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VALUATION OF THE ENVIRONMENTAL GOODS AND SERVICES PROVIDED BY THE PÁRAMO DE SANTURBÁN: FINAL REPORT

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DISCLAIMER

The authors' views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government.

TABLE OF CONTENTS

Table of Contents.....	i
List of Tables.....	iii
List of Figures.....	iv
List of Graphs	iv
Acronyms and Abbreviations.....	vi
Summary	vii
1. Introduction.....	1
2. Valuation of Eco-systemic Services.....	4
3. Water Provision and Regulation Valuation	6
3.1. Methodology.....	6
3.2. Results	8
3.3. Conclusions.....	11
4. Recreation Value	13
4.1. Introduction	13
4.2. Travel Cost Methodology.....	14
4.2.1 Zonal Travel Cost Method.....	16
4.3. Results	16
4.3.1 Estimation of Demand	19
4.3.2 Consumer Surplus	20
4.4. Discussion of Results and Conclusions	21
5. Carbon Sequestration Value.....	23
5.1. Methodology	23
5.2. Results	24
5.3. Conclusions.....	24
6. Existence and Bequest Value.....	25
6.1. Theoretical Framework	25
6.1.1 Bivariate Probit Model.....	27
6.1.2 Generalized Linear Model.....	28
6.2. Results	28
6.2.1 Model Estimates	28
6.3. Discussion of Results	32
6.4. Conclusions.....	33
7. Total Economic Value	34
8. Conclusions and Policy Recommendations.....	35
9. Social and Demographic Characterization of the Inhabitants of the Páramo de Santurbán	38
9.1. Household Members and their Description	38

9.2. Housing features	43
9.3. Land.....	44
9.3.1 Information on Land Plots	44
9.4. Economic Production	45
9.4.1 Agricultural Production.....	46
9.4.2 Livestock Production	48
9.4.3 Mining Production.....	49
9.4.4 Other Economic Activities	50
10. References	51
11. Annexes.....	54
11.1. Descriptive statistics of water users´ survey	54
11.2. Building of the Knowledge of the Moor Index	65
11.3. Building of the Environmental Attitudes Index.....	65
11.4. Willingness to pay as a proportion of the water bill by social level.....	67
11.5. Descriptive statistics of the Páramo de Santurbán´s visitors.....	68
11.6. Descriptive statistics of existence and bequest surveys.....	77
11.7. Building the concern Index.....	79
11.8. Descriptive Statistics of the inhabitants of Páramo de Santurbán	80

LIST OF TABLES

Table 1: Probit Valuation Model: Fixed Effects.....	10
Table 2: Average Willingness to Pay According to the Value Assigned to Protest Votes.....	11
Table 3: Average Willingness to Pay According to the Value Assigned to Protest Votes.....	11
Table 4: Travel Cost per Zone.....	18
Table 5: Travel Demand Estimate by Zone.....	19
Table 6: Total Annual Consumer Surplus—Estimated Recreation Value (Million Pesos per Year).....	21
Table 7: Marginal Effects of the Probit Model.....	30
Table 8: Final Estimates of the Generalized Linear Model.....	31
Table 9: Averages, Medians, Maximum, and Minimum of Estimated Willingness to Pay (in Pesos)	32
Table 10: Aggregate Willingness to Pay for Medellín and Bogotá	32
Table 11: Total Economic Value of the Páramo de Santurbán	34
Table 12: Surveys by Municipality	38
Table 13: Age, Education, Gender, and Income Statistics.....	39
Table 14: Main Occupation Statistics	40
Table 15: Main Activity Performed by the Company/Business Worked for Last Month.....	41
Table 16: Income of the Heads of Household.....	42
Table 17: Transfers from Social Programs	42
Table 18: Access to Public Services	43
Table 19: Main Economic Activities in Household Lands	46
Table 20: Main Agricultural Products	47
Table 21: Potato Cultivation Statistics.....	48
Table 22: Onion Cultivation Statistics	48
Table 23: Livestock Production Income and Employment	49
Table 24: Gold Mining Production Statistics	50

LIST OF FIGURES

Figure 1: Map of the Páramo de Santurbán Area..... 2
Figure 2: Economic Value of Goods and Services Provided by the Páramo de Santurbán..... 5
Figure 3: Contingent Valuation Methodology for Water Provision and Regulation 7
Figure 4: Places of Origin..... 17
Figure 5: Design of the Auction-Type Question..... 26

LIST OF GRAPHS

Graph 1: Benefits for Recreation..... 15
Graph 2: Consumer Surplus per Each 100,000 Inhabitants per Area..... 21
Graph 3: Size of Plots 44

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ACRONYMS AND ABBREVIATIONS

CDM	Clean development mechanism
CO₂	Carbon dioxide
GEIH	Great Integrated Household Survey (known by Spanish acronym)
GLM	Generalized linear model
ha	Hectare
IAA	Attitudes toward the Environment Index (known by Spanish acronym)
ICBF	Colombian Institute of Family Welfare
ICP	Index of Moor Knowledge (known by Spanish acronym)
PES	Payment for environmental services
TEV	Total economic value
WTP	Willingness to pay

SUMMARY

Moors are Andean mountain ecosystems. They are strategic because of the environmental services they provide, and especially because of their ability to provide water and regulate the hydrological cycle. In addition to water-related ecosystem services, moors provide another set of services, including recreation services, which are closely related to the scenic beauty of these ecosystems.

The Páramo de Santurbán, or Santurbán Moor, is a strategic ecosystem for the region of Santander and Norte de (North) Santander in Colombia. It provides important water and regulation services to neighboring towns and villages and nearby cities, and also provides other environmental goods and services such as recreation, carbon sequestration, and biodiversity.

Currently there is much debate on the conservation of the ecosystem in the face of other economic activities, mainly mining. This issue has placed the region in the center of the conservation and economic development discussion and has become a clear example of the types of conflicts that can arise between the preservation of strategic ecosystems and the exploitation of large mineral resources.

For these reasons, the valuation of these environmental services is a necessary input for conservation decision-making and in seeking the necessary financing mechanisms. This paper provides a first assessment for the Páramo de Santurbán. The paper provides an economic valuation of five of the environmental services provided by the ecosystem: water provision and regulation, recreation, carbon sequestration, existence, and bequest. This valuation exercise is also important because few countries in the world have this type of ecosystem.

The water provision and regulation services valuation was estimated from the contingent valuation of residential water users in Bucaramanga, Cúcuta, and Pamplona, the three main cities in the area of influence of the Páramo de Santander. The average willingness to pay (WTP) was obtained using a probit model. By expanding the average WTP obtained from the surveys, the value of the service ranged between 127 and 733 billion pesos. It is important to note that this assessment considers only residential water users of these three cities, leaving aside the value given to the moor and its resources by other sectors and populations. For this reason, it can be considered a minimum value for the water provision and regulation service provided by the Páramo de Santurbán.

The travel cost methodology was used to value the recreational service. A survey of a sample of visitors to the Páramo de Santurbán was carried out, to collect information on the socioeconomic characteristics of visitors, the trip, and the visit to the páramo, as well as on attitudes regarding the conservation of the site. From these data, the minimum value of the recreational services of the Páramo de Santurbán was calculated using the linear model; it amounted to 9,592 million pesos, using a social discount rate of 12 percent. To the extent that the ecosystem is better preserved and more facilities are provided for visitors, the number of visitors would be expected to increase, which would also increase the services' value.

The third service valued was carbon sequestration, using a benefits transfer methodology. The total area of the páramo was taken into account for this purpose, as well as the estimated average carbon dioxide

(CO₂) sequestered from five moorland areas based on previous research and the potential sequestration in the páramo areas. Based on a market value of \$5 for a ton of carbon, the carbon sequestered in the Páramo de Santurbán has a value of \$31.9 million dollars, or 58 billion pesos. If the cost per ton of CO₂ is \$2, then the value is 23 billion pesos.

