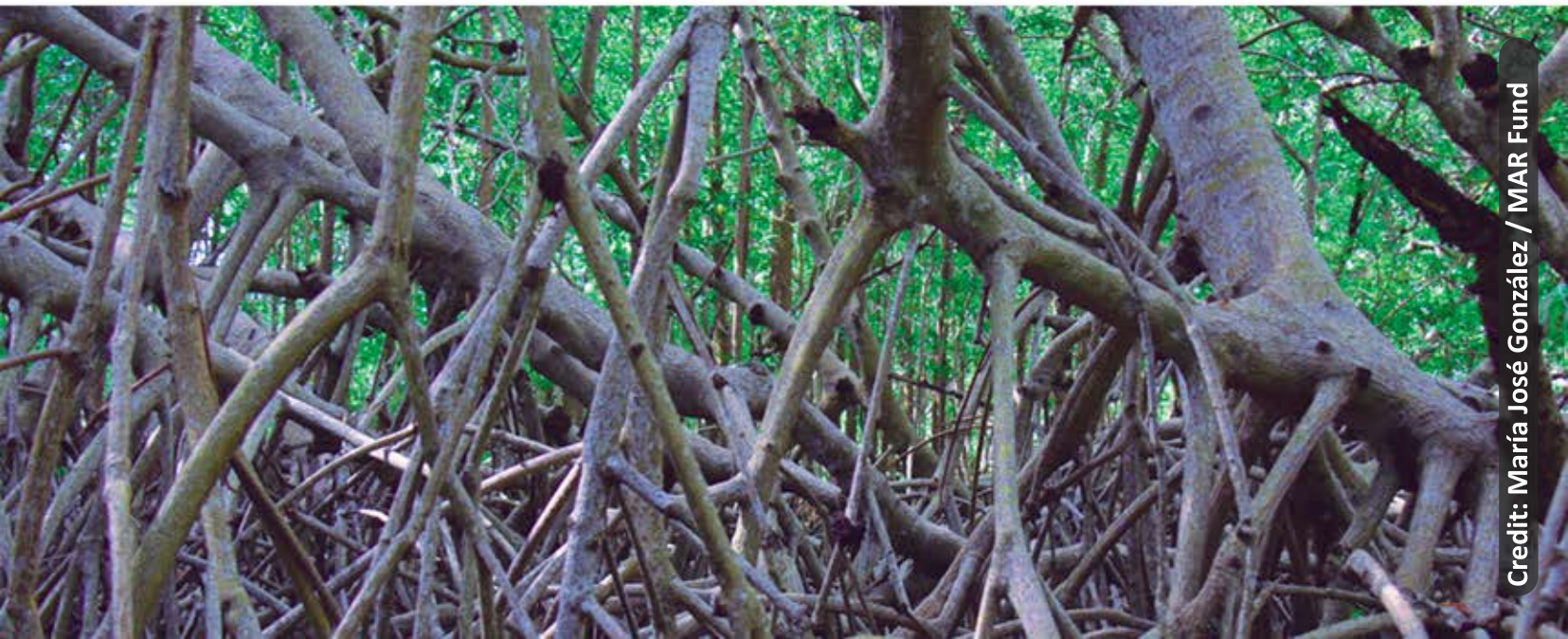
² Regarding the structural plant composition in the mangrove area, despite the differences found in the various types of forests, a structure of layers of three heights can generally be recognized: one, including moss and leaves; second, a layer of shrubs, known as undergrowth, and the third one is a higher layer formed by trees and tree crowns. The latter, known as canopy, refers to the crown of trees in which foliage performs photosynthesis.

over the structure, productivity, and mangrove resistance, as part of the most important disturbing agents on mangroves. A study carried out by Adame *et al.*, (2013) has quantified blue carbon values in nine sites in the Sian Ka'an Biosphere Reserve, which proves, even more, the value that healthy and intact mangroves have in a warming planet. Measuring exercises of blue carbon are being performed in the natural protected areas of Yum Balam and Cozumel Island.

CONABIO estimated a 10% loss of national mangrove cover between 1970 and 2005 (Valderrama *et al.*, 2014; CONABIO, 2019). In the Yucatan peninsula, according to data from CONABIO, mangroves cover loss was at an annual rate of 1.8%, from 1976 to 2000, although recent investigations suggest that there has been some recovery due in part to restoration efforts (CONAFOR, 2010; Valderrama *et al.*, 2014). The loss rate in Quintana Roo is under the national average.

According to Wilson *et al.*, (2018), a positive trend shows that approximately 43% of the total mangrove cover in Mexico is within 32 areas protected by the federal government. Along the eastern edge of the Yucatan Peninsula, mangroves are found in well-known protected areas near Cancun and Puerto Morelos. On the reef, they are grouped in Isla Contoy, Isla Mujeres, Cozumel, and the coral atoll Banco Chinchorro (Spalding *et al.*, 2010). Further south of Cancun, they are mainly located in the Sian Ka'an Biosphere Reserve, which is also a World Heritage site.

According to Wilson *et al.*, (2018), leading mangrove researchers are now using consistent monitoring and mapping techniques at a national level: the Mexican Mangrove Monitoring System, to further refine mangrove cover and loss estimates, report the resource management and catalyze ongoing restoration work. Scientists in the Yucatan Peninsula have developed a robust methodology for mangrove restoration and efforts are underway at various sites. A study points out that restoration programs should focus on the proper identification of the site, the characterization of environmental conditions, and the development of clear objectives of the program (Zaldiver-Jiménez *et al.*, 2010).



2.4.2. Belize

In 1996, the barrier reefs in front of Belize, including mangroves found throughout the area, was listed as a UNESCO World Heritage Site for outstanding universal values (UNESCO, 1996). A study by the World Resources Institute (WRI) showed that mangroves contribute between \$74 million and \$209 million annually to Belize's economy (Cooper *et al.*, 2008). Today, much of the country's natural and cultural wealth is preserved in a wide network of land and marine protected areas. Mangroves are found in most coastal areas of Belize, including rivers, bays, and lagoons, and extend through numerous cayes and coral atolls. A total coverage of 74,684 hectares has been estimated (Canty *et al.*, 2018).

In Belize, there has been a significant loss of mangroves, mainly as a result of infrastructure development or agriculture, around the city of Belize and its cayes, in Corozal, the northern district of Belize, and the popular tourist destination of Ambergris Caye (CZMAI, 2013). Similarly, in the south, shrimp farming and coastal development have contributed to the degradation and loss of mangroves in several coastal areas. More recently, mangroves around Placencia lagoon and several coastal islands have been cut down, sometimes illegally, to make way for local development projects (Mckee *et al.*, 2009; Spalding *et al.*, 2010). Like the Yucatan Peninsula, Belize's coastal regions, especially its islands, also experience frequent hurricane and tropical storm impacts. Granek and Ruttenberg (2007) demonstrated the role of intact mangrove forests in protecting coastal areas during extreme weather events, as well as the resilience of mangroves to recover after a climate event such as a hurricane or tropical storm (Piou *et al.*, 2006).

In 2009, UNESCO classified the barrier reef environment as a World Heritage Site in Danger, in part due to the sale of public lands on small mangrove islands (UNESCO, 2009). This fact catalyzed meetings of conservation leaders in Belize to review and strengthen the country's outdated mangrove legislation.

In early 2015, the government of Belize negotiated a "desired state of conservation" with UNESCO, which sought to remove the barrier reef from the list of "Endangered site." The agreement established indicators and verification methods to measure progress towards the proposed target. The establishment of key legal instruments, including (1) the integrated coastal zone management plan, (2) the living aquatic resources bill and (3) the new regulation for the protection of mangroves (approved in 2018), were fundamental instruments for the achievement of the objectives of the agreement. Finally, in 2018, UNESCO removed Belize's barrier reef from the list of endangered sites.

