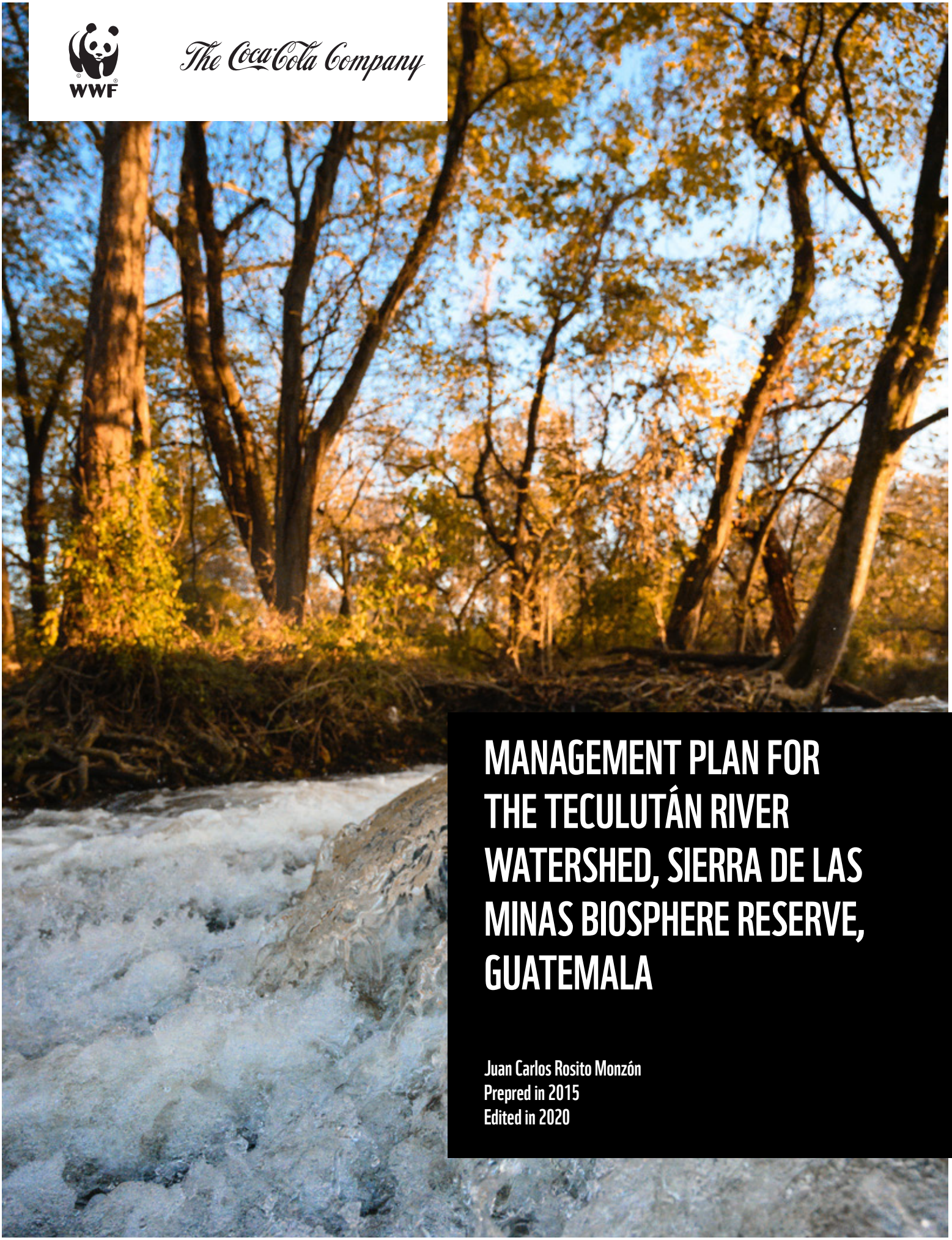
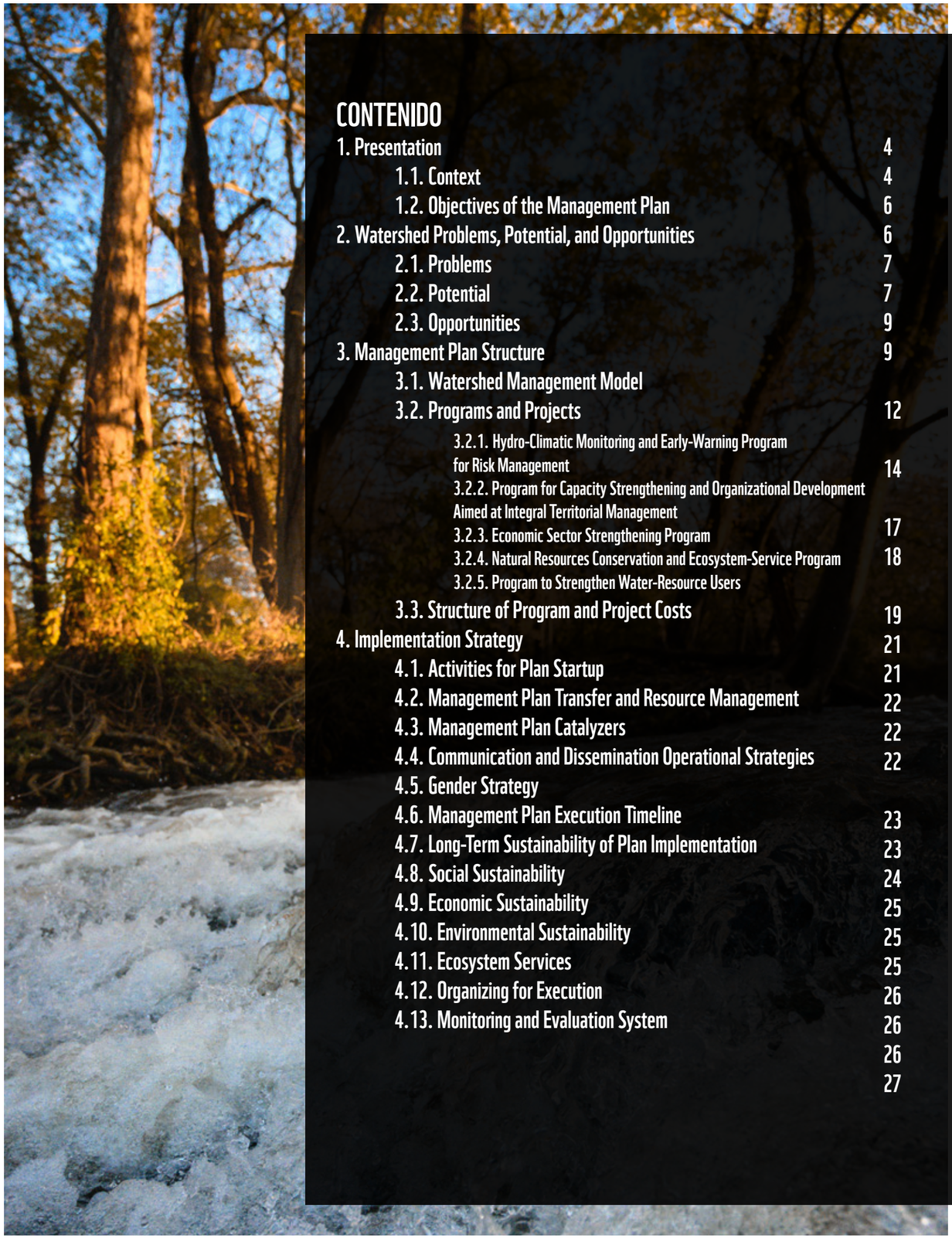


MANAGEMENT PLAN FOR THE TECULUTÁN RIVER WATERSHED, SIERRA DE LAS MINAS BIOSPHERE RESERVE, GUATEMALA

Juan Carlos Rosito Monzón
Prepred in 2015
Edited in 2020



CONTENIDO

MANAGEMENT PLAN FOR THE TECULUTÁN RIVER WATERSHED, SIERRA DE LAS MINAS BIOSPHERE RESERVE, GUATEMALA

Juan Carlos Rosito Monzón

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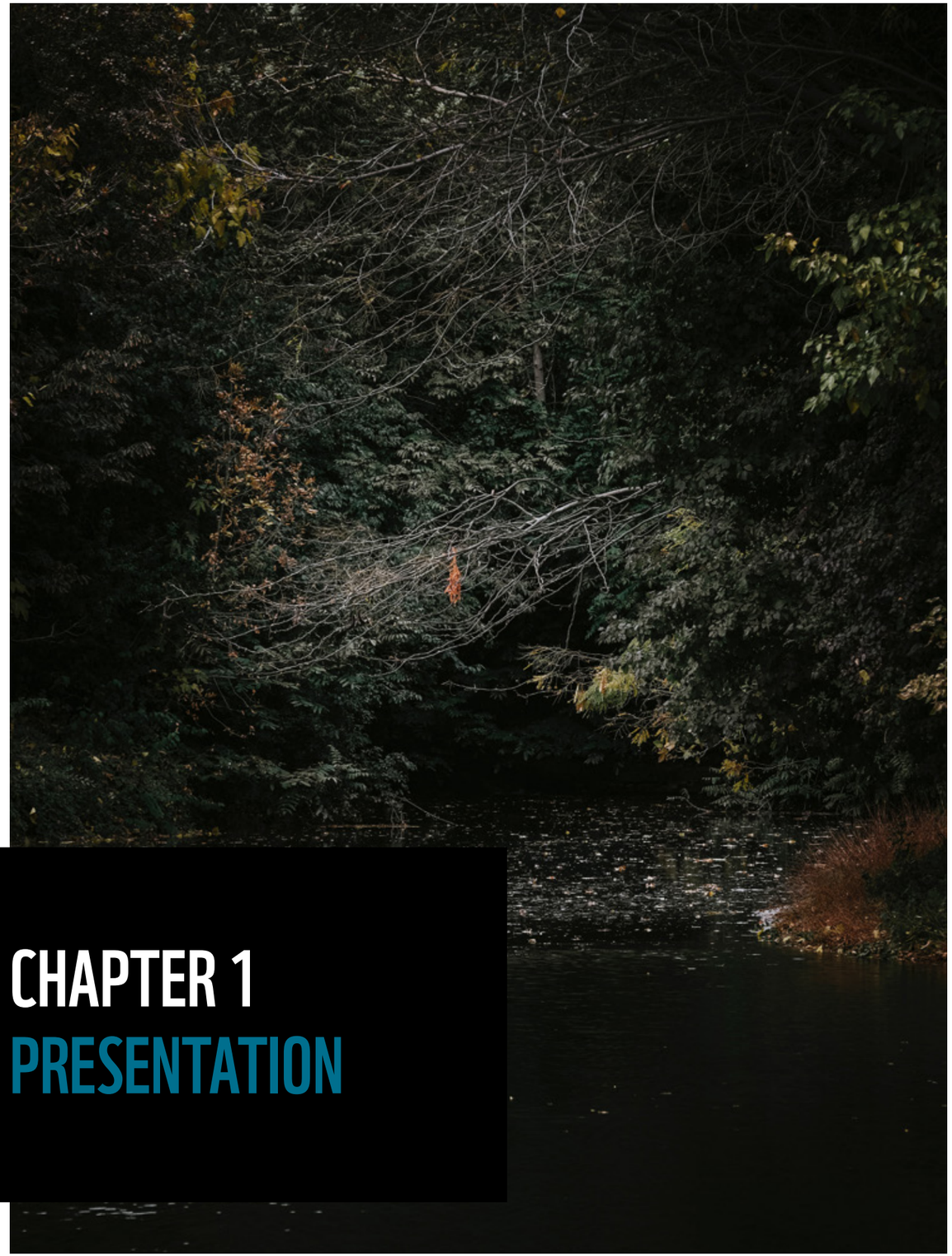


