Watershed Valuation
as a Tool for Biodiversity Conservation

Lessons Learned from Conservancy Projects

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Author & Editor

Karin M. Krchnak, Senior Freshwater Policy Advisor, The Nature Conservancy

Secondary Authors and Contributors

This report draws directly on six case studies prepared by Marcia B. Brown and Caroline Stem, Foundations of Success, for The Nature Conservancy (TNC) that detail TNC and partner project experiences in Bolivia, Ecuador, Guatemala, Honduras and Mexico. The full case studies are available at www.fosonline.org. It also includes sections from a paper prepared by Marcia Brown and Caroline Stem on Lessons Learned Across Several Sites Using Watershed Valuation as a Conservation Strategy. In addition, this report uses studies prepared by ESG International Inc. for The Nature Conservancy Indonesia Program entitled The Value of Water Resources in Berau Regency, East Kalimantan and The Value of Water Resources in Lore Lindu National Park, Central Sulawesi. The author would like to thank these authors without whom this summary report would not be possible as well as Marlou Church, TNC's former Senior Advisor for International Water Policy, who had the vision to urge TNC to pursue this type of work over a decade ago. Special thanks to Randy Curtis, Jose Yunis, Marie Claire Paiz, Marcia Brown, Sandra Mendoza, Paul Hartman, Lorena Calvo, Ricardo Aguilar, Monica Ostria, Oscar Nunez, Ian Dutton, Karen Luz, Marta Echavarria, Aurelio Ramos, Martha Martinez for translation, and Sarah Bolton and Jennifer McKnight who reviewed and commented on this report.

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The individual case studies and this summary report document work carried out by countless organizations. The Nature Conservancy has tried to document these efforts to help further dialogue and discussion among organizations about how to use lessons learned to augment existing projects and replicate these projects across the globe. We apologize for not listing each and every individual who made these projects possible but want to recognize the organizations that have both implemented and funded these efforts.

It is important to emphasize that a number of the projects have achieved results that are not detailed in the individual case studies or this summary report. Readers are encouraged to contact the organizations involved in the projects to obtain more information on all the work underway to help further watershed conservation.

Disclaimer

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INTRODUCTION

One of the challenges in moving toward ecosystem security-preserving the natural functions of ecosystem goods and services for all future generations-is convincing policymakers that protecting ecosystem goods and services will promote social and economic development. The Millennium Ecosystem Assessment gives an in-depth look at the range of ecosystem goods and services and their current state. However, there is a lack of economic data to convince national leaders to "invest" in ecosystem conservation. The United Nations Economic Commission for Europe notes that the degradation of ecosystem services represents loss of a capital asset. Despite this, the methodologies for estimating the value of these capital assets vary widely in terms of type and quality.

Reaching the Millennium Development Goals will require greater investments by countries as well as improved laws and regulatory systems. However, market-based mechanisms may offer a way to help move a step closer to conserving ecosystems. Payment for environmental services (PES) in the water sector, in essence, promotes the conservation of upstream areas and, thus, ultimately entire watersheds through compensation for ecosystem friendly land use practices. A challenge for exchanging lessons learned with PES approaches is one of terminology. In some instances, "recompense", "compensation" or "reward" are utilized. PES projects are also referred to as "improved management of hydrological resources" or "reciprocal arrangements." Payments for ecosystem services may be called "incentive-based cooperative agreements," "stewardship payments" or economic incentives," "compensatory schemes" or even "performance payments."

Environmental service fees have been established in a number of places across the globe, with Latin America being one of the most advanced in experimenting with different approaches. These systems offer valid lessons learned on how to create new mechanisms that encourage governments-including national, regional and local governments, individuals, communities, and businesses to recognize the value of ecosystem services.

Over the past ten years, The Nature Conservancy has experimented with using watershed valuation as a tool for biodiversity conservation in Latin America and Asia-Pacific. The reader should take note that this report is not a description of how to carry out watershed valuation studies. Rather, the focus is on the role of watershed valuation as a tool in biodiversity conservation.

The case studies reveal the different ways in which watershed valuation can serve as a catalyst for watershed conservation. This report provides a summary of several projects in Latin America and Indonesia, where the Conservancy has been involved to some extent over the past decade. It also offers some lessons learned from the compilation of detailed case studies on the projects through site visits and interviews with a broad group of individuals. As with any effort, this is a work in progress as the Conservancy continues to work with partners in developing these programs, sharing information and obtaining more data and information on the impacts of these efforts in the long term.

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PROTECTING THE WATER SOURCE FOR PEOPLE & BIODIVERSITY

This paper is not aimed at providing a comprehensive study of freshwater ecosystem goods and services. However, a short description of the current thinking on the linkages between maintaining protected area systems and supplying water to people can help provide additional background to the Conservancy's efforts.

To provide the range of services on which humans depend, including water purification, freshwater systems depend on the cycling of water and on functioning ecological processes and species assemblages. Quantity and quality issues are interlinked, as sufficient flows not only sustain the social, ecological and hydrological functions of watersheds and wetlands, but also offset pollution. In addition, groundwater and surface waters are interlinked; thus, degradation or diminution of groundwater may affect surface waters and the associated ecosystems.

Water management traditionally has focused on meeting the needs and desires of a growing and changing human population without due consideration to the needs and limits of our freshwater systems. As more people move to cities, government officials seek ways to meet the water needs of the growing human population but often fail to adequately consider the long-term health of freshwater ecosystems to support the growing urban areas. Currently, 47 percent of the world's people reside in towns and cities, a percentage that is expected to increase to 55 percent by 2015. Latin America already tops the list of regions with high urbanization with 77 percent living in urban areas as of 2003, making it comparable to the European Union.

Globally, there are few standards or guidelines for ecological uses of water. Thus, water treatment may occur near and around cities, but little attention may be paid to protecting the upstream watershed. New York City is an example of a city that opted for watershed protection measures in place of spending billions of dollars on water purification and treatment.

As noted in the Millennium Ecosystem Assessment, a study carried out by the World Bank and WWF International in 2003 found that of the worlds' 100 largest cities, more than 40 percent rely on runoff producing areas that are fully or partially protected for their drinking water. The study also pointed out that most of the world's population lives downstream of forested watersheds. It is critical, therefore, that management of protected areas include improving watershed conservation practices and approaches and that payment for ecosystem service schemes take a holistic approach.

Some studies have concluded that watersheds with significant areas of protected or managed forests offer water purification services. Better water quality means lower treatment costs borne by cities and communities **(see Table 1)**.

Share of Water-Shed Forested	Treatment Costs per 3,785 m3	Average Annual Treatment Costs	Cost Increase Over 60 % Forest Cover
60%	$37	$297,110	--
50%	$46	$369,380	24%
40%	$58	$465,740	57%
30%	$73	$586,190	97%
20%	$93	$746,790	151%
10%	$115	$923,450	211%

1Based on treatment of 22 million gallons (83,270 m3) per day, the average production of the water suppliers surveyed.
Source: Postel and Thompson, 2005, adapted from Ernst, 2004.

Table 1. Forest Cover and Predicted Water Treatment Costs Based on 27 U.S. Water Supply Systems

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The 2003 study by the World Bank and WWF International drew on analysis that showed that there is a link between forests and the quality of water arising from a catchment, a more sporadic link between forests and quantity, and a variable link between forests and constancy of flow. Generalizations are difficult as the study noted that the services that forests provide depends on individual conditions, species, soil types, climate, management regimes and needs from the catchment.

However, it is clear that protected or managed forested areas alone cannot provide safe water to people. Studies conducted by The Nature Conservancy in Lore Lindu National Park in Central Sulawesi, Indonesia indicated that there is a strong correlation between forest clearing, increased runoff and heavier sediment loads in rivers. Increased sediment loads resulting from high erosion rates of slash-and-burn agriculture in the upper catchments, in some cases, have caused main river channels to widen and were cited as causal factors in the alteration of river regimes.

Best management practices are critical to improve land or forest use in or around protected or managed areas. Examples of best management practices described in this report include:

- Organic agriculture
- Sustainable livestock management
- Community gardens
- Tree nurseries
- Soil conservation
- Reforestation
- Riparian restoration
- Certification of private land conservation

In Chiapas, Mexico, for example, Instituto de Historia Natural y Ecología (INHE), a TNC partner, has been promoting forestry and agricultural best management practices in and around a protected area. One activity they believe has been particularly successful is the promotion of organic agriculture in Nuevo Paraíso. Community members became interested in organic agriculture after participating in an awareness raising workshop hosted by IHNE. Fifteen landowners participated in the program and were able to see a marked improvement in production and in soil quality. These farmers have adopted organic methods and have ceased destructive practices, like burning the land to prepare it for cultivation. This reduction in burning should decrease sedimentation entering local waters, thereby improving water quality for downstream users. Most of the community members who did not participate initially were impressed with the results and also planned to use organic methods in the coming years.

In the Cuxtepec watershed in Chiapas, another TNC partner, Comisión Nacional de Áreas Naturales Protegidas (CONANP) has been promoting restoration of the Rio Grijalva's riparian vegetation. The agency has helped establish community nurseries with fruit and ornamental plants and trees. Because the plants and trees hold economic value, they have served the dual purposes of helping to restore riparian vegetation and providing people with additional food and income. CONANP also has promoted restoration work in other regions, such as the watershed feeding into La Encrucijada. Prior to this work, the high levels of sediment and the heat-due to lack of vegetative cover-prevented shrimp from inhabiting the lowland fishing areas. Now, shrimp catches have increased, and fishermen have noticed the change. Although the fishermen are not yet willing to pay for environmental services, they are starting to realize the importance of conserving the mangroves and the watershed.

Integrated water resource management requires the engagement of all stakeholders. As the examples described in this report show, farmers, forest owners and other private landowners must play a critical role in ecosystem service protection and management.

METHODOLOGY

The objective of watershed valuation projects is to help local actors recognize the importance of natural areas and take action to protect them, in order to ensure the integrity of the critical environmental services they provide. When people are motivated to take action to protect their water resources, they also are contributing to biodiversity conservation.

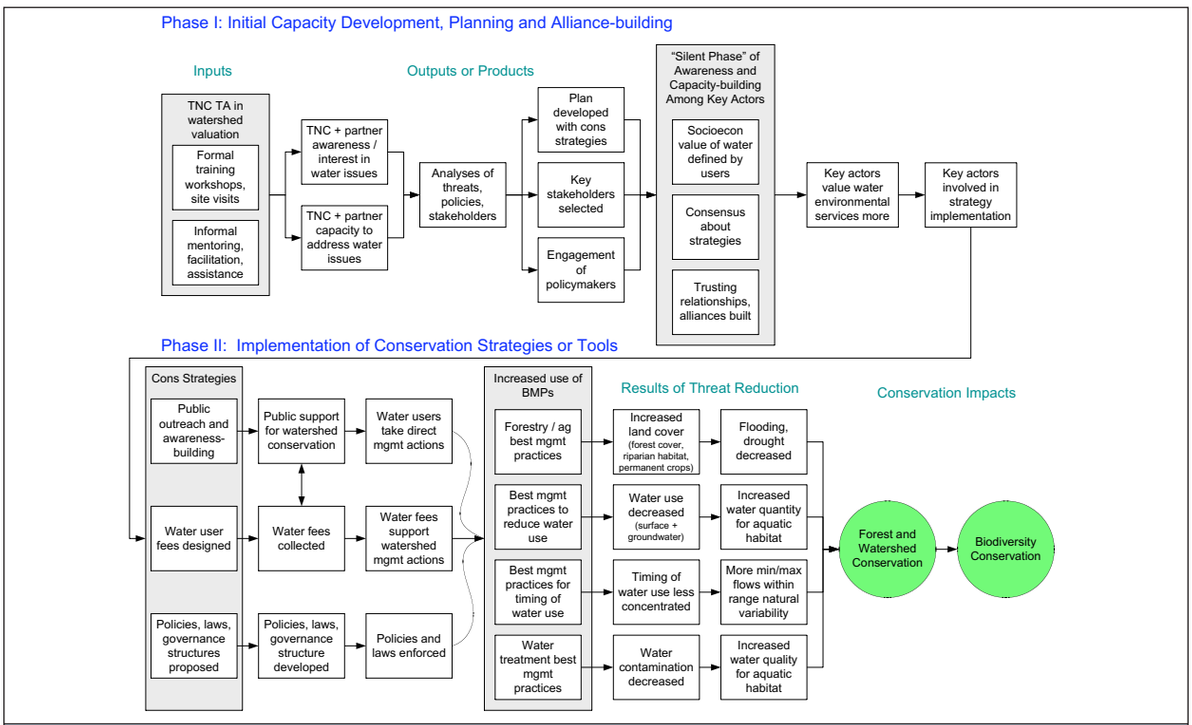

Figure 1. Causal Chain Defining How TNC Watershed Valuation Projects Are Intended to Contribute to Biodiversity Conservation

Over the past ten years, the Conservancy and its partners have developed watershed valuation projects to increase forest and watershed conservation in specific sites to advance biodiversity conservation. The results chain **(see Figure 1)** outlines the approach adopted by the Conservancy. Phase I focuses on initial capacity development, planning and alliance-building. Phase II involves the implementation of specific conservation strategies or tools.

Efforts in Phase I focus around technical assistance in watershed valuation, which contributes to building awareness and interest in water issues and the capacity to address them. Increased interest and capacity enables partners to produce initial outputs or products such as analyses of threats. It also helps them develop a watershed valuation action plan and select key stakeholders that need to be involved in implementing it. A "silent phase" of information-sharing, awareness and capacity-building among key actors is necessary to achieve consensus about what conservation strategies to undertake and to build trust among the key actors. During this period, a water valuation process is usually conducted, and the key actors may form a watershed group. All of the products of the silent phase contribute to increased recognition by the key actors of the value of watershed environmental services, which contributes to their involvement in the implementation of conservation strategies in Phase II.

Phase II focuses on the implementation of one or more of the following three conservation strategies: (1) public awareness campaigns, (2) water user fees and (3)

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policy development and enforcement. For each of these strategies, a short chain explains expected results. Public outreach and awareness-building can increase public support for watershed conservation. This will encourage water users to take action to improve watershed conservation. The design of a water user fee will result in collection of water fees that are used to support watershed management actions. Engagement of policymakers will result in the development of new laws, regulations or governance structures. Enforcement, however, is key if the new laws and regulatory systems are to change behavior.

If these conservation strategies are well executed, then they should result in increased adoption of best management practices related to forestry and agricultural activities, reduction of water use, and the timing of water use or water treatment. Best management practices depend on the conditions in the specific site.

Although the results chain is presented as a linear sequence of actions and results, results often are not achieved in the order presented by the chain. The Conservancy's experiences to date have shown that some sites may jump directly to working on the development of water user fees, while others postpone water user schemes indefinitely. These differences help us to learn about the advantages and disadvantages of different approaches and their relative effectiveness under different conditions.

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SUMMARY OF PROJECT SITES

QUITO, ECUADOR

Figure 2. Condor Biosphere Reserve, Ecuador

The Site

The Condor Biosphere Reserve (CBR) is made up of several protected areas and their areas of influence that together form an ecologically functional site comprising more than one million hectares **(see Figure 2)**.

Conservation of this area will guarantee the conservation of the headwaters and biodiversity of the Napo and Aguarico watersheds, two of the most important Amazon basin watersheds. With about 7 percent of the surface of the country, the CBR holds almost half the species of birds and mammals found in Ecuador. The region's extraordinary biodiversity is a function of its large variety of habitats: sixteen different vegetation types have been identified within the CBR, providing habitat for more than 760 species of birds, 150 species of mammals and 110 species of amphibians. Scientists consider this number to be conservative as several areas remain unexplored.