Belize Coastal Zone Management Authority and Institute (CZMAI), in its report of the State of the Coastal Zone of Belize 2003-2013, includes recommendations to strengthen mangrove management, research, and monitoring throughout Belize. In 2018, the Belize Forest Department partnered with researchers at Duke University to measure blue carbon values in Turneffe Atoll, the first study of its kind in Belize. The current net value of blue carbon contained in the biomass and soils of Turneffe's mangroves and seagrass, based on a price of USD 15 per tCO₂e, would be USD 3,473,072 over 25 years. These benefits would be reduced by the costs of establishment and

annual management. However, these costs should be relatively low, given the extensive development work of the marine reserve and its management plan, and recent mangrove protection regulations.

2.4.3. Guatemala

Guatemala's Caribbean coast corresponds to the shortest portion of the Mesoamerican Reef. However, the Río Dulce and the Río Motagua basin provide the most considerable freshwater runoff to the MAR. Guatemala's Caribbean coast stretches approximately 150 km along the Gulf of Honduras. The coastal environment and nearby waters are home to tropical forests, mangroves, seagrass meadows, and limited coral reefs. The dominance of estuary and freshwater systems favors the development of mangroves on the coasts. The most abundant mangroves are located in La Graciosa Bay, in the Punta de Manabique Wildlife Refuge and near the river mouths of the Río Dulce and Río Sarstún.

The mangroves in Río Dulce extend to El Golfete and Izabal lake inland, mainly due to the saltwater intrusion through the estuary in these areas (Spalding *et al.*, 2010). For the first time in 1998, Guatemala enacted the Forest Law with measures to protect mangroves. Subsequently, a joint association of governmental and non-governmental organizations began mapping and monitoring the country's forests, including mangroves (Hernández *et al.*, 2012).

Large areas of mangroves in the shorelines of the Pacific coast, and to a lesser extent on the Caribbean coast of Guatemala, have been cleared to make way for agriculture and aquaculture, particularly for shrimp farms. The conversion of coastal lands in the Caribbean has resulted in the loss of mangrove cover, particularly in the area between Punta de Manabique and the mouth of the Río Motagua, contributing to sedimentation and erosion. In addition, the increase in the use of pesticides and fertilizers in these lands has contaminated much of the coastal water in which mangroves are found (Kramer *et al.*, 2015).

Available statistics on mangrove cover and loss in Guatemala vary widely and may require validation to determine accuracy. A FAO study, from 2005, estimates that 11km² (1,100 hectares) of mangroves were lost between 1980 and 2005, representing almost 10% of the country's total mangrove cover (FAO, 2005). A more recent UNEP publication suggests that both Guatemala and Honduras have lost up to 40% of their historical mangrove cover (UNEP, 2014). The fact is that most of the mangrove literature has traditionally been focused on Pacific mangroves, and few studies and publications have been devoted to the Caribbean region.

The most recent assessment that includes the Guatemalan Caribbean coast, carried out by the Ministry of Environment and Natural Resources (MARN) and the Center for Water for the Humid Tropics for Latin America and the Caribbean (CATHALAC in Spanish) in 2013, states that mangroves still cover approximately 188km² (18,800 hectares) of land throughout the country. Today, almost 90% of the mangroves on the Caribbean coast are within the national protected

areas (Hernández *et al.*, 2012). In addition, the Rio Sarstun Multiple-Use Area and the Punta de Manabique Wildlife Refuge, home to extensive mangrove forests, are also internationally recognized Ramsar sites.

2.4.4. Honduras

Honduras has important mangroves in its territory. Although mangroves on the Caribbean coast are less extensive, they have been more heavily impacted, mainly by agricultural activities. The Bay Islands (Guanaja, Roatán, Utila) and the Cayos Cochinos archipelago also have mangrove cover, but especially on the south coast of each island have been affected by real estate development (Spalding *et al.*, 2010).

Similar to Guatemala, the statistics available for national mangrove cover and loss vary widely. In Honduras, according to the results of a FAO's thematic mangrove study (2005), a mangrove cover of approximately 152,500 hectares was reported in 1980, and a reduction in coverage to approximately 67,200 hectares was reported in 2005 for the whole country. As noted above, a recent publication suggests that Honduras has lost approximately 40% of its total mangrove cover (UNEP, 2014). The National Institute of Forest Conservation and Development, Protected Areas and Wildlife (ICF) estimates that, as of 2014, 52% of the nation's remaining mangroves are located in the Gulf of Fonseca, 33% in the Moskitia, 12% in Colon-Cortés, and 3% in the Bay Islands (ICF, 2014).

While there is no historical analysis study of mangroves for the Honduran portion of the MAR, the coastal plain of Honduras, between La Ceiba and the border of Guatemala, has, since 1950, been and continues to be today an area for intensive agriculture of banana, plantain, pineapples, coconut trees, and more recently, palm oil, and some forest crops, with which mangrove areas gradually have disappeared. Lately, real estate development for tourism has been added to the causes of mangrove conversion in the Caribbean area of Honduras.

Across the country, firewood collection remains a common practice near coastal communities, as it is a source of energy for cooking and the production of salt and coal. In popular tourist destinations such as the Bay Islands, the loss of mangroves is often the result of clearing the land to build hotels, roads, and other tourism infrastructure. An ICF study shows that approximately 3.3km² (3,300 hectares) of mangroves were lost in the Honduran Caribbean, mainly as a result of a port development project at Laguna Alvarado in Puerto Cortés (ICF, 2014).

Honduras also experiences hurricanes frequently, which in some cases, have had devastating impacts on the region's mangroves. In 1998, Hurricane Mitch destroyed 97% of the mangroves on Guanaja Island in the Bay Islands department (Spalding *et al.*, 2010). Vanselow *et al.*, (2007), show that as a result of widespread destruction, sediment and peat loss has hindered the recovery of mangrove throughout the island.

Many of the mangroves along the Caribbean coast and Bay Islands are now found in protected areas and national refuges, many of which are also Ramsar sites. In 2013, the entire Utila island

was formally listed as a Ramsar site, becoming the last mangrove area in northern Honduras to receive international recognition.

Researchers have begun to evaluate the blue carbon values of mangroves at selected sites in Honduras. A study between 2018-2019 –pending publication– sampled mangroves in 24 sites in three coastal areas of Honduras, including Tela and the Bay Islands. Extensive field sampling was performed to assess the composition, structure, biomass, and values of carbon stocks above and below the ground.

2.5. State of conservation and legal and administrative scope of mangroves in the MAR ecoregion

There is no analysis of the condition or viability of mangroves in the Mesoamerican Reef region, which represents an opportunity and a starting point for the process of preparation and implementation of the strategy, facilitated by MAR Fund in coordination with the Smithsonian Institution and the MAR2R/CCAD Project. There are, however, specific assessments within protected areas that could be considered as a baseline for estimating the general state of mangroves. According to the literature consulted, there is evidence that mangroves have suffered from multiple sources of pressure, both natural and anthropogenic, and that in recent years at least 30% of their coverage has been lost (Canty *et al.*, 2018).

