

“Environmental Valuation of the Páramo de Santurbán, Colombia”

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Executive Summary

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Introduction

Paramos are mountain ecosystems that can be found in Colombia, Venezuela, Ecuador, and to a smaller extent in Costa Rica and Panama. Páramo's main characteristic is their high capacity for hydric provision and regulation that results from their highly porous and permeable soil. Additionally they provide other environmental services such as biodiversity, carbon capture, recreation.

The Páramo de Santurbán is in the Northeast of Colombia, in the departments of Santander and Norte de Santander. It covers an area of approximately 82,664 hectares between 3000 and 4290 meters above sea level. Two thirds of the Páramo are in Norte de Santander and the rest in Santander.

The ecosystem is very important for water provision in the region. It is part of the basin of the Catatumbo, Magdalena and Arauca Rivers and is subdivided in 7 smaller basins, namely the Zulia, Lebrija and Chitagá Rivers. It provides water for 48 municipalities with an estimated population of 2.3 million people. Additionally, it provides water for the Tasajero thermoelectric station and for agroindustrial and other economic activities in the region.

It also has high biodiversity and offers beautiful landscapes for ecotourism. There are currently two regional natural parks in the area, Sisivita and Parque Natural Regional Santurbán with over 40 lakes.

In addition to its richness as an ecosystem, Páramo de Santurbán is also rich in gold and is used by local farmers to grow onions and potatoes or livestock. In the past few years, with the increase in international prices for minerals, large mining companies have started operations in the region. This made local NGOs and activists mobilize for the protection of the Páramo. During this time we observe a conflict of interest among the different stakeholders in the region: miners, farmers, environmentalists, and water users in the main cities.

This has put the Páramo de Santurbán in the news and it has become an example of the debate between mining and environmental protection. While these large mining projects can represent economic gains for the region and its population, at the same time they threaten a delicate ecosystem and the water supply for millions of users.

This project provides information on the value of environmental goods and services provided by the Páramo de Santurbán in order to inform possible policy decisions for the protection of this ecosystem and ways to finance its conservation. It values five ecosystem services: water provision, recreation, carbon capture, and existence and bequest values. Additionally, it describes the population that lives in the Páramo de Santurbán and provides policy recommendations.

Economic valuation of environmental goods and services

Environmental goods and services do not usually have a market or a price, since they are public goods. This leads in many cases to underprovision or an insufficient allocation of funds for the protection of the ecosystems that provide them. Economic valuation of environmental services strives to provide a monetary value for these goods and services so that they can be sustainably managed.

There are two main methods for the economic valuation of environmental goods and services: observed and revealed preference. In the first case it is possible to infer the value consumers give to the good in question by observing their behavior. If we assume consumers are rational economic agents, then their consumption decisions are the result of a utility maximization process that gives us information on the value of environmental goods. In the second case we do not observe consumers' actual behavior; instead, through a series of questions the researcher creates a hypothetical market whereby the consumer reveals his valuation. In this project we use both methods in addition to the benefit transfer methodology. Benefit transfer uses existing valuation studies to approximate the value of environmental services in a very similar location. As a result we obtain a lower bound of the Total Economic Value (TEV) of an ecosystem which is the sum of the different goods and services it provides.

Water provision

Water provision is the most important service provided by the Páramo de Santurbán. In order to value the service we used the contingent valuation method. This method calculates the value consumers give to the environmental service through their willingness to pay (WTP) to protect the ecosystem. It is a revealed preference method, where a hypothetical market is constructed using a survey to consumers. It is one of the most widely used valuation methodologies.

We applied a survey to 712 households in the three main cities in the Páramo region: Bucaramanga, Cucuta and Pamplona. This survey captured information on socioeconomic characteristics, knowledge about the Páramo and its environmental services, as well as attitudes towards the environment. The two main questions we wish to know is what makes a person be willing to pay for conservation and how much are they willing to pay.