The high plateaus of the Condor Biosphere Reserve include the headwaters of more than 20 rivers in 6 large watersheds that provide water for many uses, including urban and rural drinking water, irrigation, electricity generation, recreational activities such as fishing and hot springs, and other activities such as aquaculture and navigation. Of all these activities, urban drinking water and electricity generation use the most water at specific sites and generate the greatest economic value.

The Condor Biosphere Reserve is the source of water for more than 1.8 million people who live in the city of Quito, Ecuador. Every month, Quito residents and businesses drink and wash with about 4.5 billion gallons of water from the rivers of the CBR. The Quito Municipal Water and Sewage Agency (EMAAP-Q) manages several large water projects that pump waters from the CBR rivers, while Quito's Electric Company (EEQ) relies on CBR waters for electricity generation.

Threats to Biodiversity

Despite their hydrologic value, the watersheds that provide drinking water and generate hydroelectric power for Quito residents are being degraded at an alarming rate. The main threats include advance of the agricultural frontier, inappropriate agricultural practices and poorly planned infrastructure projects. Rural residents convert paramo and montane forests to cattle and sheep pastures, and fields are used for subsistence and commercial agriculture. Residents use poor agricultural practices, such as overgrazing and burning of the paramo, that seriously degrade the high plateaus.

The water and electric companies, municipalities and private companies have taken environmental criteria into account only partially when planning and constructing roads, dams, water distribution systems, oil and gas pipes and other infrastructure projects. As a result, all of these factors are contributing to soil erosion and compaction and reductions in dry season flow and water quality.

As the quantity and quality of water available for human consumption, electricity generation and other uses is decreasing, demand for water and conflicts between water users are increasing. EMAAP-Q estimates that the population of the Quito metropolitan area will nearly double by 2025, growing from 1.85 to 3.61 million inhabitants and causing maximum daily water demand to rise from 7.67 cubic meters to 13.33 cubic meters. To

help meet this demand, the company is planning the Ríos Orientales Project that will draw drinking water from 28 rivers in the Amazon basin.

Project Activities

For over 10 years, the Conservancy has been working with Fundación Antisana, a local partner, the United States Agency for International Development (USAID) and others in establishing a water-based finance mechanism as a long-term source of financing for the conservation of the Condor Biosphere Reserve, particularly the Antisana and Cayambe-Coca Ecological Reserves, which are the primary source of drinking water for Quito (see Box 1). In April 1998, the Conservancy proposed to the Municipality of Quito the development of the Water Conservation Fund (Fondo para la Conservación del Agua-FONAG).

Key Dates for the Condor Bioreserve Watershed Valuation Project

1997	*Water: Together We Can Care For It!* Developed
1998	TNC and Quito Municipality officially launched the Water Conservation Fund (FONAG) initiative, agreeing to collaborate on the design and development of the water fund.
1999	TNC facilitated an ad-hoc committee to design and develop the water fund
2000	Development of FONAG bylaws that defined its financial structure (as a trust fund) and governance structure.
2001	EEQ signed the FONAG trust fund contract, committing to an annual contribution of 0.5% of profits.
2002	FONAG developed a process for presentation and review of proposals and approved its first proposal.
2003	Quito Mayor pressured FONAG to finance more projects.
2004	FONAG hired a new Technical Secretary with strong capacity in watershed management. FONAG Board approved new policies, procedures and criteria for project selection. TNC and FONAG conducted a general technical analysis of the river basins and water demand in Quito's area of influence *(Hoja de Quito)*.

Box 1. Dates for the Condor Biosphere Reserve Watershed Valuation Project

In determining the appropriate finance mechanism to develop to help protect the Condor Biosphere Reserve, the Conservancy and its partners evaluated various options (e.g. taxes, incentives) according to the following criteria:

- **Ecologically sustainable** - promoting long-term watershed conservation
- **Legally feasible** - based on the local regulatory environment
- **Politically viable** - likely to be accepted politically
- **Multidisciplinary** - allow the participation of public and private organizations
- **Efficient** - should not create more organizations, and no bureaucracy
- **Participatory** - ensure and promote multi-stakeholder participation, in particular at the community level.

It was determined that a water user fee was the most appropriate tool to help achieve conservation goals in the area. Early in the process of developing a water fund, TNC and Fundación Antisana chose to focus on those water users with the greatest economic and political weight. EMAAP-Q, the water utility, was identified due to its role in providing water to urban residents. Urban growth in Quito over the last three decades has created demand for water, and the growing supply of untreated wastewater has affected the water quality of local rivers, which prompted water specialists to look beyond the Pacific slope watersheds and existing groundwater resources. This has placed great pressure on the company to expand their service and exploit rivers in the Amazon Basin, often with little attention given to the environmental impact particularly of water diversion projects from one watershed to another. Furthermore, little is being done to address the loss of approximately 38.5 percent of Quito's municipal water supply due to unreported sales, illegal connections and water leaks in the infrastructure.

The Quito Electric Company (EEQ) was also identified as a key stakeholder as it has been providing electricity generated by hydropower for the past 40 years to Quito and the region. The government has given EEQ concessions to exploit hydropower in specific locations without requiring the company to pay for the right to use the water. EEQ's data show that stream flow has decreased in the San Pedro River over the past 40 years, and the company attributes this to poor watershed management. Thus, EEQ became interested in working with other institutions to maintain existing stream flow levels through reforestation and other watershed management activities.

FONAG was created in January 2000 as a trust fund,

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under an Ecuadorian law allowing companies that handle public funds to put money into a trust fund designated for a specific purpose. As a Fideicomiso, a contract through which assets are transferred to a fiduciary agent, FONAG receives resources from the EMAAP-Q (1 percent of its monthly water sales or approximately $360,000 per year), EEQ ($45,000 per year), a private beer producer ($6,000 per year) and the Swiss Agency for Development and Cooperation ($10,000 per year for two years).

The governance structure of FONAG includes a Board of Directors and a Technical Secretary. The FONAG contract defined that the funds could be used for activities in the following areas:

- Legalization of land tenure and land acquisition
- A system of patrols to control illegal activities such as fires, fishing and hunting
- Hydrologic protection measures such as installing fencing around springs and erosion control
- Promotion of sustainable agricultural production systems
- Monitoring and evaluation of project results.

During the start-up phase of FONAG, Fundación Antisana conducted a simple economic valuation study in the Cayambe-Coca Ecological Reserve. It estimated the cost of maintaining park guards to effectively patrol the upper parts of the Papallacta, Chalpi Grande and Oyacachi watersheds and divided this cost by the amount of water extracted from the area for urban water supply. These studies provided a preliminary estimate of the level of a user fee that could be considered. In addition, the Conservancy supported hydrologic research and research on aquatic biodiversity that has provided baseline information about certain watersheds in the CBR. While watershed and other studies were used to help develop FONAG, most project work focused on developing the political support necessary to create and make operational a fund financed by user fees.

Preliminary Outcomes

The Conservancy, the Municipality of Quito, EMAAP-Q, EEQ and the Andean Beer Company have achieved significant results in the design and development of a water fund financed solely by local Ecuadorian institutions. As of the end of 2004, FONAG had $2,112,000 in capital, which provided a budget of $301,000 for projects in 2005. The design of the fund allows the capital and funds available for projects to increase each year, and by 2011, it is projected to have over $7 million in capital and generate over $800,000 for projects each year.

The interest generated by the Fund began to fund watershed protection projects in 2003 in the rivers considered to be of key importance for water provision and biodiversity protection for the city. FONAG is currently funding a host of activities in the San Pedro, Pita, Antisana, Oyacachi and Papallacta rivers. In particular, in the last two rivers, FONAG is evaluating community needs for micro-credit to determine possible production activities that would generate income for land owners in the area, replacing or reducing activities that negatively affect the area's hydrological and biological integrity. Currently, community development activities such as cattle and potato farming deteriorate water quality and reduce land cover.

It is too soon to evaluate the full impact of these projects in terms of improving watershed management. Some of the other projects funded to date include:

- A study of hydrologic resources, forestry planning, reforestation and river cleaning will contribute to the recuperation of the lower parts of the San Pedro and Pita watersheds.
- Clean-up of clandestine solid waste dumps and recuperation of the river banks in the San Pedro and Pita basins.
- An environmental education and restoration project in the Pita watershed was conducted by The Páramo Foundation.
- Reforestation in critical zones, supported by FONAG in collaboration with Vida para Quito.
- Improved cattle ranching practices in the Cayambe-Coca Ecological Reserve and the Papallacta and Oyacachi watersheds, that have reduced conflicts between cattle and the Andean bear and reduced the environmental impact of cattle ranching on the watersheds.
- Salary and expenses of nine community park guards in Condor Biosphere Reserve.

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In September 2004, the Conservancy and FONAG completed a general technical analysis of the river basins and water demand in Quito´s area of influence (Hoya de Quito). This study represents the largest effort to date to consolidate information about these watersheds and provide a strong technical basis for management. Over the past two years, FONAG has been conducting a series of workshops to share the findings with key actors, create a common understanding of the critical situation of these watersheds and facilitate collaboration on watershed management.

Overcoming Challenges: The Future

FONAG has faced countless challenges, including constant pressure from local government to show results. With limitations on fundraising due to its status as a trust fund, FONAG has faced the added hurdle of trying to increase financial resources to bring about concrete results. The FONAG Board is interested in increasing the operating budget of FONAG, either by increasing membership, developing strategic alliances that generate matching funds, or fundraising. Of these three options, matching funds have the greatest potential to increase the money available for watershed management projects over the short term. Beginning in 2004, the Conservancy has provided matching funds to co-financed projects with FONAG, increasing the fund's operating budget by 18 percent.

FONAG also has begun to collaborate with the Corporación Vida para Quito, an initiative of the Quito Municipality. In Ecuador, all taxpayers can decide to dedicate 25 percent of their income tax to a specific cause of a public entity. Under this program, the Quito Municipality formed this corporation to address pressing environmental and social needs. Quito could receive approximately $100 million through this program over the next five years. Currently, the corporation is focusing on the restoration of the three rivers that flow through the city. Because FONAG's priority areas include two of these rivers, the San Pedro and Pita rivers, the objectives of the two organizations overlap, and they both have supported small hydrologic research and reforestation projects. Although the city has many needs, including the need to invest a substantial amount in sewage treatment, this municipal corporation has the potential to be a valuable partner for FONAG.

FONAG was created by an 80-year contract signed initially between TNC and EMAAP-Q and later by EEQ and the Andean Beer Company and, recently, the Swiss Agency for Development and Cooperation. EEQ and EMAAP-Q are municipal companies, and on three different occasions over the past eight years, changes in city leadership have required TNC to invest in lobbying a new mayor to continue honoring this contract. TNC and the FONAG Technical Secretary believe that it important to institutionalize FONAG through a municipal ordinance, and they are taking steps toward this.

The ultimate goal of FONAG is the conservation and management of the watersheds that provide water to Quito. This will require, however, a fundamental cultural change in key agencies such as EMAAP-Q, EEQ and the Municipality of Quito. It requires both the creation of a culture of integrated watershed management and the improvement of the environmental practices of the principal water-using agencies and industries in Quito. Decision-makers in these agencies recognize that there is growing demand for drinking water and other water uses. Their investment in FONAG demonstrates that they also recognize the need to address threats such as overgrazing and deforestation. They are slow to recognize the need for integrated watershed management (i.e., for integrated planning and management of all activities that affect water resources within each watershed). Gradually, they have come to recognize how the actions of their agencies contribute to watershed degradation. For example, EEQ drains the San Pedro river completely and leaves the river bed dry for several kilometers. Although EMAAP-Q contributes to FONAG, the construction of its water infrastructure continues to represent one of the biggest threats to biodiversity conservation and a major threat to watersheds in the Condor Bioreserve. Although the company wants to apply environmental best practices in its planning and construction, EMAAP-Q and the Municipality of Quito promote large infrastructure projects such as Ríos Orientales as the only way to meet the city's growing demand for water. Demand management practices are overlooked even though significant water savings could be achieved by fixing leaks, controlling illegal connections and charging unpaid connections in the city's water system. Funding from the Inter-American Development Bank is being secured for the development of a Water Resources Management Plan, which will include demand side issues.

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SAMA RANGE BIOLOGICAL RESERVE, BOLIVIA

Figure 3. La Vitoria and Tolomosa Watersheds, Bolivia
Source: Blanco, A. and R. Aguilar. 2004.

The Site

The Sama Range Biological Reserve is located in the western part of the Department of Tarija in southern Bolivia. The reserve covers 108,500 hectares of mountainous terrain that extends from 2,020 to 4,706 m. The higher altitude (3,600-4,700 m.) portion of the reserve includes part of the High Andes Ecoregion, Puna Ecoregion and Prepuna Ecoregion and the lower portion (2,000-3,600 m.) includes part of the Inter-Andean Dry Valleys Ecoregion and the Bolivian Tucuman Forest Ecoregion.

The reserve was created in 1991 to protect the principal sources of water for the city of Tarija and nearby communities, to conserve the biodiversity of the area and to protect valuable archeological sites. Important biological assets include the Tajzara wetlands, a group of a seasonal, semi-permanent and permanent lakes, high altitude streams, marshes and high Andean pastures declared a Ramsar Convention Wetland of International Importance in 2000. These wetlands provide habitat for 40 species of birds indigenous to high Andean aquatic systems. The wetlands also are important for migratory shorebirds, including three of the world's six flamingo species: the Chilean flamingo, the Andean flamingo and the James flamingo. Other species of particular importance to conservation include the condor, the Andean goose, numerous species of ducks, mountain lion or puma, Andean cat, vicuna, Andean deer and Andean fox.

The city's water comes from the La Vitoria and Tolomosa watersheds **(see Figure 3)**. During the rainy season, Tarija gets 70 percent of its potable water from the La Vitoria watershed and 30 percent from groundwater. During the dry season, approximately 50-60 percent of the city's water comes from groundwater, 20-30 percent from the La Vitoria watershed, and a maximum of 10-20 percent from the San Jacinto reservoir in the Tolomosa watershed.

Threats to Biodiversity

Despite their hydrologic value, these watersheds are being degraded by current land use practices. Deforestation and fires have reduced groundcover and increased soil erosion. Overgrazing of watershed recharge areas (especially in the Tolomosa watershed) has compacted soils and caused significant soil erosion. Although site managers have not documented changes in the hydrologic regime, they believe that the deforestation, fires and overgrazing have increased runoff and decreased infiltration, thus decreasing dry season flow.

Water quality also has decreased. Inadequate management of agrochemicals and wastewater are the main sources of water pollution. While the quantity and quality of water available from these watersheds for human use in Tarija have decreased over the last few years, the population has increased dramatically. Between 1992 and 2004, the population increased by over 50 percent, from 90,000 to 145,000. When demand for water exceeds the capacity of these watersheds, groundwater is exploited. The water company and government authorities have no information about current groundwater reserves or recharge rates. No one knows, therefore, whether current groundwater extraction rates are sustainable.

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Project Activities

Initial watershed valuation work involved conducting hydrologic research on the Bermejo River in the Tariquía Reserve. With guidance from TNC, PROMETA (the Association for the Protection of the Environment of Tarija) organized a series of four watershed valuation workshops in which key stakeholder groups analyzed water use and threats to water quantity and quality. After the second watershed valuation workshop, all of the participants determined that PROMETA's watershed valuation work should focus on the Sama Reserve because of its importance in providing water to the city and surrounding communities.