A piece of encouraging news is that a good portion of the mangroves in the MAR region is located within or associated with protected areas. But, as Canty *et al.*, (2018), point out, environmental authorities do not have the resources to achieve the implementation of the regulatory framework necessary for their full protection. Moreover, there are other sites outside the protected areas that, despite whether or not they have been designated as priority sites or with international recognition, may not be adequately protected. For the above, there will be at least three legal and administrative areas where extensive work is required to achieve mangrove conservation, such as the following:

- 1) Strengthening of the existing legal frameworks for the conservation and the sustainable use of mangroves in the MAR;
- 2) The development of creative governance models that engage local users and the private sector in processes involved in the sustainable use of mangroves and their conservation;
- 3) The incorporation, if possible, of market methods that allow to value mangroves and recognize the value of their goods and services to society, raising public awareness on the need for conservation.





3. Threats to mangroves of the MAR ecoregion

3.1. Background on threats

According to Spalding *et al.*, (2010), approximately 50% of mangroves have been lost globally. On the other hand, Duke *et al.*, (2007), indicate that during the 1990s, between 30 and 86% of mangroves were lost to deforestation. The causes of mangrove loss, as well as the rate of their disappearance, vary between countries and regions. For example:

- The Quintana Roo region has lost 5.5% of mangrove cover since it was declared a state in 1974 (CONABIO, 2016);
- Belize lost 2% between 1980 and 2010 (Cherrington *et al.* 2010);
- A loss of at least 36% between 1950 and 2006 (TNC, 2008) has been estimated for the Guatemalan Caribbean;
- In Honduras, according to the results of a FAO's thematic mangrove study (2005), mangrove cover of approximately 152,500 hectares was reported in 1980, and a reduction in coverage of about 67,200 hectares was reported in 2005 for the whole country.

According to Sullivan and Bustamante (1999), the main threats to mangrove forests are (1) disruption of hydrological regimes, flood control, and urban development (including tourism); (2) drainage and filling of mangrove areas to establish coastal developments and aquaculture, and (3) extraction of mangrove timber products, such as firewood, wood and construction poles.

In an exercise led by TNC between 2007 and 2008, the Ecoregional Plan of the Mesoamerican Reef System was developed (Arrivillaga and Windevoxhel, 2008). In this plan, which involved more than 145 people from at least 27 different organizations in the MAR region, the mangrove was selected as one of the conservation targets. The result of the threat analysis in the MAR ecoregion showed that the region, in general, has a very high threat level, while mangroves have a high threat level. Table 5 summarizes the results obtained from the exercise.

Table 5. Summary of threats to mangroves of the MAR ecoregion 2008 .

Threat Levels	Threats
High	Climate change (particularly rise of sea level), increase of temperature, and CO ₃ reduction. Development of tourism infrastructure. Coastal urban development. Extensive cattle farming.
Medium	Development of infrastructure and transportation. Shrimp aquaculture.
Low	Wastewater discharge. Use of agrochemicals and pesticides. Damage associated with the effects of navigation, anchoring, and spills.

Source: Arrivillaga and Windevoxhel (2008)

3.2. Current situation of threats to mangroves in the MAR ecoregion

3.2.1. Results of the regional survey to experts and key stakeholders conducted by MAR Fund and the Smithsonian Institution

As part of the process of collecting information on the current situation of mangroves in the MAR region, the MAR Fund team and the Smithsonian Institution conducted a survey to experts and key stakeholders, including NGOs, academia, governments, and local communities in the region, who make up the *MAR Mangrove Network*, in order to learn about their perception and the information available on the mangrove situation.

The most important considerations that reflect the existing strengths, weaknesses, opportunities, and threats (SWOT), and that are also related to mangrove management, conservation, restoration, and monitoring, are highlighted. Table 6 shows the results.

The survey also collected information on topics of common interest that stakeholders identify as necessary to strengthen the management, conservation, restoration, and monitoring of the mangrove ecosystem. These are:

- 1) Climate change;
- 2) Enforcement of existing legislation;
- 3) Resource availability;

- 4) Studies and mitigation measures for mangrove diseases;
- 5) Strengthening of institutions and partnerships among stakeholders, and
- 6) Monitoring and research.

Table 6. Results from SWOT analysis of mangrove management in the MAR.

Strengths	Weaknesses
Existing legislation Monitoring and Evaluation Restoration projects NGOs and local interested parties Presence of protected areas	Lack of enforcement of existing legislation Lack of financial resources Data gaps Complicated governance
Opportunities	Threats
Projects underway Existing legislation Payment for services Blue carbon New partnerships between key stakeholders	Complicated governance in resource management Inadequate coastal development Farming (use of agrochemicals) Deforestation Pollution in bodies of water Climate change Lack of enforcement of existing legislation

In addition to the information from SWOT and from common themes, data was also obtained from the concluded and ongoing projects that are implemented in the MAR ecoregion. The information is available in link:

https://marfund.org/en/wp-content/uploads/2020/02/Results-survey_c-mangroves-manglares.pdf

3.2.2. Analysis results of current threats to the mangrove ecosystem in the MAR identified in the regional workshop for the strategy

As part of the results obtained during the workshop for the development of a regional strategy for mangrove management, conservation, restoration, and monitoring in the Mesoamerican Reef, carried out in September 2019, the following threats were identified:

- 1) Global climate change (temperature and sea-level rise and CO₃ reduction);
- 2) Waste/residual water discharge and leachate infiltration;
- 3) Pollution derived from aquaculture;
- 4) Oils and lubricants;
- 5) Use of agrochemicals and pesticides;
- 6) Agroindustry;
- 7) Changes in land use in mangrove areas and mangrove-related basins;
- 8) Development of tourism, urban, road, and transportation infrastructure (roads, ports, dredging);
- 9) Navigation (anchor damage, spills, boat scars);
- 10) Mangrove deforestation (mangrove extraction);
- 11) Dams (surface and groundwater) and hydraulic flow disruption in the system;
- 12) Illegal financing/drug-related activities;
- 13) Overfishing;
- 14) Livestock farming;
- 15) Sedimentation (although it was also considered a stressor rather than a threat, it is worth considering it).

The conceptual framework established in the workshop (see Chapter 4) was the basis for this exercise, as well as the results of the Ecoregional Analysis for the MAR 2008, prepared by TNC, and the results of the survey rendering the perception of experts, conducted by MAR Fund and the Smithsonian Institution in August 2019.