CHAPTER 1
PRESENTATION

1.1 Context

The Teculután river watershed is located mainly in the municipality of Teculután in the department of Zacapa, in the eastern part of the country.

This sub-watershed feeds into the Motagua river and it is one of its tributaries. It also shares its south slope with the Sierra de las Minas mountain range. The most important populated area in the watershed is the municipal capital, Teculután, which is located 28 kilometers from the departmental capital of Zacapa. Furthermore, the middle and upper reaches of the watershed are located in the core zone, the recovery zone, and the buffer zone of the Reserva de la Biósfera Sierra de las Minas (Sierra de las Minas Biosphere Reserve–RBSM in Spanish), which stands out because of its biodiversity and the source of several rivers that feed into the Motagua valley.

The expanse of the Teculután river watershed is divided mainly into the departmental territory of Zacapa and El Progreso. In Zacapa, it is located in the municipalities of Teculután, with an area of 17,701 hectares (177.01 km2, 82%) and Usumatlán, with an area of 977 hectares (9.77 km2, 5%). In the department of El Progreso, it covers 2.207 hectares (22.07 km2, 10%), which correspond to the municipalities of San Agustín Acasaguastlán, and San Cristóbal Acasaguastlán, with an area of 459 hectares (4.59 km2). It spans a total of 21,626 hectares (216.26 km2)[1].

[1]There are other municipalities (Río Hondo, Purulhá, Santa Catalina La Tinta and Panzós) with less area, representing 1.30% of the total sub-watershed area.

Municipalities	Area (ha)	Area %
Teculután	17,701.24	81.85
San Agustín Acasaguastlán	2,206.74	10.20
Usumatlán	976.94	4.52
San Cristóbal Acasaguastlán	459.42	2.12
Río Hondo	152.16	0.70
Purulhá	58.36	0.27
Santa Catalina La Tinta	45.65	0.21
Panzós	25.90	0.12
TOTAL	**21,626.41**	**100.00**

Elevations range from 200 to 2,900 meters above sea level. According to the records of recent years, its average flow is 2,454.74 liters per second (l/s), with a specific flow of 11.01 l/s/m2, and a forest cover of 12,158 ha (56 % of the total area) recorded for the year 2016. In addition, the total length of its rivers is 46,455.715 meters.

Six life zones are present in the Teculután sub-watershed: tropical montane rainforest (bp-MT 2%), tropical low montane very humid forest (bmh-MBT 53%), tropical premontane very humid forest (bmh-PMT 21%), tropical premontane humid forest (bh-PMT 11%) and tropical premontane dry forest (bs-PMT 1%) and tropical dry forest (bs-T 12%).

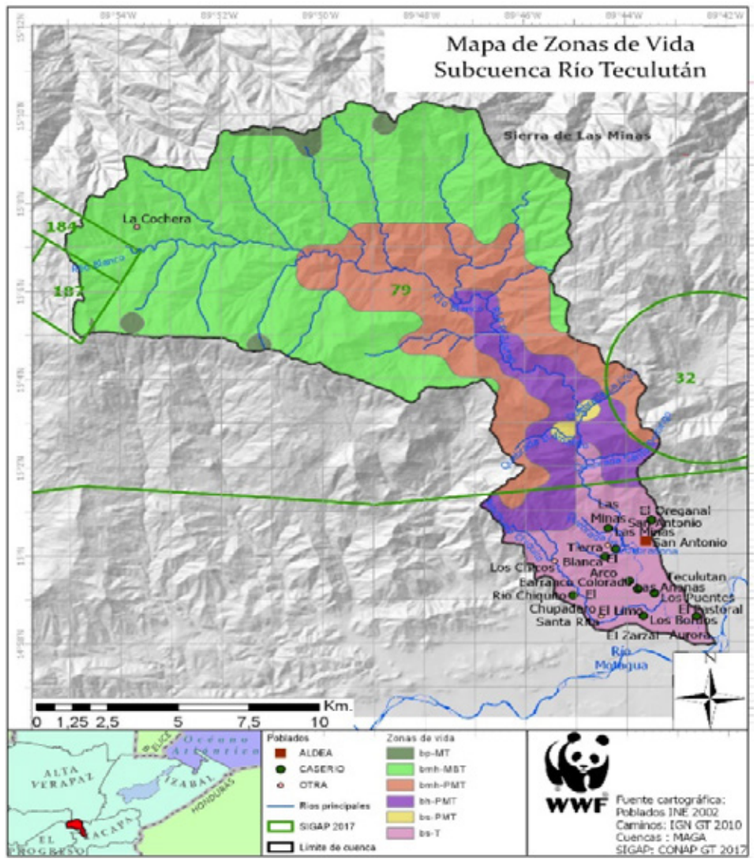


Figure 1. Zones of Life Map in the Teculután River Sub-Watershed

Eleven drinking water systems depend on the Teculután sub-watershed. According to Defensores de la Naturaleza staff, water is also tapped for 26 irrigation intakes throughout the municipality and neighboring municipalities. This defines the Teculután sub-watershed as one of the most important in the eastern region of Guatemala.

The sub-watershed is sub-divided into nine micro-watersheds, of which six are vital (69% of the entire sub-watershed), as they are in the core and recovery zones (upper part), where the largest forest cover of the sub-watershed is located (core zone). It guarantees water catchment, regulation, and recharge. Land use capacity indicates that the sub-watershed can support forest-protection activities in 75% of its area.

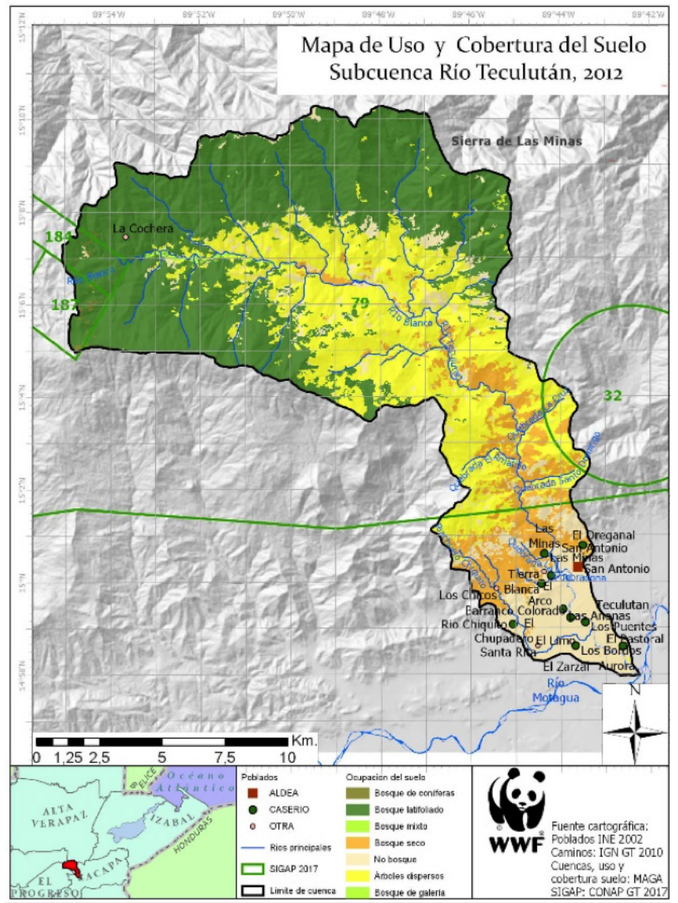


Figure 2. Land Use and Soil Coverage in the Teculután River Sub-Watershed.

However, the sub-watershed has areas devoid of forest cover, which has a negative effect on the productive conservation of the soil, mainly the loss of its infiltration capacity. This results in an increase in the rate of surface runoff, which, in turn, causes an increase in nutrient transport and soil erosion. The degradation of the natural resources of the sub-watershed, due to the populated areas located inside and outside the sub-watershed, is causing environmental problems. These affect the quality and quantity of surface water and other natural resources, and leads to underutilization of the comparative advantages of the sub-watershed.