PROMETA identified the goal of the watershed valuation project for the Sama Reserve as the development of a strategy to provide the resources necessary to implement conservation, environmental education and watershed management programs that will guarantee the long-term sustainability of the Tolomosa and La Vitoria watersheds' environmental service provision to nearby communities and the city of Tarija (see Box 2). PROMETA has used several strategies to reach its goal. First, the organization has conducted an outreach campaign to raise awareness of the importance of watershed conservation. Second, specialists have conducted hydrologic and economic valuation research to help reserve managers determine what actions need to be taken to conserve watersheds and build stakeholder support for those actions. Third, PROMETA has worked with key stakeholder institutions to develop a governance structure for improved watershed management.

In 2001, PROMETA signed an agreement to initiate watershed conservation activities in the Sama Reserve in collaboration with the Municipality of Tarija, the governor's office (Prefectura), the water company (COSAALT, Cooperativa de Servicios de Agua Potable y Alcantarillado de Tarija), and SERNAP Servicio Nacional de Areas Protegidas (National Protected Areas Service). PROMETA collected hydrologic and geographic data about the Tolomosa and La Vitoria watersheds in the Sama Reserve, organized it into a database and used it to map vegetation cover, current land use and land use capacity. PROMETA then analyzed the hydrologic value of these watersheds and reported the results back to these agencies. At the same time, they initiated an outreach campaign and an economic valuation study.

In 2001-2002, PROMETA used the information in the database to conduct a hydrologic valuation study that included four components. First, they mapped current land use in the watersheds and modeled future land use scenarios, including a "no protection" and a "protection" scenario. Second, they estimated water availability and demand for water for irrigation. Third, they estimated the effect that changes in land use could have on erosion rates and, fourth, the effect land use changes could have on streamflow.

Key Dates for this Watershed Valuation Project

1996	*Governments of Bolivia and Argentina propose dam on Bernejo River*
2000	*PROMETA attended Conservation Training Week and learned about other sites' experiences*
2001	*PROMETA received technical assistance from Marlou and conducted watershed valuation workshops*
2001	*PROMETA decided to focus on the watersheds in the Sama Reserve and signs a cooperative agreement with the Municipality of Tarija, COSAALT, SERNAP and the Governor's office*
2001	*PROMETA initiates educational campaign*
2002	*PROMETA completely hydrologic and economic valuation research*
2002	*Fire in La Vitoria and Tolomosa watersheds*
2003-4	*Design and development of PRO-AGUA*

Box 2. Key Dates for the Sama Watershed Valuation Project

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While conducting this hydrology research, PROMETA also undertook an economic valuation study of the watershed environmental services that the Sama mountain range provides to the city of Tarija and surrounding communities. This study included two components: a contingent valuation study to estimate how much urban and rural residents value these watershed environmental services, and an estimate of the costs that the water company and hydroelectric company would incur if the Sama reserve were not protected, based on the results of the hydrology research.

In 2002, a fire burned 15,000 hectares of the La Vitoria and Tolomosa watersheds, including the microwatershed that provides water to the city. From the city, people could see the forests burning for several days. This disaster dramatically increased people's concern about water supply and interest in watershed conservation. Suddenly, watershed conservation became a topic that the local media discussed and local policy-makers were expected to address.

PROMETA organized a workshop to share the results of the hydrology and economic valuation research with representatives of the Municipality of Tarija, COSAALT, the Tarija Departmental government, SERNAP and other key stakeholder groups. The presentation of these results coincided with very strong government concern about watershed management, due to the public outcry after the fire in 2002. Government officials expressed concern about these rather alarming hydrologic and financial projections and interest in working on watershed management.

PROMETA also used the results of the hydrology research as one of the inputs in developing a site conservation plan for the two watersheds. PROMETA organized a series of three workshops to involve local organizations in the development of the site conservation plan. These organizations included the departmental government, the Municipalities of Tarija and San Lorenzo, COSAALT, SERNAP, the San Jacinto hydroelectric project and local non-governmental organizations.

SERNAP signed a co-management agreement with the communities around the reserve. These communities are very involved in forest fire prevention and control, reforestation, sustainable cattle ranching and other activities.

Beginning in 2001, PROMETA hired a communications professional to organize an educational campaign about watershed conservation oriented toward secondary school students and adults in the city of Tarija and surrounding communities. The campaign has focused on helping water users to understand where their water comes from and the need to conserve the watersheds that provide water to the city.

Preliminary Outcomes

There is broad public consensus about the importance of protecting the watersheds that provide water to the city. PROMETA believes that this is the result of the combined impact of the outreach campaign and the fire.

The 2002 forest fire demonstrated that institutions were operating independently, with little or no inter-institutional coordination. The fire provoked a massive response on the part of ordinary citizens, as well as all local and national institutions. This resulted in duplication of efforts, inefficient use of existing resources and even increased risk, due to the lack of adequate security measures. After the fire, several institutions expressed interest in working together and coordinating their individual actions. As a direct result of the disaster, PROMETA facilitated the development of an inter-institutional program for the prevention, detection and control of forest fires in the Central Valley of Tarija.

To address watershed conservation needs in an integrated and coordinated fashion, PROMETA helped create a coalition to coordinate the efforts of existing institutions-The Association for the Protection of the Water Sources of the City of Tarija and the Communities in the Tolomosa and La Vitoria Watersheds (PRO-AGUA). This coalition includes representatives of both governmental agencies and civil society. It facilitates fundraising, helps to avoid the duplication of efforts and increases fiscal accountability and transparency.

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The member organizations recognize the value of working together and believe that PRO-AGUA increases their collective capacity to manage the watersheds effectively. Although the Departmental government has primary responsibility for the management of water resources, it has little experience or expertise in watershed management. PRO-AGUA members have the needed expertise in watershed management and can help the Departmental government identify and fund priority actions.

One of the initial results of PRO-AGUA has been COSAALT's decision to dedicate part of its budget to watershed conservation. Historically, COSAALT interpreted its responsibilities as management of the springs and water collection area and the provision of water from the springs to the city, through extensive water infrastructure. The institution had never invested in watershed conservation, which they considered to be the job of foresters and agronomists, not engineers. As of January 2005, however, COSAALT created a Department for the Protection of Water Sources and the Environment, with an annual budget of $25,000 for watershed conservation activities. This represents a fundamental change in the goals of the institution.

Overcoming Challenges: The Future

The formal creation of PRO-AGUA has taken more time than anticipated. Many organizations have experienced turnovers and bureaucratic red tape as well as fears that people will be charged water user fees or that PRO-AGUA may privatize the water. Water has become a politically sensitive topic throughout Bolivia since 2000, when there were riots in Cochabamba after the government privatized the city's water supply, and the new company doubled and tripled water rates for more than half a million people, including many poor families.

PRO-AGUA still faces to the challenge of establishing watershed conservation as a high priority on the agenda of government agencies. Some point out that Tarija's population has grown dramatically over the past two decades, primarily due to development associated with the exploitation of gas reserves (approximately 90 percent of Bolivia's gas reserves are located in this department). During this period, the Departmental government has received gas royalties and has invested in the construction of roads and irrigation systems, but they have done little to ensure the protection of scarce and highly threatened water resources, because they do not consider it to be a top priority. Last year, the Departmental government even returned money to the central government, because it did not have the capacity to spend all of its budget. Meanwhile, the Sama Reserve did not have adequate staff or resources to adequately protect critical watersheds. PROMETA has asked the Departmental government to include money for PRO-AGUA activities in its annual operational plans.

When PROMETA began working on watershed valuation, they were interested in implementing a water user fee as a payment for environmental services. Although the organization is still interested in this innovative conservation tool, they believe that it may not be politically viable at this time. Their goal is watershed conservation, and to achieve this goal, they need to increase financial support for watershed conservation activities, but water users are only one potential source of funding. For the immediate future, they are working to convince the PRO-AGUA member institutions to dedicate more of their budgets to watershed conservation.

PROMETA believes that certain conditions must exist before it proposes a water user fee. First, PRO-AGUA must be legally established, and it must develop a positive public image. It should implement some conservation projects successfully, so that the public sees that the organization has the capacity to get things done. Second, Tarija needs to achieve a higher level of political, social and institutional stability. For example, over the last three years, Tarija has had five governors (prefectos). Throughout Bolivia, there has been social tension due to the economic situation. The Cochabamba situation remains on the mind of many Bolivians. Relative to other parts of the country, people in Tarija pay a substantial sum for water and electricity. They complain about these charges, a situation which reduces the feasibility of charging for water use in the near term.

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SIERRA DE LAS MINAS BIOSPHERE RESERVE, GUATEMALA

Figure 4. Sierra de las Minas Reserve, Guatemala © Peg Kohring/TNC

The Site

The Sierra de las Minas Biosphere Reserve (SMBR) is located in eastern Guatemala, in one of Central America's oldest and most biologically diverse mountain ranges **(see Figure 4)**. The reserve covers approximately 240,000 hectares and extends from close to sea level to over 3,000 meters. This altitudinal gradient creates a large variety of ecosystems that provide habitat for over two thirds of all mammal and reptile species registered in Guatemala and Belize, including endangered species such as the quetzal, yellow-cheeked warbler, jaguar, ocelot, tapir, and others. The SMBR is considered a very important "gene bank" for economically important coniferous species.

Sixty-three permanent rivers originate in the dense cloud forest of the core zone of the reserve. The rivers that flow out of the reserve are tapped to supply domestic water to over 500 impoverished rural communities (approximately 400,000 people), to irrigate subsistence crops and small-scale cattle pastures through numerous artesanal irrigation systems built by local residents, for small-scale coffee and cardamom processing, for drip irrigation systems constructed by agro-industrial companies that grow and export fruits, and to produce energy by hydroelectric plants. In the Motagua Valley, several businesses and industries depend on groundwater resources, including three bottling companies and a paper mill.

Threats to Biodiversity

Despite the socioeconomic and financial value of these water resources, current land use practices are degrading the watersheds of the SMBR. On the northern side of the reserve, poor Q'eqchí and Pocomchí residents cut down the forest to expand their subsistence agricultural areas. On the southern side, inappropriate agricultural and cattle ranching practices cause forest fires that reduce forest cover and contribute to soil erosion. Forest disease outbreaks also have contributed to deforestation. Over the last few years, several land invasions have occurred that have resulted in deforestation in the core zone and buffer zone of the reserve. Deforestation, forest fragmentation, soil erosion and soil compaction all have an impact on water supply and water quality. Residents throughout the area complain that deforestation has led to a decrease in water supply, particularly during the dry season. Many water users also complain of conflicts over increasingly scarce water resources.

There are currently no financial mechanisms in place to charge water users for watershed environmental services, channel user fees to the managers of the SMBR or compensate private forest owners for protecting their forests and providing valuable environmental services. A few municipalities and towns have water fees that cover the maintenance costs of surface water distribution systems, but in most cases, consumers do not even pay for maintenance. Where they exist, water fees do not vary according to consumption levels. For example, domestic water users and members of some irrigation systems pay fixed monthly maintenance fees. Users of surface water and groundwater pay nothing for the right to use the resource or for the protection and management of the watersheds and aquifers that provide it.

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Project Activities

To reduce the threats to the reserve and its watersheds, Fundación Defensores de la Naturaleza (Defensores), a TNC partner, determined that a key long-term approach was to involve downstream water users in supporting upstream forest conservation through the creation of a water-based finance mechanism for the Sierra de las Minas Biosphere Reserve. Over the past few years, Defensores has focused primarily on planning and alliance-building (see Figure 1). This has included studies and consultations with the principal water users around the reserve - all of whom are considered important stakeholders:

- Municipalities and community committees responsible for domestic water supply
- Farmers who use artesanal irrigation systems
- Agro industrial companies that use more complex drip irrigation systems, some of which draw on groundwater and others surface water
- Small-scale hydroelectric companies that operate or plan to operate in one of the RBSM watersheds
- Beverage companies and other industries that use groundwater and surface water.

Analysis of Guatemalan legislation related to water resources determined that the country's legislation is inadequate. While the nation's Constitution states that "all waters are public goods" and water use is to be regulated by a national water law, this law has never been developed. In addition to legal deficiencies, there are many institutional gaps. Although the Ministry of Environment and Natural Resources (MARN) has the responsibility to oversee the management of the nation's water resources, it has limited capacity to exercise this authority and thus different aspects of water use are overseen by different sectors, resulting in overlaps and conflicts between different water users. For example, concessions for hydroelectric companies are given without coordination with other sectors, such as local irrigation and domestic systems, generally creating conflicts between these users. In addition, there is no mechanism that prioritizes different water uses based on relative socioeconomic value. The result is that water use by those with stronger political and economic power take precedence over the needs of poor communities. In 2005, the government adopted a water policy that MARN coordinates. This should help address some of these institutional gaps and overlaps and ease conflicts between water uses.

Other studies included an assessment of domestic water supply systems in the ten municipalities in and around the SMBR in the departments of El Progreso, Zacapa and Baja Verapaz. Although many water users do pay a monthly fee for their water, it is quite low-generally between 1 quetzal and 12 quetzals (approximately between 14 U.S. cents and 1.60 U.S. dollars)-and usually is not sufficient to cover even the costs of operating and maintaining their water systems, much less the cost of watershed conservation. Very few communities have water meters, and those that do have them, do not always read them. Thus, in almost all cases, payments are not based on consumption levels, and no incentive exists to conserve water.

Defensores also conducted several watershed valuation studies as part of the effort to create a water-based finance mechanism. A contingent valuation study analyzed the economic value that local residents give to watershed environmental services. The study found that most residents understand the role played by the cloud forest at the top of the watershed in capturing water through fog drip and regulating stream flow. However, many are dissatisfied with the amount of water available to them and the inequitable access to the resource. At the same time, they perceive of themselves as poor and unable to pay for watershed conservation. The study found that most of these households pay Q20 to Q40 per month for electricity. Their willingness to pay much more for electricity than for water may be due to a perception that water always has been and should be a free resource, as well as their higher level of satisfaction with the electric service and their perception of equitable access to the service.

Another study involved four different methods to estimate the value of water for different industries,

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including hydroelectric companies, bottling companies and a paper company. The range of valuation estimates-from US $0.38 to US $1.99 per cubic meter-formed the basis for discussions with companies located in the Motagua Valley to try to establish voluntary agreements on payments for watershed services.

As part of this effort, Defensores is organizing key stakeholders at two levels. First, they are creating a Motagua-Polochic System Water Foundation that would include representatives from all the different water user groups in and around the Sierra de las Minas Biosphere Reserve and the Bocas del Polochic Wildlife Refuge. Second, they are helping to create local watershed committees in key micro-watersheds as models of local level decision-making and collaboration between sectors.

In addition, Defensores has designed a Water Resources Research and Monitoring Program to provide information to support decision-making for the Motagua-Polochic System. Within this program, Defensores is monitoring water quality and stream flow monthly at approximately 45 sites throughout the Motagua-Polochic System. Water quality measures include pH, total dissolved solids (TDS), conductivity, dissolved oxygen, temperature, phosphorus and nitrogen. Defensores also takes meteorological data monthly and monitors changes in forest cover every five years.

Preliminary Outcomes

Although the project is aimed at raising awareness of the value of water and the need to protect and reforest upper watershed areas, Defensores and its partners recognize that water users are more concerned with increasing their water supply and resolving conflicts. By helping the communities to resolve their immediate concerns about water supply, Defensores hopes to increase community awareness, interest and involvement in reforestation and forest protection. Since the end of 2003, Defensores has worked to form pilot watershed committees in three of the largest and most critical watersheds: San Jerónimo, Teculutan and Lato. In these watersheds, demand for water is high and, in some cases, tension exists between different user groups and between users in the upper and lower parts of the basins.

