Wetlands and Livelihoods in the Lower Basin of the Río Paz

El Salvador – Guatemala

Melibea Gallo and Eduardo Rodríguez

WETLANDS INTERNATIONAL

Wetlands and Livelihoods in the Lower Basin of the Río Paz

Project: Integrated Management of Water Resources and Livelihoods on the Río Paz, El Salvador – Guatemala

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Wetlands International

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Salvadorian park rangers in the Barra de Santiago Natural Protected Area.

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Introduction

With an eye on the entire range of values and services that wetlands provide, **Wetlands International** *works to sustain and restore the resources and biodiversity of wetlands for future generations. The aim of our* **Wetlands and Livelihoods** *programme is to ensure the recognition of these values and services as well as their integration with sustainable development. We promote dialogue between the sectors of environment and development with regards to the management of wetlands and their resources, finding a common agenda that offers solutions that are beneficial to both conservation and the fight against poverty.*

The project **Integrated Management of Water Resources and Livelihoods on the Río Paz, El Salvador – Guatemala** *is undertaken as part of the Wetlands and Livelihoods Programme. It promoted the participatory generation of management recommendations that arose directly from the knowledge and needs of the communities of the lower basin. These recommendations focus on the principal themes that link the provision of ecosystem services to livelihoods.*

As part of this project, a number of activities have been developed and are summarized in this document. Chapter 1, "Wetlands and Livelihoods," describes the relationships between the wetlands of the lower basin of the Río Paz and the livelihoods of local populations. Included are descriptions of the hydrological dynamics and particular ecological conditions that were researched in three main project studies:

1. **Our Resources, Our Assets:** *This is a participatory diagnosis of the livelihoods and assets of the people in communities in the lower basin of the Río Paz, between El Salvador and Guatemala. The study used the focus of sustainable livelihoods and is based on the individual or the family as the unit of analysis. The major part of this work was done by a local team comprised of community representatives. Another group helped motivate and systematise the work. The leaders conducted an interview with each family in the area of study on the social, human, natural, physical, and financial assets on which they rely. (For more information, see Guiselle Rodríguez Villalobos and Jackeline Siles Calvo, 2010.)*
2. **Description of Landscapes and Ecosystems:** *This study focused on the conditions of ecosystems, comparing the diversity of indicator flora and fauna in El Botoncillo and Garita Palmera, the wetlands of the area of study, as compared to those in Barra de Santiago y Barra El Jiote, the two control wetlands in the best state of conservation (following the directives proposed by RAMSAR, 2005 and MARN, 2002). Field data were collected by a team of biologists whose members were Jorge Ramos, Roberto Carlos Martínez, Douglas Müller, and Adalberto Salazar. (For more information, see Melibea Gallo and Eduardo Rodríguez, 2010).*
3. **Hydrological Dynamics in the Lower Basin of the Río Paz:** *The analysis of the hydrological dynamics in the lower basin of the Río Paz was based on testimonies from inhabitants, field visits, and visual interpretation of satellite images. Several field visits were made in the company of community leaders, who demonstrated the impacts of floods and presented on-site the solutions which are collected in the management recommendations in the section on water resources management in the lower basin of the Río Paz. (For more information, see Eduardo Rodríguez, 2010).*

From considerations and knowledge developed and acquired jointly, the communities generated the Management Proposals that are presented in Chapter 2 of this document, "Territorial Management." (See Appendix 1: Contributors).

Wetlands and Livelihoods

Coastal Populations

Shared by Guatemala and El Salvador, the basin of the Río Paz has a total area of 2,647 Km^2, of which 34% belong to El Salvador and 66% to Guatemala (SNET, 2002). The Río Paz has its source in the department of Jutiapa, Guatemala, at an elevation of 1,700 msl.

The river's course measures 134 km and forms the border between El Salvador and Guatemala from its confluence with the Chalchuapa River (14°4'49.94"N - 89°44'20.95"W) to its former mouth on the Pacific Ocean (approximately 13°44'43.13"N - 90° 8'0.02"W). The lower river basin includes the municipality of San Francisco Menéndez (Department of Ahuachapán, El Salvador) and the municipality of Moyuta (Department of Jutiapa, Guatemala).

The upper basin contains remnant forest masses mainly comprised of broadleaf species, and the principal permanent crop in the area is shade grown coffee. The middle basin contains open woodlands interspersed with grasslands on which there is extensive cattle grazing. Other areas of the middle basin are dedicated to sugar cane production.

In the basin as a whole, principal crops consist of basic grains grown on hillsides and in small areas of interior valleys. Also in the valleys are found grasslands and sparse woodlands. As a result of traditional agricultural practices, many areas dispersed throughout the basin are subject to strong erosion (CCAD, 2009).

The project's area of study is located on the alluvial plain of the Río Paz, which forms the borderline between the Republics of Guatemala and El Salvador, at the geographical coordinates of 13°47'00"N and 90°07'00"W. It contains more than twenty communities, from among which five in each country were chosen to participate in the various studies and processes involved in the project (See Figure 1 and Table 1).

Figure 1: Map of the Area of Study.

Table 1: Participating Communities in the Study Area (data from the Project's assets study).

Country	Community	N° of Residents	N° of Families
Guatemala	La Barrona	440	110
	La Blanca	228	76
	Las Barritas	384	96
	Monte Rico	650	130
	Garita Chapina	600	115
El Salvador	El Botoncillo	260	52
	Bola de Monte	500	110
	Garita Palmera	1532	383
	El Tamarindo	710	142
	El Limón	292	73

Hydrological Description

The current condition of water resources in the lower basin of the Río Paz is the result of an aggressive process of environmental deterioration. This is caused by high pressure on resources, a lack of educational processes and environmental awareness, and the extreme poverty of the population (CCAD, 2009).

According to the Tropical Agricultural Research and Higher Education Center (Spanish acronym CATIE), the Río Paz basin shows moderate degradation, in that a certain amount of vegetation protection exists in the middle and upper basin (approximately 29,931 ha. covered by vegetation, primarily shade grown coffee). Yet there is an imbalance in the middle basin caused by land used for annual crops (sugar cane). The risk from floods and droughts is moderate to high (drought: 55,444 ha. and floods 3,010 ha.) (CATIE-CRS, 2005).

There is a hydrological imbalance that shows an alteration in the hydrological condition of the soils or the lack of management of the basin, especially in its middle and upper parts (CATIE-CRS, 2005). This hydrological imbalance has manifested itself in one of the most drastic changes in the region: the change in the course of the Río Paz. Estimates show that this event occurred between 1965 and 1970, a period during which the area witnessed two of the most destructive hurricanes in history: Hurricane Camille (1964) and Hurricane Fifí (1974) (Rodríguez Herrera, El proceso de transformación territorial en al zona de estudio a partir de la historia oral., 2004) (See Appendix 3: Accounts and Testimonies.) By 1974, it was noted that the Río Paz "… splits into two courses after flowing out of the hills …" (Consejo Nacional de Planificación y Coordinación Económica, 1974).

In the lower basin, the main river course had diverted to a new branch called "Nuevo Paz" in Guatemala. From this point downstream, the natural (original) course of the river towards its mouth in the El Botoncillo mangrove forest is now abandoned and dry year-round, except in periods of flooding during the rainy season, usually caused by extreme events, when one part of the course flows to the Zanjón El Aguacate in El Salvador (13°48'30.74"N - 90° 6'20.92"w) (See Figure 2.)

According to testimonies from older inhabitants, this change occurred when, during cresting caused by an extreme event, the river took the course of an irrigation canal. Since that time, the main course of the river has been diverted to Guatemalan territory. The diversion point is located 15 kilometers upstream from the river's original mouth (6 kilometers perpendicular to the coast, coordinates 13°47'52.25"N - 90° 7'2.06"W), and produces a decrease in water availability and quality and the loss of aquatic and marine coastal ecosystems (UICN - Programa Alianzas, 2007); (Candelario Arriola 2010, Mauricio Lemus, 2010[1]). If we use the estimated mean annual flow for the year 2000[2] at the hydrometric station nearest the river mouth[3] as a constant during the period of the last 30 years, we see that approximately 2.6 billion cubic meters of fresh water no longer flowed towards the mouth and the coastal wetlands in the area through the lower 15 kilometers of the river's course.

[1] Comments made during interviews conducted for the Project.
[2] The Master Plan and Feasibility Study for Sustainable Management in the Paz River Basin estimates the mean annual flow at La Hachadura at 28.10 m^3/sec. (OEA, 2000).
[3] La Hachadura Station (13º 51´34.3" N 90º 05'17.1" W) (SNET, 2005).

Although this is a rough calculation, it allows us to estimate the impact that the decrease in supply of fresh water can have on the ecosystem functions of the wetlands in the area. This is especially true for the mangrove forest of Garita Palmera, fed by a branch of the Río Paz known as El Zanjón del Aguacate, and the mangrove forest of El Botoncillo, located at what used to be the mouth of the Río Paz (Gallo M. and Rodríguez E., 2010).

Various studies have shown a reduction in the flow of fresh water to the coastal aquifer, causing problems of access to water for consumption and production. This reduction may have affected the balance between saltwater and fresh water in the coastal aquifer as well, facilitating saline intrusion and upsetting the balances of salts in the mangrove forests and river outlets, seriously affecting ecoystem production in the marine coastal zone (CCAD, 2009).

Figure 2: Hydrological Changes in the Lower Basin of the Paz River.

This situation could worsen in the future; the analysis of hydrological behaviour in El Salvador indicates that for the 2001-2002 dry season, behaviour below historical averages was noted in records from the La Hachadura and La Atalaya Stations[4] (SNET, 2002). Considering the gradual decrease in flow volumes at the stations analysed, SNET made a projection in time, drawing

[4] This station is located on the San Pedro River, a tributary of the Barra de Santiago in El Salvador, one of the control sites mentioned in the description of ecosystems prepared by Wetlands International (Gallo M. and Rodríguez E., 2010)

A bank of sandy sediment deposited in one of the floodways during Tropical Storm Agatha, near Los Naranjos, Guatemala (Photo: Melibea Gallo).

tendency lines of flow volumes for the dry-season months[5]. The result has La Hachadura Station showing a tendency to change from a permanent river to a winter runoff by about the year 2100 for the most critical month (SNET, 2002).

It should be emphasised that the presence of fresh water is fundamental for the reproduction of species (fish, molluscs, crustaceans) in marine coastal ecosystems of the area of study, and it is on these resources that more than 70% of the population rely. Fresh water from the Río Paz and its tributaries is the primary regulator of salinity levels in the mangrove forests, and most likely for the coastal aquifer that sustains these populations and their productive activities. (See the section on livelihoods and ecosystem services.)

Another factor to consider in the hydrology of the lower basin of the Río Paz is the disorganised management of the river along its course, whether it be to divert water for irrigation or for purposes of exploiting sand and stone for use in construction. This affects the hydrological behaviour of the lower course of the river, causing conflict among local authorities and damage and loss throughout the entire region.

The disorganised and inequitable use of hydric resources in the Río Paz basin, particularly in its lower part, complicates the hydrology of the region. Some sugar cane and cattle producers in the middle and lower parts of the basin block and divert the river in order to use water for irrigating cane fields or pastures. This limits availability of the resource downstream, for human populations as well as for ecosystems (UICN, 2004).

[5] According to the study, these tendency lines are indicators of the possible behaviour of the flows. This tendency may accelerate or decelerate, depending on the possible factors that are currently causing the decrease in the volume of the flows.

Background: the remains of destroyed levees. Foreground: carts used for removing sand from the riverbed. (Photo: Eduardo Rodríguez)

For its part, the extraction of sand and petrific material for use in public works or for sale as construction materials is done without any control at various points on the river's course near the communities of La Hachadura in El Salvador and El Salamar and Los Naranjos in Guatemala.

Serious erosion and sedimentation problems have in fact been reported in the sub-basins of the Río Paz and along its main course (UICN - Alianzas Programme, 2007) (SNET, 2005) (UICN, 2004) (OEA, 1998). Erosion has been associated with processes of deforestation in Guatemala and the middle part of the basin in El Salvador. Lands in the upper basin in El Salvador contain extensive plantations of shade grown coffee. The same is not true of the middle basin in El Salvador, where large sugar cane plantations are found.

When the river reaches the alluvial plain, its waters lose their carrying capacity, and sediments are deposited on the bottom, clogging the riverbed. This reduces the riverbed's capacity to contain higher volumes, resulting in more frequent flooding. During the rainy season, the river spreads out on the alluvial plain, flowing into old riverbeds and abandoned meanders, and returning to its old floodplains (formerly wetlands and coastal lagoons), causing great damage to the productive systems that currently occupy these places, as well as to roads and ecosystems in the area (CCAD, 2009).

In 1974, El Salvador's National Board of Planning and Economic Coordination (Spanish acronym CONAPLAN) pointed out that the cresting levels recorded at the El Jobo site, where crests of 1,000 to 1,200 cubic meters per second are common, cause a protection problem for lands adjacent to the mouth of the Río Paz in El Salvador as well as in Guatemala (OEA, 1974).