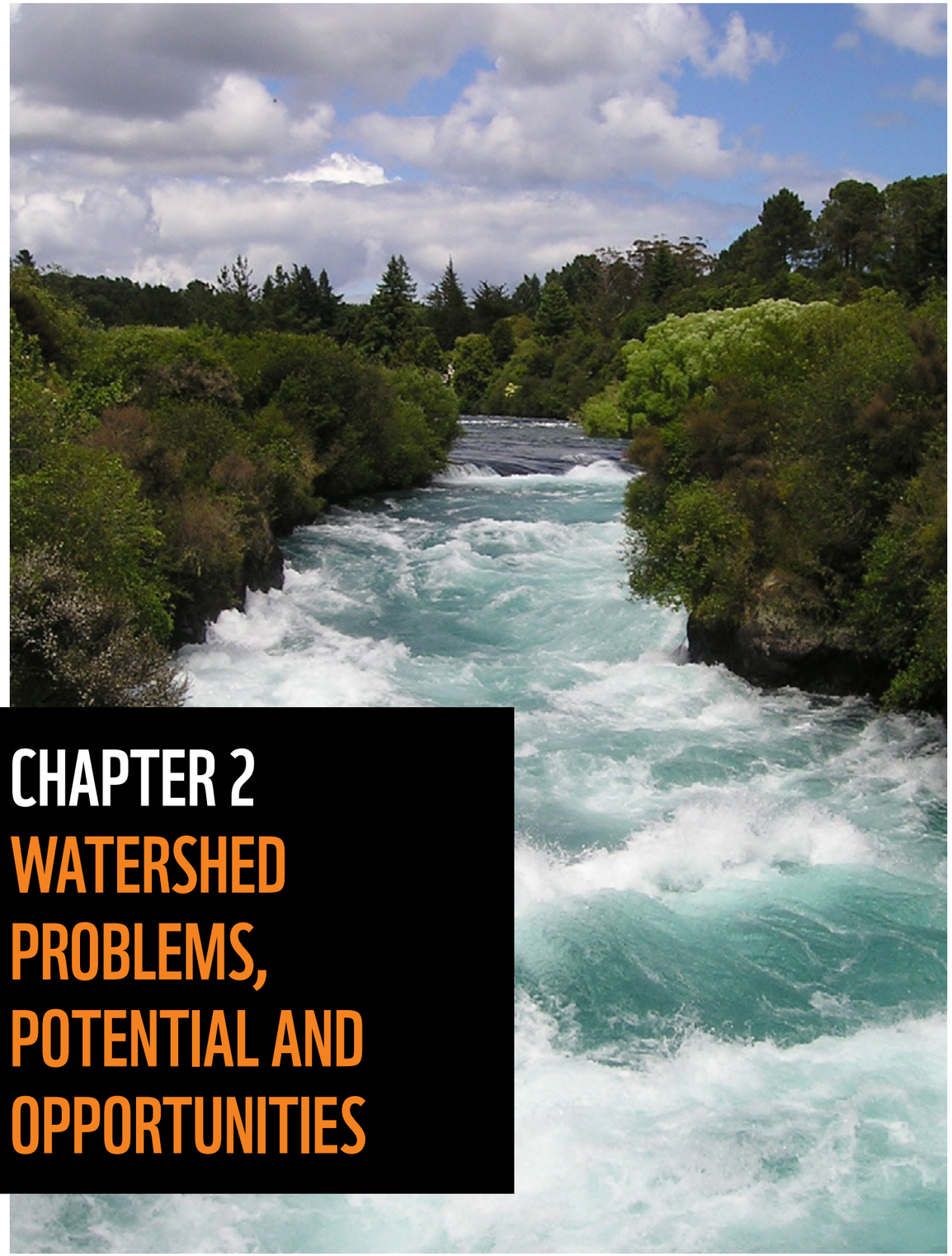
Thus, it is necessary to develop a Management Plan that integrates and organizes the relevant actions to achieve both the adequate development of the population and the sustainability and conservation of natural resources and the natural heritage.

1.2 Objectives of the Management Plan

A 10-year Management Plan for the Teculután sub-watershed will be prepared and implemented, with the active participation of central Government entities, non-government organizations, municipal governments, COCODES, and other local organizations.

The purpose of this plan is to have all the actors engaged in managing the sub-watershed coordinate all the planning, execution, and assessment of water, soil and biodiversity resource conservation and sustainability actions efficiently, and also generate norms and technical and financial instruments to undertake the integral management of the territory of the Teculután sub-watershed and its area of influence.

It is expected that the sub-watershed can become a model for the region and for all of Guatemala as to the harmonization of the natural and social heritage and the production matrix, in order to improve the quality of life of all inhabitants continually and sustainably. In addition, the model is expected to effectively promote high-quality environmental processes and risk management, with an emphasis on extreme weather events.



CHAPTER 2
WATERSHED PROBLEMS, POTENTIAL AND OPPORTUNITIES

2.1 Problems

The management plan proposes alternative solutions to mitigate or solve the problems in the sub-watershed. Based on the diagnosis of the Teculután river sub-watershed and the consultation with focus groups and experts on the subject, a list of the problems has been developed, condensed by topics:

1. High levels and continuous increase of risk, especially linked to climate change and deterioration of water resources, such as droughts, storms, landslides, change in rainfall patterns, and contamination.
2. Considerable social conflict, lack of capacities and poor institutional leadership for the integrated management of water resources and the territory, which generate conflict.
3. Underdevelopment of economic sectors, inefficient and unsustainable use of renewable natural resources (soil, forest, and water), and underutilization of comparative advantages in the sub-watershed.
4. Accelerated degradation of the natural heritage and ecosystem services in the sub-watershed, such as an increase in fires, lack of restoration and protection initiatives, and the advance of the agricultural frontier.
5. Poor management of water resources, especially unequal access to water and its inefficient and unsustainable use, which includes a range of adverse situations.

2.2 Potential

Potential has been identified throughout the sub-watershed, both for conservation and for socioeconomic and institutional development. Several activities that can contribute to the solution of the previously-identified problems are proposed to achieve sustainable development in the sub-watershed.

1. Sites with scenic, forestry, fruit, tourism, and conservation potential.
2. Diversified field-work knowledge.
3. Labor availability.
4. Existence of community and producer organizations.
5. Strategic location for commercial, tourist, and production flows.
6. Presence of government institutions that cooperate in environmental and conservation issues.
7. Increased demand for efficient use of water resources and an increase in recreational sites.
8. Presence of companies with high economic power.
9. Presence of local and government institutions involved in water management.

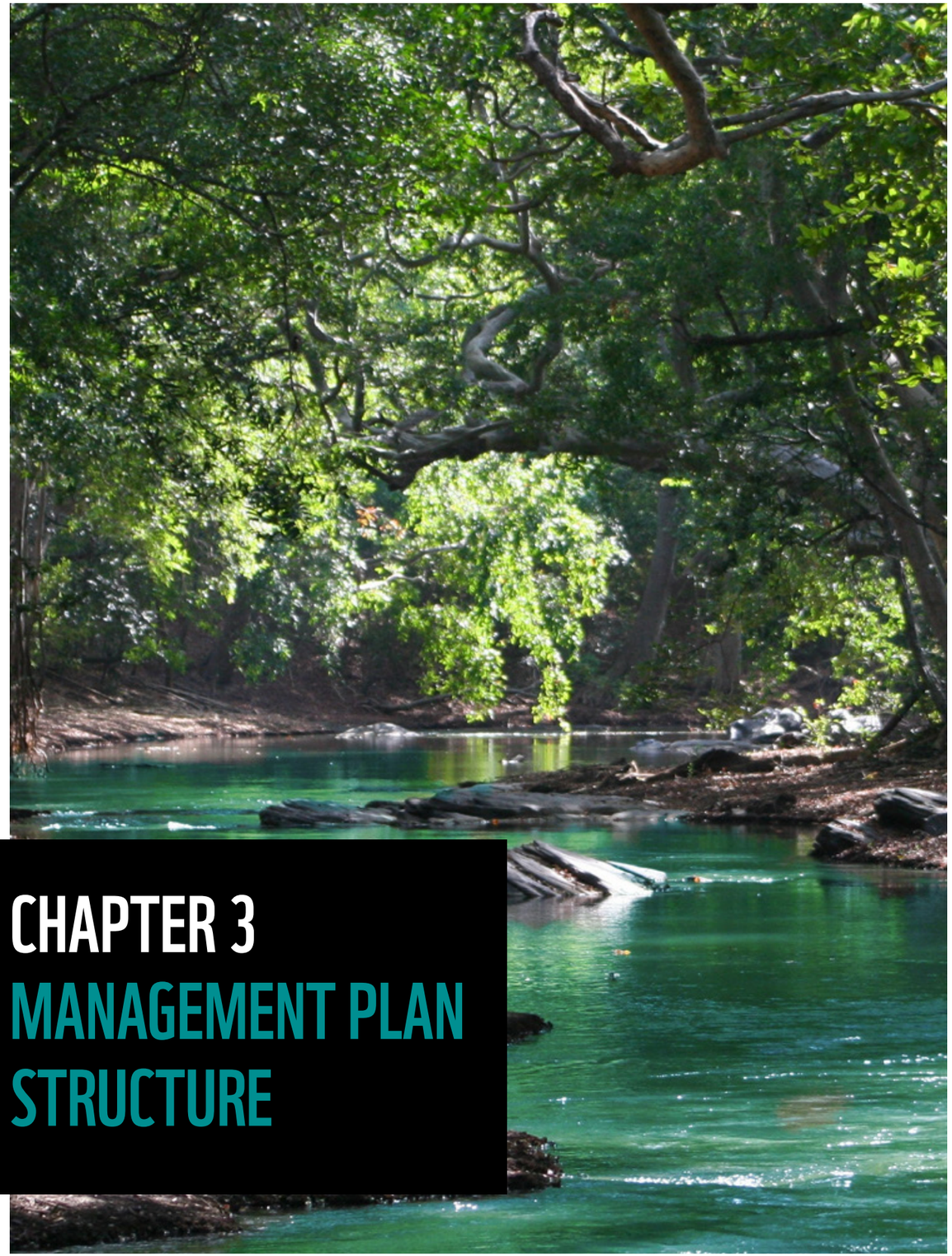
2.3 Opportunities

Based on the potential, the following opportunities covering the entire watershed were identified, as well as the pertinent proposals to take advantage of them.

Productive technification, landscape value, using natural resources, and land-use planning are elements that will contribute to the conservation and sustainable development of the sub-watershed.

