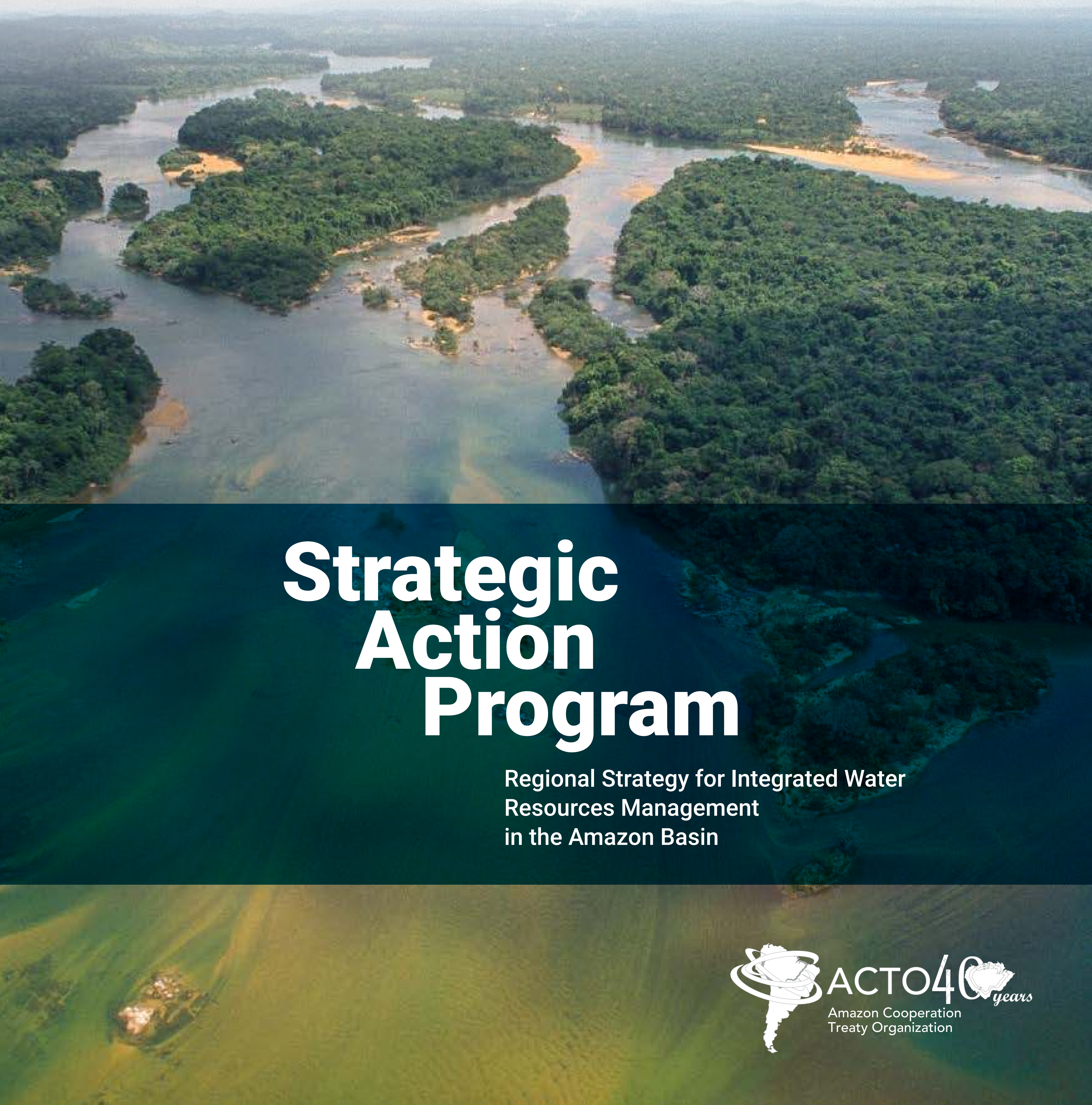
ACTO
Amazon Cooperation Treaty Organization

PROJECT gefamazon
WATER RESOURCES AND CLIMATE CHANGE

gef

UN environment
United Nations Environment Programme



Strategic Action Program

Regional Strategy for Integrated Water Resources Management in the Amazon Basin

ACTO 40 years
Amazon Cooperation Treaty Organization

Strategic Action Program
Regional Strategy for Integrated Water Resources Management in the Amazon Basin

1st Edition
Edited by ACTO
Brasilia, 2018

Permanent Secretariat - Amazon Cooperation Treaty Organization (ACTO/PS-Brasilia)

Secretary General
Maria Jacqueline Mendoza Ortega

Executive Director
César Augusto De las Casas Díaz

Administrative Director
Antonio Matamoros

Environment Coordinator
Theresa Castillion-Elder

Coordinator of Indigenous Affairs
Sharon Austin

Coordinator of Science, Technology and Education
Roberto Sánchez Saravia

Coordinator of Climate Change and Sustainable Development
Roberto Sánchez Saravia (a.i)

Coordinator of Health
Francisco Sánchez Otero

Special thanks to: Robby Ramlakhan, former Secretary General of ACTO and Mauricio Dorfler, former Executive Director of ACTO.

Address
SHIS QI 05, Conjunto 16, Casa 21, Lago Sul
CEP 71615-160 Brasilia D.F. Brazil
Tel. (+5561) 3248-4119 F: + (5561) 3248-4238
www.otca-oficial.info

United Nations Environment Programme (UN Environment) Washington D.C.

Task Manager
Isabelle Van der Beck

GEF Amazon Project - Water Resources and Climate Change (ACTO, Brasilia)

Regional Technical Coordinator
Maria Apostolova

Scientific Advisor
Norbert Fenzl

Communications Specialist and Editorial Coordination
Maria Eugenia Corvalán

Financial and Administrative Officer
Nilson Nogueira

Administrative Assistant
Marli Coriolano

More information:
http://gefamazonas.otca.info

Photography
ACTO and GEF Amazon Project
Rui Faquini
Photo by Luciezr de Shutterstock

Graphic Design, Design and Layout:
TDA Brasil

Printed by:
ATHALAIA Gráfica e Editora

Published with the support of:
United Nations Environment Programme (UN Environment)
Global Environment Facility (GEF)

S898 Strategic Action Program: Regional Strategy for Integrated Water Resources Management in the Amazon Basin. / ACTO/OTCA. Brasília, DF, 2018. 000 p. : il.

Publication in digital format

ISBN: 978-85-00000-00-0

1. Amazon Region. 2 Hydrography. 3. Biodiversity. 4. Amazon Forest. 5. Population.
6. Strategic Action Program, 88. I. Organização do Tratado de Cooperação Amazônica.

CDU: 556.18(811)

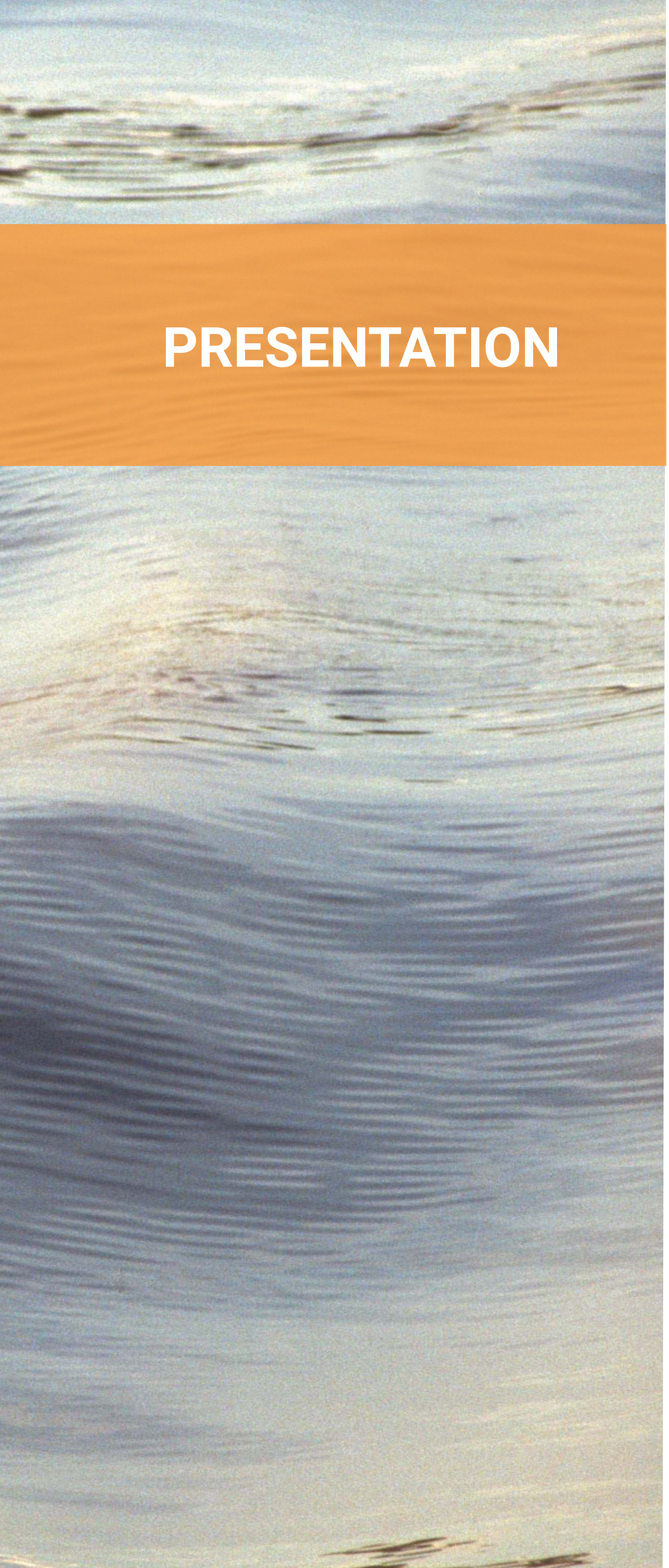
TABLE OF CONTENTS

TABLES

GRAPHICS

FIGURES

Rui Faquini



PRESENTATION

The implementation of a Regional System to Monitor Water Quality in the Rivers of the Amazon Basin, the development of a Program for the Protection and Use of Groundwater for Public Supply in the region, and the creation of Forecast and Warning Systems for Extreme Hydroclimatic Events (droughts and floods), as well as the establishment of an Integrated Regional Platform for Information on Water Resources in the Amazon Basin, are some of the 19 **strategic actions**, carefully designed with scientific rigor, that were agreed by the Member Countries of the Amazon Cooperation Treaty Organization (ACTO). All of these strategic actions are detailed in the Strategic Action Program (SAP), which I am pleased to present, and which represents an unprecedented achievement for ACTO.

For the first time in our region, the eight ACTO Member Countries–Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname, and Venezuela–agreed to adopt a **Strategic Action Program for the Integrated Management of Water Resources of the Amazon Basin**, to ensure future national, regional, and international support for the implementation of key strategic actions in benefit of the peoples and ecosystems of the Amazon Basin.

This Strategic Action Program is the most significant result of the **ACTO/UN ENVIRONMENT/GEF Project on Integrated and Sustainable Management of Transboundary Water Resources of the Amazon River Basin, Considering Climate Variability and Change**. This project is a regional initiative, created by the ACTO Member Countries, funded jointly by the GEF and the countries, implemented by the United Nations Environment Programme, and executed by ACTO.

The SAP is a guiding instrument for regional cooperation and actions by the Member Countries. It must have the support of the highest levels of the corresponding government agencies because it establishes strategies and priorities for regional action. It also proposes policies and guidelines for institutional strengthening.

The Strategic Action Program is built on three fundamental pillars. First, a common vision, developed and shared by the countries, on the integrated management of water resources and sustainable development in the Amazon

Basin. Second, a Regional Transboundary Diagnostic Analysis that made it possible to determine the priority transboundary problems in the basin, identified thanks to ample participation by experts at workshops held in the eight countries. At these workshops, the main transboundary problems of the basin were identified, along with their root causes, and the environmental and socioeconomic impacts were analyzed. Third, the SAP contains the results and recommendations from other project activities and ACTO initiatives.

The countries defined and consolidated three strategic lines of response within the SAP: 1. Strengthening Integrated Water Resources Management (IWRM); 2. Institutional Adaptation to Climate Variability and Change; 3. Knowledge Management.

In order to develop these three lines of response, the strategic actions were formulated. These are being implemented as a large portfolio of projects, in that each action needs to be executed as a specific initiative, with the participation of multiple actors at the local, national, regional, and international levels. There is a place for everyone in the SAP. To raise awareness about the Amazon River, it is incumbent upon all of us to participate: decision-makers, working with technicians, academics, and scientists, as well as artists.

In this sense, ACTO, as a South-South cooperation agency, is especially gratified to have contributed as a platform for political and technical dialogue, through which the linkages between the Amazon countries have been strengthened, with a view to adopting an integrated approach to the management of water resources in the basin, in accordance with the United Nations' paradigms, in keeping with the Sustainable Development Goals, and toward achieving the 2030 Agenda.

I invite you to join the SAP, making commitments to strategic actions from the perspective of your sector or organization, to contribute to the inexorable responsibility of ensuring the protection and conservation of the Amazon Basin, which is of fundamental importance in the beautiful but fragile and vulnerable ecosystem that we call the Earth.

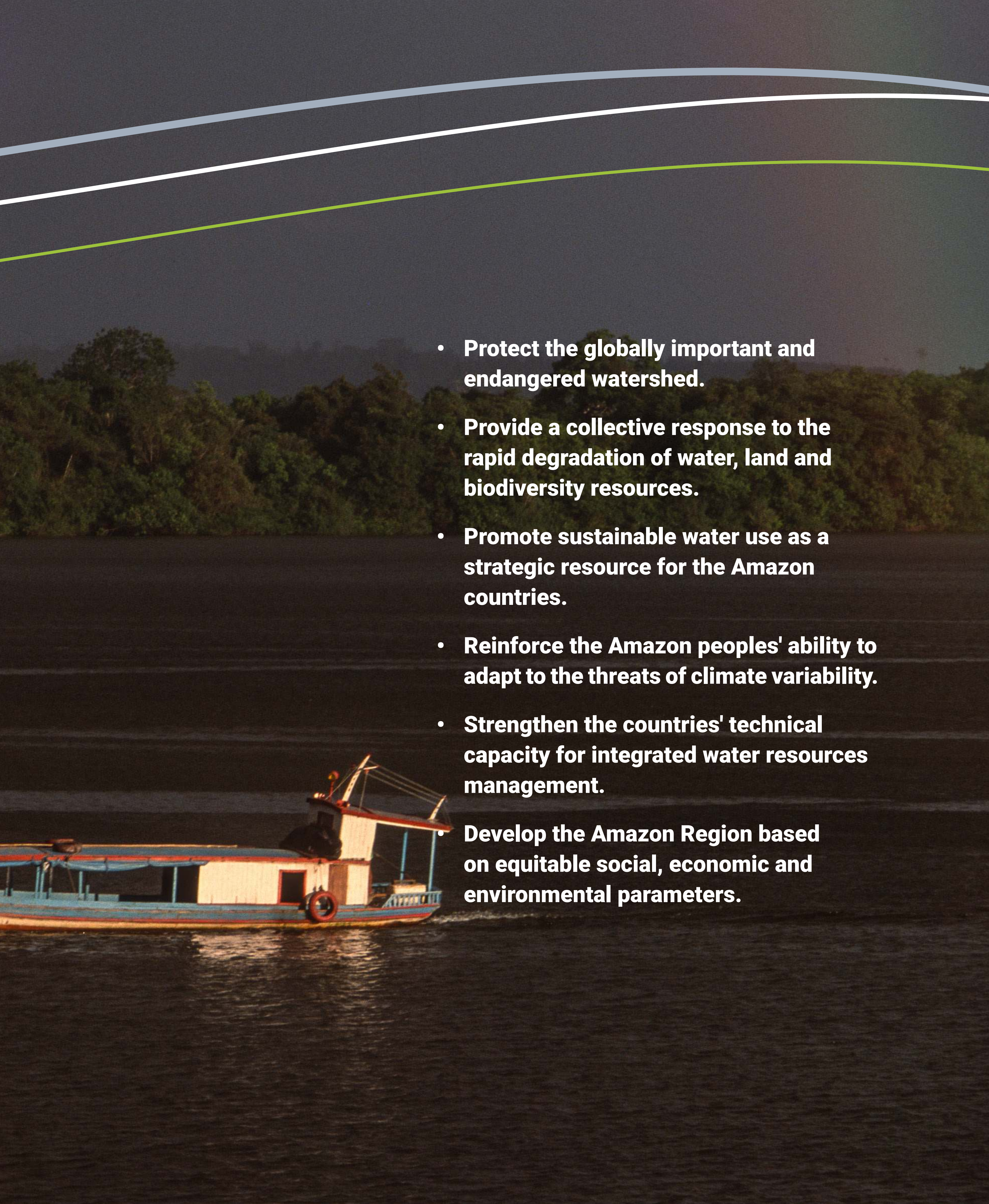
Amb. Maria Jacqueline Mendoza Ortega
ACTO Secretary-General

Rui Faquini

SIX REASONS

TO DEVELOP A STRATEGIC ACTION PROGRAM FOR THE AMAZON BASIN

Rui Faquini



- **Protect the globally important and endangered watershed.**
- **Provide a collective response to the rapid degradation of water, land and biodiversity resources.**
- **Promote sustainable water use as a strategic resource for the Amazon countries.**
- **Reinforce the Amazon peoples' ability to adapt to the threats of climate variability.**
- **Strengthen the countries' technical capacity for integrated water resources management.**
- **Develop the Amazon Region based on equitable social, economic and environmental parameters.**

Rui Faquini

INTRODUCTION

Implementing transboundary Integrated Water Resources Management (IWRM) in the Amazon Basin poses countless challenges associated with the region's socioeconomic development, as well as anthropogenic and climate impacts. The basin forms a single hydrologic system that crosses the national borders of eight countries—Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname and Venezuela, all of which consider it necessary to have a regional IWRM framework to meet the needs of the population and for sustainable development in the Amazon Region.

In 1978, the eight basin countries signed the Amazon Cooperation Treaty and subsequently created the Amazon Cooperation Treaty Organization (ACTO) as a platform for political dialogue and regional cooperation. As part of this regional process, the Member Countries approved the Strategic Plan (2004-2012) and later the Amazonian Strategic Cooperation Agenda (2011-2018) that establishes ACTO's vision, mission and strategic objectives and defines thematic axes and cooperation activities. Water is particularly emphasized, with a view to adopting an integrated approach to water resources management in the basin.

In this context, on behalf of the Amazon countries, ACTO requested financial support from the GEF's international waters sector, for the project "Integrated and Sustainable Management of Transboundary Water Resources in the Amazon River Basin considering Climate Variability and Change," implemented by the United Nations Environment Programme (UN Environment) and executed by the Permanent Secretariat of the Amazon Cooperation Treaty Organization (PS/ACTO). Its main objective is to develop a Strategic Action Program (SAP) for the Amazon Basin and create an enabling environment for its future implementation, strengthening the institutional framework to plan and execute activities to protect and sustainably manage the basin's water resources in a coordinated and consistent manner.

To develop the SAP, the Member Countries applied the methodology of the Global Environment Facility (GEF), an institution that for the last 20 years has been helping different countries address international water concerns by undertaking over 30 Transboundary Diagnostic Assessments (TDAs) and Strategic Action Programs (SAPs) in response to shared transboundary problems that affect large marine ecosystems, groundwater, lakes and watersheds.

To prepare this Strategic Action Program for Integrated Water Resources Management (IWRM) in the Amazon Basin considering Climate Variability and Change, the eight ACTO Member Countries worked together to identify and analyze the problems that affect the basin's water resources. Subsequently they developed a shared vision and defined objectives, strategies and ways to tackle the problems and find solutions (the SAP).

This initial process concluded when the member country governments formally approved the SAP, thereby ensuring national, regional and international support to implement its strategies and actions, in benefit of the Amazon peoples' socioeconomic conditions and the Amazon Basin's ecosystems.

Context, Objectives and Methodology

In 2003, in collaboration with the United Nations Environment Programme and the Organization of American States (OAS), ACTO sought support from the Global Environment Facility (GEF) to develop a project proposal entitled "Integrated and Sustainable Management of Transboundary Water Resources in the Amazon River Basin considering Climate Variability and Change."

Rui Faquini

The project's main objective: to develop a Strategic Action Program (SAP) for the Amazon Basin and create an enabling environment to implementing it in the future.

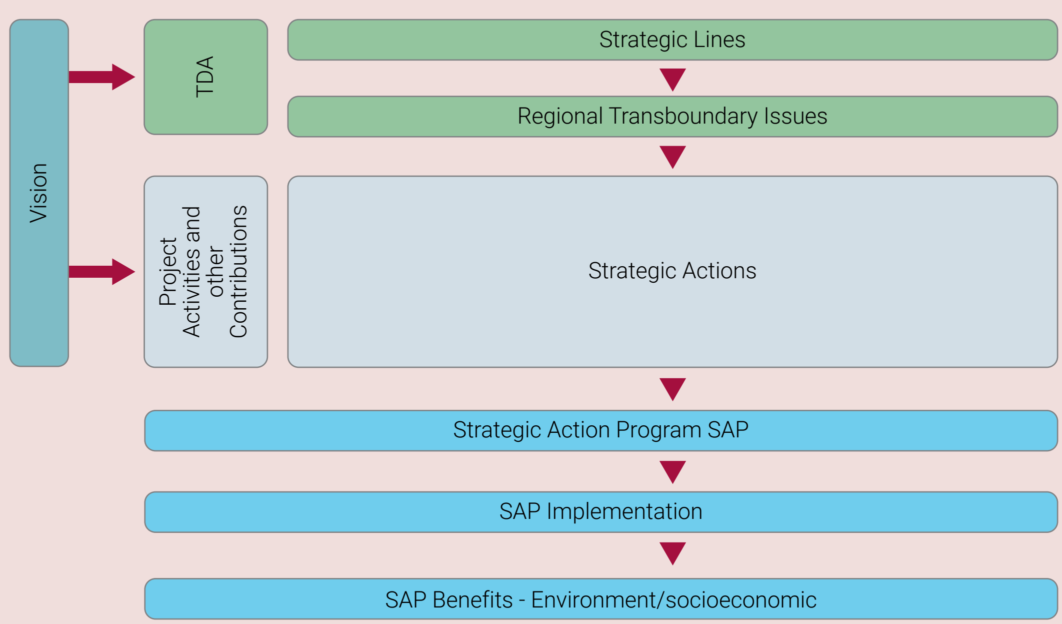
Taking into account the need to adapt to climate variability, this SAP will have a catalyzing effect in achieving integrated water resources management (IWRM) in the Amazon Basin.

In accordance with the GEF methodology and ACTO's political, institutional and regional cooperation framework, the Strategic Action Program (SAP) is based on:

- A common and shared vision for integrated water resources management and sustainable development in the Amazon Basin.
- A regional Transboundary Diagnostic Analysis (TDA) that consolidates the transboundary problems that were identified through workshops in the eight countries with broad national stakeholder participation, as well as their environmental and socioeconomic impacts and root causes.
- Results and recommendations from project activities and other regional initiatives developed under ACTO.

The SAP is a concerted document and a guiding instrument for activities. It was developed by the Member Countries and regional cooperation agencies, and it needs to be backed by the highest levels of all relevant government sectors of the Amazon countries. It establishes strategies and priorities for regional action and recommends policy guidelines and legal instruments in a context of institutional and capacity strengthening.

Below is a diagram of the SAP development process:



GLOBAL SIGNIFICANCE OF THE

AMAZON

Rui Faquini

AMAZON BASIN IN NUMBERS

Surface: 6.118.000 Km^2

Geomorphology: The geomorphology of the basin varies from 6,500 m to sea level

Origin: Quebrada Apacheta in the Andes, Arequipa, Peru. (5.597 m)

Length: 6.992 Km

Averege flow: 150.000 m^3/s

Flow in the mouth: 230.000 a 300.000 m^3/s

Mouth: Marajó Delta, Pará, Brasil

ACTO/CIIFEN, 2018

The Amazon River Basin is the biggest watershed in the world and occupies the entire central and eastern part of South America, extending from the Andes mountains to the Guyana highlands in the north and the Brazilian highlands in the south.

It occupies 44% of South America's surface area (6,118,000 km²) covering parts of Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname and Venezuela. A great variety of climates and land reliefs characterize the area, with elevations going from sea level at the river mouth to 6,500 m above sea level in the Andes. Precipitation levels range from 200 mm per year in the Andes to over 6,000 mm per year in some areas of the Amazon lowlands. Seasonal rainfall variations are caused by movements in the intertropical convergence zone, with maximum precipitation levels occurring from March to June in the northern hemisphere and December to March in the southern hemisphere.

Fed by approximately 1,000 tributaries and extending close to 6,992 km, the Amazon River also has the world's highest discharge, with an average flow of 150,000 m3/s and an annual discharge of 6.6 billion m3 of water into the Atlantic Ocean[1].

The Amazon's freshwater supply far exceeds the region's demands. Even so, the quantity and quality of water resources is being negatively impacted by economic activities (agriculture and mining, among others), accelerated urbanization and land occupation.

The Amazon accounts for more than half of the tropical rainforest in the world, which together with intense evaporation and absorption of carbon dioxide from the atmosphere make the region a global climate modulator.

Forests extending from the eastern side of the Andes in the Pacific to the Amazon Plains in the Atlantic create an interdependence between both ends that make continental Amazon a strategic region in terms of biodiversity[2]. More than 30,000 plant species, nearly 2,000 fish species, 60 reptile species, 35 mammal families and approximately 1,800 bird species live in the region.

The Amazon Basin is also an important source of non-renewable natural resources, with vast reserves of gold, silver, zinc, tin, copper, oil and natural gas, in addition to large known reserves of bauxite (approximately 15% of the global total) •

1 Brazilian National Institute for Space Research (1 July 2008). INPE studies indicate that the Amazon River is 140 km longer than the Nile. National Institute for Space Research Ministry of Science, Technology and Innovation of Brazil.

2 See Chapter 1.5. Biodiversity

1 THE AMAZON REGION

Rui Faquini

1.1 Hydrography

The Amazon River starts in the Peruvian Andes in the Apacheta ravine, next to Nevado Mismi mountain, at 5,597 meters above sea level. Glacial runoff flows towards the Apurimac, a tributary of the Ucayali, which finally joins the Marañon to form the main channel of the Amazon. After the Apurimac and Ucayali blend into one, the river leaves the Andes behind and enters a gently undulating alluvial floodplain. The five rivers whose confluence form the Amazon are the Apurimac, Huallaga, Mantaro, Marañon and Urubamba–Vilcanota. The river reach we know as the Amazon goes from the confluence of the Marañon and Ucayali in Nauta (Iquitos), to the river delta in the Atlantic.

From the highlands of Arequipa (Peru), the Amazon runs 6,992 km until it reaches the Atlantic, discharging 6.6 billion m^3 of water into the ocean per year. With an average discharge of 150,000 m^3/s, the Amazon is considered the world's most torrential river. Its close to 1,000 tributaries extend across 6.11 million km^2.

Figure 1. Proposed delimitation of the Amazon Basin and Region (Biome)

Legend
Study area — Hydrographic area — Biogeographical area

Source: ACTO/CIIFEN, 2018. *Hydroclimatic Vulnerability Atlas*, Brasilia.

Close to Marajo Island (delta), the Amazon River splits into two streams. Its main course, with 90% of the river's water, passes north of Marajo Island, while the remaining 10% enters a narrow stream at Obidos (located in Brazil, about 800 km from the Atlantic), a river 1.6 km wide by 60 m deep with an average velocity of 7 km/h.

Upon reaching the river mouth, the Amazon flows into the Atlantic Ocean at approximately 206,000 m^3/s. The amount of sediment it releases into the Atlantic varies from 0.4 to 1 million tons per year. In 1977, 1.7 million tons were reported in Iquitos and 4.7 million tons in Obidos (Brazil).

Amazonian rivers usually have two morphological components: channels and floodplains. The channels contain water all year long, while the floodplains are flooded seasonally and have numerous lakes that retain water in the dry season.

The river's narrowest channel is in Peru with widths varying from 1 to 3 km, while its largest flood bed is extremely wide, spreading as far as 20 km. In Brazil, its width varies from 25 to 50 km, with a maximum width of 200 km in the Marajo delta.

From a hydrologic and political-administrative perspective, the Amazon Basin's territorial distribution is quite heterogeneous. In hydrologic terms, the basin is 6,118,334 km^2, while in political-administrative terms its area is 7,413,827 km2 (UNEP, 2009).

1.1.1 Streamflow in the Amazon River

The Amazon River consists of two morphological components: the main channel and the floodplain. The main channel is where the river's discharge flows, and it contains water throughout the entire year. The floodplain, including most of the islands, is a complex of seasonally flooded lands that contains countless seasonal lakes and connecting channels, many of which retain water in the dry season.

The Amazon's average depth is approximately 80 m (Richey et al.,1986; Filizola, 2003) and its physiography features alternating high and low riverbanks, most of which flood during high flow periods. Its riverbed is made up of fine particles (silt and clay) and fine and medium grain sand, and islands abound along its course (Mertes et al., 1985; Armijos, 2015).

At the mouth, discharge can be as high as 300,000 m^3/s in the rainy season. Studies conducted over the last 50 years, and cited by various authors, show that average annual streamflow at the mouth fluctuates at around 210,000 m^3/s (Molinier et al., 1992 Callède et al., 2010). That said, average streamflow readings taken during the

Rui Faquini

rainy season (May–June) at the Obidos station, located 870 km upstream of the mouth in Brazil, produced measurements of about 250,000 m^3/s (Callède, 2004, 2010; Filizola et al., 2011; www.ore-hybam.org).

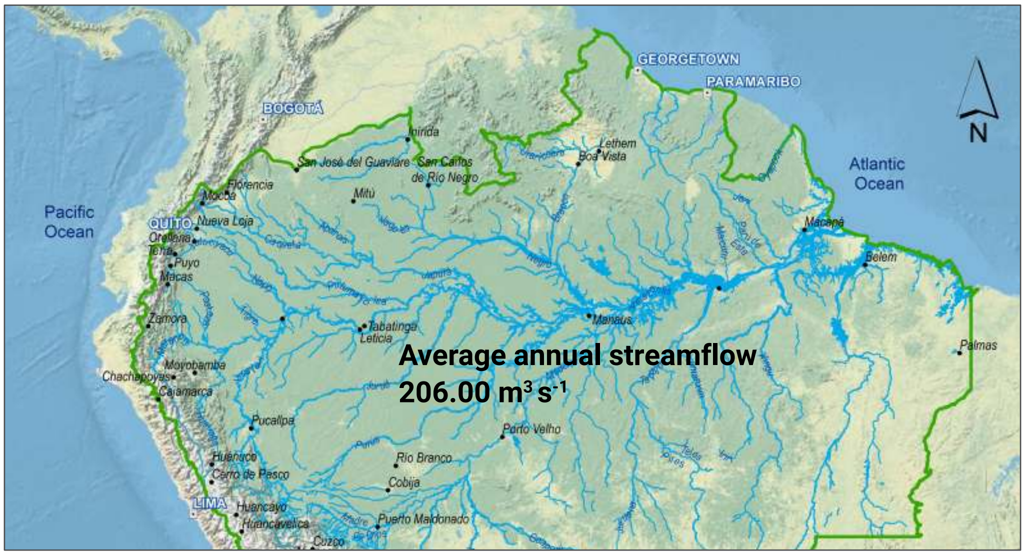
The Amazon River's hydrologic fluctuation is characterized by a high flow period between the months of November and May, that reaches its highest point in March/April. The low flow season goes from July to September, with the lowest levels recorded in August and September.

TABLE 1: AVERAGE ANNUAL STREAMFLOW IN THE AMAZON AT ÓBIDOS STATION, BRAZIL

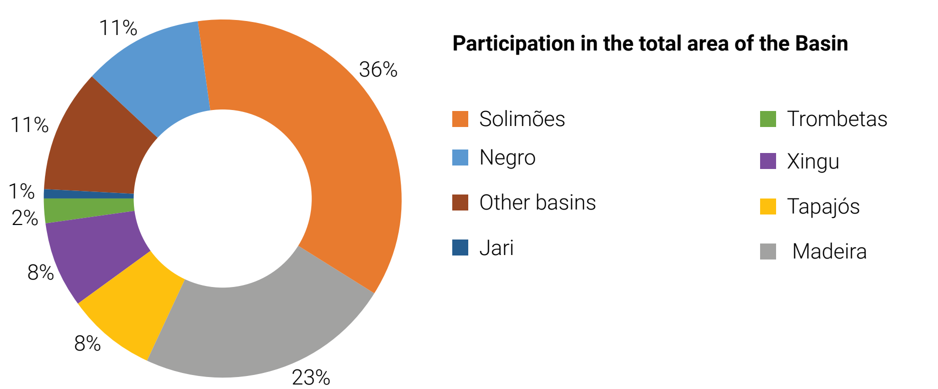
Study	Average flow (1000m^3/s)
Leopold (1962)	113.20
UNESCO (1971)	150.90
Nace (1972)	175.00
UNESCO (1974)	173.00
Baumgarther and Reichel (1975)	157.00
Villa Nova et al. (1976)	157.00
Milliman and Meade (1983)	199.70
Oki et al. (1992)	155.10
Matsuyama (1992)	155.10
Russell and Miller (1990)	200.00
Vorosmarty et al. (1989)	170.00
Sausen et al. (1994)	200.00
Marengo et al. (1994)	202.00
Perry et al. (1996)	169.00
Costa and Foley (1998a)	162.00
Zeng (1999)	205.00
Leopoldo (2000)*	160.00
Leopoldo (2000)**	200.00
Roads et al. (2002)	224.00
Dai and Trenberth (2002)	217.00
Marengo (2005) *	175.00
Marengo (2005) **	210.00

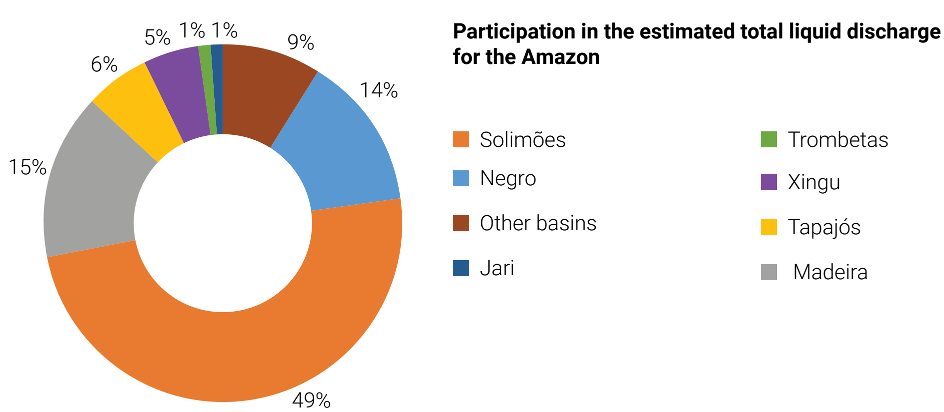
* Measurements in Óbidos
** Measurements (corrected) at the mouth.
Source: Marengo, 2004.

Figure 2. Average annual streamflow in the Amazon Basin



Source: ACTO/CIIFEN, 2018. *Hydroclimatic Vulnerability Atlas*, Brasilia





Source: Filizola, N.2003, Filizola et al., 2011.

Rui Faquini

1.1.2 Erosion, Sediment Transport and Sedimentation (ETS)

Sediment flux in the Amazon's tributaries provides information about:

- Erosion in the Andes mountains.
- Problems related to the anthropogenic impacts of land occupation and deforestation.

According to estimates made in the 1960s and 1970s (Sioli, 1950, 1964; Gibbs, 1967), the amount of sediment that the Amazon River carries to the sea varies from 500 to 600 million tons per year. In 1977, a total of 1.7 million t/yr were reported in the city of Iquitos (Peru), while in Obidos (Brazil) the amount was above 800 million t/yr (Guyot et al., 2005; Filizola et al, 2011).

Estimates of suspended sediment flow carried by the Amazon to the Atlantic Ocean vary, depending on the author:

- 500 million t/yr (Gibbs, 1967).
- 800 million t/yr (Guyot et al., 2005; Filizola et al., 2011).

More recent studies indicate that the western part—where the Andes Mountains are located, which account for 15% of the Amazon Basin's total surface area—has the highest erosion rate and produces almost all the suspended sediments transported by the large rivers of the Amazon. (Filizola, N., 2003)

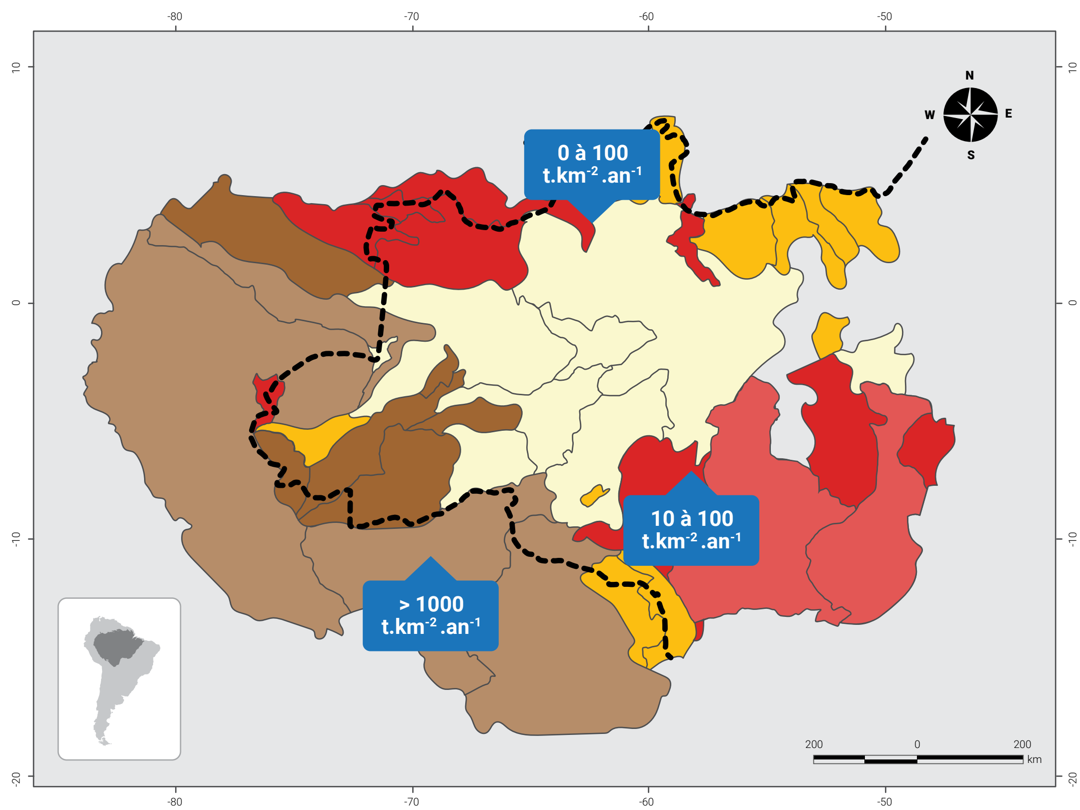
The ETS process does not stop at the coast; ocean currents transport the sediment to the northern part of South America.

Figure 3. Production, Transportation and Deposition of Sediments in the Amazon Basin

Sources: "*Transferencia sedimentaria actual por los ríos de la Amazonía*". *Filizola, 2003* [3]. ACTO/CIIFEN, 2018.

3 Data from: (a) 60 Brazilian National Water Agency (ANA) hydrosedimentological stations, bimonthly sampling from 1980 to 2000; (b) eight HYBAM Project (IDR/ANA) sampling studies of sediment transport from 1995 to 1998; (C) 10 Brazilian measuring stations belonging to SO HYBAM.

Figure 4. Spatial Distribution of the Amazon Basin's Erosion Rate



Legend

SSY (t.km-2.yr-1)

- Negative Erosion rates
- < 10
- 10 > 100
- 100 > 1000

Source: (Filizola, N.; Guyot, J. L., 2003).

1.1.3 Water Characteristics

Studies show a direct link between the geological/hydrologic environment and the chemical characteristics of water in Amazonian rivers. These are classified as whitewater, clearwater and blackwater rivers (Sioli & Klinge, 1962; Santos & Ribeiro, 1988; Cunha, 2000; Horbe et al., 2005; Queiroz et al., 2009).

Whitewater rivers originate in the Peruvian and Ecuadorian Andes and are high in suspended sediment loads and dissolved salts. They have a pH of 6.5 to 7.0, high concentrations of calcium (Ca^{2}), magnesium (Mg^{2}) and bicarbonate (HCO^{3-}), with average conductivity of 60 µS/cm, and lack transparency. The Solimoes, Amazonas, Madeira, Purus, Blanco, Jurua are typical examples of whitewater rivers. Sioli (1968), Konhauser et al. (1994), and Gaillardet et al. (1997) classify whitewater rivers as carbonated rivers.

Blackwater rivers originate in the Guyana and central Brazilian shields and flow through areas of low-lying vegetation and sandy soils. Their dark color comes from organic matter decomposing in the humic and fulvic acid that is dissolved in the water. They are characterized by high concentrations of sodium (Na) and potassium (K), with


Rui Faquini

a pH of close to 4.0, average conductivity of 8.0 µS/cm, and almost no suspended sediment (Furch, 1984; Walker, 1987; Forti et al., 1991). Some well-known blackwater rivers are the Negro, Nhamunda and Maues Rivers.

Finally, the clearwater rivers of the Central Amazon have transparent water with a pH of 4.5 to 7.0 (Sioli, 1960; Stallard & Edmond, 1983). The Tapajos, Xingu, Trombetas and Tocantins are examples of this type of rivers.

Pollution in these rivers is produced mostly by the following activities:

- Extraction of raw materials for export, like gold, timber, oil and various forest products.
- Flooding by large hydropower plants.
- Expansion of livestock production and agro-industrial activities with the intensive use of pesticides.
- Intense inland waterway transportation.

Mercury from alluvial gold mining is the main hazardous pollutant in the region's water, soil, sediments and air.

The extent of mercury contamination in the Amazon may be seen in its high concentration in humans and in different carnivorous fish species, with levels up to five times higher than the maximum allowed by Brazilian law (Vilas Boas et al., 2001).

Combustion of biofuels is the second biggest source of mercury; releasing close to 90 tons of mercury into the atmosphere every year (Veiga et al., 1994).

In regions where coca is grown and processed, the intensive use of pesticides and various chemical products like defoliants, cement, gasoline, sulfuric acid and ammonia, contaminate the rivers and soil (Garcia et al., 2000).

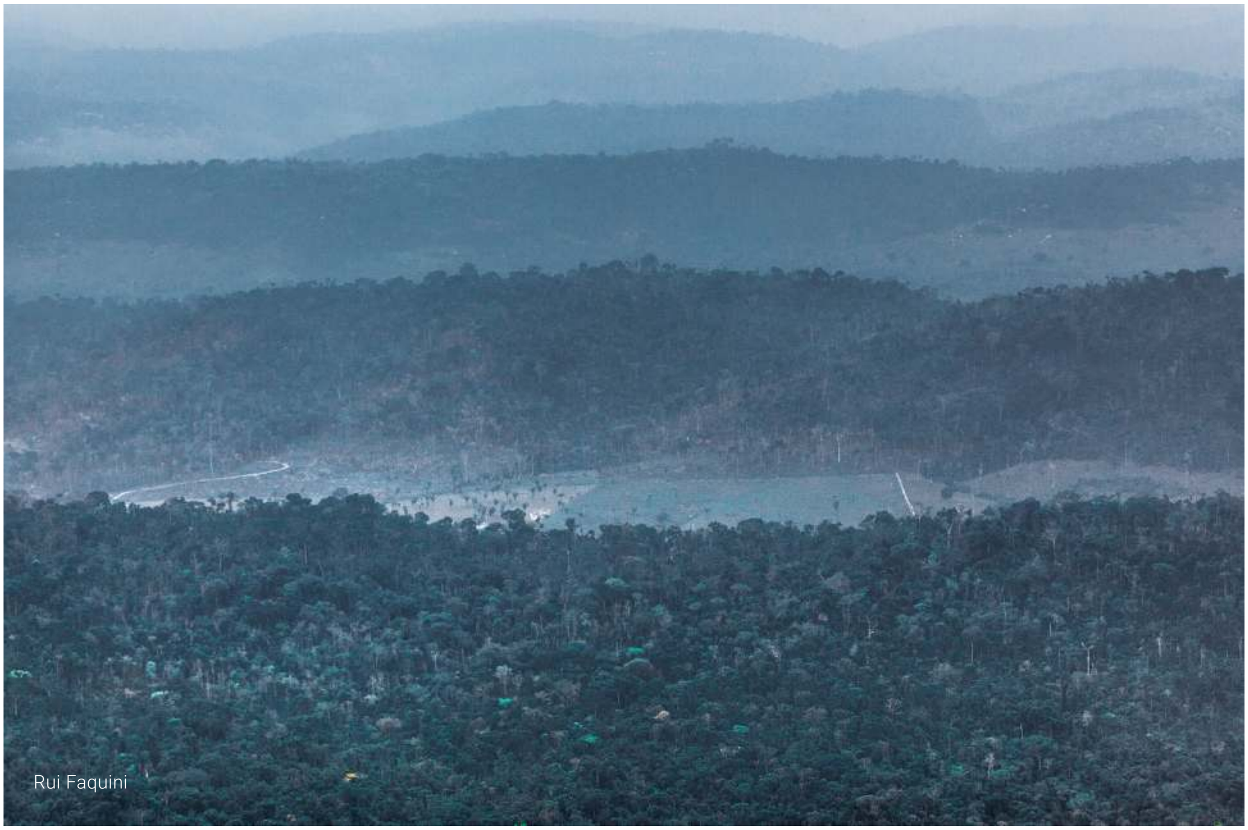
Household and industrial effluents released directly into the rivers also compromise water quality in the Amazon's main urban centers (Mazzeo & Ramos, 1989; Mazzeo, 1991; Nascimento, 1995/2000; Nascimento et al., 1996/1997/2001/2006/2011).

In view of the above, regional water quality monitoring in Amazonian rivers using common parameters is essential to manage the basin's water resources efficiently. Each country may also include other parameters that it considers important to assess water quality and determine its suitability for environmental uses (source of food, recreation or reservoir) or human consumption, for example.

TABLE 2. MOST FREQUENT TYPES OF POLLUTION IN THE AMAZON REGION

Type	Source	Agent	Other
Chemical	Industrial, from cities on the river and tributaries	Fertilizers, petrol and its derivatives, oil, acids, soda ash, deep or formation waters. Chlorinated waste and humic substances.	
	Effluents from mining	Mercury, cyanide, arsenic, lead, iron, copper, nickel, zinc. Sediment.	Lead is also a possibility.
	Agricultural industry	Pesticide residues. Fertilizers and other nitrogen-rich compounds.	Leachates and percolates that can affect plants and waterbodies.
Biological	Untreated wastewater	Effluents containing fecal matter, detergents, industrial residues, petrol, oils and substances that are toxic to aquatic plants and animals. Release of substances like detergents and slaughterhouse residues that cause an increase in nutritive substrates and augment the risk of water nitrification.	
Physical	Thermal contamination	Wastewater at temperatures higher than the waterbody into which it is released.	
Mixed	Garbage and construction waste thrown in the water	Plastic, glass, cans and organic waste, which do not decompose or produce toxic substances when they do.	
	Leachates and percolates from landfills or dumps	Byproducts of decomposing household, industrial and hospital wastes.	Some laws regulate cemeteries.
	Atmospheric precipitation	Particulate/precipitate materials, heavy metal, pesticide or polychlorinated biphenyl residues.	