Finally, the costs of existence and bequest were estimated as non-use costs for the residents of Bogotá and Medellín, who do not receive direct services from the Páramo de Santurbán. The inhabitants of these cities were surveyed; the average WTP in these cities is 31,335 pesos, in the aggregate a total of 238 billion pesos. These results point to the possibility of having conservation of these ecosystems be financed by the population not receiving direct services from the páramo.

A minimum total economic value (TEV) of 398 billion pesos and a maximum of 1.5 trillion pesos were calculated from this exercise. It is worth noting that this exercise gives a lower ceiling to the value of the environmental services provided by Páramo Santurbán, but it can also be used to design financing mechanisms for conservation as payment for environmental services (PES) and for public policy discussions.

This paper also describes the population of the páramo area, including socio-demographic and economic characteristics, in order to establish appropriate compensation schemes in case the area's conservation status is changed. A total of 250 household surveys were carried out in the páramo. The data provided by these surveys shows that the Páramo de Santurbán is inhabited by a rural population, mainly dedicated to agricultural activities (50 percent) and to a lesser extent mining (10 percent). The average monthly income of this population is \$1,165,870 per month; higher for those households engaged in mining activities. This average masks high differences between household incomes, which range from 200,00 pesos to 4,000,000 pesos per month. The household size is four, slightly above the national average, with an average educational level of primary or an incomplete secondary level.

Most people over 18 are workers; of these, most are male. Women are mostly engaged in household chores. A total of 58 percent of households participate in state programs called *Familias en Accion* and *Adultos Mayores*. In terms of access to public services, the surveys show that almost all households have electricity, but that water and sewage coverage is low compared to the rest of the country.

The farms cultivated by these households are small: 90 percent are less than 10 hectares. The main crops are potatoes and onions, while the main livestock products are sheep and cattle. The households dedicated to mining activities extract gold. On average, their annual sales amount to 16.2 kg of gold per year.

I. INTRODUCTION

The moorland's ecosystem extends discontinuously between latitudes 11 degrees north and 6 degrees south, mainly through Venezuela, Colombia, and Ecuador, with few outcrops to the north in Costa Rica and Panama. The moor consists of plains and rugged glacial valleys with a variety of lakes, marshes, and wet meadows.

The most relevant feature of the moorland's soil is its high capacity to regulate water; its high water storage capacity is due to the combination of its high porosity and high permeability (infiltration). Additionally, the moors provide biodiversity, recreation, and carbon sequestration services, among others.

The Páramo de Santurbán is located in the departments of Santander (municipalities of Charta, Vetas, California, Suratá, and Tona) and Norte de Santander (municipalities of Abrego, Arboledas, Cáchira, Cécota, Chitagá, Cucutilla, La Esperanza, Labateca, Mutiscua, Pamplona, Pamplonita, and Toledo). It covers about 82,664 hectares (ha) between 3,000 and 4,290 meters above sea level.

Around two-thirds of the complex (61,000 hectares) is in the territory of the Autonomous Regional Corporation of the Northeast Frontier (Corponor) and the remaining 21,553 is in the territory of the Autonomous Regional Corporation for the Defense of the Bucaramanga Plateau. Thirty-five percent of the total area of the Páramo de Santurbán is cultivated, mainly with crops and pastures. The municipalities with the highest transformation are Tona (whose urban area is within the boundaries of the complex), Mutiscua, Cécota, and Silos. Natural ecosystems correspond to 53,800 ha of the total area; among these the most representative is the wet moor in the glacial till mountain (IAVH 2007).

The Santurbán complex pertains to the basin areas of the Caribbean, the Magdalena, the Cauca, and the Orinoco. It is divided into the areas of the Catatumbo, Medio Magdalena, and Arauca rivers, and seven sub-watershed areas, especially the Zulia, Lebrija, and Chitagá rivers. This moorland is a recharge and retention zone of surface and groundwater, serving as the source of water for 48 municipalities—15 in Santander and 33 in Norte de Santander—with an estimated total population of 2.3 million. Additionally, Santurbán supplies water to the Tasajero power plant; the aqueducts of Cúcuta and its metropolitan area; agro-industrial activity for thousands of hectares of coffee; and the Zulia irrigation district, with 10,000 hectares of rice production. The Santurbán will also provide water for the future expansion of Phase II of the Termotasajero area and Cínera, a multipurpose reservoir. In Santander, the Santurbán provides water for all economic developments in the Bucaramanga Metropolitan Area, as well as for the mining sector.

In addition, the Santurbán complex is rich in flora, fauna, and microbiota, and it offers Andean landscapes with potential for ecotourism (Corponor 2009). The Páramo de Santurbán corresponds to a regional natural park in which three moors stand out: the regional Páramo de Sisivita, the Páramo de Berlín, and the Complejo Lagunario del Norte, with a total of 40 lagoons. The first section of the lagoons is located in the municipalities of Cáchira, Salazar, and Arboledas and is called Lagunas del Norte. The second is located in the municipalities of Vetas and Muticua, and is called Lagunas del Sur.

In general, there is a conflict of interest among miners, farmers, water users, and environmentalists. Each group has very different goals and fails to find common points of agreement. This conflict surfaced in the debate surrounding the Regional National Park of Santurbán declaration, dated January 2013, which caused considerable concern and discontent among miners and farmers, and in the political difficulty in defining the regional natural park's borders. Environmentalists believe that the protected area is not sufficient, while the inhabitants of the area are not clear on whether there will be compensation for the economic activities that they will no longer be able to carry out because of the declaration of the park or on how the people living in the protected area will be compensated.

The case of the Páramo de Santurbán is an example of the situation facing the country today, in which mining and energy development—the current administration's hallmark projects for economic development—confront the protection of areas of high ecological value. Despite the economic development that they could generate, these projects may endanger the area's biodiversity and decrease the quantity and/or quality of water received by inhabitants in the towns of Bucaramanga and Cúcuta, and in 22 other neighboring municipalities.

The objective of this paper is to estimate the total value of goods and environmental services provided by the Páramo de Santurbán. For this purpose, five environmental services provided by this ecosystem have been valued: three "use" values and two "non-use" values. As use values, this study appraises water provision and regulation services, recreation, and carbon sequestration services. The moor's existence and bequest services are valued as non-use values.

This report is divided into nine sections. The first is this introduction. The second presents the principles of economic valuation of environmental goods and services. Sections 3, 4, and 5 present the valuation of use services. Section 6 describes the valuation of non-use services and Section 7 looks at the total economic value of these ecosystem services. Section 8 states the conclusions and policy recommendations. Finally, Section 9 describes the demographic conditions of the residents of the area.

2. VALUATION OF ECO-SYSTEMIC SERVICES

The environment provides numerous direct and indirect services to society. However, many of these services have no market price, partly because of their nature as public goods. This lack of prices to guide the allocation of resources for conservation is far from optimal, since the resources allocated do not ensure an adequate supply of goods and services. Thus the need for a valuation of the environmental goods and services provided by ecosystems and for economists to develop models for this purpose.

