

## Honduras: The case of drinking water supply in Tegucigalpa

**Did you know that in some places the water you get from your tap is affected by what happens in the forest?** Climate change and demographic pressures are leading policy makers to rediscover the connection between healthy forests and trees, and the welfare of other sectors such as agriculture, water and energy. Honduras provides a case study for how sustainable forest management and improved land use practices could enhance resilience to climate change by helping protect water resources.

In Honduras, climate change is expected to increase temperatures and decrease rainfall through 2050, exacerbating a lack of drinking water that has already forced the government to ration water in the capital of Tegucigalpa so that some of the city's one million residents receive water only once a week.

Natural disasters, agriculture, and urban sprawl have depleted forests and left watersheds vulnerable to extreme weather events. Hurricanes and tropical storms have repeatedly whipped through the Central American nation, damaging the reservoirs that are the primary source of water for people and crops. The situation became so dire

that from 1992 to 2011, Honduras ranked third on a global climate risk index.

Adaptation measures based on healthy forests and trees in landscapes could help reverse that trend. Forests are critical to preserving the water supply by preventing soil erosion, slowing flooding, and storing carbon, which helps to slow the rate that temperatures increase due to climate change. By providing alternative sources of income during drought or crop failure, forests may also help farmers adjust to the drier growing conditions and erratic rainfall patterns that scientists predict will be caused by climate change.



**Trees and forests in the Guacerique watershed provide plant fiber, food, pollination, nutrient cycling and other resources that contribute to the livelihoods of the local population.**

## BACKGROUND

While several watersheds provide Tegucigalpa with water, the city relies on just two reservoirs—Concepcion and Los Laureles—to supply drinking water to more than one million inhabitants. Of the two, only the Los Laureles reservoir is located in the Guacerique watershed, an area that the Government of Honduras identified as one of the most vulnerable to climate change following Hurricane Mitch in 1998. Since Mitch, the reservoir has lost an estimated 15 percent of its storage capacity due to increased sedimentation. The watershed is important because it supplies 25 percent of the water supply in Tegucigalpa.

In addition to the decreased reservoir capacity, urban development and several tropical storms that followed Hurricane Mitch have resulted in rapid deforestation of the watershed, leading to greater soil erosion, more runoff, and less water captured by the reservoir. Meanwhile, farmers have steadily moved into the area, despite laws designating the watershed as a protected public forest and a smaller part of it as a biological reserve. From 1993 to 2008, an estimated 15 percent of forests in the watershed were converted to agricultural use.

**Figure 1: Location of Guacerique Watershed**



## GOVERNMENT RESPONSE

To address the water shortage in Tegucigalpa, the national water utility has drawn up plans over the years to construct new reservoirs or improve existing ones; repair an inflatable barrier on the Los Laureles reservoir; and lay a pipeline that would run from Los Laureles to a nearby water treatment plant. However, financing has not been secured for any of these projects.

In 2011, the water utility switched gears and created a plan for ecosystem-based adaptation to climate change, designed to increase the amount of drinking water coming from the Guacerique watershed by preserving forests, among other environmental measures. Specifically, the government's \$4.2 million water management plan called for:

- Reforesting 1,236 hectares (ha) around springs and creeks
- Creating 100 ha of fuel wood plantations
- Transitioning to agroforestry on 161 ha of steeply sloping agricultural land
- Concentrating forest fire control on reforested areas
- Reducing illegal timber extraction on 6,063 ha of forest reserves
- Concentrating pest control on 4,338 ha of existing pine forests
- Implementing soil conservation measures on 2,000 ha of agricultural fields

Although the plan received ministerial approval in 2012, the water utility has not been able to get the adequate funding and community buy-in to move forward. One of the challenges is the ongoing decentralization of drinking water services from the water utility to municipal service providers. Another challenge is that the overlapping institutional arrangements around water and forests complicate perceptions about which group has management authority over these resources. Furthermore, stakeholders feel that resource governance processes are often interrupted by election cycles, losing momentum and resulting in a lack of consistent political will.

## THE STUDY

In 2011, the Program on Forests (PROFOR), the Center for International Forestry Research (CIFOR) and the Tropical Agricultural Research and Higher Education Center (CATIE) began exploring how ecosystem services provided by forests can build the resilience of other sectors. The Honduras case study investigated how climate change and land use management impact the capacity of the Guacerique watershed and the Los Laureles reservoir to provide water for the municipal water supply to residents of Tegucigalpa. To do this, the research team collected primary data and used 16 possible climate change scenarios and four land use scenarios over a 20- to 50-year time horizon, and downscaled these to understand the impact of both climate change and land use management on the capacity of the Guacerique watershed and the Los Laureles reservoir to provide reliable, high quality drinking water to residents of Tegucigalpa. The study considered the potential environmental and economic impact of the government's plan to manage forests in the watershed.

## MAIN FINDINGS

All 16 climate change models showed increasing temperatures to the years 2030 and 2080, and the majority of the models predicted a reduction in rainfall and a shortened rainy season, resulting in reduced runoff except during periods of extreme weather, when soil erosion and the deposits of sediment into the reservoir would increase.