Source: Modified from EPA. Water quality 2014 and ANA 2010.



Rui Faquini

1.2 Groundwater

The largest groundwater reserves are located in the central part of the Amazon sedimentary basin, in a flow system that goes from the Paleozoic outcroppings in the Amazon's riverbanks to the Cenozoic rock that occupies the entire central part of the basin (Pedrosa and Caetano, 2002).

Below is a description of the Amazon Basin's main aquifer systems:

- The *Boa Vista aquifer system* is made up of Cenozoic sediments, particularly conglomerate sandstone, meaning large rocks and consolidated sediment. It is located in the State of Roraima, Brazil, and partially in Venezuela and Guyana, and covers an area of close to 14,900 km^2. Its maximum depth is estimated at 120 m and its water availability (usable volume) is approximately 32 m^3/s. It is an important source of water for the city of Boa Vista (ANA, 2005).
- The *Alter do Chao Aquifer System* is unconfined and is part of the Amazon sedimentary basin. It is located in the northern central region of Para State in the eastern Amazon, occupying approximately 312,600 km^2. This aquifer provides part of the supply to cities like Manaus, Santana, Macapa, Santarem and Marajo Island. The water quality is good. (ANA, 2005).
- The *Solimoes Aquifer System* has an approximate recharge area of 457,600 km^2, and is mainly located in Acre State, parts of Bolivia and Peru, and the western part of Amazonas State. In Rio Branco, the capital of Acre State, the system is an important source of water for the population and has good chemical composition. Nevertheless, in microbiological terms there are limitations in urban areas due to its great natural vulnerability (as a shallow groundwater aquifer located close to the surface) and high potential for contamination from poorly built wells, and inexistent/

insufficient health protection and sanitation regulations. (ANA, 2005).

- The *Parecis Aquifer System* is made up of layers of sandstone (hard sedimentary rocks alternating with softer layers) interspersed with pelitic conglomerate layers (softer rocks) and Cretaceous rock lenses (mixed rocks). The system starts in western Mato Grosso State and the far eastern part of Rondonia State, occupying approximately 88,150 km² with an average depth of 150 m. Its usable volume is estimated at close to 464 m³/s. (ANA, 2005).

Hypothetically, there is also the Amazon Transboundary Aquifer System (ATAS) that underlies Bolivia, Colombia, Ecuador, Peru and Venezuela. The existence of this enormous aquifer system will be the object of future hydrogeological research projects. (Figure 5) .

Figure 5. Map of the Amazon Transboundary Aquifer System (ATAS)

Sources: Adapted from the Transboundary Aquifer Systems of the Americas Report. UNESCO/OAS 2008, and ACTO/CIIFEN, 2018.

It is also possible that a transboundary aquifer exists in the northern part of South America (Suriname, Brazil, Guyana) (Source: UNESCO/OAS 2008, 5th Coordination Workshop on Transboundary Aquifers).

1.3 Amazon – Atlantic Interface

1.3.1 General Aspects

Between the Amazon Basin and the Atlantic Ocean lies a complex region whose width is neither fixed in time nor space due to countless hydrologic (discharge), oceanographic (tides, waves) and climatic (rain, extreme events, wind, etc.) processes. Information about how these processes work is scarce and any data that exist only represent the momentary conditions in specific areas of the region, and not the region as a whole.

Rain, the Atlantic tides, the Amazon and Para Rivers and thousands of estuaries are the main sources that feed the water system between the Amazon Basin and the Atlantic Ocean. The region's high tides (which vary from 3 m to 12 m), in combination with its low land relief and low soil permeability are largely responsible for the extensive floods that occur mainly in the rainy season from December to June. The influence of the tides is evident in the mangroves that extend along the entire coast.

Sediment reaches the Atlantic mainly through the Amazon and Para Rivers and thousands of Atlantic tributaries.

The Amazon River dominates the estuary north of Marajo Island, with an approximate liquid discharge volume of 175,000 m3/s, in addition to carrying approximately 1.19 billion t/yr of dissolved and suspended sediments to the Atlantic (Neiff et al., 1994; Sioli, 1984; Tundisi, 1994). The 300 km-long Para River, in turn, is a hydrographic complex formed by countless rivers leading to a succession of bays and inlets that extend along the southern coast of Marajo Island. There they form the Bay of Marajo, which receives most of its water from the Tocantins River, and the Bay of Guaruja, where the Guama, Moju, Acará and Capim Rivers empty into the ocean. This river system's discharge constitutes close to 10% of the Amazon's total discharge into the Atlantic. (Figure 6)

Rui Faquini

Figure 6. Amazon – Atlantic Interface

Source: Marine and Coastal Studies Group. Federal University of Para (Brazil).

1.3.2 Oceanographic Parameters

Sediment Plume and Salinity of the Amazon River Estuary

According to Gibbs (1967), more than 80% of the annual suspended sediment (500 million tons) comes from the Andes, and 65% (160,000 m^3/s) of the liquid and solid discharge occurs in the northern canal of Marajo Island (Geyer et al., 1996). (Figure 6)

According to Candela et al. (1992) and Lentz (1995), the Amazon River plume, with salinity lower than 10 mg/l, is transported northwest by the **North Brazil Current** (NBC), extending 100 km away from the coastline (Milliman et al., 1974).

At the mouth, north of Marajo Island, the Amazon's salinity is very low, even in the dry season (Limeburner et al., 1995). During the rainy season, the river's pressure toward the Atlantic Ocean increases and a water plume from the Amazon River forms a surface layer that varies from 10 to 20 m thick, extending as far as 100 km into the open sea.

In the Bay of Marajo, at the southern part of the island, salinity increases during the dry season, with brackish water penetrating up to 300 km inland.

Tides and Tidal Currents

Information about the coastal hydrodynamics and estuaries of the Atlantic side of the Amazon Basin remains scarce. Semi-diurnal tides are common and the currents they produce control the circulation of waters over the continental shelf. The tides reach maximum heights of 5 m and 4 m in Salinopolis and the Caete River estuary respectively, producing strong currents of up to 250 cm/s in the Amazon River estuary. In the Bay of Marajo, maximum tidal range varies from 3.6 m to 4.7 m, measured on the islands of Mosqueiro and Guaras, respectively (DHN, 2012).

The trade winds produce waves of 1 m to 1.5 m on the open sea. Nevertheless, tropical cyclones occasionally produce **waves** as tall as 3 m on the northern coast of Brazil (Innocentini et al., 2000).

The North Brazil Current (NBC) is the biggest current in the Atlantic's western tropical region, and it transports southern Atlantic waters across the equator to the north (Fonseca, 2000). As such, the NBC exercises a strong influence north of the equator, taking water and sediments north to the outer continental shelf, at a velocity that can reach 1.2 cm/s (Richardson et al., 1994).

1.3.3 Meteorological Parameters

Extreme weather events like floods, droughts, heat and cold waves, storms and strong rains have different frequencies and durations. Tornados, for instance, are short-lived, but other meteorological phenomena like climate instability (dry, cold or hot seasons) occur over the course of a few days.

Slow onset events resulting from climate change and sea level rise are also seen in the basin.

On a larger scale, the Amazon is modulated by oceanic-atmospheric phenomena associated with the Pacific Ocean's El Niño - Southern Oscillation (ENSO) cycles, which produce sea surface temperature (SST) anomalies in the intertropical Atlantic Ocean by means of significant changes in tropospheric circulation (De Souza, 2004).


Rui Faquini

1.3.4 Conclusion

The Amazon Basin's interaction with the Atlantic Ocean is vital due to the enormous amounts of soluble and insoluble materials transported to the ocean. This continental material, resulting from erosion and sedimentation in the Amazon, is responsible for fertilizing a significant part of the coast in the continental shield, as well as for maintaining the aquatic biodiversity and fisheries that ensure the livelihoods of coastal communities (Lacerda, 2010). According to the same author, the continent/ocean interface is a rich biodiversity and ecosystem reservoir upon which many functions that are essential for the planet's survival depend.

1.4 Transboundary Nature of the Amazon Basin

1.4.1 Introduction

In order to create a digital cartographic base at 1: 1 million-scale for water resources management, conservation and planning purposes, in 2008 the Andean Community of Nations (CAN) delimited and coded South America's hydrographic units using the Pfafstetter system. The resulting hydrographic maps are useful to show the Amazon's transboundary basins. The method consists of dividing, delimiting and coding **hydrographic regions** in a hierarchical manner, starting at the continental scale (Level 1) and moving on to levels 2, 3 and more, respectively [4]. South America has 10 Level 1 hydrographic units, 93 Level 2 units, and 801 Level 3 units.

The Amazon (4), Plata (8), Orinoco (2) and Tocantins (6) hydrographic units are among the 10 most important Level 1 hydrographic regions.

4 Delimitation and coding of hydrographic units South America – Level 3. Final Report. International Union for Conservation of Nature (IUCN); Andean Community of Nations (CAN); Spanish Agency for International Development Cooperation (AECID), Lima, Peru, 2008.

TABLE 3. LEVEL 1 HYDROGRAPHIC UNITS IN SOUTH AMERICA

Code	Hydrographic region	Area (Km²)
2	Orinoco Hydrographic region	934,339.31
4	Amazon Hydrographic region	5,892,235.65 (*)
6	Tocantins Hydrographic region	769,445.28
8	La Plata Hydrographic region	2,588,980.33

Source: CAN / IUCN, 2008. (*) This value differs from the 6,118,000 km² presented in the introduction to this paper because Suriname was not included in this exclusively hydrographic classification

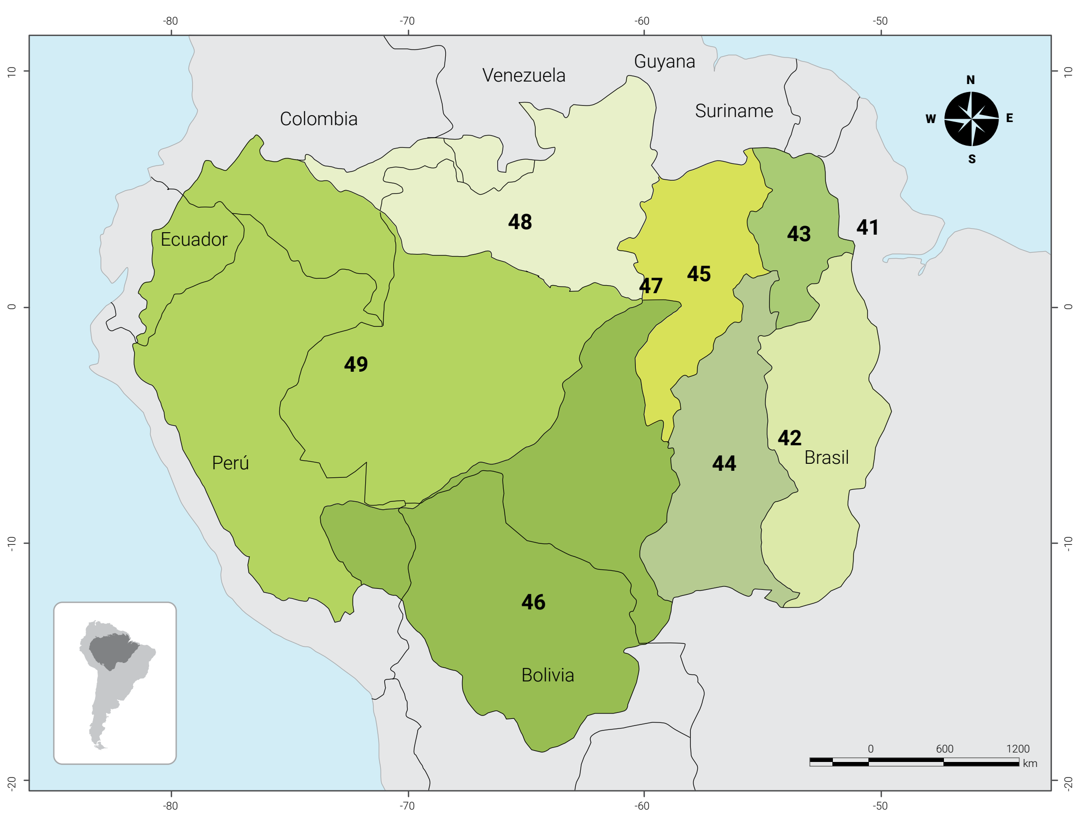
1.4.2 The Amazon River Basin Hydrographic Region

The Amazon hydrographic region (Code 4) is made up of parts of the territories of seven countries: Colombia, Bolivia, Brazil, Ecuador, Guyana, Peru and Venezuela.

At Level 2, the Amazon hydrographic region has seven main hydrographic units:

- Hydrographic unit 49 (headwaters of the Amazon River) covers 2,207,171 km² and includes Peru, Ecuador, Colombia and Brazil.
- Hydrographic unit 46 (Madeira River basin) covers 1,363,698 km² and includes Bolivia, Peru and Brazil.
- Hydrographic unit 48 (Negro/Branco River basin) covers 711,552 km² and includes Venezuela, Brazil and part of Guyana.
- Hydrographic unit 42 (Xingu River basin) covers 511,166 km² and is located in Brazil.
- Hydrographic unit 44 (Tapajos River basin) covers 492,526 km² and is located in Brazil.
- Hydrographic unit 45 (Tocantins River basin) covers 388.822 km² and is located in Brazil.
- Hydrographic unit 43 (Jari River basin) covers 200,736 km² and is located in Brazil.

Figure 7. Level 2 Hydrographic Units of the Amazon Basin



Source: Adapted from CAN / IUCN, 2010.

At Level 3, the Amazon Hydrographic region consists of 63 units: nine interbasins in each of the seven hydrographic units (42, 43, 44, 45, 46, 48 and 49).

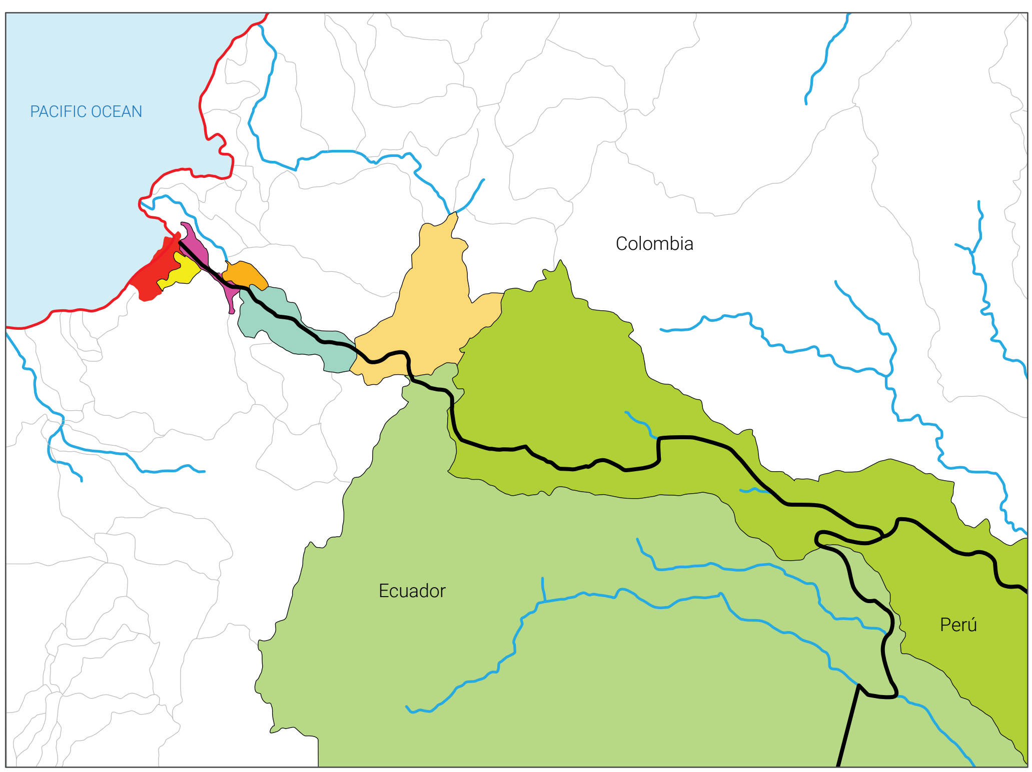
According to the *Pfafstetter System*, hydrographic units that are headwater watersheds are denoted by having 9 as the last digit of the code. As such, Code 499, for example, corresponds to the Marañon River basin (363,286 km²) and Code 498 to the Ucayali River basin (352,302 km²).

1.4.2.1 Transboundary Hydrographic Units Between Ecuador and Colombia

The transboundary hydrographic units between Ecuador and Colombia include:

- Two Level 1 transboundary hydrographic regions.
- Two Level 2 transboundary hydrographic units.
- Four Level 3 transboundary hydrographic units.
- Seven Level 4 transboundary hydrographic units.

Figure 8. Level 4 Transboundary Hydrographic Units of Between Ecuador and Colombia



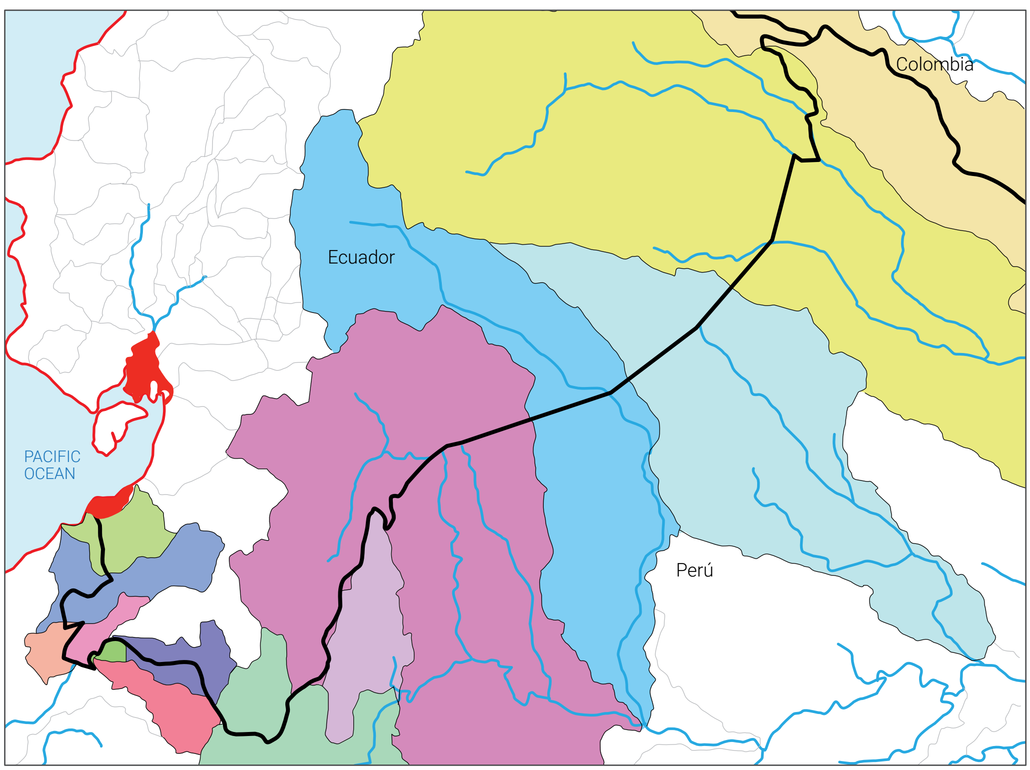
Source: CAN / IUCN, 2010.

1.4.2.2 Transboundary Hydrographic Units Between Ecuador and Peru

The transboundary hydrographic units between Ecuador and Peru include:

- Two Level 1 transboundary hydrographic regions: Hydrographic region 1, the Pacific; and Hydrographic region 4, the Amazon River basin.

Figure 9. Transboundary Hydrographic Units Between Ecuador and Peru



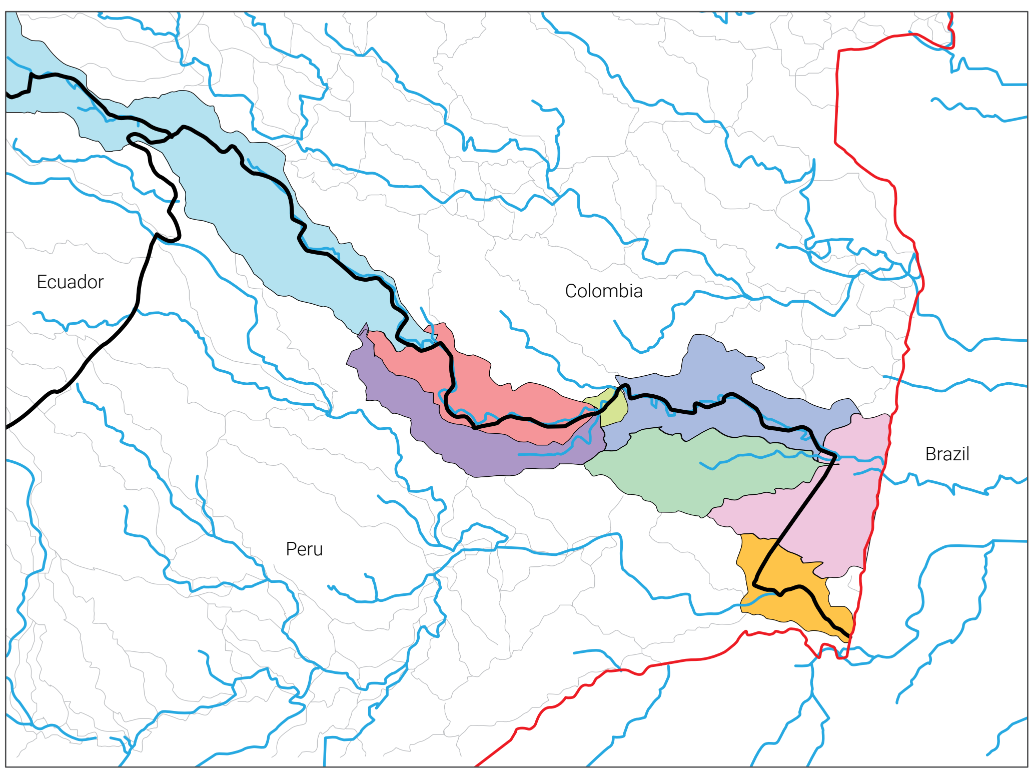
Source: CAN / IUCN, 2010.

1.4.2.3 Transboundary Hydrographic Units Between Colombia and Peru

The transboundary hydrographic units between Colombia and Peru include:

- One Level 1 transboundary hydrographic region: Hydrographic region 4 (Amazon River basin).
- One Level 2 transboundary hydrographic unit: hydrographic unit 49 (Amazon headwaters)
- One Level 3 transboundary hydrographic unit: hydrographic unit 497
- Two Level 4 transboundary hydrographic units: hydrographic unit 4974 (Putumayo River basin) and hydrographic unit 4977.
- Eight Level 5 transboundary hydrographic units: covering an area of 37,177 km². Hydrographic unit 49749 (Putumayo headwaters) is the largest and is also transboundary with Ecuador.

Figure 10. Transboundary Hydrographic Units Between Colombia and Peru



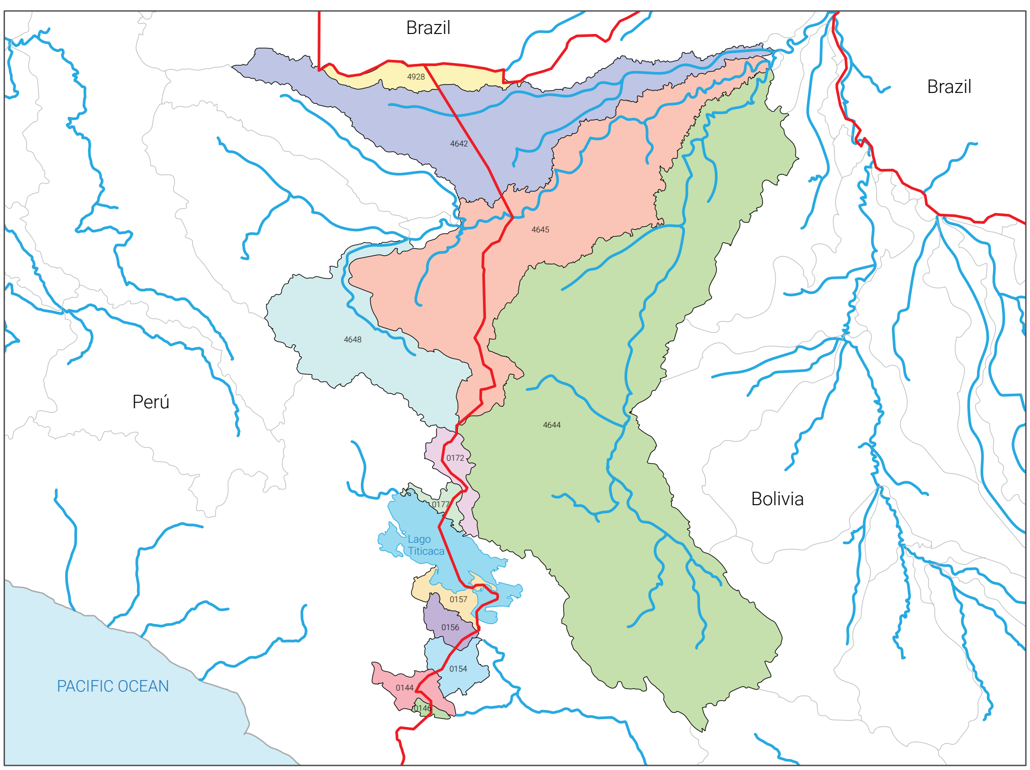
Source: CAN / IUCN, 2010.

1.4.2.4 Transboundary Hydrographic Units Between Bolivia and Peru

The transboundary hydrographic units between Bolivia and Peru include:

- Two Level 1 transboundary hydrographic regions
- Two Level 2 transboundary hydrographic regions
- Five Level 3 transboundary hydrographic units: the main one being the Madre de Dios River basin.
- (12) Level 4 transboundary hydrographic units: the Orthon and Beni River basins are among the most important ones.

Figure 11. Transboundary Hydrographic Units Between Bolivia and Peru



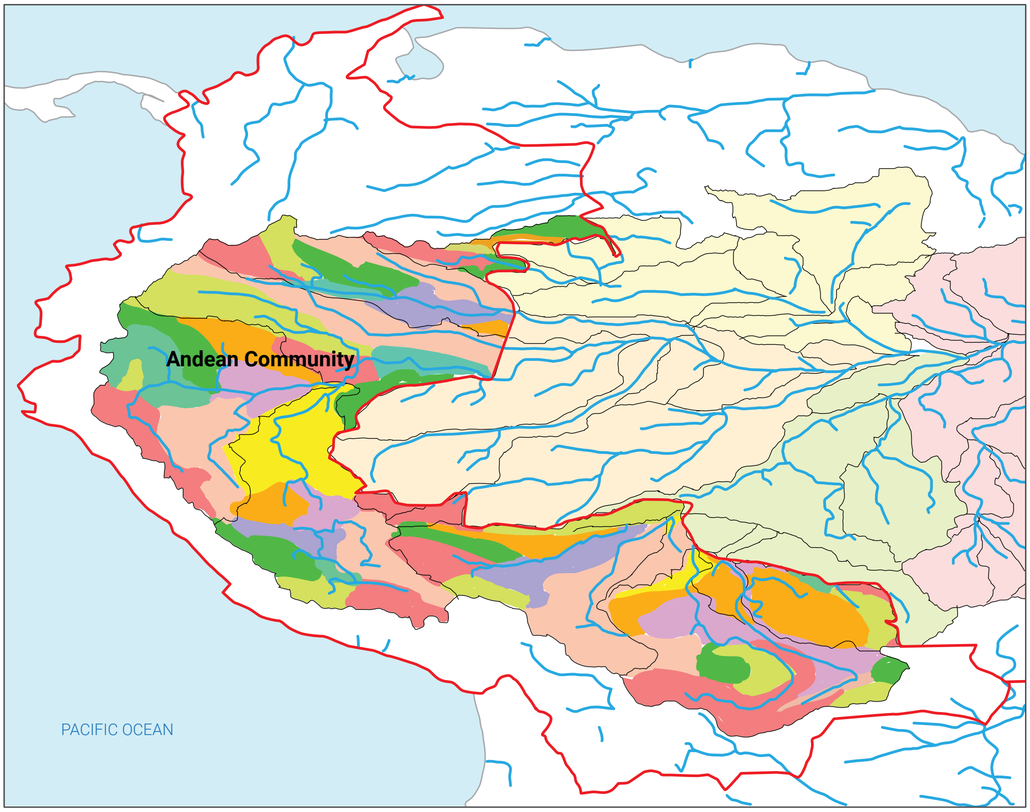
Source: CAN / IUCN, 2010.

1.4.2.5 Transboundary Hydrographic Units between the Andean Community of Nations and Brazil

The Amazon Hydrographic region (4) is the main transboundary basin between the Andean region and Brazil, with 96 Level 4 hydrographic units, of which the largest are:

- Beni River basin of 118,948 km², which is the main tributary of the Madeira River
- Lower Basin of the Ucayali River, 109,110 km²
- Putumayo River basin, 108,365 km²
- Napo River basin, 101,728 km²
- Huallaga River basin, 89,892 km²
- Branco River basin, 76,665 km².

Figure 12. Level 4 Hydrographic Units Between the Andean Community of Nations and Brazil



Source: CAN / IUCN, 2010.

1.5 Biodiversity

1.5.1 Diversity

The Amazon is considered one of the richest areas in terms of biological diversity. It is estimated to shelter approximately 10% of the world's known biodiversity. It includes parts of 56 ecoregions from the list of ecological systems of international importance (Global 200 Ecoregions), six Natural World Heritage sites and over 10 Endemic Bird Areas. It is made up of more than 600 different types of land and freshwater habitats, of which 20 freshwater ecoregions are considered of global importance because of their diversity (WWF, 2010).

Renowned as a complex and heterogeneous region, as the result of various geological, geomorphic, climatologic, hydrographic and biological processes, its global importance lies in its variety of ecosystems, abundant species and endemism. The greatest diversity of birds, fresh water fish, primates and butterflies is found in the Amazon. The region is considered to be the last global refuge for endangered species like harpy eagles and pink river dolphins, and is the habitat of one third of the planet's known vascular plants. Its floodplain forests represent between 3% and 4% of the basin's surface area, and its aquatic biodiversity includes river dolphins, manatees, giant otters and anacondas, in addition to fish like piranha, paiche and pirarucu, among many others (UNEP and ACTO, 2008; WWF, 2010).

Of the 5 to 30 million species found in the region, only 1.4 million have been catalogued: 750,000 insects, 40,000 vertebrates, 250,000 plants and 360,000 microbiota species (ACTO, 2008; UNEP and ACTO, 2008). At least 1,200 new plant and vertebrate species were discovered between 1999 and 2009, including 637 plants, 257 fish, 216 amphibians, 55 reptiles, 16 birds and 39 mammals, in addition to thousands of new invertebrate species (WWF, 2010).

Species diversity is not homogeneously distributed in the Amazon basin. Studies of the non-western Amazon in the Andean piedmont show these forests to be significantly richer in species than those of the central Amazon. This greater wealth in the piedmont forests of Ecuador and Peru is explained by theories that point to hydrologic and geomorphic factors, as well as the climate (Chaves, 2015).

In terms of continental fish, estimates reveal a great wealth of species, but knowledge about the ichthyofauna is still incomplete. Between 2,200 and 3,000 freshwater fish species are estimated to live in the Amazon as a whole, but given that many species are yet to be formally catalogued, they are often wrongly categorized under common names (Albert & Reis, 2011b in Alho, 2104/ACTO/GEF/UNEP; Chaves, 2015).

Table 4 shows the number of species of different groups of plants and animals. A major part of the Amazon biome is considered *megadiverse* because it harbors the greatest species diversity and endemism worldwide (UNEP and ACTO, 2008).

TABLE 4: NUMBER OF SPECIES BY GROUPS REPORTED IN THE COUNTRIES OF THE AMAZON

Country	Plants		Mammals		Birds		Reptiles		Amphibians	
	Total	Amazon	Total	Amazon	Total	Amazon	Total	Amazon	Total	Amazon
Bolivia	(1) 20,000	N.D.	(2) 402	N.D.	(3) 1,422	N.D.	(2) 308	N.D.	(2) 259	N.D.
Brazil	55,000	30,000	428	311	1,622	1,300	684	273	814	232
Colombia	45,000	5,950	456	85	1,875	868	520	147	733	N.D.
Ecuador	15,855	6,249	368	197	1,644	773	390	165	420	167
Guyana	8,000	N.D.	(4) 225	N.D.	(4) 814	N.D.	(4) 179	N.D.	(4) 30	N.D.
Peru	35,000	N.D.	513	293	1,800	806	375	180	332	262
Suriname	4,500	N.D.	200	N.D.	670	N.D.	131	N.D.	99	N.D.
Venezuela	21,000	N.D.	305	N.D.	1,296	N.D.	246	N.D.	183	N.D.

Source: (1) UNEP; 2009; (2) EPB, 2015; (3) Atlas de la diversidad de la flora y la fauna de Bolivia, 2011 (4) Bynoe, P. and P. Williams, 2007; EPA, 2014.
N.D. = No Data available.

TABLE 5: ENDEMISM IN THE AMAZON BASIN

	Number of species registered	
	Endemic	% endemic
Vascular plants	30,000	75
Mammals	173	40.5
Birds	260	20
Reptiles	216	57
Amphibians	384	90

Source: Adapted from Ruiz et al. 2007.

1.5.2 Threats

The Amazon is a region of great contrasts. On one hand, it is one of the planet's greatest reserves of tropical forests, water and biodiversity; on the other, it is endangered by massive deforestation, water pollution and environmental degradation. The region is rich in mineral resources, with large natural deposits of oil, natural gas and water. This makes it strategic for economic development and it attracts large investments and infrastructure projects, hydrocarbon prospecting, and formal and informal mining, activities often associated with social conflicts and environmental degradation.

As the Amazon countries have reported in their national reports to the Convention on Biological Diversity (CBD), the main threat to biodiversity conservation in the Amazon is habitat loss and degradation caused by deforestation, which is mainly driven by changing land-use to expand the agricultural frontier. Despite public policies and efforts to enforce laws to prevent and control livestock production, this remains an important force behind deforestation in the region.

Forest degradation is also associated with human actions related to increased mining and oil production, narcotics crops and logging of tropical timber.

Among the factors that affect wildlife conservation are unsustainable fishing and hunting (subsistence and commercial), wildlife trafficking, the introduction of invasive species, pollution and the effects of climate change.

Selective fishing of species of high commercial or nutritional value endangers both the exploited species and the ecosystem to which they belong, and threatens the social benefits that were generated. Invasive species introduced into the basin cause the greatest impacts, contributing to biodiversity deterioration due to competition with native species, direct depreciation, displacement and changes in aquatic environments, causing irreversible damage. This situation is very difficult to control and is often devastating for the affected ecosystems.

Although the greatest threat to the region's biodiversity comes from the advancing agricultural frontier, the effects of climate change put pressure on aquatic ecosystems, which are considered the most vulnerable to climate change (UNDP, 2013). The most vulnerable species are the endemic ones that have a very specialized habitat and low tolerance for environmental factors, and those that depend on environmental resources or interactions between

species that are interrupted by climate change. Fire is also a great cause of concern.

Contamination by waste, heavy metals and chemical products has been exacerbated by the spread of hydrocarbon exploration, mining, livestock production and intensive agriculture, new roads and other infrastructure works built without applying good practices. Pollution by these activities changes the hydrologic cycle, reduces streamflow, destroys water deposits and recharge areas, and leads to a loss of basic services and food.

Destruction and loss of habitats, selective logging, overexploitation and deforestation, illegal trade in wildlife and forest products and the introduction of invasive species have contributed to changes in species behavior and distribution, considerably reducing populations and endangering many of them. Evidence thereof is presented in the IUCN Red Lists, which record an increase in the number of endangered species.

These impacts worsen the health and quality of life of local peoples, reducing and deteriorating their sources of food and productive potential. Socioeconomic and socioenvironmental conflicts are increasing, while socioeconomic activities and opportunities for jobs and income are decreasing, causing a rise in migration.

Unless an institutional and political policy is established to improve management and control, as well as regional and participatory planning, degraded areas will continue to spread, compromising more basins and creating more health problems for the population.

1.5.3 Legal Instruments

All the countries of the Amazon region have broad regulatory frameworks that reflect the importance they assign to multilateral environmental agreements and treaties. These regimes govern issues that range from climate change and biodiversity protection, to trafficking in endangered species, desertification, wetlands and their resources, cross border transport of hazardous wastes, production and sale of long-lasting organic pollutants, among others. On the whole, they uphold the principles of state sovereignty, precaution, shared but differentiated responsibility, international cooperation and sustainable development.

Table 6 presents the agreements and treaties signed by the Member Countries that are particularly relevant for the Amazon Region, especially those related to biodiversity, water and climate change.

TABLE 6: ENVIRONMENTAL AGREEMENTS AND TREATIES SIGNED BY ACTO COUNTRIES

Treaty/Agreement	Country (date of effectiveness)							
	Bolivia	Brazil	Colombia	Ecuador	Guyana	Peru	Suriname	Venezuela
Ramsar Convention on Wetlands of International Importance, Especially as Waterfowl Habitat. Effective on 1 July 1975.	27Oct90 # of sites 11	24Sep93 # of sites 12	18Oct98 # of sites 6	07Jan91 # of sites 18		30Mar92 # of sites 13	22Nov85 # of sites 1	23Nov88 # of sites 5
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Effective on 1 July 1975.	04Oct79	04Nov75	29Nov81	01Jul75	25Aug77	25Sep75	15Feb81	22Jan78
Convention on Biological Diversity (CBD). Effective on 29 December 1993.	01Jan95	29May94	26Feb95	29Dec93	27Nov94	29Dec93	11Apr96	12Dec94
United Nations Framework Convention on Climate Change (UNFCCC). Effective on 21 March 1994.	01Jan95	29May94	20Jun95	21Mar94	27Nov94	21Mar94	12Jan98	28Mar95

Source: ACTO. 2014.

Rui Faquini

In compliance with the mandates deriving from the ratification of environmental treaties and agreements, the Amazon countries have developed a series of national policy guidelines and a vast body of regulations on biodiversity, water and climate. These efforts reflect the conventions' implementation instruments, which include national strategies, action plans and subsequent national reports derived from the conventions' obligations.

At the national level, constitutional rights are the main underpinnings for biodiversity-related laws that apply to the Amazon Basin. These uphold the right to live in a healthy environment and the importance of conserving and managing biodiversity and natural resources sustainably in order to protect each country's natural assets.

In fact, some of the national constitutions that have been enacted more recently have a direct impact on the Amazon Region, its people and the environment, not just in response to international environmental guidelines, but also directing efforts towards comprehensive sustainable development in the Amazon through public policies and social inclusion.

The region's countries have developed abundant laws and rules on natural assets and biodiversity that cover biodiversity protection and conservation, and the multiple economic and livelihood activities associated with biodiversity management and use (regulations for fishing, aquaculture, forest management, wild animals, non-timber wild plants and protected areas).

In each Member Country, environment ministries are in charge of the formulation of national policies, plans, programs and regulations related to biodiversity. In a number of countries, biodiversity is managed by decentralized institutional structures, whose powers are more clearly defined in some countries than in others.

1.5.4 Economic Potential

Biodiversity at all levels provides multiple resources that are essential for human wellbeing and for socioeconomic development. Its resources have become a unique source of income, and the capitalist Member Countries see great potential in offering Amazonian products. Amazonian biodiversity is used by different economic sectors: timber, pharmaceutical, food, cosmetics, small producers and fishing, all of which generate millions of dollars in commercial value each year.

Nowadays, the region's main economic activities are fishing, logging, plant harvesting, agriculture and livestock production, tourism, mining, hydrocarbon extraction and large infrastructure projects.

At least 150 to 200 species of the Amazon's great diversity of fish, estimated at 1,200 to 2,500 species, are used for subsistence and commercial fishing. Thirty of these are the most important commercial species in the basin (Barthem, Guerra and Valderrama, 1995; Barthem and Goulding, 2007). Fishing gives significant economic, social and cultural impetus to the region, and generates over $50 million dollars in sales. In addition, thousands of people depend on fish for food.

As to agrobiodiversity, rice, cacao, coffee, tea, manioc, achiote, fibers and fruits are relatively common crops in some Amazon countries. Nevertheless, progress in sustainable agricultural production systems is limited, compared with non-sustainable systems, due to market incentives and the limited scope and lack of enduring public policies.

Its abundant plants and animals give the Amazon a comparative advantage in terms of regional development. In this sense, insects like butterflies, bees and ants; reptiles like caimans, boas, turtles and lizards; amphibians like frogs and salamanders; birds like macaws, parrots, parakeets, toucans and eagles; fish like paiche, piranhas, ornamental fish and rays; mammals like monkeys, tapirs, jaguars; and rodents like otters; trees offering excellent woods like cedar, mahogany, laurel, capirona, lignum vitae, and palms like tagua and other varieties, in addition to medicinal plants (guayusa, ayahuasca, curare, etc.) and ornamental ones like orchids, are the most sought-after species for local, national and international trade.

For aquarium lovers[5], the Amazon is the main source of fish species. The main importers are the United States, Japan, and in Europe, Germany, France and Britain.

Traditional Amazonian communities depend on the forest's wealth as an important source of food and livelihood, as the direct and indirect base for countless production activities. These communities possess knowledge about the uses of biodiversity and historically they have conserved the environment.

1.6 Forests and Land Use

Despite occupying only 6% of the planet's surface, the Amazon accounts for more than half of the existing tropical rainforests. The Amazon forest extends from the eastern side of the Andes Mountains in the Pacific, to the fertile Amazon Plain in the Atlantic. This creates an interdependence between both parts that makes the continental Amazon a strategic region in terms of its biodiversity[6]. Furthermore, its role in the global water and carbon cycles make it the planet's great natural climate regulator.

The Amazon is a region characterized by considerable heterogeneity in its climate, soil, biology, water and geology. The number of plant species identified as potential sources of food, medicines, waxes, fats, latex, tannins, colorings, spices and toxic substances, among others, easily exceeds 3,000.

Biodiversity is probably greater in the various habitats of the Amazon floodplains than in any other ecosystem in the world. All forests, especially tropical ones, display a great wealth of species. These habitats vary from dryland forests to floodplain forests (varzeas), and include savannas and other less lush landscapes. Very diverse wildlife is associated with these areas, with complex relationships with their surroundings.

The complex and multilevel nature of tropical and old growth forests creates an impressive range of habitats that are occupied by a wide variety of organisms. Without this diversity of plants for habitat, refuge and food, there would be no variety of animals. Without animals to pollinize, control pests and spread seeds, the variety of plant species would not last long.

Tropical forests have a more elaborate structure than temperate forests. In the tropics, different classes of trees grow to very different heights, in addition to a great variety of other plants like lianas and epiphytes (plants that grow on tree branches instead of soil). All this variety creates more habitats that, in turn, make it possible for more animals to live in the same amount of space.

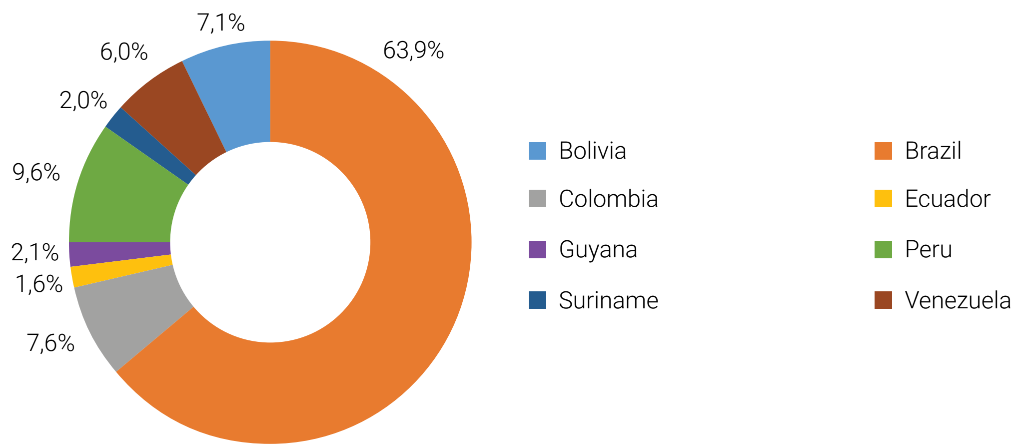
Tropical forests provide year-round sources of food, including nectar, leaves and insects. In temperate forests, similar food sources are available only on a seasonal basis. Animals must be capable of changing their diets as different sources of food become available. However, in the tropics the same food type is available all year, which means certain species may specialize in a specific food and leave other resources to other species.

In terms of the percentage of the Amazon forest located in each country, according to what the countries reported to the FAO Forest Resources Assessment (FRA) in 2015, Brazil continued to rank first (64%), followed by Peru (10%), Colombia (7%) and Bolivia (7%).

5 The Amazon is a region characterized by considerable heterogeneity in its climate, soil, biology, water and geology. The number of plant species identified as potential sources of food, medicines, waxes, fats, latex, tannins, colorings, spices and toxic substances, among others, easily exceeds 3,000.

6 See Section 1.5. Biodiversity.

Graphic 1. Total Forest Area in the Amazon (2015)



Source: FRA 2015. FAO.

1.6.1 Importance of the Amazon Forest

Forests have economic, social, environmental and ecological importance.

1. Their economic importance results from the numerous products they provide, both timber and non-timber.
2. Their social importance lies in how greatly people depend on forest resources to obtain different materials (firewood, food, medicines, fibers, etc.) as well as for cultural purposes, as in the case of the indigenous communities that live in the Amazon forest.
3. Their environmental or ecological importance consists of the environmental functions they perform, like conservation of water and waterways, soil and biodiversity (plant and animal species, microorganisms and genetic resources). Forest conservation is a big priority.

1.6.2 Wealth and Threats

The Amazon forest has abundant **renewable** and **non-renewable** resources that arouse great interest worldwide. Activities with both national and international involvement, both public and private, include (i) monoculture of crops such as soy, maize, oil palm, sugarcane, rice, etc.; (ii) fisheries to breed fish and shellfish; (iii) timber and non-timber forest products; (iv) mining, oil and natural gas extraction; and (v) water, where hydropower potential can reach 100,000 MW.

Unfortunately it must be noted that many of the above-mentioned activities cause extensive environmental impacts. The extent of the damage depends on whether government authorities and the laws can be relied on to ensure appropriate planning and implementation.