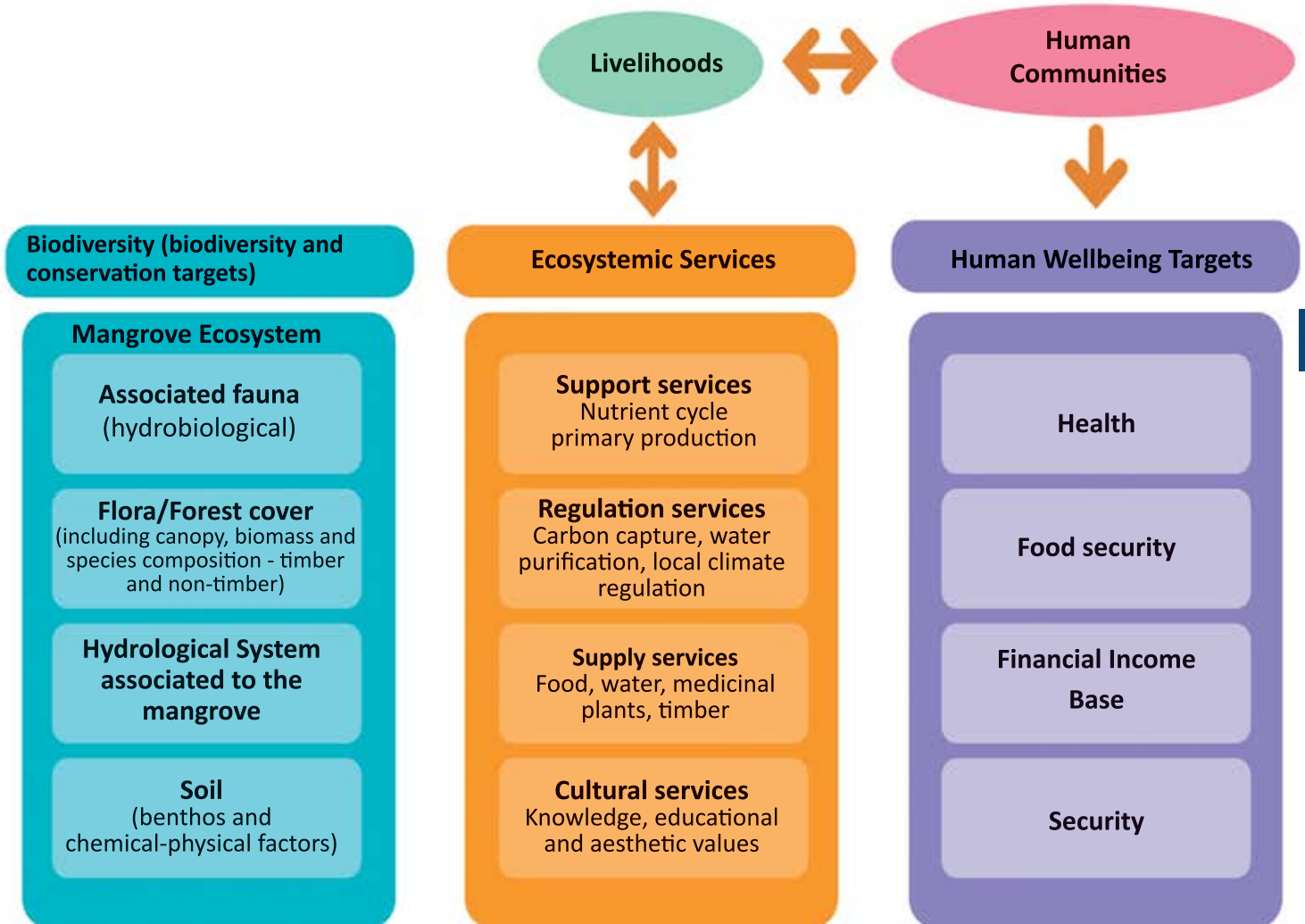
After concluding the exercise of analysis and identification of current mangrove threats in the SAM ecoregion, participants recognized the importance of having an instrument such as the strategy, which contributes to the coordination of actions that generate impacts on a larger scale. Although many measures have been taken in the last twenty years, the threats have also increased, so it is clear that dispersed investments in the region are an additional factor that challenges the achievement of regional impacts





4. Strategic framework for mangrove management, conservation, restoration and monitoring in the MAR region

4.1 Methodology



Source: Workshop Development of a Regional Strategy for Mangrove Management, Conservation, Restoration and Monitoring in the Mesoamerican Reef, Guatemala, September 2019.

The process of developing the **Regional Strategy for Mangrove Management, Conservation, Restoration and Monitoring in the Mesoamerican Reef 2020-2025 (the strategy)** started out with a regional workshop with the participation of 69 key stakeholders from the MAR region who are linked to the mangrove ecosystem management/conservation. Among them were government officials, community leaders, as well as representatives from NGOs, environmental funds, and donors among others.

As part of the analysis of the mangrove ecosystem in the MAR ecoregion, the existing information was systematized (chapter 2), in addition to the survey sent to key stakeholders. During the regional workshop, a conceptual model was designed for the MAR mangroves, in which four ecosystem conservation targets were identified: associated fauna, forest cover, hydrological system, and soil. Characteristics, stress sources and threats were determined for each one of these targets. Based on the identified threats, an analysis of the current ecosystem status was conducted. Strategies were proposed for the conservation and restoration of the mangrove ecosystem.

4.2. Foundations and principles of the strategy

4.2.1. Scope

The Regional Strategy for Mangrove Management, Conservation, Restoration and Monitoring 2020-2025 is the result of the consensus among key stakeholders of the MAR ecoregion. The strategy has been laid out as a guiding platform of actions shared between the four countries that make up the MAR. These actions, coordinated and agreed upon between different key stakeholders of the region, will enable the achievement of realistic and effective conservation goals. To that end, it is necessary to establish an action plan with key stakeholders and strategic partners that can push the strategy implementation forward.

4.2.2. Purpose

The purpose of this strategy is to enable this collaboration among different stakeholders by providing a strategic framework to achieve coordinated actions in the MAR ecoregion, with a ridge to reef focus to:

- Ensure that actions for the management, protection, and restoration of mangroves are coherent and complementary at all scales and between all sectors;
- Promote the restoration and maintenance of the ecological integrity of mangrove ecosystems in order to conserve the ecosystem's goods and services;
- Promote the generation of knowledge and the exchange of best practices among local populations which contribute to guiding the planning and comprehensive management of mangroves and that facilitate the implementation of the strategy;
- Strengthen and build capacities of different stakeholders, such as protected area managers and local communities, to ensure the conservation of mangroves;
- Promote sustainable management and conservation of mangroves as habitat and breeding grounds for fisheries and other wild species that support the livelihoods of residents of the region;

- Promote the actions, policies and regulations required to support the implementation and vision of the strategy;
- Promote strategic alliances among involved stakeholders and sectors in order to accomplish the purpose of this strategy.

The strategy takes into consideration the recommendations issued by regional and international agencies associated with the Sustainable Development Goals (SDG), Aichi Targets, Convention on Biological Diversity, the UN Framework Convention on Climate Change and regional institutional mandates from the Central American Commission for Environment and Development (CCAD, for its initials in Spanish). The latter also responds to policies, regional strategies and initiatives related to the conservation and management of natural resources and biodiversity, particularly those originating from the Framework Regional Environmental Strategy 2015-2020 (ERAM, for its initials in Spanish).

4.2.3. Regional Political Foundations

Some of the instruments that frame and provide support to the strategy are the following:

ALIDES: (*Alianza Centro Americana para el Desarrollo Sostenible*): The Alliance for the Sustainable Development of Central America was endorsed by the Central American presidents in October 1994, to achieve growth through a process of progressive change in human quality of life, represented by economic growth with social equality, the transformation of production methods and patterns of consumption based on ecological balance, an important foundation for the region.

ERAM: (*Estrategia Regional Ambiental Marco*): The Framework Regional Environmental Strategy 2015-2020 tackles the current challenges in the region and addresses new sustainability problems in the current systemic crisis, driving an environment-friendly economy that enables the eradication of poverty and social inequalities by promoting a sustained inclusive and equitable growth. It fosters and promotes synergies between multilateral and regional environmental agreements of which the MAR countries are signatories. This contributes to sustainable growth and to the integration process of the region.

ERAS: (*Estrategia Regional Agroambiental y de Salud*): The Regional Agro-Environmental and Health Strategy has the general goal of promoting a cross-sector mechanism for agro-environmental management, with a strong focus on sustainable management of land, biodiversity, variability and climate change, agro-environmental business, and healthy spaces and lifestyles, aimed at sustainable human growth.

ERB: (*Estrategia Regional para la Conservación y Uso Sostenible de la Biodiversidad*): The Regional Strategy for the Conservation and Sustainable Use of Biodiversity in Mesoamerica seeks to promote and enable the cooperation and coordination of activities in the region in order to attain understanding, valuation, conservation and sustainable use of biodiversity in the Mesoamerican region, aligned with national policies, strategies and action plans, as well as with the international biodiversity agenda.