In the Teculután watershed, the largest watershed on the southern side of the Sierra de las Minas Biosphere Reserve, Defensores has been working with the mayor to broaden participation in the Pro-Teculután River Sierra de las Minas Biosphere Reserve Association. To date, the Association has developed a watershed management plan to guide land use planning and define priorities related to water use, reforestation, environmental education and productive agricultural activities. They have supported the establishment of a municipal forest office and collaborated on municipal reforestation projects.

Throughout the process of establishing this and other local watershed committees, Defensores has worked to raise awareness regarding the importance of water, freshwater biodiversity and sustainable resource management in the Motagua-Polochic System, through formal and informal education programs. Defensores has presented short presentations and videos about the reserve, the role of watersheds, the water cycle, the value of water and threats such as forest fires. Defensores prepares conservation-oriented public service messages for local radio stations. It has also prepared an educational guide for primary school teachers that can be adapted for each watershed.

The mayors of the municipalities in and around the Reserve have a growing appreciation for the importance of protecting the watershed. During the 2004 dry season, fourteen municipalities provided a total of 15 municipal park guards to work with Defensores staff and the Guatemala Protected Areas Council (CONAP) park guards to address forest fires and other threats in the SMBR. In 2005, they increased their support to include 30 municipal park guards and 6 municipal fire brigades. In addition, several municipalities opened Technical Units on Environmental Management.

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Overcoming Challenges: The Future

One of the biggest challenges that Defensores faces as it works to build one regional and many local governance structures for water resources (the Water Foundation and local watershed committees) is the inadequate legal and institutional framework for water resource management in Guatemala.

Another significant challenge in working with local water committees is to stay on mission and maintain Defensores' focus on the protection and sustainable management of upper watershed areas. In creating these committees, Defensores brings together stakeholders with diverse and often very strong water-related interests. The Municipalities would like Defensores to help them strengthen their capacity to manage domestic water supply systems. The Association of Irrigation Users of San Jerónimo (AURSA) members would like help resolving their conflict with the San Isidro-Matanzas hydroelectric company so that they will have more water available for irrigation. Other groups of farmers would like help in developing more efficient irrigation systems. Hydroelectric companies would like help in improving their relations with local communities. Industrial companies would like help in reducing their water use, adopting cleaner technologies and meeting the requirements of new regulations and market trends.

Many of the real costs of conservation and management of the core zone of the Sierra de las Minas Biosphere Reserve are not visible. They involve park guards' salaries, ongoing patrols, participatory planning processes with local stakeholders, inter-institutional collaboration to resolve problems such as illegal land invasions, and others. Within its training and education component, Defensores and its partner constantly reinforce the importance of conserving the SMBR core zone. Moving forward, one of the challenges will be to enlist water users to support concrete, visible projects as well as essential, less visible management actions.

Defensores originally envisioned the water fund purely as a finance mechanism in which water user fees and voluntary contributions would be used to cover most or all of the basic ongoing expenses of conservation and management of the core zone of the Sierra de las Minas Biosphere Reserve. In meeting with representatives of important stakeholder groups, however, Defensores found that they wanted to be involved in deciding how that money would be used. For this reason, the original idea of a water fund evolved into the creation of a water foundation and local watershed committees with representation from all major user groups. As different user groups participate in the water foundation, Defensores believes that transparency in decision-making and financial management over time will build trust and increase contributions. For the future, efforts will focus on the development of a governance structure in which all water user groups could participate in decision-making.

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CHIAPAS, MEXICO

Figure 5. Sierra Madre © Mark Godfrey/TNC

The Site

The state of Chiapas, located in southwestern Mexico is just one-third the size of California, but is home to over 640 bird species, more than 1,200 butterfly species and 17 natural plant communities. Chiapas' Sierra Madre mountain range resides in a transition zone between the Neoarctic and Neotropical biogeographical regions and, as such, is host to flora and fauna at the northernmost and southernmost extension of its range. Initially, the focus was on El Triunfo and the Cuxtepec watershed. Over time, TNC expanded the geographic scope to include La Encrucijada and the connecting Coapa watershed. Currently, watershed valuation activities cover three reserves (El Triunfo, La Encrucijada and La Sepultura) and five watersheds found in those reserves (Cuxtepec, Coapa, Lagartero, Zanateco and Pijijiapan) (see Figure 5).

Nestled in the Sierra Madre mountain range, El Triunfo is one of the most biodiverse forest reserves in Mexico and worldwide, protecting cloud forest, tropical forests, oak-pine forest and hydrologic systems in its nearly 120,000 hectare expanse. It provides habitat for 40 percent of the birds in Mexico, including the Quetzal. El Triunfo's importance to watershed conservation is undisputable. Its drainage captures 10 percent of Mexico's rainfall, providing water to all of Chiapas' economically important regions, including the fertile Soconusco plain. It also provides water to the Rio Grijalva in the Cuxtepec watershed, a river that is an important source of hydroelectric energy for Mexico.

Located on Chiapas' southern Pacific coast, La Encrucijada Biosphere spans over 144,000 hectares and includes mangrove estuaries, semi-deciduous tropical forest and seasonally-flooded coastal forest. The reserve forms one of the largest marine fishery spawning areas on Mexico's western coast and provides critical wintering habitat for migratory waterfowl, pelicans, wading birds and shore birds. From a conservation standpoint, La Encrucijada is one of Mexico's most important wetlands. Of particular importance are the unique zapotonal (pachira aquatica) forests and spectacular stands of mangroves that can reach over 25 meters in height.

With elevations ranging from 40 to 2550 meters above sea levels and some gradients as steep as 45 degrees, La Sepultura provides varied habitat that supports a wide range of plant and animal species. Its ecological zones are equally diverse and include semi-arid, humid, tropical, and temperate regions.

Threats to Biodiversity

Each watershed experiences threats unique to its region. However, some general threats include: high population density, slash and burn agriculture, cattle ranching, coffee production, logging, deforestation associated with these productive activities, heavy sedimentation and forest fires. Social and political strife, including conflicts over land, also have led to violent clashes in the area.

El Triunfo's main threats include: (1) deforestation from expanding coffee plantations, subsistence agriculture, cattle ranching and forest fires; (2) soil and water contamination from agrochemicals and coffee pulp; and (3) increasing pressure on surrounding natural resources as a result of social-agrarian problems such as poverty, marginalization, scarce agricultural resources and high population growth.

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Most of the major threats to La Encrucijada occur outside the reserve's boundaries and include: (1) deforestation in the upper and middle watershed, which causes erosion upstream and sedimentation downstream; (2) hydrologic alteration to increase cultivatable land for farmers and migrants upstream, which also increases sedimentation downstream; and (3) water contamination from heavy use of agro-chemicals. The fact that most of the major threats to La Encrucijada come from outside of the reserve has been a primary motivator for reserve management to adopt a watershed approach to conservation. Threats within La Encrucijada include the conversion of forested areas, mangroves and cattail marshes for grazing and agriculture, illegal timber harvesting, wildlife poaching, canal and coastal lagoon contamination, land ownership conflicts and a sharp increase in shrimp farming along the Pacific coast.

One of the main threats to La Sepultura area-and to watershed conservation in particular-is that the city of Tonalá extracts much more water than it returns, causing the downstream lagoons to become more salty and reducing fish and shrimp catches. Other threats to La Sepultura and neighboring regions include extensive ranching, slash and burn agriculture and clearing for logging. These threats have reduced downstream water flows, resulting in heavy eutrophication and sedimentation.

Project Activities

A key approach to ensuring the long-term conservation of Chiapas' reserves lay in helping people understand and value the connection between their economic activities and ecosystem services related to water. The most effective way to maintain water resources was to work in the entire watershed-from the headwaters in El Triunfo through the agricultural mid-section that depends on those waters down to the lowland mangroves that filter the water before it enters the ocean. With this in mind, TNC and its partners developed project activities to work with stakeholders to create awareness of the inter-connectivity of the watershed. The main focus was on three long-term goals: (1) determining the value of watershed services in the Chiapas Coastal Watersheds and providing the tools needed to secure long-term financing for those services; (2) building institutional and technical capacity for watershed management; and (3) informing and creating awareness about the value of water so that people feel a commitment to watershed conservation.

To achieve these goals, TNC and its partners have been working to build institutional capacities in Chiapas by strengthening a multi-institutional watershed planning committee. On-site technical assistance, training, exchanges and guidance have centered on strengthening the technical capacity of various stakeholders. Throughout this effort, results have been shared widely through publications.

TNC also has hosted workshops and training events on watershed management, project planning and other relevant issues for watershed conservation in Chiapas. These events have included participation from many stakeholders, including several local and national governmental and non-governmental organizations.

TNC and its partners conducted economic and biological feasibility studies to determine the value of environmental services provided by the watersheds and the willingness of local users to pay for those services. IHNE carried out these studies in the rural areas of Coapa and Cuxtepec, while Pronatura carried out studies in the urban areas of Tuxtla Gutierrez, San Cristobal de las Casas, Arriaga, Pijijiapan, La Concordia and Tonalá. Based on the results of these studies, the municipalities of Arriaga and Pijijiapan appeared to be places where water user fees might be most feasible.

TNC and its partners developed a draft site conservation plan for the Coastal Watersheds of Chiapas-a platform site that includes all three reserves and several watersheds. These site conservation plans included analyses of threats, which have helped inform where TNC and its partners work and which interventions they choose. The plan for the Coastal Watersheds of Chiapas was developed with participation from several actors in the area, including TNC, Conservation International, Comisión Nacional de Áreas Naturales Protegidas (CONANP), IHNE, Instituto para el Desarrollo Sustentable en Mesoamérica, A.C. (IDESMAC) and Pronatura.

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Preliminary Outcomes

As a result of these efforts, IHNE established its own environmental services office within the Department of Natural Areas and hired a full-time investigator dedicated to this area. In addition, Fondo de Conservación El Triunfo (FONCET) was created as a new NGO to help manage conservation funds for El Triunfo. It has developed a strategic plan and a business plan and has achieved tax-deduction status.

The partners also have secured US$2 million, which has gone into an endowment fund for El Triunfo that is managed by a branch of the Fondo Mexicano para la Conservación de la Naturaleza (FMCN). The Fondo de Conservacion El Triunfo and CONANP's El Triunfo Biosphere Department receive the interest from this US$2 million for management activities at El Triunfo. TNC and partners plan to transfer the $2 million to FONCET in the future.

Bringing together diverse institutional efforts has resulted in the diffusion and adoption of various planning and management methodologies and tools among organizations such as CONANP, IHNE, watershed committees and municipalities. For example, the Municipality of Arriaga began a site conservation planning process for the Lagartero watershed in March 2004. Those who have helped develop the plan include CONANP, personnel from La Sepultura Biosphere Reserve and local residents. Arriaga municipality representatives see local participation as critical because "they are the ones who know the work best." The plan, which municipal authorities saw as a critical step for watershed management, was completed in late 2004 and is in the process of being implemented.

CONANP helped facilitate a participatory planning process in the Coapa watershed that connects El Triunfo and La Encrucijiada. The planning process involved numerous stakeholders, including upland residents, fishermen from downstream, government organizations, NGOs and researchers. One key product of this process was an ecological land zoning plan, which now officially governs land use in the watershed. The Coapa Watershed Community Committee formed as part of this participatory planning process. TNC and its partners realized, however, that the watershed needed a stronger force, and so they helped form the Pigua (Crawdad) Committee, an inter-institutional committee with representatives from TNC, IHNE, CONANP and IDESMAC. The objective of the Pigua Committee was to consolidate Coapa's watershed management.

Overcoming Challenges: The Future

Together with WWF and the Consejo Civil Mexicano para la Silvicultura Sostenible (CCMSS), TNC conducted study of the legal environment for establishing a water use fee system. This study did not prove useful for informing project design, because it was too general and focused on national level policies. As a result, TNC conduct a local level study in the municipalities of Arriaga (Lagartero watershed) and Tonalá (Zanateco watershed). The current municipal presidents have been supportive of watershed work, but TNC and its partners are concerned because the presidents and the municipal policies change with each election. Consequently, TNC wants to undertake a legal analysis that will help ensure that watershed management is a longer term process in which local governments actively participate but changes in governing administrations do not cause drastic negative impacts to ongoing watershed valuation work.

A key force in watershed planning and management has been the Consejos de Cuenca, or Watershed Councils and the Watershed Committees within them that represent the individual watersheds. The Comision Nacional de Aguas (CNA), the state organization in charge of administering and preserving Mexico's water sources, established the watershed councils and watershed committees structure as a way to enlist greater local participation across various sectors in watershed management. This was in response to a federal policy re-established in 2000 that places greater emphasis on watershed management. The Consejo de Cuenca para la Costa de Chiapas (Chiapas Coastal Watershed Council), also established in 2000, has various committees within it at the individual watershed level. These committees provide an important opportunity for different organizations and local user groups (e.g., agriculture, urban, livestock, fishing, etc.) to take part in watershed planning. However, these councils and committees are still relatively new, and it will take some time for them to be truly participatory, representative, democratic, and transparent.

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QUINTANA ROO, MEXICO

Figure 6. Sian Ka'an Biosphere Reserve, Quintana Roo, Mexico © Connie Gelb/TNC

The Site

Located along the Caribbean coast in the State of Quintana Roo, 130 kilometers, or 80 miles, south of the resort city of Cancun the Sian Ka'an Biosphere Reserve (SKBR) **(see Figure 6)** is a UNESCO World Heritage Site covering 617,265 hectares and containing one-third lowland tropical forest, one-third wetlands (marshes, flooded savannahs and mangrove forests), and one-third coastal and marine habitats (lagoons, bays, and coral reefs). Reserve boundaries encompass 68 miles of the Mesoamerican Reef, the world's second largest barrier reef, and protect unique features including sinkholes, hummocks, lagoons and freshwater springs.

SKBR harbors old growth and seasonally flooded lowland forests as well as grasslands and sandy beaches, each of which provides important habitat to species such as jaguars, pumas, tapirs, marsh and river crocodiles, turtles (loggerhead, leatherback, hawksbill, and green) and more than 330 species of birds, including large numbers of wintering neotropical songbirds. This tropical forest represents one of the last secure sites for these endangered species. Moreover, according to SKBR's site conservation plan, the reserve's wetlands, estuaries and bays are critical for nutrient recycling and reproduction phases of marine resources, and its mangroves and reef systems are among the most productive systems in the world.

The Sian Ka'an site is unique in that its watersheds include the Caribbean Sea and an inter-connected network of surface and underground freshwater flows. In fact, much of the watershed remains unknown and unexplored due to the "hidden" nature of the largely underground network of water systems.

Threats to Biodiversity

Over the last 30 years, Cancun has grown from a sleepy fishing village to the largest resort destination in Mexico. Tourism has spread south down the Quintana Roo coast, with some communities such as Playa del Carmen, reaching annual growth rates well over 20 percent. This rapid pace of development has brought numerous threats to SKBR and the region, including unregulated tourism development, associated water pollution and hydrologic alteration, overfishing, forest fires and uncontrolled resource extraction.

According to the Sian Ka'an site conservation plan, the main threats to the site's priority animal species (puma and jaguar) include tourism development, agro-chemical and heavy metal contamination of water sources and global warming. In addition, local organizations note threats related to the lack of adequate sanitation infrastructure and waste disposal services, the rapid pace of development (especially of the tourism sector) and poorly managed solid waste disposal throughout the area. With water demands for the tourist industry

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growing, some aquifers are showing evidence of increasing salinization.