Attempting to abate flooding, both countries have invested great sums in the construction of levees along both sides of the Río Paz. In 2010 alone, the government of Guatemala spent Q4,058,530.00 (about US$580,000.00) on dredging and levee construction on the Río Paz, in a section located between the communities of Los Naranjos and Valle Nuevo (Sistema de Contrataciones y Adquisiciones del Estado de Guatemala, 2010) (See Table 2.)

Table 2: Total Costs of Some Projects Damaged By Floods during the 2010 Rainy Season in the Lower Basin of the Paz River.

Project	Damage	Cost
Bailey Bridge on the Paz River, Guatemala	Destroyed	US$450,000.00
Las Barritas community levee (2009-2010)	Partially destroyed	US$22,850.00
Los Naranjos-Valle Nuevo levee, Guatemala (2010)	Partially destroyed	US$580,000.00
Levee near El Zanjón del Aguacate, El Salvador (2006)	Partially destroyed	US$823,000.00
Rural road between Cara Sucia and Garita Palmera, El Salvador (2009)	Partially destroyed 2 bridges washed out	US$5,300,000.00
Total of some costs due to damage in 2010		**US$7,175,850.00**

Residents of Guatemalan coastal communities, along with the municipality of Moyuta, have also spent considerable sums on levee construction along the lower part of the river. In 2009, the communities of Monte Rico, Las Champas, Garita Chapina, La Blanca, Las Barritas, and La Barrona repaired a levee located to the south of the new course of the Río Paz, at a cost of approximately Q75,000.00 (about US$10,700.00). Of this amount, 87% was put up by *parceleros*[6] and other local residents. The levee collapsed again in the rains of 2009 and had to be rebuilt in April of 2010, at an approximate cost of more than Q50,000.00 (about US$7,150.00). Local residents paid for the fuel for this effort, at a cost of Q35,000.00 (about US$5,000.00) (Menéndez, 2010).

Tropical Storm Agatha broke this levee once again at various points, along with other levees. These levee breaks resulted in the flooding of lands and homes in the communities, including pastures, causing the death of 175 head of cattle as well as an unknown number of pigs and chickens, not to mention losses to fisheries.

(Photos: Eduardo Rodríguez)

The levee built in 2006 is seen destroyed (left), or submerged in the rising waters of the Paz River (right).

[6] A *parcelero* or *parcelera* is any person who is an owner, renter, or holder of a parcel—a legally defined division of land.

Left: Site of the bridge near the community of La Arenera, on the road that leads from Pedro de Alvarado to the Guatemalan coastal area. Right: Bridge over El Zanjón del Aguacate, on the road between Cara Sucia and Garita Palmera, El Salvador. (Photos: Eduardo Rodríguez)

In 2006, the government of El Salvador spent US$823,000.00 on a levee structure with 110 metres of dikes. The structure consisted of two concrete shields filled with compacted material and with its upper portion sealed with asphaltic concrete. Also constructed at this site was a 410-meter levee with gabion walls. (El Diario de Hoy, 2006).

According to statements made by residents to the local press on June 22, 2006, this levee on El Zanjón El Aguacate would prevent high waters in the Río Paz from causing this tributary from flooding the area towards Colonia ISTA and Garita Palmera, but flooding would probably affect communities downstream, where the levee remained unrepaired. (La Prensa Gráfica, 2006).

In El Salvador alone, Tropical Storm Stan destroyed 839 manzanas (586 ha) planted in corn and 49 homes, due to flooding of the Río Paz. (Ministerio de Gobernación, 2010). Flooding during Tropical Storm Matthew washed out two bridges on the road between Cara Sucia and Garita Palmera. This road, more than ten kilometres long, had just been asphalted in 2009 at a cost of US$5.3 millions (MOP, 2009). Also destroyed was the bridge over the current course of the Río Paz near the community of La Arenera. This bridge is the only means of access from within Guatemala to the coastal communities of Garita Chapina, Las Champas, La Blanca, Las Barritas, and La Barrona. High waters constitute a serious flooding problem, due to the fact that the riverbed along the lower basin is actually higher than the adjacent lands (CATIE-CRS, 2005).

A more detailed evaluation of the terrain, as well as interviews with older people from communities in the area, reveal that a good portion of the area most heavily affected by flooding is an area of

former wetlands—marshes and mangrove forests—that have been drained by locals in order to open up pasture land. This is especially true in the area to the north of the communities of Las Barritas and La Blanca in Guatemala (See Figure 3.)

This complicated socio-environmental dynamic, the important place that ecosystems hold in the ways of life of coastal communities, and the complex dynamics of the degradation of ecosystems which provide vital services in terms of food security, all require a careful process of management, one that is oriented towards recovering not only the ecosystem functions of coastal wetlands, but also the hydrological dynamic of the Río Paz. These things also require that the inhabitants of these areas know and understand ecosystems and adapt to the conditions of the countryside, rather than fighting against them. (Rodríguez Herrera, Dinámica hidrológica en la cuenca baja del río Paz, 2010). This means that flow volumes must be restored, producers and irrigators must be organized, and investments must be made in alternative means of production and primary agro-industrial and commercial systems, in addition to the recovery of the productive infrastructure

(Photos: Eduardo Rodríguez)

Yulcini Menéndez listens to Don Luis, who tells her about how the area was filled with water "in winter and summer". On the right, a cow grazes in a flooded pasture or ancient plain. On the bottom, a pasture turns back to a wetland during the rainy season.

Figure 3: Area of Drained Floodplain.

that has been lost. But most importantly, this calls for the use and rehabilitation of the natural infrastructure as a means of flood mitigation, and as a means towards local adaptation and development, so that the natural infrastructure can serve as a source of potable water, food, energy, and opportunity.

With this situation in mind, Wetlands International designed a research process that included the ecological description of the mangrove forests in the region. For this description, a comparative study was undertaken between two control sites and two study sites, following the directives proposed by Ramsar (2005). Samples were made of the salinity conditions in the control and study sites, and it was determined that the reference wetlands, (El Jiote and Barra de Santiago) evidence mesohaline conditions (moderately brackish), while the study wetlands (Garita Palmera and El Botoncillo) evidence euhaline conditions (brackish) (Gallo M. and Rodríguez E., 2010).

These results support the claims of residents of the area: that all actions aimed at restoring the mangrove forests[7] and other wetlands associated with the lower basin of the Río Paz to healthy conditions must begin by re-establishing the supply of fresh water to these deltaic systems. (See Appendix 3: Accounts and Testimonies.)

[7] Healthy ecosystems are those which maintain their level of functionality, in which the use of resources or the demand for ecosystem services does not exceed what they can supply, and in which their value to future generations is considered.

Ecological Description

The mangrove forests of the lower basin of the Río Paz belong to the Southern Dry Pacific Coast Mangrove ecoregion (Olson et al., 2001), which stretches in patches along the Guatemalan and Salvadoran coastlines. Mangrove forests and marshes dominate the shorelines of the estuaries along coastal flatlands.

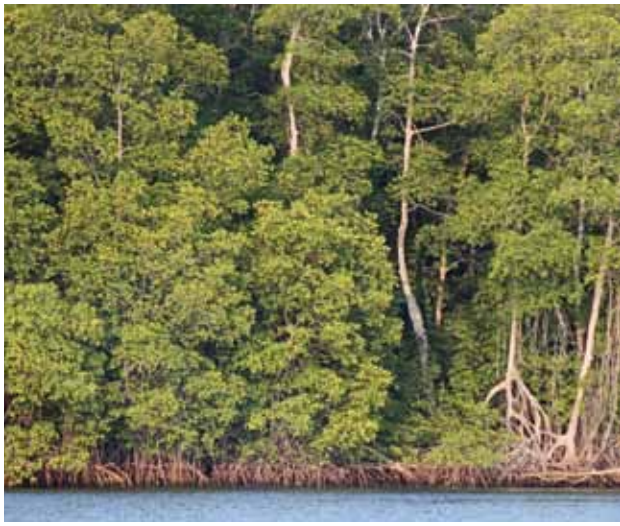
The coastal wetlands of Garita Palmera and El Botoncillo are perhaps the least known and most degraded wetlands on the Pacific coastlines of Guatemala and El Salvador. (MARN - AECI, 2003). Nevertheless, a significant number of people live in or about them in more than twenty communities, and their livelihoods are intimately related to the services of these ecosystems.

The current conditions of the mangrove forests of the lower basin of the Río Paz are the result of diverse processes such as deforestation and changes in land use along the entire length of the basin, as well as alterations to its hydrological regime. This has caused a reduction in the productivity of the ecosystems and their capacity to provide services to the local communities. Ecologically, mangrove forests function as recycling systems for organic material and as habitats for the spawning and reproductive cycles of species, outstanding among which are species that provide sustenance for the most dispossessed human families. Dynamically, mangrove forests are the interface between land and sea. Within them, freshets or flash floods are buffered and nutrients are transported from one side of the ecosystem to the other. In addition, their shallow waters and soft bottoms and the supply of fresh water from tributary rivers, along with the patterns of tides and currents, create an estuarial habitat that is ideal for the reproduction of fish species.

The Project included an analysis of the condition of the wetlands ecosystems, focusing on the comparison of the control mangrove forests (Garita Palmera and El Botoncillo) with the study mangrove forests (Barra de Santiago and Barra el Limón). (See the complete study in Gallo M. and Rodríguez E.; 2010.) Five species of mangrove were

(Photo: Eduardo Rodríguez)

Mangrove forest at El Jiote – Guatemala



(Photo: Eduardo Rodríguez)

Mangrove forest at Barra de Santiago – El Salvador

(Photo: Eduardo Rodríguez)

Mangrove forest at Garita Palmera – El Salvador

(Photo: Eduardo Rodríguez)

Mangrove forest at El Botoncillo Guatemala – El Salvador

recorded, occurring in various site conditions (Table 3).

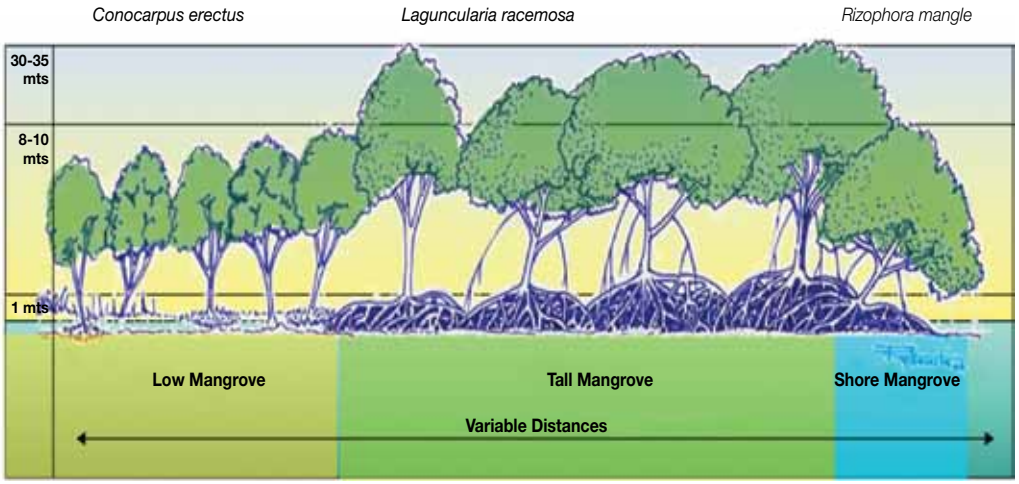
Colonisation in this type of ecosystem usually begins with *Rhizophora mangle* (red mangrove), a species that tolerates salinities between 0 and 45 psu[8], requires greater periods of soil immersion and waters with higher circulation, and roots well in very soft, unstable soils, which it consolidates and stabilises as it grows. The establishment of *R. mangle* and its consequences in the micro-habitat permit colonisation by other species, such as *Avicennia germinans* (black mangrove or istatén). *Laguncularia racemosa* (white mangrove) is sometimes found interspersed among the others mentioned. It tolerates salinities between 0 y 45 psu and requires frequencies of soil immersion that are less than those for red mangrove and greater than those for black mangrove. *Conocarpus erectus* (buttonwood or botoncillo), is present at some sites. It occupies the transitional zone between mangrove forest and freshwater forest and is in greater contact with land vegetation (See Figure 4).

Table 3: Mangrove Species Recorded in the Study and Control Wetlands and their Site Conditions.