In the survey we found a high number of *protest* responses, that is, people who give a positive value to the services provided by the Páramo, but that are not willing to pay since the government should be the one to pay for the protection of the ecosystem. In order to take into account these respondents, we assigned the median value people were willing to pay, \$1000 COP, to these respondents. We also ran sensitivity tests using higher values: \$2000, \$3000 and \$4000 COP. The results did not change greatly.

Using a probit model we found that the perception of water supply quality, the number of uses for water in the household, knowledge about the Páramo, and the number of children in the household have a positive effect on willingness to pay for the Páramo protection. On the other hand, income has a negative effect on willingness to pay, contrary to what we expected.

On average, the households in the three cities are willing to pay between \$3066 and \$17686 COP on top of their regular water bill (the amount varies according to the value assigned to protest voters). These values are 5% of the household bimonthly bill as a minimum, and 28.8% as a maximum.

When we expand these values to the total population in the three cities, it sums up annually to between 15,259 million COP and 88,025 million COP. With a social discount rate of 12%, this value amounts to 127 thousand million COP in the low scenario and 733 thousand million COP in the high scenario.

It is important to note that these values are a lower bound to the value of water provision from the Páramo de Santurbán since they only take into account residential water users in three cities, and do not include the rest of the population in the region (rural towns) nor economic activities that also benefit from the water coming from the Páramo.

Recreation

Páramo ecosystems provide beautiful landscapes, natural sites, such as lakes, and biodiversity that are attractive to visitors. Even though the Páramo de Santurbán is not a National Natural Park and does not have any tourist infrastructure, it receives an important number of visitors. We do not know the total amount of visitors, since there are no registers, but other Páramos that have been declared National Parks, such as Chingaza near Bogotá, receive around 13,000 visitors per year.

Using the travel cost method we value the recreation service provided by this ecosystem. This method estimates the value of the service assuming that the cost for visitors to the site is the minimum value people give to the ecosystem. The travel cost method estimates the demand for recreation trips given the cost of the trip and other characteristics of the visitor. In this sense, the value of the site is given by the consumer surplus of the visitors to the site. The consumer surplus is the difference between what a person would be willing to pay and what they actually pay added over the total number of visitors.

In order to calculate the demand for visits, 140 short surveys were collected in the Páramo during November 2012. The surveys included questions on socioeconomic characteristics of visitors, information on their trip, and attitudes towards the site preservation. Visitors to the Páramo de Santurbán are, on average, have higher education and belong to the middle class. They visit the Páramo for hiking, fishing and observation of nature. In general, they are interested in the area becoming a National Park and would be willing to pay to visit.

Since the majority of visitors were visiting the Páramo for the first time, we used zonal travel cost method that calculates a demand for visits to the site per zone instead of per individual since we would have had close to zero variance in the number of visits per person. 17 zones were defined for this study according to the visitors' point of origin.

We calculated travel costs using information from the Ministry of Transport and for the opportunity cost of time we used information for Colombia from urban transport studies. Using a linear model we find that recreation in the Páramo de Santurbán is valued at 1,150 million COP per year (not taking into account the cost of time spent at the site). If we include the cost of time spent at the site (on average 2.2 days), the value is 1,363 million COP.

Carbon Capture

The soil in Páramos has low mineralization and nutrient cycling rates due to low temperatures and the porous nature of the soil. This promotes a slow and continuous absorption of CO² from the atmosphere that is fixed in the soil for long periods of time.

To value the service of carbon capture we used the benefit transfer methodology. This method uses as its main inputs existing valuation studies in similar sites to the one we want to study. The benefit transfer consists in taking the monetary value of an ecosystem service found in the existing study and transferring it to the site of interest. It is a useful methodology since it is less expensive than conducting a primary valuation exercise. There are two types of benefit transfers: value transfers and function transfers. Value transfers use the monetary value found in the primary valuation study, while function transfers use the coefficients found in the primary valuation study and applies the local characteristics of the study site to calculate the value of the environmental service.