1.Developing agricultural value chains, mainly fruit.
2. Diversifying agricultural production.
3. Agricultural and rural ecotourism; cultural, natural and landscape heritage sites close to those who demand these services (Guatemala City and other large towns).
4. Carbon sales.
5. Market options for differentiated products.
6. High agricultural production.
7. Possible development of a biological corridor.

Based on the analysis of the problems, the potential, and the opportunities, a management model was proposed, including priority projects that contribute to the development of the Management Plan.



CHAPTER 3
MANAGEMENT PLAN STRUCTURE

3.1 Watershed Management Model

The management model for the Teculután sub-watershed seeks to integrate efforts and actors, as well as to create concepts and approaches, such as the shared vision of the territory, in accordance with the identity, relevance, and participation, aimed at common interests and the need to undertake cooperative and integration processes.

The model is based on both biophysical (natural) and socioeconomic elements, such as climate, geology, and soil characteristics; land-use capacity; conservation areas; water recharge zones; current land use; land-use conflicts, and vulnerable zones, among other variables. It also considers the active participation of the entities in charge of the Sierra de Las Minas Biosphere Reserve, such as CONAP and Fundación Defensores de la Naturaleza (FDN). FDN has been the administrator of the Sierra de las Minas Biosphere Reserve since 1990.

The Management Plan considers climate as a determining factor for many of the actions proposed for the sub-watershed and it is part of risk management, integrating climate variability and environmental deterioration. In this regard, it is essential that local actors develop leadership, capacities, and initiative to guarantee the flow of sub-watershed ecosystem services in relation to the risks.

The management model encourages participation as a process of joint and collaborative actions among entities such as COCODES, CONAP, FDN, local authorities, resource users and NGOs, with the aim of generating and strengthening capacities and using resources efficiently, at different times (Figure 1). For this purpose, it is essential to be aware of how natural systems function and to generate adequate local policies and financial instruments. The management model proposes empowering the Unidad de Gestión Ambiental Municipal (Municipal Environmental Management Unit–UGAM in Spanish), and COCODES, in order to strengthen organization at every level, with the aim of promoting sustainability.

In terms of the territory, zoning for the watershed establishes that the upper and middle reaches are protected areas. However, institutions and their capacities are very weak due to the lack of resources. That is why the model proposes FDN to lead capacity training and strengthening of institutions and local actors on this and other related topics for a period of six years. FDN is well known for its conservation efforts and the administration of the RBSM protected area, and furthermore, it has credibility with authorities and other national and international actors due to its good environmental management in the area. In addition, FDN will lead the creation of a governing body in the sub-watershed.

The management model needs investments or financial resources. The productive projects proposed in the Management Plan should be profitable, and thus, they should be linked to economic strategies to achieve returns on the investments in resource recovery, rehabilitation and/or protection.

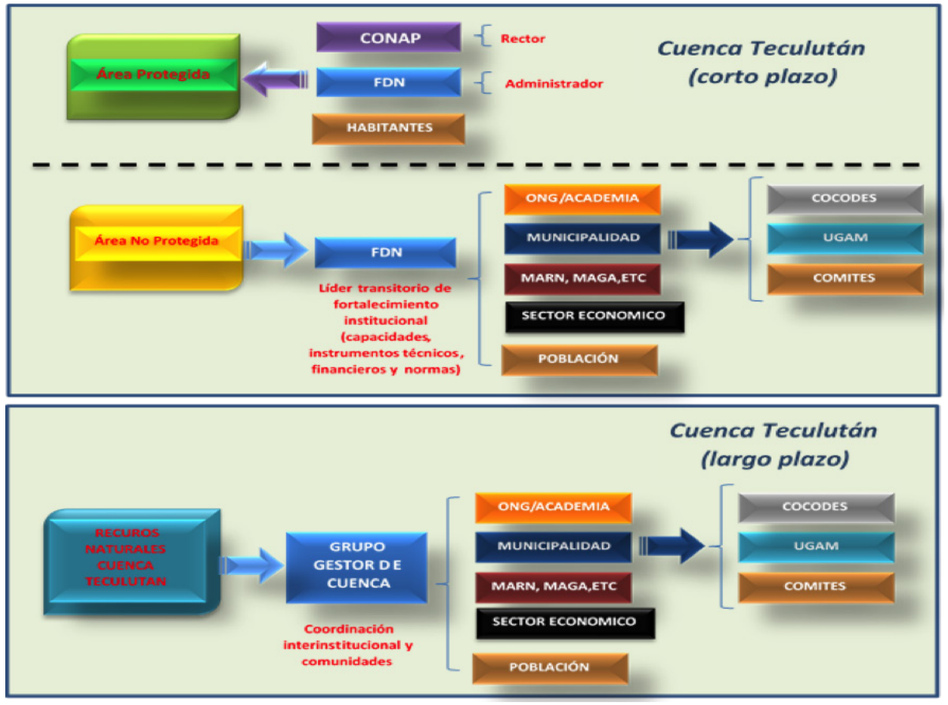


Figure 3. Institutional Management Model for the Teculután Watershed

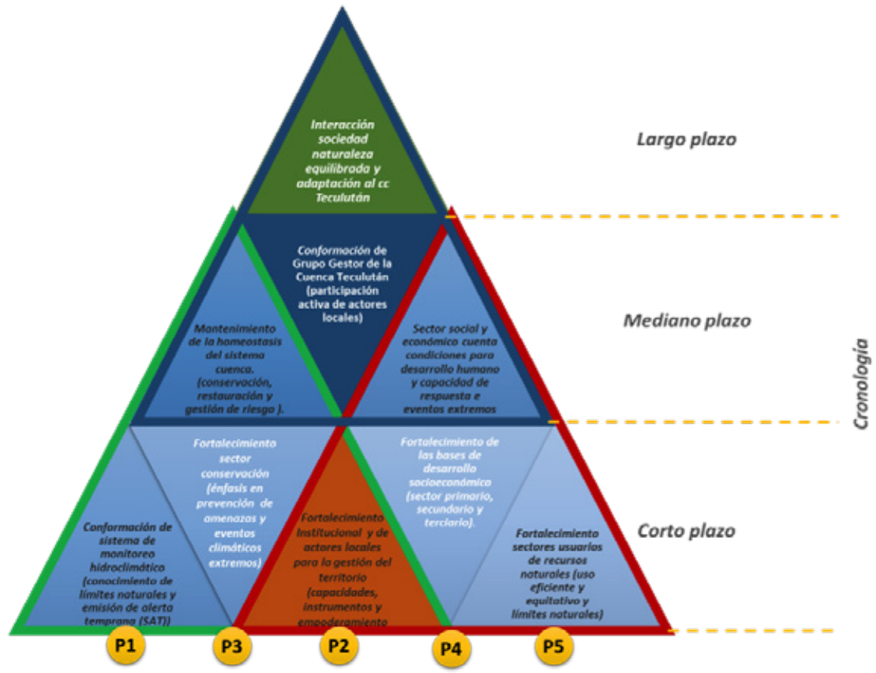
3.2 Programs and Projects

The proposal for programs and projects has been developed based on the participative diagnosis and the technical analysis, which considers territorial planning and the quality of natural resources, and the use of water and soils as determining factors to structure the Sub-Watershed Management Plan.

The Management Plan is composed of five programs that, in turn, include various projects, presented, and organized by common objectives, administrative issues, goals, monitoring, control and evaluation.

The projects for each program respond to concrete problems. A technical profile has been developed for each project. It presents action plans, activities, location, main actors, goals, and inasmuch as possible, the costs and benefits of each project.

Figure 3 illustrates the chronology of these five programs and the development of the projects at different times. It is expected that important results will be obtained in the medium term in the areas of agriculture, the use of natural resources, and conservation, based on changes in land use, investments in the production systems and coherent decisions among key actors and decision makers.



3.2.1 Hydro-Climatic Monitoring and Early-Warning Program for Risk Management

RISK MANAGEMENT

Risk management is defined as the process to identify, analyze, and quantify the probability of losses and secondary effects deriving from disasters, as well as the corresponding preventive, corrective and reductive actions that should be undertaken. It is important to understand the concepts of risk, vulnerability, and natural threat illustrated in Figure 5.

Figure 5. Risk Analysis Diagram Based on Threats and Vulnerability

The integral approach to risk management highlights the measures before and after events, and it depends essentially on: (a) identifying and analyzing risks; (b) devising and applying prevention and mitigation measures; (c) introducing financial protection by transferring or retaining risk, and (d) undertaking the preparatory work and actions for the subsequent consideration, rehabilitation, and reconstruction phases. The risks present in the Teculután river sub-watershed are the following:

A. Disasters Related to the Weather. Intense droughts and rains, with inter-annual frequency, associated with climate change, which impact supplies of drinking water and water for irrigation. In 1998, Hurricane Mitch caused damage to agriculture, infrastructure, and the riverbed. Teculután was one of the places most affected by the hurricane. Deforestation is a factor in both drought and runoff erosion during extreme rains. Although drought does not pose significant risk for the upper and middle zones of the watershed, it does pose potential risk to the lower zone, which must be addressed in the short term. The decrease in river flow could generate potential conflicts among the different users.

B. Disasters Unrelated to the Weather. Two types of disasters unrelated to the weather have been identified in the area: earthquakes and landslides. The most intense earthquake was recorded in 1976. It registered a magnitude of 7.5 on the Richter scale and it originated in the Motagua fault. This earthquake caused severe damage to the water system and the buildings then existing. Currently, there are about 100 minor earthquakes per year in the country; therefore, the risk of these events occurring is high.

Landslides on the mountain slopes where the sub-watershed is located have been caused by both intense rains and earthquakes. These are the reasons why water sources, springs and conveyance lines are at risk of partial destruction. However, after Hurricane Mitch, rains have not caused any damage to the drinking water systems, so the risk of damages to the system as a result of flooding is low. It is important to mention that the Teculután sub-watershed is constituted by numerous slopes that produce landslides. The zones with the steepest slopes are located mainly in the middle and high reaches of the watershed, essentially in the areas near the riverbeds with permanent and intermittent flows.