Scientific Name	Common Name	Soil	Salinity
Avicennia bicolor	Madresal	well-drained soils	little tolerance to salt (0 a 40 psu)
Avicennia germinans	Black Mangrove	less soil immersion, only at highest tide line, little drainage	greater salinity (65 psu, tolerating up to 100 psu)
Conocarpus erectus	Buttonwood	occasional soil immersion	high salinity (0 - 90 psu, tolerating up to 120 psu)
Laguncularia racemosa	White Mangrove	greater soil immersion and time living in water	lower salinity (0 - 42 psu, tolerating up to 80 psu)
Rizophora mangle	Rred Mangrove	greater soil immersion	lower salinity (0 - 37 psu, tolerating up to 65 psu)

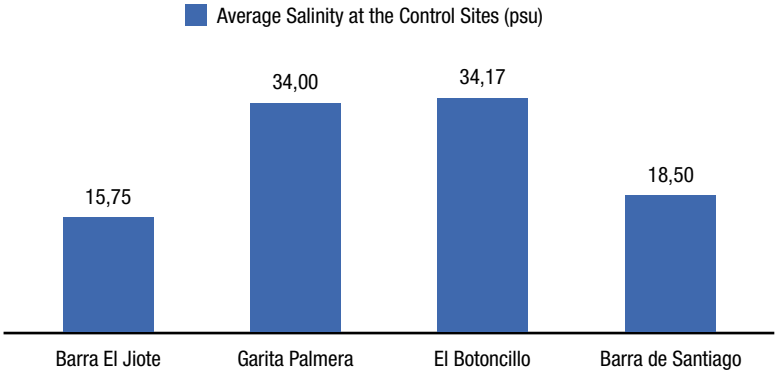
[8] PSU: Practical Salinity Units

Figure 4: Profile of Mangrove Forest Vegetation on the Pacific Coast of Central America (Estero de Jaltepeque – El Salvador) Taken from MARN (2005).



The study revealed that there are distinct differences between the control wetlands (El Jiote and Barra de Santiago) and the study wetlands (El Botoncillo and Garita Palmera). The study wetlands have a higher level of salinity in the soil than the control wetlands (See Figure 5). This is reflected in the composition and structure of the mangrove forests inventoried. The species dominating the study ecosystems is *A. germinans* (black mangrove), with an Importance Value Index (IVI)[9] of more than 200 in both cases, while in the control wetlands the dominant species is *R. mangle* (red mangrove), with an IVI of more than 200 in both cases.

Figure 5: Average Results of Salinity Analyses at the Control Sites (data from the Project's description of landscapes and ecosystems). Note: PSU are Practical Salinity Units.

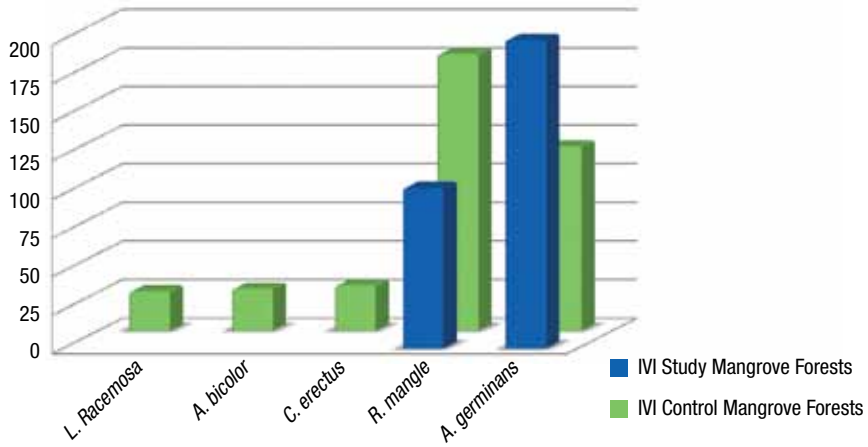


[9] IVI is a measure of the dominance of a species in an ecosystem (developed by H. Lamprecht). A high Importance Value Index shows that a species is dominant in terms of number of individuals, frequency, and basal area occupied by the species at the control sites. Species with high IVI values are those that define the structure and function of the ecosystem.

The dominance of *A. germinans* is due primarily to soil types; it needs those with a high content of sediments deposited by the river and a greater salt content. (See Figure 6) The dominance of *R. mangle* (red mangrove) at El Jiote and Barra de Santiago demonstrates a natural process of colonisation, in sites in which there is an adequate interchange of water and salts, since *R. mangle* is usually associated with muckier soils containing a lower saline concentration. (See Figure 7) (Gallo M. and Rodríguez E., 2010).

The study of the ecosystems revealed that the mangrove forests in the area of study have an average height of 12 metres and an average basal area of 19 m^2/ha, in keeping with a mangrove forest of the Southern Dry Pacific Coast. It also revealed that the control mangrove forests have a greater average height (12,15m) than do the study mangrove forests (11m) (Gallo M. y Rodríguez E., 2010).

Figure 6: IVI Comparisons of Various Species of Mangrove in Study versus Control Wetlands (data from the Project's description of landscapes and ecosystems).



Also investigated was the process of regeneration at both the control and study sites. At all sites, it was observed that most regeneration involves *A. germinans* (black mangrove), which colonises in soils with greater salinity. Some isolated individuals of *L. racemosa* (white mangrove), *R. mangle* (red mangrove), and *C. erectus* (buttonwood) were found in the study wetlands (See Figure 7). It should be noted that some formations of *R. mangle* were found, relatively young and restricted to the riverbanks and canals, due to limited availability of light mucky, immersed soil, which would allow it to root and develop well.

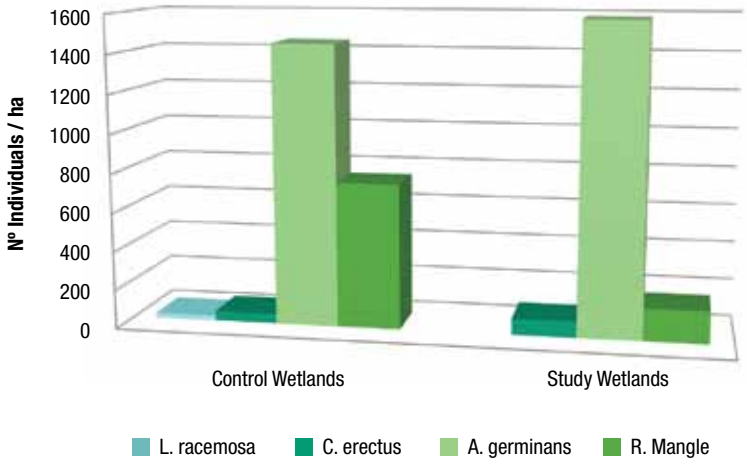
(Photo: Melibea Gallo)

Rizophora mangle (red mangrove)
El Jiote, Guatemala

(Photo: Eduardo Rodríguez)

Avicennia germinans (black mangrove)
El Botoncillo, El Salvador

Figure 7: Regenerating Species in Study versus Control Wetlands (data from the Project's description of landscapes and ecosystems).



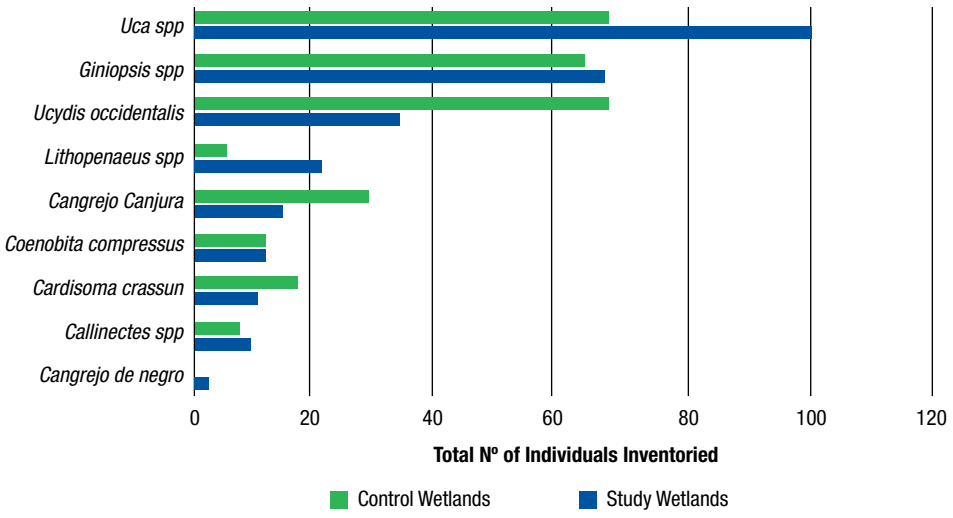
From this data, it was concluded that, in order to initiate processes of recovery in the study mangrove forests, it will be necessary to include seed planting of other species of mangrove, since diversity in the regenerative process is very low. This will have to be in conjunction with a reduction of salinity levels, most likely by increasing quantities of fresh water in the old beds of the Río Paz, which could be achieved through more appropriate river management. Otherwise, *A. germinans* (black mangrove) will be the species that dominates competitive exclusion, as residents in the area have pointed out is currently the case. (See Appendix 3: Accounts and Testimonies).

It is also important to point out that an increase in the basal area of *A. germinans* (black mangrove) and *L. racemosa* (white mangrove) at fertile sites with high nutrient content can limit the development of R. mangle (red mangrove), due to competition for light. For this reason, the process of mangrove restoration will have to be accompanied by monitoring the establishment of the species. Such monitoring would have to be done by local organisations. With respect to the structure of the vegetation communities, two layers were observed in all cases: the canopy of mature trees and the inferior layer, consisting only of regenerating individuals of mangrove species. An analysis of distribution by size class[10] of the species showed that no individual of *R. mangle* (red mangrove) with a diameter of more than 30cm was present in the study wetlands, and that at the study as well as the control sites, only *A. germinans* was present in all size classes.

As was the case with species of flora, the analysis showed that the study wetlands contain a lesser wealth, diversity, and abundance of species of fauna (molluscs, crustaceans, reptiles, birds, and mammals) than do the control wetlands. For species of molluscs as well as crustaceans, inventories showed that the dominant species at the study sites are those with no commercial or consumption value. Such was the case with *Uca spp.* (fiddler crab), *Goniopsis spp.*, and *Cerithidea spp.* (horn snail) (See Figure 8).

Species of fauna that are indicators of healthy ecosystems were found only in the control wetlands, and not in the study wetlands (Gallo M. and Rodríguez E., 2010). This was true

Figure 8: Inventory of Species of Crustaceans in Study versus Control Wetlands (data from the Project's description of landscapes and ecosystems).



[10] Organisation by size class gives an idea of the structure of a forest. A healthy forest should show a graph of class intervals in the form of an inverted J. These intervals can indicate, among other things, whether or not a specific class of diameters is being extracted or if the forest is regenerating appropriately.

for *Amazona auropalliata* (yellow-naped parrot), *Amazona albifrons* (white-fronted parrot); *Aratinga strenua* (Pacific parakeet); *Buteogallus anthracinus* (common black-hawk); *Campephilus guatemalensis* (pale-billed woodpecker); *Dryocopus lineatus* (lineated woodpecker), *Aramides cajanea* (grey-necked wood rail) and *Lutra longicaudis* (Neotropical river otter).

Various factors are responsible for the degradation noted both in hydrological systems and in ecosystems in the study area. Important among these factors are deforestation; changes in land use that tend away from forests and soil-protective crops and towards cultivation of crops such as grains, grass, and sugar cane, among others; intense pollution from irrational use of chemical pesticides and fertilizers; contamination from untreated waste water and solid waste; and the reduction in the supply of fresh water to the coastal wetlands, due to the diversion of Río Paz waters for use in irrigation. (See Hydrological Description.)

As has been seen from the results in the Ecological Description, when planning the recovery of ecosystem functions in the coastal wetlands of the lower basin of the Río Paz, it is essential to consider the question of increasing the supply of fresh water.

This recovery will bring countless benefits to local communities; benefits of which, as will be seen in the following Chapter, local residents are already aware and mention. Important among these are the increase in availability of provisioning services (mainly fish, molluscs, and crustaceans, but also wood and wild fauna) and improvements in the control of floods and tidal surges (Gallo M. and Rodríguez E., 2010).

(Photo: Melibea Gallo)

Eudocimus albus (American white ibis).
El Jiote - Guatemala

(Photo: Eduardo Rodríguez)

Cochlearius cochlearius (boatbill).
Barra de Santiago – El Salvador

(Photo: Eduardo Rodríguez)

Numenius tahitiensis (bristle-thighed curlew)
Barra de Santiago – El Salvador

Nyctanassa violacea (yellow-crowned night heron). Barra de Santiago – El Salvador
(Photo: Eduardo Rodríguez)

Himantopus mexicanus (black-necked stilt) . Barra de Santiago – El Salvador
(Photo: Melibea Gallo)

(Photo: Eduardo Rodríguez)

Catoptrophorus semipalmatus (willet). Barra de Santiago – El Salvador

Livelihoods and Ecosystem Services

The livelihood strategies[11] of inhabitants of the area combine various livelihoods,[12] the most important among these being fishing and gathering; agriculture, and the raising of cattle, fowl, and pigs (See Table 4.)

Table 4: Principal Livelihoods by Country in the Lower Basin of the Río Paz (data from the Project's assets study).