Rui Faquini

1.6.3 Soil and Land-use Change

The Amazon forest has many different types of soils. Many soils are fragile and easily lost when the plant cover is removed. The land is suitable for agriculture, pastures, forestry, mining, protection and conservation, etc. Forests can change due to forest recovery and expansion processes, or forest loss and deforestation, which make them an important indicator that provides information on the dynamics of natural habitats and biodiversity.

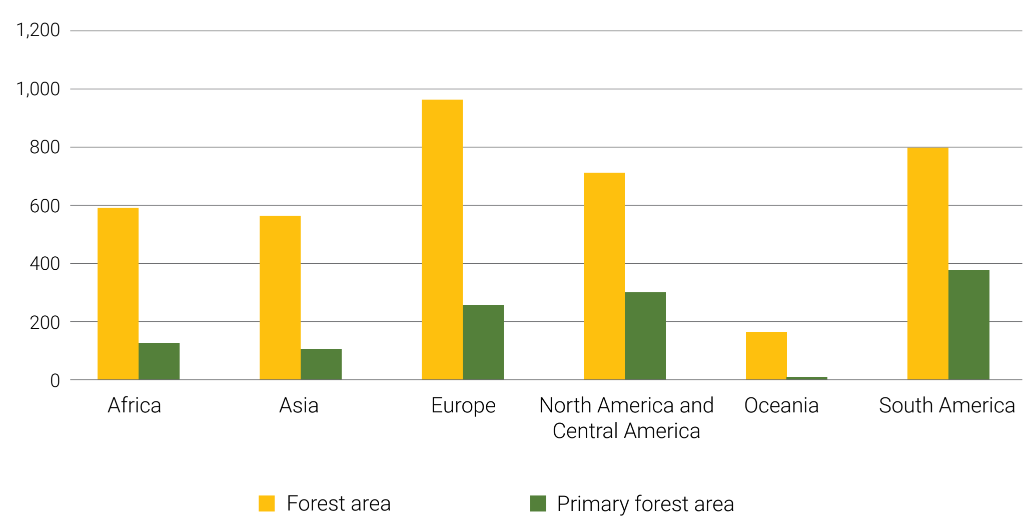
In recent years, however, change has been mostly negative due mainly to socioeconomic processes that have led to population growth and accelerated land-use change in the Amazon. The spread of economic activities and infrastructure development have also caused significant changes in land-use, with ecosystem fragmentation, deforestation and biodiversity loss. More recently, increased biofuel production may also be accelerating land-use change in the region.

Studies by the United Nations Food and Agriculture Organization (FAO) have shown that as the population increases and forest areas are converted for agriculture and other uses, the world's forests continue to shrink.

Paradoxically, however, in the last 25 years, the global net deforestation rate fell by over 50%. Most of the world's forests belong to high-income countries (temperate forests), followed by upper-middle, lower-middle and low-income ones. This goes for total forest area, primary forests, naturally regenerated forests and planted forests (See Graph 2). Nevertheless, more than 50% of primary forests, particularly tropical rainforests, are located in Central and South America, a region with the greatest share of primary forests on the planet, especially in the Amazon.

In Brazil, the Action Plan for Prevention and Control of Deforestation in the Legal Amazon (PPCDAM) has been underway since 2004, having established a new comprehensive action framework to fight illegal deforestation, and it has contributed decisively to reducing deforestation rates. The plan brought this issue into the highest echelons of the Federal Government's political agenda, with the participation of a large number of ministries. Deforestation in the Brazilian Amazon fell by 79% between 2004 and 2013. The plan has three main areas (territorial and land-use planning, monitoring and control, and promoting sustainable production activities) which are the key to promoting the transition from the current development model to a more sustainable one.

Graphic 2. Proportion of Forests and Primary Forests in the World



Source: FRA 2015. FAO.

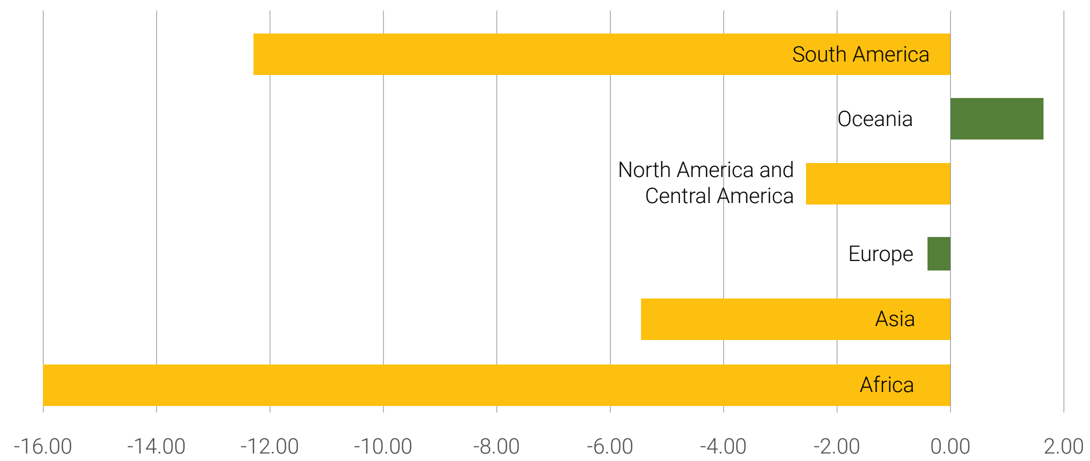

Rui Faquini

1.6.4 Forest Cover Monitoring

According to the FAO Global Forest Resources Assessment 2015 (FRA), the world has lost approximately 129 million hectares of forest since 1990. Even so the publication concludes that protected forests are increasing as more countries improve their forest management practices. This is usually made possible by legislation that includes measuring and monitoring forest resources and increasing the participation of local communities in development planning and policies.

The report also states that the greatest loss of forest surface occurred in the tropics, especially in South America and Africa. It should nevertheless be noted that forest loss rates have dropped considerably in the last five years. In temperate countries, the net forest area has actually increased in each of the measurement periods, with slight variations in the boreal and subtropical ecological zones. In addition, as shown in the graphic below, most of the world's natural forest loss took place in South America and Africa.

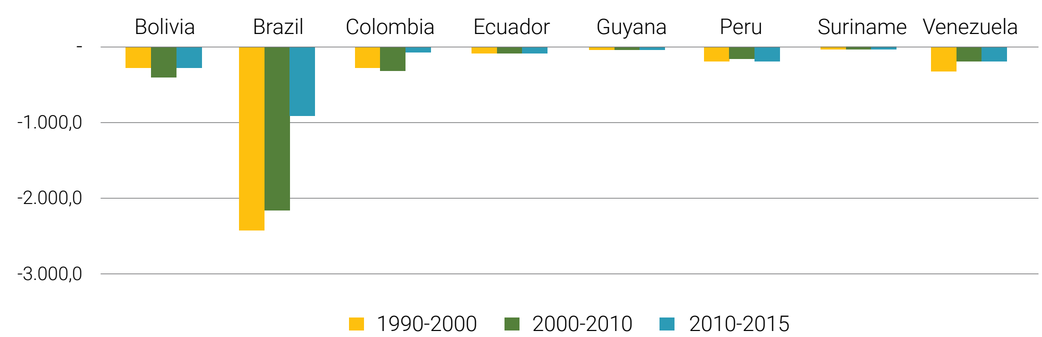
Graphic 3. Net Change in Natural Forest 2010-2015



Source: FRA 2015. FAO.

A downward trend in forest cover change rates may be seen in the last period, save for a few countries where the rates remained stable and others where they spiked.

Graphic 4. Forest Cover Change Rate in Amazon Countries



Source: FRA 2015. FAO.

Another very important parameter for monitoring forest cover—and one that is complex to define—is forest degradation, which allows us to observe changes in biodiversity and atmospheric carbon flows, which can be indicative of possible forest conversion.

Historically Guyana has reported a relatively low deforestation rate. The loss of forest ranges between 0.02% and 0.068% per year. The trend suggests that deforestation rates have increased since 1990, but have remained relatively constant over the last assessment periods, with a small decrease in 2012 followed by an increase in 2013 (0.079%) and a subsequent decrease in 2014 (0.068%)

In this context, identifying degradation through new deforestation monitoring techniques, such as satellite-based remote sensing, has become increasingly important. Ensuring that the Amazon's natural resources are protected and managed sustainably, requires real-time data on the extent and quality of forest cover, among other factors. In this sense, implementing a monitoring system that provides basic information for sound decision-making in Amazon countries is becoming increasingly necessary.

1.6.5 Regional Prospects

Considering the inadequate and uneven ability to monitor deforestation and land-use change in the Amazon region, the Amazon Cooperation Treaty Organization (ACTO) has developed an initiative to monitor deforestation that uses estimates and reliable data sequences on deforestation and forest degradation to provide an essential indicator for the Amazon forest's sustainability.

In so doing, ACTO is supporting its Member Countries in their quest towards integrated and sustainable forest management and conservation. In mid-2011 ACTO initiated the project "Monitoring Forest Cover and Land Use Change in the Amazon" to generate other inputs for forest stewardship. So far the initiative has produced two regional Amazonian deforestation maps for the periods 2000-2010 and 2010-2013. A third one is being prepared for 2013-2014.

The initiative will provide a stronger evidence base so that Member Countries may design and/or implement public policies aimed at reducing deforestation rates in the Amazon, as well as for land-use planning associated with land-use change

1.7 Climate

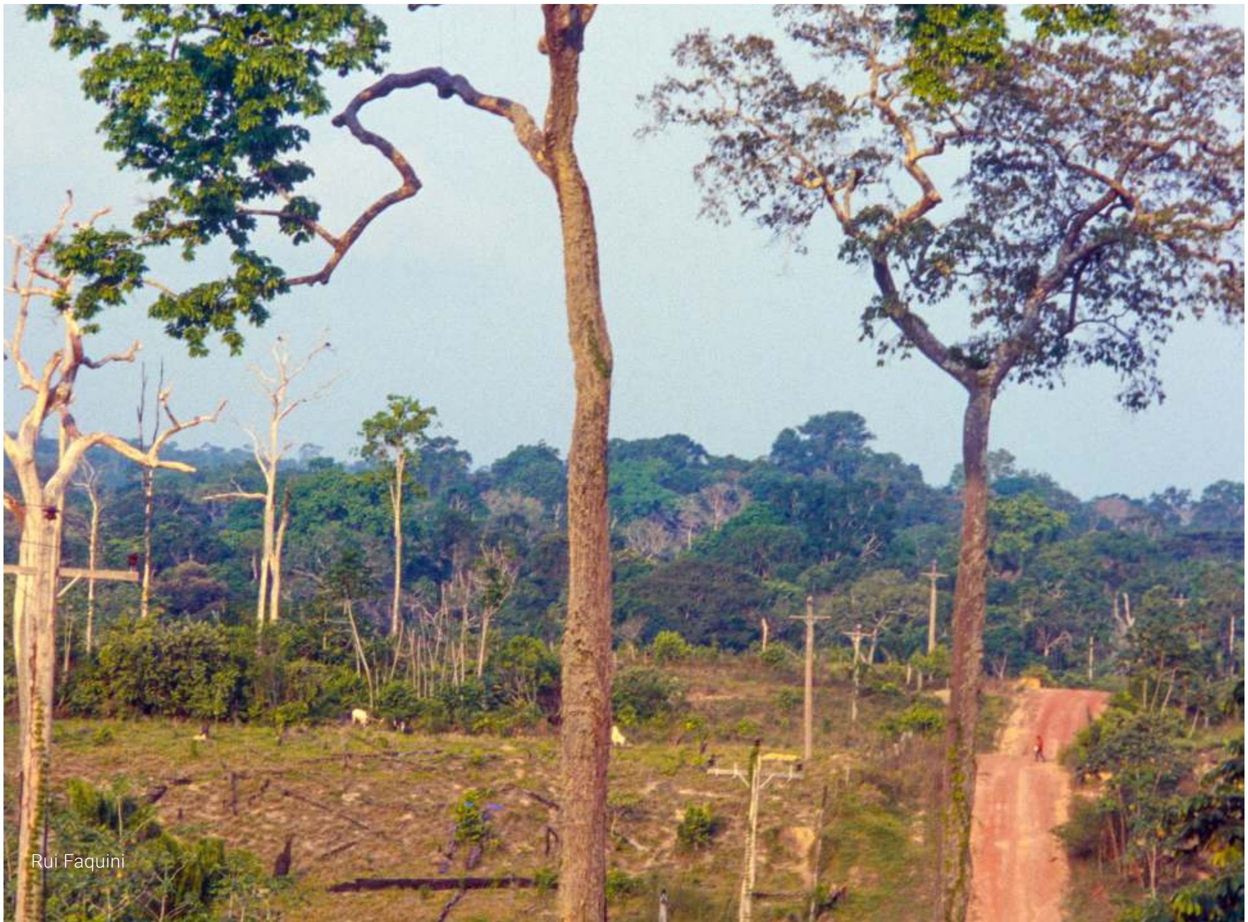
Most of the Amazon Basin is covered by tropical rainforest that produces intense evapotranspiration with high precipitation levels and heat release, which influence the regional and global climate.

The various forces that affect the Amazon are exacerbated by the pressure of climate variability, especially in the form of intense floods and droughts. Acting as a giant heat consumer, the forest absorbs half of the world's solar energy, which makes it an important factor in the global climate.

Relatively little is known about climate impacts on the Amazon Basin and its average hydroclimatic characteristics. This gives rise to many questions about interannual and multiannual variability in rainfall and streamflow, among them:

- What variations in rainfall and streamflow characterize the Amazon Basin?
- How does variability change over time and space?
- Is there a climate variability that characterizes the Andean-Amazon countries?
- Are there any trends and/or breaks in the hydrologic series?
- In this context, what explains the extreme droughts of 2005 and 2010 and the extreme floods of 2006 and 2012 in the western Amazon?
- Can climate variability explain the rainfall variability observed in the main channel of the Amazon River?
- Is there a link between hydrologic variability, large scale atmospheric circulation and sea surface temperature on the interannual, decennial and long term scales?

An analysis of the variability of extreme hydrologic events (floods and droughts) in the Amazon Basin, based on records from 18 hydrologic stations in the period 1974–2004, shows the complexity of the region's hydrologic system. The trends and variability over time of streamflow series (measured at the Obidos station) show an overall reduction in streamflow during the dry season, particularly in the southern basins, and an increase in floods in the


Rui Faquini

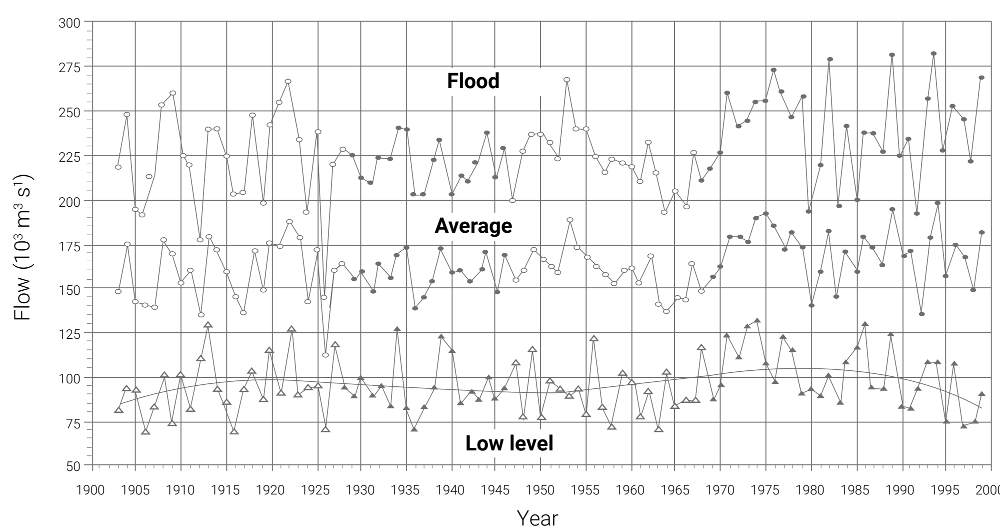
northwestern ones. This contrast, that especially affects the Andean-Amazon countries, becomes clearer starting in 1990 and is the result of strong regional hydrologic variability within the Amazon Basin.

A spatial-temporal variability analysis of precipitation highlights the important role played by land relief and exposure to the season's dominant winds.

In the northeast of the Amazon Basin, variability during the rainy season (December-May) follows a decennial pattern. Rainfall increased in the 1970s, followed by a decrease, and has increased again since the 1990s. The opposite took place in the southern part of the Amazon Basin.

During the dry season (June-November), long term variability prevails; a sudden change was observed at the start of the 1980s, and less rain in the northeastern part of the basin. This would explain the decline in dry season streamflow in the sub-basins of the northwest. Long term variability in rainfall and streamflow is related to surface temperature variability in the tropical northern Atlantic Ocean. A shortage of rain in the northeastern Amazon Basin is linked to warmer temperatures in the North Atlantic and a reduction in the Ecuadorian tropical convergence in the region as the result of a reduction in the trade winds across the Andes. (Graphic 5).

Graphic 5. Evolution of Average Annual Atreamflow (1903 - 2000) at the Obidos Station



Source: Callède et all. 2002, 2004 [Cited by Espinoza, J. C. (2009)]. (The black symbols represent observed values and the white ones are values that were estimated based on water levels at the stream gauge station in Manaus, Brazil).

Interannual pluviometric variability is greater in the eastern Amazon Basin, due to reduced rainfall during El Niño years. This variability is weaker towards the west, and it is stronger in the northwest of the Bolivian plateau and the Andean region of the Amazon Basin.

Rui Faquini

Interannual precipitation variability is also linked to sea temperature variability in the tropical northern Atlantic Ocean. Effectively, the highest rainfall in the central and eastern Amazon Basin occurs when temperatures decrease in the tropical northern Atlantic.

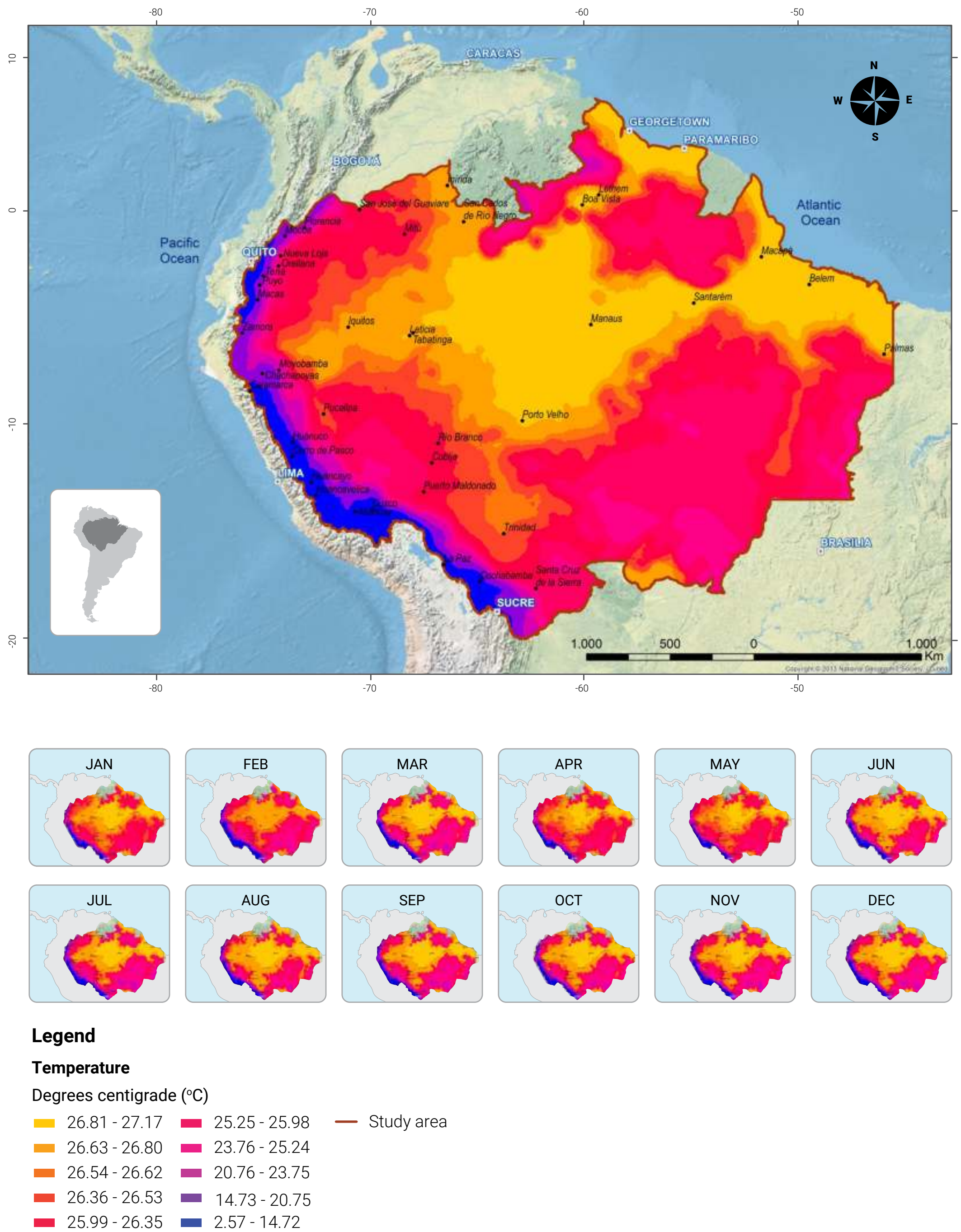
An analysis of the runoff coefficient indicates considerable consistency between hydrologic and pluviometric variability in the Amazon Basin. Nevertheless, despite the existence of 756 pluviometric stations in 2004, this number of pluviometric stations is low, given the size of the basin (approx. 8,000 km2/station), particularly in the Bolivian, Ecuadorian and Peruvian Amazon.

The impact of climate on the Amazon Basin's hydrology on the decennial and multiannual scales is little understood. Even though the river's average annual streamflow variability has been analyzed—especially in the eastern subbasins of Brazil—no significant correlation was detected in the 20th century (Marengo, 2004).

An analysis of the stream gauge records from the Obidos station (Brazil) for the period 1903-2003, shows that at the start of the 1970s there was a change in the trend of average annual water flows during low and high flow periods, with higher measurements appearing after this year. Water flows during high and mid-range periods show a relative increase until the start of the 21st century, while dry period flows show a significant decrease as of 1975. The 2005 drought and 2006 flooding are part of this climatic variability (Marengo, 2004).

In this context, it is important to mention regional cooperation by ACTO Member Countries to establish a first pilot hydroclimatic monitoring network in Brazil, Bolivia, Peru and Colombia. Through the strategic action *Implementing a Hydrometeorological Monitoring Network in the Amazon Basin, taking into account the findings of the pilot initiative*, proposed in this SAP, the initiative will be expanded to the rest of the Amazon Basin.

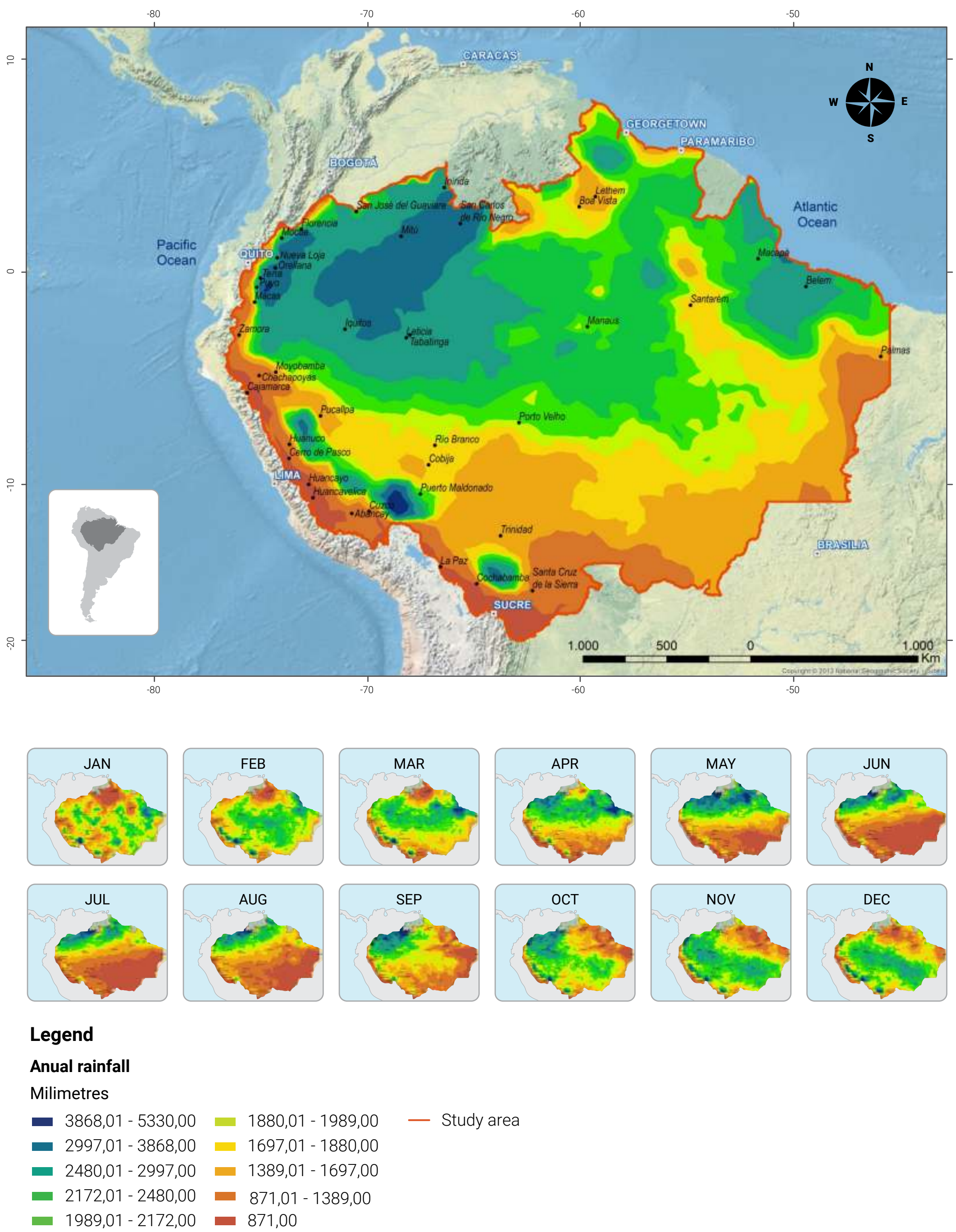
Figure 13. Average Annual Temperature in the Amazon Region



Source: ACTO/CIIFEN, 2018.

Temperature observations during the last century in the South American tropics show a temperature increase of 1.5°C. This trend is consistent with observations done in the Peruvian Amazon from 1965 to date. Rainfall trends, however, are very specific to the period analyzed. Recent studies (Espinoza et al., 2009a,) show that rainfall has been decreasing since 1970. This reduction is more marked in the southwestern Amazon Basin (Bolivia and Peru), where a strong drop in dry season water flows has been observed since the 1970s (Espinoza et al., 2009b).

Figure 14. Precipitation in the Amazon River Basin

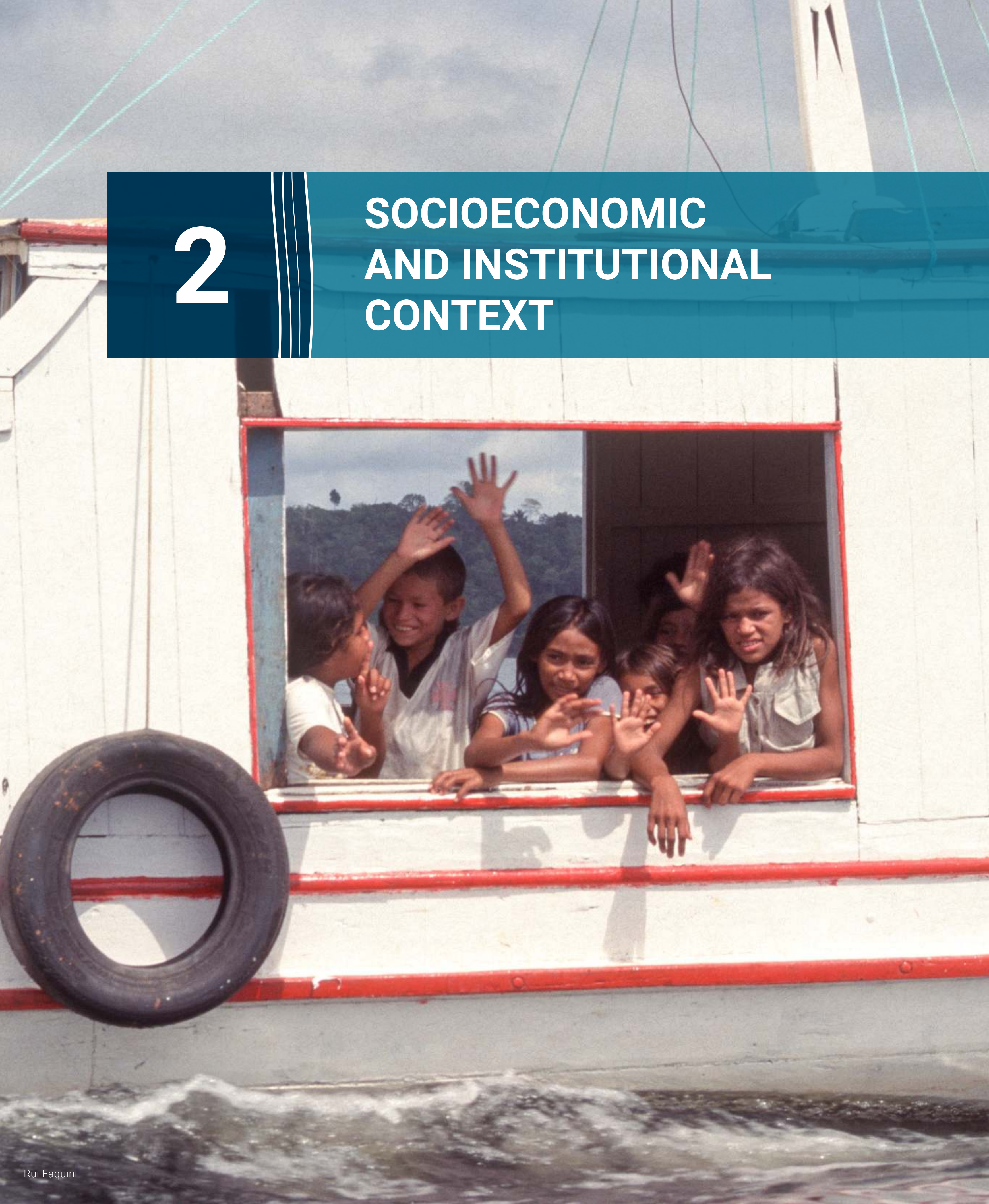


Source: ACTO/CIIFEN, 2018.

In recent decades, droughts have become more frequent and more severe, causing a 400% increase in forest fires, compared to normal years (Fernandes et al., 2011, Espinoza et al., 2011; Marengo et al., 2011, Brando et al., 2014).

These events are mainly attributed to El Niño and La Niña. In fact, studies show that extreme droughts are mainly associated with warmer sea surface temperatures in the tropical Atlantic Ocean, while stronger floods are linked to La Niña and colder than normal conditions in the tropical southern Atlantic Ocean

2 SOCIOECONOMIC AND INSTITUTIONAL CONTEXT

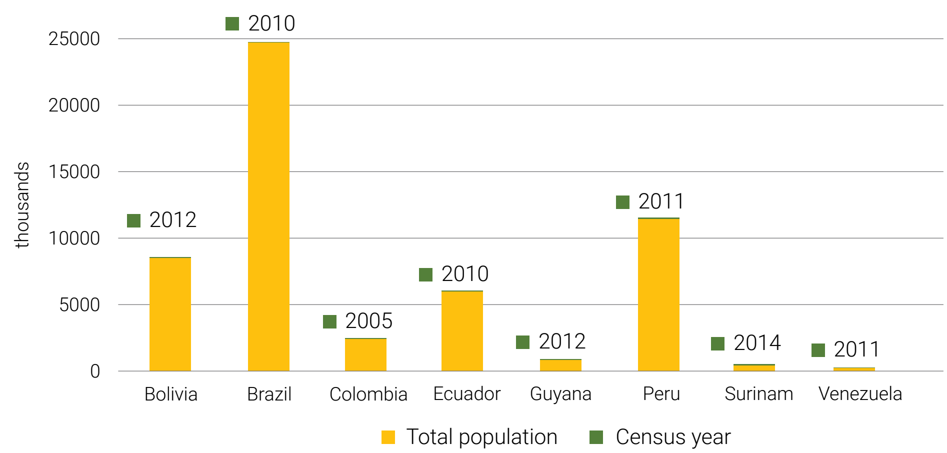


Rui Faquini

2.1 Population

In 2012 the population of the Amazon was estimated at over 44 million inhabitants (for the territory known as the *Amazon Biome*), this being an approximation due to a lack of homogeneous census data in the Amazon countries. Graphic 6 shows the population distribution according to demographic censuses from each country.

Graphic 6. Estimated Population Distribution in the Amazon Region According to Census Data

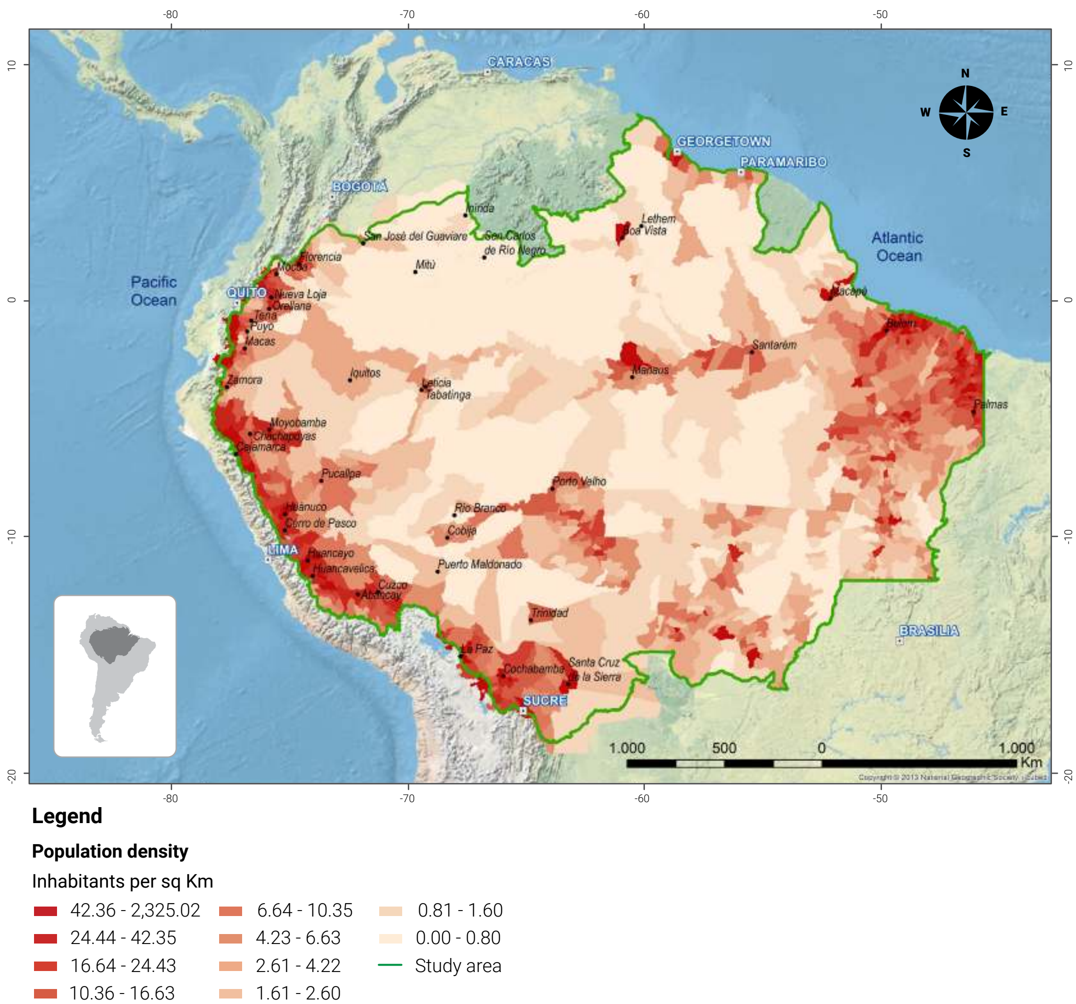


Source: ACTO/CIIFEN, 2015. Final Report: Hydroclimatic Vulnerability Atlas.


ACTO

The population is not homogeneously distributed, with a greater distribution in the Atlantic plain and Andean region of the Amazon. (Figure 15).

Figure 15. Population Density in the Amazon Region



Source: ACTO/CIIFEN, 2018.

The population of the Amazon Basin (only the territory in the basin area) is heterogeneous with a variety of sociocultural characteristics. In 2007 it was estimated at 33,485,981 inhabitants (UNDP, 2008) representing 11% of the total population of the ACTO Member Countries. Brazil is home to close to 75% of the Amazon's total population, followed by Peru with 13%. From 1990 to 2007, the Amazon's population grew at an annual average rate of 2.3%. Ecuador recorded the greatest annual average growth at 3.6%.

The population's geographic distribution varies extensively, from urban centers of over 1.5 million people and municipalities of 500,000 people, to far-flung rural villages, indigenous communities and settlements, and nomadic indigenous groups.

There are 420 different indigenous peoples, 86 languages and 650 dialects in the Amazon (2007) that attest to the region's cultural diversity, not to mention its isolated and recently contacted villages. Each of these peoples has its own demographic dynamics, fertility and mortality rates, profiles, and settlement patterns. They move between borders, according to social conventions rather than geographical ones. Socioeconomic and environmental changes in the Amazon have seriously affected the indigenous populations, forcing them to change their way of life and reducing their numbers.

Figure 16. Location of Indigenous Territories in the Amazon

Legend

Indigenous territories

Study area · Proposed Territorial Reserve · Territorial Reserve or Intangible Zone · Officially recognized IT · IT without official recognition

Source: ACTO/CIIFEN, 2018.

The main urban centers are: Manaus with 1,802,014 inhabitants (Brazil: IBGE, 2010) and Belem with 1,393,399 inhabitants (Brazil: IBGE, 2010) in Brazil; Santa Cruz in Bolivia with 1,545,648 inhabitants (INE, 2008); and Iquitos in Peru with 432,476 inhabitants (Peru: INEI, 2014).

2.1.1 Health

There are many difficulties in relation to health issues in the Amazon: isolation and difficult access make it impossible to provide homogenous health service infrastructure in the region, and qualified technical and professional personnel are scarce.

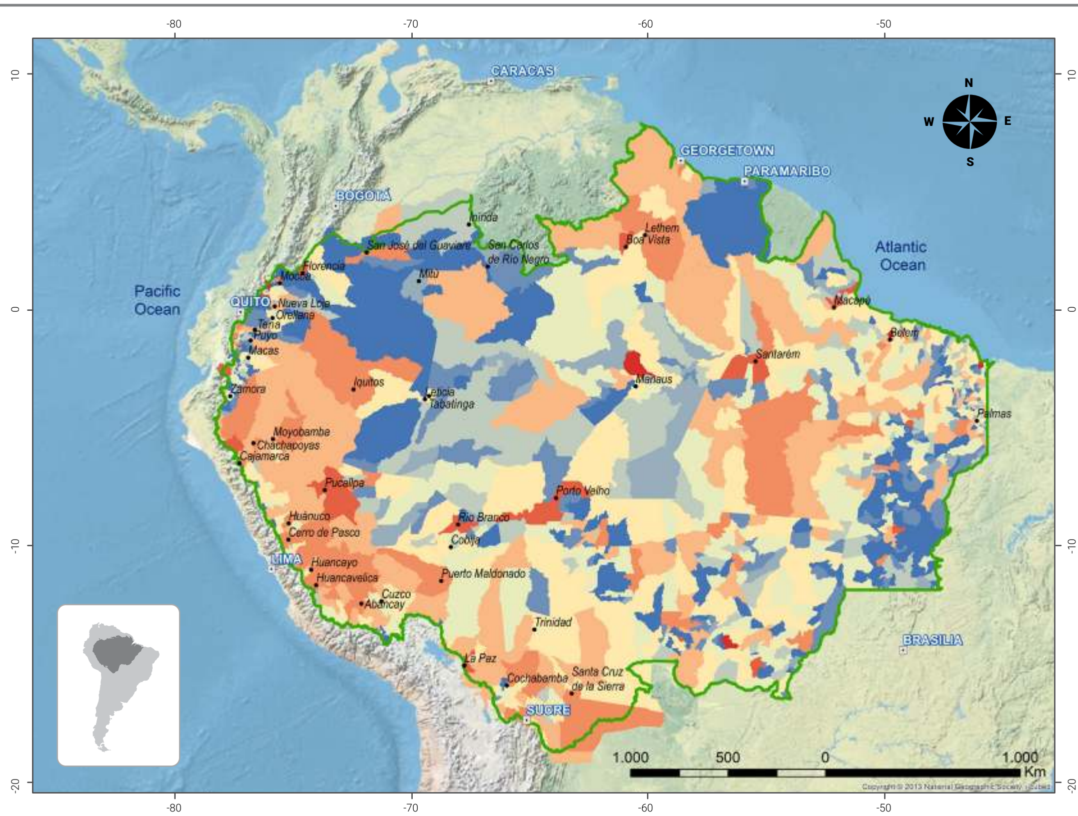
The most common diseases are malaria, dengue, tuberculosis, HIV-AIDS, hepatitis, leishmaniosis, Chagas and yellow fever, as well as gastrointestinal and respiratory diseases caused by contaminated water and air.

Recent studies have shown that malaria transmission is greater in deforested areas (Vittor, Gilman, Tielsch, Glass and Shields, 2006), with a significant increase seen in urban areas, due mainly to standing water that serves as a breeding ground for the carrier.

On the whole, economically vulnerable and elderly populations are the most likely to develop gastrointestinal and respiratory infections. In the Brazilian Amazon, the annual infant mortality rate fell from 51 to 36 deaths per 1,000 live births between 1991 and 2000. The mortality rate in children under age 5, in turn, fell from 67 to 46 deaths per 1,000 live births (Celentano and Veríssimo, 2007). In Ecuador, the child mortality rate was 39.5 per 1,000 live births in 2001 (Institute for Eco-development in the Amazon Region (ECORAE) 2006).

A map of health facilities in each intermediary political division of the Amazon has been compiled based on information on the location of health facilities in the Amazon Region, provided by some Member Countries. Figure 17 shows the distribution and number of health facilities in the Amazon. It identifies the areas with the most units, including hospitals and small clinics, in each administrative political division.

Figure 17. Distribution and Number of Health Facilities in the Amazon



Legend

Health Facilities

Number

257 - 702	26 - 51	8 - 9	0 - 5
122 - 256	15 - 25	7	Study area
52 - 121	10 - 14	6	

Source: ACTO/CIIFEN, 2018.

2.1.2 Education

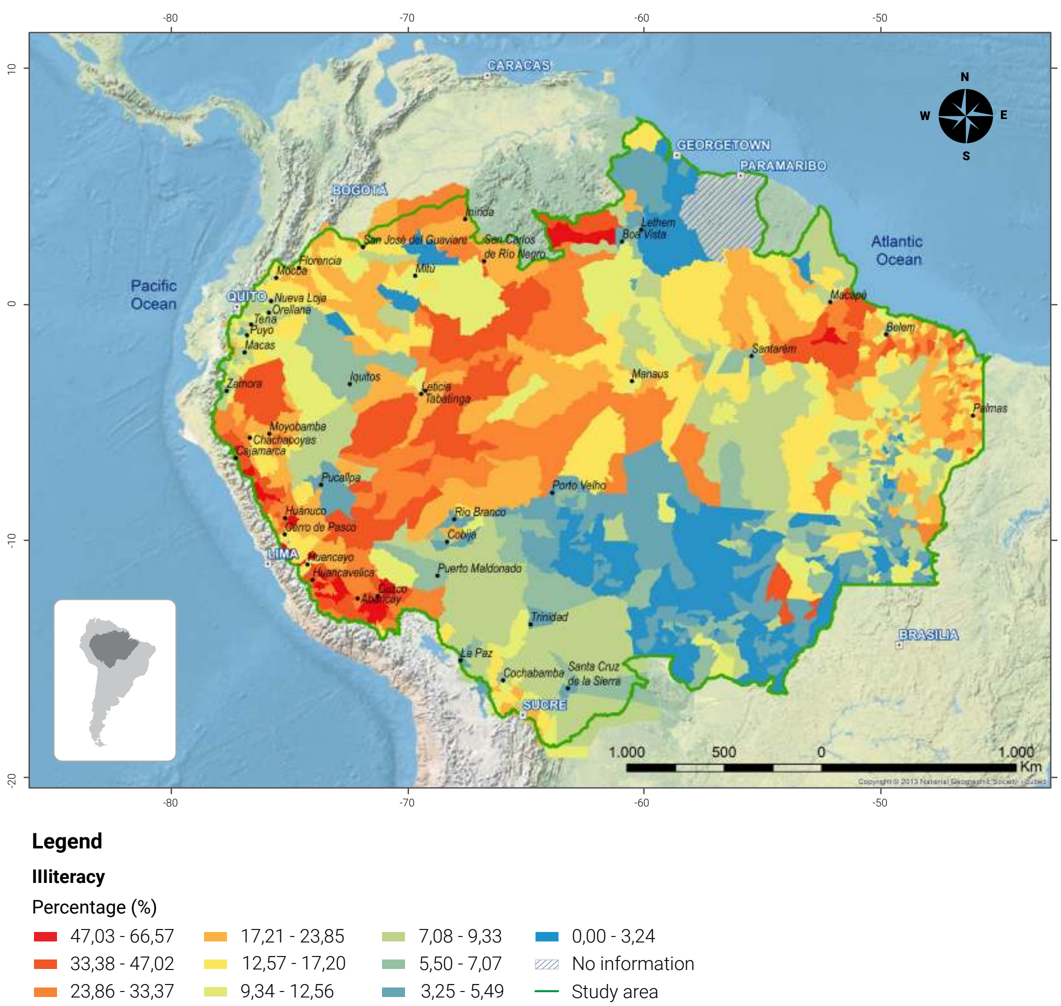
Adult illiteracy is high in the Amazon, with rates varying from 10% to 93%, depending on the area. In the largest urban centers, the illiteracy rate fell by 7% on average, going from 20% to 13% between 1990 and 2005 in the population over 15 (Celentano and Verissimo, 2007).