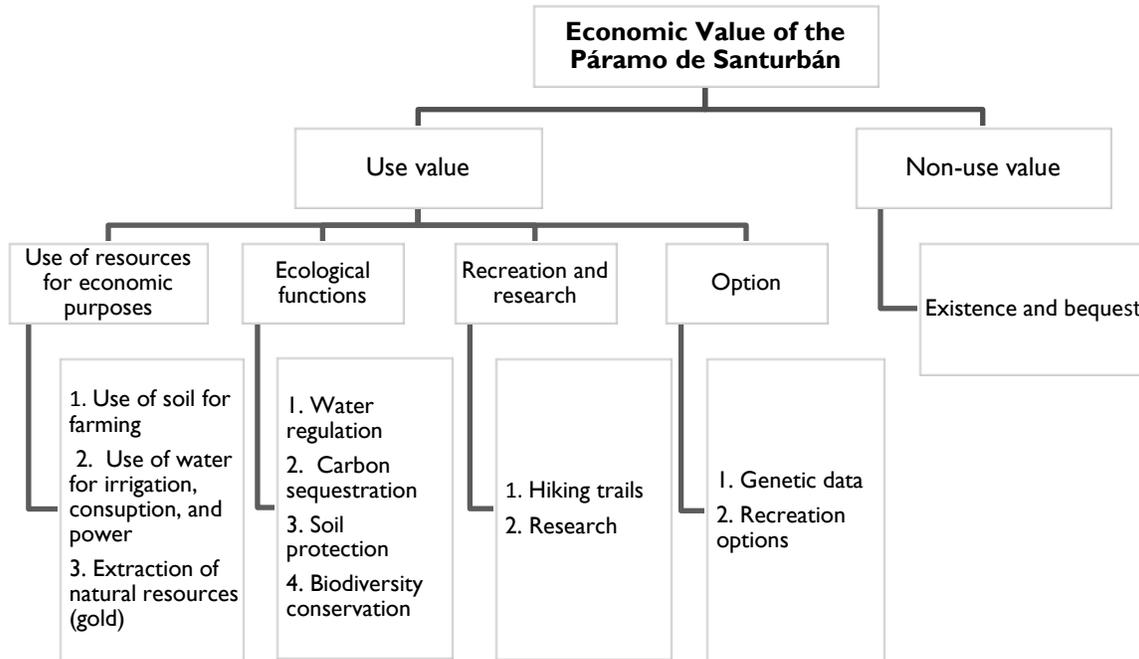
Environmental goods and services can be divided into use values and non-use values. Use values are economic values associated with the use "in situ" of a resource (Freeman 1993). They, in turn, are subdivided into direct use values, indirect use values, and option values. Direct use values refer to the value of using a resource in a specific place. This use can be consumptive or non-consumptive. In the first case, the resource is consumed by the activity that takes place in it, for example, the extraction of firewood and fruit, hunting, and fishing. In the non-consumptive case, use is contemplative, as in the case of visits to a recreational or scenic view.

Indirect use values, in turn, occur when people do not come into direct contact with the resource in its natural state, but the individuals still benefit from it. This is the case with ecological or ecosystem functions such as climate regulation and nutrient and waste recycling. Option values refer to the potential use value of a resource in the future. Additionally, some authors have developed the concept of quasi-option value, which reflects the net benefit of postponing a decision to use a resource or not, while more information is collected.

Non-use or passive values refer to values that are in the nature of things, yet are dissociated from the use or even the option to use. The non-use value includes the bequest and existence values. The first refers to the value that an individual assigns to a resource just by knowing that others can benefit from it in the future. The second is the value that is assigned to a resource simply because it exists, even when individuals are not in contact with it, either now or in the future.

The total economic value is the total value of goods and ecosystem services, i.e., the sum of the use values and non-use values (TEV = use value + non-use value).

Figure 2: Economic Value of Goods and Services Provided by the Páramo de Santurbán



Source: Own data

There are several approaches to reaching the TEV, which can be divided into two large groups: revealed preference methods and stated preference methods (Mitchell and Carson 1989). Revealed preference methods use a consumer's behavior to derive the value assigned to these environmental assets, within their utility maximization process. Stated preference methods or hypothetical markets, as the name suggests, create fictitious markets for environmental goods to approximate individuals' willingness to pay for the conservation of natural resources or the improvement of environmental quality.

Both methods are used in this paper. Each section describes in detail the methodology used to conduct a valuation of each ecosystem service.

3. WATER PROVISION AND REGULATION VALUATION

The main environmental service provided by the moors is the provision and regulation of water. The Páramo de Santurbán provides water to approximately 2.3 million people for various economic activities in the region. This section determines the WTP of the inhabitants of the three major cities in the region—Bucaramanga, Cúcuta, and Pamplona—to preserve the quantity and quality of water from the Páramo de Santurbán. The contingent valuation method was used, based on the answers to 712 surveys inquiring about respondents' willingness to pay an additional amount of money in the bimonthly water services bill for the protection of the moor.

A probit model was used to estimate the value of the willingness to pay an additional amount in the bimonthly water service bill, yielding an average value per person of between \$3,066 and \$17,686 pesos. When extended to the population of the three cities, this amounts to \$2,543 million pesos and \$14,671 million pesos. It was found that the variables that increase the probability of making a payment of this nature are related to individuals' medium-term goals, such as the presence of children in the household, and knowledge about the moors.

This is one of the first attempts to quantify the importance of this environmental service, for which no market exists. It is particularly important because few countries in the world have this type of ecosystem. Furthermore, valuation of the resource allows future funding strategies to be set and provides parameters for the extent to which a fee charged by the state could be seen as acceptable or not by taxpayers.

3.1. METHODOLOGY

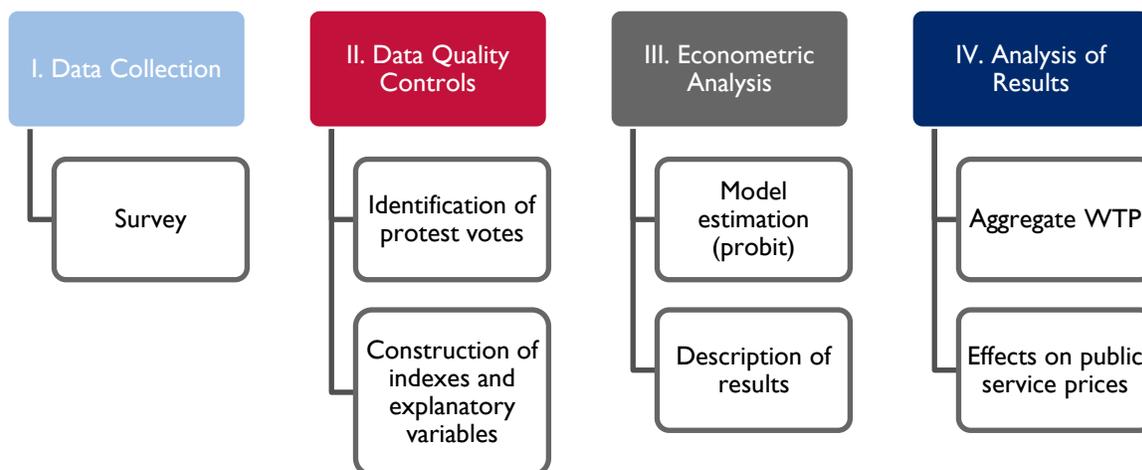
The contingent valuation method is one of the methods used to appraise environmental goods and services. It is used in cases where there is no market for the goods in question. It is a revealed preference method in which a market is simulated through the use of surveys of potential consumers. Supply is represented by the interviewer and the survey form, while demand is represented by the respondent, who is questioned about the valuation of the environmental good or service. It is called contingent valuation because individuals' willingness to pay is contingent upon the hypothetical scenario proposed by the interviewer.

Two central questions must be answered by this method: (1) What makes an individual likely to be willing to pay to preserve the quantity and quality of water from the Páramo de Santurbán? and (2) How much are they willing to pay?

In theory, an individual will be willing to pay when he is better off (i.e., has greater utility) when the payment is made to maintain or improve the level of the environmental service, than if the payment is not made. The WTP amount depends on socioeconomic and demographic characteristics empirically analyzed through the survey.

The contingent valuation methodology for water provision and regulation used in this study has four components. The following diagram describes them together with their respective sequences.

Figure 3: Contingent Valuation Methodology for Water Provision and Regulation



Source: Own data

A total of 712 representative surveys were administered to inhabitants of Bucaramanga, Cúcuta, and Pamplona, the three major cities in the area of influence of the Páramo de Santurbán. A simple randomized sample strategy was used by neighborhood and social level in each of the cities.

Valuation questions were open-ended and asked in terms of the value that the responder would be willing to pay to preserve the quantity and quality of water received from the Páramo de Santurbán:

Question:

To preserve the quantity and quality of the water you receive, it is necessary to protect its sources in the Páramo de Santurbán, which implies increased funding by users. How much more are you willing to pay on each water services bill, in addition to what you currently pay?

Based on the answers, respondents were divided into two groups. The first was those who expressed their willingness to pay through a monetary contribution, and those who said they were not willing to pay. The second group consisted of individuals who valued the Páramo but said that they were not willing to pay because they rejected the approach of treating public goods as market items. Since the value of these 242 persons is not really zero, a WTP was imputed in accordance with the median of responses: 1,000 pesos. In addition, sensitivity analyses were performed with the WTP charges of 2,000, 3,000 and 4,000 pesos.