Project Activities

TNC's partners, Amigos de Sian Ka'an (ASK) and the Comisión Nacional de Areas Naturales Protegidas (CONANP), have been working in the Sian Ka'an area and the State of Quintana Roo for numerous years. It was only recently, however, that the organizations began to focus on watershed valuation as an approach to conservation. ASK and the Centro Ecológico Akumal (CEA) conducted two workshops in November 2003 to bring together key stakeholders to discuss a watershed valuation process and identify next steps. The primary product of this workshop was a publicly-available CD that pulled together studies, reports and maps from numerous organizations working in the Yucatan Peninsula. As a result, an enormous amount of water-related information was made centrally available, thus setting the stage for stronger institutional coordination and greater awareness of what others were doing in the Yucatan's watersheds. Access to this information helped ASK and other collaborators learn more about how watersheds in the Peninsula function.

An April 2004 meeting in Akumal ("Integrated Coastal Watershed Management"), facilitated by ASK and CEA, provided an avenue for sharing the results from the November 2003 workshop and taking some early steps in the watershed valuation process (i.e., identifying uses, actors and threats affecting the watersheds). The most significant outcome of this meeting was the decision by all participants to establish the Red de Agua Limpia del Mayab (the Mayab Clean Water Network). All those present at the meeting are considered founding members and include government and non-governmental organizations, research institutes, businesses and several community-based organizations.

ASK, CEA, Grupo XCaret (a watershed partner from the tourism sector), Centro de Investigaciones del Sistema Acuifero de Quintana Roo (CINDAQ) and other actors have helped facilitate various studies that provide a better understanding of the situation in some of the region's key watersheds. Grupo XCaret, for example, provided funding for a portion of a peninsula-wide hydrologic study conducted by the Universidad Nacional Autónoma de México (UNAM). Grupo XCaret is particularly interested in the results related to rivers that feed into XCaret and Xelha nature reserves, two areas the company manages for conservation and nature tourism.

Similarly, ASK contracted with CINDAQ to map the subterranean waterways adjacent to the Sian Ka'an Biosphere Reserve. ASK saw this as crucial information to understand water flows affecting the reserve and to make well-informed management decisions. For instance, if links to Sian Ka'an existed, then inappropriate development elsewhere could lead to contamination of the SKBR, the adjacent Ox Bel Ha underground aquifer and the Mesoamerican Barrier Reef. Results from this study revealed that water flows vary, but much of the water in the mapped areas flows from the northwest to the northeast and south. This southerly flow is what could be of concern for the reserve, as contaminants in the underground aquifers could make it to SKBR. ASK intends to use the results of this work to help inform decisions made by the Ecological Land Zoning Committee (of which ASK is a member) for the Solidaridad and Benito Juarez Municipalities.

Preliminary Outcomes

It is difficult to evaluate outcomes in terms of the role of watershed valuation as compared to some of the other studies. The groups recognize the need for watershed valuation studies but have not yet reached the stage of project development (see Figure 1) where it made sense to conduct one. Currently, various types of studies provide key inputs to the watershed conservation planning process into the future.

The biggest achievement to date has been the ability to bring diverse groups together to work on watershed matters relevant to all. Stakeholders now have a stronger sense of what is happening in the watershed, and they know who uses the water for what purspose.

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As described above in the Chiapas case study, the role of Consejos de Cuencas or Watershed Councils is important to watershed conservation in Mexico. The Yucatan Peninsula Watershed Council includes the states of Campeche, Yucatan and Quintana Roo. The Yucatan Peninsula Watershed Council includes water users organized by sectors of use (e.g., industry, urban public, agriculture and livestock) and two scientific groups that help the Council make informed decisions-the Specialized Group on Sanitation (a committee for the northern zone and another for the southern zone) and the Clean Beaches Committee.

Alliance-building is occurring through interactions among members and committees within the Yucatan Peninsula Watershed Council. ASK has been involved with the Watershed Council primarily through participation in its technical committees. ASK staff feel that the water valuation meetings were instrumental in helping them secure their participation in the Yucatan Peninsula Watershed Council. Given the central role of watershed councils to water resource planning, use and preservation, it is key to have supporters of a watershed valuation process participating in the watershed councils and their committees.

Overcoming Challenges: The Future

The two workshops that TNC partners facilitated in 2003 and 2004 were aimed primarily at building awareness and, to a lesser extent, capacity in watershed valuation. Watershed valuation activities are still in their infancy in Quintana Roo. Capacity-building in watershed valuation is a process that will take much more time. Part of the challenge has been the lack of clarity about the roles and the objectives of the many different groups working on water issues, including TNC and governmental organizations (Secretaría de Medio Ambiente y Recursos Naturales, the National Water Commission, municipalities, etc.).

One of the greatest threats to the Quintana Roo watersheds is the inadequate sanitation system. There is no proper infrastructure to deal with wastes. Instead, pollutants directly enter the waste stream. This, combined with the rapid pace of development, is causing much concern among conservation organizations. Conservation actors are taking some discrete actions, but there is not, as of yet, a strategy that includes a watershed valuation process. Conservation leaders feel it is important to look at the sanitation problem from a human health perspective-human health costs and increased diseases-which, ultimately, will have an important economic impact on the region.

Funding also remains an issue. CEA had been tasked with heading up the Mayab Clean Water Network, but limited funding and staffing have prevented the organization from fully launching the network. Objectives for the Network have been delineated as: (1) define and consolidate the Network's internal structure, functional organization, and strategy (including the establishment of an institutional charter and the definition of projects and allocation of partners' responsibilities); and (2) successfully launch the Network's public activities and advocacy efforts (including education and awareness-raising activities as well as the identification of sustainability criteria for Akumal's development). Many of the activities defined under the second objective are critical for the water valuation process (e.g., awareness-raising, policy advocacy and development, and ecological, social and legal background studies).

There is an opportunity for stronger coordination among the Yucatan Peninsula Watershed Council members who are focused on water for human uses and the municipal ecological land use zoning committees, which are focused on water conservation and preservation. The groups are interested in water resource use, but they do not coordinate their work. ASK is a member of the Watershed Council and the Ecological Land Use Zoning Committee for the Solidaridad and Benito Juarez municipalities (CEA is also a member of the latter committee). ASK hopes that its dual membership in these two groups will help improve the coordination and collaboration between them.

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They also hope to encourage the Watershed Council to take a broader perspective and consider water not only in terms of human uses, but also in terms of its biological and conservation importance.

Because the representatives participating in the Mayab Clean Water Network come from a variety of sectors, there are unique opportunities to influence policies and actions beyond the governmental realm. The most obvious example is the potential to lobby the tourism industry and influence the way that tourism develops and operates. One of the greatest threats to Quintana Roo's watershed is the exponential growth of mass tourism that often pays little regard to environmental impacts.

One of the greatest challenges to watershed public outreach in the Yucatan Peninsula and Quintana Roo is the nature of the watershed itself. People cannot see the water. Even if they know there is subterranean water, they are not aware of the intricate networks, how they flow, and how they influence water quality or are affected by water contamination. Conservation actors in Quintana Roo and the Yucatan face this in terms of law and policy effectiveness. Although Mexican water laws and regulations are fairly strong, they generally are not relevant for the Yucatan's watershed because of their unique underground nature. Mexican standards are developed for conditions in the middle of the country, not for coastal areas with subterranean watersheds. The unique ecological conditions also make it difficult to communicate effectively with policymakers. A priority for the region, according to ASK, is to make the official water quality norms stricter or, at a minimum, acceptable for the local conditions.

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LAKE YOJOA, HONDURAS

Figure 7. Lake Yojoa, Honduras

The Site

Lake Yojoa, located in central-western Honduras, is Honduras' only natural lake and covers about 79 square kilometers. In 1971, the Honduran Congress declared Lake Yojoa and its watershed a protected area. In 1975, the government developed a "multiple use plan" for the area. Since then, Hondurans have considered the lake and its watershed to be a multiple use area, although this management category has no legal basis in Honduras. The 1971 legal decree defined the boundaries of the protected area, but to date, the area has no zoning. This means that it does not have (as most protected areas do) a "core zone" that defines and protects the most intact and ecologically significant areas. The lake is located between two other protected areas **(see Figure 7)**, established in 1987, when Honduran Decree 87-87 gave legal protection to all montane areas above 1800 m. On the western side of the lake is the Santa Bárbara Mountain National Park (PANAMOSAB) and on the eastern side is Cerro Azúl Meambar National Park (PANACAM). Together, these three protected areas cover 635 square kilometers.

The Lake Yojoa area contains diverse ecosystems that have been categorized into the following four groups: (1) the lake ecosystems, including wetlands and flooded forests, (2) the submontane, broadleaf forests around the lake, (3) the montane forests of Santa Bárbara and Cerro Azúl Meambar and lower surrounding areas, and (4) the dry forests of the Zacapa and Ulúa river valleys.

An analysis of the comparative value of Honduras' protected areas for biodiversity conservation concluded that Lake Yojoa is the fourth most important of the country's 98 protected areas, due to its high biodiversity, the presence of unique or uncommon ecosystems and rare and endemic species. The Lake Yojoa region has the highest diversity of plants of any region in the country (802 species or 10.6 percent of the national flora), most of which is concentrated in the submontane zone around the lake. This floral diversity includes all of the Honduran plants on the CITES 1 list, 15 endemic plants, and 86.5 percent of the aquatic plants reported in the country. The 407 species of birds in this region represent 55 percent of Honduran bird species and 88 percent of the country's freshwater birds. The 31 species of amphibians and 72 species of reptiles represent 44.2 percent of the amphibian and 43.6 percent of the reptile species in the country. Scientists have reported 54 species of mammals, including endangered species such as the tapir, jaguar, giant anteater, spider monkey, white-faced monkey and howler monkey.

Threats to Biodiversity

In addition to its biological value, the lake and its associated watersheds have high hydrologic value. Several economic activities depend directly on the lake. For example, the national government manages two hydroelectric plants located on tributaries of the lake. The beauty of the lake and sport fishing opportunities attract both international and national tourists. Residents have constructed

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aquaculture ponds around the lake, while a foreign-owned company cultivates tilapia in cages in the lake. In addition to these economic activities, the lake's watersheds provide drinking water to approximately 200 communities with over 36,000 residents. Despite the region's value for biodiversity conservation and the socioeconomic value of its water resources, land use practices have resulted in loss of biodiversity and watershed degradation. Other economic activities have caused water pollution, altered hydrologic flow patterns and contributed to the loss of native species.

Between 1986 and 2000, land use maps show that almost all of the primary forests and pine forests in the Lake Yojoa multiple use area were converted to agricultural lands. Forest cover also diminished dramatically in the Santa Bárbara and Cerro Azúl Meambar National Parks, but to a lesser degree due to the rough terrain and inaccessibility of much of the two parks' primary forests (especially in the core zones). Because floral biodiversity is higher in the submontane region around the lake than in the two parks' montane forests, conversion of the forests in the multiple use area probably has caused significant biodiversity loss.

Hydropower generation has altered the lake's hydrologic flow patterns. In the 1970s, the Honduran government constructed a canal in the northwest part of the lake to divert water for hydropower generation to two hydroelectric plants (Cañaveral and Río Lindo). The government also constructed a dike that blocked natural drainage into the lake in the southwestern part of the lake. To make up for water diverted from the lake's watersheds, the National Electric Energy Company (ENEE) diverts two rivers from other watersheds into the lake. The increasing demand for hydropower production has lowered the level of the lake and affected wetlands that are ecologically adapted to the natural fluctuations of the lake.

Organic pollution from municipal sewage and floating aquaculture tanks contribute to the Lake's eutrophication. Most of the towns in the lake's watershed do not have sewage treatment plants. Aquaculture tanks cover 2.6 hectares of the lake, where 4,500 tilapia are grown each year. The food given to the fish every day is a constant source of organic pollution that contributes to eutrophication.

Heavy metals contaminate the lake's sediments and have been found in lower concentrations in the fish. Mining of gold, zinc, silver and lead in the lake's watershed have caused heavy metal contamination since the late 1940s. Wastewater from the mines and the processing areas (where chemicals are used to separate the minerals) used to flow directly into the lake, but the owners of the mining company constructed a settling pond in 1971 to minimize the flow of pollutants into the lake.

Agrochemicals are also a major source of water pollution. Ornamental plant nurseries, pineapple plantations and coffee plantations all contribute to this problem. In addition, in 1954, black bass was introduced into the lake, and in 1964, tilapia was introduced. Both of these exotic species have displaced native fish species. Before the introduction of these species, fishermen caught native fish, primarily guapote (rainbow bass) and bagres (catfish).

Project Activities

In 1995, a group of mayors from municipalities around the lake (both within and outside of the lake's watershed) came together to analyze the problems facing the lake and to discuss common social and economic problems. They formed the Association of Municipalities for the Protection of Lake Yojoa and its Areas of Influence (AMUPROLAGO), which currently includes representatives from 14 municipalities. During the initial phases, TNC and its partners focused on helping AMUPROLAGO with: (1) strategic planning with the municipalities in the Lake Yojoa watershed, (2) a site conservation plan for the Lake Yojoa watershed and the Santa Bárbara Mountain National Park, and (3) a watershed valuation process.

The Lake Yojoa watershed strategic planning process brought together representatives of the municipalities and other stakeholders in the Lake Yojoa watershed including AFE-COHDEFOR, Honduras' federal agency responsible for protected areas. AMUPROLAGO facilitated a series of participatory workshops in 62 area communities, during which participants analyzed socioeconomic and environmental problems as well as infrastructure and service needs. As a result of the process, AMUPROLAGO produced strategic plan documents and maps for each municipality and a strategic plan for Lake Yojoa. More importantly, the process effectively engaged local stakeholders.

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In February 2002, AMUPROLAGO and TNC organized a site conservation planning workshop for the area encompassing the Lake Yojoa and Santa Bárbara protected areas. At the workshop, scientists, managers and key stakeholders worked together to identify the most important ecosystems and species (the site's conservation targets), analyze the viability of each target, analyze the threats facing each target, and define indicators to measure success in reducing threats and conserving the site targets.

AMUPROLAGO and TNC organized a series of watershed valuation workshops with representation from all major stakeholder groups. Participants worked together to define all of the valuable services that the water from Lake Yojoa and its watershed provide and to identify water users and beneficiaries. They also defined the threats to the lake and its watershed. Finally, they defined management objectives and identified audiences that would need to be involved in order to achieve each objective.

As a result of these planning processes, AMUPROLAGO defined as its mission "to promote the sustainable development of the AMUPROLAGO region through the joint effort of the 14 member municipalities." The organization has four programmatic priorities, one of which is the conservation, protection and valuation of Lake Yojoa and its watershed. Within this programmatic area, the organization has chosen to focus on reducing water pollution, conserving priority ecosystems (such as the lake's wetlands) and involving the municipalities in natural resource management.

Preliminary Outcomes

The watershed valuation workshops produced several significant results. First and foremost, it brought together a diverse group of stakeholders with different perspectives and a history of conflicts. It enabled participants to recognize the collective value of the lake and its watershed and also convinced them of the need to pay more to protect their water resources. Participants recognized that currently they do not pay enough to ensure the conservation and management of this vital resource. In addition, two municipalities initiated processes to protect springs that provide drinking water to their communities. Finally, participants proposed the creation of a Watershed Advisory Committee, a 24-member multi-sectoral group charged with ensuring that AMUPROLAGO's priorities and projects respond to the needs of all the watershed stakeholders.