ERCC: (*Estrategia Regional de Cambio Climático*): The Regional Climate Change Strategy is the result of a strong and dynamic process of preparation, consultation and inputs from both national and regional levels. It represents a flexible guiding instrument for SICA (Central American Integration System) countries.

The ERCC intends to become a harmonized, open and dynamic instrument of regional policy that will allow the CCAD to follow through with their mission of developing a cooperation and environmental integration system that will contribute to tackle threats and take advantage of the opportunities brought about by variability and climate change in the region. Moreover, it represents a guiding tool for the measures and additional regional actions and is an added value to national actions.

PACADIRH: (*Plan Regional de Recursos Hídricos*): The Regional Plan for Water Resources represents a set of strategies and actions that guide and harmonize the joint development of hydrological wealth across the Central American isthmus, aligned with sustainable development concepts, particularly regarding shared and cross-border watersheds.

4.2.4. Principles of the strategy

Taking into consideration the rapid decline of mangrove cover, in addition to the increased threats to the ecosystem, the strategy proposes the following work principles that contribute to the implementation of the strategic lines and proposed actions:

- Regional vision;
- Shared responsibility;
- Resource optimization;
- Gender equality and youth;
- Multicultural approach;
- Ridge to reef work approach;
- CBD ecosystem approach (2004)³.

4.3. Strategy Vision

The mangrove ecosystem has the conditions that make it resilient to the effects of global change (climate change and other anthropic effects), and is acknowledged in the Mesoamerican Reef System as a priority for sustainable development that allows the conservation of the natural capital as the foundation for the provision of goods and services that contribute to human well-being.

4.4. Strategy Objectives

General objective:

To implement management, conservation, restoration, and monitoring actions in the mangrove ecosystem that reduce its vulnerability, and that of coastal communities, to climate change in the MAR ecoregion.

Specific objectives:

- 1) Manage, conserve, restore and monitor the mangrove ecosystem in the MAR ecoregion;
- 2) Promote sustainable livelihoods that reduce stress on the mangrove ecosystem;

³ It refers to the adaptation based on ecosystems and its link to the MAR ecoregion. According to the CBD Secretariat (2004), the Ecosystem Approach represents the fundamental framework of action of the CBD, where an integrated management and the restoration of lands, water bodies and living resources are proposed, because it promotes conservation and sustainable use in an equal, participatory and decentralized way. It includes social, economic, ecological, and cultural aspects in a geographic area outlined by ecological boundaries.

- 3) Promote the effective application of legal frameworks that protect the mangrove ecosystem through strengthening of institutions and key stakeholders;
- 4) Strengthen the governance and effective participation of all sectors that are linked to the mangrove ecosystem in the MAR ecoregion;
- 5) Develop a knowledge management, monitoring, and surveillance system of the mangrove ecosystem that feeds the decision-making process of stakeholders in the region;
- 6) Ensure financial resources for the implementation of the strategy, including instruments that promote equity and multiculturalism in the MAR ecoregion.

4.5. Strategic lines

Based on the analysis of the information provided (conceptual model of MAR mangroves, foundations, principles, vision, and objectives) in the process of developing the strategy, the necessary strategies and actions are proposed to conserve, restore, and monitor the mangrove ecosystem.

As a result of the systematization of the information, the following six thematic strategic lines are proposed for the MAR ecoregion:

- 1) Management, conservation, restoration and monitoring of the mangrove ecosystem;
- 2) Economic alternatives to reduce stress on the mangrove ecosystem;
- 3) Implementation of the legal framework and institutional strengthening for conservation, restoration and monitoring of the mangrove ecosystem;
- 4) Governance and effective participation of all sectors and stakeholders for management, conservation, restoration and monitoring of the mangrove ecosystem;
- 5) Research, management, and knowledge transfer;
- 6) Core components that enable the implementation of the strategy.

Actions, indicators, relevant stakeholders, strategic partners, and estimated costs were identified for each strategic line to support its implementation.





4.6. Strategy Matrix

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1. Strategic line: Management, conservation, restoration and monitoring of the mangrove ecosystem in the MAR ecoregion.

Objective: To manage, conserve, restore and monitor the mangrove ecosystem in the MAR ecoregion.

Expected outcome: Management, conservation, restoration and monitoring of the mangrove ecosystem has been promoted and implemented in a participatory and effective way.

Strategy	Actions	Indicators	Relevant Stakeholders	Strategic Partners	Estimated Cost US\$
1.1. Use and implementation of climate change adaptation measures based on ecosystems.	1.1.1. Promote and implement land-use planning focused on water use in watersheds associated with mangroves.	Number of land-use plans focused on use of water.	Governments Municipalities Academia NGOs Community members	International cooperation Foundations Private sector Universities Environmental funds NGOs	400,000
	1.1.2. Map fresh water collection systems (water harvesting).	Number of water collection systems.			Pending data
	1.1.3. Valuate goods and services related to water use in watersheds with mangroves.	Number of valuation studies of goods and services conducted in the four countries.			150,000
	1.1.4. Promote policies and guidelines to develop nature-based coastal infrastructure that contributes to improve resilience skills in populations, allowing to save water and contributing to improve their livelihoods.	Number of national or municipal policies that promote nature-based infrastructure.			300,000
	1.1.5. Include the flow of blue carbon in national accounts and reports.	Number of countries that include blue carbon in their national accounts.			400,000
1.2 Mangrove restoration to increase cover in the MAR ecoregion.	1.2.1. Diagnostic of mangrove condition and status in the MAR ecoregion.	Updated diagnosis of the current mangrove condition in the MAR ecoregion.	Governments Academia NGOs		100,000

1. Strategic line: Management, conservation, restoration and monitoring of the mangrove ecosystem in the MAR ecoregion.

Objective: To manage, conserve, restore and monitor the mangrove ecosystem in the MAR ecoregion.

Expected outcome: Management, conservation, restoration and monitoring of the mangrove ecosystem has been promoted and implemented in a participatory and effective way.

Strategy	Actions	Indicators	Relevant Stakeholders	Strategic Partners	Estimated Cost US\$
1.2 Mangrove restoration to increase cover in the MAR ecoregion.	1.2.2. Establish a standardized mangrove restoration protocol and a protocol to measure the health of mangroves.	Regional protocol of best restoration practices and health measurement validated by stakeholders.	Governments Academia NGOs		400,000
	1.2.3. Determine priority areas for restoration of the mangrove ecosystem in the MAR ecoregion, considering connectivity aspects and results from the diagnostic.	Priority restoration sites have been determined in each country.	Governments Municipalities Academia NGOs Community members		100,000
	1.2.4. Carry out restoration actions in priority mangrove areas.	Number of restored hectares in each country and in the region.			The cost may be estimated after determining the sites and the number of hectares to be restored.
1.3. Monitoring of mangrove health in protected areas.	1.3.1. Diagnostic of the main sources of contamination in mangroves at the watershed level, including a map with contamination sources.	Most critical sources/threats of contamination for each country. Map of contamination sources for mangroves.	Governments Municipalities Academia NGOs		400,000

1. Strategic line: Management, conservation, restoration and monitoring of the mangrove ecosystem in the MAR ecoregion.

Objective: To manage, conserve, restore and monitor the mangrove ecosystem in the MAR ecoregion.

Expected outcome: Management, conservation, restoration and monitoring of the mangrove ecosystem has been promoted and implemented in a participatory and effective way.