In the third step of the methodology, the mean WTP value was calculated based on the results of a probit model, where the dependent variable assumes the following values: one (1) if the respondent was willing to pay and zero (0) if not.

$$WTP(YES = 1; NO = 0) = f(P, \Phi, \Omega, \Psi, \Upsilon) \quad (1)$$

Where:

P is the dollar value (or price) that the respondents expressed their willingness to pay, being zero for those not willing to pay, and a price around the value in which 50 percent of the responses for protest votes accumulated.

Φ is the set of questions associated with social demographic variables such as nationality, place of residence, education level, social stratum, and occupation.

Ω is the set of questions associated with social-economic variables, which in this case is the level of income.

Ψ is the set of questions associated with intrapersonal variables, including knowledge, perceptions, and attitudes towards issues associated with the consumption of water from the Páramo de Santurbán.

Υ is the set of questions associated with the service and use of ecosystem services variables.

The average value of the WTP was calculated from the following equation:

$$E(WTP) = -\frac{\alpha_i}{\beta} \bar{Z}_i \quad (2)$$

Where:

\bar{Z}_i is the set of average values of the explanatory variables.

α_i is the set of coefficients of the independent variables, including the intercept.

β is the coefficient of the monetary value (or price) with which it expressed its willingness to pay.

Finally, the fourth stage of the methodology included the implications of the results in two ways. First, results were expanded from two sources—for Bucaramanga and Cúcuta, information was drawn from the 2012 Great Household Survey, while for Pamplona, the 2005 census projection was used. In both cases the population between the ages of 17 and 85 was considered, resulting in an estimated total of 829,523 people. Secondly, analysis was done to estimate the share of the WTP relative to the household's current water services bi-monthly bill, excluding sewer and garbage collection services.

3.2. RESULTS

Using a probit model, four models were estimated with different WTP values imputed for the protest votes. The main model takes the WTP median obtained and assigns it to protest votes. Models 2, 3, and 4 are sensitivity exercises with values of 2,000, 3,000, and 4,000 pesos respectively. The results were found to be consistent in all models. The WTP of individuals of the three cities studied is related to income, the perception of water quality, and the Index of Moor

Knowledge (ICP)¹. These variables were significant in all four estimates: the first variable at 95 percent in the four estimates, perception of water quality at 99 percent in three of the four estimates, and ICP at 99 percent in all four estimates. On the other hand, the proportion of children per household size and the number of uses of water from the moor were significant for three of the four models, which suggests that the WTP is associated with situations where the mid-term view on the availability and use of water plays an important role.

As expected, the better the perceptions of the quality of water consumed in the home, the better the knowledge about the moors, and the greater the number of uses given to water resources, the greater the willingness to pay to preserve the quality and quantity of water sources from the Páramo de Santurbán. Contrary to expectations, higher income was associated with a lower willingness to pay for the ecosystem's conservation.

The price coefficient is positive, perhaps because of the way the valuation question was formulated, since it was not in terms of a referendum, where the respondent is a price-taker, but rather because it was an open-ended question where the respondent determined the price of the public good. Therefore, it is understandable that a person who declared a higher WTP value for the bimonthly water service bill would be most likely to make a payment. However, the effect of this variable, although significant, is very small.

Since the coefficients of a probit model cannot be interpreted directly, Table I presents the marginal effects of the variables of the model. The results of Model I are discussed, but it is observed that the higher the WTP imputed to protest votes, the greater the effect of the variables on the probability of making a payment. If income increases, the probability of being willing to pay is reduced by 3 percent. A better perception of water quality increases the probability of being willing to pay by 3 percent. Similarly, a better understanding of the moor and the services it provides has an 8 percent effect. The variable with the greatest effect on the probability of payment is the number of children in the household as a proportion of adults. An increase of one unit in the variable increases the probability of paying for preservation by 25 percent.

¹See Annex 11.2.

Table 1: Probit Valuation Model: Fixed Effects

	(1) (1,000 Pesos)	(2) (2,000 Pesos)	(3) (3,000 Pesos)	(4) (4,000 Pesos)
Willingness to pay (WTP)	0.000236*** (4.17e-05)	0.000206*** (1.70e-05)	0.000106*** (9.80e-06)	6.21e-05*** (7.13e-06)
Income	-0.0306** (0.0155)	-0.0607** (0.0284)	-0.0527** (0.0252)	-0.0464** (0.0231)
Perception of the quality of water	0.0361** (0.0153)	0.0784*** (0.0265)	0.0754*** (0.0239)	0.0673*** (0.0220)
Index of Moor Knowledge (ICP)	0.0875*** (0.0275)	0.175*** (0.0370)	0.149*** (0.0322)	0.140*** (0.0298)
No. children/No. household members		0.253** (0.117)	0.258** (0.104)	0.259*** (0.0963)
Number of uses of water	0.0644 (0.0425)		0.129* (0.0685)	0.138** (0.0654)
Observations	609	609	609	609
*** p<0.01, ** p<0.05, * p<0.1				

Source: Authors.

Note: The value in parenthesis is the robust standard error.

Building on the probit model, the expected value of the WTP through an additional charge in the bimonthly water bill (see equation 2) was calculated for an average individual. A higher imputed value led to a higher WTP. Thus, the average value of the WTP in the bimonthly bill is between 3,066 and 17,686 pesos, according to the value imputed to protest votes. The results are shown in Table 2 below.

These values represent at least 5 percent of the bimonthly water service bill (regardless of the sewer and garbage collection services), and at most 28.8 percent of the bill for Bucaramanga and Cúcuta.² It is noteworthy that the impact is greater for the lower income population, as the bill amount is lower.

² To see the results per income level for these two cities, go to 11.4.

Table 2: Average Willingness to Pay According to the Value Assigned to Protest Votes

Value Assigned to Protest Vote (Pesos)	Average Willingness to Pay (Pesos)
1,000	3,066
2,000	6,180
3,000	11,461
4,000	17,686

Source: Calculation by Fedesarrollo together with the survey data.

In order to obtain the value of ecosystem services, it is necessary to extrapolate from the sample to the population. To this end, the information from the “*Gran Encuesta Integrada de Hogares 2012 (GEIH 2012)*” (2012 Household Integrated Survey) was used for Bucaramanga and Cúcuta, while the 2005–2012 census projection was used for Pamplona. In total, the annual WTP in these three cities is 15,260 million pesos for Scenario 1 (value of 1,000 pesos assigned to protest votes) and a maximum of 88.026 million pesos for Scenario 4 (value of 4,000 pesos assigned to protest votes).

When estimating these annual values to perpetuity, using a social discount rate of 12 percent, the minimum aggregated WTP of 127 billion pesos is obtained for Scenario 1 and a maximum value of 733 billion pesos for Scenario 4. The following table presents the results for the four scenarios proposed.

Table 3: Aggregated Willingness to Pay According to the Value Assigned to Protest Votes

Value Assigned to the Protest Votes (Pesos)	Average Willingness to Pay (WTP) (Pesos)	Annual Aggregated WTP (Million Pesos)	WTP Aggregated to Perpetuity (r = 12 percent) (Million Pesos)
1,000	3,066	15,259.90	127,165.87
2,000	6,180	30,758.71	256,322.60
3,000	11,461	57,042.97	475,358.15
4,000	17,686	88,025.66	733,547.18

r = Social discount rate
Source: Authors.

3.3. CONCLUSIONS

The estimated value of the bimonthly WTP led to an average value per person of between 3,066 and 17,686 pesos, according to the value assumed for the protest votes. Extrapolating these values to the population of the three cities, and taking them into perpetuity with a social discount rate of 12 percent, results in an amount ranging between 127 and 733 billion pesos.

It is important to note that this assessment considers only residential water users in Bucaramanga, Cúcuta, and Pamplona, leaving aside the valuation of the resource and the páramo made by other

sectors and other populations. For this reason, the estimation of the value of water provision and regulation services provided by the Páramo de Santurbán should be considered a minimum value.