During both the strategic planning process and the watershed valuation process, participants identified the need to protect micro-watersheds-especially upper watershed areas that provide drinking water to communities. For example, the Municipality of Santa Bárbara decided to purchase the land where its water sources are located. The Municipality of Santa Cruz de Laguna included in its strategic plan actions to protect micro-watersheds and improve water quality for human consumption.

With technical assistance from TNC, AMUPROLAGO invested a significant amount of time in negotiating, developing and signing five conservation easements: two easements with private landowners and three with the Municipality of Santa Cruz de Yojoa. Together the private and municipal easements protect almost 60 hectares of forest.

When AMUPROLAGO signed these conservation easements in 2000-2001, it was a significant step forward in the use of this conservation tool. At the time, conservation easements had been used extensively in North America, but their application in Latin America was quite limited. There are several incentives for landowners to place a conservation easement on their property. The Honduran government has made all land included in a conservation easement exempt from property taxes, and it has committed to give landowners help in fighting forest fires, if necessary. In this case, AMUPROLAGO also provided legal assistance to help the private landowners obtain legal rights or official title to their land.

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Overcoming Challenges: The Future

Many believe that stronger legal instruments and more technical information are needed before the mayors of AMUPROLAGO could apply user fees to companies like ENEE and Aqua Finca Saint Peter Fish.

Since 2001, AMUPROLAGO has faced countless challenges in upholding the established conservation easements ranging from new claims of property ownership to owners not upholding the obligations of the easement. Political changes in the mayor of Santa Cruz de Yojoa have resulted in less importance being placed on monitoring compliance by landowners. This experience demonstrates some of the challenges of using conservation easements in Latin America. Overlapping claims to land are common in the region, and many people do not have legal title to their land; thus, conservation organizations run the risk of getting involved in land disputes, unless they conduct thorough background research on the property before signing the easement. In addition, monitoring easement compliance requires an investment of staff time over the long term. Also, ensuring the legal enforcement of the easement potentially can be expensive; conservation organizations generally do not have the resources needed to take legal action in cases of non-compliance. Finally, because there is no legal precedent, it is not clear whether the Honduran courts would uphold a conservation easement.

Organizations like AMUPROLAGO, the Ministry of Natural Resources and Environment (SERNA) and others involved in the management of the lake need more technical information about its hydrology and water quality: a water balance study to determine why the lake level has decreased; maps of critical habitats such as wetlands, so that they can protect them; and more information about current water quality and the relative contribution of different sources of pollution, so that they can direct their actions toward decreasing the most significant sources. It has also been suggested that a study of the carrying capacity of the lake could provide information to help regulate aquaculture and other activities that directly affect water quality. Managing the lake requires regulating the various uses of the resources and resolving conflicts between user groups. Resolving conflicts in a fair and transparent way requires a good base of technical information.

Like many Latin American countries, Honduras' water legislation is outdated and inadequate to meet modern needs. The National Water Use Law was developed in 1927 and reflects the priorities of sectors that had strong political power at that time, such as the banana companies, the railroad and cattle ranchers. One of the weaknesses of the law is that it regulates different water uses such as domestic water supply, irrigation, navigation and industrial use individually (sector by sector), without considering overlaps and conflicts and the need for integrated watershed management. Another is that although groundwater is a finite resource that can be overexploited, the law allows landowners to drill wells freely, and it considers groundwater as private property once it has been extracted by the landowner. There have been many attempts to create a more modern legal and institutional system for water management but much more needs to be done to ensure its passage and implementation.

LORE LINDU, CENTRAL SULAWESI, INDONESIA

Figure 8. Conservancy Projects in Indonesia.

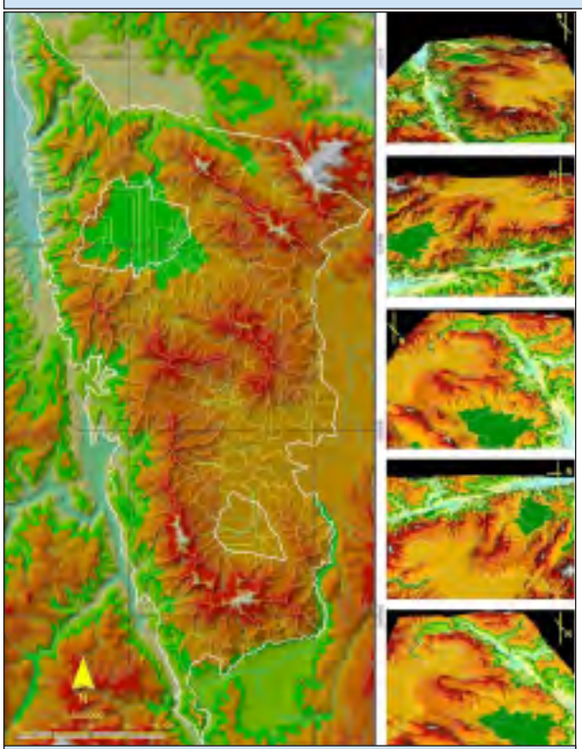

Figure 9. Lore Lindu. Central Sulawesi, Indonesia

The Site

Central Sulawesi is mostly covered in montane and sub-montane moist tropical forest, but other vegetation types that can be found there include rare cloud forest, heath forest, monsoon forest, marsh and small amounts of lowland forest. Among the threatened and endemic species found in the province of Central Sulawesi are the anoa, babirusa, Sulawesi hornbill, maleo, Sulawesi palm civet and the Tonkean macaque. The capital city of Central Sulawesi, Palu, is reputed to be the driest place in Indonesia, as the steep mountains to east and west of Palu city catch most of the rainfall and leave the valley in a rainshadow.

A large extent of forest in Central Sulawesi is under formal protection status as part of Lore Lindu National Park (LLNP). The Palu River is located in the province of Central Sulawesi. The major forested areas draining into the Palu Valley include Lore Lindu National Park and the Gawalise Mountains, both of which are crowned by montane forest **(see Figures 8 & 9)**.

Threats to Biodiversity

Small-scale illegal logging has burgeoned and deforestation has accelerated. The impact on infrastructure and living standards of local people has increased as well, although the sustainability of this growth is uncertain. High population density has created a competitive environment for cultivatable land in the area.

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Natural forests that are converted for agriculture produce soils that are highly weathered, lacking in nutrients and only productive for a short time (and then are typically abandoned). Conversion of these forests often involves 'hidden' costs, including: rapid loss of soil fertility after forest clearance that can only be compensated for by increasing investment in fertilizers; loss of sustained yields of forest products; increased soil erosion; and alterations to the hydrological regimes of watersheds.

Flooding, which has occurred every year since the late 1990s, leads to negative impacts to infrastructure and agricultural land in and around the Palu watershed. This flooding results from mismanagement of the watershed through forest encroachment and illegal logging; weak law enforcement; antiquated sectoral management that is susceptible to overlapping policies and implementation; and poorly-defined management authorities between central government, provincial and district/town.

Project Activities

In 2002, the Conservancy commissioned a study on the value of water resources in the Lore Lindu National Park. The study found that, in total in 2001, waters arising from LLNP had an estimated current annual value of approximately Rp. 89.9 billion, or US$9 million. The study noted that the forested areas of Lore Lindu National Park provide important ecological functions in the regulation of flow rates and sediment loads and assist in maintaining important groundwater reserves for the city of Palu. Through the provision of these functions, important infrastructure and irrigation systems are protected, and water quality is maintained. The study pointed out that LLNP's forests are an important part of the physical and economic character of Central Sulawesi and will continue to play a significant role in future developments in the province. As a result of the study recommendations, the Conservancy is incorporating the conservation of LLNP forests into all of Central Sulawesi's development plans for watershed protection.

The issues around mismanagement of the watershed were brought to the fore in a House of Representative Hearing in March 2003, which resulted in the emergence of a recommendation to urgently "develop a model and plan for multi-stakeholder management of the Palu watershed." However, there was no significant effort from local institutions, including the House of Representatives, to implement this recommendation. TNC, which has been working in Palu since 1994, helped catalyze inter-institutional communication on environmental issues and worked to ensure that the issue of Palu watershed management remained high on the governmental agenda.

Originally, about 40 institutions were identified as potential stakeholders, but only 15 of these had ongoing activities in Palu watershed. The next step of stakeholder analysis was to limit the number of stakeholders to an initial core committee for Palu watershed management. A priority was placed on local government institutions at provincial level that had on-going activities in the proposed project site (the Miu sub-watershed). Based on these criteria, eight institutions were selected as members in the initial core committee for the Palu watershed-BP-DAS Palu Poso, Bappeda Propinsi Sulawesi Tengah, Sub Dinas PSDA Kimpraswil Sulawesi Tengah, Bapedalda Sulawesi tengah, Dinas Kehutanan Sulawesi Tengah, Balai Taman Nasional Lore Lindu, Universitas Tadulako and Bappeda Donggala. TNC acts as the committee secretary only.

After the core committee for the Palu watershed was chosen, measures were undertaken to formally establish the committee. From June to July 2004, TNC identified and then proposed potential candidates from each institution to their respective Head Office, which made final decisions on who would represent each of these offices on the Palu Watershed Committee.

Preliminary Outcomes

The first committee meeting was held in July 2004 to announce a grant from the Japan Bank for International Cooperation (JBIC) and to introduce relevant issues and possible strategies for improved management of the Palu watershed. The meeting resulted in a better understanding about TNC's intended outcomes and agreement on the need for a multi-stakeholder approach to watershed management. Other results included: the naming of the multi-stakeholder management committee to "Forum Pengelolaan DAS Palu (FP-DAS Palu);" selection of the Miu sub-watershed in the upper Palu watershed as the project area for the grant; preparation of the work plan for FP-DAS Palu; and the decision to include TNC as one of the

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forum's members, making the total members of FP-DAS Palu nine.

FP-DAS Palu was legalized through a decree by the head of the River Area and Water Allocation Working Group RAWAWG) on August 30, 2004. According to this decree, the group is responsible for the following:

1. Establishing a watershed management forum (FP-DAS Palu) for the Miu sub-watershed.
2. Developing recommendations on the establishment of a computer model to inform the Master Plan for Miu Watershed Participatory Management.
3. Providing inputs and advice to the River Area and Water Allocation Working Group (RAWAWG) on development of the "Palu-Lariang Rivers Management Plan."
4. Database management of the Miu sub-watershed.
5. Providing regular reports on the progress of the JBIC grant to RAWAWG.
6. Forum Pengelolaan Das Palu (FP-DAS Palu) for the Miu sub-watershed has direct responsibility to RAWAWG.

The Water Resource Coordination Team is responsible for the overall management of water resources in Central Sulawesi and reports directly to the Governor. For more effective management of water resources, the Coordination Team was divided into two working groups.

Since the Palu watershed is specified as one of the most important river areas in the province and is a critical source of water irrigation, the FP-DAS Palu falls under the coordination of RAWAWG. This position is beneficial to FP-DAS Palu, increasing the likelihood that it will be sustained and funded into the future. Existing decrees provide clear direction for FP-DAS members to participate officially in the forum activities while RAWAWG finances the costs. The FP-DAS also can submit a proposal for funding to the local government under the existing decrees.

One of the key early successes of this project is that it provided enabling conditions for the watershed forum. This study led to an immediate and significant increase in local support for LLNP. Prior to the water valuation study, a seven year management partnership by the Indonesian parks agency, PHKA, The Nature Conservancy and local NGOs had led to only lukewarm support for the park. Only after the value of the park beyond its boundaries was documented did a local constituency form with agricultural users (previously a threat to the park) and local government (a key management stakeholder in the new era of decentralization in Indonesia). The economic and social values of water production now form an integral part of management effectiveness assessment of LLNP. Furthermore, as the members of the watershed management committee are acting on behalf of their institutions, they are the catalysts for coordinating the activities of the forum within their respective organizations. Government institutions also have agreed to integrate the planning of activities in the Miu watershed for the next calendar year and share budgetary burden to maintain efforts at the end of the current grant.

As part of the multi-stakeholders project approach, the Conservancy collaborated with Partnership Forum for Lore Lindu National Park (FKTNLL) to produce bulletins and documentary films and update the website (www.lorelindu.org). Three volumes of Suara Lore Lindu Bulletin have been published, 500 copies per volume, and distributed to communities surrounding LLNP and related stakeholders in Palu City. Documentary films on local planning processes and the study visit of FP-DAS Palu to Balikpapan Bay also have been produced.

Overcoming Challenges: The Future

A management structure has been developed, but significant challenges remain with regard to water usage. Depletion of groundwater has resulted in loss of pressure to operate artesian wells. Perusahaan Daerah Air Mimum (PDAM), the state-owned water supply enterprise, provides water to approximately 20 percent of the households and 35 percent of manufacturing industries in the City of Palu. It has had to close several of its deep wells. In addition to an imminent lack of water in the city, the water study conducted by Widjajanto concluded that levels of organic compounds are nearing critical levels of acceptability for clean drinking water. The study suggests that increases in these organic compounds are the result of activities linked to agriculture, plantations, communities and home-based industries adjacent to the Gumbasa River. Widjajanto identifies possible sources of contamination as fertilizers, pesticides and industrial solvents.

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Given these concerns, PDAM currently is seeking new opportunities for drinking water to provide for the City of Palu. One option being explored involves sourcing water from Lake Lindu, potentially in conjunction with a hydropower development. In order to develop a facility large enough to accommodate the required capacity of 700 litres/second, PDAM is seeking foreign investment for the intake and delivery system.

Threat analysis carried out by the Conservancy identified a number of threats that vary in scale and type of impact. All threats, however, are exacerbated by a number of root causes including lack of enforcement, conflicts over natural resource use and land tenure, lack of economic alternatives, lack of appropriate land use plans, lack of capacity, poor organizational structure and governance and lack of a conservation ethic in Central Sulawesi. Each of these alone requires significant time and investment to overcome. It will be important to build strong partnerships among organizations to ensure effective conservation of the area for people and biodiversity.

In all likelihood, increased forest clearing will result in greater frequencies of flooding and erosion and will have increasing negative impacts upon irrigation systems, riverbanks, infrastructure and households living downstream from cleared areas. The protection value afforded by the forested areas of LLNP is crucial for maintaining the economic viability of these systems as well as securing the safety of people living there.

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BERAU REGENCY, EAST KALIMANTAN, INDONESIA

Figure 10. East Kalimantan, Borneo.

The Site

Berau Kabupaten or Regency ("Berau") is located just above the equator in the Indonesian province of East Kalimantan province on the island of Borneo **(see Figures 8 & 10)**. The Segah watershed is located in Berau District, East Kalimantan and contains some of the largest tracts of undisturbed lowland forest in Indonesian Borneo. Although most of Berau lies below 500 meters, the area ranges from sea level along the east coast to 2,467 meters at Gunung Mantam (Gunung Guguang), a massif located west of Tanjung Redeb, the administrative centre for the Regency.

Surveys conducted by TNC in a remote patch of forest straddling Berau and East Kutai districts resulted in the discovery of 1,000 to 2,500 orangutans, which may represent up to 10 percent of the world's known wild orangutan. This 370,000-acre area of lowland forest harbors the last substantial orangutan habitat left in East Kalimantan and also provides refuge for an impressive 11 species of primates-making it one of the richest primate sites in the world. The area also contains many other endangered, threatened or rare mammals such as clouded leopard, sunbear and the moose-like banteng.