Families Interviewed	Fishing	Gathering	Agriculture	Cattle-Raising	Fowl and Pigs
El Salvador	*60.3*	*21.9*	*26.7*	*1.4*	*22.6*
Guatemala	*24.5*	*36.2*	*24.5*	*29.8*	*8.5*
Both countries	*46.3*	*27.5*	*25.8*	*12.5*	*17.1*

The livelihoods of 74% of the families interviewed depend directly on fishing (46.3%) and on gathering crustaceans and molluscs (27.5%). This means that the majority of the people use resources that come from wetlands for their daily diet (mangrove forests, estuaries, rivers, lagoons, and the ocean). Of the families interviewed, 25.8% said that their main productive activity is agriculture (corn, plantains, sesame, coconut, watermelon, soybeans, squash, maicillo, yucca, papaya); while 29.6% said that their main productive activity is raising cattle, pigs, and fowl.

Salvadoran communities are more dependent on resources from the ocean and from coastal wetlands (82.2%) than are communities in Guatemala (60.7%), while cattle-raising is an activity found almost exclusively in Guatemala. (See Appendix 4: Community Tendencies.) It should be noted that 54.3% of families in Guatemala base their family economies on more land-oriented livelihoods than do Salvadoran families, yet at the same time a greater percentage of Guatemalans report gathering crustaceans and molluscs. Figure 9 shows the relative importance of each of the principal livelihoods in each country.

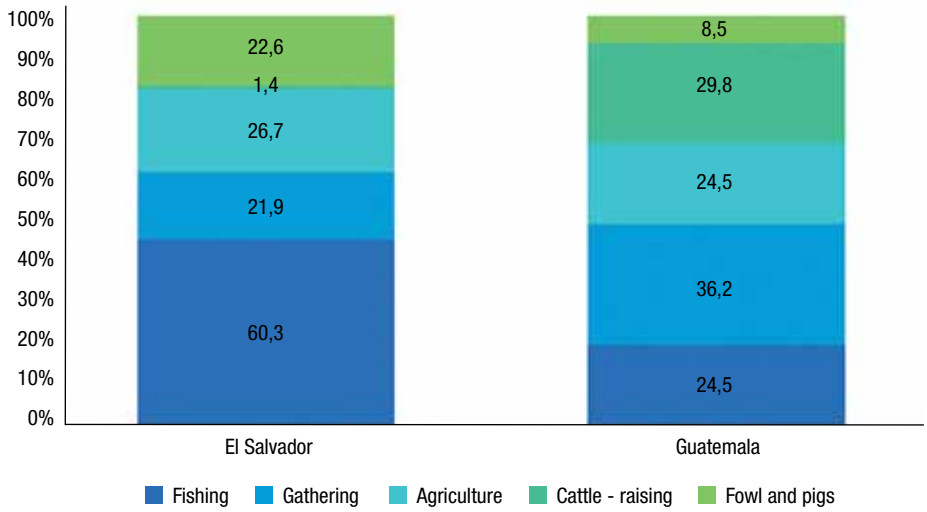
Ecosystem services are the benefits that people obtain from ecosystems. These include provisioning services, such as the provision of food and water; regulating services, such as the regulation of floods and tidal surges; supporting services, such as soil creation and the recycling of nutrients; and cultural services, such as spiritual and recreational benefits. (Millennium Ecosystem Assessment, 2005).

If we observe data by community, we see that all the Salvadoran communities found along the coast depend to a high degree on ecosystem services that come from coastal wetlands (mangrove forests, lagoons or marshes, and the ocean). Guatemalan communities located along

[11] "Livelihood strategy" is understood to mean the set of livelihoods on which a family relies in order to achieve well-being. A livelihood strategy depends on a family's skills, proximity to and levels of access to ecosystem services, or other components of the socio-ecological system to which they belong.

[12] Livelihoods are each of the activities that family members develop in order to achieve well-being. Well-being might come from direct consumption of the products of the activity in question, the sale of those products, or the satisfaction that the activity itself provides.

Figure 9: Relative Importance of Livelihoods between the Two Countries (data from the Project's assets study).



the coast, however, ascribe more relative importance to livelihoods related to agriculture and animal-raising. One exception is La Barrona, located in the mangrove forests associated with the current mouth of the Río Paz, or "Nuevo Paz," as the area is locally known (See Figure 10.)

This could be explained in terms of the land-holding situation. Figure 11 shows that those communities in which there is better judicial security with regards to land-holding coincide with those whose livelihood strategies consist of livelihoods such as the cultivation of basic grains or animal-raising. Those communities with a lesser percentage of landed property are precisely those that depend to a greater degree on ecosystem services from the coastal wetlands. Fewer than 30% of the inhabitants of the communities in the study are owners of the land on which they live and conduct their productive activities. Of the families studied, 69% own their homes (Figure 11), while fewer than 7% have some access to credit by means of which they might improve their productive activities and move them forward. So fishing and the gathering of shrimp (*Lithopenaeus spp.*), red crabs (*Ucides occidentalis*) and swim crabs (*Callinectes spp.*) are the principal livelihoods of those communities nearest the coast: Garita Palmera, El Tamarindo, Bola de Monte, and El Botoncillo in El Salvador, and La Barrona in Guatemala. Animal-raising and/or agriculture are, on the other hand, the principal activities in the communities found farther from the coast or which show greater percentages of landowning families.

In the case of La Blanca, on the coast and near mangrove forests, there is no exploitation of resources from the mangrove forest or from the ocean. In Las Barritas, fishing and gathering are considered complementary, weekend activities. Agriculture is also important in Monte Rico and La Blanca in Guatemala, as well as in the community of El Limón in El Salvador, where a bit of fishing is reported as a complementary activity.

Figure 10: Relative Importance of Each Livelihood in the Communities Studied (data from the Project's assets study).

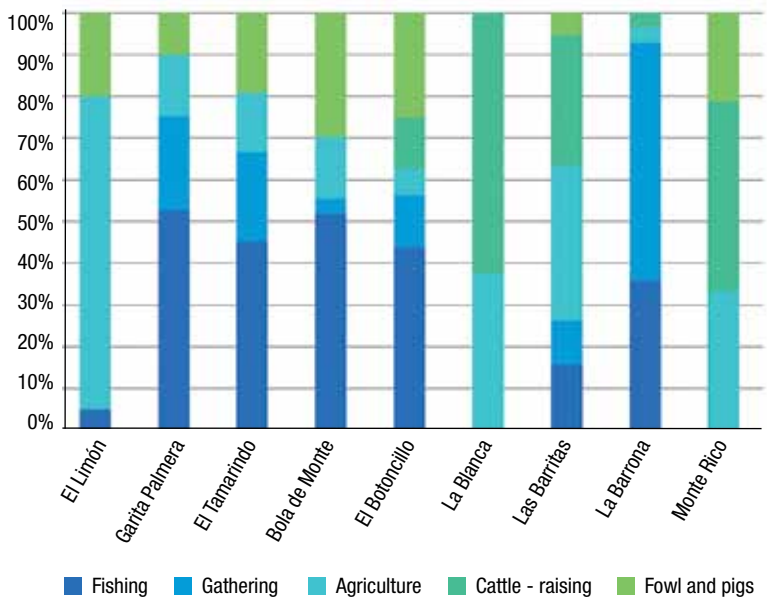
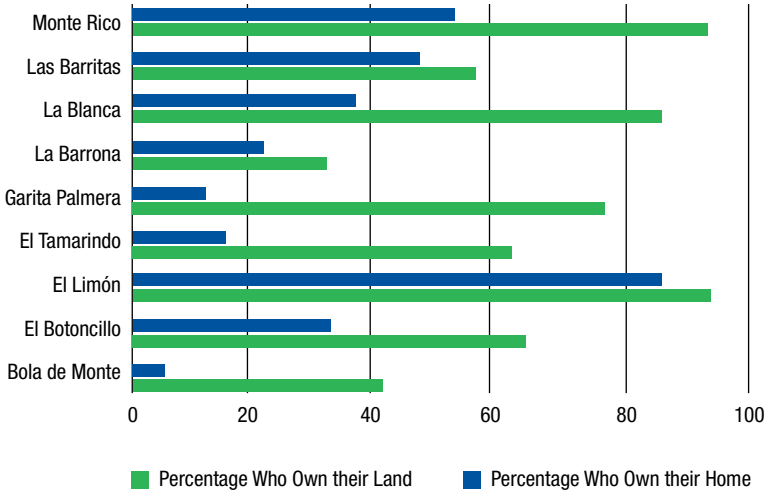


Figure 11: Percentages of Landowners and Homeowners in Each of the Communities Studied (data from the Project's assets study).



(Photo: Eduardo Rodríguez)

Fishermen in Guatemala.

It thus becomes clear that the livelihood strategies of the families interviewed have a fundamental dependence on fishing and gathering in the case of El Salvador and animal-raising in the case of Guatemala.

Besides these livelihoods, the families blend a variety of others into their strategies. These generally include the cultivation of basic grains, the raising of fowl, and the exploitation of ocean and mangrove forest resources for consumption (including wood for timber and fuel, iguanas, and turtle eggs).

Leaders in the area pointed out that, among the main activities in which they engage, both those that generate income and those that do not, other resources are involved which are not mentioned during discussions about principal livelihoods. This is the case with the exploitation of wood, palm fronds, and wild fauna. This demonstrates the close links between the rural societies of the Río Paz with services provided by wetlands ecosystems. (See Table 5.)

An average of 85% of local inhabitants consume well water and indicate that their water has been growing saltier during the past few years, 15% buy drinking water, and a small minority

Table 5: Principal Community Activities (data from workshops on formulating a management proposal).

Economic Activities Specifically Related to Generating Income	Social, Cultural, and Conservation Activities
Fishing and gathering of molluscs, crustaceans, etc. (shells, shrimp, cockles, crabs, turtle eggs)	**Traditional medicine**
Animal - raising (cattle, pigs, and fowl)	**Horse racing**
Agriculture (corn, plantains, sesame, coconut, watermelon, soybeans, squash, maicillo, yucca, papaya)	**Ball games**
Wood and royal palm (consumption and sale)	**Patron saints fairs**
Hunting / Capturing fauna (birds, iguanas, raccoons, lizards)	**Recreational visits to the ocean**
Tourism services (food provision, tours)	**Recreation on rivers**

have running water. Accounts and interviews make reference to the process of salinisation of wells and the decrease in the quantity and quality of water. Nearly half of those interviewed said that the quality of their water is bad. (See Figure 12.) The main reason given for the change in quality is increased salinity. (See Figure 13.)

It is highly probable that this process is related to the changes in the course of the Río Paz over the last 30 years, which have resulted in an enormous reduction in the supply of fresh water to the coastal system, the degradation of the basin, and the increase in sedimentation.

The functioning of the wetlands (mangrove forests, marshes, coastal lagoons, and others) is essential in order to maintain the principal livelihoods of inhabitants along the Río Paz: fishing and gathering of crustaceans and molluscs. It is also essential for the regulation of flow volumes, the mitigation of flooding and tidal surges, soil conservation, and maintaining the quality and quantity of fresh water, among many other services.

The inhabitants of the lower basin of the Río Paz strongly depend on the ecosystem services provided by the wetlands which, according to their accounts, have been deteriorating over the past few decades. (See Appendix 3: Accounts and Testimonies.) In all cases, these ecosystem services are diminishing as a result of worsening ecosystem health, due in turn to diverse territorial processes, not only in the lower basin, but throughout the entire basin of the Río Paz.

With respect to resources from fishing and gathering, the livelihoods of the inhabitants—and their food security in particular—are seriously threatened due to over-exploitation, a lack of control over fishing activities on the part of national authorities, and the environmental degradation and pollution of the waters and the effect this has on the species that live in them.

Figure 12: Opinions on Water Quality from People Interviewed in the Communities.

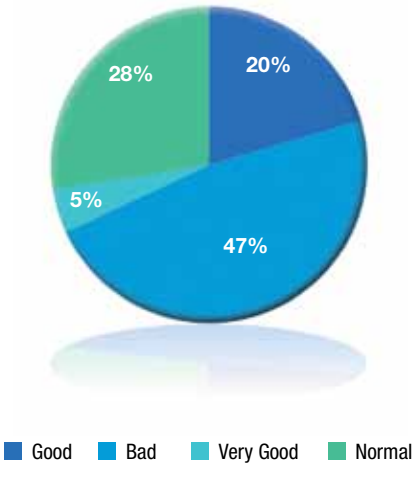
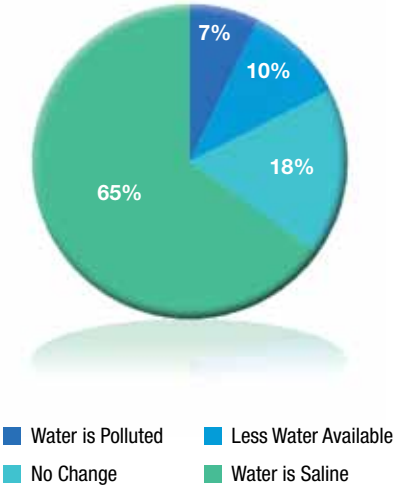


Figure 13: Opinions on Changes in Water Quality from People Interviewed in the Communities.