Strategy	Actions	Indicators	Relevant Stakeholders	Strategic Partners	Estimated Cost US\$
	<p>1.3.2. Monitoring and surveillance of the mangrove ecosystem within coastal protected areas in the MAR.</p> <ul style="list-style-type: none"> • Establish joint monitoring systems between stakeholders responsible for the protection of natural resources within protected areas; • Development and application of remote monitoring systems. 	Protected areas with monitoring and surveillance systems for mangroves.	Governments Academia NGOs		600,000
1.4. Environmental sanitation of the coastal region in the MAR ecoregion.	1.4.1. Promote the construction of waste water treatment plants in coastal communities prioritized by country.	<p>Number of feasibility studies for treatment plants.</p> <p>Number of coastal water treatment plants built.</p>	Governments Municipalities	International cooperation Fundations Private sector Universities Environmental funds NGOs	Pending data collection
	1.4.2. Promote the development of solid waste management systems where they are lacking and improve the existing ones in coastal communities.	Number of systems or experiences of solid waste management.	Governments Municipalities Community members		Pending data collection

2. Strategic line: Economic alternatives to reduce stress over the mangrove ecosystem in the MAR ecoregion.

Objective: To promote sustainable livelihoods that reduce stress over the mangrove ecosystem.

Expected outcome: The social vulnerability of coastal populations in the MAR ecoregion relying on the mangrove system has been reduced.

Strategy	Actions	Indicators	Relevant Stakeholders	Strategic Partners	Estimated Cost US\$
2.1 Identification and strengthening of livelihoods and/or sustainable productive activities for coastal communities in the MAR ecoregion.	2.1.1. Identify and promote blue economy models at a local scale.	Number of pilot initiatives identified and implemented.	Governments Municipalities Academia NGOs Community members Private sector	International cooperation Foundations Private sector Universities Environmental funds NGOs	400,000
	2.1.2. Improve the fishing marketing and production chain.	Four experiences of improved marketing chains for the fishing sector have been applied.			400,000
	2.1.3. Strengthen the organization of the fishing sector.	At least two fishing associations have been strengthened and have improved their organization in each country.			200,000
	2.1.4. Promote and implement sustainable ecotourism and community tourism actions.	At least one ecotourism experience is implemented in mangrove areas per country.			330,000
	2.1.5. Conduct economic feasibility studies for: <ul style="list-style-type: none"> • Extraction and use of mangrove tannins as environmentally-friendly dyes; • Apiculture (mangrove flower honey); • Coconut oil; • Recycling micro-enterprises; • Handcrafts; • Sargassum; • Others. 	One feasibility study per country and/or type of economic activity.	Academia NGOs Private sector Community members		200,000

2. Strategic line: Economic alternatives to reduce stress over the mangrove ecosystem in the MAR ecoregion.

Objective: To promote sustainable livelihoods that reduce stress over the mangrove ecosystem.

Expected outcome: The social vulnerability of coastal populations in the MAR ecoregion relying on the mangrove system has been reduced.

Strategy	Actions	Indicators	Relevant Stakeholders	Strategic Partners	Estimated Cost US\$
2.2. Promotion of incentives for the conservation and restoration of the mangrove ecosystem.	2.2.1. Identify and design forestry incentives, both private and public, for conservation and restoration of mangroves in the MAR ecoregion.	Identification of at least one forestry incentive mechanism for conservation and restoration of mangroves in the MAR ecoregion per country.	Governments Municipalities Academia NGOs Private sector Community members	International cooperation Foundations Private sector Universities Environmental funds NGOs	200,000
	2.2.2. Promotion and adoption of incentives by competent authorities in each country; e. g. forestry authorities, as well as private entities.	Number of experiences of mangrove incentives adopted in each country.			400,000
	2.2.3. Implementation of forestry incentives for the conservation and restoration of mangroves in the MAR ecoregion.	Number of forestry incentives implemented.			400,000
2.3. Promotion and implementation of sustainable and responsible agriculture programs in the coastal region of the MAR.	2.3.1. Implement agroforestry systems in buffer zones located between development, agriculture and mangrove areas, under existing legal frameworks.	Number of pilot experiences implemented in the MAR ecoregion.	Private sector Community members		Pending data collection
	2.3.2. Promote the use of bio-fertilizers and bio-pesticides instead of agrochemicals.	Number of producers and communities adopting the use of bio-fertilizers.	Governments Municipalities Private sector Community members		Pending data collection

3. Strategic line: Implementation of the legal framework and institutional strengthening for management, conservation, restoration and monitoring of the mangrove ecosystem in the MAR ecoregion.

Objective: To promote effective implementation of the legal frameworks that protect the mangrove ecosystem through the strengthening of institutions and key stakeholders.

Expected outcome: Public policy instruments for the regional management of the mangrove ecosystem are put forward by key stakeholders.

Strategy	Actions	Indicators	Relevant Stakeholders	Strategic Partners	Estimated Cost US\$
3.1 Strengthening and implementation of management tools that contribute to the conservation, restoration and monitoring of the mangrove ecosystem.	3.1.1. Design, officialize and implement the strategy Action Plan.	Number of countries that acknowledge the strategy.	Governments CCAD	International cooperation Foundations Private sector Universities Environmental funds NGOs	100,000
	3.1.2. Replicate capacity-building and strengthening models (e.g. Blue Economy Leadership Team –BELT– Honduras).	Number of trained entities/people.	MAR2R CCAD Governments		250,000
	3.1.3. Include mangrove restoration as an item in the Blue Economy Regional Agenda and in the Decade of Restoration.	Mangrove restoration has been included as an item in the Blue Economy Regional Agenda and in the process of the Decade of Restoration - CCAD.	MAR2R CCAD Governments Municipalities NGOs		50,000
3.2 Standardize, disseminate and implement legal frameworks and environmental guidelines linked to the mangrove protection, restoration and monitoring.	3.2.1. Conduct a cross-sector analysis on regulations for the use and management of forests, protected areas, fisheries, and tourism, in order to establish existing gaps and/or duplication regarding the use and protection of mangroves.	Cross-sector analysis in each country. Number of actions taken to improve the application of standards.	Governments Municipalities Community members NGOs		200,000
	3.2.2. Strengthen the legal framework and regulations related to the development of the following types of infrastructure regarding the use and protection of mangroves: <ul style="list-style-type: none"> • Tourism; • Urban-coastal; • Roads and transportation. 	Number of modernized and updated regulations and standards per country and in the region.	Governments Municipalities		400,000

3. Strategic line: Implementation of the legal framework and institutional strengthening for management, conservation, restoration and monitoring of the mangrove ecosystem in the MAR ecoregion.

Objective: To promote effective implementation of the legal frameworks that protect the mangrove ecosystem through the strengthening of institutions and key stakeholders.

Expected outcome: Public policy instruments for the regional management of the mangrove ecosystem are put forward by key stakeholders.

Strategy	Actions	Indicators	Relevant Stakeholders	Strategic Partners	Estimated Cost US\$	
3.2 Standardize, disseminate and implement legal frameworks and environmental guidelines linked to the mangrove protection, restoration and monitoring.	3.2.3. Strengthen the legal framework and regulations related to the use of agrochemicals and pesticides, promoting the application of international standards.	At least one country strengthening its own regulatory framework.			150,000	
	3.2.4. Strengthen the legal framework and regulations related to the following: <ul style="list-style-type: none"> • Change in the use of soil in mangroves and up the watershed; • Agroindustry; • Aquaculture; • Dams; • Interruption of water flow into the system (surface and underground water). 	Number of updated standards.			400,000	
	3.2.5. Strengthen the legal framework and regulations related to the disposal of oil and lubricants directly into the water.	Number of strengthened national or municipal regulations.				200,000
	3.2.6. Develop a system of fines and penalties across the chain involved in the consumption of regulated/protected species.	A proposal developed per country.	Governments Municipalities			200,000

- 4. Strategic line:** Governance and effective participation of all sectors and stakeholders for the management, conservation, restoration and monitoring of the mangrove ecosystem in the MAR ecoregion.
- Objective:** To strengthen the governance and effective participation of all sectors linked to the mangrove ecosystem in the MAR ecoregion.
- Expected outcome:** Spaces of regional, national and local governance for the management of the mangrove ecosystem are strengthened.