People older than 15 are considered illiterate when they declare that they are not being able to read or write in the official language. The numbers show the percentage of the population without formal education in Spanish, Portuguese, English and Dutch, depending on the official language of the country. Indigenous populations have their own languages, knowledge and ancestral cultures that have made it possible for them to interact in their own social groups (ECLAC, CELADE, 2014)

In 2010, illiteracy rates were of 0% to 49.5% in different parts of Brazil, 4% to 23% in Ecuador, 4% to 67% in Peru, and 4% to 22% in Bolivia. Educating indigenous people is a means to social development that allows them to be included and integrated in society, and guarantees their enjoyment of human and collective rights (United Nations, 2005; ECLAC, CELADE, 2014).

Rui Faquini

Figure 18. Illiteracy rate in the Amazon Region



Source: ACTO/CIIFEN, 2018.

2.1.3 Poverty

People are considered poor if they are deprived of at least two basic needs according to the unsatisfied basic needs (UBN) indicators[8], based on empirical estimates (ECLAC, 2013).

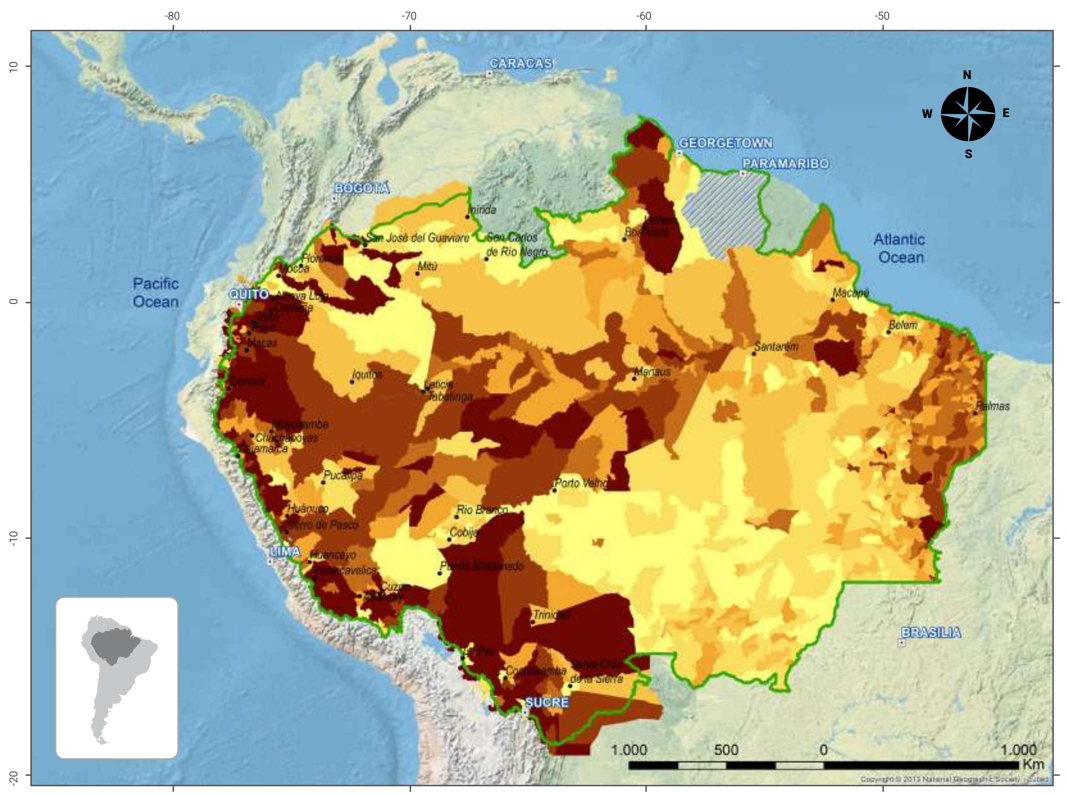
In this context, illiteracy, chronic malnutrition and limited access to food, factor in poverty in the Amazon region. However, it must be noted that some countries present a

8 UBN: A direct method to identify critical deficiencies and characterize a population's poverty. It uses indicators related to people's basic needs (housing, sanitation, basic education and minimum wages) that are available in the countries' population and housing censuses. www.cepal.org/deype/mecovi/docs/taller5/10.pdf

marked deficiency in access to basic services (as is the case of indigenous populations) but have high literacy levels and access to livelihood means in accordance with their cultural development, (IDB, UNDP, ACT), while others have fewer limitations accessing basic services but have serious problems in terms of illiteracy and malnutrition.

Figure 19 shows a map of the spatial distribution of poverty percentiles, calculated according to unsatisfied needs, expressed in percentage points. The information presented refers only to three countries that provided up-to-date data for this indicator.

Figure 19. Poverty by unsatisfied basic needs in the Amazon Region



Legend

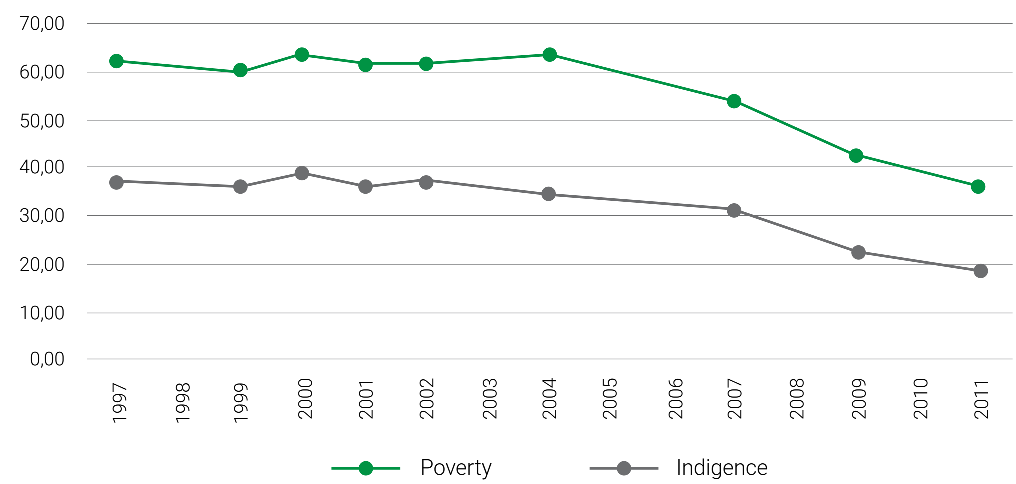
Percentage (%)

- 68.21 - 100.00
- 58.15 - 68.20
- 53.24 - 58.14
- 46.76 - 53.23
- 39.76 - 46.75
- 32.50 - 39.75
- 0.00 - 32.49
- No information
- Study area

Source: ACTO/CIIFEN, 2018.

The poverty data for Bolivia is from 2001 (the data needs to be updated using the 2012 census). However, according to the information on poverty and income distribution in Bolivia published by ECLAC, the poverty rate on the whole fell to 36.3%, or 25.4 percentage points, in 2011 compared with 2001, as shown in Graphic 7 (ECLAC, 2014).

Graphic 7. Poverty and Abject Poverty in Bolivia in 2011



Source: ECLAC, 2014.

2.2 Economic Activities

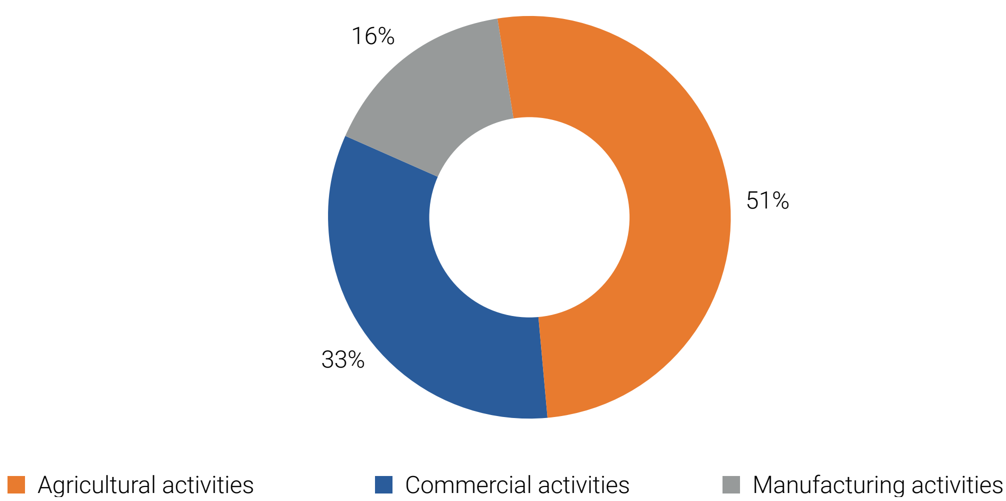
All economic activities carried out in the Amazon put pressure on natural resources in different ways and to different degrees.

Because the Amazon's soil is not very suitable for agriculture, it produces small yields (BID, PNUD, TCA, 1992). As such, economic activity focuses mostly on natural resource extraction (raw materials), either mineral or forest resources, and in some places agriculture or small-scale tourism.

Natural resources harvesting began in the Amazon Basin with rubber, which was produced until 1914. Extractive activities then fell considerably until after the Second World War, when forest harvesting, agriculture and livestock production changed how the land was used. Since then the Amazon's population has been growing steadily, with the construction of large infrastructure works to produce electricity and communication infrastructure, both of which are key for the extraction of mineral resources and oil (Salati et al., 1990).

Graphic 8 shows the main economic activities in the Amazon region of Bolivia, Brazil, Ecuador and Peru. Census data from 2010 to 2012 show that approximately 6,085,256 people work in agricultural activities, forestry, fishing and hunting. These are followed by trade-related activities, manufacturing and construction.

Graphic 8. Main Economic Activities in the Amazon

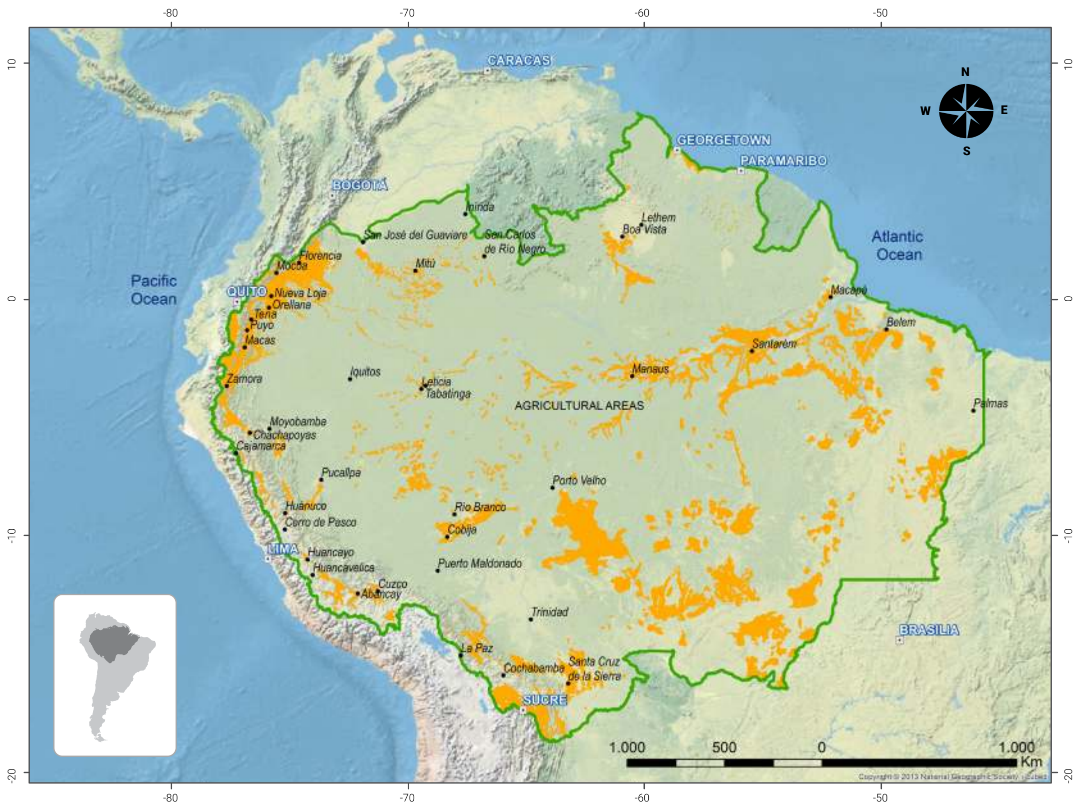


Source: ACTO/CIIFEN. 2015.

2.2.1 Agriculture and Livestock

Approximately 22% of the Amazon's surface is used for agriculture and livestock production. The highest percentage is found in the grasslands, tropical savannas and mountains, particularly in the highlands, in the Bolivian valleys and lowlands, and in the eastern Andes of Ecuador and Peru. Agricultural activities also extend to the tropical forests of Peru, particularly in the province of Maynas, Iquitos (Peru), as shown in Figure 20.

Figure 20. Distribution of Agricultural Areas in the Amazon



Legend

- Study area
- Agriculture areas

Source: ACTO/CIIFEN, 2018.

Agriculture in the region consists of single-species plantations that are one of the main causes of deforestation, land-use change and loss of important woodlands in the Amazon. It must be noted that agriculture is also driven by road construction and waterway development.

In Brazil, 23% of the Amazon is occupied by farms (115.5 million hectares). According to Brazilian law, 80% of the area of productive properties located in the forest areas of the Legal Amazon are supposed be preserved (legal reserve lands) (IBGE Agricultural Census, 2006; CASTRILLON FERNÁNDEZ, A. J., 2006).

Peru (with 70% of its territory in the Amazon) pursues agricultural activities in the Amazon region mainly because of easy access to water. Agriculture in the Amazon is necessary for the country's economic development and food production in general, with large maize, rice, manioc and banana plantations (CIAT, 1993).

It is also important to mention cultivation by indigenous peoples, which have identified over 2,000 plant species for medicinal purposes, food or oils, fats, waxes, varnishes, aromas, saponins, latex, rubber, spices, drugs, etc., and approximately 4,000 timber species (RUTTER, 1990). Because Peru has the greatest diversity of plant species, the Amazon people consume more than 200 species of fruits and the country uses 2,786 timber species (Vasquez & Gentry, 1989), while in Brazil there are approximately 260 species of high economic value (Sternadt, Ternadt, & Camargos, 1988). Of the forest's total economic value, 90% comes from products other than wood (Peters, Gentry, & Mendelson, 1989; IDB, UNDP, ACT, 1992).

2.2.2 Mining

Mineral and energy resources are widely found across the Amazon Basin. The region has reserves of gold, bauxite, zinc, coal, manganese, iron and a large number of smaller minerals. It also stores large deposits of oil and natural gas. Water resources make it possible to produce hydropower.

Informal and/or illegal mining poses a threat for aquatic and terrestrial ecosystems in the Amazon Basin, especially in the Guyana Shield, the Andes mountains of Bolivia and Peru, and the Colombian piedmont. Small-scale gold mining is extensive and environmentally destructive. The Guyana and Brazilian shields are regions were gold originates, and it is extracted from alluvial deposits in large rivers and ravines. In Brazil, the main gold producing regions are the northern part of Mato Grosso State, the Tapajos riverbanks in Para State, and the State of Amapa, where large companies and illegal miners have taken hold. Gold production is also a source of water pollution with other mineral elements like iron, magnesium and phosphorus due to their great solubility in water—which means they are found in waterbodies, sediments and sludge—, as well as cyanide, which is also used to purify gold.

In Ecuador, gold mining is done mainly in the Provinces of Morona Santiago, Zamora Chinchipe and El Oro. There may be as many as 100,000 to 200,000 artisanal miners in Colombia, a similar number in Peru, and double that number in Brazil (Socioenvironmental Institute -ISA, 2006).

Gold production has spread to the high basin of Madre de Dios, Peru, and the highlands of Beni, Bolivia. Currently, thousands of small-scale miners operate in the high basin of Madre de Dios, where mercury has contaminated the water and created considerable environmental problems.

At the border between Colombia and Brazil, gold mining and mercury contamination are causing similar problems, while in Ecuador gold mining causes contamination by arsenic. In Guyana, diamonds are produced by multinational corporations, while gold and bauxite are mined by small and medium-sized companies. Artisanal miners are also putting pressure on the Guyanese Amazon on a small scale. In Suriname, small-scale gold mining known as "porknokking," is done by artisanal miners, which causes mercury contamination just like in Guyana. In Suriname, gold is also extracted by multinational corporations.

Mineral wealth is extracted both legally and illegally in the Amazon region. Nowadays, most Amazon countries extract iron, zinc, oil and natural gas. Without environmental oversight, these activities can cause substantial impacts on surface and groundwater in the entire region.

TABLE 7. MAIN MINERAL EXPLORATION ACTIVITIES IN THE AMAZON REGION

COUNTRY	ACTIVITIES
BOLIVIA	Mining iron, gold, oil, gas
BRAZIL	Mining iron, gold, bauxite, zinc, aluminum, potassium
COLOMBIA	Mining iron, gold, coltan, oil, gas
ECUADOR	Mining iron, gold, oil, gas, copper
GUYANA	Mining gold, bauxite, kaolin, aluminum
PERU	Mining iron, gold
SURINAME	Mining gold, bauxite, kaolin, aluminum, oil
VENEZUELA	Mining gold

Source: Modified from *Amazonía sin mitos*, 2008.

2.2.3 Oil Extraction

The largest oil and gas fields are located in the western Amazon, close to the Andes, in Colombia, Ecuador, Peru and Bolivia. Oil exploration in the Brazilian Amazon is concentrated around the Urucu River. The Amazon's largest oil refineries are located in Manaus. Peru, Colombia and Ecuador have oil pipelines running from the oilfields to the refineries in the Andes and Pacific coast.

Guyana is prospecting for oil in the Takatu River basin (ACT, 1995; Goulding, Barthem and Ferreira, 2003a). Ecuador produces 74,9% of its oil in the Provinces of Sucumbios, Napo, Orellana and Pastaza.

Oil and natural gas reserves are located in some of the most ecologically sensitive areas of the Amazon Basin. Oil extraction areas often overlap with Natural Protected Areas (NPA). Peru has hydrocarbon operations in a number of NPAs, like Pacaya-Samiria National Reserve, Machiguenga Communal Reserve and the Pucacuro Reserve Zone.

Located in the lower Urubamba jungle, the Camisea gas field in Peru is one of the largest energy projects in South America. Bolivia also has large natural gas reserves that represent important economic potential for the future of the country and region.

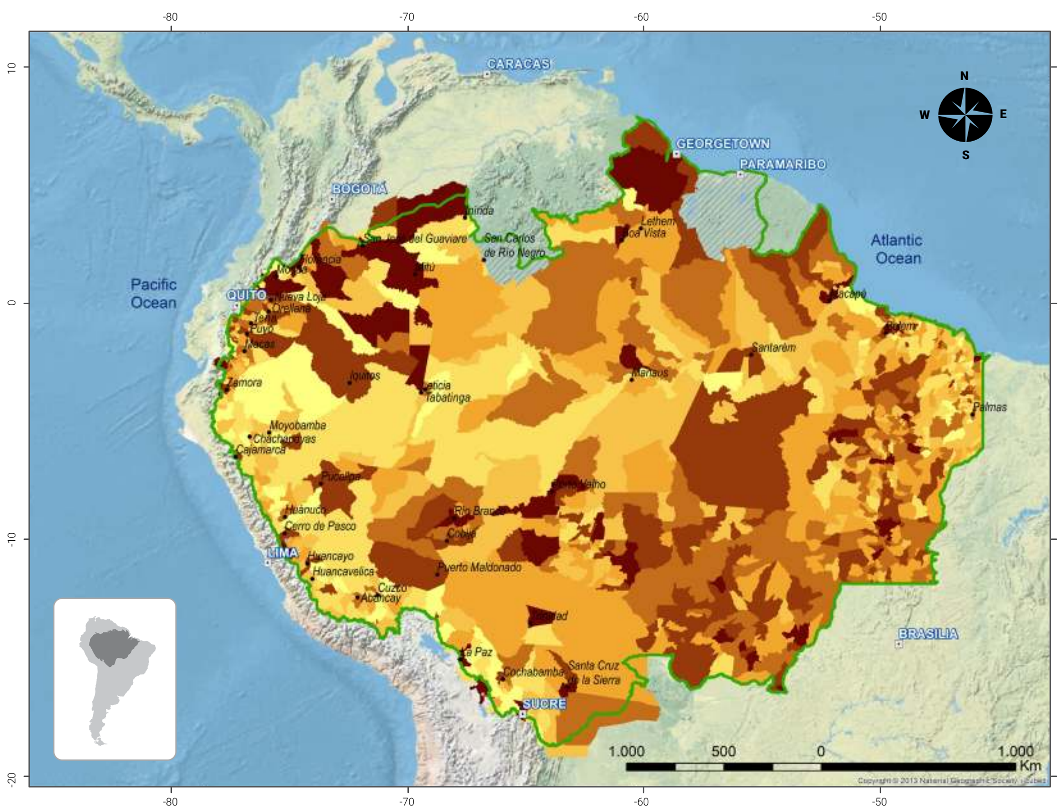
2.2.4 Alternative Activities

People working in alternative activities are mostly involved in trade, fishing, mining, masonry, administrative activities and education, among others.

Rui Faquini

Figure 21 shows a map of the distribution of people engaged in a wide variety of economic activities across the Amazon region. They are mostly concentrated in the east, and in a more isolated manner in the Amazonian territory of Peru, Province of Maynas in Iquitos, Puerto Maldonado in the south, and especially in the river port cities of the Amazon.

Figure 21. Map of the Economically Active Population Engaged in Activities Other than Agriculture



Legend

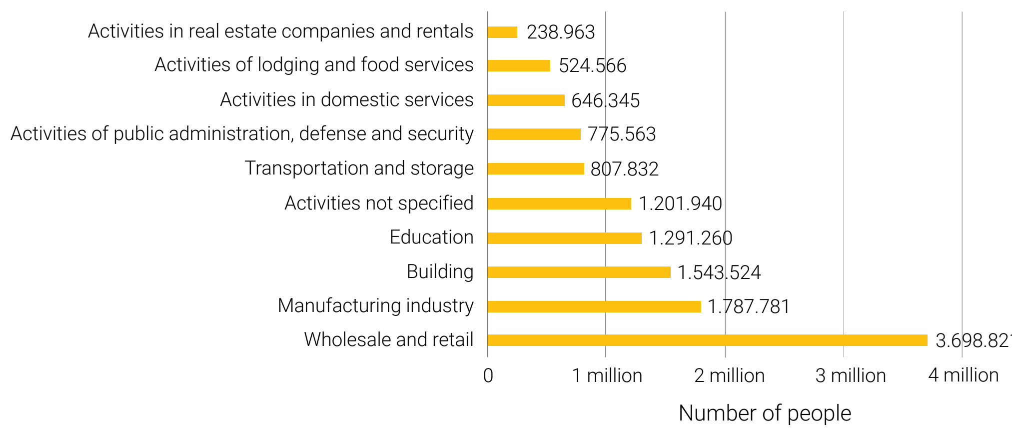
Percentage (%)

- 86.64 - 100.00
- 72.30 - 86.63
- 61.11 - 72.29
- 51.86 - 61.10
- 42.40 - 51.85
- 29.78 - 42.39
- 0.00 - 29.77
- No information
- Study area

Source: ACTO/CIIFEN, 2018.

Trade is one the most common economic alternatives to agriculture in the Amazon, with the second largest number of workers. As shown in Graphic 9, work in manufacturing and construction is also common.

Graphic 9. Economic Activities Other than Agriculture



Source: ACTO/CIIFEN. 2015.

Graphic 9 shows the eight economic activities with the greatest demand for labor. This graphic compiles information on the economically active population, by type of activity, in four ACTO countries, based on census data from 2010 to 2012.

2.3 Institutional Frameworks

2.3.1 National Level

The current institutional framework for water resources management in each ACTO member country has been analyzed based on each country's national constitution and legal instruments (policies and laws that define jurisdictions, duties and responsibilities) as well as the plans and programs of water resources management institutions, with special emphasis on each country's Amazon region and identifying the main lines and elements in common.

This analysis revealed a wide variety of legal instruments (laws and policies) implemented in each country that reflect their different models of state (federal, unitary), levels/orders of government (national, regional and local) and institutional organization (ministries, water authorities/agencies, secretariats, governorships, etc.). Despite the differences, they share certain institutional trends:

- Each member country's current institutional framework is defined by its national constitution, which establishes the public policies to be implemented for the environment and water resources.
- On the whole, most of the eight countries' constitutions identify water resources as a state-owned strategic resource to be protected, used, conserved and sustainably managed, preserving the environment for current and future generations.
- The constitutions of Bolivia, Brazil and Peru attach special importance to their Amazon regions.
- In most countries, water management is defined by specific water resources laws and/or policies: Bolivia (Water Law, National Watershed Management Plan), Brazil (National Water Resources Policy), Colombia (National Policy for Integrated Water Resources Management), Ecuador (Organic Law on Water Resources, Uses and Exploitation), Peru (Water Resources Law and National Water Resources Policy and Strategy), Suriname (Water Supply Act) and Venezuela (Water Law).
- Two countries have specific water management systems: Brazil (National Water Resources

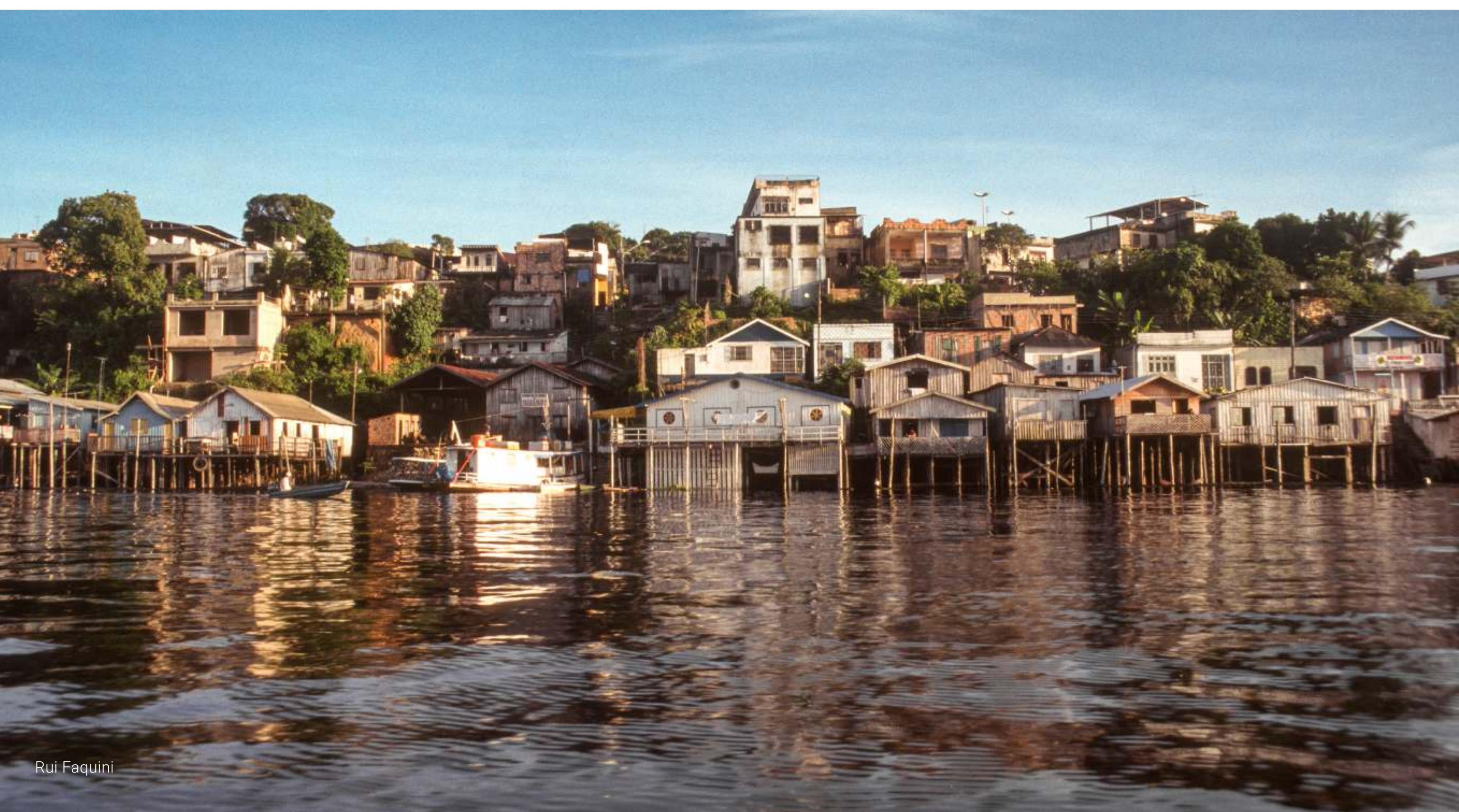
Management System-SINGREH) and Peru (National Water Resources Management System).

- Some of the countries have national institutions responsible for managing water resources: National Water Agency (ANA-Brazil), National Water Authority (ANA-Peru), Ministry of Public Works (Suriname), Ministry of Ecosocialism and Water, Vice-Ministry of Ecosocialist Water Management (Venezuela), and Water Secretariat (SENAGUA-Ecuador). Other Member Countries have ministries with jurisdiction over water resources and the environment.
- All countries have national technical institutions responsible for meteorology and hydrology, mining (hydrogeology/groundwater activities) and irrigation, among others, that also have responsibilities in water resources management. Water resources management institutions in the Amazon vary according to the country's institutional context: autonomous departmental governments (Bolivia); regional governments (Peru and Venezuela); federal states (Brazil); regional autonomous corporations (Colombia); as well as the coordinating institutions: basin committees, boards and agencies (Brazil, Colombia, Peru and Venezuela), and specialized institutes (Brazil -INPA; Colombia -SINCHI Institute; Ecuador -ECOARE and Peru -IIAP), among others.

- Most also have specific legal instruments that govern water resources management in the Amazon, many of which are in the process of being implemented.

Analyses of the institutional technical and administrative capacity of the countries' national institutions, considering national institutional capacity and the Amazon region, show that:

- Institutional capacity (technical and administrative) differs in each of the eight Amazon countries, depending on their state models and institutional organization, which is closely linked to their areas of authority, and is a key factor in developing and/or applying water resources management policies.



Rui Faquini

Additionally, institutional development needs were identified in the eight countries by analyzing the following issues:

1. Organizational resources
2. Human resources
3. Financial resources
4. Infrastructure
5. Developing and/or strengthening protection in the Amazon region
6. Developing and/or strengthening coordination mechanisms.

Based on this analysis, the countries were found to have the following elements in common:

- The extent of their institutional development needs varies according to their internal institutional policies.
- All the countries need to develop and/or consolidate coordination and protection mechanisms for the Amazon Basin.
- Bolivia, Guyana and Suriname have institutional development needs in all the areas analyzed, while Brazil, Colombia, Ecuador, Peru and Venezuela do not require organizational resources.

Finally, the main coordination mechanisms in place to protect the Amazon's water resources were identified. The study analyzed their jurisdictions, duties and attributions related to water resources and environmental matters in the main subregional and regional organizations of which ACTO countries are members: Bolivarian Alliance for the People of our America – Peoples' Trade Treaty (ALBA–TCP), Union of South American Nations (UNASUR), Community of Latin American and Caribbean States (CELAC), and the Andean Community of Nations (CAN).

The study found that although there is no regional coordination mechanism to protect water resources yet, institutional coordination initiatives for water resources exist in the subregional and regional organizations mentioned above, in most cases closely linked to environmental matters.

- **ALBA-TCP**[9] gives special importance to protecting natural resources. It has an institutionalized committee (Nature Defense Committee), and has plans to implement its environmental agenda and pursue the development and implementation of the "Rights of Mother Earth."
- **UNASUR**[10] establishes, among its specific objectives, protection of biodiversity, water resources and ecosystems, and fostering cooperation to prevent natural disasters and combat the causes and effects of climate change.
- **CELAC**[11] is implementing the Caracas 2012 Action Plan, which includes the possibility of creating a multidisciplinary knowledge center to strengthen its institutions and prepare them and the communities to implement a common agenda for water resources management.
- **CAN**[12] is implementing the Andean Strategy for Integrated Water Resources Management (AS-IWRM), with the aim of undertaking joint actions for IWRM in the Andean countries, strengthen these and making them more sustainable.
- **MERCOSUR** Sub-working Group 6, on the environment, brings together national ministers, and has a technical group.

2.3.2 Interinstitutional Coordination in Amazon Countries

The Amazon countries are making an important effort to coordinate water resources management at the national, regional and local levels. Nevertheless, interinstitutional coordination and interaction is fragmented due to the array of stakeholders, functions and responsibilities for water resources management, which hinders the implementation of established policies.

9 ALBA-TCP: Bolivarian Alliance for the People of our America-People's Trade Agreement.
10 UNASUR: Union of South American Nations.
11 CELAC: Community of Latin American and Caribbean States.
12 CAN: Andean Community of Nations.

Most of the countries are currently in the process of implementing interinstitutional coordination mechanisms and/or adapting their legal frameworks. Additionally, note that:

- The Permanent National Commissions of the ACTO Member Countries are interinstitutional entities with responsibilities, among others, related to natural resources, including water resources.
- The following interinstitutional mechanisms have been identified for water resources management in the Amazon Basin: Brazil (National Water Resources Council, entity responsible for coordinating WRM in the national territory that brings together national and federal bodies), Colombia (Amazon Basin Councils and Joint Amazonian Commissions that are currently going through a regulatory adjustment), Ecuador, (ECORAE, government institution responsible for Amazonian development), Peru (Amazon Basin Councils and Amazon Subbasin Councils are in the process of being implemented), Venezuela (People's Power Ministry for Ecosocialism and Water) through the Vice-Ministry of Ecosocialist Water Management.

2.4 Legal Frameworks

In the countries of the Amazon Basin, the constitutions establish the set of legal instruments and principles that govern how the state is organized. The constitution is the document with the highest legal authority.

Enshrined among the constitutional values is the right to the environment, which shall be "healthy, protected and balanced" (Bolivia), "ecologically balanced" (Brazil), "healthy environment" (Colombia), "healthy, balanced and appropriate" (Peru), "not detrimental to health and wellbeing" (Guyana). There is also a recognition of the "rights of nature or Pacha Mama" (Ecuador), and "safe, healthy and ecologically balanced environment" (Venezuela).

These last two documents dedicate a chapter and a specific section to water resources, respectively. Although water resources management and conservation issues are only mentioned in constitutional provisions in Brazil, it must be noted that water is an important environmental element in all countries. In that sense, the constitutional legal framework established for the environment and natural resources also applies to water resources.

Amazon countries are moving toward the adoption of specific water management laws based on modern management criteria, considering the watershed a management unit, social participation and planning. Four of them have already done so: Brazil (1997), Ecuador (2014), Guyana (2002) and Peru (2009). Note also that in Bolivia water resources management is included in the framework for living well in harmony with Mother Earth (2012). Water resources management is furthermore linked to sanitation services, drinking water, risk management, fishing, mining, forests, hydrocarbons, ports, hydropower and exotic species.

Water is considered a public good in all the Amazon countries, which makes the government responsible for managing it for the collective good. Private property rights to water do not exist.

In order to manage water resources, all the Amazon countries except Suriname have adopted the basin as their water management unit, taking into account that the territorial dimension of the area occupied by the basin does not necessarily coincide with their political-administrative divisions or administrative territories. Bolivia, Brazil, Colombia, Ecuador, Venezuela and Peru have already completed the process of delimiting and coding their watersheds.

Ensuring integrated water resources management presents the challenge of implementing mechanisms to promote a coordinated approach to land management and associated resources with the goal of achieving sustainable development. The first question is whether any legal instruments prevent the integrated management of surface and groundwater. In the Amazon countries, legal instruments refer to complete and integrated water resources management. While Brazil, Guyana and Peru have specific laws that address joint groundwater and surface water management, Bolivia and Colombia's laws call for integrated water management, and Suriname has nothing specific on the subject. In terms of an ecosystem approach, Brazil, Colombia, Ecuador, Guyana and Peru specifically refer to this in their water resources regulations or policies, or in their environmental policies. Although Bolivia does not mention the term "ecosystem approach," it uses the expression "integrated and sustainable water resources management," which is similar to the ecosystem approach.

The laws of all of the Amazon countries (except Suriname) envisage multiple water uses, and all ACTO Member Countries prioritize water for human consumption. Bolivian law contemplates new possibilities by establishing that water use must reconcile the needs of conserving Mother Earth, human consumption and production processes to ensure sovereignty with food security.

All of the Amazon countries have adopted the principle of decentralized water management. This principle gives new meaning to decision-making power that may contribute to democratizing water management.

All the countries, save for Suriname, have adopted the principles of information and participation. Rounding out this overview of water resources management principles is the fact that environmental education is a constitutionally established principle in environmental and education regulations in general.

In terms of water management tools, all of the Amazon countries have water quality standards, although in Suriname these only apply to drinking water. As to classifying waterbodies, only Suriname has not done so yet. While in Bolivia, Brazil, Colombia, Ecuador, Guyana, Venezuela and Peru environmental impact assessments are mandatory, either by carrying out environmental impact studies before implementing an action, or by means of other instruments, in Suriname prior environmental impact studies are voluntary.

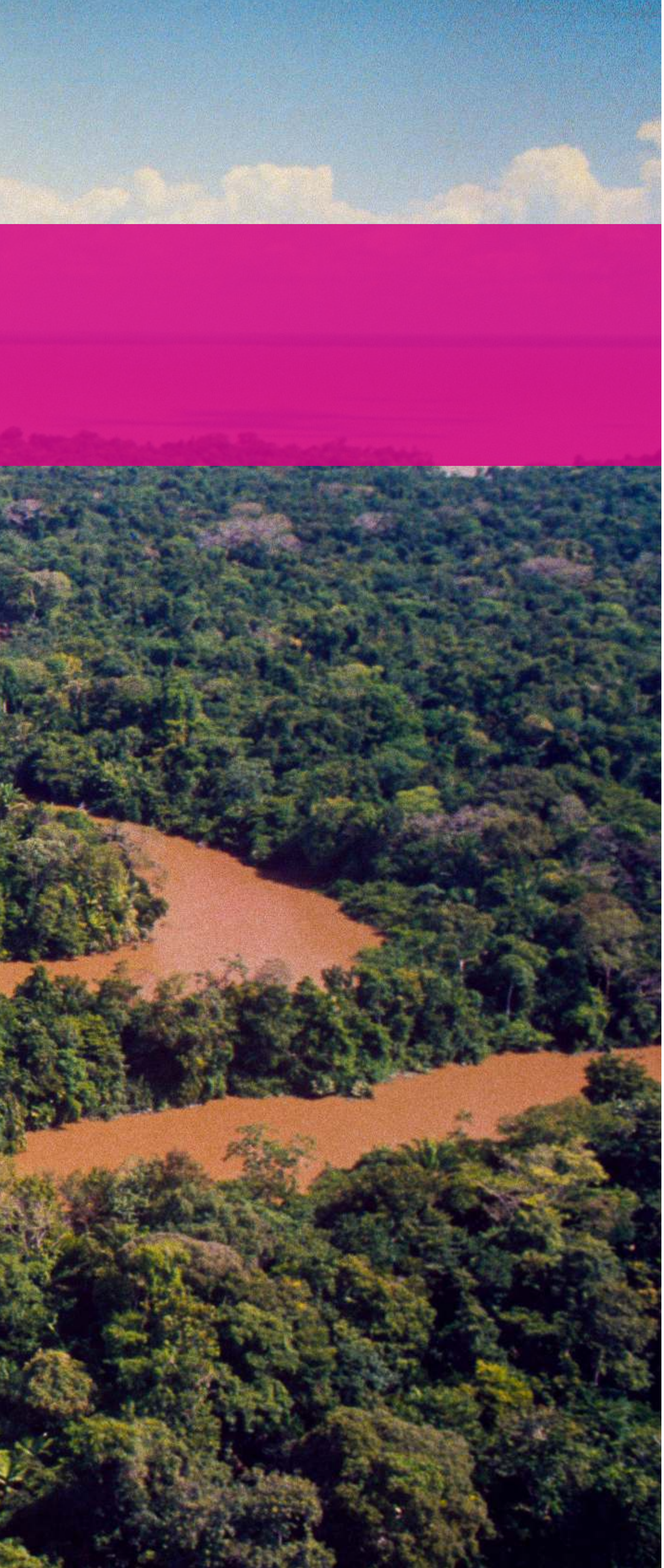
In terms of protecting springs, only Guyana and Suriname have no specific laws; the rest of the Amazon countries include specific provisions in their national legislation. Bolivia, Brazil, Colombia, Ecuador, Guyana, Venezuela and Peru have included water use permits/subsidies in their legal frameworks. To help pay for water management, Brazil, Ecuador, Colombia and Peru have chosen to implement water fees •

Rui Faquini

3 VISION

"Water resources are strategic for the balanced and sustainable development of the peoples of the Amazon River Basin. These resources are subject to protection and conservation for their multiple uses with the purpose of improving quality of life[13] of present and future generations, respecting the ethnic and cultural diversity and the sovereignty of the Member Countries. The integrated management of water resources is made feasible by means of participatory management, exchange of information, research, implementation of actions to adapt to variability and climate change, through regional cooperation and the support of adequate institutions".

[13] Good living/wellbeing in harmony with Mother Earth; concept recognized by some Amazon countries.



3.1 Shared Vision for IWRM in the Amazon Basin

On 5-6 May 2015, the Member Countries met in Bogota, Colombia to build a shared vision on integrated and sustainable management of transboundary water resources in the Amazon Basin, considering climate variability and change. This shared vision was approved at the 5th Meeting of the Project Steering Committee (Brasilia, Brazil, 25-26 June 2015).

3.2 Public Opinion Survey Findings

A public opinion survey was conducted with relevant stakeholders of the Amazon regions of ACTO Member Countries to find out what the Amazonian people think about water resources, in order to have a clear understanding of socioeconomic, political and environmental conditions, and to find out how they feel about the future of water resources and sustainable development in the Amazon Basin. The findings from more than 8,700 survey respondents in the countries provided information and indicators that contributed to consolidating national views about the future of water resources in the Amazon. These views, in turn, guided the consolidation of a shared regional vision and the definition of targets for the Strategic Action Program (SAP)

4 TRANSBOUNDARY DIAGNOSTIC ANALYSIS (TDA)

Rui Faquini

The Transboundary Diagnostic Analysis (TDA) is a technical-scientific document that identifies, quantifies and establishes priorities for water-related problems of a transboundary nature. The TDA is based on two fundamental pillars: (i) **Information** and experiences available on the various aspects of IWRM in the Amazon Basin, and (ii) **Participation** of the **main** national **stakeholders** of IWRM (public and private organizations, institutions, etc.), identifying their perception of the main transboundary problems, their impacts and underlying causes.

The Regional TDA of the Amazon Basin was prepared through 11 national TDA workshops, attended by over 470 representatives of institutions from the eight ACTO Member Countries, and the results were officially validated by the National Focal Points in each country. It also benefited from the contributions of scientific and demonstration activities implemented in the context of the GEF Amazon Project. Finally, the proposal for the Regional TDA received input from national TDA consultants (Technical Meeting, Brasilia, 13-14 October 2014) and the contributions of the national focal points during the Validation Workshop: Regional Proposal for the Transboundary Diagnostic Analysis (TDA) / 4th Meeting of the Project Steering Committee (Brasilia, 20-21 November 2014) and the Regional Workshop: Shared Vision and Strategic Action Program (SAP) (Bogota, 5-6 May 2015).

4.1 Priority Regional Transboundary Problems

Based on the 50 priority critical transboundary problems obtained from the national TDAs, a typological analysis identified **nine priority regional transboundary problems (PRTP)** that summarize the results of the national processes. In order to prioritize the problems, a frequency analysis was done of the 50 problems identified in the national TDAs (Table 8).

Realization of 11 national ADT Workshops, with more than 470 representatives of institutions of the 8 ACTO Member Countries

TABLE 8: PRIORITY REGIONAL TRANSBOUNDARY PROBLEMS (PRTP) IN THE AMAZON BASIN

PRIORITY REGIONAL TRANSBOUNDARY PROBLEMS OF THE AMAZON BASIN	
1	WATER POLLUTION
2	DEFORESTATION
3	LOSS OF BIODIVERSITY
4	EXTREME HYDROCLIMATIC EVENTS
5	EROSION, SEDIMENT TRANSPORT AND SEDIMENTATION
6	LAND USE CHANGE
7	LOSS OF GLACIERS
8	LARGE INFRASTRUCTURE PROJECTS
9	LIMITED INTEGRATED WATER RESOURCES MANAGEMENT

4.2 Main Root Causes

Table 9 lists the main root causes of the priority regional transboundary problems of the Amazon Basin identified in the national TDA documents.

TABLE 9: ROOT CAUSES OF PRIORITY REGIONAL TRANSBOUNDARY PROBLEMS

PROBLEM	ROOT CAUSES
1 Water pollution	Poverty in local communities and populations
	Population growth and migration
	Centralized political and economic power
	Little environmental education and a conscientiousness about water
	Socioenvironmental and land tenure conflicts
	Few employment opportunities in cities and rural areas
	Insufficient technological innovation
	Little capacity-building and awareness in communities and local populations
	Little water-related education and culture
	Weak state presence in border communities and populations
2 Deforestation	Population growth and migration
	Poverty
	Poor education policy
	Extractive macroeconomic models
	Socioenvironmental conflicts
3 Loss of biodiversity	Displacement and migration (forced or voluntary) of affected communities
	Population growth in urban centers
	Low population density in border zones
	Poverty in local communities and populations
	Weak government leadership for biodiversity conservation
	Slash and burn farming
	Local communities and populations not aware of their rights
	Little technological innovation

Sigue...