Early Warning System (SAT in Spanish)

The primary objective of an early warning system is to equip people and communities with the capabilities to respond in a timely and appropriate manner to weather hazards and threats, in order to reduce the risk of death and property damage. Warnings should send a clear message and encourage those at risk to act. Effective early warning systems must integrate at least six key elements:

1. **People-centered.** For alerts to be effective they must have not only a scientific and technical basis, but also be centered mainly on the people exposed to the risk. In addition, it is essential that emergency managers and the media be involved, so that the information being disseminated is clear, accessible, opportune, and relevant to the measures.
2. **Knowledge about the risks.** The climate monitoring systems should gather information and perform a systematic analysis of the risks, aiming to develop a database, especially on the past and present extreme meteorological phenomena, considering the dynamics of hazards and vulnerabilities arising from the socioeconomic conditions and the changing environment. The climate monitoring systems used in risk-management planning should establish collaboration methods to ensure the effective exchange of information among severe hazard databases to facilitate monitoring, assessment, and prediction.
3. **Risk Evaluations and Maps** help to establish priorities for the early-warning systems and constitute a guide for disaster prevention preparations and the corresponding response.
4. **Monitoring and Alert Services** The monitoring and alert services are a fundamental component of the system. It is necessary to have a robust base to predict and prevent threats and to have a trustworthy forecast and alert system that works 24 hours a day. In addition, in order to prepare precise and timely alerts, it is essential to engage in constant monitoring of parameters and events that have preceded the hazards.
5. **Dissemination and Communication** Clear messages with simple and useful information are needed for alerts to reach the greatest number of people in danger, thus generating adequate responses that help to save lives and livelihoods. It is necessary to define communication channels at the regional, national, and local levels.
6. **Response Capacity.** Education and preparation programs play an essential role for communities to understand the risk that they face, heed the alert service, and know how to react. Similarly, it is essential to have previously tested disaster-management plans. The population should be informed about safe behavior, the escape routes that are available, and the best way to prevent property damage and loss.

3.2.1.1 Objective of the Hydro-Climatic Monitoring and Early- Warning Program for Risk Management

The objective of the program is to generate information and create the mechanisms, structures, and relationships that are necessary to adequately manage risks, predict, deal with, and minimize them, carrying out the social process of risk management, with the purpose of offering protection to the population of the Teculután river sub-watershed, in addition to providing sustainable improvements to safety, wellbeing and quality of life and contributing to sustainable development. Risk management in the Teculután sub-watershed should engage the active participation of all local authorities, government entities, international institutions, and community organizations for the program to be successful.

3.2.1.2 Brief Description of the Projects Included in the Program

Project 1. Preparing a Risk Map and a Risk Diagnosis

The objective of the project is to prepare a risk map, a participative diagnosis and a compilation of historical climate and hydrological information to identify threats, vulnerabilities, and risks in each zone of the sub-watershed and reduce their social and economic impact. This will be done by seeking appropriate technical assistance from the corresponding entities to train the various local actors and to hold periodic meetings to generate the diagnosis and the participative plan. The project will be implemented in all the areas of the sub-watershed, during a period of 10 years, at a cost of US$50,000.

Project 2. Creating a Risk and Emergency Management Committee

The objectives of the project are to increase the response capabilities of local actors to minimize the impact of vulnerabilities, risks, and natural hazards, and to establish, plan, and execute corrective and preventive actions to increase the response capabilities of all actors in the event of a natural phenomenon or hazard. This will be achieved by creating an Emergency Committee for the Teculután river sub-watershed, in addition to providing it with the necessary equipment and constant training. The project will be implemented in all areas of the sub-watershed during a period of 10 years, at a cost of US$95,000.

Project 3. Creating a Monitoring, Alert Issuance, and Emergency Communication Sub-System

The objective of the project is to create, establish, and implement warning, surveillance, and alarm systems that will enable timely corrective and preventive actions. The design of the warning, surveillance, and alarm systems will be undertaken jointly with the sub-watershed Emergency Committee. In addition, the parameters and variables to be monitored will be defined. They will constitute the activators of the warning, surveillance, and alarm system. The project will be implemented in all watershed areas during a period of 10 years, at a cost of US$200,000.

3.2.2. Program for Capacity Strengthening and Organizational Development Aimed at Integral Territorial Management

According to the Teculután Municipal Government Census, there are 18 communities located in the watershed, with a population of 13,044 inhabitants. This population is complemented by the Río Chiquito community in the municipality of Usumatlán, which is part of the watershed, with a population of 582 inhabitants. Combined, both populated areas total 13,626 inhabitants. In the lower part of the Teculután sub-watershed, there are many new settlements, whose inhabitants will demand water supply in the future. On the other hand, it is interesting to mention that 76.68% of the watershed population over 7 years old is literate, and about 2.7% have university-level education, which is an advantage for this program.

There are several community-development and water-resource management organizations, although the Asociación Río Teculután Sierra de las Minas (Teculután River Sierra de las Minas Association–ARTSIM in Spanish) is considered the most important one. This association has strong coordination ties with the Ministry of the Environment and FDM. In order to achieve the changes proposed for the Teculután river sub-watershed, the project must rely on personnel that is open to change and that has the capacities to plan, manage, execute, negotiate, evaluate, communicate, and make decisions.

3.2.2.1 Objective of the Program for Capacity Strengthening and Organizational Development Aimed at Integral Territorial Management

The objective of this program is to ensure that local organizations and institutions working on different matters and issues related to the Teculután sub-watershed acquire the tools that they need to strengthen their organizations so that they are able to manage resources to implement the Management Plan that will benefit the families living in the watershed and contribute to the sustainability of natural resources.

3.2.2.2 Brief Description of the Projects Included in the Program

Project 1. Strengthening Capacities and Organizational Development

The objective of the project is to develop the capacities of the various institutions, local authorities, and community organizations to implement the Management Plan in the Teculután river sub-watershed. This will be accomplished by incorporating the Management Plan into the institutions involved, providing institutional training on how to manage natural resources, developing participative management mechanisms and integral coordination. The project will be implemented in populated centers of the sub-watershed during a period of 4 to 6 years, and at a cost of $20,000.

Project 2. Training on Liquid- and Solid-Waste Management

The objective of the project is to develop capacities for liquid- and solid-waste management and better practices to reduce water, soil, and air pollution in the sub-watershed. This will be done by identifying the people and entities that produce high pollutant discharge, providing training on waste management, and compiling environmental impact studies in the sub-watershed. The project will be implemented in the populated centers of the sub-watershed during a period of 2.5 years and at a cost of US$10,000.

Project 3. Training on Project Design, Evaluation, and Management

The objective of the project is to develop capacities to design, evaluate and manage projects in order to contribute with Management Plan implementation and the sustainability of natural-resource management actions in the sub-watershed. This will be accomplished through pertinent training. The project will be implemented in populated centers of the sub-watershed during a period of 2.5 years, at a cost of US$5,000.

Project 4. Training on the Legal Framework and Norms Related to the Environment

The objective of the project is to develop capacities on the legal framework and norms related to the environment, seeking to contribute to the sustainable natural-resource management in the sub-watershed. This will be accomplished by means of training that will be managed with the relevant institutions, involving other entities that are linked to environmental laws pertaining to natural resources and productive elements, and by engaging UGAM directly.

Project 5. Compulsory Environmental Education Course Included in the Curricula

The objective of the project is to have a course on environmental education included in the curricula of the basic- or diversified-cycle of secondary education. The Ministry of Education will be approached to present to them the need to include this course in the curricula and establish an inter-institutional organization to design, develop and implement a pilot plan for the course. The project will be implemented in populated centers of the sub-watershed during a period of 5 years, at a cost of US$100,000.

3.2.3. Economic Sector Strengthening Program

This program addresses the problems relating to the agricultural / livestock and forest problems that have been identified in the sub-watershed, whose characteristics include low socioeconomic development. Broadly, almost 60% of the overall watershed area does not have any type of forest cover, and agricultural crop, pastures and infrastructure areas prevail. In 11 years, 2,316.65 hectares of forest cover have been lost, which is equal to an annual loss of almost 1% of the total area of the watershed. The main cause for the deforestation, according to maps presented by the Grupo Interinstitucional de Monitoreo de Bosques y Uso de la Tierra (Inter-Institutional Forest and Land Use Monitoring Group–GIMBOT in Spanish) in 2014, is the conversion of forest lands into agricultural lands and grasslands.

An adaptation of INAB's methodology has been used to determine the capacity of land use in Guatemala. Five categories of land use have been identified in the whole Teculután river sub-watershed, which range from areas where agricultural activities can be undertaken, which are concentrated in the lower sub-watershed and a few in the middle stretch; densely forested areas that are prevalent in the upper sub-watershed with protection aims, and an area with low shrub vegetation, located mainly in the middle watershed, which reflects the improper use of its capacity. Based on the information that was gathered, it can be inferred that this is one of the most important programs for the Teculután river sub-watershed, in regard to forest, agricultural and livestock features.

Table 1 shows a summary of the various categories of land-use in the sub-watershed, as well as their location, area, and percentage.

Categoría	Parte de la cuenca	Superficie (ha)	Porcentaje
Agriculture without limitations	Low	1,536.78	7.11
Silvopastoral systems	Low	516.70	2.39
Agroforestry with annual crops (within the protected area, so that the zoning contained in the RBSM Master Plan is recommended).	High, Middle and low	1,502.25	6.95
Forest lands for production (within the protected area, so that the zoning contained in the RBSM Master Plan is recommended)	High	1,881.17	8.70
Protected forest areas	High and middle	16,185.85	74.85
	TOTAL	**21,622.75**	**100.00**

Table 1. Land-Use Categories in the Teculután Watershed

The most intensive land-use categories are concentrated in the low watershed, especially those areas with slight slopes and good soil depth that allow agricultural activities. These areas may be productive during most of the year due to rain reduction and variability. In contrast, forest areas are concentrated in the middle and upper watershed, with the exception of some small agricultural areas scattered in the upper watershed. These areas are not viable as a result of protected-area zoning.

3.2.3.1 Objective of the Economic Sector Strengthening Program

The objective of this program is to improve the socioeconomic capacity of the men and women living in the watershed, based on profitable agricultural, livestock and forest production that combines ecological and organic production, food security, and conservation of natural resources.