With respect to agriculture and animal-raising, these activities have been undertaken without taking natural ecological conditions into account. Wetlands have been gradually drained in order to use the lands as pastures or for cultivating (see Hydrological Description and Appendix 3: Accounts and Testimonies), bringing about changes in natural ecological processes. To this must be added the impacts of climate change, since wetlands in general are highly vulnerable to climate change threats.

By means of this Project's accounts and studies, changes to many of these ecosystem services over time have been gauged, especially those changes affecting the livelihoods of inhabitants living nearby (See Table 6.)

(Photos: Eduardo Rodriguez)

Fisheries Products – El Tamarindo, El Salvador

Table 6: Ecosystem Services as Perceived by Inhabitants of the Area of Study, and their Changes over Time.

PROVISIONING	PERIOD 1980 – 1990	CURRENT (2010)
Foods		
Fish	2000 kg/day	500 kg/day
Molluscs	25 dozen/day for sale	no commercial species available
Crustaceans	100 kg/day	10 kg/day
Water	Better quality, no pollutants or salt	Inferior quality, 65% indicate saltier water, 7% indicate contamination
Fibre and Energy		
Firewood and Timber	Not taken from wetlands	Taken from wetlands
Biochemicals	Not perceived	Not perceived
Genetic Materials	Not perceived	Not perceived
REGULATING		
Climate Regulation	Not perceived	Not perceived
Hydrological Cycle Regulation	Course of river unchanged	Course of river changed and increased sedimentation
Water Purification	Water fresh, found at shallow levels	Water saltier, found at deeper levels
Regulation of Extreme Events (flooding and tidal surges)	Flooding during extreme events	Yearly flooding
Pollination	Not perceived	Not perceived
CULTURAL		
Spiritual	Not perceived	Not perceived
Recreational	Unchanged	Unchanged
Aesthetic	Not perceived	Not perceived
Educational	Not perceived	Not perceived
SUPPORTING		
Soil Formation	Capacity for the establishment of various species of mangrove	Diminished diversity in established mangrove species
Recycling of Nutrients	Not perceived	Not perceived

Although the inhabitants do not adequately perceive it, the desiccation of the wetlands has deteriorated their capacity to regulate flow volumes on the alluvial plain, a situation that is seriously affecting the quality of life in terms of losses to people's productive infrastructures and harvests, as well as in terms of the impacts that floods and tidal surges have on the ecosystems of mangrove forests and coastal lagoons.

Territorial Management

Local Actors

Vulnerability, poverty, and the absence of a policy of environmental management characterise this area shared by two nations, which is also beset by problems typical to a border zone. Although this area is a unified socio-ecological entity, the fact that it is administered without any coordination between two national governments results in great difficulties for the management and recovery of ecosystems and the support of livelihoods associated with them. Inhabitants and leaders of the area point out the consequences of conflicting fisheries legislation, for example, in which there are different close seasons for the same species, or different regulations for the size of trammel nets. They also point out the lack of enforcement of legislation concerned with adequate environmental management in both countries.

Various local organisations exist that control territorial and ecosystem management processes. In Guatemala, the main authorities of participation and coordination are the COCODES[13] of each community, while in El Salvador; they are ADESCOs[14] and the municipality of San Francisco Menéndez (Rodríguez G. and Siles J., 2010).

Nevertheless, social organisation is weak, and most bodies focus their actions on solving immediate problems, acting in fragmented fashion and in many cases unnecessarily duplicating their efforts. Though there are many local actors and agents for cooperation, they have low levels of inter-institutional coordination, despite the fact that their work involves the same social topics, the same ecosystems and, in many cases, the same problems. When dealing with the socio-environmental dynamic, they lack a systemic vision. Thus are lost valuable opportunities for feedback; impact deepening; efficient management of human, technical, and financial resources; learning; and capitalising on experience.

This Project undertook activities designed to unite and coordinate the various proposals that local actors are making. Such management recommendations were expressed by community leaders during the research process and during interviews and workshops, and their aim is to promote the recovery of the ecosystems on which these communities depend, thereby strengthening their livelihoods.

Identified from among the proposed measures were those that the communities made a commitment to undertake given available capital, as well as those that require support from various collaborators, non-governmental and governmental alike, including local governments of both countries and ministries of the environment, health, and agriculture and cattle-raising. The key points on which local actors require support are:

- Recovery of traditional ecological knowledge and its application to the recovery of ecosystems and the strengthening and diversification of livelihood strategies.

[13] COCODE: Spanish acronym for “Community Council for Development.”
[14] ADESCO: Spanish acronym for “Association for Community Development.”

- Strengthening of the processes of community integration at local, regional, and binational levels, in order to achieve the broad participation of all sectors that manage and depend on the ecosystems of the lower basin.

- Strengthening of vehicles for dialogue and discussion on the theme of environmental management.

- Support of processes of management of water resources throughout the basin, in order to guarantee minimum flow volumes in the lower basin and aid the recovery of ecosystems and livelihoods associated with them.

- Development and strengthening of community organisational structures and productive structures (of various types) that allow for realising the proposed management recommendations as well as monitoring and evaluation processes that are related to activities for the recovery of ecosystems and the strengthening of livelihoods and livelihood strategies.

(Photos: Melibea Gallo)

Group Work at a Management Recommendations Workshop
Cara Sucia – El Salvador

Management Recommendations

Through various Project products and processes, Wetlands International facilitated the generation of Management Recommendations within the framework of national and regional contexts. Recommendations were linked to the Plan for Socio-environmental Management of the Río Paz Basin, which was developed in 2009 by the Central American Commission on the Environment and Development (Spanish acronym CCAD) for the entire basin. This management plan is designed to ensure that the Río Paz basin becomes an economically, socially, ecologically, and culturally functioning territory, relying on collaborative, multi-sectoral, and consolidated mechanisms of environmental management (CCAD, 2009).

Goal

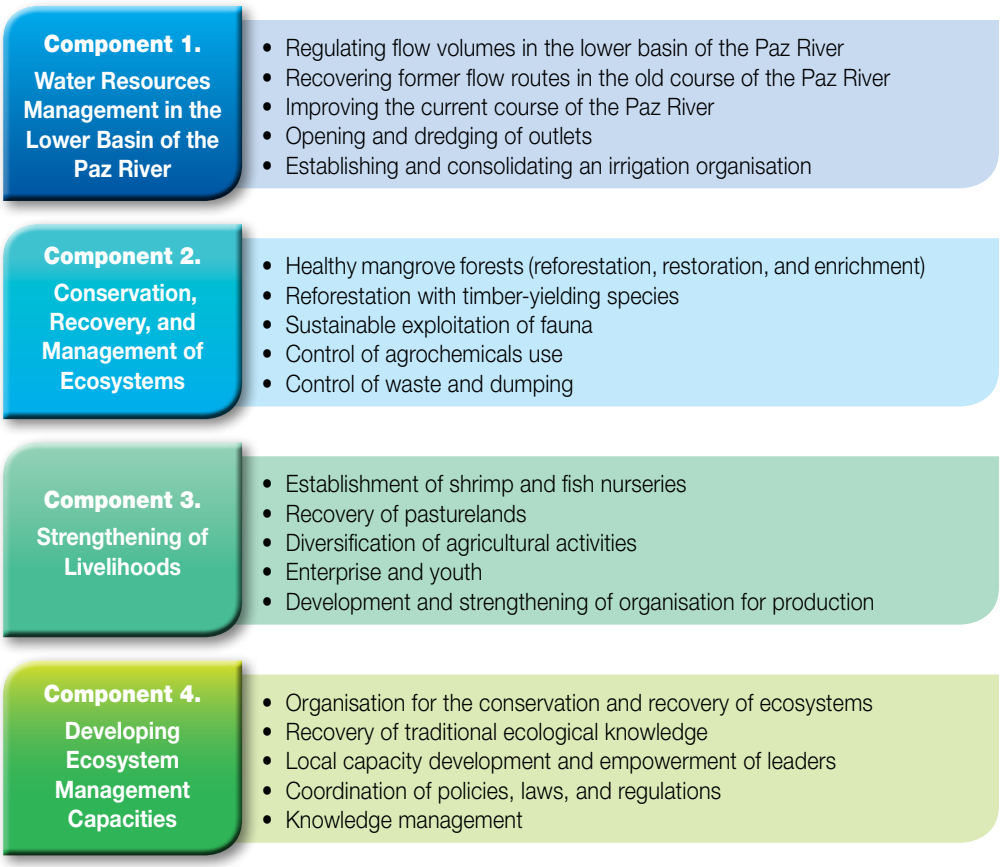
To contribute to the strengthening of the livelihoods of communities through the recovery and conservation of the wetlands ecosystems of the lower basin of the Río Paz, thereby bettering the quality of life for its inhabitants and reducing vulnerability to environmental degradation.

Objective

The communities perform a number of actions oriented towards the strengthening of their livelihoods and the recovery and conservation of ecosystems and their services, for the achievement of human well-being and biological diversity in the lower basin of the Río Paz.

The Management Recommendations are organised according to four principal components: 1) management of water resources, 2) conservation and recovery of ecosystems, 3) strengthening of livelihoods, and 4) capacity development (See Figure 14).

Figure 14: Components and Management Recommendations.



Component 1: Water Resources Management in the Lower Basin of the Río Paz

1. ***Regulating flow volumes in the lower basin of the Río Paz:*** In light of changes in the hydrological dynamic of the lower basin of the Río Paz, it is necessary to perform a number of actions oriented towards the regulation (control) of flow volumes in the area, with the aim of distributing and dissipating flows and reducing impacts from floods, through the gradual recovery of the natural infrastructure.

2. ***Recovering former flow routes in the old course of the Río Paz:*** Specific sites are identified for dredging in order to permit the controlled flow of water along the old course of the river and other diversion canals, with the aim of increasing the supply of fresh water to wetlands ecosystems and coastal aquifers that provide communities with water and dissipate flooding during extreme events.

3. ***Improving the current course of the Río Paz:*** Currently, the Río Paz spreads out on the alluvial plain in Guatemalan territory, in a shallow bed that quickly overflows during the rainy season. This overflowing has impacts on livelihoods (loss of harvests, infrastructure, grasslands, and animals) as well as on wetlands ecosystems (silting). The communities consider it necessary to increase the riverbed's capacity for water volume and reduce flooding.

4. ***Opening and dredging of outlets:*** Due to the reduction of flow volumes, outlets have become closed off during the dry season, impeding the adequate interchange of fresh and salt water in mangrove forest ecosystems. The outlets affected are that of Garita Palmera at the mouth of the Aguacate River, a diversion flow of the Río Paz whose flow volume has been regulated by a levee, and the outlet at Botoncillo, at the mouth of the Río Paz, which is currently dry year-round.

5. ***Establishing and consolidating an irrigation organisation:*** Part of the hydrological problem has its origin in disorganised management and inadequate irrigation practises (including, among others, the blocking of water flows or badly planned irrigation and drainage canals). It is necessary to establish an entity that regulates irrigation practises and coordinates the equitable and organised exploitation of water resources for irrigation, taking into account the effects of exploitation of water resources on ecosystems and their appropriate functioning. This entity must be able to count, at least, on the participation of local governments and producers' organisations.

Component 2: Conservation, Recovery, and Management of Ecosystems

1. ***Healthy mangrove forests:*** Areas both public and private are identified for mangrove forest recovery, through activities that include mangrove reforestation and wetlands restoration and enrichment, among others, that enable the adequate interchange of fresh water and saltwater. Such activities are planned in conjunction with those of Component 1, in order to guarantee the sufficient supply of fresh water for the various species. Priority is given to sites that function as regulators of flooding, tidal surges, and tsunamis.

2. ***Reforestation with timber-yielding species:*** Community areas are defined for reforestation with diverse native species, with the long-term objective of sustainable exploitation of timber for construction and firewood for heating fuel in the communities. Priority is given to sites on channels along rivers and near lagoons that can help control erosion and lessen the impacts of flooding.

3. ***Sustainable exploitation of fauna:*** Sizes, ages, and capture periods of crustaceans, molluscs, fish, and other wild animals are studied, defined, and recorded. These activities are based on a familiarity with legislation and move forward a process of unification of existing legislation in both countries in terms of close seasons, allowable capture sizes, and permissible sizes of fishing nets.

4. ***Control of agrochemicals use:*** Agreements are reached for reducing the use of agrochemicals; organic alternatives for fertilizing and pest control are sought and implemented; and appropriate disposal of agrochemical waste is regulated. These activities are controlled and planned by the entities established in Component 4. (See below.)

5. ***Control of waste and dumping:*** Processes for the recycling of trash in communities are defined and implemented on a community basis. Funds are administered for the establishment of collection sites for inorganic trash, and management is set up for the construction of pit toilets in those communities that do not have them, particularly in Guatemala.