Continuation

TABLE 9: ROOT CAUSES OF PRIORITY REGIONAL TRANSBOUNDARY PROBLEMS

PROBLEM	ROOT CAUSES
4 Extreme hydroclimatic events	Population growth and migration
	Poverty
	Lack of development planning
	Lack of environmental education
	El Niño
	Climate variability and climate change
	Weak state presence in border communities and populations
5 Erosion, Sediment Transport and Sedimentation	Population growth
	Poverty
	Geodynamics and climate change
	Little understanding of the subject
	Little technology
6 Land use change	Population growth and migration
	Poverty and unemployment
	Lack of capacity-building and training
	Lack of education
	Lack of technology
7 Integrated Water Resources Management (IWRM)	Poverty and unemployment
	Economic models
	Cultural alienation of indigenous communities
	Lack of information and data
	Lack of capacity-building and training
	Social conflicts
	Climate variability and climate change
8 Loss of glaciers	Risks and vulnerability due to climate change
	Geodynamics and geophysical faults
	Greenhouse gases generated by industrial activity
	Desertification
9 Large infrastructure projects	Lack of planning
	Population growth and migration
	Unregulated urban sprawl
	Extractive economic models
	Impacts on food security
	Poverty
	Lack of education, capacity-building and training
	Social and environmental conflicts


ACTO

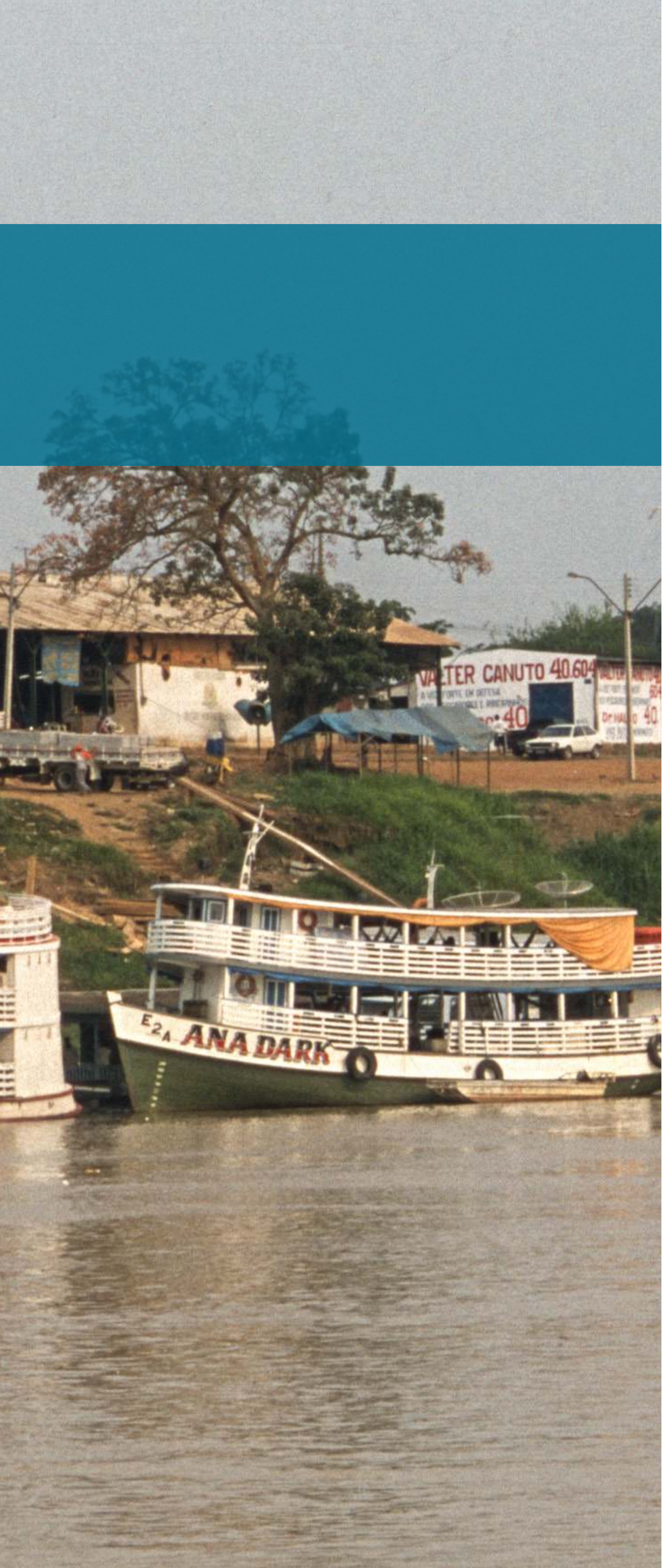
4.3 Recommendations from the Transboundary Diagnostic Analysis (TDA)

Based on the national TDA processes, including 11 workshops in the eight Member Countries and national documents consolidated and supplemented by: (i) results of scientific research activities carried out under the GEF Amazon Project and (ii) analyses of institutional and legal frameworks at the national and regional levels, the countries produced a series of recommendations for the Strategic Action Program (SAP):

- **Strengthen the administrative and technical capabilities** of the national institutions in charge of water resources management in the eight countries, in accordance with their national institutional contexts.
- **Strengthen the technical, financial and institutional capabilities** of key stakeholders to give them the skills to mitigate water pollution and ensure effective participation in the management of water resources in the region.
- **Promote regional systems for monitoring and oversight** of water resources and strengthen the Integrated Water Resources Information System, with the participation and engagement of public and private institutions and civil society; to promote research, information flow and the generation of knowledge for IWRM in transboundary basins.
- **Create a fund to finance** and implement IWRM projects in transboundary basins.
- **Establish regional guidelines and harmonize national standards** for IWRM in transboundary basins.
- **Establish regional public policy guidelines** for basinwide IWRM, combating water pollution, promoting territorial and land-use planning, forest and aquatic ecosystem management, and promoting sustainable production practices.
- **Promote water culture and environmental education**, based on information and knowledge of water resources issues.
- **Establish early warning systems in transboundary basins** and promote tools and measures for **adaptation to climate variability** in transboundary basins.
- **Strengthen communication**, promotion and publicizing of public policies and strategies on water resources in transboundary basins; strengthen technical and scientific cooperation in the field of water resources through multilateral agreements between Amazon countries.
- **Strengthen institutional coordination mechanisms** for IWRM in the Amazon countries at the national, regional and local levels, by implementing, updating and/or creating guidelines and/or regulations.
- **Strengthen communication and information exchange** mechanisms between the national institutions responsible for the management of water resources in each country for a better understanding of this subject. At the regional level, define and implement mechanisms for communication and information exchange between government agencies in the eight Member Countries.
- **Consider the creation a Permanent Steering Committee to coordinate IWRM** in the Amazon Basin with the goal of liaising and coordinating water issues among the Member Countries, with the initial task of seeking funding and implementing the Strategic Action Program

5 STRATEGIC ACTION PROGRAM (SAP)

Rui Faquini



5.1 Strategic Action Characteristics

National stakeholder **recommendations** for the nine **priority regional transboundary problems** clearly indicate the need to support the Member Countries and ACTO by providing training and strengthening their national institutions for **integrated water resources management (IWRM)** in the Amazon Basin, and by **developing and strengthening the legal and institutional frameworks**.

By analyzing the transboundary problems and recommendations for the SAP, the Member Countries have consolidated three **strategic response lines** for the definition and implementation of the **strategic actions**:

STRATEGIC RESPONSE LINE No.

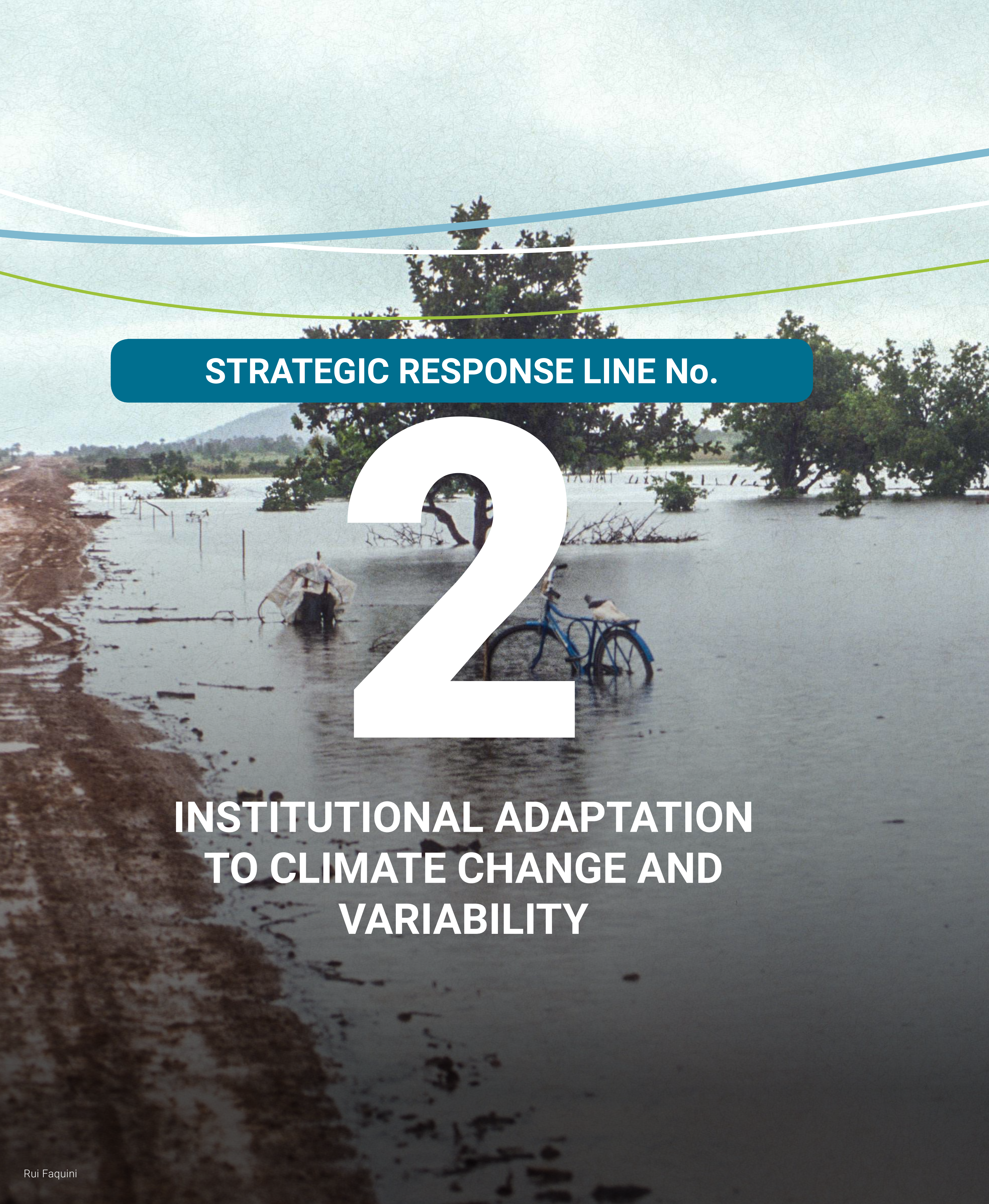
1

STRENGTHENING INTEGRATED WATER RESOURCES MANAGEMENT (IWRM)

Rui Faquini

The main objective of strengthening integrated water resources management (IWRM) is to prepare the countries for institutional cooperation and interaction at the regional Amazon level. To cooperate efficiently, the national institutions involved in regional cooperation need to have compatible institutional infrastructure and human resources. Strategic actions in this strategic response line will meet this need with laboratories, monitoring systems and equipment, among others, in addition to personnel training.

In this context, monitoring and protection systems for water resources, wetlands, bioaquatic ecosystems and ETS processes are particularly important. Strategic actions will require the acquisition of infrastructure and materials, training courses and technical capacity-building of the human resources needed to operate and maintain the systems.



Rui Faquini

STRATEGIC RESPONSE LINE No.

2

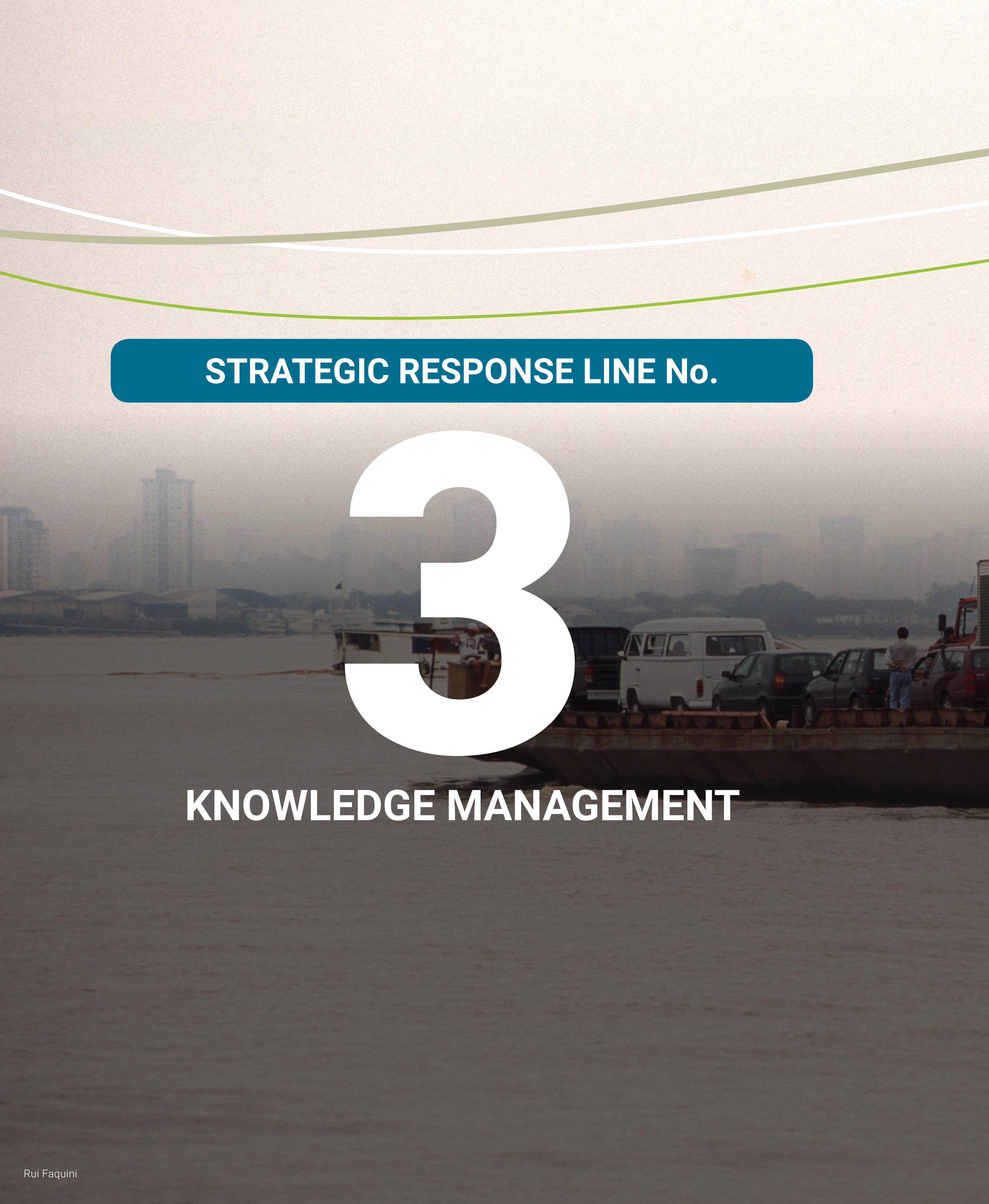
INSTITUTIONAL ADAPTATION TO CLIMATE CHANGE AND VARIABILITY

In the Amazon Region, the greatest challenge faced by local administrations is their inability to respond quickly and efficiently to the extreme hydrometeorological events that affect all Member Countries. As a result, droughts and floods cause tremendous economic and social losses for the region's population. To face this challenge, strategic actions will implement prevention, early warning and risk management systems, and a network of hydrometeorological stations to improve the ability of local governments and people to cope with droughts and floods, while keeping losses at a minimum. In order to help strengthen institutional adaptation capacity in the Member Countries, the strategic actions under this response line will require substantial investments in infrastructure and technical training.

STRATEGIC RESPONSE LINE No.

3

KNOWLEDGE MANAGEMENT



Rui Faquini

In each member country, a large number of technical public and private institutions, entities and organizations produce large amounts of information and knowledge about natural resources, and specifically about Amazonian water resources.

Nevertheless, accessing said knowledge and applying it to policy-making is difficult due to its dispersion, inadequate communication, and incompatibility between the various information systems and databases.

As such, one of the recommendations is to create an integrated information system for IWRM and relevant issues of the ACTO Strategic Agenda.

At the same time, despite extensive scientific research on the Amazon, various areas of knowledge remain unexplored and require specific research projects to respond to the needs raised in the TDA.

The strategic action Increasing Scientific Knowledge about Water Resources and topics relevant to the ACTO Amazonian Strategic Cooperation Agenda responds to this recommendation.

The GEF Amazon Project also undertook pilot activities, to be replicated across the Amazon Basin. Based on these activities, and in keeping with the TDA recommendations, two strategic actions in the area of technology transfer were designed: (i) terraced vegetable gardens and fisheries in floodplain forests and (ii) rainwater harvesting and sanitation systems in small isolated communities of the Amazon.

This strategic response line also meets the recommendation of promoting cultural, educational and artistic events to increase the Amazon people's awareness of the importance of natural resources in general and water in particular, emphasizing the need to preserve them and use them sustainably.

Flow chart of the formulation of strategic actions:

Rui Faquini

TABLE 10: PRIORITY REGIONAL TRANSBOUNDARY PROBLEMS AND STRATEGIC ACTIONS

Strategic Response Line	Transboundary Problem	Strategic Actions
Strengthening IWRM	*Water Pollution*	1. Implementing a regional water quality monitoring system for the rivers of the Amazon Basin. 2. Developing a groundwater use and protection program for public supply in the Amazon region. 3. Protecting, managing and monitoring aquifers in the Amazon river basins.
	Deforestation	4. Conserving and using water resources sustainably in the headwaters and lowlands of the Amazon Basin, where páramo and wetland ecosystems prevail.
	Loss of Biodiversity	5. Reducing the vulnerability of bioaquatic ecosystems of the Amazon Basin.
	Erosion, Sediment Transport and Sedimentation (ETS)	6. Monitoring erosion, sediment transport and sedimentation in the Amazon Basin to help mitigate negative effects and maximize positive ones.
	Land Use Change	7. Action program to respond to the impacts of current land occupation and land-use on water resources in the Amazon Basin.
Adaptation to Climate Change and Variability	*Extreme Hydroclimatic Events*	8. Creating a regional hydrometeorological monitoring network in the Amazon Basin. 9. Creating systems to forecast and warn about extreme hydroclimatic events (droughts and floods). 10. Implementing a risk management model and increasing institutional adaptation to climate change in the Amazon Basin. 11. Developing and implementing the Integrated Monitoring System for Climate Change Vulnerability and Adaptation in the Amazon Basin. 12. Protecting coastal areas affected by rising sea levels.
	Loss of Glaciers	13. Developing and implementing adaptation measures to deal with glacier retreat in the Andes of the Amazon Basin.
Strategic Response Line for transversal themes		
Knowledge Management	*Developing an Integrated Regional Information Platform*	14. Creating an integrated regional platform of information on water resources in the Amazon Basin.
	Strengthening Scientific Knowledge	15. Increasing scientific knowledge about water resources and topics relevant to the ACTO Amazonian Strategic Cooperation Agenda. 16. Establishing rainwater harvesting systems (RHS) to provide safe water to isolated riverside communities of the Amazon Basin. 17. Implementing regional agrotechnology systems for terraced vegetable gardens and fisheries in floodplain forest communities.
	Regional Cultural and Educational Activities	18. Promoting and undertaking regional cultural, educational and artistic activities related to water resources and climate change in the Amazon Basin.
	Legal and Institutional Frameworks	19. Supporting the strengthening of institutional and management frameworks to improve water resources management.

Strategic actions are projects that, as a group, consolidate the SAP and the financial and political considerations needed to implement it. The project budgets are estimates, and should be reviewed and adjusted in a consolidated and integrated financial proposal for the implementation of the SAP.

In terms of IWRM as a transboundary problem, answers to the various governance problems will be addressed by strengthening the national institutions for IWRM in the Amazon Basin.

Knowledge management is defined as a specific strategic response line that addresses different crosscutting issues: producing scientific knowledge, systematizing and managing the information generated, technology transfer (rainwater harvesting and agrotechnology systems for terraced vegetable gardens), and filling the gap of educational and cultural activities related to water resources and climate problems, all of which were mentioned at every national TDA meeting. As such, strategic actions must be proposed in response to these concerns.

Below are a number of important aspects to consider in relation to the selection and nature of strategic actions:

- Due to the nature of the SAP, these strategic actions must be mainly regional. Although projects resulting from the strategic actions might have national or local ramifications, the ultimate goal of the SAP is to consolidate IWRM at the regional Amazon level..

At the same time, the strategic actions have elements in common. They:

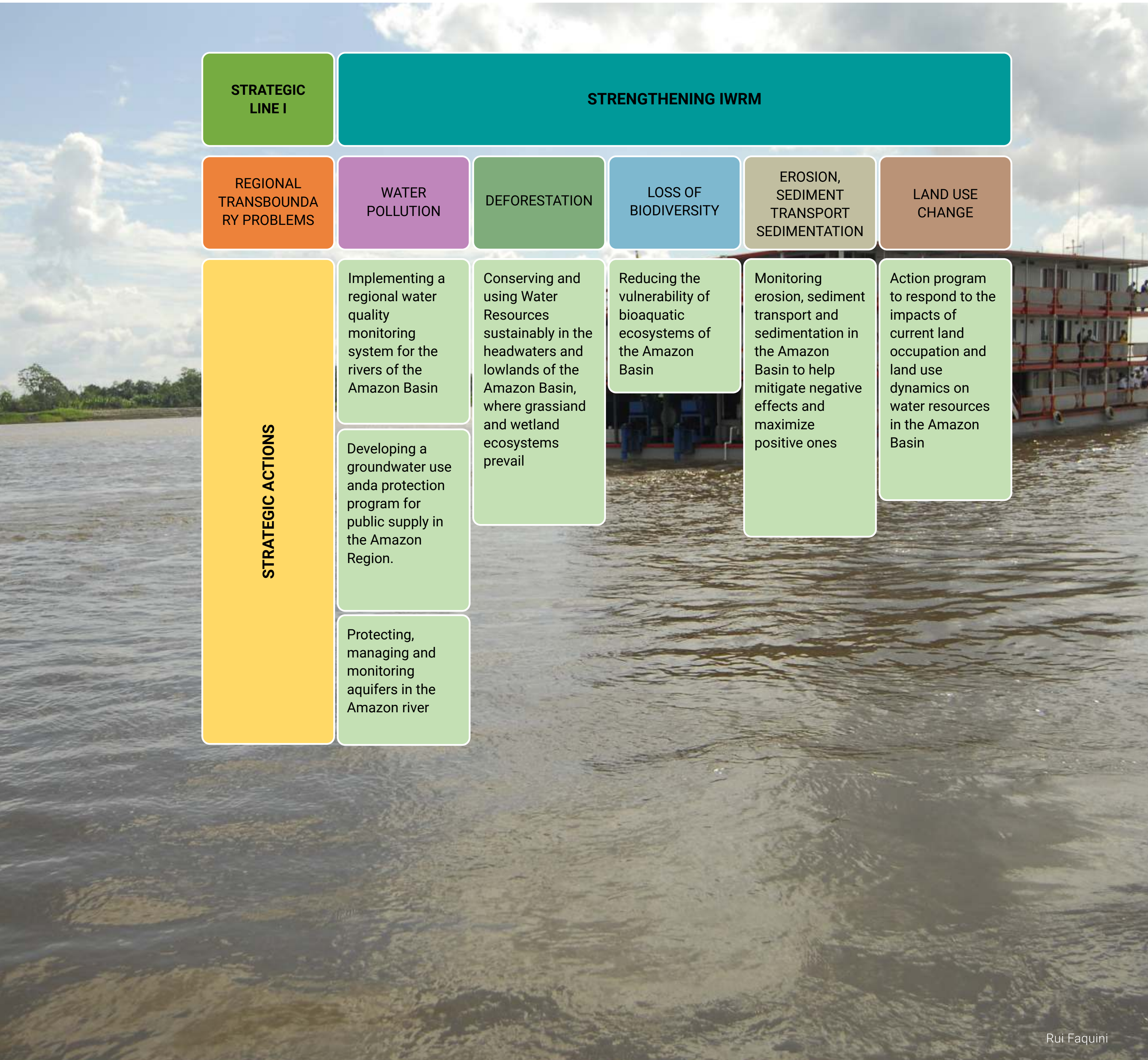
- Strengthen and promote agreements and regulations established by mutual agreement between ACTO Member Countries.
- Stimulate scientific research and help to consolidate a regional integrated information platform, thereby strengthening knowledge management.
- Strengthen the national institutions responsible for IWRM in the Amazon Basin and ACTO.
- Contribute to sustainable development and social wellbeing in the Amazon.
- Uphold gender equity guidelines.
- Bring measurable benefits.

5.2 Strengthening IWRM

Five of the nine regional priority transboundary problems -water pollution; deforestation; loss of biodiversity; erosion, sediment transport and sedimentation; and land-use change- clearly indicate the need to strengthen the national institutions and ACTO to create an enabling environment for effective IWRM at the regional level.

Table 11 shows the strategic actions that correspond to each transboundary problem.

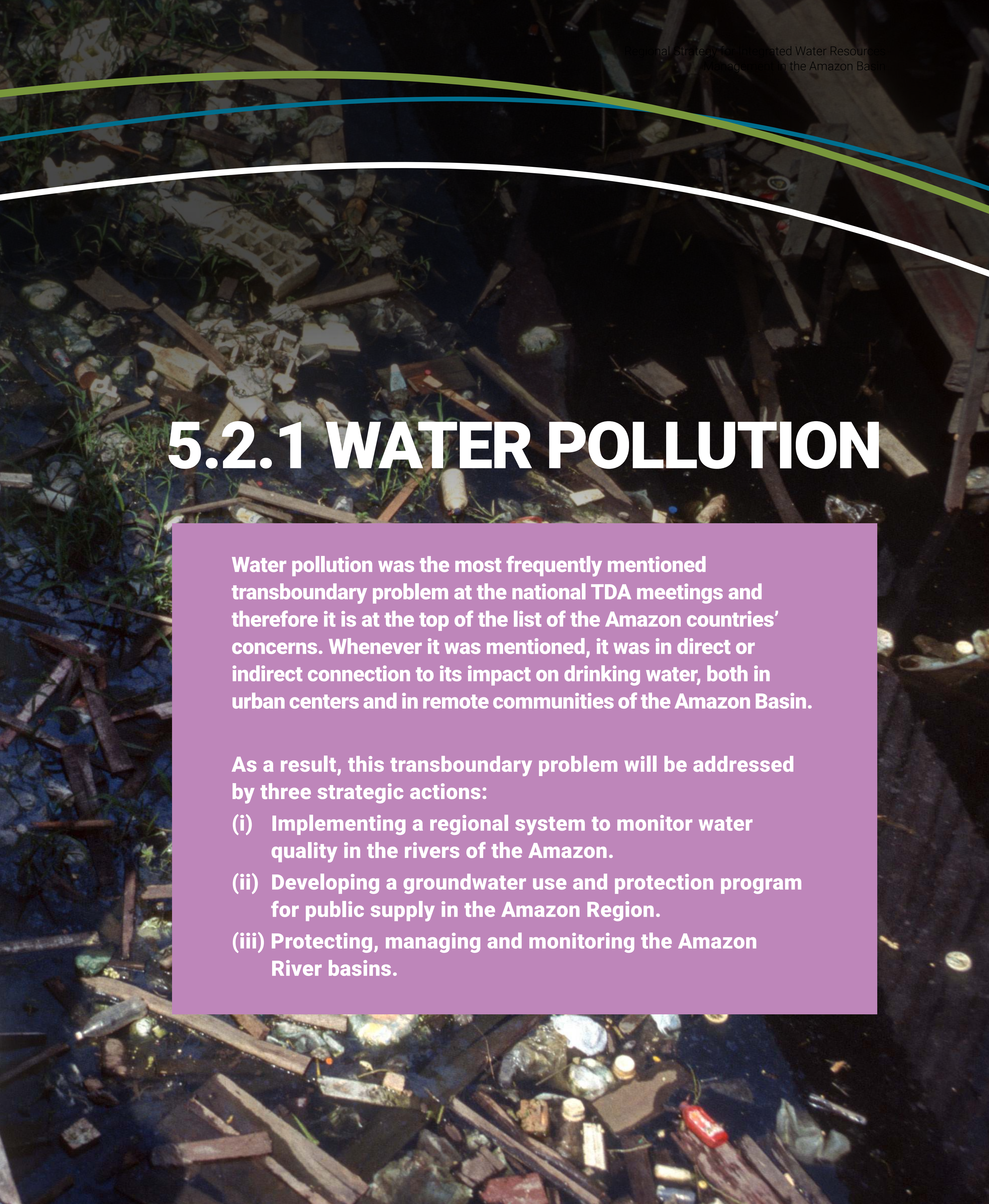
TABLE 11: STRATEGIC ACTIONS TO STRENGTHEN INTEGRATED WATER RESOURCES MANAGEMENT (IWRM)



STRATEGIC LINE I	STRENGTHENING IWRM				
REGIONAL TRANSBOUNDARY PROBLEMS	WATER POLLUTION	DEFORESTATION	LOSS OF BIODIVERSITY	EROSION, SEDIMENT TRANSPORT SEDIMENTATION	LAND USE CHANGE
STRATEGIC ACTIONS	Implementing a regional water quality monitoring system for the rivers of the Amazon Basin	Conserving and using Water Resources sustainably in the headwaters and lowlands of the Amazon Basin, where grassland and wetland ecosystems prevail	Reducing the vulnerability of bioaquatic ecosystems of the Amazon Basin	Monitoring erosion, sediment transport and sedimentation in the Amazon Basin to help mitigate negative effects and maximize positive ones	Action program to respond to the impacts of current land occupation and land use dynamics on water resources in the Amazon Basin
	Developing a groundwater use anda protection program for public supply in the Amazon Region.				
	Protecting, managing and monitoring aquifers in the Amazon river				

Rui Faquini

Rui Faquini



5.2.1 WATER POLLUTION

Water pollution was the most frequently mentioned transboundary problem at the national TDA meetings and therefore it is at the top of the list of the Amazon countries' concerns. Whenever it was mentioned, it was in direct or indirect connection to its impact on drinking water, both in urban centers and in remote communities of the Amazon Basin.

As a result, this transboundary problem will be addressed by three strategic actions:

(i) Implementing a regional system to monitor water quality in the rivers of the Amazon.

(ii) Developing a groundwater use and protection program for public supply in the Amazon Region.

(iii) Protecting, managing and monitoring the Amazon River basins.

5.2.1.1 Implementing a Regional Water Quality Monitoring System for the Rivers of the Amazon Basin

Strategic Line I: Strengthening Integrated Water Resources Management (IWRM).

Regional Transboundary Problem: Water pollution.


Rui Faquini

Background

Each year thousands of tons of chemicals and waste from industrial, mining, agricultural and livestock activities, and waterway transport, are disposed into the Amazonian rivers. These wastes contain elements like pesticides, heavy metals, oil byproducts, sewage and wastewater from urban and rural settlements, among others. This pollution creates serious problems for the Amazon people.

Although the potential danger is well known, pollution attributable to human activities in the Amazon region is growing, and remains mostly unstudied at the regional level.

Analyzing pollution in Amazonian rivers is difficult as this is such as large territory and there are few laboratories and specialized technical teams in the Amazon region. In this context, a regional operational framework needs to be created to protect and monitor the rivers and aquatic systems, training the corresponding institutions to manage risk and resolve local or regional cases of contamination in the water/river systems of the Amazon Basin.

Activities in this strategic action are in accordance with those that were pursued under the GEF Amazon Project, and others that are being implemented in the various countries to develop environmental indicators and a baseline for water quality in Amazonian rivers.

The Regional Transboundary Diagnostic Analysis (TDA) indicated the need to develop a regional water quality monitoring program in the Amazon region that can be linked to public health actions and endeavors to counter the socioeconomic and environmental impacts caused by pollution in rivers and aquatic ecosystems.

This Regional Water Quality Monitoring System would be based on a network of sampling points, chemical parameters, sampling and analysis frequency, and methodology agreed by the Amazon countries. Continuous monitoring would allow the countries to identify sources of pollution early and to mitigate the consequences of environmental accidents quickly.

Overall Objective

Ascertain water quality in the rivers of the Amazon Basin to improve IWRM.

Specific Objectives

1. Strengthening technical and human capacity for the water quality monitoring system.
2. Designing and deploying a regional water quality monitoring system with standardized quality parameters in the rivers of the Amazon Basin.
3. Making the monitoring results available through the ACTO integrated regional information platform.
4. Strengthening cooperation between the Amazon countries so the regional monitoring system can be developed and operated.

Activities

1. Identifying and analyzing the regulations and activities undertaken by ACTO Member Countries in their water quality monitoring systems for the rivers of the Amazon Basin.
2. Identifying the capacity-building and strengthening needs of accredited laboratories, according to each country's regulations.
3. Preparing an inventory of technical and human expertise in ACTO Member Countries, in order to train technical staff for the regional monitoring system.
4. Providing eight national laboratories with equipment and reactants to detect water pollutants (metals, metalloids, pesticides); and acquisition of 24 portable laboratories (three per country), with equipment for sampling, sample storage and transport, and more.
5. Training 400 people (50 per country) in sampling techniques and the use of specialized diagnostic equipment.
6. Developing the indicators, parameters, methodologies and protocols of the Regional Monitoring Plan for the Amazon Basin, in conjunction with the Member Countries.
7. Designing the network and deploying the water quality monitoring system for the rivers of the Amazon Basin.
8. Publishing monitoring data in the ACTO regional integrated information platform.
9. Reaching cooperation agreements between the Amazon countries to develop and operate the regional monitoring system.

Products

- A regional water quality monitoring system for the rivers of the Amazon Basin that is integrated with other national systems and ACTO's regional information platform.
- A regional network of specialized laboratories with qualified technical staff trained to monitor water quality in Amazonian rivers.
- Standardized procedures and parameters for water quality monitoring and consistent technical capacity (laboratories and equipment).
- A regional information system with up-to-date information on water quality within ACTO.

Results

- Knowledge about water quality in the rivers of the Amazon Basin.
- Regional and national capacity to monitor and control water quality in the Amazon Basin.
- Regional and national decision-making capacity for water resources management.
- Regional and national capacity for risk management and response to river pollution accident emergencies in the Amazon Basin.
- Access to regional information about water quality in the rivers of the Amazon.

Schedule

ACTIVITIES	YEAR 1				YEAR 2				YEAR 3				YEAR 4			
Identifying and analyzing the regulations and activities undertaken by ACTO Member Countries in their water quality monitoring systems for the rivers of the Amazon Basin.	■	■	■													
Identifying the capacity-building and strengthening needs of accredited laboratories, according to each country's regulations.		■	■	■	■	■	■	■	■							
Preparing an inventory of technical and human expertise in ACTO Member Countries, in order to train technical staff for the regional monitoring system.						■	■	■	■	■	■					
Providing eight national laboratories with equipment and reactants to detect water pollutants (metals, metalloids, pesticides); and acquisition of 24 portable laboratories (three per country), with equipment for sampling, sample storage and transport, and more.						■	■	■	■	■	■					
Training 400 people (50 per country) in sampling techniques and the use of specialized diagnostic equipment.						■	■	■	■	■	■					
Developing the indicators, parameters, methodologies and protocols of the Regional Monitoring Plan for the Amazon Basin, in conjunction with the Member Countries.				■	■	■	■	■	■	■	■	■	■	■	■	■
Designing the network and deploying the water quality monitoring system for the rivers of the Amazon Basin.												■	■	■	■	■
Publishing monitoring data in the ACTO regional integrated information platform.															■	■
Reaching cooperation agreements between the Amazon countries to develop and operate the regional monitoring system.												■	■	■	■	■

Participating countries

Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname and Venezuela.

Estimated Budget: US $10.66 million

5.2.1.2 Developing a Groundwater Use and Protection Program for Public Supply in the Amazon Region

Strategic Line I: Strengthening Integrated Water Resources Management (IWRM).

Regional Transboundary Problem: Water pollution.

Rui Faquini

Background

In the Amazon region, more water is estimated to be found in aquifers and groundwater than the volume of available surface water. Groundwater is accessed mainly through shallow artesian wells that are susceptible to environmental contamination around water extraction points. Urban centers tend to prefer to use surface water for public supply. Deeper aquifers, in turn, have the advantage of providing safer water that is less prone to contamination than surface water. Drawing on groundwater, however, usually requires more technical resources, which makes it economically more problematic.

Despite the growing use of groundwater to supply urban centers in the Amazon, wells are usually drilled without having conducted the appropriate hydrogeological studies and without policies to protect the water and collect it in a way that ensures that it is safe for human consumption.

The GEF Amazon Project analyzed the use of groundwater in two urban centers: Manaus and Leticia/Tabatinga. The findings revealed the need to create a regional operational framework to determine possibilities and potential for local use, as well as regulations concerning the protection of groundwater for public supply.

Overall Objective

Promoting water supply through a regional program for protection and rational use of groundwater in the Amazon region.

Specific Objectives

1. Characterizing aquifers and identifying their use for public supply in urban and rural areas.
2. Determining and promoting national regulations on use of groundwater for public supply.

Activities

1. Selection by the Member Countries of the areas of interest to include in the program.
2. Mapping the aquifers used for public supply in the areas of interest selected by the Member Countries, defining their vulnerability levels and protection zones.
3. Physicochemical and bacteriological analysis of water taken from aquifers, and inventory of pollutant loads.
4. Identifying the capacity-building needs of technical staff in the laboratories of institutions and bodies that work in the field of aquifer characterization.
5. Identifying infrastructure strengthening needs in the institutions and bodies that work in the field of aquifer characterization.
6. Establishing technical guidelines to protect and use aquifers to supply drinking water to people in urban and rural areas.
7. Identifying possible cooperation agreements between Amazon countries to protect aquifers and make it feasible to use groundwater to supply the population in urban and rural areas of the Amazon Basin.

Products

- A regional program for public water supply in urban and rural areas of the Amazon Basin that protects aquifers and uses them rationally and includes at least the following components: mapping and characterizing aquifers, identifying capacity-building and infrastructure strengthening needs, and identifying cooperation mechanisms between ACTO Member Countries.

Results

- Inputs for the plan for public water supply by protecting and aquifers in regional and urban areas of the Amazon Basin.

Schedule

ACTIVITIES	YEAR 1				YEAR 2				YEAR 3				YEAR 4			
Selection by the Member Countries of the areas of interest to include in the program.	■	■														
Mapping the aquifers used for public supply in the areas of interest selected by the Member Countries, defining their vulnerability levels and protection zones.			■	■	■	■	■	■								
Physicochemical and bacteriological analysis of water taken from aquifers, and inventory of pollutant loads.			■	■	■	■	■	■	■	■						
Identifying the capacity-building needs of technical staff in the laboratories of institutions and bodies that work in the field of aquifer characterization.			■	■	■	■	■	■	■	■	■	■	■	■		
Identifying infrastructure strengthening needs in the institutions and bodies that work in the field of aquifer characterization.											■	■	■	■	■	■
Establishing technical guidelines to protect and use aquifers to supply drinking water to people in urban and rural areas.												■	■	■	■	■
Identifying possible cooperation agreements between Amazon countries to protect aquifers and make it feasible to use groundwater to supply the population in urban and rural areas of the Amazon Basin.												■	■	■	■	■

Participating countries

Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname and Venezuela.

Estimated budget: US $4 million

5.2.1.3 Protecting, Managing and Monitoring Aquifers in the Amazon River Basins

Strategic Line I: Strengthening Integrated Water Resources Management (IWRM)

Regional Transboundary Problem: Water pollution

Background

In 2005, a meeting was held of the UNESCO/OAS ISARM-Americas Programme in Sao Paulo, Brazil, to discuss transboundary aquifers in the South American continent, with emphasis on the Amazon Basin.

The Amazon Aquifer System, as it was initially called, is a mix of the Cretacic and Cenozoic sediments in the Amazon Basin that occupies an approximate surface area of 3.95 million km2. A summary of the information that Bolivia, Brazil, Colombia, Ecuador, Peru and Venezuela shared about this aquifer system was published in 2007 in the book Evaluación Preliminar de los Sistemas Acuíferos Transfronterizos en las Américas. Nevertheless, confirming the existence of an aquifer system of continental dimensions would still require several studies to determine its hydraulic behavior and the relation to regional geological formations, in addition to learning more about the region's stratigraphy and structure.

In 2011, the Brazilian Government, through its National Water Agency (ANA), launched the study "Assessment of sedimentary aquifers in the hydrogeological province of the Brazilian Amazon (scale 1:1,000,000) and pilot cities (scale 1:50,000)" with the main goal of generating hydrogeological knowledge about the main aquifer systems of the country's Amazon. Five urban areas were selected for pilot hydrogeological studies: Macapa, Porto Velho, Rio Branco, Santarem and Tabatinga. This study is part of the National Groundwater Program (PNAS), one of the components of the Brazilian National Water Resources Plan (PNRH).

Subsequently, in 2012, GEF/UNEP/ACTO began the project "Integrated and Sustainable Management of Transboundary Water Resources in the Amazon River Basin considering Climate Variability and Change," with a series of activities related to groundwater, such as a preliminary hydrogeological characterization of the Amazon aquifer and two pilot projects, one in Manaus (Brazil) and one in the border area of Tabatinga (Brazil) and Leticia (Colombia).

In view of the above, the strategic action for protecting, managing and monitoring aquifers in the basins of the Amazon River will help to promote the strategic objectives agreed by the Member Countries in the context of ACTO, given that groundwater is strategic for the Amazon people.

Overall Objective

Strengthening protection, management and monitoring of groundwater in the Amazon Basin by conducting hydrogeological research, and developing and strengthening groundwater management and protection guidelines for the Amazon Basin.

Specific Objectives

1. Increasing hydrogeological knowledge about the Amazon Basin.
2. Developing groundwater management measures for the Amazon Basin.
3. Establishing a groundwater monitoring system.
4. Strengthening capacity in national hydrogeological services.

Activities

1. Compiling the hydrogeological information that exists in the ACTO Member Countries.
2. Defining a regional research program and methodology, and mapping the geology/hydrogeology of the Amazon region.
3. Preparing a water balance model.
4. Designing and implementing a regional groundwater monitoring system for the Amazon Basin.
5. Developing regional guiding principles to manage and protect groundwater in the Amazon Basin.
6. Conducting an assessment to identify areas that need strengthening in national hydrogeological services.

Products

- Documented maps of hydrogeological units of the rivers of the Amazon Basin.
- Water balance of the Amazon Basin.
- A regional system for groundwater monitoring.
- Strengthened national hydrogeological services.

Results

- Knowledge and capacity to manage groundwater in the Amazon Basin.

Schedule

ACTIVITIES	YEAR 1		YEAR 2		YEAR 3		YEAR 4		YEAR 5		YEAR 6	
Compiling the hydrogeological information that exists in the ACTO Member Countries.	■	■										
Defining a region research program and methodology, and mapping the geology/hydrogeology of the Amazon different region.			■	■	■	■	■	■	■	■		
Preparing a water balance model.									■	■		
Designing and implementing a regional groundwater monitoring system for the Amazon Basin.											■	■
Developing regional guiding principles to manage and protect groundwater in the Amazon Basin.										■	■	■
Conducting an assessment to identify areas that need strengthening in national hydrogeological services.										■	■	■

Participating countries

Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname and Venezuela.

Estimated budget: US $20 million

Rui Faquini

5.2.2 DEFORESTATION

In some countries of the Amazon, deforestation is the result of intense clearing of forests for roads, agriculture and mining, large infrastructure projects, urban centers, and above all illegal logging and trade in timber.

To counter this problem, the ACTO Member Countries have developed the project "Monitoring Forest Cover and Land-use Change in the Amazon" that, among other objectives, includes the formulation of national plans to monitor forest cover.

In August 2014, representatives of Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname and Venezuela participated in the Regional Workshop on National Monitoring Plans (Lima, Peru). At this event each country presented its national proposal for the development of a regional information system to monitor forest cover and a mechanism to institutionalize dialogue at the subregional level.

The strategic action "Conserving and using water resources sustainably in the headwaters and lowlands of the Amazon Basin, where páramo and wetland ecosystems prevail" will complement the monitoring project, focusing on deforestation in areas where it has a direct impact on water resources.

5.2.2.1 Conserving and Using Water Resources Sustainably in the Headwaters and Lowlands of the Amazon Basin, Where Páramo and Wetland Ecosystems Prevail

Strategic Line I: Strengthening Integrated Water Resources Management (IWRM).

Regional Transboundary Problem: Deforestation.

Rui Faquini

Background

Extensive livestock production and the spread of agriculture are among the main reasons for deforestation in a large part of the basin. More than 60% of the deforested area is estimated to have first been used for livestock and then for agriculture. Illegal logging and the illegal trade in wildlife are also important causes of deforestation (UNODC, 2011). Currently, an arc of deforestation may be seen in the southern part of the Amazon Basin where close to 240,000 km2 of rainforest were deforested between 2000 and 2010 (RAISG, 2012).

Among the various types of forests are ecosystems with a predominance of Mauritia flexuosa, Euterpe oleracea and Bambusa Sp, and flooded forests with species like Mauritia flexuosa, which play a very important economic, social and environmental role in the Amazon Basin. Their lands are characterized by periodic flooding as the result of the land relief, poor drainage and overflowing rivers. Floodplains are closely linked to the life and culture of the Amazon people.

Recent studies (Junk, W., Piedade, M., Schöngart, J., Cohn-Haft, M., Adeney, J., Wittmann, F., 2011; Macedo, M. and L. Castello., 2015) indicate that close to 30% of the 6 million km2 that make up the Amazon Basin meet the international criteria for wetlands. Although the vast majority of the countries that share the Amazon Basin have signed the Ramsar Convention on Wetlands of International Importance, the countries still lack comprehensive wetland inventories, classification systems and management plans. Amazonian wetlands vary considerably in their hydrology, water and soil fertility, plant cover, plant and animal species diversity, and primary and secondary productivity. These highly biodiverse ecosystems are key to several ecological processes. They play an important role in the hydrological and biogeochemical cycles of the basin, and provide environmental benefits to local populations of the Amazon countries (WWF, 2013).

The Amazon Basin's flood cycle is the key ecological process in creating and maintaining these ecosystems, which is why it is so important to keep it functional, from the headwaters to the floodplains, based on the concept of river continuum (Vanotte et al., 1980). This concept describes the structure and function of the riverside communities, according to which "energy input is regulated along the length of the river by geomorphological river processes" (Orozco, 2012). Important headwaters and springs that form the tributaries of the Amazon Basin come from the Andean páramos. As such, we must determine which páramos are fundamental and propose ways to manage and protect them.

Due to the frailty, biodiversity and socioeconomic importance of these ecosystems, protecting the headwaters of the Basin and conserving the páramos, ecosystems with a predominance of Mauritia flexuosa, Euterpe oleracea and Bambusa Sp, and wetlands, will contribute substantially to countering deforestation in the Amazon.

Overall Objective

Promoting protection and conservation of water resources in the headwaters and lower parts of the basin, predominantly in mountain reservoirs (above 3,800 mamsl), páramos and wetlands, to reduce impacts and threats in the Amazon Basin.

Specific Objectives

1. Identifying and analyzing the condition of the Andean marshes, páramos and wetlands that supply the headwaters and lowlands of the Amazon Basin.
2. Investigating appropriate technologies for integrated sustainable management of headwaters, with emphasis on páramos and wetlands.
3. Creating a regional information system using the existing platforms on the effects of deforestation.
4. Identifying and prioritizing threats and mitigation alternatives for headwaters and lowlands with a predominance of páramos and wetlands.
5. Having an integrated management plan to protect the headwaters, páramos and wetlands of the Amazon Basin.

Activities

1. Inventory of important ecosystems in Amazonian basin headwaters, páramos and wetlands.
2. Identifying management problems and natural threats, as well as the economic activities and social benefits associated with deforestation.
3. Identifying the impact of deforestation in the basin's headwaters, páramos and wetlands.
4. Creating guidelines for land-use planning in Amazonian páramos, ecosystems with a predominance of Mauritia flexuosa, Euterpe oleracea and Bambusa sp, and wetlands.
5. Implementing a regional management plan for sustainable use of the headwaters, páramos and wetlands of the Amazon Basin.