Threats to Biodiversity

Most of the forests in East Kalimantan are overlaid by active logging concessions. Destructive land clearing practices and drought resulted in forest fires in 1982-83 that affected an estimated 3.6 million hectares of forest in East Kalimantan and another million hectares in neighboring Sabah. Fires in 1997-98 affected an estimated five million hectares throughout Indonesia, including 3.06 million hectares in Kalimantan. The total economic value of the damages caused by the 1997-98 fires has been estimated conservatively at US $4.47 billion, most of which was borne by Indonesia. It also has been estimated that 30 percent of Kalimantan is susceptible to landslides. The most critical zones under threat are the hill and mountain areas where forests have been cleared or partly felled.

The forests of Berau have a high abundance of dipterocarp trees, which are seriously threatened by destructive logging practices and habitat degradation. The entire district of Berau has been parceled into allotted concessions for timber and mining for coal and other minerals. There is presently no knowledge of the areas most prone to soil loss and how this discharge may increase the total sediment load carried out into the ocean and nearby reefs.

Increased sediment loads, as a result of forest clearing, also is found along the two major river systems-the Kelay and Segah-in the Berau District of East Kalimantan. Locals report that increased sedimentation in these rivers resulted from elevated erosion rates in the upper catchments as a cumulative effect of forest conversion activities.

Communities along both the Kelay and Segah rivers report erosion and the loss of productive land for agriculture. Erosion of productive land impacts 19.6 percent of rural households annually. Anecdotal information from the Berau local government indicates that as recently as twenty-five years ago, it was possible to see fish on the bottom of the Kelay River in Tanjung Redeb. Today, the river there is very murky and visibility is near zero.

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Project Activities

With its partners, TNC developed a project aimed at a participatory approach to watershed management that involves stakeholders such as local government, communities and industry in the management of the watershed. TNC also is developing a computer simulation model to help serve as a decision-making tool for land use planners and policy makers.

In 2002, the Conservancy commissioned a study on the value of water resources in the Berau District. The study looked at the economic contributions of water from the Kelay and Segah rivers. The study estimated the value of these contributions to the economy of Berau District through the monetization of agricultural production, livestock inventories and other sources of protein, and household consumption of waters from these two rivers.

The study concluded that, in total in 2002, water from the Kelay and Segah rivers had an estimated annual value of Rp. 48.2 billion, or approximately US $5.62 million. The study noted that the forested areas of the greater Kelay and Segah watershed provide important ecological functions in the regulation of flow rates and sediment loads and the provision of water to people and agricultural systems. Through the provision of these functions, important infrastructure and irrigation systems are protected, and water quality is maintained. The study pointed out that these forests are an important part of the physical and economic character of Berau District and will continue to play a significant role in future developments. The relationship between forests, water, economy and human well-being were set out in this report. The study recommended that the various functions need to be considered by planners and decision-makers and that the needs of conserving Berau's forests should be incorporated into all of the Regency's development plans. Based on these recommendations, the Conservancy began designing a project around improved watershed management.

In Berau, the Conservancy initiated its approach through an internal identification of potential stakeholders followed by intensive discussion with select institutions to gain support for the project. In August 2004, TNC began by engaging the Ministry of Forestry in improved management of the Segah watershed, including discussions around management policies, establishment of a watershed management forum and establishment of a micro watershed study and modeling. That same year, a stakeholder workshop was held in Berau on Segah watershed management and forest/land rehabilitation to obtain commitment on establishing a forum to coordinate all activities related to Segah watershed management. Meetings with community representatives from the Segah sub-district were held to introduce the program.

In September 2004, a workshop was held to reach consensus on the functions provided by Segah watershed and confirm the urgency of maintaining its functions. Participants identified institutions responsible for activities related to the Segah watershed management. TNC then invited pertinent institutions to participate as core team members of a Segah Watershed Management Committee (SWMC) in October 2004. The Committee met in December 2004 to develop a short-term work plan, which included specific roles and responsibilities.

Capacity-building at the local level was carried out through training activities, regular meetings, peer evaluations and learning missions between key stakeholders at both locations. Studies and computer simulation models for a major watershed were developed to identify problems and issues including the likelihood of flooding if certain portions of the watershed were deforested and/or degraded.

Preliminary Outcomes

With strong support from the Provincial Watershed Management Agency (BPDAS), a core team and the secretariat of the Segah Watershed Management Committee (SWMC) have been established. The ultimate goal is to create a Segah Watershed Management Forum to oversee watershed management in the Segah watershed. The core team includes:

1. District Planning Agency (BAPPEDA) of Berau District
2. District Environmental Agency (BAPELDA) of Berau District
3. District Forestry Agency of Berau District
4. District Mining Agency of Berau District
5. District Estate Plantations Agency of Berau District
6. District Public Works Agency of Berau District
7. Model Forest Secretariat
8. Upper Segah Natural Resources Management Body
9. District Drinking Water Authority (PDAM TIRTA SEGAH) of Berau District
10. PT Sumalindo Lestari Jaya Unit IV of Berau District
11. The Nature Conservancy, Berau Field Office

Core team members have agreed to hold regular meetings to discuss and find solutions for issues related to the management of Segah watershed. The District Planning Agency has provided office space and meeting rooms for the activities of the secretariat.

To enhance the ability of the Segah Watershed Management Committee (SWMC), TNC and its partners have undertaken several approaches. First, one person from each of the pertinent local institutions has been assigned to the committee. Second, cross learning is taking place through a study visit to Balikpapan Bay and a cross visit between the study sites (Palu and Berau). Committee members also will be trained on the use of the hydrological model and interpretation of the resulting scenarios.

Overcoming Challenges: The Future

Establishing a Segah Watershed Management Forum as the coordinating agency is key to sustainable watershed management. Progress on this has been impeded due to the remoteness of the district and its distance from the provincial capital of Samarinda. Furthermore, the Berau Basin has been assigned as a third-level priority for rehabilitation activities planned by the Ministry of Forestry. Although the Berau forum has not yet been inaugurated, select stakeholders have agreed to establish the Committee and serve as the core team to work on work plan preparation, initial field studies and institutional arrangements in the interim. Several meetings have been held to identify needs and discuss and share information about challenges faced in the Segah watershed. A work plan has also been formulated.

TNC and World Education (WE) are the only NGOs actively working with the villages of the upper Segah. No local NGO operates in this area, and there are few NGOs focused at all on terrestrial conservation and none on watershed management in the Berau District. TNC has been working in the upper Segah for over three years on issues related to community empowerment and raising awareness on environmental issues. As a result, the core team members deemed that TNC has sufficient experience to represent NGO interests. The study invites the participation of local NGOs; however, at this time, none exists.

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Lessons Learned

In some places, such as Ecuador, the Conservancy has engaged in watershed valuation projects as a tool for biodiversity conservation for the past ten years. In other countries, like Mexico and Honduras, the Conservancy efforts are more recent. Even ten years, however, is a relatively short time for environmental projects. To see real impacts, time is often needed as well as tools and funding for monitoring and evaluating progress.

Although Indonesia was not part of the U.S. Agency for International Development (USAID) grant to TNC in Latin America, the two case studies from Indonesia are included here to broaden awareness within TNC and externally on the use of watershed valuation in biodiversity conservation. They are also included to help break down geographic barriers in sharing experiences with these tools. Despite differences in legal regimes, cultures and approaches to sustainable development across the globe, valuation of water by governments, the private sector and the public will benefit from improved understanding of how to change behavior and attitudes in managing the world's freshwater resources.

With a decade of experience and work in at least six countries, TNC and its partners continue documenting lessons learned to improve existing efforts and influence future projects.

Strong Leadership & Consistent Funding

These processes require long-term commitment, consistent leadership and continuous funding. Because watershed valuation processes require a long process of outreach, consultation and capacity-building of stakeholders (see Figure 1), it generally takes several years for them to produce concrete results such as stronger local or national policies, water user fees and more sustainable resource use. During that time, maintaining momentum and long-term funding is critical. In the cases described in this summary report, local conservation organizations and the Conservancy are playing this role. However, they too are dependent on external funding sources, such as USAID.

Political and multi-sectoral leadership are essential to moving forward effectively. Even when the legal mechanisms for implementing water user fees may not be clearly defined, political support is critical to moving water valuation activities, including long-term financing mechanisms, forward. In Chiapas, for example, Coapa had many of the desirable characteristics for launching a pilot watershed valuation project but lacked the political will. In contrast, the municipality of Arriaga lacked some key characteristics (good, reliable water service), but the municipality's president and administration strongly supported watershed conservation and environmental services payments. As a result, Arriaga is one of the two main areas under consideration for a pilot water user fee mechanism.

In many sites, the support of municipalities is essential to the watershed valuation process. Thus, TNC and its partners have worked to build alliances and secure political will. With municipal elections occurring every three or four years, though, projects face the prospect of losing hard-won support with each change in administration. In the short term, organizations consider it important to work with candidates and elected representatives early on to gain their support.

Throughout the projects described in this report, TNC and its partners have dedicated extensive time and resources to cultivate relationships. However, over the long-term, some of the organizations would like to develop structures that are more immune to political turnover. In Ecuador, for example, FONAG was created by an 80-year contract signed between TNC, the municipal water company (EMAAP-Q), the Quito Electric Company (EEQ), the Andean Beer Company and the Swiss Agency for Development and Cooperation. Because EEQ and EMAAP-Q are

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municipal companies, on three different occasions over the past eight years, changes in city leadership have required TNC to invest in lobbying a new mayor to continue honoring this contract. TNC and the FONAG Technical Secretary consider it essential to institutionalize FONAG through a municipal ordinance. This process is currently underway.

In addition multi-sectoral leadership is critical for project success. For example, important skills needed to help facilitate the creation of a water fund include technical capacity in water resources management and knowledge and experience in conservation policy. In addition, knowledge of politics, negotiation skills and the ability to develop strategic alliances are crucial. The most important skills, however, may be patience and the ability to continue investing in long-term processes.

Both types of leadership are critical to securing stable funding. To date, TNC-Ecuador has invested about 10 years in the Environmental Fund for the Protection of Watersheds and Water (FONAG), with support primarily from USAID-Ecuador. In Bolivia, the Association for the Protection of the Environment of Tarija (PROMETA) began working on watershed valuation in the Sama Reserve in 2000, and most of its work over the past five years has been supported by TNC and USAID-Bolivia. TNC and its partners in Chiapas began working on watershed valuation in the late 1990s and have received nearly $6 million in support, primarily from USAID, the Packard Foundation and TNC. In Guatemala, Defensores began working on the design of a water fund for the Sierra de las Minas Biosphere Reserve, and many organizations have supported its work over the past three years, including World Wildlife Fund (WWF), SwissRe and others. In Indonesia, the Conservancy has received financial support from the Japan Bank for International Cooperation and has used these resources to help build local political support for the projects.

Until recently in Quintana Roo, Mexico, limited funding and staffing prevented the launch watershed valuation activities. Fortunately, Amigos de Sian Ka'an (ASK) recently has received UNESCO funds to help support work in the watershed, which may used to reactivate inter-institutional collaboration and launch the Mayab Clean Water Network. In Honduras, the Association of Municipalities for the Protection of Lake Yojoa and its Areas of Influence (AMUPROLAGO) worked on watershed valuation between 1999 and 2002, but a change in leadership brought that process to a halt.

Stakeholder Involvement & Institutional Collaberation

In all of these projects, conservation organizations (TNC and/or local NGO partners) have facilitated communication and collaboration among a diverse array of stakeholders, including water companies, government agencies responsible for natural resource management, municipalities, communities, citizens groups, private industries, tourism businesses, hydroelectric companies and others. Conservation organizations cannot implement these projects on their own. Watershed valuation projects are designed to link water users to watershed conservation. They seek to get water users to contribute to conservation either financially (through user fees or increased public financing of conservation activities) or by taking direct actions to reduce threats to water resources. Because of this, conservation organizations must implement these projects in collaboration with other stakeholders, especially major water users and the municipalities and national government agencies responsible for regulating water use. It is important, however, to clarify institutional roles and responsibilities to avoid potential misunderstandings.

Many organizations, companies, agencies and groups are involved in water use. However, due to funding and time limitations, it is not feasible to work with everyone, and determining who to involve can be challenging. Most of the conservation organizations target major water users that have the capacity to pay for water or contribute to watershed management and are willing and able to participate.

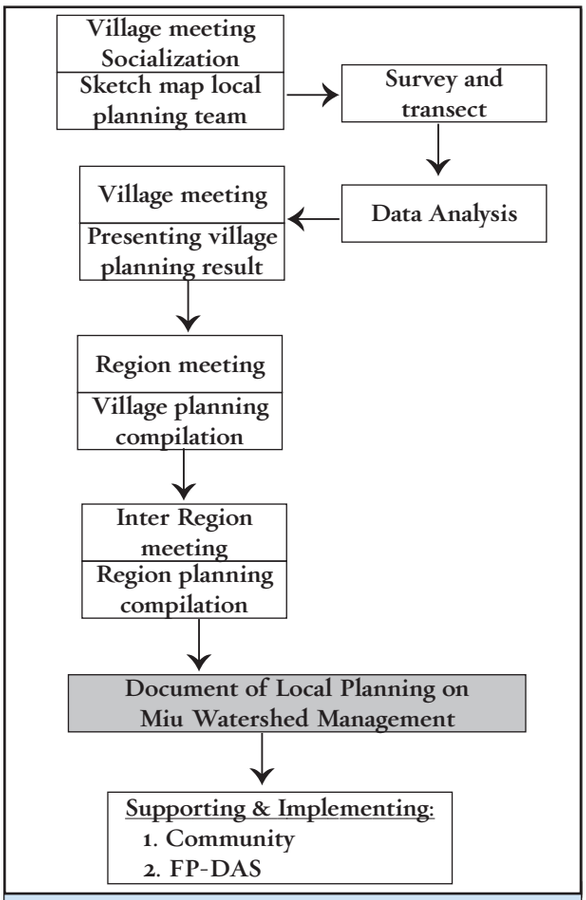

Figure 11. Local Planning in the Miu Sub-Watershed

In Berau, Indonesia, the Conservancy began by identifying potential stakeholders following intensive discussions with select institutions. Afterwards, a workshop was conducted to reach consensus on the functions provided by the Segah watershed, participants identified institutions responsible for activities related to management of the Segah watershed. As a result, the Conservancy collaborated with key government agencies as well as the Jambata Foundation, a local environmental NGO based in Palu, which helped facilitate the process of local planning development in 17 target villages in the Miu sub-watershed **(see Figure 11)**.

In Bolivia and Ecuador, conservation organizations have focused primarily on major water users. For example, PROMETA's principal partner in Bolivia is the Potable Water and Sewer Services Cooperative (COSAALT), a water cooperative that has a concession from the Municipality of Tarija to provide the city's drinking water. Other partners are government agencies (local, departmental and national) and two civic organizations. In Ecuador, the major players in the Water Conservation Fund are the Municipal water company and the Quito Electric Company. In Guatemala, Defensores is working closely with hydroelectric companies and water-using industries as well as water users with less capacity to pay for watershed environmental services. In both Honduras and Chiapas, conservation organizations have tried to work with hydroelectric companies, but to date, they have not found substantial interest in improving watershed management. In Quintana Roo, Mexico, one of the main partners in the watershed valuation activities is a tourism company concerned about ecologically-sustainable tourism. Partners there hope that this company will provide leverage for working with other tourism companies to show that water conservation is critical for maintaining tourism in the area over the long-term.