Component 3: Strengthening of Livelihoods

1. ***Establishment of shrimp and fish nurseries:*** Specific sites are analysed and defined, along with the community associations that will work for the establishment of this type of activity. Support is given for the formation or strengthening of fisheries cooperatives for the establishment of nurseries. Administration of the necessary resources for the establishment of nurseries, or support for soliciting micro-loans for the community cooperatives, takes place together with municipalities and other actors.

2. ***Recovery of pasturelands:*** New grazing technologies are tested and evaluated in areas devoted to animal-raising. This might include the implementation of forest grazing (pastures that contain trees and grazeable bushes), soil and water conservation practises, diversification to include pasture species that are more adapted to current local situations, or using hybrid seed.

3. ***Diversification of agricultural activities:*** Pilot projects are implemented on family parcels for the trying of new crop species or productive systems that are better adapted to area conditions. Support is given to the establishment of agricultural producers' cooperatives that promote crop diversification and perform tests of crops and productive systems better adapted to area conditions.

4. ***Enterprise and Youth:*** Stimulation is provided for the development of new micro-sized and small services and production enterprises. These will in turn stimulate economic articulation and the circulation of capital within the area. Such activities might entail the production of concentrates, the production and commercialisation of organic or semi-organic supplies, tourism services, etc.

5. ***Development and strengthening of organisation for production:*** The idea of this activity is to support the organisation of producers in order to plan production processes in ways that can be adapted to the ecological and hydrological conditions of the alluvial plain in the lower basin of the Río Paz.

Component 4: Developing Ecosystem Management Capacities

1. ***Organisation for the conservation and recovery of ecosystems:*** Principal actors are defined for the establishment or strengthening of at least two community-based organisations (one for each country) that promote and coordinate recovery and conservation efforts in the mangrove forests and other wetlands on which community livelihoods depend. This organisation will require the support of municipalities in both countries, and will be responsible

for promoting and coordinating community activities aimed at recovering specific mangrove forest sites, vigilance, and environmental awareness raising.

2. ***Recovery of traditional ecological knowledge:*** People are identified who possess traditional ecological knowledge and can share this knowledge, placing it at the disposition of the communities in the lower basin, so that it may serve in the recovery of wetlands ecosystems. Knowledge management will be an essential tool for community-based organisations responsible for implementing recovery measures.

3. ***Local capacity development and empowerment of leaders:*** Capacities, competencies, and limitations of local actors, including youth and women, are identified with an eye on environmental management and development, and a capacity development plan is established. This plan will develop and strengthen capacities based on practical experience for the resolution of key environmental problems (learning-by-doing methodology). The plan should address themes that the communities have already specified, such as: the recovery and restoration of mangrove forests, waste management, enforcement of laws and regulations controlling fishing and hunting, conflict resolution management, risk management, and technical assistance for production and diversifying production.

4. ***Coordination of policies, laws, and regulations:*** Local and national governments in both countries have a number of policies, laws, and regulations concerned with environmental management. The coordination of these instruments will be promoted in order to reduce irregularities between the countries and integrate experience in the environmental management of shared ecosystems.

5. ***Knowledge management:*** Despite difficulties, Central American experience in management, conservation, and recovery of wetlands ecosystems has grown. This experience, however, has not been sufficiently recorded, systematised, and organised, so that it might serve as feedback and support in similar processes undertaken by many local organisations and communities.

Conclusions

It is often thought that nature conservation works against the interests of the fight against poverty and vice versa—that it is not possible to conserve nature and combat poverty at the same time. Through its Wetlands and Livelihoods programme, Wetlands International maintains that, not only do efforts at nature conservation and development reinforce each other, they actually need each other in order to be successful.

In order to have long-term effects on the conservation of ecosystems, development, and the reduction of poverty, people must sustainably manage the resources on which they depend. This is particularly true in wetlands regions, where a great number of people depend on the water, the foods, and the regulating services that these ecosystems provide.

The Project Wetlands and Livelihoods in the Lower Basin of the Río Paz has shown that disorganised territorial management and the lack of coordination among national and local authorities has accelerated the processes of degradation in the Río Paz basin. This has countless consequences for the wetlands ecosystems, the livelihoods of local populations in the lower basin, and the present and future well-being of those people.

The wetlands of the area of study currently display a structure and a composition of species that are the result of processes of salinisation and desiccation, due in turn to changes in the hydrological dynamic that the area has experienced since 1980.This can be seen in the dominance of one species of mangrove that is resistant to salinity (A. germinans) and the absence of other species typical to these ecosystems.

The livelihoods of local inhabitants are based on provisioning services of mangrove forests, especially fish, crustaceans, and molluscs. In all cases, these ecosystem services are being diminished, due to the worsening health of the ecosystems. It is interesting to note the different configurations of livelihood strategies in El Salvador and Guatemala. In El Salvador, a high percentage of families depend on fishing and the gathering of crustaceans and molluscs, services provided by the ocean, the marshes, and the mangrove forests, while a high percentage of Guatemalan families say they depend on land-based activities, such as animal-raising and agriculture. This most likely is due to two factors: the availability of land and better judicial security with respect to land-holding in Guatemala—that is to say, better access to other resources.

The Project showed—and people in the area point out—that consideration of the issue of improving the supply of fresh water is essential when planning the recovery of ecosystem functions in the coastal wetlands of the lower basin of the Río Paz. This recovery—and by consequence, the recovery of the principal livelihoods of the local communities—depends on the recovery of hydrological processes and the adequate interchange of fresh water and saltwater.

A recovery of this type will bring countless benefits to the local communities, benefits that the residents understand and point out. Outstanding among these are the increased availability of provisioning services (mainly fish, molluscs, and crustaceans, but also timber and wild fauna) and regulation services in the form of improved flood and tidal-surge protection. Recovery of

the wetlands ecosystems will also increase opportunities for well-being in the communities by increasing the likelihood of potential opportunities for development via other activities, such as rural or community tourism.

This is particularly relevant if we consider that the effects of climate change on coastal wetlands ecosystems, in those areas in which reductions in rainfall and droughts are foreseen, will notably affect the availability of ecosystem services and therefore the food security of coastal communities who depend on them, communities of the poorest and most marginalised people.

Although the inhabitants do not adequately perceive it, desiccation of the wetlands has decreased their ability to control flow volumes on the alluvial plain, and this situation seriously affects people's quality of life, due to damages to harvests and the productive infrastructure, as well as to the impacts that flooding has on mangrove forest and coastal lagoon ecosystems.

In order to improve the health of ecosystems, as well as to make other improvements such as increasing the capacity for adaptation in the face of extreme events, it is essential to achieve a process of social, collective construction in the territory and develop capacities for joint, associative management, with the goal of improving the social and ecological resiliency of this region.

Experience gained from the Project in the lower basin of the Río Paz shows once again that conservation and development are intimately related and cannot be dealt with separately, and that the deterioration of wetlands ecosystems means the impoverishment of many communities.

References

CATIE-CRS. (2005). *Identificación de cuencas con alto potencial económico*. San Salvador.

CCAD. (2009). *Plan de gestión ambiental participativo de la cuenca del río Paz*. San Salvador: Comisión Centroamericana de Ambiente y Desarrollo.

Consejo Nacional de Planificación y Coordinación Económica. (1974). *El Salvador - Zonificación Agrícola - Fase I*. Gobierno de El Salvador, Departamento de Desarrollo Regional. Washington D.C.: Organisation of American States.

Duarte; JR. (2007). *Estudio de Balance Hídrico de Seis Subcuencas Hidrográficas Prioritarias Regiones Hidrográficas Cara Sucia -San Pedro Belén, Río Grande de Sonsonate y Banderas*. San Salvador, El Salvador: Proyecto USAID Mejor Manejo y Conservación de Cuencas Hidrográficas Criticas.

El Diario de Hoy. (June 23, 2006). Inauguran la borda en el río Paz. San Salvador, San Salvador, El Salvador.

Erazo Chica, A. M. (2006). *Variaciones hidroclimáticas o evidencias de cambio climático en El Salvador*. San Salvador: Servicio Nacional de Estudios Territoriales, MARN.

Gallo M. and Rodríguez E. (2010). *Caracterización de paisajes y ecosistemas*. San Salvador, El Salvador: Wetlands International Project: Gestión integrada de recursos hídricos y medios de vida en el río Paz.

La Prensa Gráfica. (June 22, 2006). Persiste temor en riberas de río Paz por ruptura de borda. San Salvador, El Salvador.

MARN - AECI. (2003). *Inventario Nacional y Diagnóstico de los Humedales de El Salvador*. San Salvador: MARN - AECI.

Menéndez, Y. (24 de Noviembre de 2010). Impacto de las inundaciones y costo de las obras de mitigación para las comunidades. (E. Rodríguez, Interviewer)

Millenium Ecosystem Assessment. (2005). *Ecosystems and human well-being: Wetlands and Water Syntesis.* Washington, DC. USA: World Resources Institute.

Ministerio de Gobernación. (June 03, 2010). *Ministerio de Gobernación*. Accessed 24 November 2010 from previous news and notices: http://www.gobernacion.gob.sv/index.php?option=com_content&view=article&id=302:proteccion-civil-confirma-120-mil-afectados-por-lluvias-y-su-impacto-en-la-agricultura&Itemid=164

MOP. (December 03, 2009). *Ministerio de Obras Públicas, Transporte, Vivienda y Desarrollo Urbano: Noticias Ciudadano.* Accessed 14 November 2010 from Ministerio de Obras Públicas, Transporte, Vivienda y Desarrollo Urbano: Trabajando con Transparencia: http://www.mop.gob.sv/index.php?option=com_content&view=article&catid=1:noticias-ciudadano&id=144:paso_vehicular_habilitado__en_ruta_hacia_garita_palmera&Itemid=77

OEA. (1998). *Diagnóstico general de la cuenca binacional del río Paz, El Salvador - Guatemala. Programa de manejo sustentable de los recursos naturales de la cuenca binacional del río Paz, Guatemala* - El Salvador. San Salvador - Ciudad Guatemala: Organización de Estados Americanos.

OEA. (1974). *El Salvador - Zonificación Agrícola - Fase I.* Gobierno de El Salvador, Departamento de Desarrollo Regional. Washington D.C.: Organisation of American States, National Council on Planning and Economic Coordination.

OEA. (2000). *Plan de desarrollo integrado y sostenible de la cuenca alta binacional del río Paz*. San Salvador: Organización de Estados Americanos.

Olson et al. (2001). *Terrestrial Ecoregions of the World: a new map of life on earth.* Bioscience 2001 Vol. 51 N° 11.

RAMSAR. (2005). *Directrices para la evaluación rápida de la biodiversidad de los humedales continentales, costeros y marinos.* Kampala (Uganda), 8 to 15 November 2005: 9ª Reunión de la Conferencia de las Partes Contratantes en la Convención sobre los Humedales Resolución IX.1 Anexo E i.

Rodríguez G. and Siles J. (2010). *Nuestros recursos, nuestros capitales: Diagnóstico participativo sobre medios de vida y capitales de la comunidad en la cuenca baja del Río Paz, El Salvador y Guatemala*. San Jose, Costa Rica: Wetlands International.

Rodríguez Herrera, E. (2010). *Dinámica hidrológica en la cuenca baja del río Paz*. San Salvador: Wetlands International.

Rodríguez Herrera, E. (2004). *El proceso de transformación territorial en al zona de estudio a partir de la historia oral*. San Salvador, El Salvador.: BASIM Project: Manejo Integrado de Cuencas Asociadas al Complejo Hodrigráfico El Imposible - Barra de Santiago - El Salvador.

Servicio Nacional de Estudios Territoriales. (July, 2002). *Informe del análisis del comportamiento hídrico en El Salvador, posibles causas e implicaciones*. Accessed 15 November 2010 from Servicio Nacional de Estudios Territoriales: http://www.snet.gob.sv/Documentos/comp_hidrico.htm

Sistema de Contrataciones y Adquisiciones del Estado de Guatemala. (November 15, 2010). *Sistema de Contrataciones y Adquisiciones del Estado de Guatemala*. Accessed 15 November 2010, from Guatecompras: http://www.guatecompras.gt/concursos/consultaDetalleCon.aspx?nog=1064088&o=1

SNET. (2005). *Balance hídrico integrado en El Salvador: componente evaluación de recursos hídricos.* San Salvador, El Salvador: Ministerio de Medio Ambiente y Recursos Naturales de El Salvador- Servicio Nacional de Estudios Territoriales.

SNET. (July, 2002). *Informe del análisis del comportamiento hídrico en El Salvador, posibles causas e implicaciones*. Accessed Noviembre 15th, 2010, from Servicio Nacional de Estudios Territoriales: http://www.snet.gob.sv/Documentos/comp_hidrico.htm

UICN - Programa Alianzas. (2007). *Diagnóstico rápido del río Paz*. San Salvador, El Salvador: UICN.