Products

- A diagnostic assessment of the current situation and problems faced in managing the headwaters, páramos and wetlands of the Amazon Basin.
- A regional integrated management plan for the headwaters, páramos and wetlands of the Amazon Basin.

Results

- Capacity in Amazon countries for regional and national sustainable management of the headwaters, páramos, ecosystems and wetlands of the Amazon Basin.


ACTO

Schedule

ACTIVITIES	YEAR 1				YEAR 2				YEAR 3				YEAR 4				YEAR 5			
Inventory of important ecosystems in Amazonian basin headwaters, páramos and wetlands.	■	■	■	■																
Identifying management problems and natural threats, as well as the economic activities and social benefits associated with deforestation.					■	■	■	■												
Identifying the impact of deforestation in the basin's headwaters, páramos and wetlands.									■	■	■	■								
Creating guidelines for land-use planning in Amazonian páramos, ecosystems with a predominance of Mauritia flexuosa, Euterpe oleracea and Bambusa sp. and wetlands.																	■	■	■	■
Implementing a regional management plan for sustainable use of the headwaters, páramos and wetlands of the Amazon Basin.													■	■	■	■	■	■	■	■

Participating countries

Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname and Venezuela.

Estimated budget: US $4 million

Rui Faquini

5.2.3 LOSS OF BIODIVERSITY

5.2.3.1 Reducing the Vulnerability of Bioaquatic Ecosystems of the Amazon Basin.

Strategic Line I: Strengthening Integrated Water Resources Management (IWRM).

Regional Transboundary Problem: Loss of Biodiversity.

GEF Amazon Project-Video

Background

Loss and degradation of aquatic biodiversity is a serious problem in the Amazon Basin, due mainly to overexploitation, industrial expansion, and unsustainable and illegal production practices. This has created imbalance in the ecosystems and habitats, and changes in species behavior and distribution, accentuating ecosystem vulnerability and deteriorating the health and quality of life for local people.

Changes in biodiversity affect the ability of ecosystems to carry out their environmental, social and economic functions, especially in relation to the poorest populations that are especially dependent on these resources, in particular resources such as fish. Bioaquatic ecosystems are made even weaker by the lack of regional participatory planning, land-use planning and legal planning at the basin level due to conflicting social interests.

This strategic action aims to apply the experience and results of the GEF Amazon Project activity Managing aquatic ecosystems in hotspots at the Amazon Basin level. The activity was implemented as a pilot project in four bioaquatic ecosystem hotspots (in Brazil and Colombia) and it demonstrated how the ichthyofauna is endangered and the economic and social consequences for the local people.

Overall Objective

Reducing the vulnerability of bioaquatic ecosystems through strategic measures that foster their sustainability, with emphasis on endangered fish species of the Amazon Basin.

Specific Objectives

1. Socioeconomic and ecological mapping/zoning of the bioaquatic ecosystems of the Amazon Basin most vulnerable to climate change and human impacts, to improve knowledge and planning.
2. Developing guidelines and minimum regional criteria, agreed by the countries, for good environmental and social practices in the economic activities that affect aquatic biodiversity in the Amazon Basin, as well as participatory monitoring mechanisms, paying special attention to fish species of economic importance for the local people.
3. Developing a regional monitoring system of socioeconomic and ecological indicators, and emergency interventions in endangered bioaquatic ecosystems.

Activities

1. Compiling and analyzing available information about priority and endangered ecosystems and associated species.
2. Identifying and evaluating systems for mapping and zoning, as well as methodologies, databases and software, climate change models, and information recording systems, zoning risks, and identifying priority basins.
3. Reviewing the existing legal instruments for aquatic ecosystems in the Amazon countries, and preparing a regional proposal to strengthen/develop them.
4. Creation of a database linked to the ACTO Integrated Information Platform.
5. Proposals and regional agreements to reduce the vulnerability of bioaquatic ecosystems, developing strategic actions to conserve and protect them, with emphasis on ichthyofauna.
6. Implementing a regional monitoring system of socioeconomic and ecological indicators and interventions in endangered bioaquatic ecosystems.

Products

- A database about the most vulnerable ecosystems and species of the Amazon Basin, linked to the ACTO information and knowledge management platform.
- A regional system to monitor socioeconomic and ecological indicators for emergency interventions and planning in the most vulnerable bioaquatic ecosystems, based on recommendations, legal instruments and related regional or international agreements.

Results

- Strengthened national regulations and participatory monitoring for conservation and sustainable use of priority bioaquatic ecosystems.
- Reduced vulnerability of aquatic ecosystems.

Schedule

ACTIVITIES	YEAR 1				YEAR 2				YEAR 3				YEAR 4				YEAR 5			
Compiling and analyzing available information about priority and endangered ecosystems and associated species.	■	■	■																	
Identifying and evaluating systems for mapping and zoning, as well as methodologies, databases and software, climate change models, and information recording systems, zoning risks, and identifying priority basins.			■	■	■															
Reviewing the existing legal instruments in place for aquatic ecosystems in the Amazon countries, and preparing a regional proposal to strengthen/develop them.						■	■	■	■											
Creation of a database linked to the ACTO Integrated Information Platform.							■	■	■	■	■	■								
Proposals and regional agreements to reduce the vulnerability of bioaquatic ecosystems, developing strategic actions to conserve and protect them, with emphasis on ichthyofauna.											■	■	■	■						
Implementing a regional monitoring system of socioeconomic and ecological indicators and interventions in endangered bioaquatic ecosystems.															■	■	■	■	■	■

Target audience

Environment and/or water authorities/governments, production sectors, local populations.

Participating countries

Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname and Venezuela.

Estimated budget: US $2.12 million

5.2.4 EROSION, SEDIMENT TRANSPORT AND SEDIMENTATION (ETS)

Rui Faquini

5.2.4.1 Monitoring Erosion, Sediment Transport and Sedimentation in the Amazon Basin To Help Mitigate Negative Effects and Maximize Positive Ones.

Strategic Line I: Strengthening Integrated Water Resources Management.

Regional Transboundary Problem: Erosion, Sediment Transport and Sedimentation (ETS).

ACTO - GEF Amazon Project

Background

Rivers are the main means of transport of the products of erosion (physical and chemical) from the continents to the seas. The following factors play a role in hydraulic erosion processes: rain, soil, topography, vegetation and land-use. Tropical water basins are the main sources of dissolved and particulate materials carried to the seas. For this reason, identifying, understanding and quantifying local sediment transport and storage (volumes and rates), are key components in understanding the dynamics of hydrosedimentological and environmental consequences. The rivers of the Amazon Basin, the world's largest river basin, carry between 880 million to a little over 1 billion tons of sediment to the Atlantic Ocean each year. Ocean currents then carry the sediment to the coastal areas of the northern South American countries. Transportation of sediment is linked to a series of factors—such as the rivers' water volume—that are affected by climate variability and human activities, including the construction of dams, illegal mining, indiscriminate deforestation and unplanned urbanization.

Changes in the natural sedimentation patterns of rivers cause changes in hydrology and the dynamics of natural ecosystems. When excess sediment accumulates in the riverbed, it change the river's velocity and streamflow, in addition to impacting the biotic communities that live at the bottom of the river. It also increases turbidity, which changes the natural patterns of photosynthesis and food chains, since predatory fish need transparent water to find food to eat.

This strategic action is based on the results of the GEF Amazon ETS project, in which ETS measurements were taken in the Madeira River basin and part of the Amazon River (Solimoes).

The proposed strategic action will be executed in three stages: 1. Creating a baseline (ETS-BL) for the Amazon Basin based on the GEF Amazon project results. 2. Measuring the baseline indicators annually. 3. Verifying changes in the baseline every four years and proposing actions to improve the indicators.

Overall Objective

Supporting governments in their actions to monitor, control and mitigate the problems caused by erosion, sediment transport and sedimentation (ETS) in the Amazon Basin, evaluating their respective positive effects.

Specific Objectives

1. Establishing a baseline and monitoring indicators to get to know the current state of impacts of ETS processes in the Amazon Basin.
2. Identifying ETS hotspots in the Amazon Basin.
3. Improving national institutions' ability to monitor ETS baseline indicators.
4. Developing a regional monitoring program for ETS processes in the Amazon Basin.

Activities

1. Collecting information on ETS in the rivers of the Amazon Basin.
2. Developing protocols, procedures and techniques for use in ETS in hotspots, through a regional technical group (RTG) made up of ACTO Member Countries.
3. Developing capacity-building programs for the technical staff involved in the regional monitoring program.
4. Tracking and monitoring the application of the protocols, procedures and techniques agreed by the RTG.
5. Publicizing the results obtained from monitoring ETS processes and impacts, to provide information for decision-makin.

Products

- A regional monitoring program for erosion, sediment transport and sedimentation processes.

Results

- ETS control and mitigation capacity in the countries.
- Information for decision-making purposes.

Schedule

ACTIVITIES	YEAR 1				YEAR 2				YEAR 3				YEAR 4			
Collecting information on ETS in the rivers of the Amazon Basin.	■	■														
Developing protocols, procedures and techniques for use in ETS in hotspots, through a regional technical group (RTG) made up of ACTO Member Countries.			■	■												
Developing capacity-building programs for the technical staff involved in the regional monitoring program.					■	■	■	■								
Tracking and monitoring the application of the protocols, procedures and techniques agreed by the RTG.									■	■	■					
Publicizing the results obtained from monitoring ETS processes and impacts, to provide information for decision-making.				■				■				■				■

Target audience

Environment and water authorities, governments.

Production sectors and local populations.

Participating countries

Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname and Venezuela.

Estimated budget: US $1.25 million

5.2.5 LAND-USE CHANGE

Land-use change in the Amazon has been the result of a complex, accelerated and disorderly occupation process over time, that has changed the region's vegetation coverage.

Due to the complexity and crosscutting nature of this transboundary problem, this strategic action focuses mainly on the impacts that land occupation processes are having on the Amazon Basin's water resources.

Land occupation and the various ways that Amazonian lands are used can cause different impacts on water systems: erosion and sedimentation, silting and pollution in rivers, changes in runoff, floods, etc.

Rui Faquini

5.2.5.1 Action Program To Respond to the Impacts of Current Land Occupation and Land-use on Water Resources in the Amazon Basin.

Strategic Line I: Strengthening Integrated Water Resources Management (IWRM).

Regional Transboundary Problem: Land-use change.

Rui Faquini

Background

Land occupation leads to deforestation, overexploitation of natural resources, climate change, social inequalities and loss of biodiversity, in addition to making human settlements more vulnerable to natural disturbances and extreme climate events.

Among the underlying factors of land-use change are regional production dynamics, including the expansion of the agricultural frontier, driven by monocropping and intense livestock production, informal mining, illegal logging, large infrastructure projects (dams and roads), incomplete regulatory frameworks (undefined property rights), limited government capacity to enforce laws and apply penalties, market incentives, and changes in people's behavior and values.

Overall Objective

Mitigating the impacts that land occupation and land-use change in the Amazon Basin have on water resources, socioeconomic and environmental conditions.

Specific Objectives

1. Evaluating existing policies and strategies for land-use and occupation in the Amazon in each ACTO member country.
2. Making projections of urbanization, and evaluating the impact on water resources caused by the current dynamics of land occupation and land-use change.
3. Developing regional policy and integrated management proposals to mitigate the impacts that unplanned land occupation and land-use change in the Amazon Basin have on water resources and socioeconomic and environmental conditions.

Activities

1. Analyzing the political, legal, sociocultural, historical, and economic entities of each country, as well as institutional responsibility concerning land occupation in the Amazon Basin.
2. Analyzing the dynamics of the socioeconomic, political and cultural processes linked to urbanization in the Amazon.
3. Characterizing the economic activities, and public and private investment projects and programs. Identifying the productive capacity of the land, environmental impacts resulting from land occupation, and ways to resolve land-use conflicts.
4. Strengthening national entities and their institutional capacity to mitigate the impacts of land occupation and land-use change on water resources and socioeconomic and environmental conditions in the Amazon Basin.

Products

- Projections of development and land-use change in the Amazon Basin.
- A regional policy and integrated management proposal to mitigate the impacts that unplanned land occupation and land-use change in the Amazon Basin have on water resources and socioeconomic and environmental conditions.

Results

- Capacity-building and commitments by national institutions to control the impacts caused by land occupation and land-use on water resources in the Amazon.

Schedule

ACTIVITIES	YEAR 1				YEAR 2				YEAR 3				YEAR 4			
Analyzing the political, legal, sociocultural, historical, and economic entities of each country, as well as institutional responsibility concerning land occupation in the Amazon Basin.	■	■	■	■												
Analyzing the dynamics of the socioeconomic, political and cultural processes linked to urbanization in the Amazon.					■	■	■	■								
Characterizing the economic activities, and public and private investment projects and programs. Identifying the productive capacity of the land, environmental impacts resulting from land occupation, and ways to resolve land-use conflicts.									■	■	■	■				
Strengthening national entities and their institutional capacities to mitigate the impacts of land occupation and land-use change on water resources and socioeconomic and environmental conditions in the Amazon Basin.													■	■	■	■

Target audience

Local, regional/state, national/federal governments of the Amazon Basin countries.

Civil society, communities, local associations and users.

Participating countries

Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname and Venezuela.

Estimated budget: US $2.6 million

5.3 Adaptation to Climate Change and Variability

Between 2005 and 2014, strong droughts punished the Amazon Basin, causing the death of thousands of tons of fish, and dramatic social and economic impacts for riverside communities. According to the Brazilian National Institute for Space Research (INPE), the likelihood of intense periods of drought occurring in the Amazon Region could increase from the current 5% (one strong drought every 20 years) to 50% in 2030, rising to 90% in 2100 (Marengo, 2008). As a matter of fact, the region has been hit by three important droughts during the current period: 2005, 2010 and 2014. During the 2010 drought, the water level recorded in the Port of Manaus (Brazil) fell to 13.63 m, the lowest in 102 years of monitoring.

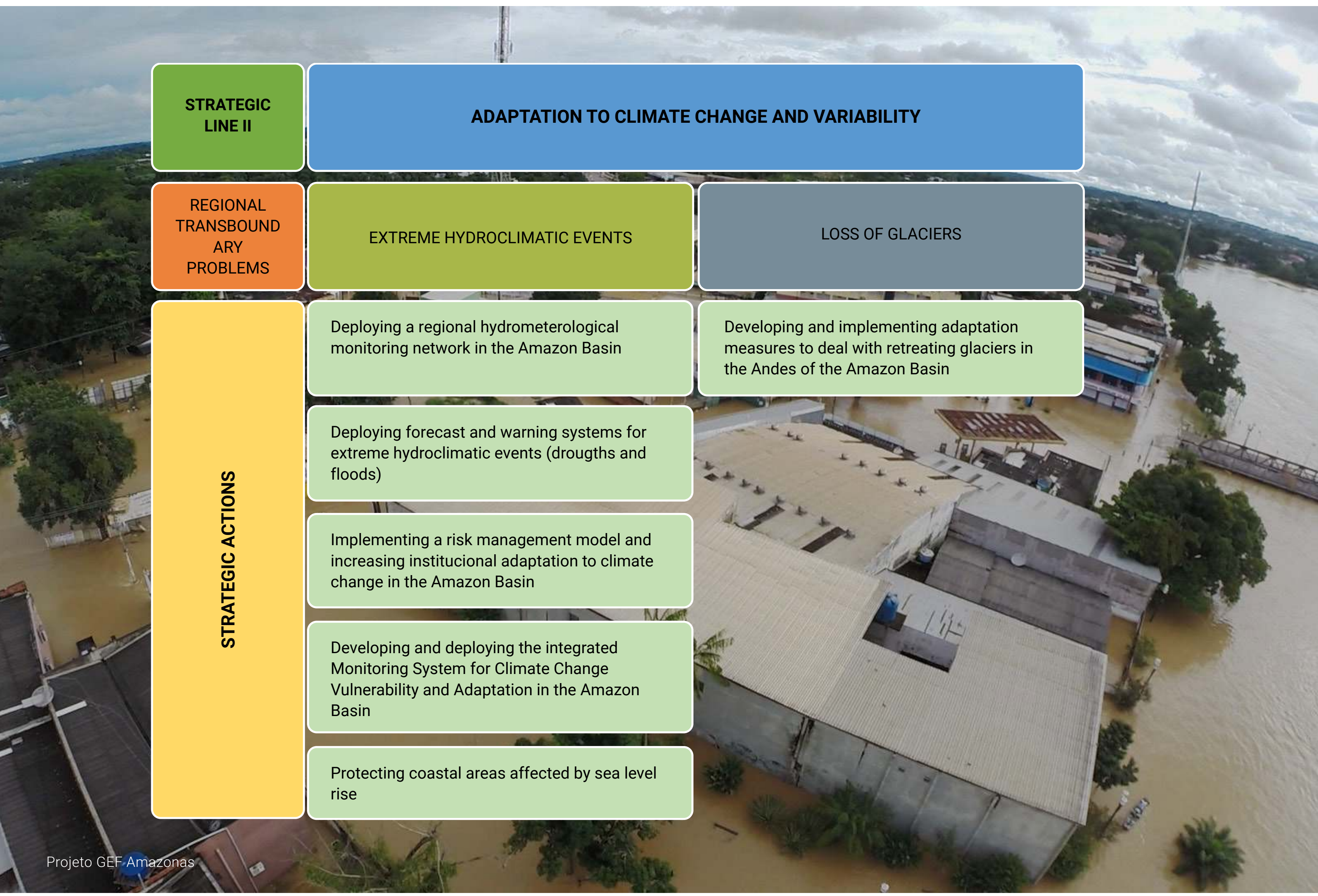
In terms of floods, the February 2014 flood in the Madeira Basin was particularly severe, affecting the Brazilian states of Acre and Rondonia with significant highwater measurements recorded on the Madeira River. In March 2014, discharge of 56,000 m3/s was recorded in Porto Velho (Rondonia, Brazil), well over the usual maximum discharge of 38,000 m3/s. In view of this situation, the Rio Branco municipal government was forced to declare a state of emergency that lasted almost two months. Rain falling at twice the average rate for two consecutive months caused the largest flood in the history of the Madeira River, leaving close to 100,000 families homeless. According to the municipality of Porto Velho, reconstruction costs were about $1.7 billion dollars.

ACTO - GEF Amazon Project

The social, economic and environmental impacts caused by increased climate variability must be countered by setting up a network of hydrometeorological stations and a system to observe climate indicators, including early warning systems and hydroclimatological risk management models.

The proposed strategic actions are based on pilot experiences developed by the GEF Amazon Project, among them the early warning system in the MAP transboundary region, the hydroclimatological risk management model tested in the Purus River basin and the Hydroclimatic Vulnerability Atlas of the Amazon Basin.

TABLE 12: STRATEGIC ACTIONS FOR ADAPTATION TO CLIMATE CHANGE AND VARIABILITY



STRATEGIC LINE II	**ADAPTATION TO CLIMATE CHANGE AND VARIABILITY**	
REGIONAL TRANSBOUNDARY PROBLEMS	EXTREME HYDROCLIMATIC EVENTS	LOSS OF GLACIERS
STRATEGIC ACTIONS	Deploying a regional hydrometerological monitoring network in the Amazon Basin	Developing and implementing adaptation measures to deal with retreating glaciers in the Andes of the Amazon Basin
	Deploying forecast and warning systems for extreme hydroclimatic events (drougths and floods)	
	Implementing a risk management model and increasing institucional adaptation to climate change in the Amazon Basin	
	Developing and deploying the integrated Monitoring System for Climate Change Vulnerability and Adaptation in the Amazon Basin	
	Protecting coastal areas affected by sea level rise	

Projeto GEF Amazonas

5.3.1 EXTREME HYDROCLIMATIC EVENTS

Rui Faquini

5.3.1.1 Creating a Regional Hydrometeorological Monitoring Network in the Amazon Basin.

Strategic Line II: Adaptation to Climate Change and Variability.

Regional Transboundary Problem: Extreme Hydroclimatic Events.

Rui Faquini

Background

To perform hydrometeorological monitoring of a basin of continental dimensions requires setting up and operating a network, with equipment installed at relevant points on the Amazon River system, and concerted and permanent effort by ACTO Member Countries to overcome technical and financial constraints.

To achieve this goal, at the technical meetings in Brasilia (August 2013 and August 2014) the eight ACTO countries agreed to set up a hydrometeorological monitoring network in the Amazon Basin.

Initially they identified six hydrometeorological monitoring points, located in Colombia, Peru and Bolivia, for the Amazon Basin's Monitoring Network Pilot Project, as the first step toward a regional network. All these points will perform streamflow gauging, water quality and sediment sampling, as well as automated telemetric data transmission. The six points initially proposed for the pilot initiative are located in the following countries and rivers (Table 13).

TABLE 13: SAMPLING POINTS FOR HYDROMETEOROLOGICAL MONITORING NETWORK PILOT PROJECT

Point	Location	Country
1	Madre de Dios River mouth, into the Beni River	Bolivia
2	Madre de Dios River, near the city of Porto Maldonado	Bolivia
3	Marañon River, near the city of Iquitos	Peru
4	Napo River, near the Peru-Ecuador border	Peru
5	Purui River	Colombia
6	Cuiari River	Colombia

In the context of its pilot project, Venezuela subsequently proposed installing automated stations to measure hydroclimatic and hydrometric parameters and strengthen its hydrometeorological network in the Venezuelan Amazon. This means that two stations, located on the Casiquiare-Tamatama branch and in Rio Negro municipality, Venezuela, will be added to the regional monitoring network, for a total of eight stations.

This strategic action will take into account the experience of the pilot project, and proposes expanding the network to the entire Amazon Basin, with the support and commitment of the Member Countries involved to select specific sites and ensure the stations' operation once they are set up. Monitoring activities in this action are synergetic with the water quality monitoring and sedimentation activities, in addition to providing important input for the early warning and forecast system that will foster adaptation to extreme climate events in the basin, based on data provided by the network.

Overall Objective

Establishing the mechanisms needed to exchange hydrometeorological information between the countries of the Amazon Basin, with the purpose of contributing to IWRM.

Specific Objective

1. Coordination between the national institutions responsible for hydrometeorological monitoring in the Amazon Basin.
2. Establishing protocols and agreements for the countries to exchange hydrometeorological information.
3. Implementing a hydrometeorological monitoring network (HMMN) in the Amazon Basin.
4. Training technical staff to operate and maintain the HMMN.
5. Identifying sources of funding to implement the HMMN in the Amazon Basin.

The GEF Amazon Project implemented the Trinational Early Warning System in the MAP region. The equipment was delivered and the staff was trained to operate the Terra MA2 platform. (Cobija, December 5, 2013)

Activities

1. Defining an institutional liaison model for participating entities and counterparts in the countries involved.
2. Preparing protocols for storage, transmission and sharing of hydrometeorological data, to be done by a regional technical group (RTG) made up of ACTO Member Countries.
3. Ensuring compatibility between hydrometeorological monitoring technologies and technical infrastructure.
4. Implementing and operating the HMMN, with local/national entities providing technical operational support.
5. Designing and implementing capacity-building programs for technical staff involved in managing the HMMN.
6. Preparing an inventory of sources of funding to implement the HMMN.
7. Providing the information produced by the HMMN to the countries, for institutional decision-making.

Products

- A functioning hydrometeorological monitoring network for the Amazon Basin.

Results

- Increased institutional integration and capacity for regional water resources monitoring and management in the Amazon countries.
- Ability to make decisions based on having information available at the regional level.

Schedule

ACTIVITIES	YEAR 1				YEAR 2				YEAR 3				YEAR 4			
Defining an institutional liaison model for participating entities and counterparts in the countries involved.	■	■														
Preparing protocols for storage, transmission and permission to share hydrometeorological data, to be done by a regional technical group (RTG) made up of ACTO Member Countries.			■	■	■	■										
Ensuring compatibility between hydrometeorological monitoring technologies and technical infrastructure.			■	■	■	■										
Implementing and operating the HMMN, with local/national entities providing technical operational support.			■	■	■	■										
Designing and implementing capacity-building programs for technical staff involved in managing the HMMN.					■	■	■	■	■	■	■	■	■	■	■	■
Preparing an inventory of sources of funding to implement the HMMN.																■
Providing the information produced by the HMMN to the countries for institutional decision-making.																■

Target audience

Government officials in the areas of the environment, water and natural resources; water users; governments, production sectors, local populations.

Participating countries

Brazil, Bolivia, Colombia Ecuador Guyana, Peru, Suriname and Venezuela.

Estimated budget: US $3.3 million

5.3.1.2 Creating Systems To Forecast and Warn About Extreme Hydroclimatic Events (Droughts and Floods).

Strategic Line II: Adaptation to Climate Change and Variability.

Regional Transboundary Problem: Extreme Hydroclimatic Events.

Rui Faquini

Background

This strategic action is based on the experience of the Early Warning System of the Transboundary MAP Region and the information provided by the Hydroclimatic Vulnerability Atlas of the Amazon, both undertaken in the GEF Amazon Project. It is also linked to the proposal of setting up the Hydrometeorological Monitoring Network (HMMN) in the Amazon Basin. Preventing the impacts of extreme climate events is essential to adapt to climate change, because these events are becoming more frequent and intense in the basin, particularly droughts in the east and floods in the west. After experiencing several extreme climate events, the Brazilian state of Acre received support from the National Water Agency to set up a situation room to forecast these events and prepare the population to take preventive measures. The proposed activity also aims to identify, strengthen and enhance the capacity of already existing early warning systems in the Amazon Basin.

Overall Objective

Reducing risks and developing adaptation responses to climate change and variability, with emphasis on extreme hydrometeorological events (floods and droughts).

Specific Objectives

1. Identifying, evaluating and classifying areas at risk for extreme hydrometeorological events in the Amazon Basin (droughts and floods).
2. Training people involved with water resources, hydrologic monitoring technologies, warning systems and adaptation and contingency plans for extreme events.
3. Setting up and operating forecast and warning systems in the main risk areas of the Amazon Basin.
4. Implementing an adaptation and contingency plan for extreme events in the Amazon Basin.

Activities

1. Identifying and classifying hydrologic risk areas in the Amazon Basin.
2. Assessing the experience of the warning system deployed in the MAP region.
3. Training human resources in the areas of water resources management, hydrologic monitoring technologies, forecast and warning systems, and adaptation and contingency plans for extreme events.
4. Setting up and operating forecast and warning systems in the main risk areas of the Amazon Basin.
5. Developing a medium and long term regional adaptation and contingency plan for extreme hydroclimatic events in the Amazon Basin, based on the practical experience of operating and regularly assessing existing forecast and warning systems.

Products

- Forecast and warning systems implemented and operating in the regions that are most sensitive to extreme hydroclimatic events in the Amazon.
- A regional adaptation and contingency plan to tackle the effects of climate variability in the Amazon Basin.

Results

- Significant reduction of economic and social losses in Amazon areas hit by extreme hydroclimatic events.

Schedule

ACTIVITIES	YEAR 1				YEAR 2				YEAR 3				YEAR 4				YEAR 5			
Identifying and classifying hydrologic risk areas in the Amazon Basin.	■	■																		
Assessing the experience of the warning system deployed in the MAP region.		■																		
Training human resources in the areas of water resources management, hydrologic monitoring technologies, forecast and warning systems, and adaptation and contingency plans for extreme events.			■	■	■	■	■	■	■											
Setting up and operating forecast and warning systems in the main risk areas of the Amazon Basin.									■	■	■	■	■	■	■	■	■	■	■	■
Developing a medium and long term regional adaptation and contingency plan for extreme hydroclimatic events in the Amazon Basin, based on the practical experience of operating and regularly assessing existing forecast and warning systems.																■	■	■	■	■

Target audience

Government officials for the environment, water and natural resources; water users; governments, production sectors, local populations and civil society.

Participating countries

Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname and Venezuela

Estimated budget: US $3.7 million

5.3.1.3 Implementing a Risk Management Model and Increasing Institutional Adaptation to Climate Change in the Amazon Basin.

Strategic Line II: Adaptation to Climate Change and Variability.

Regional Transboundary Problem: Extreme Hydroclimatic Events.

Rui Faquini

Background

Risk management models are important tools for local and regional governments and administrations to adapt and react quickly and efficiently to extreme hydroclimatic events.

This strategic action was designed based on the experience of creating a risk management model for climate change in the transboundary basin of the Purus River and the Hydroclimatic Vulnerability Atlas, both developed under the GEF Amazon Project.

Overall Objective

Improving risk management capacity and climate change adaptation in the Amazon Basin.

Specific Objectives

1. Identifying the ability of local and/or regional governments of ACTO Member Countries to respond to extreme hydroclimatic events.
2. Selecting an appropriate model for risk management and adaptation to hydroclimatic vulnerability for selected risk areas.
3. Training human resources to implement, operate and maintain a risk management model and technologies to adapt to droughts and floods, including provision of drinking water, food, electricity, housing, transportation, healthcare and environmental sanitation.
4. Implementing and operating risk management models in critical areas of the Amazon Basin, together with a regional risk management plan and a good practices guide.

Activities

1. Identifying and classifying hydroclimatic risk areas (droughts and floods) in the Amazon Basin and assessing the experiences of the pilot project developed in the Purus River basin.
2. Training the human resources needed for water resources management and technologies to adapt to droughts and floods, including provision of drinking water, food, electricity, housing, transportation, healthcare and environmental sanitation.
3. Acquiring equipment, implementing and operating risk management models in the main critical areas of the Amazon Basin.
4. Preparing a good practices guide on hydroclimatic vulnerability in the Amazon Basin, to be validated at meetings with the local people in areas affected by droughts and floods.

Products

- Risk management models implemented in critical areas of the Amazon Basin, together with a regional risk management plan and a good practices guide.

Results

- Governments and local and regional administrations better able to adapt and react quickly and efficiently to counter the risks of extreme hydroclimatic events.
- Riverside communities less vulnerable to extreme climatic events.

Schedule

ACTIVITIES	YEAR 1				YEAR 2				YEAR 3				YEAR 4				YEAR 5			
Identifying and classifying hydroclimatic risk areas (droughts and floods) in the Amazon Basin and assessing the experiences of the pilot project developed in the Purus River basin.	■	■	■	■																
Training the human resources needed for water resources management and technologies to adapt to droughts and floods, including provision of drinking water, food, electricity, housing, transportation, healthcare and environmental sanitation.			■	■	■	■	■													
Acquiring equipment, implementing and operating risk management models in the main critical areas of the Amazon Basin.								■	■	■	■	■								
Preparing a good practices guide on hydroclimatic vulnerability in the Amazon Basin, to be validated at meetings with the local people in areas affected by droughts and floods.													■	■	■	■	■	■	■	■

Target audience

Local and regional government authorities, production sectors and local populations.

Participating countries

Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname and Venezuela.

Estimated budget: US $2.4 million

5.3.1.4 Developing and Implementing an Integrated Monitoring System for Climate Change Vulnerability and Adaptation in the Amazon Basin.

Strategic Line II: Adaptation to Climate Change and Variability.

Regional Transboundary Problem: Extreme Hydroclimatic Events.

Background

Many countries have recently developed systems to monitor, observe and understand the extent and nature of climate change, to develop prevention and adaptation measures.

This strategic action aims to select, validate and monitor climate change and variability indicators in the Amazon Basin. Different indicators are used in the Amazon countries. It is recommended that the corresponding experts from each country, who know the weak points and vulnerabilities, as well as the potential and limitations of local institutions, should discuss and decide which indicators to use.

Climate change has direct and indirect impacts that lead to chain reactions. Impact indicators are classified at two main levels:

- **Primary Indicators** to monitor the observable effects of climate change on the physical world. Broadly speaking, primary indicators, also called key indicators by the World Meteorological Organization (WMO), are the same for countries in regions with similar physical-geographical conditions:

- **Atmospheric indicators**
  - Surface monitoring
  - Altitude monitoring
  - Chemical atmospheric monitoring.

- **Water Indicators**
  - Inland surface water monitoring (strategic action envisaged in the SAP)
  - Coastal and continental sea monitoring.

- **Secondary Indicators** to monitor impacts on ecosystems and social systems. These are more complex and tend to change according to the different socioeconomic vulnerabilities of the countries or social groups to which they apply.

The Amazon Basin also needs an institutional network to regulate and manage vulnerability and adaptation to climate change risks, a permanent capacity-building program, and guidelines on adaptation techniques and technologies (water, electricity, food, healthcare, housing and transportation). It is also important to identify and encourage integration between climate variability mitigation and adaptation actions.

Overall Objective

Establishing mechanisms to identify the effects of climate change in the Amazon Basin for adaptation and vulnerability reduction purposes.

Specific Objectives

1. Identifying the current state of systems for monitoring climate change vulnerability and adaptation.
2. Determining indicator measurement points and associated infrastructure in each country.
3. Training technical staff to monitor climate change vulnerability and adaptation in the Amazon Basin.
4. Developing, implementing and operating the Integrated System for Climate Change Monitoring, Prevention and Adaptation in the Amazon Basin (SIMA-Amazonas).

Activities

1. Establishing methodologies and technologies to identify and monitor adaptation to climate variability at the national and international levels.
2. Collecting and validating technical information at the climate change vulnerability and adaptation measurement points.
3. Designing and offering programs to train human resources in technologies and techniques to monitor climate change vulnerability, adaptation and mitigation in the Amazon Basin.
4. Developing the SIMA-Amazonas monitoring system.

Products

- An integrated climate change monitoring, prevention and adaptation system installed and operating in the Amazon Basin.

Results

- Amazon countries trained for climate change prevention and adaptation.

Schedule

ACTIVITIES	YEAR 1				YEAR 2				YEAR 3				YEAR 4				YEAR 5			
Establishing methodologies and technologies to identify and monitor adaptation to climate variability at the national and international levels.	■	■																		
Collecting and validating technical information at the climate change vulnerability and adaptation measurement points.			■	■	■	■														
Designing and offering programs to train human resources in technologies and techniques to monitor climate change vulnerability, adaptation and mitigation in the Amazon Basin.				■	■	■	■	■												
Developing the SIMA-Amazonas monitoring system.									■	■	■	■	■	■	■	■	■	■	■	■

Participating countries

Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname and Venezuela.

Estimated budget: US $1.75 million

5.3.1.5 Protecting Coastal Areas Affected by Rising Sea Levels

Strategic Line II: Adaptation to Climate Change and Variability

Regional Transboundary Problem: Extreme Hydroclimatic Events


Rui Faquini

Background

The GEF Project activity "Adaptation to sea level rise in Marajo Island" has produced important results to help us understand how sea level rise caused by climate change affects society and coastal ecosystems.

Its findings can be scaled up to develop a strategic action to protect similar coastal areas in other Amazon countries.

Problems caused by rising sea levels include loss of land and croplands, and destruction of mangroves.

Various low impact ecological measures, known and applied in other parts of the world, can be used to counter these problems, such as preventing erosion, fixating sediments to reclaim land, and restoring damaged and destroyed mangrove forests.

Overall Objective

Implementing adaptation measures to protect coastal ecosystems and communities that live in endangered coastal areas of Suriname and Guyana from the impacts of sea level rise.

Specific Objectives

1. Implementing a GIS (geographic information system) to delimit and characterize endangered and eroded coastal zones precisely.
2. Creating an observatory to monitor the dynamics of the changing coastline.
3. Selecting and implementing suitable sediment traps and wave control structures to reduce energy and reclaim lost land.
4. Restoring damaged mangroves.

Activities

1. Compiling primary and secondary data to develop an information baseline for the GIS.
2. Collecting data regularly for the GIS and creating a model to monitor changing coastline dynamics.
3. Selecting and providing suitable materials to build wave control structures and sediment traps, according to the guidelines established.
4. Restoring the aquatic environment and planting species to restore damaged mangroves.

Products

- An observatory to monitor the dynamics of the changing coastline.
- Sediment traps
- Wave control structures
- Restored mangroves.

Result

- Restored ecosystems and communities protected from the effects of sea level rise.

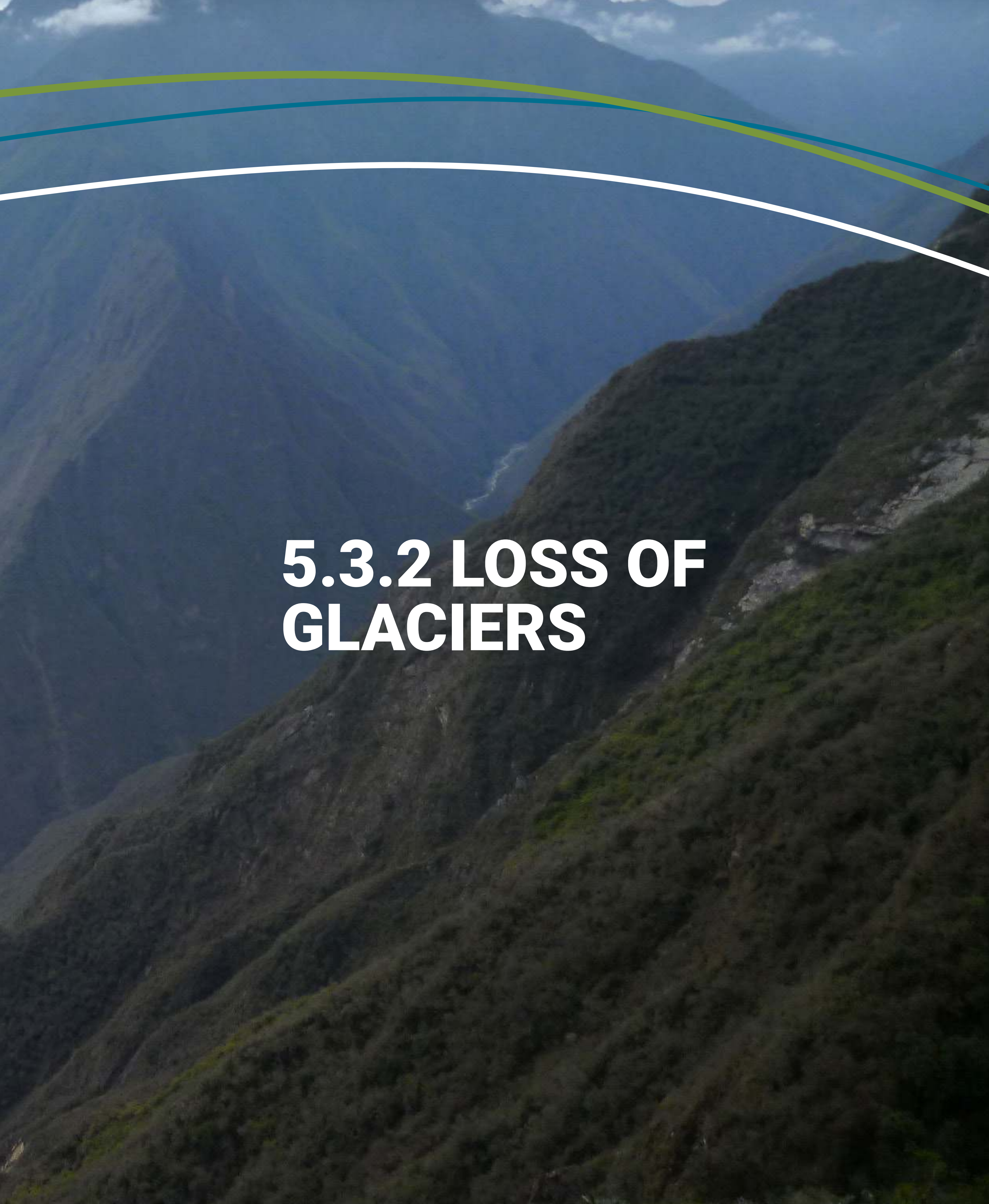
Schedule

ACTIVITIES	YEAR 1				YEAR 2				YEAR 3				YEAR 4			
Compiling primary and secondary data to develop an information baseline for the GIS.	■	■	■													
Collecting data regularly for the GIS and creating a model to monitor changing coastline dynamics.			■	■			■			■			■			
Selecting and providing suitable materials to build wave control structures and sediment traps, according to the guidelines established.			■	■	■	■	■	■	■	■	■	■	■	■		
Restoring the aquatic environment and planting species to restore damaged mangroves.			■	■	■	■	■	■	■	■	■	■	■	■		

Estimated budget: US $2.6 million

Shutterstock

5.3.2 LOSS OF GLACIERS



5.3.2.1 Developing and Implementing Adaptation Measures To Deal With Glacier Retreat in the Andes of the Amazon Basin.

Strategic Line II: Adaptation to Climate Change and Variability.

Regional Transboundary Problem: Loss of glaciers.

Background

Estimates by the Intergovernmental Panel on Climate Change (IPCC) indicate that warming in the Central Andes will cause the glaciers to disappear or reduce them substantially, affecting water supply in communities and urban centers located in the lower areas of the Andes Mountains.

The main causes of glacier melt are:

- The greenhouse effect.
- El Niño.
- Regional volcanic activity that affects the troposphere, glaciers and wildlife of mountain ecosystems.
- Industrial activity, urbanization, increased transportation and mining.
- Glaciers' steep slopes hinder the accumulation of snow and are susceptible to large avalanches due to seismic activity in the region.

Retreating glaciers affect the availability of water (surface and groundwater) in lower lands. This strategic action analyzes the effects and consequences of glacier melt on the supply and availability of water resources in communities and cities located in the area of influence of these glaciers.

Overall Objective

Developing mechanisms and measures to adapt to receding glaciers in areas of the Amazon Basin influenced by the Central Andes.

Specific Objectives

1. Determining the current baseline measurements for Central Andes glaciers in the Amazon Basin.
2. Assessing the availability of water resources coming from glaciers and lakes in the Central Andes.
3. Preparing and implementing measures to adapt to the effects of loss of glaciers on water supply for communities and/or urban centers located in the Central Andes of the Amazon Basin.

Activities

1. Selecting the glaciers and lakes that are relevant for water supply in the Central Andes of the Amazon Basin.
2. Preparing an inventory of communities and/or urban centers located in areas of influence of glaciers in the Central Andes of the Amazon Basin.
3. Implementing prevention and adaptation measures to compensate for the loss of water due to receding glaciers, with the communities and local populations affected.
4. Coordinating the countries in the area of influence of retreating glaciers, to enable mutual cooperation projects to be implemented.

Products

- Measures to adapt to the loss of glacier water resources used by Andean communities and/or urban centers of the Amazon Basin.

Results

- Amazon countries trained to adapt to the consequences of receding glaciers on the water supply.

Schedule

ACTIVITIES	YEAR 1				YEAR 2				YEAR 3				YEAR 4				YEAR 5			
Selecting the glaciers and lakes that are relevant for water supply in the Central Andes of the Amazon Basin.	■	■	■																	
Preparing an inventory of communities and/or urban centers located in areas of influence of glaciers in the Central Andes of the Amazon Basin.				■	■	■	■													
Implementing prevention and adaptation measures to compensate for the loss of water due to receding glaciers, with the communities and local populations affected.								■	■	■	■	■								
Coordinating the countries in the area of influence of retreating glaciers to enable mutual cooperation projects to be implemented.													■	■	■	■	■	■	■	■

Target audience

Local, regional/state, national/federal governments of Amazon Basin countries.

Civil society, communities, local associations and users.

Participating countries

Bolivia, Colombia, Ecuador and Peru.

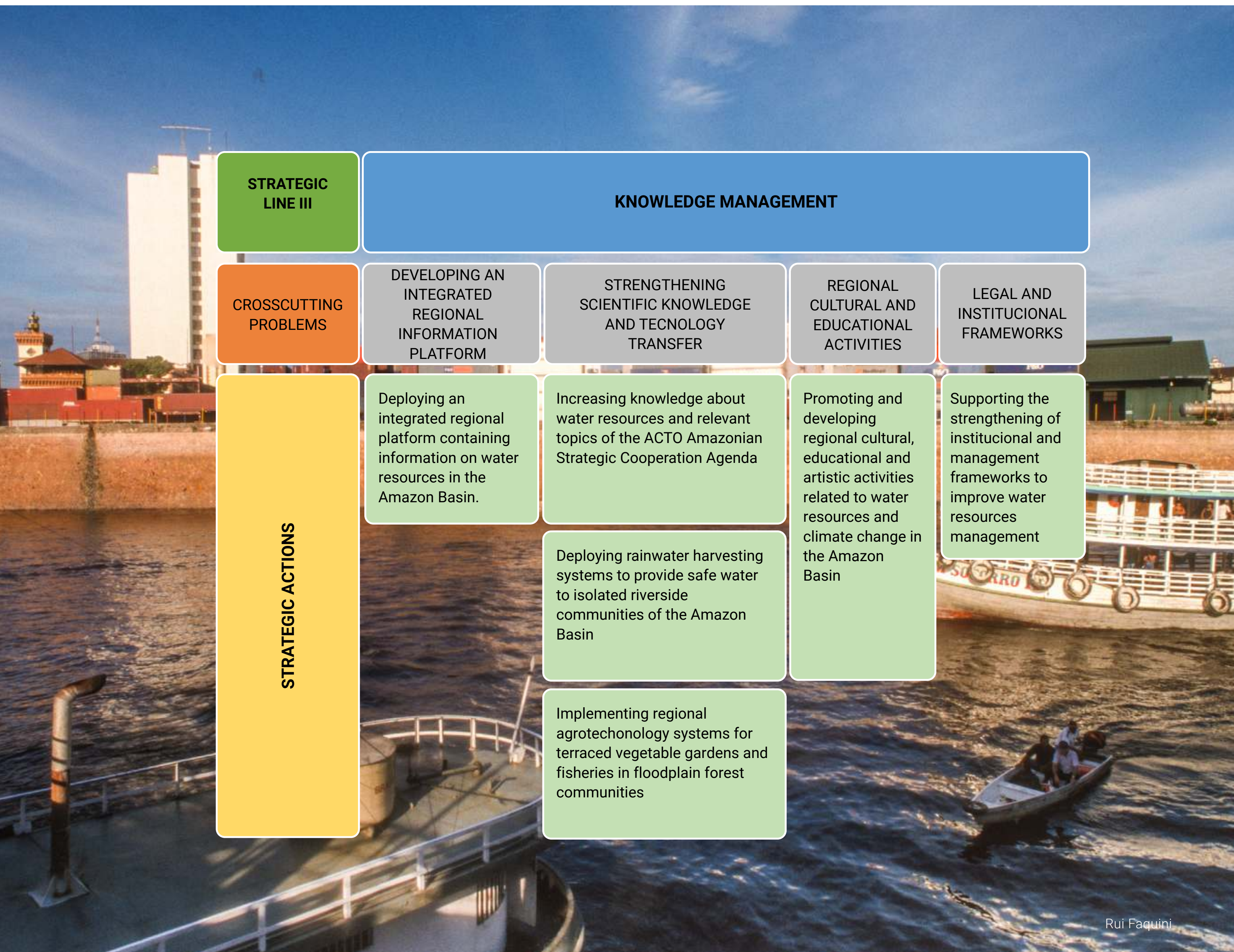
Estimated budget: US: $3.15 million

Rui Faquini

5.4 Knowledge Management

The strategic line Knowledge Management consists of four crosscutting problems: Developing an integrated regional information platform about water resources in the Amazon Basin; Strengthening scientific knowledge and replicable technology transfer; Regional cultural and educational activities; and Legal and institutional frameworks.