For carbon capture in the Páramos de Santurbán we used the results from 5 studies in different Páramos in Colombia and Peru that calculate the potential carbon capture in Páramo. On average, each Páramos hectare can store 79.8 tons of CO₂. If 80,000 hectares in Santurbán are protected, then 63 million tons of CO₂ are stored in the soil. With a price per ton of carbon of 5 USD, the carbon stored in the Páramo de Santurbán is worth 31.92 million USD or 58,340 million COP.

Existence and bequest values

In addition to use values provided by ecosystems, there are also non-use values such as existence and bequest. These categories represent the fact that people can value ecosystems regardless of whether they receive any direct goods and services from them. Existence value means people value a natural site just because it exists, and bequest value means people value the fact that the site will exist for future generations.

To estimate these values we used the contingent valuation methodology. We asked 400 people in Bogota and Medellin whether they would be willing to pay to conserve the Páramo de Santurbán region independently of whether they visited it, as well as socioeconomic characteristics and attitudes towards the environment.

Using a bivariate probit model we found that income, education attainment, and the level of concern for the environment have a positive effect on willingness to pay. We found that WTP for existence and bequest of the Páramo de Santurbán ranges between \$31,335 and \$102,172 COP.

When we expand these values to the total population in Bogota and Medellin, the total existence and bequest value for these two cities is between 238,218 million COP and 776,741 million COP. Since these two cities are not representative of the total population in the country we cannot extend our results beyond the two cities. In this sense, these values are a minimum for the total value of existence and bequest of the Páramo de Santurbán.

Total Economic Value (TEV)

From the estimations described above and using a 12% discount rate, we obtain a TEV for the Páramo de Santurbán of 398,311 million COP in the low scenario and 1.6 billion COP in the high scenario. The low scenario takes the minimum values found in the estimations and uses a price for carbon of US\$2 per ton. The high scenario takes the maximum values found in the estimations and a carbon price of US\$5 per ton.

Table 1: TEV Páramo de Santurbán

Service	Low scenario Million COP	High scenario Million COP
Water provision	127,165.87	733,547.18
Recreation	9,592.00	18,075.00
Carbon capture	23,336.00	58,340.00
Existence and bequest values	238,217.95	776,741.79
TEV	398,311.82	1,586,703.97

Policy Recommendations

The results from this valuation exercise provide us with a minimum estimate for the total value of the services provided by the Páramo de Santurbán. It is a minimum estimate because there are services that were not valued, such as biodiversity, and others were only partially valued, such as water provision and non-use value. Regarding water provision we only took into account residential water users in three main cities in the region, so all other users and their valuation is not included. For non-use values of existence and bequest we only have values for Bogota and Medellin and not the rest of the country.

These results also give us direction with respect to possible policy alternatives for the conservation of the Páramo de Santurbán. An important result is the fact that households that receive water from the Páramo are willing to pay to conserve water sources, and that they are aware of the role the Páramo de Santurbán has in the water they receive. Establishing the minimum DAP as a Payment for Environmental Services (PES) fee to conserve the Páramo would allow water users to directly compensate the owners of Páramo land for conserving it. PES programs acknowledge the positive

externalities from conservation and compensate land owners for the opportunity cost of conserving versus other economic activities.

Contrary to a scheme where the government buys the land or a PES program financed through general government budget, schemes with a more direct connection between consumers and providers of the environmental service have been proven to be more sustainable over time since they do not rely on political will or budget availability.

With respect to protest votes, we know they do not imply a valuation of the water provision service of zero, but they are a statement regarding the role of government. At the same time, we found education and information about the ecosystem can increase willingness to pay. In this sense, through information campaigns and communication it can be possible to change those protest votes into actual payments.