Another priority group is government agencies with responsibility for the management of water resources. In Bolivia, PROMETA is working with municipalities, the departmental government, and the national agency responsible for natural resource management. In Honduras, Guatemala and Chiapas, the projects all have worked closely with municipalities and mayors, because of the responsibilities that local governments have to provide residential water service to communities and to manage natural resources.

Many people involved in these projects have emphasized the importance of presenting watershed conservation and environmental services fees in terms that are relevant to specific user groups. Different user groups will require different outreach strategies and interventions. Only when they can understand the benefit in a concrete, relevant fashion will they be willing to support a fee mechanism or participate in watershed conservation activities. For example, rural residents are most interested in how watershed management activities (or the lack of watershed management) will affect the availability and quality of their water. Hydroelectric companies are interested in minimizing maintenance costs,

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prolonging the productive lifespan of their plants and sometimes also improving relations with local communities. Private industries may be interested primarily in reducing their costs and improving their environmental quality.

Several people also highlighted the importance of working with groups from the upper, middle and lower sections of a watershed, because each group tends to value and use water resources differently. Those in the lower watersheds typically will place a higher value on water than will upstream users, because they receive less water or water already contaminated from upstream uses. TNC and its partners have found it effective to use workshops and exchanges to help people from different parts of the watershed understand how their actions impact other users.

The Role of Studies & Technical Assistance

Throughout the projects described in this report, the database, hydrologic simulations and economic valuation studies were valuable for building credibility and convincing stakeholders of the importance of taking action. However, the types and range of studies depends on a number of factors, including time and resources (e.g., financial, capacity). In cases where water user fees will not be used, it may not be necessary to conduct a contingent valuation assessment, which is expensive. An estimate of the cost of watershed degradation under a "no protection" scenario may be sufficiently persuasive.

Although there is some variation among the case studies, it appears that in most cases, TNC and its partners have found it essential to generate a strong basis of technical information (primarily hydrologic and economic information) early in the process. In several cases, this information provided a strong foundation for building consensus about the need for conservation. In Bolivia, PROMETA found that the hydrologic research and economic valuation studies they conducted increased their credibility with mayors, the governor, the water company and other key actors. In essence, it enabled them to facilitate the organization of a formal inter-institutional governance structure for water (PRO-AGUA). In Quintana Roo, Mexico, maps of underground waterways provided crucial information to understand water flows that stakeholders cannot see. By mapping these waterways, partners there have been able to make the case for how water (and contaminants) flow and have started to use this type of information to help inform decisions made by local municipalities' ecological land zoning committees.

In Guatemala, Defensores invested most of the project's first year and a half conducting research needed to support the design and development of the water fund. This included research on Guatemalan legislation related to water and studies of water use and valuation of watershed services by major users, including households, farmers who irrigate their crops, hydroelectric companies, beverage industries and a paper company. Similarly, in Chiapas, TNC and its partners conducted economic and biological feasibility studies early in the process to determine the value of environmental services provided by the watersheds and the willingness of local users to pay for those services. They used these studies to identify municipalities where water user fees might be most feasible.

The Conservancy's Indonesia Program dedicated significant time and resources to a long list of studies to help determine how best to address the threats in the watersheds. In addition to the valuation studies, the Conservancy and its partners collected data to help complete hydrologic modeling for the study sites, land cover analysis for the watershed modeling and field surveys. The computer simulation models were important in developing scenarios on watershed ecology. Spatial and land use patterns around the watershed strongly influence existing watershed quality. Scenarios developed helped build stakeholders awareness and served as the basis of future management. Given time constraints and a range of "off the shelf" models, TNC did not seek to develop new hydrological models for the selected watersheds. Instead an existing model was chosen that would best meet the project objectives, given the data and software availability on two sites.

In contrast, in Ecuador, TNC and its partners did not consider hydrologic or economic research a high priority during the start-up phase of the Environmental Fund for the Protection of Watersheds and Water (FONAG). At that time, a TNC partner organization made a relatively simple estimation of the cost of upper watershed protection in one protected area. TNC considered that getting key actors to make long-term financial commitments to the water fund depended more on awareness-building and negotiation than on the results of economic research. In 2004, however, TNC and FONAG decided to conduct a technical analysis of the river basins and water demand in Quito's area of influence (Hoja de Quito) to consolidate information about the watersheds and provide a stronger technical basis for management.

While the idea of linking water users to watershed conservation activities sounds attractive to conservation organizations, these groups tend to have little experience in watershed valuation. Technical assistance is often essential to help organizations design, plan and implement projects. TNC's senior advisor for international water policy helped many of these projects to concentrate on building a constituency for watershed conservation and encouraged them to not focus too much on the development of a water-based finance mechanism or water fund. TNC partners also have drawn on technical assistance from in-country partners to help them better understand the context in which they were working. For example, in Chiapas, the TNC office there partnered with a few local organizations to undertake studies related to the economic and ecosystem service benefits that well-maintained watersheds provide, whether local users are willing or able to pay additional fees to support conservation of those watersheds, and how the country's legal framework might influence the development of a water fund mechanism. Likewise, in Quintana Roo, partners leading watershed valuation activities there have worked closely with the Centro de Investigaciones del Sistema Acuifero de Quintana Roo (CINDAQ) to map underground aquifers. These maps have been critical in showing how pollution from one area migrates to fragile areas and can pose threats to clean water sources as well as the Yucatan Peninsula's profitable tourism business.

The subterranean nature of Quintana Roo's watersheds poses a unique challenge worth noting as this may be applicable to other areas across the globe. Those living in the watershed and using its resources cannot always see the waters that sustain the watershed or understand how it operates. This makes it difficult to reach policymakers and users alike. Those working in watershed conservation in Quintana Roo have learned that the laws and policies are not adequate for their local situation and that education and awareness-raising are key to helping policymakers make informed decisions. They also have learned that they need to work with local users to help them understand what a subterranean watershed is, how it functions and how their actions impact it.

Managing Expectations

The experiences of these sites seem to indicate that water funds do not have the potential to become a primary source of funding for protected areas and biodiversity conservation. Protected areas of particular value for biodiversity conservation tend to be large areas that encompass many watersheds. Water users generally want to support management activities specifically in the watersheds that provide their water, not entire reserves or ecologically functional sites.

For example, the early literature about FONAG presented the fund as a finance mechanism for the Antisana Ecological Reserve and the Cayambe-Coca Ecological Reserve, or potentially the entire Condor Biosphere Reserve, which includes more than one million hectares. The watersheds of interest to FONAG member organizations, however, include a smaller area-the headwaters of several basins that supply drinking water and support hydropower generation and other economically productive activities that depend on water. Similarly, in Bolivia, PRO-AGUA's goal is to stop the deterioration of Tarija's water sources, which only encompass part of the Sama Biological Reserve. In Chiapas, TNC partners are trying to work in important watersheds

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that have sufficient political will and public support to institute a water fund. Nevertheless, there are only a couple of watersheds that meet this criterion, and they cover only a small portion of the Chiapas Coastal Watershed Platform Site, which includes three protected areas: El Triunfo, La Encrucijada and La Sepultura Biosphere Reserves.

Watersheds that produce economically valuable water may not be the areas of greatest biodiversity value within a protected area. Conserving these watersheds only achieves a small part of what is necessary to conserve the biodiversity of the entire protected area. While it may seem obvious that water funds cannot be the sole source of funding for large protected areas, it must be taken into account so that organizations will be realistic when projecting the geographic area that could potentially benefit from a water-based finance mechanism.

Based on the case study experiences, rural communities frequently do not have reliable service and clean, potable water. Poverty makes it difficult to implement an environmental services payment mechanism. Inhabitants in some of these areas have great difficulties making ends meet and would likely have financial difficulties making payments for watershed conservation. Nevertheless, surveys in Chiapas have found that local people would be willing to pay at least a small fee if they could be guaranteed reliable service and clean, potable water. While this fee might not be sufficient to cover all of the costs of watershed conservation, it would help instill an awareness of the value of water resources and conservation. Similarly, in Bolivia and Guatemala, local residents expressed willingness to work to conserve their water supply.

The goal of watershed valuation projects is to involve water users in conservation. Water users can contribute to conservation either by paying a user fee or by taking direct actions to reduce threats to water resources. Most of these projects began with a focus on establishing payments for watershed services, but many broadened their scope over time.

For example, PROMETA learned that water user fees were not politically feasible in Tarija and that they could take an alternative approach to watershed conservation by developing an inter-institutional body (PRO-AGUA) that would coordinate and strengthen the efforts of existing institutions. In Guatemala, the idea of a water fund evolved into the creation of a water foundation and local watershed committees with representation from all major user groups-in other words, the development of a governance structure in which all water user groups participate in decision-making. The water fund continues to be an important component of this broader process. In Honduras, AMUPROLAGO started with the idea of charging a water fee to the electrical company but ended up conducting an extensive participatory planning process with all of the municipalities and key stakeholders around the lake. Similarly, in Quintana Roo, partners have worked primarily on participatory planning and advocacy. There is some interest in exploring a water fund, but it is not a central focus of their work, and they are only considering it for one area just north of Cancun. Partners are, however, trying to engage the tourism sector to take on greater responsibility for water conservation and possibly for contributions to a water fund, if implemented.

In Chiapas, TNC partners are most actively considering piloting a water fund in two watersheds that have critical political support and potential public willingness to pay. They also are trying to work with a hydroelectric company and coffee farmers in another watershed to determine potential for a water fund there. Nevertheless, in all these watersheds, incomes are modest-even among those with a greater ability to pay-and it is unlikely that an environmental services payment mechanism could ever generate enough funds to fully support watershed conservation activities. Beyond generating money, water valuation work should create greater awareness so that landowners will manage water and forest resources more effectively from a conservation standpoint.

In Indonesia, the initial goal was not to establish a fee system but rather to gain a better understanding of ecosystem services and the value

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people placed on these services. In this process, the Conservancy and its partners have supported a collaborative management approach facilitated through the use of Community Conservation Agreements in the Lore Lindu National Park and Segah Management Body to improve the willingness locals to commit to the long-term survival of the forest and the watershed. One lesson that came out of the two Indonesia projects was about urgency and 'tipping points.' In Berau, the stakeholders agreed that watershed management is important, but because the impacts of poor management practices (increased flooding, salination of freshwater systems and sedimentation) have yet to materialize, action following the project has been slow. In contrast, in Central Sulawesi, the tipping point is now. Increased population growth and land use activities, especially farming, are causing top soil to wash away. Localized incidents of flooding have occurred as a result of illegal logging. The time to act is now, and the government has taken swift action to incorporate the project results into legislation and development planning.

Building Governance Systems

Watershed valuation is a tool not simply for funding watershed protection but also for building effective governance for watershed management. Governance systems that mandate open, transparent and accountable decision-making can help ensure that decisions are based on sound science, take into account the interests of all stakeholders and the environment, and effectively allocate resources for current and future uses. Good governance often is advanced as a concept but seldom exists in practice. Developing systems of good governance is challenging as it requires putting into place sound political, social, economic and administrative systems. Water management, to date, has tended to be fragmented and uncoordinated as interests operate within sectors (energy, agriculture, forestry, sanitation), and the political will to facilitate cross-sectoral decision-making at different levels (e.g., national, regional, local) is often lacking.

One of the biggest challenges and most important short-term results of watershed valuation projects is to build trust among the major stakeholders involved in the process. Watershed valuation processes bring together institutions with diverse and often conflicting interests, and this can be a useful process for improving governance systems. For example, water companies want to provide clean water; hydroelectric companies want to generate electricity cost-effectively; industries want to use water in production processes; communities want drinking water; farmers want to irrigate crops; and conservation organizations want to conserve watersheds and their associated biodiversity. When successful, watershed valuation processes bring together stakeholders with different perspectives and a history of conflicts and enable them to think beyond their own interests to recognize the collective value of their watersheds. They must work together to create institutions to better manage water resources and improve existing institutions. The importance of this process is underscored in Latin America and other places, where there is an ongoing trend toward government decentralization. The success of inter-institutional structures such as FONAG in Ecuador, PRO-AGUA in Bolivia, the Honduran Water Platform, Pigua Committee in Chiapas and watershed committees in Guatemala demonstrate the progress these projects have made in building trust among diverse stakeholders.

Defensores originally envisioned the water fund purely as a finance mechanism in which water user fees and voluntary contributions would be used to cover most or all of the basic ongoing expenses of conservation and management of the core zone of the Sierra de las Minas Biosphere Reserve. In meeting with representatives of important stakeholder groups, however, Defensores found that they wanted to be involved in deciding how that money would be used. For this reason, the original idea of a water fund evolved into the creation of a water foundation and local watershed committees with representation from all major user groups. As different user groups participate in the water foundation, Defensores believes that transparency in decision-making and financial management will build trust and increase contributions. The focus, nevertheless, is on the

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development of a governance structure in which all water user groups participate in decision-making. Defensores also recognizes that actors can participate in many different ways-not only by giving money. Rather than focusing purely on payments, Defensores recognizes that some actors will participate directly in management activities, for example, by helping to prevent and control forest fires, implementing soil conservation measures or planting trees.

The development of new institutions can be a way to help move toward participatory decision-making. In Indonesia, inappropriate land-use planning at national and local levels contributes significantly to these threats and often is rooted in a lack of human and financial resources required to develop integrated and participatory watershed management plans. As such, TNC used the studies not only to identify the impacts of forest loss on river system functions, but also to better inform decision-makers on the down-stream consequences of poor planning and, ultimately, to build capacity to manage these watersheds in a participatory and sustainable manner. This has involved the creation of the Segah Watershed Committee and Forum, which has been a vehicle for evaluating the policy framework, plan, implementation and impacts of current watershed management measures as inputs for the district's decision makers. The Committee has been tasked with: evaluating policies, plans and programs to be held in the watershed; evaluating problems occurring due to watershed management policies and natural disasters; providing further considerations and solutions to the Regent (Bupati) on the issues of land use allocation in the watershed, soil and water conservation and land reclamation, water resources utilisation, and mining in the watershed; and preparing and conducting meetings of the Watershed Forum. Such new institutions offer a way to bring divergent interests together to improve watershed management at the local, regional and national levels.

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Conclusion

This report is meant to be a contribution to global, national, regional and local dialogues on how to protect our important watersheds and the people and biodiversity that depend upon them.

Although the experiences to date have fallen short in prioritizing economic valuation research, the projects showcase the fact that even some level of watershed valuation can lead to significant results in moving toward better management of water resources. The basic intention of watershed valuation projects is to help local actors recognize the importance of these natural areas and take action to protect them in order to ensure the integrity of this critical environmental service.

The projects of the Conservancy and its partners have shown that these processes often require basic hydrology and economic valuation studies, long-term commitment, consistent leadership, institutional collaboration and long-term funding. Managing expectations and clearly communicating among partners is necessary. Regarding water funds, the projects have noted that more analysis is needed on whether funds should be invested in capital funds, technical assistance and/or field projects. There needs to be a realistic understanding that once these financial mechanisms are created, investments will take time and involve trade-offs.

In addition, a strategy for building support for integrated watershed management in key institutions is important for long-term success. A multi-faceted strategy is necessary. Conservation work in large areas, in particular, requires working with different strategies, including a water-based financial institution, but also private lands conservation, collaboration with indigenous communities and others.

Watershed management and the implementation of an environmental services payment mechanism are relatively new concepts that involve long-term processes and commitments. To ensure success, they need ongoing supervision to monitor progress toward goals and objectives. This ongoing monitoring should inform watershed managers and stakeholders about necessary adjustments to adapt and improve their actions. While this type of adaptive management is always good practice, it is especially important with relatively unknown tools and strategies, such as those used for watershed valuation work.

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