The variables that increase the probability of making a payment to protect water quality and quantity are related to individuals' medium-term goals, such as the presence of children in the household and knowledge about the Páramo de Santurbán. In addition, a better perception of the quality of drinking water increased the likelihood of payment. It is important to note that social stratum does not play a role in the willingness to pay and that income has a negative effect.

These results shed light on possible funding mechanisms for the protection and conservation of the Páramo de Santurbán. A payment for environmental services (PES) scheme could be funded through the water bill. A payment of 3,000 pesos, the minimum payment estimated in the analysis, would be acceptable to a large part of the population. A scheme of this nature should be linked to education programs that improve knowledge about the moors, as they increase people's willingness to pay. Similarly, improvements in the quality of water services or in perceptions about the quality of water services have an effect on the sustainability of the PES scheme for the conservation of the Páramo de Santurbán. Another alternative would be to establish a proportional charge per socio-economic stratum, according to the values obtained in the study. An acceptable minimum would be 3 percent of the water bill.

4. RECREATION VALUE

Recreation is one of the key ecosystem services provided by the moors. Attributes such as their scenic beauty, the presence of lagoons, and the flora and fauna found only in these ecosystems attract visitors interested in enjoying the landscape and activities that can be carried out in these areas. While the Páramo de Santurbán is not a regional natural park³ and does not have tourist infrastructure, it receives an important flow of visitors every year.

This study approximates the economic value of the recreational services provided by the Páramo de Santurbán, using the travel cost method. This method estimates the value of a place used for recreational activities based on the assumption that the cost associated with the trip to visit the site is the minimum value that people assign to a recreation service.

A survey was administered to a sample of visitors to the Páramo de Santurbán to collect information on the socio-economic characteristics of visitors, on the trip and the visit to the moor, and finally on the visitors' attitudes towards the conservation of the site. From these data, the minimum value of the recreational service provided by Páramo de Santurbán was estimated at 1,150 million pesos a year.

Additionally, analysis of the information provided by visitors indicated that they perceived the Páramo de Santurbán to be a suitable place for recreational activities, that they were interested in its preservation as a regional natural park, and that they would also be willing to pay an entrance fee to the site. The study shows that there are significant social benefits related to the protection of the moor in terms of the well-being it generates for the people who use it for recreation and culture.

4.1. INTRODUCTION

People enjoy being in natural environments, such as the pristine moor ecosystem, to enjoy the landscape and perform various activities on the moor that generate well-being. Given that only a fraction of the Páramo de Santurbán was declared a regional natural park in Santander and that visitor records are lacking for the Sisavita Regional Park in Norte de Santander that is part of the moor, the total number of people visiting the Páramo de Santurbán each year is unknown. However, there is data, including records on the numbers of visitors, from other moorlands in the country that are regional natural parks. For example, in 2012 the Chingaza Park located near Bogotá received 13,809 visitors, a 45 percent increase compared to 2011 (MADS y PNN 2013).

The Páramo de Santurbán has more than 80 natural lagoons located between 3,500 and 4,385 meters above sea level. It has a rich fauna and 64 recorded species of *frailejones* (a perennial subshrub). The area is also home to deer, red foxes, native condors, cougars, and black trout. In addition, an important part of the moor is not very disturbed (65 percent, according to the IAVH, 2008) and attracts tourists seeking direct contact with nature in places away from human intervention.

³ Only a small portion of the moor constitutes a regional natural park.

To estimate the value of the recreational services provided by the Páramo de Santurbán, it is important to find out how much visitors value being able to access this wilderness and enjoy the scenery, the hikes, and other recreational activities that can be carried out on the site.

There are two approaches to measuring how much an individual values visiting a natural site, from the consumer satisfaction perspective. The first approach is based on an individual's revealed preferences (observed behaviors); it estimates the demand curve for visits to the recreation area as a function of the cost of access to the site and visitors' socioeconomic characteristics. This approach is known as travel cost. This approach is based on the assumption that the value that visitors assign to a certain recreation area is at least equal to the amount of money and time they spent on the trip to enjoy the area. The second approach is the contingent valuation.

In this paper we use the travel cost methodology. Below is a detailed explanation of the methodology and the results obtained.

4.2. TRAVEL COST METHODOLOGY

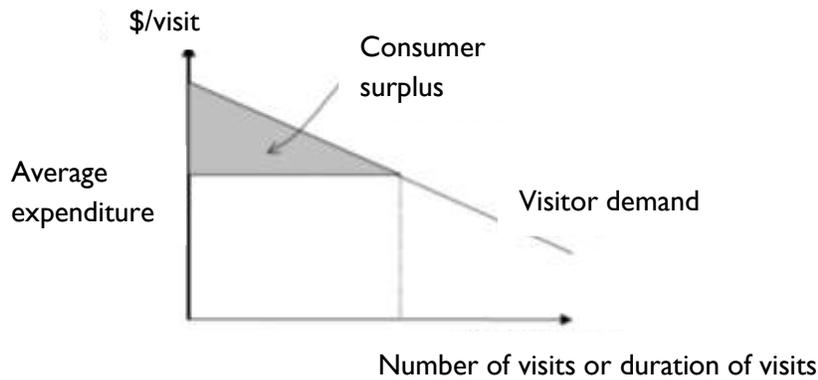
People spend money to visit specific areas and regions, such as parks, for recreational activities, since these visits produce a sensation of well-being. From this fact, it is assumed that costs associated with visiting a place for recreational purposes are at least equal to the minimum benefit that an individual obtains from the visit by enjoying the goods and services that the area offers.

The travel cost methodology indirectly measures the economic benefits of ecotourism and derives the demand for recreational services provided by the zone by measuring the number of visits to a park or natural region (Parson 2003; Wieland & Horowitz 2007). It assumes that the behavior observed by the economic agents (i.e., eco-tourists) can be used to estimate the value of environmental services for which there is no market and therefore no price. It is based on cost estimates related to the use of the environmental good or service with recreational purposes. The money and time that individuals spend to travel to a natural area (such as a forest or moor) are used to measure the value of their recreational experience. Thus, the value of the site in terms of providing recreational services is reflected in the number of individuals who are willing to pay to visit the site; the costs incurred and time invested by visitors to the site are valued as the opportunity cost of labor, representing the price of the resource (MAVDT 2003).

The economic value to be estimated is the consumer surplus, which is a quantitative measure of the net benefit that the consumer derives from the use of a good or service at a given price. Specifically, it is the difference between an individual's willingness to pay for a good or service and the amount actually paid. Therefore, it is necessary to estimate the demand for the recreational service offered by the area using the travel cost of each visitor.

Assuming that an individual visiting the region r times in a given period of time derives utility from visiting the park and enjoying its many recreational amenities, then the park entrance fee for each individual is determined by the cost of access to the park, c , which includes travel costs, the entrance fee to the park, the park's environmental quality, q , and the social and economic characteristics of the visitor, H (Carriazo, Ibanez, and Garcia 2003). Thus, the demand for park visits can be shown by $r=f(c,q;H)$.

Graph I: Benefits for Recreation



Source: Carriazo, Ibañez and García 2002

The main assumptions of the model are that the recreational service lacks an observable market; that the visitor maximizes the park's utility subject to entrance restrictions and time; that each recreational trip has a single purpose; that there is an opportunity cost of travel time; that visitors react the same way to an increase in the cost of travel as they do to an increase in the price of entrance to the site; that for many individuals, the demand for the good (for the recreation site) is zero; and that to use this good, the individual needs to transport himself to the place of recreation.

It is important to note that this method has certain advantages but also some limitations, as do many of the methods used to value environmental goods and services. One of the advantages claimed for the travel cost method is that it is based on revealed preferences, i.e., on observed and not hypothetical behaviors. Furthermore, the application of the method is not as expensive; on-site surveys provide opportunities for large samples, as visitors tend to be interested in participating; and the results are relatively easy to interpret and explain (Maradan 2011).