3.2.3.2 Brief Description of the Projects Included in the Program

Project 1. Promoting Silvopastoral and Agroforestry Systems

The objective of the project is to increase, complement, and diversify agricultural / livestock production and forestry products and environmental services provided by silvopastoral and agroforestry systems in the sub-watershed. This will be accomplished by establishing and managing silvopastoral and agroforestry systems with native species and species with high commercial and environmental value, and by recovering degraded pastures and improving crops associated with agroforestry systems. The project will be implemented in the lower, middle, and high sub-watersheds during a period of 10 years, at a cost of US$10,000.

Project 2. Promoting Agroindustry and Value Chains

The objective of the project is to strengthen primary sectors and industrialization and commercialization of small- and medium-scale agroindustry products. This will be accomplished by developing a feasibility study of small- and medium-scale agroindustry, strengthening the entrepreneurial capacities of community organizations and groups of women and young entrepreneurs and the institutional strengthening and coordination to promote agroindustry and value chains.

Project 3. Promoting Agrotourism and Ecological Tourism

The objective of this project is to achieve economic complementarity of rural families through the use of natural attractions in the sub-watershed and the agricultural / livestock activities with potential interest for tourists. This will be achieved by promoting ecotourism (forests, rivers, lookout points, promoting agrotourism (fruit-tree route) and the development of fund-raising mechanisms for the environmental management of the sub-watershed. The project will be implemented in the middle and high sub-watershed during 5 years, at a cost of US$120,000.

3.2.4 Natural-Resource and Ecosystem-Service Conservation Program

Soil, water, and forests are resources that have been deteriorating, mainly due to human intervention. This causes a decrease in water recharge, loss of biodiversity, loss of soils, soil erosion, threats, hazards, and risks due to landslides in mountain slopes, riverbeds, and ravines, as well as overflow of rivers. Furthermore, the previously-mentioned loss of forest mass is associated with deforestation and firewood extraction by families located within the watershed. In this context, it is urgent to foster medium- and long-term rehabilitation of renewable natural resources and to minimize the degradation of lands at the various locations.

In regard to water management, 8 out of the 19 communities do not have a drinking-water committee to manage the system, so that the investment is considerable and requires more support, responsibility, and participation by the population. 72% of the drinking water is piped into homes and 95% is used by households.

Regarding industrial water management, companies such as Cervecería Centroamericana, Cervecería Río, and Licorera Zacapaneca, groundwater resources are used intensively, and these would be the most appropriate companies to establish alliances for the integral management of the Teculután sub-watershed.

A set of projects have been defined to promote payment for water environmental services (PSA in Spanish) in the short term, as well as actions to protect the sub-watershed by means of permanent vegetable cover and sustainable agriculture. Integrated conservation of natural resources will generate services and will control the negative impacts of climate and non-climate events.

3.2.4.1 Objective of the Natural-Resource and Ecosystem-Service Conservation Program

The objective of the project is to rehabilitate soils and vegetable cover in affected zones, as well as to conserve and increase permanent vegetable coverage so that it constitutes the basis for sustainable agricultural / livestock and forestry production, while generating environmental services, all of them with a productive approach, conserving and producing.

3.2.4.1 Objective of the Natural-Resource and Ecosystem-Service Conservation Program

Project 1. Local Ecosystem-Service Fund

The objective of the project is to promote the conservation and/or generation of environmental services, as well as to develop financial compensation mechanisms for using them in the Teculután river sub-watershed. This will be accomplished by developing a detailed inventory of the ecosystem services being provided, emphasizing the ones regulating water; managing and establishing mechanisms to pay for ecosystem services based on current norms (fees, rates, and others that are applicable to the watershed); developing sub-projects based on coordination and commitment among offerors and users of ecosystem services, within and outside the watershed, and establishing a local monitoring system and local institutional coordination. The project can be implemented in the whole sub-watershed, but it applies mainly to zones with environmental services. It will last 10 years, at a cost of US$25,000.

Project 2. Ecological Conservation and Restoration to Prevent Hazards

The objective of the project is to reforest new areas and to manage reforested areas, aiming to conserve and restore forest resources and promote environmental services provided by these ecosystems. This will be accomplished by identifying reforestation priority areas with the aim of conserving and protecting forest resources, reforestation, and ecological restoration in priority areas of the watershed, and generating economic benefits by means of Forest Incentive Programs. The project will be implemented in the high, middle, and low reaches of the sub-watershed, during a period of 10 years, at a cost of US$320,000.

Project 3. Restoration of Degraded Soils

The objective of the project is to restore degraded soils in priority areas that meet the proper conditions to achieve their recovery. This will be accomplished by means of technologies and better practices in farms. The project will be implemented in the zones of the sub-watershed with degraded soils, especially in the low and middle reaches. It will last 10 years, at a cost of US$50,000.

3.2.5 Program to Strengthen Water-Resource Users

In the Teculután river sub-watershed, managing irrigation systems is an individual endeavor, without considering that it is a resource that is meant to be used by all, and that it benefits many of the users. There is no entity to regulate, administrate and supervise its efficient use nor are there significant regulatory measures. Water resources are essential for the operation of existing industries and agricultural / livestock production of the region, which generate considerable employment sources.

Both the water for human consumption and for irrigation are important for the communities in the Teculután sub-watershed. However, the water balance in the middle reaches of the watershed indicates that there is water deficit during the nine months of the year. Water input from rainfall during the dry season is practically null in the middle and low reaches. The total irrigation area is estimated at 2,046 hectares, and another 3,439 hectares are considered as a potential irrigation area. The water of the Teculután river is currently being channeled toward risk areas by basic derivation systems with simple structures and no metering. However, this is the basis for considerable investment in agricultural enterprises that use irrigation and support the socioeconomic development of the region. The current area with irrigation may be increased if water use is optimized by modernizing surface irrigation systems, improving their operation, and renovating the water-conduction systems in water intakes.

This program is closely linked to the Natural-Resource Conservation and Environmental Service Program, since it is important to keep adequate vegetable coverage in the sub-watershed, not only to protects soils, but also to foster detention, retention, and infiltration of water in the soils, thus contributing to superficial flows and to groundwater. The program and its projects are related to the integrated water-resource management, which takes into account superficial and groundwater, its quantity and quality, its availability with a multi-actor and multi-sector approach and with a long-term vision.

3.2.5.1 Objective of the Program to Strengthen Water-Resource Users

The objective of the program is to improve the quality, quantity, and availability of the water resources needed to undertake all productive, service, and environmental activities, mainly meeting rural and urban families' demands for water.

3.2.5.2 Brief Description of the Projects Included in the Program

Project 1. Pre-investing to Protect Water Sources and Critical Water-Regulation Areas

The objective of the project is to ensure the continuance of water resources by protecting the existing water sources in the sub-watershed. This will be done by performing an inventory and prioritizing water resources and the critical water-regulation areas; engaging in institutional awareness raising, strengthening and cooperation; identifying and implementing better practices for water-source conservation, and controlling and monitoring water resources. The project will be implemented in the low, middle, and high stretches of the sub-watershed during a period of 10 years, at a cost of US$60,000.

Project 2. Pre-investing to Ensure that Water for Irrigation and for Use by People is Efficient and Equitable

The objective of the project is to strengthen the technical and administrative capacities to manage, operate and provide maintenance to water-supply systems. This will be accomplished by evaluating water-supply systems; implementing measures to improve the management, operation, and maintenance of supply systems; strengthening technical and administrative capacities, and securing funds to improve water-catchment and distribution infrastructure. It will be implemented in the whole sub-watershed during a period of 5 years, at a cost of US$50,000.

Project 3. Norms to Promote the Integral, Equitable, and Sustainable Use of Water

The objective of this project is to develop the norms for water-resource investment and protection. This will be achieved by means of an inventory and the prioritization of the water resources and the critical water-regulation areas; institutional awareness raising, strengthening and cooperation; identification and implementation of better practices for water-source conservation, and water-resource control and monitoring. The project will be implemented in the low, middle, and high stretches of the sub-watershed during a period of 10 years, at a cost of US$60,000.

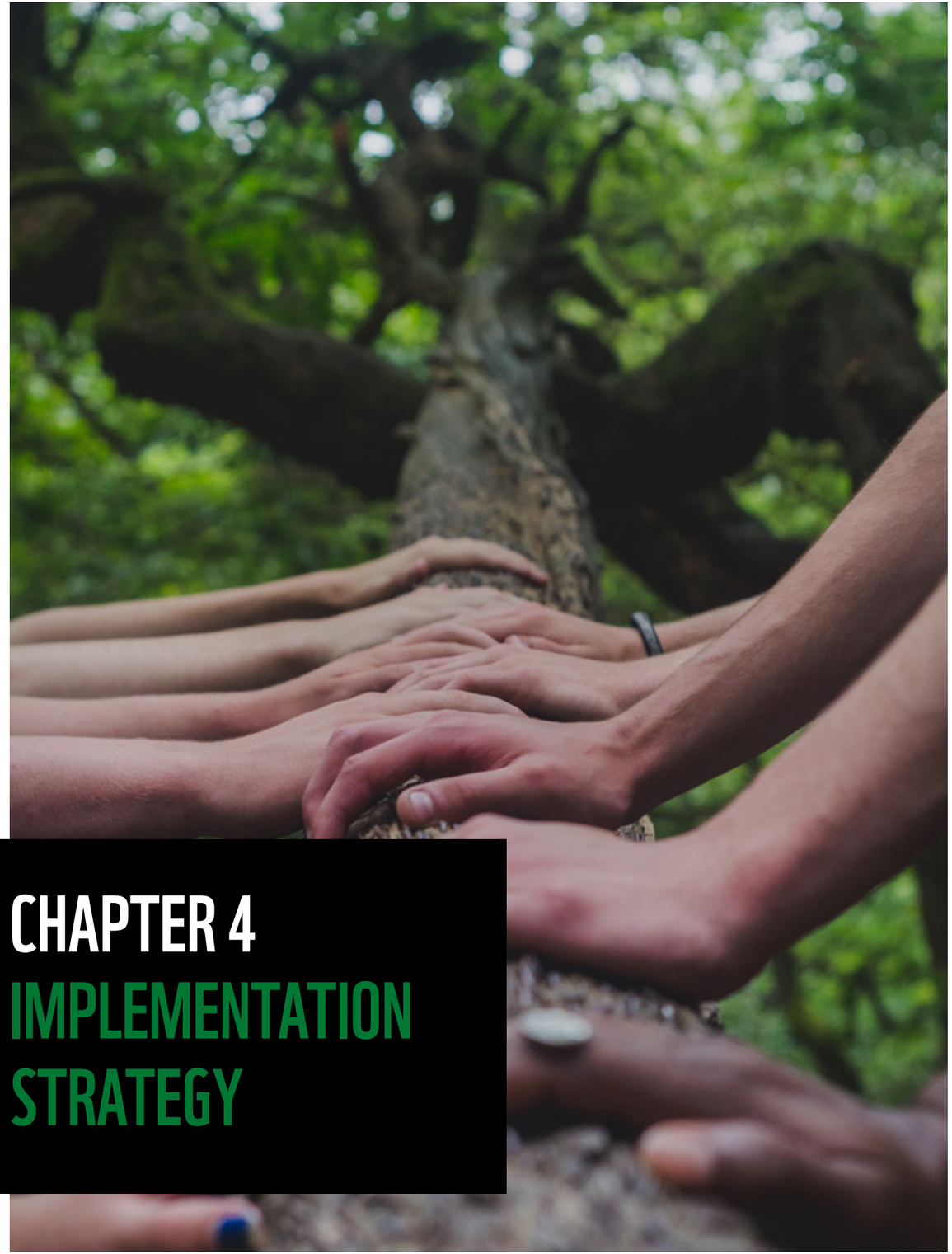
Project 4. Water-Resource Quality and Sustainability Management