Another important result from this study is that the Páramo de Santurbán has a high potential for ecotourism. Currently, even though there is no tourism infrastructure, there are many visitors to the site who value the ecosystem and are willing to pay to conserve it. Low impact tourism can help conserve the area by making it known as an attractive destination and thus increasing awareness and generating new economic activities for the local population, while at the same time generating resources through entrance fees for sustainable management of the area.

Páramo zones have a high capacity for carbon capture. By exactly measuring how much carbon is captured in the Páramo de Santurbán soil and how it could be affected if no changes are made to its conservation status, it is possible to finance conservation through voluntary mechanisms.

Finally, financing conservation of the ecosystem does not have to rely solely on the local population. From our findings of existence and bequest values, it would be worthwhile to organize a national donation campaign to finance a PES program or other activities to preserve the Páramo de Santurbán.

Specifically regarding the conflict between mining and conservation in the region, it is important to note that this is only in a certain area of the Páramo that provides water for the city of Bucaramanga. There are various policy options for a possible solution. The first one is to ban mining in the area. This implies social and economic losses for a specific group that the government would have to compensate. This could be partially financed using payments from the households that receive water.

A second option would be to ban only the processing step. This would imply mining companies extract the rocks at the site and transport them to a different site where no water sources are affected to be processed. These costs would be borne by the mining company. A third option would be to require mining companies to install a water treatment plant that would guarantee water quality for Bucaramanga. Once again, the costs would be borne by the mining companies. In these two policy options mining companies internalize the negative externality of their activities and the

government does not need any additional resources. Moreover, an intermediate solution such as these can be more sustainable, since the different stakeholders and their interests are taken into account.

Socioeconomic characteristics of the population in the Páramo de Santurbán

In addition to the economic valuation of the environmental services provided by the Páramo de Santurbán, this study describes the population in the Páramo region. These are rural communities, their main economic activities are agriculture and livestock, and in certain specific areas, mining.

We conducted 250 surveys with questions on sociodemographic characteristics, economic activities, income, and housing characteristics, among others. Households in the Páramo region on average have 4 members, slightly above the national average of 3.8 members per household. Average age is 47.6 years for adults. One third is minors, and 88% of these go to school, and approximately 90% can read and write. Most adults have primary or incomplete secondary education; there are no significant differences between men and women.

58% of households participate in government programs, mainly Familias en Acción (conditional cash transfer program) and Atención al Adulto Mayor (transfers for seniors). Most houses have access to public services, although water and sanitation is lower than the national average. They are built out of durable materials.

Most men are workers, while the majority of women work in their homes. Most people are farmers or ranchers (49.5%), while 10% work in mining. 30% work at the home, and the rest have other economic activities. Average monthly income is \$1,000,533 COP, slightly less than the minimum wage. Income for those people who work in mining is higher than the rest.

Land holdings are small; 89% are smaller than 10 hectares and 41.5% are smaller than one hectare. Most owners invest in their land, be it through construction, or irrigation infrastructure. The main agricultural products are potatoes and onions. Most of the production is sold, although 12% and 3% of production respectively are consumed by the household. Production is mostly self-financed, although farmers have access to formal and informal credit. Most farmers have some degree of mechanization and use of fertilizers. Livestock is mostly sheep and cows. Households produce milk and wool for consumption and in some cases, for selling.

Gold is the main mining product. It is centered in the Vetás and California municipalities. Some land owners sold their properties to large mining companies in 2007. Those who still own the land do small-scale mining. On average these households produce 16.2 kilos of gold per year. Households with other economic activities include stores, food preparation, education, and services associated to agriculture, livestock and mining.

Final remarks

The Páramo de Santurbán is an important ecosystem for Colombia. Not only for the services it provides to communities, but also because it has become an example of the challenges for economic development related to certain economic activities, such as mining, and their impact on the environment and for local communities.

Having better information about the ecosystem and the services it provides can lead to better policy decisions for conservation and development. This study provides first-hand information about the value of the environmental goods and services provided by the Páramo de Santurbán. It is one of the first studies for the region and for this type of ecosystems.