Among the main difficulties that the method faces are the valuation of the cost of time, the fact that some visitors spend the night at the site and others do not, and the need to account for travel to multiple destinations. Additionally, evaluating the quality of recreation and relating it to environmental quality is not a trivial task (Maradan 2011). In particular, defining and measuring the opportunity cost of time or the value of the time spent traveling is a complex task and there is no consensus on which is the best method to do so. For example, if people enjoy the journey as such, then the travel time can be converted into a benefit rather than a cost (Mendes 2002; Wieland and Horowitz 2007).

As mentioned, the essence of the method is to capture the relationship between (1) the number of visits and (2) the cost of the trip. There are several functional ways to capture this relationship. A simple way of explaining this is one used by Wieland and Horowitz (2007), which consists of modeling the natural logarithm of the number of visits per year reported by the respondent as a linear function of the costs of travel and the individual characteristics of visitors.

$$\ln y = \alpha C + X\beta + \varepsilon \quad (1)$$

Where,

y is the number of trips made by the respondent per period.

C is the cost per trip.

X is the individual characteristics of the agents.

ε is a normally distributed error.

Cost:

$$C = C_v + C_T$$

C_v = Cost of travel (distance * travel cost per km).

C_T = Opportunity cost of time spent on visiting or travelling. Generally it is compared to salary.

The coefficient α accompanying the cost variable is the opposite of the consumer surplus per visit (S_i). The coefficient is expected to be negative, because it is expected that the higher the cost of the trip, the less frequently visitors will go to the Páramo.

Thus, the annual consumer surplus of all trips made by an individual, i , is given by:

$$S_i = -\frac{y_i}{\alpha} \quad (2)$$

The consumer surplus per trip is $-\frac{1}{\alpha}$, which is the result that is usually reported in the literature of travel costs.

4.2.1 Zonal Travel Cost Method

In economic valuation literature there are different approaches for making an assessment through the travel cost method that suit the availability of information and the characteristics of the area of study. For this work, the method of zonal travel cost was used, since the surveys showed that most visitors were first-time visitors to the Páramo de Santurbán, which does not enable estimation of the individual travel demand.

The zonal travel cost method is based on the collection of information on the number of visits to the site under study from different distances. The assumption behind the method is that travel time increases with distance, which allows a calculation of the number of visits at different "prices" (distances). In turn, this information is later used to estimate the demand function and consumer surplus, or the economic benefits of the recreation site (Ecosystem Valuation n.a.). In this case, the estimation of travel and demand costs of the recreational service is based on zone averages; the demand per zone of origin is the average propensity to visit a place under study for various pre-selected areas that have different entrance fees (Azqueta 1994).

4.3. RESULTS

To apply the travel cost methodology, 140 visitors to the Páramo de Santurbán responded to surveys, to approximate the number of visitors that use the moor's recreational services and to identify the visitors' characteristics. Visiting days were chosen randomly, interviews were conducted in areas of high visitor traffic, and a short and quick survey (five minutes) was prepared

since visitors are usually not willing to spend much time completing a survey, but rather want to continue their visits without interruptions.

The surveys were carried out in the municipalities of Pamplona, Cúcota, Cúcira, Cucutilla, Vetás, and Suratá. These areas were chosen because they were either part of the moor or were close to the moor's accesses, and because they are the most popular due to the presence of lakes and other attractions.

The survey included a module that characterized the visitor by asking questions about place of residence, age, monthly income range, education, and main occupation. The second module asked for information concerning the cost of travel. This section asked about the number of visits in the last two years, the visitor's starting location for the visit to the site, the type of transport used to get to the páramo, the time elapsed from the place of origin, and the number of people traveling together. In addition, questions about the duration of the visit and the main reason for the trip were included, as were questions about the reason for the visit and the activities carried out in the Páramo de Santurbán (See Annex 11.5 for more complete descriptive statistics).

To implement the zonal travel cost methodology, visitors need to be grouped by place of origin, visit rates need to be calculated by area of origin, and then demand functions and consumer surplus need to be estimated.

Zones were defined by grouping visitors according to their places of origin. The municipalities near the moor had several observations for which they were left as an individual zone, and the ones far from the moor with few observations were grouped by taking into account the distance to the moor. In total 17 areas were identified.

Figure 4: Places of Origin



Source: Authors, Google Maps

To calculate the number of visitors per year, it is necessary to take into account both the number of visits recorded from Monday through Friday and the number of visits on weekends (Saturday and Sunday). Based on this information, it was assumed that the number of visits per year would follow the pattern of the visits in the sample, resulting in a total of around 7,400 visitors a year. Similarly, the annual rate of visitors was calculated for each zone. This was done because there is

no record of the number of visitors to the Páramo de Santurbán, as it is not classified as a regional natural park or a reserve area that records the number of visitors. Then the number of visitors from each zone was divided by the number of inhabitants and multiplied by 100,000 to obtain the rate of visits per 100,000 inhabitants.

To measure the average distance per zone, the distance from the starting place of the trip to the Páramo de Santurbán was calculated. The cost of travel was estimated by taking an average cost of 405 pesos per kilometer, based on the costs for freight reported by the Ministry of Transport⁴ for the destinations of Bogotá–Bucaramanga, Medellín–Bucaramanga, Cúcuta–Bucaramanga.

Since the roads in Colombia are not homogeneous and not all are paved, it is not appropriate to assume an average time per kilometer. For this reason, the average time to the Páramo de Santurbán from the starting point of the trip was approximated by asking visitors about the estimated travel time of public fleet services and using Google Navigate. To calculate the time between the different towns and places near the moor, people who live in the area and travel to it frequently were asked.

To calculate the cost of time, a total amount of 2,435.61 pesos per hour was set. This figure was used to assess the time for a transport study in Colombia that took into account an average monthly income of the population of Bogotá (EMBARQ 2009). Table 4 presents the results per area.

Table 4: Travel Cost per Zone

Zone	Distance (Km)	Time ^a (Hours)	Travel Cost (Pesos)	Cost of Travel Time (Pesos)	Total Cost (Pesos)
Bogotá	921	21	373,046	50,904	423,950
Medellín	952	21	385,560	51,635	437,195
Bucaramanga	207	8	83,835	18,930	102,795
Cali	1,590	33	643,950	80,862	724,812
Caracas	2,054	82	831,870	200,110	1,031,980
Cúcuta	247	9	100,035	21,709	121,761
Duitama/Sogamoso	760	19	307,800	46,642	354,442
El Zulia	300	12	121,500	28,010	149,510
Los Patios/Villa del Rosario	373	13	151,065	31,216	182,281
Montería	1,540	30	623,700	73,637	697,337
Barranquilla	1,260	23	510,300	56,019	566,319
Pamplona	110	5	44,550	11,485	56,222
Ibagué/Pereira	1,453	29	588,465	71,810	660,275

⁴Available at: <https://www.mintransporte.gov.co/publicaciones.php?id=359>

Zone	Distance (Km)	Time ^a (Hours)	Travel Cost (Pesos)	Cost of Travel Time (Pesos)	Total Cost (Pesos)
Tunja/Vélez	612	17	266,606	40,854	307,460
Betulia	270	16	109,431	38,564	147,995
San Cristóbal/San Antonio/Ureña	348	14	139,320	33,514	172,834
Puerto Wilches	392	16	158,760	38,564	197,324

^a This includes the time of the round trip. All figures are rounded, which may result in minor discrepancies.
Source: Authors

4.3.1 Estimation of Demand

After obtaining information about the distance traveled, travel time, and costs associated with travel, it is possible to calculate the econometric estimates. In this case, a travel rate per 100,000 inhabitants was estimated based on the average travel cost for each zone.

$$\frac{\text{Number of visits}}{100.000 \text{ inhabitants}} = f(\text{Travel cost, controls}) \quad (1)$$

Three estimates were assumed, taking into account (1) the total travel cost (travel cost and time cost) to explain the number of visits per zone; (2) only the travel cost; and (3) the median average cost reported by visitors. The travel cost coefficient has a negative sign, as expected, and is significant at 1 percent for the first two estimates, but not for the cost estimate based visitors' reports. In the first model, the travel cost coefficient indicates that an increase of 1,000 pesos in the cost of travel causes a decrease of 0.63 percent in the rate of visits per 100,000 inhabitants, when all costs are taken into account, and of 0.73 percent when only the cost of the trip is taken into account. The remaining variables that are introduced as controls (average income, willingness to pay to visit a hypothetical natural park, main destination) are not significant in explaining the number of visits. One explanation for this is that by adding the visitors by areas and averaging their characteristics, the variance of explanatory variables is lost.