UICN. (2004). *Análisis de actores de la región hidrográfica Cara Sucia - San Pedro Belén, Ahuachapán El Salvador*. Ahuachapan, El Salvador: Proyecto BASIM "Manejo integrado de cuencas hidrográficas asociadas al completo Barra de Santiago - El Imposible".

Wetlands International. (August, 2010). *Humedales y desarrollo sostenible*. Accessed from http://lac.wetlands.org/WHATWEDO/Usosostentable/tabid/1150/Default.aspx

Wetlands International Latinoamérica y El Caribe. (2010). *Uso sostenible y medios de vida*. Accessed August 2010 from Gestión Integrada de Recursos Hídricos y Medios de Vida en Río Paz, El Salvador/Guatemala: http://lac.wetlands.org/WHATWEDO/Usosostentable/R%C3%ADoPaz/tabid/2138/Default.aspx

Wetlands International. (August 2010). *Wetlands International: Latinoamérica y el Caribe*. Accessed from Misión y Visión: Wetlands International

Appendix 1: Contributors

These are the 111 leaders who participated in the generation of the Management Recommendations for the recovery of livelihoods and their related ecosystems in the lower basin of the Río Paz.

Country	Community	Name	Organisation or Institution
El Salvador	Bola de Monte	Jorge Alberto Jiménez José David Sarzeño María Oneyda Brigalba Maritza Lizeth Rodríguez	Asociación de Desarrollo Comunitario Bola de Monte (ADESCO)
	Brisas del Mar	Miguel Ángel Ortiz Santos Peña Jiménez	
	Colonia ISTA	Juan Carlos Ramírez	
	El Botoncillo	María del Carmen Díaz Mauricio Gallardo	Asociación Pro Comunidad
		Ana Lilian Ángel Brenda Beatriz Ángel	El Botoncillo Community
		Luis Díaz Milton Sarzeño	Student
	El Limón	Benjamín Carranza Eugenia Hernández Beltrán Hortensia Henríquez Ignacio Escobar Isabel Beltrán	Asociación de Desarrollo Comunitario El Limón (ADESCO)
		Armando Román Pedro Antonio Ramírez	Student
		Virginia del Rosario Lazo	Fisheries, saleswoman
		Leticia Elizabeth Hernández Natalia Antonio García Yessenia Evelyn Miranda	
	El Tamarindo	Agustina Nicolasa Colocho Berta Alicia Rodríguez Mejía Celso Daniel Rodas Celso Orellana Jesús Gómez Díaz Tamarindo	Asociación de Desarrollo Comunitario El Tamarindo (ADESCO)
		Nicolasa Alvarado	Fisheries, saleswoman
		Ana Cecilia Girón Delmi Ines Guandique Francisco Espinoza Colocho José Walter Díaz Serrano Nehemías Ismael Guardique Roberto López Saldaña	

Country	Community	Name	Organisation or Institution
Guatemala	Garita Palmera	Antonio Guerra Eduardo Suriano Corado José Hernán Vásquez Tereso Soriano Corado	Asociación de Desarrollo Comunitario Garita Palmera (ADESCO)
		Antonio Guerra de la Cruz Candelaria Flores Erazo Mercedes de la Cruz Rojas Miguel Ángel Rivera Rojas	
	s/d	José Domingo Donis	Asociación de Desarrollo Comunitario (ADESCO)
		Lidia Guardado Reina Jiménez Yensi Carolina Landaverde	
	San Francisco Menéndez	Carlos Martínez Claudio Rivas Juan Leiva María Ofelia León de Solórzano Rafael Ernesto Galindo Reina Ester Surian Rudy Orlando Arriola Walter Díaz Zulma Yesenia Girón Carlos Humberto Rodríguez Francisco José Rodríguez Juan Pablo Lara Durán María Dolores Estrada Mayra López Herrera Wilberth Machado	San Francisco Menéndez Municipal Government
	Champas La Ceiba	Gladis Arévalo Jorge Alberto Lucero	
	Champas Monte Rico	José Humberto Dávila H. Ulises Ramos	
	Garita Chapina	Lucía Pineda Escobar	Garita Chapina Health Centre
		Eligio Alvarado Feliciano Ascencio Trigueros Feliciano Atencio Figueroa Luis Alfonso Najera Neri Asencio Lucero	Comité Comunitario de Desarrollo Garita Chapina (COCODE)
		Elizabeth González Ernesto Orellana Hugo Carranza José Luis Rivera Peña José S Magaña Marcela Díaz Nájera Onan Hernández Víctor Corado	

Country	Community	Name	Organisation or Institution
	La Barrona	Dorsin Hernández Castillo Mercedes Antonia Méndez Mirtala Noreli Cabrera Rizo	Asociación Ajub (Youth), La Barrona
		Alba Nineth Cabrera Rizo Evangelina Méndez	Asociación de Mujeres La Barrona
		Aníbal Castillo Carlos Roberto MF Fredy Méndez Geovani Barrantes Jorge Ramos León Debell	Comité Comunitario de Desarrollo La Barrona (COCODE)
		Bernardo Chilín	La Barrona Resource Guardian, a functionary of Consejo Nacional de Áreas Protegidas de Guatemala CONAP
		Melvin Argelio Monterrosa H. Miguel Hernández	
	La Blanca	Gerardo A Quijarros Senia Lisbeth Marín Carrillo	Comité Comunitario de Desarrollo La Blanca (COCODE)
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		Maryuri Casatillo Valle	Organización de Mujeres de Las Barritas
		Julio César Aguirre Yulsini Menéndez Corado	Representatives of the Municipal Government of Moyuta, Región 1
		Evelin Johana Lemus Manuel Estrada	
	Monte Rico	Silvia Marilú Orozco M. Macaria Enríquez Israel Gonzáles José David Enríquez Godoy	Comité Comunitario de Desarrollo Monte Rico (COCODE)
	Nuevo Amanecer	Melvin Montero	

Appendix 2: Additional Maps

Flood Fronts in the Lower Basin of the Río Paz

Locations of Wetlands Ecosystem Control Sites

Locations of Salinity Control Sites

Appendix 3: Accounts And Testimonies

The People Who Tell the Story

Don Abraham Castillo – Village of Las Barritas, Guatemala
Born in Las Barritas in 1939, son of Ezequiel Hernández and Enriqueta Castillo. His father was from Conguaco, and his mother from La Danta, a village near Pedro de Alvarado. His father came to Las Barritas as a farm labourer. Don Abraham was born there and is currently a cattleman.

Doña Reina Estrada – Village of Las Barritas, Guatemala
Daughter of José Candelario Estrada and María Isabel Recinos, she was born in Las Barritas. Her father is from the village of Pasaquillo, near Las Lisas, and her mother from the upper basin of the Río Paz. She tells us that in the village there are currently about 300 families— the Castillos, the Hernándezes, the Menéndezes, and the Estradas—who are the founders of Las Barritas. She describes her village as a peaceful place and says that this is because the people are very unified.

Don Candelario Arriola – Community of Bola de Monte, El Salvador
Candelario Arriola, or "don Cande," as he is known in the community, has lived in Bola de Monte for 31 years. He came here during the war, which is the case for the majority of residents of the area. Before that, he was a tenant farmer on farms in Zacatecoluca, Zapotitán, and Sonsonate, working in cane fields and with animals. He is currently in charge of the turtle nursery established between the communities of El Tamarindo and Bola de Monte.

Doña Nicolasa Alvarado and Don Mauricio Lemus – Community of El Tamarindo, El Salvador
Doña Nicolasa, was born in 1957, of a Guatemalan father and a Salvadoran mother, in the community of Bola de Monte. When she married, she moved to the neighbouring community of El Tamarindo. Doña Nicolasa and Don Mauricio Lemus, her partner, have seven children. They sell fish. For doña Nicolasa, the ocean is "her growing field, her factory, her means of support." She is President of the "Reyes del Sol" independent fisheries cooperative, and is a representative of the Asociación de Desarrollo Comunal de El Tamarindo (El Tamarindo Association for Community Development).

Doña Mariana Najario and husband – Garita Chapina, Guatemala
With their four children, they came to live in Garita Chapina in 1973, working as labourers on a plantain farm. They arrived with other people from Jutiapa to settle in the area. They remember that when they arrived, there was more forest and an abundance of blue crab, which they used to sell.

Changes in Ecosystems and the Countryside

Early settlers in the area talk about changes that occurred in ecosystems since their arrival. About ten families lived in the village of Las Barritas at the beginning of the 1930s. Doña Reina Estrada is from one of these families, as is Don Abraham Castillo. Both remember childhoods spent in abundance. Don Abraham tells us that when he was a boy *"the entire area around Las Barritas was montaña[15], and people lived by clearing little places to grow corn and raise pigs and chickens."*

Doña Reina recalls that her parents also worked at animal-raising (pigs, cows, and fowl), but they also grew white beans, corn, and sesame. Her mother travelled by boat to the port of San José to sell her produces, especially chickens, eggs, and meat. She says, *"47 years ago, the only way to travel was by boat."*

When Don Abraham was young *"you could find almost everything you needed to live in the mangrove forest: crabs, a great variety of shellfish, iguanas, shrimp, fish, firewood and timber."*

Similar accounts are told in El Salvador where, according to testimonies, the entire area was forested, with deer (*Odocoileus virginianus*), crocodiles (*Crocodilus acutus* and *Caiman crocodilus*), otters (*Lutra longicaudis*), garfish (*Atractosteus tropicus*), boas (*Boa constrictor*), a great diversity of birds, and an abundance of fish. *"The mangrove forests were wonderful; they were great swamps abounding in fish like snook, gar, and dentex. The Aguacate was deeper, and there were crocodiles. When we went out at night to lucear,[16] we saw the big crocs."* (An account from Carlos Reyes Arévalo, taken from Rodríguez 2004.)

Don Abraham recalls that everything began to change between 1970 and 1980, when *"people from colder places began to arrive; there were a lot of people."* The Agrarian Law allotted 10 to 15 manzanas (about 7 to 10 ha) to each family that settled in the area, a piece of land that was much bigger than what the people already living in Las Barritas had.

These new settlers in the area, "the people from colder places", didn't know how to take advantage of the wetlands resources as well as the old-time residents. Many of the new arrivals, who came from Jutiapa, settled in Las Barritas, Garita Chapina, and La Barrona. This was the case for Doña Mariana Najario and her husband and four children, who arrived in Garita Chapina in 1973. They tell us that they took up agriculture (mainly plantains, corn, maicillo, sesame, and peanuts) and fishing (for personal consumption and for sale), but they never raised animals. They remember that when they arrived, there was more forest and a great quantity of blue crabs that they caught and sold. Smaller blue crabs can still be found, and these they catch for personal consumption but not for sale.

Two processes defined the settling of the Salvadoran areas. The first occurred during the 70s, when cotton-growing was expanding and permanent and temporary labourers were needed. *"They came and cleared the scrubland and groves of trees all the way to the beach in order to plant cotton. In those days, they did this with poison; planes would fly over spraying poison, and every single mosquito died, and quite a lot of fish, too. Who knows what poison they used. With*

[15] *montaña:* term that rural people use to refer to forest in general.
[16] *lucear:* activity in which fish are blinded with a torch and captured with a harpoon.

the cotton, a lot of people arrived because there was work. In those days, there was only the community of Garita Palmera; the rest of us were tenant farmers. The tenant farmers had rights to use the land for a part of what they produced, two bags per manzana. But that was all over when the cotton came" (An account from Carlos Reyes Arévalo, taken from Rodríguez 2004).

The process of land concentration changed with the coming of agrarian reform in the 80s, in which the lands of the haciendas were subdivided and given over to farmers. This reform did not prevent armed conflict in El Salvador, however, and this was the second process that defined the settling of the area, during the 80s (Rodríguez, 2004). Candelario Arriola is one who arrived during the war to settle in Bola de Monte. He recalls that *"you would find 30 to 40 people in every house. A great number of war refugees came here. Some left; some stayed on."*

In this way the territory, formerly covered in mangrove forests and coastal wetlands, was transformed into a collection of productive systems with small remnants of forest. The fragmentation of the mangrove forest ecosystems in the area is due primarily to small land allotments, where marginal rural communities have become established, as well as to the exploitation of the mangrove.

Changes in Water Resources: Quantity and Quality of Water

Residents tell about how fresh water was abundant when they settled, before the Río Paz changed its course. *"Water was a blessing because part of the Río Paz flowed through the Aguacate, and part along the border with Guatemala. Wherever you dug a well, you would find fresh water, and you only had to dig down a vara*[17] *or two"* (An account from Carlos Reyes Arévalo, taken from Rodríguez 2004.)

"Already by '82, the Río Paz no longer flowed here. It had been blocked since 1955. It would get blocked up in the winter, and only a little water came through, and then in the summer it went dry. But by '70 or '75 no more water came through at all. The river changed its course over to Guatemala and flowed out at El Limón. Then it developed another course farther upstream, then in 2003 it made another, but that one they managed to block. But the truth is that here we have a big problem with the Río Paz, and because of this the water is getting saltier. The saltiness has been getting worse, and the water tables just have less and less of the fresh water that they once had" (An account from Candelario Arriola, taken from Rodríguez 2004.)