The objective of this project is to establish an efficient groundwater and surface water management with effective regulation measures of water resources and wastewater. This will be accomplished by evaluating the current surface water and groundwater exploitation system; strengthening water-management capacities to establish efficient rational exploitation and use of groundwater; strengthening capacities to manage wastewater; strengthening wastewater-management capacities; managing information, communication, awareness-raising and public participation, and training with respect to integrating water-resource and project management. The project will be implemented in the sub-watershed zones detected as main surface and groundwater sources. It will last 5 years, at a cost of US$60,000.

3.3. Structure of Program and Project Costs

The following table shows the costs of the Management Plan, disaggregated by programs and projects for the Teculután sub-watershed.

Programs	Projects	Partial Costs (US$)	Total Costs (US$)	Years
Hydro-Climatic Monitoring and Early Warning for Risk-Management	1. Developing a Risk Map and a Risk Diagnosis	50,000	345,000	10
	2. Creating a Risk Management and Emergency Committee	95,0000		
	3. Creating an Emergency Monitoring, Alert Emission, and Communication Sub-System	200,000		
Organizational Strengthening and Development	1. Institutional and Organizational Strengthening	20,000	140,000	10
	2. Training on Liquid and Solid Waste Disposal	10,000		
	3. Training on Developing, Evaluating, and Managing Projects	5,000		
	4. Training on the Legal Framework and Norms Relating to the Environment	5,000		
	5. Compulsory Environmental Course in the Diversified Cycle (secondary-school) Curriculum	100,000		
Economic Sector Strengthening	1. Promoting Silvopastoral and Agroforestry Systems	10,000	140,000	6
	2. Promoting Agroindustry and Value Chain	10,000		
	3. Promoting Agrotourism and Ecological Tourism	120,000		
Natural Resource Conservation	1. Local Ecosystem Service Fund	25,000	395,000	10
	2. Ecological Conservation and Restoration to Prevent Hazards	320,000		
	3. Restoring Degraded Soils	50,000		
Water Resource Management	1. Pre-investing to Protect Water Sources and Critical Water-Regulation Areas	60,000	230,000	10
	2. Pre-investing to Ensure that Water for Irrigation and for Use by People is Efficient and Equitable	50,000		
	3. Norms to Promote the Integral, Equitable, and Sustainable Use of Water	60,000		
	4. Water-Resource Quality and Sustainability Management	60,000		
TOTAL (US$)			**1,250,000**	**10**



CHAPTER 4
IMPLEMENTATION STRATEGY

4.1 Activities for Plan Startup

Executing the Management Plan in the Teculután river sub-watershed will depend mainly on the resource management required for each activity.

The following table shows the proposal for immediate actions that should be led by the Fundación Defensores de la Naturaleza, based on the Management Plan timeframe. Executing these actions is essential to Management Plan implementation in the Teculután river sub-watershed.

No.	Activity	Management Plan 10-Year Timeframe									
		Short Term		Medium Term				Long Term			
		1	2	3	4	5	6	7	8	9	10
1	Creating the Sub-Watershed Management Group	■									
2	Sharing the Management Plan transfer		■	■							
3	Executing the immediate action plan	■	■	■							
4	Managing resources		■	■							
5	Defining the investment plan		■	■							
6	Executing Plan projects		■	■	■	■	■	■	■	■	■
7	Annual Reports	■	■	■	■	■	■	■	■	■	■
8	Annual operating plans	■	■	■	■	■	■	■	■	■	■
9	Monitoring	■	■	■	■	■	■	■	■	■	■
10	Evaluation		■		■		■		■		■

Table 2. Timetable for Immediate Actions

4.2 Management Plan and Resource Management Transfer

Fundraising is proposed to cover the total cost of the Management Plan in the Teculután river sub-watershed. This may be accomplished by managing financial, economic, technological, human, material, and information resources.

To that end, it is necessary that local actors be organized and undertake management processes in accordance with the demands and needs described in the Management Plan. The bases to develop resource management are grounded on a strategy designed and agreed on, which considers the following issues:

- Achieving official recognition and political and institutional support from the authorities linked to watersheds.
- Disseminating the Plan to all local sectors in order to make it known.
- Developing, strengthening, or consolidating resource-management capacities through in-service training, and technical support.
- Encouraging institutions and organizations involved in the projects in the Plan to include the policies, guidelines, or strategies son watershed management in their agendas.
- Proposing resource mobilization and joint efforts with local organizations, institutions, and groups to implement the proposed projects.
- Identifying external and private cooperation sources. Implementing linking mechanisms to channel resource-management efforts, according to the needs of the Plan and the technical and financial cooperation offer that is available.
- Promoting the development of payment or compensation mechanisms for environmental services in the medium term or whenever it is convenient.
- Performing a review and update of the Plan to adjust the resource-management strategy, as changes arise.
- Identifying and promoting the development of financial resource management for high-yielding projects, which considers investments from the private sector.
- Generating viable proposals to submit to various financing sources. Productive activities may be subject to normal financial mechanisms, since their final design should be based on credit and market conditions. Conversely, it is assumed that conservation, environmental-management, education, training, and organization activities or projects that generate considerable environmental and social benefits will receive support through non-reimbursable funds, which generate positive externalities.

4.3 Management Plan Catalyzers

• Technical cooperation, accompaniment or outreach to participants, beneficiaries, and actors in the watershed, by means of projects in various levels and processes.
• The greatest possible participation of community committees, COCODES, small- and medium-scale producer groups, resource users, and others.
• Involvement of Environmental Management Units under local Municipal Governments, so that they take watershed development into account.
• Implementing participative territorial ordering that is gradual, localized, and negotiated by means of water-recharge zone protection.
• Developing and visualizing actions that protect from natural disasters and that strengthen the safety of the community.
• Concrete results that show the improvement of land productivity as a result of technology, the market, and commercialization.
• Empowering the processes through the profitability of potential investments and adoption of conservation and production practices.

4.4 Communication and Dissemination Operational Strategies

The communication strategy for the Management Plan should be designed by the Management Group. The objective of this strategy is to disseminate implementation of the Management Plan and to provide information about the watershed, awareness-raising, and participation of actors, which promote changes in attitudes, practices, and their involvement as agents for sub-watershed development. The strategy should be based on technology and the media. Effective communication should always consider social, political, and cultural circumstances that are involved in its development, seeking to impact on the various actors of the sub-watershed. The communication strategy is aimed at various audiences.

Main Audience. The main audience includes high-level political and administrative agencies; normative, regulatory, and supervisory institutions; water-user organizations; producers' organizations; the population, and leaders, with the aim of promoting new attitudes and behaviors.

Secondary Audience. This audience, which includes social grassroots organizations, technical-assistance facilitator teams, development promoters, and investment promoters, will be in charge of supporting the principal audience's initiatives and proposals to manage the watershed. The secondary audience should be encouraged to assume new roles, such as coordinating, summoning, facilitating, and raising awareness.

Allies: Allies are opinion, pressure, influence, mobilizer groups that can validate the core aspects on topics related to the Plan, in addition to legitimizing or de-legitimizing positions and opinions contrary to watershed management. They can include opinion-makers, higher-education institutions, and opinion leaders.

4.5 Gender Strategy

With the aim of contributing to gender equity, gender inequalities currently existing in the sub-watershed should be identified, using adequate techniques and tools to develop a model of respect, regardless of gender.

The sub-watershed Management Plan includes gender equity as a policy priority in the local agenda, from planning to management, in monitoring and evaluation. However, this strategy should be implemented in such a way that its impact does not increase existing inequalities. Thus, it is important to secure the will and the commitment of all actors involved in the project by means of human and financial resources.

The relationship between the sub-watershed and the gender aspect occurs at the macro-, meso- and micro-scales. At each of these three scales, the relationship of gender has different nuances. At the micro-scale, the relationship between gender and water is more evident, since the dynamics established between people and natural resources –above all, water– determines the way in which women and men act in relation to their ways of life, their relationship with institutions, and their perceptions of water in regard to conservation. It is necessary to use a gender approach when performing this work at these three scales, in order to contribute to the change pertaining to equitable access and control of resources.