Table 5: Travel Demand Estimate by Zone

Dependent Variable	(1)	(2)	(3)
Natural Log Visit Rate	Total Travel Cost	Travel Cost	Average Cost Reported
Total Cost	-0.00627*** (0.000927)		
Income	-0.321 (0.342)	-0.230 (0.340)	-1.027 (0.695)
Willingness to Pay an Entrance Fee to the Park	1.222 (0.927)	1.058 (0.911)	1.970 (2.070)
Main Destination Moor	-0.416	-0.461	-0.877

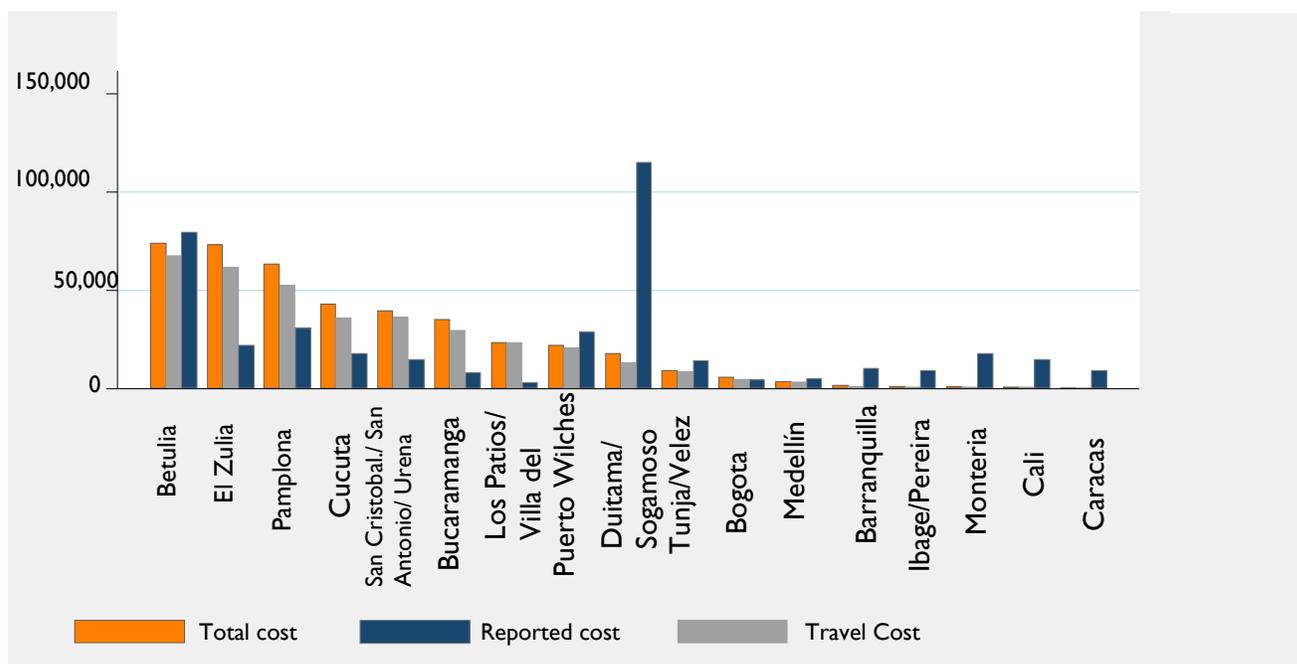
Dependent Variable Natural Log Visit Rate	(1) Total Travel Cost	(2) Travel Cost	(3) Average Cost Reported
(Dummy)	(0.664)	(0.652)	(1.388)
Cost of Trip		-0.00732***	
		(0.00106)	
Cost Reported			-0.00377
			(0.00341)
Constant	6.807***	6.638***	7.796***
	(1.107)	(1.087)	(2.541)
Observations	17	17	17
R-square	0.821	0.827	0.221
Standard error in parenthesis			
*** p<0.01, ** p<0.05, * p<0.1			

4.3.2 Consumer Surplus

The results of the annual consumer surplus per 100,000 inhabitants for each visitor's place of origin are presented below. For cases in which the cost was estimated rather than reported by visitors, it is observed that the areas for which consumer surplus is higher are Bethulia, El Zulia, Pamplona, Cúcuta, and Bucaramanga. This is because these are the areas with the highest number of visitors and, in the case of Bethulia, because its total population is small, and thus, the rate of visitors is high. Also, as expected, consumer surplus is higher if the cost of time is taken into account. Graph 2 shows the results for the three models estimated.

After transferring the consumer surplus from pesos/100,000 inhabitants to pesos/population in each zone, it is evident that the zone for which consumer surplus is highest is Bogotá. This is due to the fact that the population of Bogotá is larger than in the rest of the areas.

Graph 2: Consumer Surplus per Each 100,000 Inhabitants per Area



Source: Authors

Finally, to calculate the value of recreation in the Páramo de Santurbán, the surplus of all the areas was added, resulting in a value of between 1,150 million and 2,169 million pesos per year (Table 6). With a social discount rate of 12 percent, the consumer surplus value in perpetuity is between 9,592 million and 18,075 million pesos, according to the opportunity cost of time taken into account and assuming a number of zones and visitors by constant areas.

Table 6: Total Annual Consumer Surplus—Estimated Recreation Value (Million Pesos per Year)

Annual Surplus per Zone Total Cost	Annual Surplus per Zone Travel Cost	Annual Surplus per Zone Reported Cost
1,363	1,150	2,169

Source: Authors

4.4. DISCUSSION OF RESULTS AND CONCLUSIONS

Based on the surveys of visitors to the Páramo de Santurbán, it was concluded that the minimum value that society assigns to this ecosystem service ranges between 1,150 and 2,169 million pesos a year. The rate of visits to the moor by area or zone is related to the costs associated with the visit, including both the cost of travel and the cost of time. It was possible to estimate the demand for visits to the Páramo de Santurbán and the value of well-being, in monetary terms, associated with these visits.

While the cost of travel is a widely used method for estimating the value of ecosystem services associated with recreation, it is important to recognize its limitations. In this exercise there are two important limitations. First, it is not possible to capture all the visitors to the páramo because it does not keep a record of visitors; therefore the value associated with the recreational service is the lowest limit. Moreover, for 42 percent of the sample, the Páramo de Santurbán was not the main destination of their trip, which could overestimate the individual consumer surplus in some way.

Beyond the estimated monetary value, this exercise shows that people believe that the Páramo de Santurbán is a suitable place for recreation and enjoyment of various ecotourism activities. This is in spite of the difficulty in reaching the site and the fact that it currently offers no tourist infrastructure. Additionally, it was found that not only local people visit the area, but also people from around the country and even from abroad, which indicates that the area has considerable tourism potential.

Another finding is that over 92 percent of the visitors agree with declaring the area a regional natural park, even if it means that some activities will be restricted. Furthermore, most of the visitors (58 percent) would agree to pay an entrance fee to the páramo if it were declared a regional natural park. The average WTP among those who would agree to pay an entrance fee is 21,176 pesos.

This study is a tool to facilitate policy decision-making on the use of the Páramo de Santurbán by recognizing that it provides ecosystem recreation services and a sense of well-being that are valued by members of society, but that in the absence of a market, are often ignored or undervalued. The evidence that the páramo should be preserved is the fact that it not only protects water resources that benefit nearly two million people, but it also benefits people who do not use its water directly but who benefit from the recreational activities that can be enjoyed at the site.

5. CARBON SEQUESTRATION VALUE

Low temperatures and other characteristics of the páramo cause low mineralization and nutrient recycling rates, which favor a slow but steady absorption of CO₂. Páramo soils' high capacity to hold water favors the prevalence of anaerobic conditions for long periods during the year, which fixes carbon in the soil for long periods of time.