TABLE 14: STRATEGIC ACTIONS FACING KNOWLEDGE MANAGEMENT



STRATEGIC LINE III	KNOWLEDGE MANAGEMENT			
CROSSCUTTING PROBLEMS	DEVELOPING AN INTEGRATED REGIONAL INFORMATION PLATFORM	STRENGTHENING SCIENTIFIC KNOWLEDGE AND TECNOLOGY TRANSFER	REGIONAL CULTURAL AND EDUCATIONAL ACTIVITIES	LEGAL AND INSTITUCIONAL FRAMEWORKS
STRATEGIC ACTIONS	Deploying an integrated regional platform containing information on water resources in the Amazon Basin.	Increasing knowledge about water resources and relevant topics of the ACTO Amazonian Strategic Cooperation Agenda	Promoting and developing regional cultural, educational and artistic activities related to water resources and climate change in the Amazon Basin	Supporting the strengthening of institucional and management frameworks to improve water resources management
		Deploying rainwater harvesting systems to provide safe water to isolated riverside communities of the Amazon Basin		
		Implementing regional agrotechonology systems for terraced vegetable gardens and fisheries in floodplain forest communities		

Rui Faquini

5.4.1 Developing an Integrated Regional Information Platform.

5.4.1.1 Creating an Integrated Regional Platform of Information on Water Resources in the Amazon Basin.

Strategic Line III: Knowledge Management.

Regional Transboundary Problem: Developing an integrated regional information platform.

Background

The national TDA workshops indicated the need to create a platform for an integrated information system that provides easy access to the main databases with information on water resources in the Amazon Basin.

The purpose of this strategic action is to fulfill this need expressed by the Amazon countries, based on the experience of the Integrated Information System (IIS) implemented under by the GEF Amazon Project, which compiles the project's findings.

The aim is to extend the IIS regionally, to serve as the technical basis to develop a regional integrated information platform on water resources in the Amazon Basin. The platform will collect official data about subjects relevant to integrated water resources management (IWRM) in the Amazon Basin and other topics of ACTO's Amazonian Strategic Cooperation Agenda.

Overall Objective

Establishing mechanisms, tools and processes to promote scientific research about IWRM in the Amazon Basin.

Specific Objectives

1. Developing and implementing protocols and agreements to exchange data between existing information systems.
2. Creating the platform's technical infrastructure and training technical staff from the Member Countries to use it.
3. Implementing an integrated water resources information platform (IWRIP) of the Amazon Basin by scaling up the GEF Amazon Project's IIS.

Activities

1. Identifying IWRM-related institutions and information systems in the Amazon countries, as well as existing protocols.
2. Developing appropriate legal agreements for exchange and integration of databases between institutions of the Amazon countries.
3. Offering technical training in the Amazon countries to operate the IWRIP.
4. Acquiring the infrastructure needed to deploy the IWRIP.

Products

- An integrated regional platform with information about water resources in the Amazon Basin installed and operating. Agreements and conventions signed between the participating IWRM institutions and ACTO.

Results

- ACTO institutionally strengthened to implement, manage and maintain an integrated water resources information platform for the Amazon Basin.
- Stronger mechanisms, tools and processes to promote scientific research about IWRM in the Amazon Basin.

Schedule

ACTIVITIES	YEAR 1				YEAR 2				YEAR 3				YEAR 4			
Identifying IWRM-related institutions and information systems in the Amazon countries, as well as existing protocols.	■	■														
Developing appropriate legal agreements for exchange and integration of databases between institutions of the Amazon countries.			■	■	■	■	■	■								
Offering technical training in the Amazon countries to operate the IWRIP.					■	■	■	■								
Acquiring the infrastructure needed to deploy the IWRIP.									■	■	■	■	■	■	■	■

Target audience

Public and private institutions and the general public interested in the subject.

Participating countries

Bolivia, Brazil, Colombia, Ecuador, Guyana, Suriname, Peru and Venezuela.

Estimated budget: US $1.9 million

5.4.2 Strengthening Scientific Knowledge and Technology Transfer.

5.4.2.1 Increasing Scientific Knowledge About Water Resources and Topics Relevant to the ACTO Amazonian Strategic Cooperation Agenda

Strategic Line III: Knowledge Management.

Regional Transboundary Problem: Increasing scientific knowledge and upscaling replicable technology transfer.

Rui Faquini

Background

This strategic action has the purpose of identifying important scientific projects to fulfill the knowledge requirements of the Amazon countries and ACTO in matters of IWRM and associated issues.

Effectively implementing IWRM in the Amazon Basin and creating a regional Amazon information platform requires a strategy that promotes scientific research about protection and use of water resources and other issues in consonance with the various strategic activities and initiatives developed under ACTO. Aside from water resources, other issues that are fundamental for the Amazon region, such as biodiversity, deforestation, health, indigenous peoples, tourism and social affairs, among others, will also be included.

The strategic action proposes to address the most important scientific issues, and design priority scientific research projects to advance IWRM in the Amazon Basin and strengthen ACTO activities and projects.

Overall Objective

Identifying and developing scientific projects related to IWRM in the Amazon Basin and topics relevant to the ACTO Amazonian Strategic Cooperation Agenda.

Specific Objectives

1. Identifying relevant research subjects to increase scientific knowledge on IWRM and other strategic areas for ACTO.
2. Preparing, formulating and selecting priority scientific projects in strategic areas for ACTO.
3. Identifying research institutions in the Amazon countries that have the scientific capacity to conduct scientific research projects that meet the needs of ACTO's strategic activities.
4. Conduct selected research projects and publicize the findings through the information platform and other appropriate media.

Activities

1. Creating a regional scientific coordination unit to identify priority subjects for scientific research projects, coordinate projects in an integrated manner, and define requirements and standards for designing and conducting research projects.
2. Promoting workshops with national research groups and institutions to prepare priority scientific projects and seek funding.
3. Executing projects through selected scientific institutions and disseminating the results.

Products

- Scientific projects conducted and results disseminated.

Results

- Increased scientific and technical knowledge about topics relevant to IWRM in the Amazon Basin and the ACTO Amazonian Strategic Cooperation Agenda, and a stronger ACTO Integrated Information Platform.
- Countries' intervention capacity strengthened through scientific and technological knowledge.

Schedule

ACTIVITIES	YEAR 1				YEAR 2				YEAR 3				YEAR 4				YEAR 5			
Creating a regional scientific coordination unit to identify priority subjects for scientific research projects, coordinate projects in an integrated manner, and define requirements and standards for designing and conducting research projects.	■	■																		
Promoting workshops with national research groups and institutions to prepare priority scientific projects and seek funding.			■	■	■	■	■	■												
Executing projects through selected scientific institutions and disseminating the results.									■	■	■	■	■	■	■	■	■	■	■	■

Target audience

Public and research institutions, scientists, main IWRM stakeholders and the interested public in general.

Participating countries

Bolivia, Brazil, Colombia, Ecuador, Guyana, Suriname, Peru and Venezuela.

Estimated budget: US $1.95 million

5.4.2.2 Establishing Rainwater Harvesting Systems (RHS) To Provide Safe Water to Isolated Riverside Communities of the Amazon Basin.

Strategic Line III: Knowledge Management.

Regional Transboundary Problem: Increasing scientific knowledge and upscaling replicable technology transfer.


ACTO

Background

Supplying drinking water to coastal and isolated communities is a basic need enshrined in the Millennium Development Goals (MDGs), the Sustainable Development Goals (SDGs), the health policies of ACTO Member Countries, and the Social Determinants of Health. As an essential element for human consumption, water must have the appropriate characteristics to avoid diseases and health problems resulting from infectious agents, parasites and chemical pollutants.

Despite its tremendous abundance, freshwater in the Amazon Basin is rarely apt for human consumption without prior treatment. One of the simplest and cheapest ways to provide safe water is to use rainwater.

This strategic action has the purpose providing drinking water through rainwater harvesting systems (RHS) that are simple to install, cheap to build and maintain, and easy to replicate in different regions of the Amazon.

The proposed RHS consists of units that can meet the needs of up to one to four families of four-persons. In addition to the harvesting system, each unit will include a photovoltaic cell and a septic tank to ensure basic sanitation at the site.

Overall Objective

Deploying rainwater harvesting systems to provide drinking water to isolated riverside communities of the Amazon Basin and reduce the prevalence of diseases.

Specific Objective

1. Developing a rainwater harvesting system (RHS) that can be replicated in different countries of the Amazon Basin.
2. Developing agreements and protocols to enable the installation of RHS at the regional level.
3. Installing RHS in selected Amazonian communities of ACTO Member Countries.

Activities

1. Analyzing different rainwater harvesting proposals from around the world and from the Amazon countries.
2. Identifying the Amazon areas at greatest risk of drinking water scarcity and selecting communities to install RHS.
3. Studying the characteristics of rainwater in the Amazon region to determine what treatment is needed to make the water potable.
4. Developing agreements, policies and a program to monitor the impacts of RHS on people's health.
5. Preparing teaching materials and RHS installation guides for community agents, sanitation technicians and the community in general.
6. Replicating the program regionally by building a number of RHS units (to be defined) in each country.

Products

- A number (to be defined) of rainwater harvesting systems installed in isolated communities of the Amazon Region.

Results

- Reduction in comorbidities associated with consuming contaminated water.
- Reduction in family spending on bottled water and pollution from plastic residues in the Amazon Basin.

Schedule

ACTIVITIES	YEAR 1				YEAR 2				YEAR 3				YEAR 4			
Analyzing different rainwater harvesting proposals from around the world and from the Amazon countries.	■	■														
Identifying the Amazon areas at greatest risk of drinking water scarcity and selecting communities to install RHS.			■	■												
Studying the characteristics of rainwater in the Amazon region to determine what treatment is needed to make the water potable.				■	■	■	■									
Developing agreements, policies and a program to monitor the impacts of RHS on people's health.								■	■	■						
Preparing teaching materials and RHS installation guides for community agents, sanitation technicians and the community in general.									■	■	■	■	■	■	■	■
Replicating the program regionally by building a number of RHS units (to be defined) in each country.													■	■	■	■

Participating countries

Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname and Venezuela.

Estimated budget: US $3.92 million

5.4.2.3 Implementing Regional Agrotechnology Systems for Terraced Vegetable Gardens and Fisheries in Floodplain Forest Communities.

Strategic Line III: Knowledge Management.

Regional Transboundary Problem: Increasing scientific knowledge and upscaling replicable technology transfer.

GEF Amazon Project – Fish tanks

Background

Lack of economic opportunities is one of the causes of loss of biodiversity, deterioration and reduction of food sources and production activities, such as agriculture, fishing and tourism, upon which many of the Amazon's low income inhabitants depend directly for subsistence.

Floodplain forests and wetlands are among the most endangered and beneficial ecosystems that exist, and countless wildlife species depend on them. Their exceptional biological wealth represents important potential for the production and commercial activities needed for sustainable development. When these activities are pursued appropriately, they help to protect ecosystems from threats and improve the socioeconomic conditions of riverside populations. Nevertheless, serious floods do annual damage to crops and interfere with the next year's harvest. In addition, low technology agriculture and fishing in varzea forests means that the communities are not using biodiversity resources efficiently under sustainable conditions, and this hinders their access to local, national and international markets. Immediate solutions are needed.

The pilot project in technology extension developed by the GEF Amazon Project in varzeas of Brazil and Peru, has shown that technological production systems adapted to local conditions optimize the use of these areas, boosting and diversifying production during high flow periods and increasing income and participation by riverside fishers and farmers in local markets.

Overall Objective

Improving the economic situation of communities located in Amazonian floodplain forests by implementing regional agrotechnology systems for terraced vegetable gardens and fisheries.

Specific Objectives

1. Introducing alternative systems and technologies, as well as successful traditional ones, for agriculture, aquaculture and renewable energy to support the sustainability of riverside communities in Amazon varzeas.
2. Creating family-based agribusinesses and strengthening local ventures through market studies, diversified production, better logistical and commercial infrastructure and training.

Activities

1. Identifying varzeas in Amazon countries to introduce alternative agriculture and aquaculture technologies by conducting ethnobotanical assessments, investigating available fish resources and evaluating the socioeconomic conditions of local populations.
2. Installing and operating semi-hydroponic vegetable growing nurseries, sprinkler irrigation, low impact mechanization, and renewable energy for agricultural crops based on studies of feasibility, impact and maintenance.
3. Installing and operating mesh aquaculture tanks and hybrid fishing-aquaculture systems.
4. Periodically assessing economic yields and possible needs for technological adjustments.
5. Installing training and demonstration centers for the proposed technologies and to share experiences.

Products

- Alternative agrotechnology systems for terraced vegetable gardens and fisheries installed in Amazonian floodplain forests.

Results

- Improved economic conditions in communities located in Amazonian floodplain forests.
- Conservation and sustainable use of floodplain forests.

Schedule

ACTIVITIES	YEAR 1				YEAR 2				YEAR 3				YEAR 4				YEAR 5			
Identifying varzeas in Amazon countries to introduce alternative agriculture and aquaculture technologies by conducting ethnobotanical assessments, investigating available fish resources and evaluating the socioeconomic conditions of local populations.	■	■	■																	
Installing and operating semi-hydroponic vegetable growing nurseries, sprinkler irrigation, low impact mechanization, and renewable energy for agricultural crops based on studies of feasibility, impact and maintenance.			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Installing and operating mesh aquaculture tanks and hybrid fishing-aquaculture systems.					■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Periodically assessing economic yields and possible needs for technological adjustments.									■					■						■
Installing training and demonstration centers for the proposed technologies and to share experiences.																		■	■	■

Target audience

Local riverside communities/families in selected floodplain forests.

Participating countries

Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname and Venezuela.

Estimated budget: US $5.2 million

5.4.3 Regional Cultural and Educational Activities

5.4.3.1 Promoting and Undertaking Regional Cultural, Educational and Artistic Activities Related to Water Resources and Climate Change in the Amazon Basin.

Strategic Line III: Knowledge Management.

Regional Transboundary Problem: Regional Cultural, Artistic and Educational Activities.

Rui Faquini

Background

At several of the national TDA meetings, the participants mentioned the lack of regional cultural events that unite the Amazon countries for joint activities related to Amazonian subjects. Participants noted that to implement the Strategic Action Program (SAP) and continue raising awareness with the population, Amazonian society must be made to realize the importance of water resources in this globally important region.

To this end, the Member Countries propose holding cultural, artistic and educational events that highlight the importance of ecosystems, water resources and climate change in the Amazon Basin. This strategic action proposes preparing a regional agenda of cultural events and activities associated with protection and sustainable use of water resources and climate change. These events will be incorporated in an official calendar of member country celebrations that could include the Week of Amazon Waters during World Water Day week and/or other events held across the entire Amazon Basin, as well as documentaries, photographic exhibits and public conferences.

Overall Objective

Creating and promoting a regional agenda of cultural, artistic and educational events about protection and sustainable use of water resources and climate change, to be undertaken simultaneously and regularly in the ACTO Member Countries.

Specific Objectives

1. Identifying cultural institutions, organizations and movements in each Amazon country with potential to publicize and promote cultural, artistic and educational events on water resources and climate change in the Amazon Basin.
2. Preparing a regional activities plan and calendar to hold the proposed events simultaneously.
3. Preparing regional protocols and agreements for the planned events in the Amazon Basin.
4. Producing media materials (print, audiovisual, creating and maintaining a website) and advertising for local and regional projects and initiatives to raise awareness among Amazonian society and key stakeholders.
5. Hold scheduled events and document these as a historical record of the experiences.

Activities

1. Forming a regional cultural and artistic coordination group to prepare, coordinate and accompany the schedule of activities, and create internal regulations for its functioning.
2. Identifying cultural institutions, organizations and movements in each Amazon country that might have the profile needed to be part of a regional network of cultural players.
3. Holding national workshops with cultural institutions and/or organizations and preparing a regional cultural activities plan.
4. Preparing the necessary agreements and regulations to hold coordinated cultural activities in the Amazon countries.
5. Producing dissemination materials in each country and securing support from national cultural players to undertake activities.
6. Undertaking the scheduled cultural activities over the course of one year in all the Amazon countries, and producing a recap of the experiences.

Products

- An agreed regional plan for cultural activities.
- Cultural activities on the importance of protecting water resources and using them sustainably, and other associated issues, undertaken in all Amazon countries.

Results

- Amazonian society is more informed and aware of the value of water resources and the problems caused by climate change.

Schedule

ACTIVITIES	YEAR 1				YEAR 2				YEAR 3				YEAR 4				YEAR 5			
Forming a regional cultural and artistic coordination group to prepare, coordinate and accompany the schedule of activities, and create internal regulations for its functioning.	■	■	■																	
Identifying cultural institutions, organizations and movements in each Amazon country that might have the profile needed to be part of a regional network of cultural players.			■	■																
Holding national workshops with cultural institutions and/or organizations and preparing a regional cultural activities plan.					■	■	■	■												
Preparing the necessary agreements and regulations to hold coordinated cultural activities in the Amazon countries.							■	■	■											
Producing dissemination materials in each country and securing support from national cultural players to undertake activities.									■	■	■	■	■	■	■	■				
Undertaking the scheduled cultural activities over the course of one year in all the Amazon countries, and producing a recap of the experiences.													■	■	■	■	■	■	■	■

Target audience

Urban and non-urban people of the Amazon, mining communities and indigenous peoples.

Participating countries

Bolivia, Brazil, Colombia, Ecuador, Guyana, Suriname, Peru and Venezuela.

Estimated budget: US $1.3 million

5.4.4 Legal and Institutional Frameworks

5.4.4.1 Supporting the Strengthening of Institutional and Management Frameworks To Improve Water Resources Management

Strategic Line III: Knowledge Management.

Regional Transboundary Problem: Legal and Institutional Frameworks.

Rui Faquini

Overall Objective

Strengthening the Member Countries' institutional and legal capacities to support integrated water resources management (IWRM).

Specific Objectives

1. Helping Guyana and Suriname develop effective legal and institutional frameworks for IWRM.
2. Making recommendations to improve existing legal and institutional frameworks at the national and regional levels to help strengthen IWRM.
3. Creating an enabling environment to strengthen IWRM at the basin level.

Activities

1. Organizing dialogue on the technical issues, training and exchange between Guyana and Suriname and the other Member Countries to facilitate adjustments to their current legal and institutional frameworks, including strengthening laws and creating water agencies to make them more qualified for IWRM.
2. Compiling a toolkit with best practices and case studies on institutional structures, as well as manuals and sample laws.
3. Formulating guiding principles to develop legal and institutional instruments at the basin level.

Products

- Exchange of experiences, training and dialogue among Member Countries and between Guyana and Suriname to support legal and institutional adjustments that favor IWRM.
- Toolkit with a collection of best practices, case studies, manuals and sample laws in support of legal, policy and institutional strengthening related to IWRM.
- Basinwide water quality and quantity standards and other IWRM principles, as well as legal compliance protocols and other legal and risk management tools.

Results

- Countries endowed with appropriate legal and institutional capacity for IWRM at the national and basin levels.
- More effective policy, legal and institutional frameworks to better manage water quality and quantity in the basin.
- Set of guiding principles to prepare basinwide legal instruments for IWRM.

Schedule

ACTIVITIES	YEAR 1				YEAR 2				YEAR 3				YEAR 4			
Organizing dialogue on the technical issues, training and exchange between Guyana and Suriname and the other Member Countries to facilitate adjustments to their current legal and institutional frameworks, including strengthening laws and creating water agencies to make them more qualified for IWRM.	■	■	■	■	■	■	■	■								
Compiling a toolkit with best practices and case studies on institutional structures, as well as manuals and sample laws.							■	■	■	■						
Creating an enabling environment to strengthen IWRM at the basin level.	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

Estimated budget: US $4.5 million

6 IMPLEMENTING THE SAP

Rui Faquini

This Strategic Action Program (SAP) was designed to be implemented by means of a series of projects that correspond to strategic actions in response to the priority transboundary problems identified in the regional TDA. Funding will be sought for each project, either independently or in combination with other SAP projects.

Projects will be implemented through the national focal points designated by the Member Countries, with the participation of multiple local, national and regional stakeholders.

The SAP suggests creating a national action plan in each of the eight Amazon countries to guarantee that strategic actions are executed at the national level.

Progress in implementing the SAP will be tracked through a monitoring and evaluation plan (M&E) that includes objectives and indicators of success for each strategic action. Adaptive management will moreover allow the SAP implementation process to be reviewed and updated over the course of the years that its activities are executed.

6.1 Correlation Between Strategic Actions

Correlation between strategic actions that present clear synergies is important to facilitate the implementation of the SAP, and avoiding duplicating activities and costs.

The strategic actions fall into **six correlated thematic implementation areas** that are:

- Regional Monitoring
- Planning and Management
- Adaptation
- Protection
- Social Communal Technologies
- Knowledge and Awareness Raising

As such, strategic actions in the same thematic implementation area could be negotiated together through protocols, regulations and regional activities among Amazon countries. To make the process easier,

Rui Faquini

the Member Countries might consider creating working groups or committees with national representatives, with ties to ACTO, to prepare the necessary agreements and regulations to implement correlated strategic actions.

To facilitate the process, we suggest creating commissions, with ties to ACTO, with representatives of the countries, to prepare the agreements and regulations needed to implement the correlated strategic actions. Table 15 shows the strategic actions and corresponding thematic implementation areas.

TABLE 15: STRATEGIC ACTIONS AND CORRESPONDING THEMATIC IMPLEMENTATION AREAS

	CORRELATED STRATEGIC ACTIONS
REGIONAL MONITORING	Implementing a regional water quality monitoring system for the rivers of the Amazon Basin.
	Monitoring erosion, sediment transport and sedimentation in the Amazon Basin to help mitigate negative effects and maximize positive ones.
	Creating a regional hydrometeorological monitoring network in the Amazon Basin.
	Developing and implementing the Integrated Monitoring System for Climate Change Vulnerability and Adaptation in the Amazon Basin.
PLANNING AND MANAGEMENT	Action program to respond to the impacts of current land occupation and land-use on water resources in the Amazon Basin.
	Reducing the vulnerability of bioaquatic ecosystems of the Amazon Basin.
	Supporting the strengthening of institutional and management frameworks to improve water resources management.
ADAPTATION	Developing and implementing adaptation measures to deal with glacier retreat in the Andes of the Amazon Basin.
	Creating systems to forecast and warn about extreme hydroclimatic events (droughts and floods).
	Implementing a risk management model and increasing institutional adaptation to climate change in the Amazon Basin.
PROTECTION	Developing a groundwater use and protection program for public supply in the Amazon region.
	Protecting, managing and monitoring aquifers in the Amazon river basins.
	Conserving and using water resources sustainably in the headwaters and lowlands of the Amazon Basin, where páramo and wetland ecosystems prevail.
	Protecting coastal areas affected by rising sea levels.
SOCIAL COMMUNAL TECHNOLOGIES	Establishing rainwater harvesting systems to provide safe water to isolated riverside communities of the Amazon Basin.
	Implementing regional agrotechnology systems for terraced vegetable gardens and fisheries in floodplain forest communities.
KNOWLEDGE AND AWARENESS RAISING	Creating an integrated regional platform of information on water resources in the Amazon Basin.
	Increasing scientific knowledge about water resources and topics relevant to the ACTO Amazonian Strategic Cooperation Agenda.
	Promoting and undertaking cultural, educational and artistic activities related to water resources and climate change in the Amazon Basin.


ACTO

6.2 Strategic Actions and National and International Policies and Agreements on Water, Climate, Environment and Sustainable Development

As mentioned previously in this publication, the formulation and implementation of this SAP is underpinned by national and regional policies, legal instruments, priorities and commitments of the Amazon countries in the broad context of IWRM, which is considered strategic for the Amazon Basin's harmonious and sustainable development. The proposed strategic actions will join ongoing initiatives or others envisaged in the Member Countries' national instruments and policies, while at the same time helping to achieve the targets and objectives to which the countries have committed under the main international instruments and agreements for the environment, climate and sustainable development. As such, the intention is to optimize efforts and investments in human and financial resources, consolidating fruitful partnerships for all those participating in the SAP.

In this sense, it is important to highlight the connections between the strategic actions, the Member Countries' national policies on water resources and climate, and the main international environmental agreements and conventions. As regards the countries' legal frameworks, this paper focuses on laws and policies for water resources and strategies or plans for climate change and/or adaptation.

6.2.1 National Policies and Instruments

All eight Member Countries have legal instruments or frameworks that address water resources and climate change at the national level.

Most of the SAP strategic actions are aligned with national water policies and instruments, while those of the strategic line Extreme Hydroclimatic Events are linked to the countries' legal frameworks for climate change and adaptation. Particular emphasis is placed on hydrometeorological monitoring, vulnerability indicators, early warning systems, risk management, and strengthening institutional capacities.

Among others, the SAP took into account the following national legal frameworks (Table 16):

LEGAL FRAMEWORKS OF ACTO MEMBER COUNTRIES (TABLE 16):

Member Country	National legal frameworks
Bolivia	Political Constitution of the State, 2009 (Articles. 16, 20, 373-377), Water Law, 1906, Law 031, "Andrés Ibañez" Autonomies and Decentralization Framework (2010), Law 037, Mother Earth and Integral Development Framework for Living Well (2012), National Basins Plan (2007), Regional Climate Change Adaptation Mechanism (2007), Patriotic Agenda towards 2025, Law 535 on Mining and Metallurgy (2014), Law 1700, Forest Law (1996).
Brazil	National Water Resources Policy (Law 9.433 / 1997), CONAMA Resolution 357/2005; National Climate Change Plan (PNMC), 2008 National Climate Change Policy, 2009
Colombia	National Policy for Integrated Water Resource Management (2010) Law 373/1997- Water Saving and Efficient Usage Program Decree 1076 of 2015 Single Regulatory Decree for the Environment and Sustainable Development Sector. National Climate Change Adaptation Plan: ABC Conceptual Adaptation Bases, Conceptual Framework and Guiding principles (2012).
Ecuador	Water Law, 1973 Organic Law for Water Resources, Uses and Exploitation, 2014; National Climate Change Strategy, 2012-2015
Guyana	National Climate Change Adaptation Policy and Implementation Plan, 2011; Water and Sanitation Law, Low Carbon Development Strategy (2013), National Biodiversity and Action Plan (2015), Guyana National Integrated Disaster Risk Management Strategy.
Peru	Water Resources Law and National Water Resources Policy and Strategy (29338/2009). State Policy 33 on Water Resources, National Climate Change Strategy Action Plan of Adaptation and Mitigation cope to the Climate Change, 2011-2021
Suriname	Drilling Act (1952), Mining Act (1986/1997), Water Supply Act (1938), Draft Act on the Extraction of Groundwater, Draft Act on Groundwater Protection, Draft Act Water Quality Supervision
Venezuela	Water Law, 2007; Homeland Plan (2013-2019); National Biodiversity Conservation Strategy (2010-2020); Organic Law for the Provision of Potable Water and Sanitation Services (2001).

Source: Water Legislation of ACTO Member Countries.

6.2.2 International Agreements and Conventions

Strategic actions are also linked to the main international conventions and agreements for the climate and the environment like the Sustainable Development Goals 2015-2030, the Convention on Biological Diversity (Aichi Biodiversity 2011-2020), the United Nations Convention to Combat Desertification (10-year plan 2008-2018) and the Ramsar Convention on Wetlands. All strategic actions are linked to actions proposed in the plans or strategies of these international instruments. The eight Member Countries are signatories to the following conventions: CBD, fighting desertification and the Ramsar Convention (except Guyana).


ACTO

- The highest correlation was identified between the strategic actions and the Sustainable Development Goals (SDG), especially in relation to SDG No. 6 on water and sanitation. There are also correlations with the SDGs on food security, education and climate change, particularly with the following targets:

2.3. *By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment.*

4.7. *By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development.*

6.1. *By 2030, achieve universal and equitable access to safe and affordable drinking water for all.*

6.3. *By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.*

6.4. *By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.*

6.5*. By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate.*

6.6. *By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.*

6.7. *By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies.*

6.8. *Support and strengthen the participation of local communities in improving water and sanitation management.*

13.1. *Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.*

13.3*. Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning.*

13.5. *Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities.*


GEF Amazon Project video

• There is also a clear correlation between the **Convention on Biological Diversity (Aichi Targets)** and the strategic actions to protect and conserve wetland ecosystems and headwaters, and to protect fish in aquatic ecosystems. The Aichi Biodiversity Targets most directly linked to the referred actions are:

Aichi Target 1 - By 2020, at the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably.

Aichi Target 6 *- By 2020 all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems and the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits.*

Aichi Target 7 *- By 2020 areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity.*

Aichi Target 8 *- By 2020, pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity.*

Aichi Target 14 *- By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.*

- Like the biodiversity conservation targets, the **RAMSAR Convention** focuses specifically on protecting wetlands and critical floodplains to protect aquatic biodiversity, which is directly linked to the strategic action for conservation of páramos and wetlands.
- The strategic actions also reflect the actions envisaged in the 10-year strategic plan of the **Convention to Combat Desertification**, particularly regarding the following objectives and expected outcomes:

Operational objective 3:
Science, technology and knowledge

Outcome 3.1: National monitoring and vulnerability assessment on biophysical and socioeconomic trends in affected countries are supported.

Outcome 3.3: Knowledge on biophysical and socioeconomic factors and on their interactions in affected areas is improved to enable better decision-making.

Strategic objective 1:
To improve the living conditions of affected populations

Expected impact 1.1. People living in areas affected by desertification/land degradation and drought to have an improved and more diversified livelihood base and to benefit from income generated from sustainable land management.

Expected impact 2.1. Affected populations' socioeconomic and environmental vulnerability to climate change, climate variability and drought is reduced.

Strategic objective 2:
To improve the condition of affected ecosystems

Expected impact 2.2. The vulnerability of affected ecosystems to climate change, climate variability and drought is reduced.

Operational objective 5:
Financing and technology transfer

Outcome 5.2: Developed country Parties provide substantial, adequate, timely and predictable financial resources to support domestic initiatives to reverse and prevent desertification/land degradation and mitigate the effects of drought.

Table 18 (See Annex) shows the relation between strategic actions and the international environmental agreements most relevant for each action.

6.3 Financing

Financing for SAP strategic actions is expected to come from various international, regional and national sources, including South-South cooperation. Funding may be grants or loans, depending on the type of activity to be financed. The possibility of incorporating national public funds as counterpart contributions is also being considered. In the short term, the proposed strategy will seek financial support from multilateral agencies like the Global Environment Fund (GEF), World Bank, Inter-American Development Bank (IDB), Green Climate Fund (GCF), Andean Development Corporation (CAF), European Union (EU), China South-South Cooperation Climate Fund, among others. Cooperation from donor countries like Germany, Norway and Finland will also be sought to implement actions that the Member Countries consider priorities.


ACTO-GEF Amazon Project

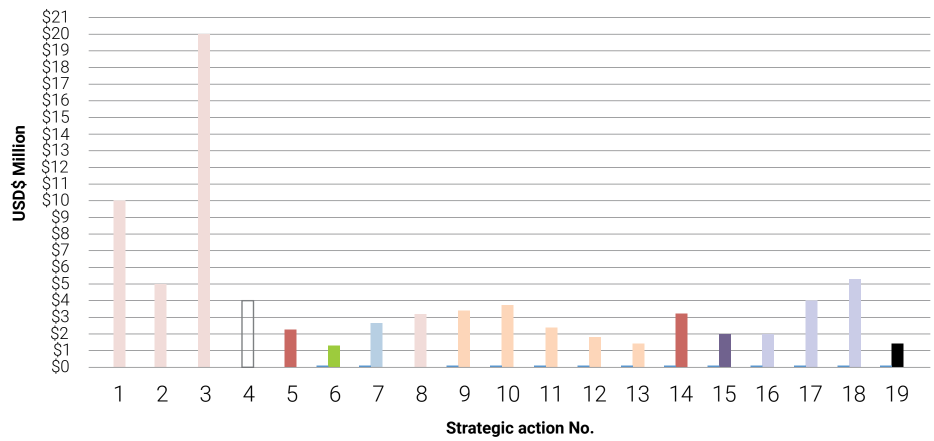
6.3.1 Budget

Based on the strategic actions contained in this document, the estimated budget to implement the SAP is US $80.3 million. Nevertheless, an effort will be made to investigate both direct and indirect counterpart contributions in the countries in the context of this financing strategy.

TABLE 17: BUDGET BY STRATEGIC ACTION

Transboundary Problem	Strategic Action	Estimated Costs (USD)
Water pollution	1. Implementing a regional water quality monitoring system for the rivers of the Amazon Basin.	$ 10.66 million
	2. Developing a groundwater use and protection program for public supply in the Amazon region.	$ 4 million
	3. Protecting, managing and monitoring aquifers in the Amazon river basins.	$ 20 million
Deforestation	4. Conserving and using water resources sustainably in the headwaters and lowlands of the Amazon Basin, where páramo and wetland ecosystems prevail.	$ 4 million
Loss of Biodiversity	5. Reducing the vulnerability of bioaquatic ecosystems of the Amazon Basin.	$ 2.12 million
Erosion, Sediment Transport and Sedimentation (ETS)	6. Monitoring erosion, sediment transport and sedimentation in the Amazon Basin to help mitigate negative effects and maximize positive ones.	$ 1.25 million
Land Use Change	7. Action program to respond to the impacts of current land occupation and land-use on water resources in the Amazon Basin.	$ 2.6 million
Extreme Hydroclimatic Events	8. Creating a regional hydrometeorological monitoring network in the Amazon Basin.	$ 3.3 million
	9. Creating systems to forecast and warn about extreme hydroclimatic events (droughts and floods).	$ 3.7 million
	10. Implementing a risk management model and increasing institutional adaptation to climate change in the Amazon Basin.	$ 2.4 million
	11. Developing and implementing the Integrated Monitoring System for Climate Change Vulnerability and Adaptation in the Amazon Basin.	$ 1.75 million
	12. Protecting coastal areas affected by rising sea levels.	$ 2.6 million
Loss of Glaciers	13. Developing and implementing adaptation measures to deal with glacier retreat in the Andes of the Amazon Basin.	$ 3.15 million
Developing an integrated regional information platform	14. Creating an integrated regional platform of information on water resources in the Amazon Basin.	$ 1.9 million
Strengthening Scientific Knowledge	15. Increasing scientific knowledge about water resources and topics relevant to the ACTO Amazonian Strategic Cooperation Agenda.	$ 1.95 million
	16. Establishing rainwater harvesting systems to provide safe water to isolated riverside communities of the Amazon Basin.	$ 3.92 million
	17. Implementing regional agrotechnology systems for terraced vegetable gardens and fisheries in floodplain forest communities.	$ 5.2 million
Regional Cultural and Educational Activities	18. Promoting and undertaking regional cultural, educational and artistic activities related to water resources and climate change in the Amazon Basin.	$ 2.6 million
Legal and Institutional Frameworks	19. Supporting the strengthening of institutional and management frameworks to improve water resources management.	$ 4.5 million
	TOTAL	$ 80.3 million

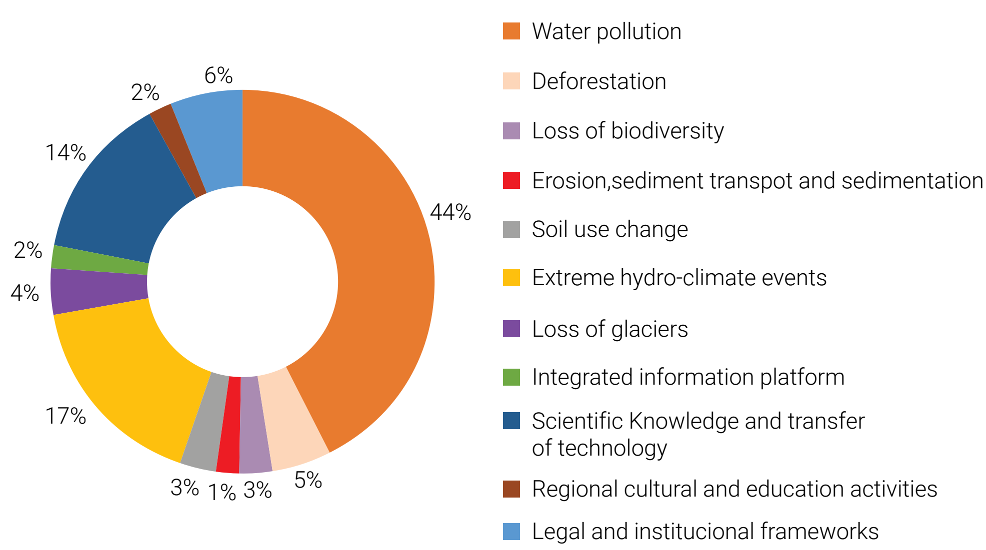
Graphic 10. Budget by Strategic Action (USD million)



Source: SAP.

The priority transboundary problem **water pollution** accounts for 41% of the total budget, followed by **extreme hydroclimatic events** (16%) and **strengthening scientific knowledge and technology transfer** (14%).

Graphic 11. Investments by Category of Transboundary Problem (Percentage)



Source: SAP.

6.3.2 Sources of Funding

In the context of the current international scenario and global mobilization to implement the 2030 Agenda for Sustainable Development, with goals to end poverty, provide clean water and sanitation, foster sustainable cities and communities, climate action, etc., the Strategic Action Program provides a great opportunity to build partnerships between Member Countries and, together with regional and global strategic partners, optimize resources to implement the strategic actions agreed and achieve the Sustainable Development Goals (SDG) in the Amazon Basin.

In this sense and in accordance with the guidelines established in ACTO's Long Term Funding Strategy, the organization contemplates the following funding arrangements: national counterpart funds from projects executed nationally, funding from public companies or mixed capital companies, triangular cooperation and international cooperation agencies. Donors offer a variety of credit lines aside from non-reimbursable cooperation, the most common ones being loans, credit and partial subsidies.

In the short term, the proposed strategy will try to raise funds from multilateral bodies: Global Environment Facility (GEF), European Union (EU) – Euroclimate, World Bank, Inter-American Development Bank (IDB), Green Climate Fund (GCF), Andean Development Corporation (CAF), KfW Development Bank, China South-South Climate Cooperation Fund, among others, as well as donor countries like Germany, Norway and Finland, to implement actions that the Member Countries consider priorities. At the same time, strategic actions will be cofinanced with national public funds to be identified in the Member Countries.

Nowadays, most countries have strategies, policies and plans for water resources and climate change adaptation. At the national level these instruments and policies are mostly implemented from each country's national budget, and in some cases with the participation of international partners. Implementing regional initiatives requires additional resources.

Overall Objective of the Financial Strategy

Mobilizing financial resources to implement the Strategic Action Program in the Amazon Basin.

Specific Objectives

1. Identifying financing sources and opportunities in Member Countries.
2. Identifying financing opportunities from international cooperation agencies.
3. Identifying innovative financing instruments and possible partnerships between governments, civil society and the private sector, adapted to the context of the Amazon Basin and the SAP.
4. Promoting the visibility of the SAP and ACTO.
5. Building and negotiating project concepts and proposals.
6. Obtaining resources to implement the strategic actions of the SAP.

Activities

- Identifying national counterpart funds from the public budgets of ACTO Member Countries for SAP thematic areas.
- Identifying potential donors, including information about their strategies, credit lines, areas of action, time horizon, project presentation and execution requirements, etc.
- Proposing innovative financing instruments and partnerships between governments, civil society and the private sector to implement the SAP.
- Preparing dissemination materials and publicity for the SAP, including a website, presentations, printed materials, etc.
- Meeting and visiting prospective donors.
- Preparing and presenting letters of intent to selected donors.
- Negotiating and following through on financial proposals.

Expected Outcomes

- Financing commitments and available funds for a portfolio of initiatives and projects developed to implement the strategic activities of the SAP.

Schedule

ACTIVITIES	YEAR 1				YEAR 2			
Identifying national counterpart funds from the public budgets of ACTO Member Countries for SAP thematic areas.								
Identifying potential donors, including information about their strategies, credit lines, areas of action, time horizon, project presentation and execution requirements, etc.								
Proposing innovative financing instruments and partnerships between governments, civil society and the private sector to implement the SAP.								
Preparing dissemination materials and publicity for the SAP, including a website, presentations, printed materials, etc.								
Meeting and visiting prospective donors.								
Preparing and presenting letters of intent to selected donors.								
Negotiating and following through on financial proposals.								


Rui Faquini

Potential donors to implement the SAP

Strategic Response Lines	Transboundary Problem	Strategic Actions	Potential donors
A) Strengthening IWRM	*I. Water pollution*	1. Implementing a regional water quality monitoring system for the rivers of the Amazon Basin. 2. Developing a groundwater use and protection program for public supply in the Amazon region. 3. Protecting, managing and monitoring aquifers in the Amazon river basins.	1. GEF, IDB, EU, World Bank, ANA. 2. GEF, IDB, World Bank, EU, KfW, ANA. 3. GEF, EU, World Bank, ANA.
	II. Deforestation	4. Conserving and using water resources sustainably in the headwaters and lowlands of the Amazon Basin, where páramo and wetland ecosystems prevail.	4. GEF, IDB, EU, World Bank, KfW, GIZ, ITTO, BNDES.
	III. Loss of Biodiversity	5. Reducing the vulnerability of bioaquatic ecosystems of the Amazon Basin.	5. GEF, IDB, World Bank, EU, KfW.
	IV. Erosion, Sediment Transport and Sedimentation (ETS)	6. Monitoring erosion, sediment transport and sedimentation in the Amazon Basin to help mitigate negative effects and maximize positive ones.	6. GEF, World Bank, KfW, ITTO, BNDES.
	V. Land Use Change	7. Action program to respond to the impacts of current land occupation and land-use on water resources in the Amazon Basin.	7. GEF, IDB, World Bank.

Strategic Response Lines	Transboundary Problem	Strategic Actions	Potential donors
B) Adaptation to Climate Change and Variability	*VII. Extreme Hydroclimatic Events*	8. Creating a hydrometeorological monitoring network in the Amazon Basin. 9. Creating systems to forecast and warn about extreme hydroclimatic events (droughts and floods). 10. Implementing a risk management model and increasing institutional adaptation to climate change in the Amazon Basin. 11. Developing and implementing the Integrated Monitoring System for Climate Change Vulnerability and Adaptation in the Amazon Basin. 12. Protecting coastal areas affected by rising sea levels.	9. GEF, ANA-Brazil, EU, IDB, World Bank, CAF, GCF, KfW. 10. GEF, EU, IDB, World Bank, CAF, GCF, KfW. 11. EU, IDB, World Bank, CAF, GCF, BNDES, KfW. 12. EU, IDB, World Bank, CAF, GCF, KfW. 13. GEF, EU, World Bank, CAF, GCF, KfW.
	VIII. Loss of Glaciers	13. Developing and implementing adaptation measures to deal with glacier retreat in the Andes of the Amazon Basin.	14. GEF, ANA-Peru, EU, GCF.
C) Knowledge Management	*IX. Developing an integrated information platform*	14. Creating an integrated regional platform of information on water resources in the Amazon Basin.	15. GEF, EU, World Bank, GCF.
	X. Strengthening Scientific Knowledge and Technology Transfer	15. Increasing scientific knowledge about water resources and topics relevant to the ACTO Amazonian Strategic Cooperation Agenda. 16. Establishing rainwater harvesting systems to provide safe water to isolated riverside communities of the Amazon Basin. 17. Implementing regional agrotechnology systems for terraced vegetable gardens and fisheries in floodplain forest communities.	16. EU, World Bank, GIZ, KfW. 17. EU, World Bank, GIZ, KfW. 18. EU, World Bank, KFW.
	XI. Regional Cultural and Educational Activities	18. Promoting and undertaking regional cultural, educational and artistic activities related to water resources and climate change in the Amazon Basin.	19. EU, World Bank, KfW.
	XII. Legal and Institutional Frameworks	19. Supporting the strengthening of institutional and management frameworks to improve water resources management.	20. GEF, EU, World Bank, KfW.

Estimated budget for the financial strategy US $65,000

6.4 Communication Strategies

A large number of local, national and international stakeholders will need to be informed of activities implemented under the SAP and progress therein. A strategic communication plan (SCP) will identify the different stakeholders (local populations, government representatives, international donors, etc.) and specify what information should be presented to each. To ensure broad dissemination, transparent processes and progress reports on the SAP objectives, the SCP will begin as soon as the SAP starts to be implemented. External partners (including donors) will also need to be kept informed and interested in the process, as well as made aware of other strategic actions that they are not financing.

6.5 Public Engagement

The efficiency of integrated water resources management (IWRM) in the Amazon Basin depends on strengthening technical and institutional capacities, but also on the participation of key stakeholders and Amazonian society in implementing the Strategic Action Program (SAP). In this context, the activity envisaged to achieve effective participation by the main stakeholders of Amazonian society, the Public Participation Plan (PPP), must reflect specific interests, different user groups and gender mainstreaming, which require different approaches, so that IWRM is representative and recognized by the Amazon people.

At the same time, making decisions based on public engagement requires taking into account the social and economic relations of the user community, their level of complexity and the population's quality of life. In this sense, at the outset information will be collected on the entities with legal responsibility and those that manage water resources in the Amazon countries, to provide legal support for the public engagement process and IWRM in the Amazon Basin.

Rui Faquini

Public or citizen participation in environmental planning and development processes were first introduced in Latin America based on the principles established in the Rio Declaration on Environment and Development (Rio Summit, 1992), recognizing that access to information, participation and justice in environmental matters are key elements to achieve environmental protection and sustainable development.

More than 20 years after Principle 10 of the Rio Declaration on Environment and Development was approved, there is a consensus that access to information, participation and justice in environmental matters are fundamental for transparency, equity and accountability in decision-making, forming the basis for environmental democracy and good governance. In addition, the body of evidence shows that citizen participation in decision-making can improve the quality and acceptance of decisions, and is a tool for poverty reduction. This recognition was reflected in the final document of the United Nations Conference on Sustainable Development (Rio+20), which states that broad public engagement and access to information and judicial and administrative proceedings are essential to promote sustainable development.

Based on these premises and conditions, the Public Participation Plan aims to create various forums for dialogue and interaction between social players and governments, to inform people of their right to participate and obtain information on the SAP, in addition to assessing and identifying actions and programs developed under the SAP in a context of consensus-seeking, so that social players can take ownership of the SAP as an instrument of their region and their land.

General and Specific Objectives of the PPP

The main goal of the Public Participation Plan is to create forums for dialogue, interaction and consensus with key stakeholders for integrated water resources management in the Amazon Basin. It will entail a process of mobilization and informed participation by collective social players in the basin, ensuring ownership of the SAP and providing a lasting and sustainable mechanism to implement IWRM through strategic actions agreed by the eight countries.