However, the analysis found that good land management plans, including reforestation, can offset some of the negative impacts of climate change on soil erosion: even though soil erosion can increase by 5 percent under one scenario, erosion can be reduced by 32 percent with good land use management. By the same token, the study found that inadequate land use management can effectively erase the positive effects on the soil predicted by some climate change scenarios: In one scenario, the benefits of lower rainfall on soil erosion were lost to inappropriate land use, with the worst scenario resulting in an increase of soil erosion of 155 percent.

The economic analysis, conducted under two climate change scenarios, provided a strong case for the national water utility's ecosystem based adaptation plan: It estimated that Honduras could expect a net economic benefit of between \$28 million and \$76 million, depending on the severity of climate change on rainfall and soil erosion. The benefits were calculated by subtracting the cost of the watershed plan from the benefits of its implementation (specifically benefits derived from decreased sedimentation in the reservoir, water inflow to the reservoir and decrease in water turbidity). The analysis relied on social discount rates of between 2.1 and 4.5. (It did not factor in extreme events, however, because of modeling challenges.)

## RECOMMENDATIONS

### SUPPORT FARMERS' ADOPTION OF SOIL AND FOREST CONSERVATION PRACTICES

Farmers will likely have to adjust to drier growing conditions and erratic rainfall patterns. They will be best equipped to make this adjustment if they have access to technical assistance to improve farming methods in ways that preserve soil and trees, and are more aware of the economic benefits of such practices. Many stakeholders see agricultural extension as key to improving not only land use and forest conservation, but also household wellbeing, including increased incomes and local and regional food security.

### HELP TO SECURE FUNDING FOR WATERSHED MANAGEMENT AND INFRASTRUCTURE PLANS

The government needs to fund not only the \$4.2 million watershed management plan, but also the \$12.2 million infrastructure plan to repair the inflatable barrier on the Los Laureles reservoir and to build the transfer pipe. This would add approximately 7 million m<sup>3</sup> of water to the distribution system every year, which is an essential complement to the watershed management plan. While sources of money are scarce, the study provides the economic case for dedicating funds to ensure that legislation regarding water management can be fully implemented.

### MONITOR THE EFFECTS OF USING FORESTS AS AN ECOSYSTEM-BASED ADAPTATION TO CLIMATE CHANGE

Forests can slow the rate of soil erosion, but uncertainties surrounding climate change can make it difficult to predict the success of any watershed management plan. Land use priorities also may change over time. Therefore, monitoring the watershed management plan's impact on soil and other resources is critical for adjusting to changing environmental and land use circumstances.

### PROMOTE ENFORCEMENT OF LEGISLATION TO PRESERVE FOREST AND WATER RESOURCES

Honduras has passed laws to manage the Guacerique watershed, but lacks the capacity to implement and enforce the legislation. Limited financial and technical resources hamper the government's ability to stop illegal logging and other harmful. For an ecosystem-based adaptation plan to succeed, various government entities must work together to enforce existing laws and to meaningfully involve communities in enforcing regulations, including providing a mediation program for resolving potential conflicts. In addition, existing regulatory frameworks provide opportunities for Payment for Ecosystem Services (PES) programs, which could incentivize conservation and reforestation.

### PUBLICIZE THE POTENTIAL OF FORESTS AS AN ECOSYSTEM-BASED ADAPTATION TO CLIMATE CHANGE THAT CAN PROVIDE OTHER BENEFITS

Trees and forests in the Guacerique watershed provide plant fiber, food, pollination, nutrient cycling and other resources that contribute to the livelihoods of the local population. However, farmers continue to use chemical fertilizers and other farming methods that harm the soil. Publicizing the potential benefits of forests to farmers could increase their willingness to comply with conservation laws and the watershed management plan.

This case study is part of a larger report on How Forests Enhance Resilience to Climate Change.

## CONCLUSION

The world's temperatures are continuing to increase, forcing long-term strategies for adaptation to climate change. The availability of water is declining and the risk of disasters is increasing. Unsustainable logging and agricultural practices have led to deforestation, resulting in deadly floods and landslides. Forests can help mitigate climate change by storing carbon and slowing the rate of temperature increases. Moreover, sustainably managed forests and trees on farms can also help soften the blow of climate-induced changes by reducing soil erosion and regulating water flows at the scale of entire landscapes.

## ABOUT US

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This brief is a summary of the PROFOR Working Paper *How Forests Enhance Resilience to Climate Change: The Case of Drinking Water in Supply in Tegucigalpa, Honduras*. PROFOR, CIFOR and CATIE collaborated on the case study which was authored by Raffaele Vignola, Amanda Procter, Angela Díaz Briones, Tim McDaniels, Bruno Locatelli, Serge Rafanoharana and Diji Chandrasekharan Behr. The case study informs the PROFOR publication *How Forests Enhance Resilience to Climate Change: What We Know and Case Studies from Burkina Faso, Honduras and Lao PDR*.

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