Strategy	Actions	Indicators	Relevant Stakeholders	Strategic Partners	Estimated Cost US\$
4.1 Environmental governance and effective participation for the implementation of the strategy in collaboration with regional, national and local stakeholders.	<p>4.1.1. Establish a regional and cross-sector executive committee to:</p> <ul style="list-style-type: none"> Coordinate the implementation of the strategy, starting with the prioritization of planned strategies and actions; Promote the development of policies to make the strategy viable; Promote the incorporation of ecosystem and climate change criteria into the national and regional management instruments for the management, conservation, restoration and monitoring of the mangrove ecosystem. 	<p>Established regional committee.</p> <p>Actions of the strategy have been prioritized.</p> <p>Implementation of the strategy has begun.</p> <p>Ecosystem and climate change criteria have been included in the management instruments for mangrove management, conservation, restoration and monitoring.</p>	<p>CCAD Governments Municipalities Academia Community members NGOs</p>	<p>International cooperation Foundations Private sector Universities Environmental funds NGOs</p>	150,000 (for five years)
	<p>4.1.2. Strengthen and provide support to local structures for environmental governance in coastal communities.</p>	<p>Number of local governance structures strengthened with support and training.</p>	<p>Governments Municipalities Academia Community members NGOs</p>		100,000
	<p>4.1.3. Facilitate the coordination of regional, national and local stakeholders for the implementation of regional instruments for mangrove management at a national scale.</p>	<p>At least one regional instrument of environmental mangrove management implemented.</p>	<p>Governments Municipalities Academia Community members NGOs CCAD</p>		400,000

- 4. Strategic line:** Governance and effective participation of all sectors and stakeholders for the management, conservation, restoration and monitoring of the mangrove ecosystem in the MAR ecoregion.
- Objective:** To strengthen the governance and effective participation of all sectors linked to the mangrove ecosystem in the MAR ecoregion.
- Expected outcome:** Spaces of regional, national and local governance for the management of the mangrove ecosystem are strengthened.

Strategy	Actions	Indicators	Relevant Stakeholders	Strategic Partners	Estimated Cost US\$
	4.1.4. Promote and provide technical assistance to national institutions for effective implementation of regional agreements.	Number of capacity-building events and trained people on regional instruments.	CCAD Governments		100,000
	4.1.5. Promote models of shared mangrove management within and outside protected areas, based on existing frameworks and policies. For example: <ul style="list-style-type: none"> • Mangrove conservation; • Community management; • Implementation of blue carbon models. 	Number of: <ul style="list-style-type: none"> • Conservation agreements; • Offset models and programs, concession models; • Blue carbon models. 	Governments Municipalities Community members NGOs		500,000
4.2 Strengthen governance related to the mangrove ecosystem and protected areas.	4.2.1. Strengthen the stakeholders responsible for compliance and application of management laws and regulations related to the mangrove ecosystem in the MAR.	Number of governmental institutions and community organizations in training.	Governments Municipalities		100,000
	4.2.2. Develop governance models for use of mangrove and management, such as community concessions.	At least one model developed. Number of community concessions.	Municipalities Community members NGOs		100,000

4. Strategic line: Governance and effective participation of all sectors and stakeholders for the management, conservation, restoration and monitoring of the mangrove ecosystem in the MAR ecoregion.
Objective: To strengthen the governance and effective participation of all sectors linked to the mangrove ecosystem in the MAR ecoregion.
Expected outcome: Spaces of regional, national and local governance for the management of the mangrove ecosystem are strengthened.

Strategy	Actions	Indicators	Relevant Stakeholders	Strategic Partners	Estimated Cost US\$
	<p>4.2.3. Strengthen protected areas through:</p> <ul style="list-style-type: none"> • Public/private alliances with governing bodies of protected areas, the private sector and communities; • Alliances between co-managers and the private sector; • Strengthen skills/leadership of governmental organizations; • Respect, address social and environmental safeguards. 	<p>Number of public/private alliances established by government entities in charge of protected areas.</p> <p>Number of trained public officials.</p> <p>Number of protected areas that apply social and environmental safeguards.</p>	<p>Governments Municipalities Academia Community members NGOs</p>		400,000
	<p>4.2.4. Strengthen scientific, technical and local community skills.</p>	<p>Number of technicians and community members with technical and scientific training on mangrove conservation, restoration and monitoring.</p>			400,000

5. Strategic line: Research, management and transfer of knowledge.

Objective: Establish a system of knowledge management, monitoring and surveillance of the mangrove ecosystem that feeds the decision-making process of stakeholders in the MAR ecoregion.

Expected outcome: The MAR ecoregion has a monitoring and surveillance system for mangrove ecosystem that feeds strategic information to key stakeholders for decision-making and improving the ecosystem's management.

Strategy	Actions	Indicators	Relevant Stakeholders	Strategic Partners	Estimated Cost US\$
5.1 Promotion and implementation of actions that contribute to improving knowledge management related to the importance and economic value of mangroves in the MAR ecoregion.	5.1.1. Develop a regional plan for Knowledge Management (KM) that includes mapping of knowledge, priority topics, knowledge gaps, involved stakeholders and users, as well as the management mechanism.	GCO strategy for mangroves in the MAR, approved by countries	CCAD Academia Governments NGOs Community members	International cooperation Foundations Private sector Universities Environmental funds NGOs	50,000
	5.1.2. Valuate and identify awareness models of "intangible capital" that include biocultural heritage sites, the promotion of inclusive/ancestral cultural models that respect local customs, traditions, ancestral thinking, traditional knowledge on mother nature in terms of the actions for sustainable development and management of natural and cultural resources addressing resolutions and international treaties and conventions regarding the mangrove system.	Number of inclusive models to raise awareness on the intangible capital.	Academia Governments Municipalities NGOs Community members		200,000

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Objective: Establish a system of knowledge management, monitoring and surveillance of the mangrove ecosystem that feeds the decision-making process of stakeholders in the MAR ecoregion.

Expected outcome: The MAR ecoregion has a monitoring and surveillance system for mangrove ecosystem that feeds strategic information to key stakeholders for decision-making and improving the ecosystem's management.

Strategy	Actions	Indicators	Relevant Stakeholders	Strategic Partners	Estimated Cost US\$
	5.1.3. Conduct an economic valuation of mangroves and blue carbon at key sites/landscapes in each country.	Number of economic valuation studies of mangroves on different environmental services, such as protection for extreme climate events, blue carbon, habitat and breeding grounds for fisheries and other wild species that provide livelihoods to residents of the region, etc.			200,000
5.2 Implementation of a regional capacity-building plan for generation of knowledge.	5.2.1. Develop a policy on local empowerment (environmental education, dissemination and empowerment regarding public policies).	Document on regional policy acknowledged and initially approved by CCAD.	CCAD Academia Governments Municipalities NGOs Community members		50,000
	5.2.2. Promote exchanges related to existing initiatives (e.g. El Cuco, El Salvador) for a tailored replica in each country.	Number of exchanges. Number of participants.	Community members Academia Municipalities Governments		120,000
	5.2.3. Generate science-based environmental education material.	Amount and number of generated materials.	Governments Municipalities NGOs		250,000

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Expected outcome: The MAR ecoregion has a monitoring and surveillance system for mangrove ecosystem that feeds strategic information to key stakeholders for decision-making and improving the ecosystem's management.