4.6 Management Plan Execution Timeline

Programas	Proyectos	Horizonte del Plan de Manejo para 10 años									
		Corto Plazo		Mediano Plazo				Largo Plazo			
		1	2	3	4	5	6	7	8	9	10
Monitoreo Hidroclimático y Alerta Temprana para la Gestión de Riesgo	1. Elaboración de un Mapa de Riesgos y un Diagnóstico de Riesgos										
	2. Conformación de un Comité de Gestión de Riesgo y Emergencias										
	3. Conformación de un Subsistema de Monitoreo, Emisión de Alerta y Comunicación de Emergencia										
Fortalecimiento de Capacidades y Desarrollo Organizacional para la Gestión Integral del Territorio	1. Fortalecimiento Institucional y Organizacional										
	2. Capacitación para la Gestión de Desechos Líquidos y Sólidos										
	3. Capacitación sobre la Formulación, la Evaluación y la Gestión de Proyectos										
	4. Capacitación sobre el Marco y la Normativa Legal Relacionada con el Ambiente										
	5. Curso de Educación Ambiental Obligatorio en el Pénsum a Nivel Diversificado										
Fortalecimiento del Sector Económico	1. Fomento de los Sistemas Silvopastoriles y Agroforestales										
	2. Fomento de la Agroindustria y las Cadenas de Valor.										
	3. Fomento del Agroturismo y el Turismo Ecológico										
Conservación de Recursos Naturales y Servicios Ecosistémicos	1. Fondo Local de Servicios Ecosistémicos										
	2. Conservación y Restauración Ecológica para la Prevención de Amenazas										
	3. Restauración de Suelos Degradados										
Fortalecimiento de los Usuarios de Recursos Hídricos	1. Preinversión para la Protección de Fuentes de Agua y Áeas Críticas de Regulación Hidrológica										
	2. Preinversión para el Abastecimiento y el Uso Eficiente y Equitativo del Agua para Riego y Uso Humano										
	3. Normas para el Fomento de Uso Integral, Equitativo y Sostenible de Agua										
	4. Gestión para la Calidad y Sostenibilidad de los Recursos Hídricos										

Cuadro 3. Cronograma para la ejecución de proyectos

4.7 Long-Term Sustainability of Plan Implementation

The structure of the Plan emphasizes social processes, and the ecological and economic perspectives that should be integrated in order to achieve sustainability.

Plan sustainability will result from the management capacity of local governments, local organizations, and national institutions, as well as from the commitment and responsibilities of their actors, participants, and beneficiaries.

4.8 Social Sustainability

The Plan integrates capacity building, institutional development, and environmental education with the purpose of having actors become leaders, managers, and self-managers to achieve the expected changes and impacts, starting with actions and interventions executed with responsibility and their own commitments.

The direct and indirect participation of social, productive, government, and non-government organizations, and the 15 communities living in the sub-watershed will allow the expected continuity and sustainability. In addition, equity, cultural values, ethics, sovereignty, and women's participation will also be part of social sustainability.

4.9 Economic Sustainability

To develop sustainable processes and financial management that can resolve watershed problems, it is necessary to integrate factors that should harmonize capacity building, watershed-management objectives, and a clear definition of competencies and responsibilities.

Management capacities at the level of local governments and community should have solid bases to plan, administrate, and manage activities aimed at watershed management. Economic sustainability requires that the Plan be executed with an integral long-term approach. Profitability is viable is the following variables are incorporated into the process:

a. Programs and projects consider generation of environmental services.
b. Agricultural production is increased.
c. Watershed organizations assume responsibility for its management.
d. When conserving and protecting natural resources, they will achieve new value.
e. Sustainable and ecological agriculture, less dependent on commercial inputs, will generate products with increased value and less production costs.
f. Added value, commercialization and planning furthered according to demand.
g. Diversifying crops.

The following funding alternatives to procure the resources that will allow implementing the Plan have been considered:

- Management related to Debt-for-Nature Swap.
- Leveraging joint implementation opportunities (international conventions).
- Access to multi-lateral funds
- Mobilizing or ordering the use of resources existing in the watershed and its municipalities, with strategic planning and an operational framework (action plan)
- Taking advantage of the provisions established by the law with regard to using water.
- Support from cooperation agencies and donors with various types of resources.
- Sale and regulation of environmental services.
- Contributions by the Central Government and the private sector.

4.10 Environmental Sustainability

The ecological sustainability of the watershed will depend on the technical treatment and the way to ensure continuity of practices, measures, works or indirect actions.

The Plan considers that it is important to invest in conserving and rehabilitating natural resources, to include technology, to improve the productive capacities of soils, to strengthen capacities aimed at protecting natural resources and using land appropriately, as well as to consider risks and vulnerabilities.

4.11 Ecosystem Services

The Plan poses the need for institutions leading sub-watershed management, along with local authorities, users, and inhabitants of the Teculután river sub-watershed, to prioritize feasible, controllable, and chargeable eco-system services by using adequate tools and by holding participative meetings.

The following ecosystemic services will generate income for all sub-watershed regions:

a) Providing water in adequate quantity and quality and with proper availability; regulating it.
b) Controlling erosion and decreasing sediments in water flows and reducing their transport downstream.
c) Landscape beauty in sites with eco-tourism or recreational value.

The ecosystem services provided by watersheds are increasingly valuable and finite, especially water for human consumption. Their sustainability will be possible through management plans and their sustainable-financing mechanisms. It is important that the organization leading sub-watershed management, local authorities, and users determine the legal framework that will be used to charge for said services.

4.12 Organizing for Execution

The Management Plan must consider the costs that are necessary to organize the execution and its administrative activities (Executing Unit), which include activities such as communication and a seed fund to create and manage projects.

The Plan considers that it is important to invest in conserving and rehabilitating natural resources, to include technology, to improve the productive capacities of soils, to strengthen capacities aimed at protecting natural resources and using land appropriately, as well as to consider risks and vulnerabilities.

4.13 Monitoring and Evaluation System

A monitoring and evaluation system (SME in Spanish), as a key tool to follow up processes and activities, has been considered for Plan execution. This system is aimed at establishing and disseminating information, as well as at performing analyses and making decisions. It will allow identifying, in real time, the problems and obstacles encountered during its execution, in order to make the necessary adjustments opportunely.

The SME will order and present the results, outcomes, and processes, through a feedback mechanism.

The objectives of the SME are to contribute to managerial and technical performance, to contribute to decision making, to determine the key factors for succeeding or failing to achieve continuous improvement in implementation, to report implementation progress and its outcomes, and to measure the established impact, and the processes and benefits achieved. Similarly, this system should have a participative approach and be coherent with Plan guidelines. SME elements include a baseline derived from the diagnosis. Monitoring will either be an annual process or be based on to measurement protocol established, and the evaluation will be used to measure and grade the intermediate and final impacts of the Plan. The SME is applied to management-performance aspects and to the other impacts generated by the Plan. Performance will be evaluated at the various staff levels, based on their responsibilities and contractual conditions that have been established. In the case of impact monitoring and evaluation, it will be performed in accordance with the changes, based on the indicators that define progress in achieving natural-resource sustainability and the wellbeing of the population living in the watershed.

In regard to monitoring and evaluating watershed sustainability, this system seeks to assess impact variables and indicators and the outputs generated by the processes, in a quantitative and qualitative manner. The purpose is to have clear and agreed-upon criteria for decision making regarding operational planning.

Variables of Impact Indicators

In many cases, indicators require more than one variable or parameter. The process to define variables will be similar to the one to define indicators. It is necessary to develop a protocol to determine variables and to ensure that their measurement is reliable. These protocols will be approved and accepted by technical and scientific communities and should comply with the requirements of national legislation or follow the recommendations of relevant institutions at the international level.

Variables can be assessed as quantitative, qualitative or both, and they depend on the criteria of the frequency in which they will be evaluated, just as indicators do. A specialist will design a system that is flexible and that adapts to Plan objectives. The tools that will be used by the SME team or person in charge to gather information will also be defined. The Plan's proposal for impact SMEs will consider baseline indicators, according to the established processes and outputs. Selection of the procedures should be based on a cost-benefit analysis and on replicability, in order to generate reliable and relevant information to monitor the plan. The relevant indicators are shown in the table below.

SME Requirements

The Plan proposes that SME be under a specific unit. The functions and responsibilities of this unit will be defined in accordance with the manual of procedures for Plan implementation. The unit will be composed of a Head of Unit, a technical specialist and the staff who will gather information temporarily. The personnel involved in these activities will be trained as warranted and processes will be homogenized. In addition, the SME will acquire the hardware and software that are necessary, as well as the office equipment, and it will take into account the maintenance and periodic updating of equipment components.

No.	Global Watershed-Management Indicator	Related Projects or Programs	Expected Impact
1	Improved water quality	Water-Resource Handling and Management	Reduced levels of water pollution and decreased risk of illness
2	Water quantity	Water-Resource Handling and Management	Water availability for all uses
3	Improvement of vegetable cover	Conservation of natural resources	Reducing soil loss through erosion and decreasing sediment loads. Hydrological-cycle regulation.
4	Decreased droughts and floods	Water-Resource Handling and Management Conservation of natural resources	Reducing physical vulnerability of the watershed's population
5	Reduced erosion	Conservation of natural resources	Maintaining soil fertility and productive capacity
6	Reduced soil contamination	Agricultural/livestock and forestry development	Improvement of productive quality of soils and conditions for ecological development
7	Forest protection	Conservation of natural resources	Protected water sources, water-recharge zones, and maintaining biodiversity conservation
8	Protecting water sources and water-recharge zones	Water-Resource Handling and Management Conservation of natural resources	Reducing runoff, increasing infiltration and recharge of water tables
9	Control of landslides	Conservation of natural resources	Reducing the physical vulnerability of the watershed's population
10	Improved land use and productivity	Agricultural/livestock and forestry development Water-Resource Handling and Management	Improving quality of life. Decreasing use of natural resources.
11	Acknowledgement of environmental services	Conservation of natural resources	Ownership of externalization in various watershed areas.
12	Organizational strengthening and management capacities	Organizational strengthening	Empowering the watershed approach and its management, execution, and evaluation instruments.
13	Improving quality of life	All programs	Harmony between nature and society.

Table 4. Indicators and Their Relationship with Projects and Programs.