Doña Reina tells us that in her childhood *"between the villages of Las Barritas and the Administrative Centre (in Guatemalan territory) there were big branches of the Río Paz, and the area was completely covered by tall mangroves. You couldn't get to the Administrative Centre on foot; you had to go by boat."*

Today, there are only two small branches of the river, with a width of about two metres. Less than 50 cm deep, they carry only a small amount of water, only growing during the rainy season, when they join and flood the village. She tells us that *"if the river goes dry, our water in the village is bitter and salty. The only good water is in the wells at Las Barritas; people from the neighbouring villages come to get water from the wells at Las Barritas. When the tide comes up,*

[17] *Vara:* an old Spanish unit of distance, equal to slightly less than a metre.

the wells get salty." The same occurs in Garita Chapina, where the water is salty nowadays, but when Doña Mariana Najario and her family arrived, it was sweet.

The same process occurred in the communities in El Salvador. Don Mauricio tells us that in the 70s, there were great stretches of white mangrove (*Laguncularia racemosa*) that was exploited when it was still green and that since the 80s *"there's no more tall mangrove; only black mangrove trees (*Avicennia germinans*) are found."* In his opinion, the white mangrove has not been able to recover since those days because the outlet of the Río Paz becomes blocked during the dry season. Before the change in the course of the Río Paz, there was better mixing with fresh water in the area. The outlet didn't fill up with sediments, and the river flowed to the ocean. Now it doesn't make it that far, and it is the local residents who have to see to obtaining the necessary machinery to open the outlet. Don Mauricio maintains that this is due to the construction of a levee upstream on the Río Paz, and the water is being used to irrigate cane fields, and this has hampered the recovery of the mangrove forest in this area. Don Mauricio Lemus also tells that *"in Botoncillo there's a bigger problem than in El Tamarindo. There, when it rains—all it has to do is rain—when the mouth gets block up, and the black water finally goes down, even the fish die… the crabs, the larvae… nothing's left. It's the poison they use upstream in the cane fields. No one controls this in Guatemala."*

Changes Caused by Extreme Events

Many accounts of residents of the area mention changes that happened during the extreme events of the past few decades: Hurricane Fifí (1974), Hurricane Paul (1982), Hurricane Mitch (1998), Tropical Storm Stan (2005), the storms of 2006 (July and October), and Tropical Storm Agatha (2010).

"When I arrived here, the forests were enormous, with trees with big trunks. They were full of crabs, and there was everything, like in Barra de Santiago. But the big blow of '82 took out everything. On Saturday 19 September, we began to get the flooded people out, and we brought them to the house. I donated the use of my dugout, and we filled five other boats as well with flood victims. The ocean was really high. The destruction was very great. The beach stank of dead animals, I lost my crops, the peppers, the yucca, the soybeans… We lost 18,000 colones that year." recounts Candelario Arriola when he remembers Hurricane Paul's passing through the area.

Mauricio and Nicolasa remember two extreme events: *"the cyclone of '74 (Hurricane Fifí) was the one that ruined the fishing, and Mitch (1998) the one that took our house and everything we had. At that time, we didn't live where we do now, on the levee. We lived at the outlet of the river. When Mitch was at his worst, the tide took the house. Mitch destroyed in two ways: on the river and on the ocean. In the time we've been here on the levee, we've never been flooded. It floods from Bola de Monte to Colonia ISTA and the junction that goes to Garita Palmera. Before, when the river burst its banks, everyone came to the levee." "Before the cyclone of '74, there were a lot of librianchа (milkfish - chanos chanos). Maybe the fish migrated, or the temperature of the water changed; it's warmer now. There aren't any more fish, or hardly any."* Adds Mauricio.

Reina Estrada remembers Mitch: *"Back 37 years ago, there was still mangrove forest. The Río Paz was still really deep. Mitch really affected the mangrove forest; he knocked down a lot of trees."*

Appendix 4: Community Assets

Summary of Community Assets in El Salvador
(taken from Rodríguez and Siles, 2010)

Community Assets – El Salvador	
Human	• Adults have very little education. Their children have a higher level of education. • People have skills primarily related to fishing (Botoncillo, Tamarindo, and Bola de Monte) and agriculture (El Limón and Garita Palmera). People in the community developed capacities in the processing and sale of fish, in environmental issues (solid waste management and the protection of turtles), and growing plantains. • Most of the population was born in the area or has lived here for more than 30 years. Frequent illnesses treated in the Health Unit are of the respiratory and gastrointestinal types. There are also occurrences of malaria and dengue.
Social	• There is an ADESCO in most communities, which works very closely with the municipality on community activities and projects. In two communities, the ADESCOS have to be reactivated. There are three fisheries cooperatives (Botoncillo, Bola de Monte , and Tamarindo). Bola de Monte is the only community in which committees are mentioned related to turtles, women, and soccer. In all communities, the work of Visión Mundial is mentioned for supporting the education of children.
Cultural	• In Bola de Monte, Botoncillo, Garita Palmera, and Tamarindo, people consider wetlands products a vital part of their diet. In Tamarindo and Bola de Monte, shark oil is used as a remedy for bronchitis. • The ocean and the wetlands are considered places for recreation, although this is less true in El Limón and Garita Palmera.
Physical	• The communities have primary schools. There is no running drinking water. An average of about 25% of the people have electricity. The roadways and tracks are in normal condition and there is bus service.
Financial	• Fishing and the gathering of crabs and other shellfish are the principal economic activities in the communities. Nevertheless, a third part of people's incomes comes from the cultivation of corn, plantains, sesame, and coconuts. In general, these activities are family labours, and mangrove forest products serve as much for family consumption as they do for sale. • People do not use credit as a production mechanism.
Political	• 75% of the people say that the local government is active with projects in the communities, through ADESCOs, and meetings with the municipality have generated concrete results. The nearest government authority is CENDEPESCA. • About a third of the population is aware of the existence of environmental legislation, but those with this knowledge state that there is no enforcement. • In general, the participation of adult men and women is very similar, but young people are much less involved. • In terms of conflict resolution, the community is the primary vehicle, but the roles of ADESCOs and municipalities are also recognized.
Natural	• Fish, crabs, shrimp, mangrove, and the earth are considered to be the most important natural resources. • Most people purchase water, and that found in wells is growing salty. • A high percentage of the population maintains that there are problems with the management of solid waste. • Climate change is acknowledged, as is a reduction in the number of species in the wetlands.

Summary of Community Assets in Guatemala
(taken from Rodriguez and Siles 2010)

Community Assets – Guatemala	
Human	• In all communities, the majority of adults have completed primary school. Their children have a higher level of education, which in some cases includes secondary school and university. • People have skills primarily related to agriculture, animal-raising, and commerce. In La Barrona a greater number of families have fisheries skills. People in the communities have developed capacities in aspects of agriculture, animal-raising, and nutrition through courses delivered by government organisations. • More than 50% of the population is from the area. The principal reported illnesses are of the respiratory and gastrointestinal types, and dengue.
Social	• There is a COCODE in all communities. There are school boards, women's organisations, a fisheries cooperative, and an environmental protection group. • With respect to community activities, a high percentage refer to community and beach clean-up campaigns as collective actions.
Cultural	• Wetlands products are considered important to the diet. People interviewed have some knowledge of natural resources as a source of medicine. In Las Barritas, Monte Rico, and La Blanca , shark oil is used as a remedy for coughs. Turtle is also used as a remedy. • The ocean and the wetlands are considered places for recreation. People consider familial relationships, church activities, and the tranquillity of the area important.
Physical	• Communities have schools, electricity, and regular public transport. The water supply comes primarily from wells. Some residents purchase water.
Financial	• Animal-raising is the principal economic activity in Las Barritas, La Blanca, and Monte Rico. Labour is supplied by families, as well as by hired labourers, and products serve as much for family consumption as they do for sale. Corn is the second most important product. Fishing is of lesser importance in these Guatemalan communities, except for in La Barrona. There, fish and products gathered from the mangrove forest are used for family consumption and any surplus is sold. • People's finances are based on loans, savings, and the sale of products. A low percentage of people use consignment. • With respect to land-holdings in Las Barritas, Monte Rico, and La Blanca, people maintain that their lands are theirs, but in general, they do not hold legal titles to the land. In La Barrona, 80% do not have their own land.
Political	• All communities have a link to the local government for the development of community projects such as road repair and school construction, among others. The CONAP is the main link to the central government. In La Blanca y Las Barritas, there are regular meetings concerned with the Corredor Tecnológico project. • There is awareness of the existence of environmental legislation among residents, as well as the perception that it is not enforced. It is important to point out that people recognise the existence of agreements on turtle conservation in La Barrona. • In general, the participation of adult men and women is very similar, but the involvement of young people is mentioned only in Las Barritas. • Conflicts in the community are resolved through dialogue, the organisation and support of the COCODE, and the municipality.
Natural	• The river is important for planting and fishing, and it is vital for soil moisture. The mangrove forest supplies wood and is the place where species live. The ocean supplies fish, and lands are for grazing and cultivation. • People maintain that the water is of regular to bad quality and that it is less abundant and saltier. • A high percentage of the population maintains that there are pollution problems due to the mismanagement of solid waste and fisheries waste.

Summary of Community Assets in the Lower Basin of the Río Paz
(taken from Rodríguez and Siles, 2010)

Community Assets – Lower Basin of the Río Paz	
Human	• Residents of the communities in Guatemala have a higher level of education than residents in El Salvador. In Guatemala, people have skills related to animal-raising, while in El Salvador people's skills are related to fishing. Opportunities for capacity development have been provided with some frequency in both countries. • The majority of residents in the lower basin are from the area or have lived there for many years. Illnesses that affect people on either side of the border are similar.
Social	• In communities in both El Salvador and Guatemala, community-based organisations (COCODES and ADESCOS) are considered as basic and are the first in residents' chain of relations. • There are other organisations in the communites, related to fishing, the church, andschools, as well as groups with specific agendas (women, sports, and turtles). • The communities have leaders associated with the COCODES and ADESCOS. Principal community activities are related to community and beach clean-up campaigns.
Cultural	• The basic diet of the residents consists of fish. They recognize medicinal properties of plants. The mangrove forests and the ocean are considered places of recreation. • People point out various community aspects with which they identify, which reveals that they identiify with the territory in which they live.
Physical	• The communities have schools, regular public transport, and basic services, albeit deficient. • Water comes from wells or is purchased. Access to electricity is better in Guatemala.
Financial	• In El Salvador, the principal economic activites for the majority of the population consist of fishing and gathering shellfish, and the labour is peformed on a family basis. In Guatemala, the principal economic activity is animal-raising, and the labour is performed on a family basis as well as hired out. In both countries, these activities are combined with the cultivation of grains, plantains, and coconuts. • Access to systems of credit is low. In Guatemala, financing is based on loans, savings, or the sale of products, with a low percentage of consignment. People in El Salvador generally do not use credit. • In terms of land-holding on either side of the border, people do not hold deeds to their lands. Land-holdings are larger in Guatemala.
Political	• A link between the community and local government exists in all communities and serves for the undertaking of community projects.There are more links between the ADESCOs and municipalities on the Salvadoran side. In Guatemala, there is interest with the Corredor Tecnológico project and regular meetings with the municipality are held on this issue. • There is awareness of the existence of environmental legislation among residents, as well as the perception that it is not enforced. It is important to point out that people recognise the existence of agreements on mangrove and turtle conservation in La Barrona. • In general, the participation of adult men and women is similar, but the involvement of young people is limited. • Conflicts in the communities are resolved at the local level and with the support of the COCODE or ADESCO.
Natural	• With regards to ecosystem resources, the river and the water it provides are essential for grazing lands and irrigation in Guatemala. On the Salvadoran side, fish and shellfish are the most important resources. Therefore, people's vision of the ecosystem is more closely tied to the river in Guatemala and to the mangrove forest in El Salvador. • People consider water to be in short supply, of bad quality, and salty. • A high percentage of the population maintains that there are pollution problems due to the mismanagement of of solid waste and fisheries waste. This shows an awareness of the problem of pollution on a concrete and immediate level. • Residents recognize climat e change and a decrease in the number of species in the mangrove forests.

Mission

To sustain and restore wetlands, their resources and biodiversity for future generations through research, information exchange and conservation activities, worldwide.

This publication documents the relationship between the communities and natural resources in the lower basin of the Rio Paz, in El Salvador and Guatemala. Through a series of studies it is sought to recognize and make visible the values and services provided by wetlands in order to integrate them into the sustainable development of local communities.

As part of the Wetlands and Livelihoods Program, Wetlands International supports the participative construction of management recommendations, formulated from the knowledge and needs of local inhabitants, and addressing the main challenges of linking the provision of ecosystem services and livelihoods.

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