Strategy	Actions	Indicators	Relevant Stakeholders	Strategic Partners	Estimated Cost US\$
	5.2.4. Implement a regional awareness campaign on the importance and benefits of adequate management, conservation, restoration and monitoring of the mangrove ecosystem aimed at government entities involved in management and conservation of mangroves, the private sector, indigenous peoples, Afro-Hondurans, local communities and the general public.	Number of learning tools generated per country and in the region.	Community members Academia, Municipalities Governments NGOs		250,000
5.3 Research and knowledge management aimed at solving management problems in the mangrove ecosystem.	5.3.1. Establish and prioritize research needs for the strategy.	Plan with research priorities concerning the mangrove ecosystem in the MAR.	Municipalities Community members Academia NGOs Governments		60,000
	5.3.2. Promote scientific research focused on the management of the mangrove ecosystem in the MAR ecoregion.	Number of investigations completed and in progress aimed at the sustainable management of the mangrove ecosystem.			400,000
5.4 Implementation of good practices instruments for the conservation, restoration and monitoring of the mangrove ecosystem.	5.4.1. Identify and implement new sustainable technologies for productive sectors that affect the mangrove ecosystem in the MAR ecoregion.	Number of identified new technologies. Number of implemented pilot experiences. .	Government Academia Private sector		200,000 (for identification process)

5. Strategic line: Research, management and transfer of knowledge.

Objective: Establish a system of knowledge management, monitoring and surveillance of the mangrove ecosystem that feeds the decision-making process of stakeholders in the MAR ecoregion.

Expected outcome: The MAR ecoregion has a monitoring and surveillance system for mangrove ecosystem that feeds strategic information to key stakeholders for decision-making and improving the ecosystem's management.

Strategy	Actions	Indicators	Relevant Stakeholders	Strategic Partners	Estimated Cost US\$
	5.4.2. Exchange of experiences using virtual platforms and/or "social networks", such as the Regional Environmental Observatory (REO-CCAD), Red Manglares y Pastos Marinos de Mesoamérica, Redmanglar Internacional para la Defensa de los Ecosistemas Marino-Costeros y la Vida Comunitaria (RMI), among others.	Number of exchanges of experiences. Number of participants.	Government Municipalities Community members NGOs		200,000
5.5 Measure current mangrove cover in the MAR ecoregion.	5.5.1. Map the mangrove cover using the same methodology in the four countries.	Map of the current mangrove cover for the MAR region.	Governments CCAD Regional technical-scientific mangrove committee.		400,000
	5.5.2. Officially establish the current mangrove cover of the MAR region recognized by the authorities. (Baseline of official cover for the MAR).	Official map of mangrove cover for the MAR.	Government CCAD Academia	International cooperation Foundations Private sector Universities Environmental funds NGOs	150,000
	5.5.3. Develop the regional monitoring system of the annual rate of change in forest cover.	Percentage of annual change of forest cover.	Governments Mangrove experts		60,000

6. Strategic line: Core components that enable the implementation of the strategy in the MAR ecoregion.

Objective: Ensure financial resources for implementation of the strategy, with instruments that promote equality and multiculturalism in the MAR ecoregion.

Expected outcome: Instruments of equality, multiculturalism and financial sustainability are applied in the implementation of strategy actions.

Strategy	Actions	Indicators	Relevant Stakeholders	Strategic Partners	Estimated US\$
6.1 Outline an action plan for the financial sustainability of the strategy.	<p>6.1.1. Prepare a portfolio of donors and of project profiles. For example:</p> <ul style="list-style-type: none"> • Forum with donors and partners for implementation of the strategy; • Proposal to the Green Climate Fund to fund projects for the implementation of the strategy's action plan; • Green Development Fund for the SICA Region, program related to investments aimed at the restoration of forest landscape. 	<p>Portfolio of potential donors.</p> <p>Number of submitted profiles/proposals for the implementation of the strategic lines of the strategy.</p> <p>Funds raised for the strategy.</p>	<p>Governments Municipalities Academia Community members NGOs Private sector CCAD</p>	<p>Multilateral Cooperation organizations Research organizations NGOs Academia</p>	150,000
6.2 Ensure the incorporation of gender and youth in the implementation of the strategy.	<p>6.2.1. Link gender and youth to all strategic lines and promote their involvement in mangrove management in the MAR ecoregion.</p>	<p>Number of women and youths effectively involved in the implementation of strategies and activities of the strategy.</p>	<p>Governments Municipalities Community members (particularly women and youth), CCAD</p>		50,000
6.3 Incorporate a multicultural approach in the implementation of the strategy.	<p>6.3.1. Incorporate the world view of indigenous peoples and local communities of the MAR ecoregion in all the actions within the strategy framework.</p>	<p>Number of mechanisms of participation and inclusion of indigenous peoples and local communities promoted by the strategy.</p> <p>Number of field interventions in which indigenous peoples and local communities take part.</p>	<p>Governments Municipalities NGOs Academia Indigenous peoples Community members Private sector CCAD</p>		100,000
	<p>6.3.2. Develop guidelines to foster inclusion and cultural relevance at regional, national and local levels across different sectors.</p>	<p>Number of developed national policy instruments, guidelines and regulations that include cultural relevance and gender aspects internationally recognized⁴.</p>		100,000	

⁴ Conventions and treaties on CBD, CC, Desertification, etc., must be observed, particularly voluntary guidelines regarding environmental and social safeguards, Convention 169, UN Declaration on the Rights of Indigenous and Tribal Peoples, for example.





5. Recommendations for the implementation of the strategy.

The strategy is an instrument that contains a set of strategies and actions necessary to achieve the goal of conserving, restoring and monitoring the mangrove ecosystem in the MAR ecoregion. The strategy includes processes that involve different timelines, as well as different priority levels of intervention.

In view of the above, in order to implement the strategy in a timely manner, we recommend the following political, strategic, technical, and operational aspects:

Political

- Promote alliances with different sectors and different stakeholders to generate the institutional coordination that will provide the adequate conditions for the effective implementation of the strategy in the MAR ecoregion, taking into consideration a ridge to reef approach.
- Share the strategy at a regional scale with agencies of the Central American Integration System (SICA) and its specialized secretariats, particularly through the CCAD, SITCA, CAC, CECC, COMISCA, CEPREDENAC, COMMCA. Involve the focal points of the national authorities of these secretariats, especially on the topic of environment and sustainable development.

Strategic

- Develop agreements at the global, regional, national, and local scales to enable the adequate conditions for the implementation of the strategy at different levels of intervention.
- Develop a resource mobilization strategy to promote the sustainability of the actions.

Technical/Operational

- Promote the creation of an Executive and Intersectoral Regional Committee (see Action 4.1.1), with the goal of promoting the development of an action plan with priorities that take into consideration the needs of the ecosystem and coastal communities, available resources –human and financial–, as well as the interest of states and donors in mangrove conservation, restoration and monitoring in the MAR ecoregion.
- Create an interim Regional Committee that defines the role and purpose of this entity, its representativity, that sets priorities and develops a plan of action for the ERCRMM. We recommend a facilitator at the beginning of the process, to support follow up of the early phases of the committee’s work.
- Encourage the construction of technical alliances to promote exchange of information and generation of knowledge.





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Appendix 1

List Participants Regional Workshop for strategy development

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