To achieve this overall objective, the following specific objectives will be pursued:

- Identifying the main social, public, private, cultural and religious players that can help to create an enabling public environment to implement the SAP in the Amazon and enact IWRM in the Amazon Basin.
- Identifying and executing public engagement actions and activities that reconcile IWRM objectives with the socioeconomic, cultural and environmental concerns of the Amazon people, taking advantage of opportunities, options and shared objectives.
- Establishing an efficient communication and information system to support public engagement agendas and activities.
- Strengthening stakeholders technically and operationally, to build permanent mechanisms to ensure rational use of water and integrated water resources management in the Amazon River Basin.
- Creating institutional opportunities to help communities participate in preserving the integrity of the basin's water resources, thus guaranteeing that IWRM remains sustainable.

To implement the PPP efficiently, activities will fall into three basic categories: 1) information exchange/ dissemination, 2) consultation and 3) workshops with Amazonian society stakeholders to share and implement SAP activities, with direct participation of the communities involved, etc.

In this context, the PPP will be organized in the following chapters: (i) the concept that upholds society's engagement in developing IWRM in accordance with the guidelines and bases established in each member country's national legal frameworks, (ii) foundations and principles of public participation, legal precepts that support social mobilization, the media and public participation in policy decisions in the Amazon, (iii) PPP guidelines, objectives, principles, strategy, costs and execution schedule, in synergy with SAP strategic actions, (iv) identifying and engaging the people involved in implementing the SAP, (v) monitoring and evaluation mechanisms.

6.6 Monitoring and Evaluation (M&E)

Developing and implementing an effective monitoring and evaluation plan for the SAP is an essential component that will be applied as soon as the SAP starts to be implemented. It will be coordinated by the PS/ACTO and each member country will report on national progress. The M&E plan must also meet the expectations of national and international donors, pursuant to their monitoring requirements for financed activities and general progress towards the SAP objectives. In addition, the M&E plan will provide important administrative information that will allow the PS/ACTO, the Regional Coordination Unit and national partners to make any adjustments needed in the SAP.

The plan will build upon the baselines obtained from the national and regional TDAs, and it will be done through two complementary processes: frequent monitoring of progress in the planned activities (within each strategic action) and regular evaluation of the SAP's impact on the environment and socioeconomic conditions of the Amazon people. Together, these evaluations will allow adjustments to be made as the strategic actions are implemented.

6.6.1 Indicators

To evaluate environmental projects, the monitoring and evaluation program will use, among others, the main types of indicators proposed by the Global Environment Fund (GEF), namely: (i) process, (ii) pressure, (iii) environmental state and (iv) socioeconomic conditions.

i. Process Indicators establish frameworks to improve the quality of the environment or quantity of resources to improve the state of an observed process.

Rui Faquini

ii. Pressure Indicators measure specific reductions in environmental stressors, like decreases in pollution discharge, more sustainable fishing practices, decreases in the introduction of invasive species in autochthonous ecosystems, increases in the number of protected areas, etc.
iii. Environmental State Indicators provide evidence of the state of the environment and water resources.
iv. Socioeconomic Indicators provide evidence of the population's socioeconomic situation.
v. Management Indicators
vi. Social and Environmental Impact Indicators

Guidelines and indicators to monitor the implementation of SAP actions will be developed and discussed in the context of implementing the SAP.

6.7 Institutional Arrangements/ Agreements

The operational execution of the SAP's implementation will be done through the PS/ACTO and existing cooperation mechanisms in the Amazon Basin, in close collaboration with the Member Countries, financing institutions and implementing agencies, as the case may be. SAP strategic actions will be implemented in stages, according to the regional priorities defined by the Member Countries and grouped by thematic implementation lines. National coordination will be led by national focal points designated by each member country, according to their abilities, and they will coordinate the process in the countries, promoting coordination with other stakeholders and/or national institutions responsible for each topic •

7 ACRONYMS AND ABBREVIATIONS

ACTO	Amazon Cooperation Treaty Organization
ALBA-TCP	Bolivarian Alliance for the People of our America - People's Trade Agreement
AMAZON FUND	Amazon Fund - Brazil
ANA	National Water Agency - Brazil
ANA	National Water Authority - Peru
BNDES	National Development Bank - Brazil
CAF	Andean Development Corporation
CAN	Andean Community of Nations
CC	Climate Change
CELAC	Community of Latin American and Caribbean States
EHSP	Program Environmental Health Surveillance System for the Amazon Region
EU	European Union
EUROCLIMATE	Regional Programme for Cooperation on Climate Change
GCF	Green Climate Fund
GEF	Global Environment Facility
IDB	Inter-American Development Bank
IIS	Integrated Information System of ACTO
INPE	Brazilian National Institute for Space Research
ITTO	International Tropical Timber Organization
IWRM	Integrated Water Resources Management
KFW	German Development Bank
MC	Member Countries of ACTO
MDG	Millennium Development Goals
MW	Megawatt
PAHO	Pan-American Health Organization
SAP	Strategic Action Program
SDG	Sustainable Development Goals
SENAGUA	Water Secretariat - Ecuador
SHD	Social Health Determinants
TDA	Transboundary Diagnostic Analysis
UBN	Unsatisfied Basic Needs
UN	United Nations
UNASUR	Union of South American Nations
UNDP	United Nations Development Programme
UN Environment	United Nations Environment Programme
WB	World Bank
WHO	World Health Organization


Rui Faquini

8 FOCAL POINTS OF THE PROJECT ACTO / UN ENVIRONMENT / GEF AMAZON

BOLIVIA

- Ministry of Foreign Affairs, Vice Minister, Amb. Juan Carlos Alurralde.
- Ministry of Foreign Affairs, Boundaries, Borders and International Transboundary Waters, General Director, Juan Carlos Segurola Tapia.
- Ministry of Foreign Affairs, Borders and Transboundary International Waters Unit, Head, Mayra Briseida Montero Castillo.
- Ministry of Environment and Water (MMAYA), General Director, Oscar Céspedes Montaño.

BRAZIL

- National Water Agency, Superintendency for Implementation of Programs and Projects-SIP, Superintendent, Ricardo Medeiros de Andrade.
- National Water Agency, Superintendency for Implementation of Programs and Projects - SIP, Deputy Superintendent, Tiberio Magalhães Pinheiro.
- National Water Agency, Superintendency for Implementation of Programs and Projects-SIP, Water Resources Specialist, Diana Leite Cavalcanti.
- Special acknowledgment to Mr Humberto Cardoso Gonçalves, co-manager of this regional initiative, Superintendent, Superintendency of Support and Implementation of the National System for Water Resources Management - SAS / SINGREH, National Water Agency.

COLOMBIA

- Ministry of Environment and Sustainable Development, Directorate of Integral Management of Water Resources, Technical Director, Luz Hicela Mosquera.
- Ministry of Environment and Sustainable Development, Directorate of Integral Management of Water Resources, Specialized Professional in Water Resources, Martha Cristina Barragán Acosta.
- Ministry of Environment and Sustainable Development, Office of International Affairs, Advisor for Borders and Subregional Organizations, Mauricio Molano Cruz.

ECUADOR

- Water Secretariat, Subsecretariat for Social Affairs and Articulation of Water Resource: Helder Ernesto Solís Carrión, Undersecretary.
- Director of Territorial and Intersectoral Articulation: Bertha Concepción Andrade Velasco.
- Technical Analyst of Water Resources: María Belén Benítez Carranco.

GUYANA

- Ministry of Public Works and Communication, Department: Work Service Group, Senior Engineer, Jermaine Braithwaite.
- Guyana Water Incorporated, Division Manager (Operations - DIV2), Marlon Daniels.

PERU

- National Water Authority: Eng. Abelardo De la Torre Villanueva, Chief.
- Director of Conservation and Planning of Water Resources: Eng. Paola Chinen Guima.
- Responsible for the Area of Management of Water Resources and Transboundary Basins: Eng. Adolfo Polidoro Toledo Parreño.
- Specialist in Water Resources Management in Transboundary Basins: Eng. Hanny María Quispe Guzmán.

SURINAME

- Ministry of Foreign Affairs, ACTO Focal Point, Marlena Wellis.

VENEZUELA

- People's Power Ministry for Foreign Affairs, ACTO Office, Office of Multilateral Affairs and Integration, Mariana Milagros Orta Osorio.
- People's Power Ministry for Ecosocialism and Water, General Directorate of Basins, General Director of Basins, Adrián Alberto León Cedeno.

ADT / SAP CONSULTANTS

National Consultants:

- National Consultant, Bolivia: Faunagua Association, AFA.
- National Consultant, Brazil: Naziano Pantoja Filizola Júnior
- National Consultant, Colombia: Gloria Inés Acevedo Arias.
- National Consultant, Ecuador: Guillermo Gallardo Estrella.
- National Consultant, Guyana: Paulette Bynoe.
- National Consultant, Peru: Percy Summers.
- National Consultant, Suriname: Tahnee Saerie.
- National Consultant, Venezuela: Guillermo A. Rey Avendaño.

Regional Consultants:

- Jorge Edwin Benites Agüero.
- Glauco Kimura de Freitas
- Marcos Aurélio Vasconcelos de Freitas
- Francisco Sánchez Otero
- Ximena Buitrón

9 BIBLIOGRAPHY

ACTO/CIIFEN, 2015. Final Report: Hydroclimatic Vulnerability Atlas, Ecuador.

ALBERT, J. S., REIS R. E. (2011B). Introduction to neo-tropical freshwaters. pp. 3-19 In.: Albert, J. S. & R. E. Reis (eds). *Historical biogeography of neo-tropical fishes*. Univ. California Press, Berkeley, 388p.

ALHO, C. (2014). *Projeto Gestão integrada e sustentável dos recursos hídricos transfronteiriços na bacia do Rio amazonas, considerando a variabilidade e mudança climática*. OTCA/GEF/PNUMA. Atividade I I.1.1 Melhorar o conhecimento dos ecossistemas aquáticos amazônicos. Atividade I I I.1.1 Manejo de ecossistemas aquáticos em *hotspots*. Relatório Final.

ANA – BRASIL. (2005). *Panorama da Qualidade das Águas Subterrâneas no Brasil*. Brasília, 80 p.

ANA - PERÚ. (2008). *Delimitación y codificación de unidades hidrográficas Sudamérica –Nivel 3. Informe Final*. Unión Internacional para la Conservación de la Naturaleza –IUCN; Comunidad Andina de Naciones –CAN; Agencia Española de Cooperación Internacional para el Desarrollo –AECI. Lima, Perú.

AUTORIDAD NACIONAL DEL AGUA-ANA/DGCRH. (2010). Dirección de Gestión de Calidad de los Recursos Hídricos/BCT. *Informe de las acciones de Vigilancia y Monitoreo de la Calidad del Agua en los ríos de Madre de Dios. Plan de Trabajo para la Vigilancia de la Calidad de Agua y Control de Descargas en los ríos de Madre de Dios*. Informe Técnico N 176 -2010. 26 p.

BARTHEM, R. B.; GUERRA, H; VALDERRAMA, M. (1995). *Diagnostico de los recursos hidrobiológicos de la Amazonia*. Tratado de Cooperación Amazónica, Lima, Perú.

BARTHEM, R.B.; GOULDING, M. (2007). *Um ecossistema inesperado: a Amazônia revelada pela pesca*. Amazon Conservation Association (ACA), Sociedade Civil Mamirauá, Belém, 241 pp.

BID, PNUD, TCA. (1992). *Amazonía sin mitos*. Banco Interamericano de Desarrollo (BID), Programa de las Naciones Unidas para el Desarrollo (PNUD), Tratado de Cooperación Amazónica (TCA), Washington, D.C., Estados Unidos.

BYNOE, P. AND P. WILLIAMS. (2007). *Draft report on Guyana study of biodiversity management in the Amazon*. Submitted to the OCTA Secretariat.

CALLÈDE, J., GUYOT, J. L., RONCHAIL, J., L'HÔTE, Y., NIEL, H., E DE OLIVEIRA, E. (2004). Evolution du débit de l'Amazone à Óbidos de 1903 à 1999. Evolution of the River Amazon's discharge at Óbidos from 1903 to 1999. *Hydrological Sciences Journal*, 49(1):85–97.

CALLÈDE, J., COCHONNEAU, G., ALVES, F. V., GUYOT, J.-L., GUIMARÃES, V. S., E DE OLIVEIRA, E. (2010). Les apports en eau de l'Amazone à l'océan Atlantique. *Revue des sciences de l'eau, Journal of Water Science*, 23(3):247–273.

CAN. (2008). *Delimitación y codificación de cuencas hidrográficas de Bolivia (aplicando la metodología de Pfafstetter)*. Comunidad Andina de Naciones, Secretaría General, Cartagena, Colombia.

CANDELA, J., BEARDSLEY, R.C., LIMEBURNER, R. (1992). Separation of tidal and sub-tidal currents in ship-mounted acoustic Doppler current profiles observations. *Journal of Geophysical Research*, 97: 769-788.

CASTRILLON FERNÁNDEZ, A. J. (2006). Tendências e mudanças da produção agropecuária e extrativista na Amazônia: uma análise do Censo Agropecuário 2006. In: SCHNEIDER, S.; FERREIRA, B.; ALVES, F. (Orgs.). *Aspectos Multidimensionais da Agricultura Brasileira - diferentes visões do Censo Agropecuário 2006*. Brasília: Ipea, 2014.

CELENTANO, D.; VERÍSSIMO, A. (2007). *O avanço da fronteira na Amazônia: do boom ao colapso*. – Belém, PA: Instituto do Homem e Meio Ambiente da Amazônia. 44p.; il.; 21,5 cm x 28 cm – (O Estado da Amazônia: indicadores, n.2). ISBN: 978-85-86212-19-2.

CEPAL. (2013). *Anuario Estadístico de América Latina y el Caribe*. Comisión Económica para América Latina y el Caribe. Santiago de Chile: (LC/G.2582-P) Publicación de las Naciones Unidas N° de venta: E/S.14.II.G.1.

CEPAL. (2014). CEPALSTAT. URL:

http://interwp.cepal.org/cepalstat/WEB_cepalstat/Perfil_nacional_social.asp?Pais=BOL&idioma=e

CEPAL. CELADE. (2014). *Los pueblos indígenas en América Latina. Avances en el último decenio y retos pendientes para la garantía de sus derechos. Síntesis*. Santiago, Chile.

CHAVES DE OLIVEIRA, P. (2015). *Projeto Gestão integrada e sustentável dos recursos hídricos transfronteiriços na bacia do Rio amazonas, considerando a variabilidade e mudança climática*.

OTCA/GEF/PNUMA SUBPROJETO III.1- Pilot Projects. Activity Nº III.1.2 - *Sustainable Management of Transboundary Floodplain Forests. Relatório final*. Santarém, Pará, Brasil.

CHONG ET AL. (2003). *Creación de una empresa exportadora de peces ornamentales*. Tesis. Escuela Superior Politécnica del Litoral -ESPOL. Guayaquil, Ecuador.

CIAT. (1993). *Desarrollo rural en la amazonia peruana*. Centro Internacional de Agricultura Tropical, International Food Policy Research Institute. Washington, D.C.: William M. Loker, Stephen Vosti. Cali, Colombia.

CUNHA, H. B., SIMÕES, C. A. (2000). Caracterização físico-químicas das águas do Rio Negro e seus tributários. In. IX *Jornada de Iniciação Científica*. Anais. Manaus- Amazonas, p. 325-329.

DAI, A., TRENBERTH, K. E. (2002). Estimates of freshwater discharge from continents: Latitudinal and seasonal variations. *Journal of Hydrometeorology*, 3, 660-687.

DE SOUZA, E.B.; KAYANO, M.T.; AMBRIZZI, T. (2004). The regional precipitation over the eastern Amazon/northeast Brazil modulated by tropical Pacific and Atlantic SST anomalies on weekly timescale. *Revista Brasileira de Meteorologia*, v. 19, n. 2, p. 113-122.

DHN-DIRETORIA DE HIDROGRAFIA E NAVEGAÇÃO. (2012). *Tábua das Marés para 2012 (Ilha de Mosqueiro e Ilha dos Guarás)*. Marinha do Brasil. Rio de Janeiro, Brasil.

EPA-ENVIRONMENTAL PROTECTION AGENCY. (2014). *Guyana's fifth national report to the convention on biological diversity*. Ministry of Natural Resources and the Environment. Funded by the Global Environment Facility. Georgetown. September 2014.

ESPINOZA J C., RONCHAIL J, GUYOT JL, JUNQUAS C, DRAPEAU G, MARTINEZ JM, SANTINI W, VAUCHEL P, LAVADO W, ORDOÑEZ J, ESPINOZA R. (2012). From drought to flooding: understanding the abrupt 2010–11 hydrological annual cycle in the Amazonas River and tributaries. *Environmental Research Letters*, 7.

ESPINOZA VILLAR, R., MARTINEZ, J.M., LE TEXIER M., GUYOT J.L., FRAIZY, P., MENESES P.R., DE OLIVEIRA, E. (2013). A study of sediment transport in the Madeira River, Brazil, using MODIS remote-sensing images. *Journal of South American Earth Sciences*, 44: 45-54.

ESPINOZA VILLAR J.C., MARENGO J.A., RONCHAIL J., MOLINA CARPIO J., NORIEGA FLORES L., GUYOT J.L. (2014). The extreme 2014 flood in South-Western Amazon basin: The role of Tropical-Subtropical South Atlantic SST gradient. *Environmental Research Letters*, 9: 124007.

ESPINOZA-VILLAR, J., RONCHAIL, J., GUYOT, J., COCHONNEAU, G., NAZIANO, F., LAVADO, W., VAUCHEL, P. (2009). Spatial-temporal rainfall variability in the Amazon basin countries (Brazil, Peru, Bolivia, Colombia, and Ecuador). *International Journal of Climatology*, 29, 1574-1594.

ESPINOZA J.C., GUYOT J.L., RONCHAIL J., COCHONNEAU G., FILIZOLA N., FRAIZY P., LABAT D., OLIVEIRA E., ORDONEZ J.J., VAUCHEL P. (2009). Contrasting regional discharge evolutions in the Amazon basin (1974-2004). *Journal of Hydrology*, 375(3-4): 297-311.

FAN. (2015). *Atlas de la diversidad de la Flora y Fauna de Bolivia*. URL: http://www.fan-bo.org/que-hacemos/ciencias/investigacion-sobre-biodiversidad/identificacion-de-patrones-geograficos-de-diversidad-biologica-a-escala-nacional-regional-o-de-paisaje/atlas-de-la-diversidad-de-la-flora-y-la-fauna-de-bolivia/ Retrieved September 2015.

FAO. (2008). Base de datos FAOSTAT. URL: faostat.fao.org. Retrieved April 2015.

FAO. (2013). *Cambio climático, pesca y acuicultura en América Latina. Potenciales impactos y desafíos para la adaptación*. Organización de las Naciones Unidas para la Alimentación y la Agricultura, Roma, Italia. URL: http://www.fao.org/docrep/018/i3356s/i3356s.pdf. Retrieved October 2015.

FILIZOLA, N. E GUYOT, J. L. (2011). Fluxo de sedimentos em suspensão nos rios da Amazônia. *Revista Brasileira de Geociências*, 41(4):566–576.

FILIZOLA, N. P. (1999). *O fluxo de sedimentos em suspensão nos rios da Amazônia brasileira*. Brasília, DF. ANEEL. 63 p.

FILIZOLA, N. P. (2003).*Transfert sédimentaire actuel par les fleuves amazoniens*. Thèse, UPS, Toulouse III, Toulouse. 273p.

FILIZOLA, N. P., & GUYOT, J. L. (2009). Suspended sediment yields in the Amazon basin: an assessment using the Brazilian national data set. *Hydrological Processes*, 23(22): 3207-3215.

FONSECA, C.A.; PATTI, J.R.; CAMPOS, E.J.D.; SILVEIRA, I.C.A. (2000). *Estudo Numérico dos Vórtices Emitidos pela Corrente Norte do Brasil*. Laboratório de Modelagem dos Oceanos. Lab. Instituto Oceanográfico da Universidade de São Paulo (IOUSP).

FORTI M. C., MELFI A. J., AMORIN P. R. N. (1991). Hidroquímica das águas de drenagem de uma pequena bacia hidrográfica no Nordeste da Amazônia (Estado de Amapá, Brasil): efeitos da sazonalidade. *Geochimica Brasiliensis*, 11(3): 311-340.

FURCH K. (1984). Water chemistry of the Amazon Basin: the distribution of chemical elements among freshwaters. In: Sioli, H. (ed.). *The Amazon Limnology and landscape ecology of a mighty tropical river and its basin*. Junk, Dordrecht: 167-169.

GARCÍA at al. (2000). *Balance anual sobre el estado de los ecosistemas y el ambiente de la Amazonia colombiana*. Instituto Amazónico de Investigaciones Científicas-Sinchi. 249 p.

GEYER, W.R.; BEARDSLEY, R.C.; LENTZ, S.J.; CANDELA, J.; LIMEBURNER, R.; JHONS, W.E.; CASTRO, B.M.; SOARES, I.D. (1996). Physical oceanography of the Amazon shelf. *Continental Shelf Research*, 16: 575-616.

GIBBS, R.J. (1967). The geochemistry of the Amazon River system. Part I. The factors that control the salinity and the composition and concentration of the suspended solids. *Geological Society of America Bulletin*, 78: 1203-1232.

GOULDING, M.; BARTHEM, R.; FERREIRA, E. (2003). *The Smithsonian Atlas of the Amazon*. Smithsonian Institution. 253p.

GUYOT, J. L., FILIZOLA, N., E LARAQUE, A. (2005). *Régime et bilan du flux sédimentaire de l'Amazone à Óbidos (Pará, Brésil) de 1995 à 2003. Sediment Budgets 1*. IAHS, (291):347.

HORBE A. M. C., GOMES I. L. F., MIRANDA S. A. F., SILVA M. S. R. (2005). Contribuição à Hidroquímica de drenagens no Município de Manaus - Amazonas. *Acta Amazônica*, 35:119-124.

ISA. (2006). URL: https://www.socioambiental.org/pt-br/o-isa/publicacoes/agenda-socioambiental-2006. Retrieved September 2014.

IAVH. (2002). *Información básica sobre el comercio mundial de peces ornamentales*. Instituto de Investigación de Recursos Biológicos Alexander von Humboldt, Bogotá, Colombia, 13 p.

IBGE (2006). Instituto Brasileiro de Geografia e Estatística. *Censo Agropecuário 2006*.

IBGE (2010). Instituto Brasileiro de Geografia e Estatística. URL: www.ibge.gov.br/. Retrieved April 2015.

IIAP. (2004). *Proyecto Diversidad Biológica de la Amazonia Peruana Fase II Componente 3 "Gestión local, manejo comunitario y desarrollo de alternativas económicas sostenibles en la Reserva Nacional Allpahuayo-Mishana RNAM y en el Jardín Botánico Arboretum El Huayo – JBAH, Cooperación Perú-Finlandia."*

INPE. (2008). *Monitoramento da floresta amazônica brasileira por satélite – Projeto PRODES*. Instituto Nacional de Pesquisas Espaciais.

INNOCENTINI, V.; PRADO, S.C.C.; PEREIRA, C.S.; ARANTES, F.O.; BRANDÃO, I.N. (2000). *Marulhos no Litoral Norte do Brasil geradas por furacões: Caso 24 de Outubro de 1999*. XI Congresso Brasileiro de Meteorologia de 16 A 20 de outubro. Rio de Janeiro: 10 p.

INSTITUTO NACIONAL DE ESTADISTICA E INFORMATICA PERÚ-INEI (2014). URL: https://www.inei.gob.pe/media/MenuRecursivo/publicaciones_digitales/Est/Lib1157/libro.pdf. Retrieved May 2015.

JUNK, W., PIEDADE, M., SCHÖNGART, J., COHN-HAFT, M., ADENEY, J., WITTMANN, F. (2011). A classification of major naturally occurring Amazonian lowland wetlands. *Wetlands* 31(4):623-640.

KONHAUSER K.O., FYFE W.S., KRONBERG B.I. (1994). Multi-element chemistry of some Amazonian waters and soils. *Chemical Geology*, 111:155-175.

LACERDA, L.D. (2010). *A Transferência de Matéria na Interface Continente - Oceano*. DVD. CNPQ/MCT.

LENTZ, S.J., (1995). The Amazon River plume during AMASSEDS sub-tidal current variability and the importance of wind forcing. *Journal of Geophysical Research*, 100 (C21): 2377-2390.

LEWIS, S.C., LEGRANDE, A.N., KELLEY, M., SCHMIDT, G.A.. (2010). Water vapor source impacts on oxygen isotope variability in tropical precipitation during Heinrich events. *Climate of the Past*. 6, 325–343: 10.5194/cp-6-325.

LIMEBURNER, R.; BEARDSLEY, R.C.; SOARES, I.D.; LENTZ, S.J.; CANDELA, J. (1995). Lagrangian flow observations of the Amazon river discharge into the North Atlantic. *Journal of Geophysical Research*, 100: 2401-2415.

MACEDO, M., CASTELLO L. (2015). *State of the Amazon: Freshwater Connectivity and Ecosystem Health*; edited by D. Oliveira, C. C. Maretti and S. Charity. Brasília, Brazil: WWF Living Amazon Initiative. 136 p.

MARENGO, J. A., TOMASELLA, J., ALVES, L. M., SOARES, W. R., & RODRIGUEZ, D. A. (2011). The drought of 2010 in the context of historical droughts in the Amazon region, *Geophysical Research Letters*, 38, L12703, doi:10.1029/2011GL047436.

MARENGO, J. A. (2004). Inter-decadal variability and trends of rainfall across the Amazon basin. *Theoretical and Applied Climatology*, 78, 79-96.

MARENGO, J. A., C. A. NOBRE. (2001). The Hydroclimatological framework in Amazonia, in *Biogeochemistry of Amazonia*, edited by J. Richey, M. McClaine, and R. Victoria, p. 1742.

MARENGO, J. A., LIEBMAN, B., FILIZOLA, N. P., WAINER, I. C. (2001). Onset and End of the Rainy Season in the Brazilian Amazon Basin. *Journal of Climate*, 14 (3), 833-852.

MARENGO, J. A., TOMASELLA, J., SOARES, W. R., ALVES, L. M., & NOBRE, C. A. (2012). Extreme climatic events in the Amazon basin. *Theoretical and Applied Climatology*, 107(1-2), 73-85.

MATSUYAMA, K. (1992). A Simple Model of Sectoral Adjustment, *Review of Economic Studies*, 59 (2): 375-387.

MAZZEO T.E. & RAMOS J.F.F. (1989). *A distribuição dos elementos Fe, Mn, Cu, Zn, Ni, Cr e Hg nas drenagens de Belém*, Pará. In: Congresso Brasileiro de Geoquímica, 2., Rio de Janeiro. 1989. Anais. Rio de Janeiro, SBGq. pp. 287-293.

MAZZEO T.E. (1991). *Avaliação ambiental das vias de drenagens da Região Metropolitana de Belém (PA) quanto a distribuição dos elementos Ca, Cd, Cr, Cu, Fe, Hg, K, Mg, Mn, Na, Ni, Pb e Zn*. Belém, Universidade Federal do Pará, Centro de Geociências. 205p. Tese (Mestrado em Geoquímica). Curso de Pós-graduação em Geologia, Centro de Geociências, UFPA.

MEADE R.H. (1985). *Suspended sediment in the Amazon River and its tributaries in Brazil during 1982-84*, Open-File Report 85-0492, U.S. Geological Survey, Denver, Colorado.

MEADE, R.H., NORDIN, C.F., CURTIS, W.F., et al. (1979a). Sediment loads in the Amazon River, *Nature*, v. 278, n. 5700 (Mar): 161-163.

MILLIMAN, J.D.; SUMMERHAYES, C.P.; BARRETO, H.T. (1974). Contribuição ao Estudo de Material em Suspensão na Plataforma Continental do Amazonas. In *REMAC*, No. 5: 97-116.

MOLINIER M., K.J. CUCO, V.S. GUIMÃES. (1992). *Disponibilidade de água na bacia amazônica* em: 2° Symposium international des Études ambiantes en forêt. Forest 92, Rio de Janeiro, Brésil, 11 p.

NACIONES UNIDAS. (2005). *Las cuestiones indígenas. Los derechos humanos y las cuestiones indígenas. Informe del Relator Especial sobre la situación de los derechos humanos y las libertades fundamentales de los indígenas, Rodolfo Stavenhagen*. Comisión de Derechos Humanos. E/CN.4/2005/88.

NASCIMENTO F.S. & KURZWEIL H. (2001). "Distribution Of Trace Metals In Sediment Profiles Of The Guajará Estuary, North Brazil". Mitt. Österr. Miner. Gesellschaft - Austria.146: 493-495.

NASCIMENTO F.S., KURZWEIL H., WRUSS W., FENZL N. (2006). Cadmium in the Amazonian Guajará Estuary: distribution and mobilization. *Environmental Pollution,* 140 (1): 29-42.

NASCIMENTO, F. S. & FENZL, N. (1996). Distribution dynamics of metallic and organic pollutants in bottom sediments of the main drainage canals of Guajará Estuary, Belem, Brazil. In: *Environmental Geochemistry in Tropical Countries* (1996). 2nd. International Symposium, Cartagena Columbia:

NASCIMENTO, F. S. & FENZL, N. (1997). Geoquímica de metais pesados em sedimentos do Rio Guamá e dos principais canais de drenagem de Belém, *Pa. Acta Amazônica*, 27 (4): 257-268

NASCIMENTO, F. S. (1995). *Dinâmica da distribuição dos poluentes metálicos e orgânicos nos sedimentos de fundo dos canais de drenagem de Belém*, PA. Belém, Universidade Federal do Pará, Centro de Geociências. 127 p. Tese (Mestrado em Geoquímica). Curso de Pós-Graduação em Geologia, Centro de Geociências, UFPA.

NASCIMENTO, F. S. (2000). *Distribution of trace metals in sediment profile of the Guajará Estuary, North Brazil*. Dissertation zur Erlangung des akademischen Grades Doctor rerum naturalium an der Formal- und Naturwissenschaftlichen Fakultät der Universität Wien. 141 p.

NASCIMENTO, F. S., FENZL, N., AUGUSTIN-GYURITS, K., KRALIK, M. (2011). Seasonal variation of trace metals in the metropolitan estuarine drainage canals of Belém, Amazonia, Brazil. *SIGES 2011 - I Simpósio de Informática e Geotecnologia de Santarém*. De 17 a 21 de outubro. Santarém – Pará – Brasil.

NEIFF, J.J., IRIONDO, M.H.; CARIGNAN, R. (1994). Large Tropical South American Wetlands: An Overview. In: LINK, G. L. and NEIMAN, R. L. (eds), *Proceedings of the Ecology and Management of Aquatic-Terrestrial Eco tones*: 156-165. Seattle 14-19, WA, USA: University of Washington.

OEA/UNESCO (2006). IV Taller de Coordinación sobre Acuíferos Transfronterizos. (Programa Unesco / OEA ISARM Américas). San Salvador, El Salvador 20- 22 de noviembre de 2006.

OEA-ISARM) Américas acuíferos transfronterizos de las Américas 4º taller de coordinación San Salvador, El Salvador 20- 22 de noviembre de 2006.

OROZCO MONTÚA, C. A. *El concepto de río continuo*. URL: https://es.slideshare.net/carlosorozco68/el-concepto-de-rio-continuo. Retrieved March 21, 2017.

OTCA. (2008). *Propuesta de mecanismo de cooperación para el monitoreo y control del tráfico de fauna y flora silvestres en la región amazónica. Fortalecimiento de la Gestión Regional Conjunta para el Aprovechamiento Sostenible de la Biodiversidad Amazónica*. Organización del Tratado de Cooperación Amazónica. Proyecto ATN/oc-9251-rg. 2008.

OTCA. (2012). *Plano Estratégico da Organização do Tratado de Cooperação Amazônica (2004 – 2012*), Brasília , setembro 2004 (DOC/ XII CCA-OTCA/04).

PANNÉ, HUIDOBRO, S. Y LUCHINI, L. (2008). *Panorama actual del comercio internacional de peces ornamentales*. Dirección de Acuicultura. Secretaría de Agricultura, Ganadería, Pesca y Alimentos. Buenos Aires, Argentina. URL: www.nuestromar.gob.pe/noticias. Retrieved March 14, 2015.

PEDROSA, C. A., CAETANO, F. A. (2002). Águas Subterrâneas. ANA - Superintendência de Informações Hidrológicas – SIH. Brasília, Agosto/, 85 p.

PETERS, C., GENTRY, A., MENDELSOHN, R. (1989). Valuation of an Amazonian Rainforest. *Nature*, 339: 655-656.

PNUD. (2014). *Informe sobre Desarrollo Humano 2014*. Programa de las Naciones Unidas para el Desarrollo, Nueva York, Estados Unidos. URL: http://hdr.undp.org/es/content/el-%C3%ADndice-de-desarrollo-humano-idh. Retrieved November 21, 2014.

PNUMA/OTCA. (2008). *Geo-Amazonía. Perspectivas de Medio Ambiente en la Amazonía*. Programa de Naciones Unidas para el Medio Ambiente y Organización del Tratado de Cooperación Amazónica, en colaboración con el Centro de Investigación de la Universidad del Pacífico (CIUP). 323 p.

PNUMA/CATHALAC. (2010). *Atlas de un ambiente en transformación. América Latina y el Caribe*. Programa de las Naciones Unidas para el Medio Ambiente, Centro de Aguas del Trópico Húmedo para América Latina y el Caribe, Panamá. URL: www.cathalac.org. Retrieved October 3, 2014.

QUEIROZ M., HORBE A. M. C, SEYLER P., MOURA C. A. V. (2009). Hidroquímica do rio Solimões na região entre Manacapuru e Alvarães - Amazonas – Brasil. *Acta Amazônica*. vol. 39 no. 4, Manaus.

RAISG. (2012). *Amazonía bajo presión*. 68 p. (www.raisg.socioambiental.org). URL:

http://raisg.socioambiental.org/system/files/AmazoniaBajoPresion_21_03_2013.pdf. Retrieved March 10, 2014.

RICHARDSON, P.L.; ARNAULT, S.; GARZOLI, S.; BROWN, W.S. (1994). North Brazil Current Retroflection Eddies. *Journal of Geophysical Research*, Vol. 99, No. 6: 997-1014.

RICHEY, J. E. et al. (1986). Water discharge and suspended sediment concentrations in the Amazon River: 1982-1984. *Water Resources Research,* 22: 756-764.

RUIZ S.L., SÁNCHEZ E., TABARES E., PRIETO A., ARIAS J.C., GÓMEZ R., CASTELLANOS D.,

GARCÍA P., RODRÍGUEZ L. (EDS). (2007). *Diversidad biológica y cultural del Sur de la Amazonia colombiana – Diagnóstico*. Corpoamazonia, Instituto Humboldt, Instituto Sinchi, UAESPNN, Bogotá D.C. – Colombia. 636 p.

RUTTER, A. (1990). *Catálogo de plantas útiles de la Amazonía peruana*. ILV. Lima, Perú.

SALATI, E. et al. (1990). *Amazonia. The Earth as Transformed by Human Action*. Cambridge University Press, New York.

SANTOS, U. M., RIBEIRO, M. N. G. (1988). A Hidroquímica do rio Solimões-AM. *Acta Amazônica*, 18 (3-4): 145-172.

SIOLI H. (1960). Pesquisas imunológicas na região da Estrada de Ferro de Bragança, Estado do Pará–Brasil. *Boletim Técnico do Instituto Agronômico do Norte*, (37): 1-73.

SIOLI H. (1968). Hydrochemistry and Geology in the Brazilian Amazon Region. *Amazoniana*, 3: 267-277.

SIOLI, H., (1984). *The Amazon: Limnology and landscape ecology of a mighty tropical river and its basin*. s. l.: Dr. W. Junk Publishers: 761 p.

SIOLI, H.; KLINGE, H. (1962). Solos, típicos de vegetação e águas na Amazônia. *Amazoniana*, 1: 27-41.

STALLARD, R. F., EDMOND, J. M. (1983). Geochemistry of the Amazon. 2. The influence of geology and weathering environment on the dissolved load. *Journal of Geophysical Research*, 88: 9671-9688.

STERNADT, G.H., TERNADT, G.H. AND CAMARGOS, J. (1988). Novas perspectivas de utilização da cor da madeira amazônica e seu aproveitamento comercial. *Brasil Florestal,* 65: 16-24.

TUNDISI, J.G., (1994). Tropical South America: Present and perspectives. In: MARGALEF, R. (Ed.). *Limnology Now: A paradigm of Planetary Problems*. Amsterdam: Elsevier: 353-424.

VANNOTE, R.L., MINSHALL, K. W. CUMMINS, J.R. SEDELL, E., GUSHING G. W. (1980). The river continuum concept. *Canadian Journal of Fisheries and Aquatic Sciences*, 37: 130-137.

VASQUEZ R.,; GENTRY A.H.. (1989) Use and Misuse of Forest-harvested Fruits in the Iquitos Area. *Conservation Biology*, Volume 3, Issue 4: 350–361.

VEIGA, M.M.; MEECH, J.A.; OÑATES, N.(1994). Mercury Pollution from Deforestation. *Nature*, V. 368: 816- 817.

VITTOR, GILMAN, TIELSCH, GLASS Y SHIELDS. (2006). The effect of deforestation on the human-biting rate of *Anopheles darlingi*, the primary vector of Falciparum malaria in the Peruvian Amazon, *American Journal of Tropical Medicine and Hygiene*, Jan; 74 (1): 3-11.

WALKER I. (1987). The biology of streams as part of Amazonian forest ecology. *Experientiae*, 73: 279-287.

WWF (2000). *Global Eco-regions*. URL: http://www.worldwildlife.org/science/wildfinder. Ret September 15, 2015.

WWF. (2010). ¡Amazônia viva! Una década de descubrimientos: 1999-2009. URL: http://www.scribd.com/doc/40457738/Amazonia-Viva-Una-decada-de-descubrimientos-1999-2009#scribd y http://wwf.panda.org/es/nuestro_trabajo/iniciativas_globales/amazonia/. Retrieved June 26, 2015.

Rui Faquini

10 ANNEXES

Rui Faquini

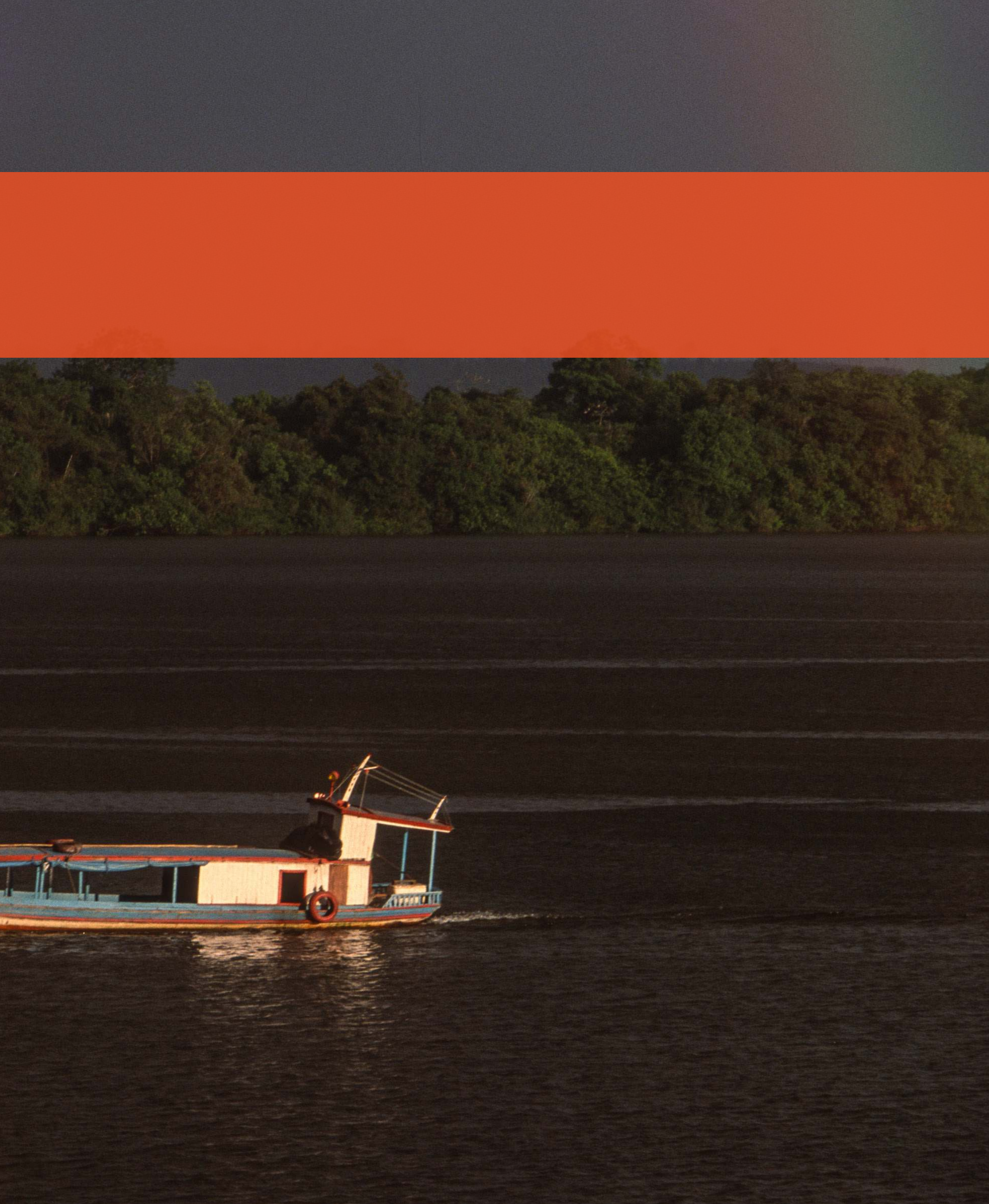


TABLE 18: STRATEGIC ACTIONS AND MAIN INTERNATIONAL ENVIRONMENTAL AGREEMENTS

PROBLEM TRANSBOUNDARY	STRATEGIC ACTION	SUSTAINABLE DEVELOPMENT GOALS (SDG)	CONVENTION ON BIOLOGICAL DIVERSITY	CONVENTION TO COMBAT DESERTIFICATION
Water pollution	1. Implementing a regional water quality monitoring system for the rivers of the Amazon Basin.	SDG 6 – WATER AND SANITATION Targets 6.3 and 6.5	Aichi Target 8	Operational objective 3 Outcome 3.1
	2. Developing a groundwater use and protection program for public supply in the Amazon region.	SDG 6 – WATER AND SANITATION Targets 6.1 and 6.4	Strategic Objective D: Target 14	
	3. Protecting, managing and monitoring aquifers in the Amazon river basins.	SDG 6 – WATER AND SANITATION Target 6.6	Strategic Objective D: Target 14	Strategic objective 2 expected impact 2.1
Deforestation	4. Conserving and using water resources sustainably in the headwaters and lowlands of the Amazon Basin, where páramo and wetland ecosystems prevail.	SDG 6 – WATER AND SANITATION Target 6.6	Aichi Target 14 Aichi Target 7 Target Aichi 3 Strategic Goal 1	Strategic objective 2 Expected impact 2.1 and 2.2
Loss of Biodiversity	5. Reducing the vulnerability of bioaquatic ecosystems of the Amazon Basin.	SDG 6 – WATER AND SANITATION Target 6.6	Aichi Target 6 Aichi sub-goal 2.1. Aichi Strategic Goal 1	Strategic objective 2 Expected impact 2.2
Erosion, Sediment Transport and Sedimentation	6. Monitoring erosion, sediment transport and sedimentation in the Amazon Basin to help mitigate negative effects and maximize positive ones.	SDG 6 – WATER AND SANITATION Target 6.3	Aichi Target 8	Operational objective 3 Outcome 3.1
Land Use Change	7. Action program to respond to the impacts of current land occupation and land-use on water resources in the Amazon Basin.	SDG 6 – WATER AND SANITATION Target 6.5		
Extreme Hydroclimatic Events	8. Creating a regional hydrometeorological monitoring network in the Amazon Basin.	SDG 13 – CLIMATE CHANGE Target 13.1		Operational objective 3 Outcome 3.1
	9. Creating systems to forecast and warn about extreme hydroclimatic events (droughts and floods)	SDG 13 – CLIMATE CHANGE Target 13.3		Operational objective 3 Outcome 3.1
	10. Implementing a risk management model and increasing institutional adaptation to climate change in the Amazon Basin.	SDG 13 – CLIMATE CHANGE target 13.3		Strategic objective 1 Expected impact 2.1.
	11. Developing and implementing the Integrated Monitoring System for Climate Change Vulnerability and Adaptation in the Amazon Basin.	SDG 13 – CLIMATE CHANGE Target 13.5		Operational objective 3 Outcome 3.1
	12. Protecting coastal areas affected by rising sea levels.	SDG 14 – OCEANS Target 14.2	Strategic Objective B. Target 10.	

TABLE 18: STRATEGIC ACTIONS AND MAIN INTERNATIONAL ENVIRONMENTAL AGREEMENTS

PROBLEM TRANSBOUNDARY	STRATEGIC ACTION	SUSTAINABLE DEVELOPMENT GOALS (SDG)	CONVENTION ON BIOLOGICAL DIVERSITY	CONVENTION TO COMBAT DESERTIFICATION
Loss of Glaciers	13. Developing and implementing adaptation measures to deal with glacier retreat in the Andes of the Amazon Basin.	SDG 6, 13 Targets 6.1 and 13.1.		
Developing an integrated regional information platform	14. Creating an integrated regional platform of information on water resources in the Amazon Basin.	SDG 6 – WATER AND SANITATION Target 6.5		Operational objective 3 Outcome 3.1
Strengthening Scientific Knowledge	15. Increasing scientific knowledge about water resources and topics relevant to the ACTO Amazonian Strategic Cooperation Agenda.	SDG 6 – WATER AND SANITATION Target 6.5	Aichi Target 1	
	16. Establishing rainwater harvesting systems (RHS) to provide safe water to isolated riverside communities of the Amazon Basin.	SDG 6 – WATER AND SANITATION Target 6.7 and 6.8		Operational objective 5 Outcome 5.2
	17. Implementing regional agrotechnology systems for terraced vegetable gardens and fisheries in floodplain forest communities.	SDG 2 and 6 Targets 2.3 and 6.8		Strategic objective 1 Expected impact 1.1
Regional Cultural and Educational Activities	18. Promoting and undertaking cultural, educational and artistic activities related to water resources and climate change in the Amazon Basin.	SDG 13 and 4 Targets 13.3 and 4.7	Aichi Target 6	
Legal and Institutional Frameworks	19. Supporting the strengthening of institutional and management frameworks to improve water resources management.	SDG 6 – WATER AND SANITATION		

Source: Legislation from ACTO Member Countries, SDG 2015.

Bolivia Brazil Colombia Ecuador Guyana Peru Suriname Venezuela

Amazon Cooperation Treaty Organization

SHIS - QI 05. Conjunto 16, casa 21
Lago Sul - Brasília - DF Brazil
CEP: 71615-160
Telephone number: 55 61 3248-4119/4132 - Fax: 55 61 3248-4238

www.otca-oficial.info

ISBN 978-85-61873-17-2