5.1. METHODOLOGY

The benefits transfer method was used to assess carbon sequestration in the Páramo de Santurbán. Benefits transfer is an economic valuation technique for environmental goods and services that uses secondary sources of information—particularly valuation exercises based on primary sources performed in a similar context—as an input for the site for which the valuation will be carried out. Benefits transfer refers to the transfer of the monetary value of an environmental asset, called the study site, to another environmental good, called intervention site (Brouwer 2000). Figures based on a benefits transfer study are an approximation of the value of the economic benefits of environmental goods and can be applied when the need for precision in well-being measures is low (Navrud and Bergland 2001).

The objective of this methodology is to transfer and adapt the monetary value calculated for certain environmental services in a place where primary estimates have been determined to another place with a similar context that still has not undergone primary valuation research.⁵ For example, if the purpose is to evaluate the benefits of reducing phosphate-related pollution in river X, the values obtained from a study of river Y are used and adjusted to take into account two factors: (1) differences in socioeconomic characteristics of service consumers, and (2) differences in the environmental context and characteristics of the river X compared to river Y.

There are generally two types of approaches for this methodology: transfer of values or transfer of functions. The transfer of values approach adapts a well-being measure from a single study or a statistical measure of a set of studies, such as the mean, to the intervention site. Meanwhile, the transfer of functions approach consists of using the functional relationships estimated for other studies and applying them to data for the site of interest. The meta-analysis of existing valuation studies is a statistical analysis of previous studies that takes the WTP as the dependent variable and the characteristics of valued goods as the independent variable.

The main advantage in the application of the transfer of benefits method is its cost-effectiveness, because in many situations it is not practical for an institution to collect primary information on which to estimate economic value, due to money or time restrictions. Therefore, in those cases where funds, time, or staff are insufficient, and where there is also information from a site with similar or comparable features to the site subject to the intervention, the transfer of benefits should be applied.

⁵ Based on Rosenberg and Loomis (2003), Osorio and Correa (2004), Brower, R. (2000).

The figures derived from the transfer of benefits methodology can be considered first approximations or inputs for policy decision-making, since they help to achieve results faster and in a more economical way than the primary valuation-based on field work.

5.2. RESULTS

To estimate carbon sequestration as an ecosystem service offered by the Páramo de Santurbán, the total area of 80,000 hectares of the moor was taken into account. Subsequently, the average CO₂ sequestration in moors was taken from three research studies and the sequestration potential for the moorland was estimated. Below are the results from this exercise.

Garcia Portilla (2003) conducted a study of the carbon content in Páramo de Chingaza soils, in which he characterizes the carbon compartments: mineral soil, mulch or top soil, and free organic matter. He found that the soils of the Páramo de Chingaza are composed of 10 percent carbon and over 70 percent water. No significant differences in the carbon content in soil, mulch, or free organic matter were found in the wet and dry slopes. He found that there are 79.8 tons of CO₂ per hectare in this moor.

Hofstede (1999) found in his study that the Peruvian moors may accumulate more carbon than the rain forests, despite the difference in biomass if soil is considered. Rondón et al (2002) found that, for the Páramo de las Ánimas in el Cauca, Colombia, carbon contents are very high on the top layers of soil (20 to 30 percent) and decrease gradually (3 to 5 percent) to one meter of depth.

This paper used the value found by Garcia Portilla, who took the values of Hofstede to estimate carbon sequestration for vegetation. Thus, if each acre of protected moor prevents the emission of 79.8 ton/ha of CO₂, the protection of 80,000 ha of the Páramo de Santurbán would avoid the emission of 6.3 million tons of CO₂ currently stored in the soil.

If the price of US\$5 per ton of carbon is adopted, the conservation of the moor for its carbon content gives a value of US\$31.92 million, or 58,340 million pesos. Priced at US\$2 per ton of carbon, the value would be US\$12.77 million, or 23,336 million pesos.

5.3. CONCLUSIONS

The conservation of the Páramo de Santurbán ensures the storage of a significant amount of CO₂. To the extent that the ecosystem degrades, especially its soils, this carbon is released into the atmosphere where it has a negative effect on climate change.

Based on these results, financing mechanisms for ecosystem conservation could be sought. Such mechanisms might include a clean development mechanism (CDM) or other payment scheme for reducing emissions. This would require a more detailed study on the areas and quantities of CO₂ stored in the Páramo de Santurbán.

6. EXISTENCE AND BEQUEST VALUE

In addition to use values (for features such as recreational access or water supply) natural resources generate non-use or passive values. This study focused on two types of passive use values: existence and bequest values, which are discussed in this section.

According to Krutilla (1967), people value certain goods just because they exist or because of their potential use by future generations, even if they never get to use them. In literature, this is known as existence and bequest values.

The value of existence and bequest that the inhabitants of Medellín and Bogotá give the Páramo de Santurbán was estimated using information obtained from surveys conducted in these two cities. It was found that the WTP to convert the moor into a regional natural park averages about 30,310 pesos. Given that the samples were representative for these two cities, the aggregate sum that individuals over 18 years of age would be willing to pay is 239 billion pesos.

6.1. THEORETICAL FRAMEWORK

The term “existence valuation” was first used in 1967 by J.V Krutilla. According to his work, people are interested in natural resources such as natural parks, regardless of their desire to visit them. That is, people feel well just by the fact that these areas exist, regardless of whether they—or even their children—will come to benefit from these resources at some point.

Krutilla (1967) also developed the term “bequest valuation,” which, unlike existence valuation, includes the desire of people to preserve a natural resource for their descendants. In this case, people are willing to pay to protect the páramo (in this specific case) because they expect their children or grandchildren to enjoy the direct services (water, recreation, biodiversity) that this area provides.

Due to the absence of a market in which to establish people’s willingness to pay to conserve natural resources, even though they do not make use of them, a method known as contingent valuation was developed. This method creates a hypothetical market through surveys, asking about individuals’ willingness to pay for the conservation of a natural resource.

Within contingent valuation, there are several survey designs to determine the value of the payment. However, some methods perform better than others, and have been better welcomed in the literature.⁶ The double-limit methodology is one of them. Because of its strengths, discussed below, it was chosen to estimate individuals’ willingness to pay for services offered by the Páramo de Santurbán even though they do not benefit from them.

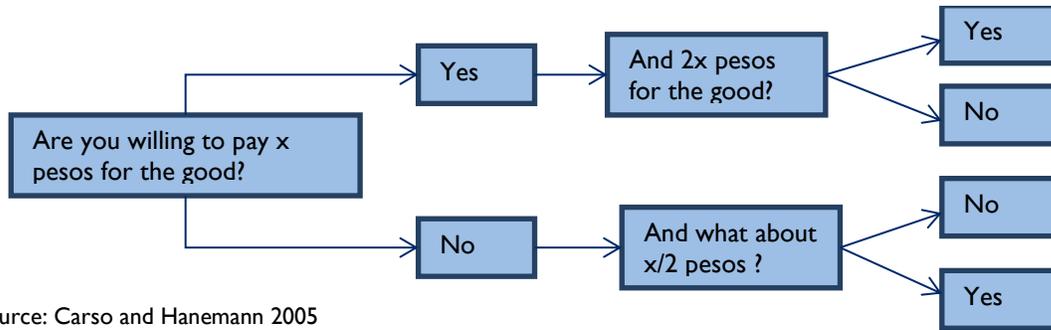
Under this methodology, a central question is designed like an "auction" (see Figure 6). In the first stage, a person is asked if he or she is willing or not to pay a given sum of money for the

⁶See Adamowicz et al. (1995); Shechter et al. (1998); and Carso, R. and Hanemann, W. M. (2005); among others.

conservation of the Páramo. If the respondent answers affirmatively in this first phase, the next question is whether he or she is willing to pay a higher amount (twice as much). A ceiling is determined based on the responses of participants on the maximum amount they are willing to pay for the conservation of the Páramo.

If a responder answers negatively to the first phase, the next question will be if he or she is willing to pay a lower amount to preserve the moor (half the price). Based on the responses obtained in the second stage, the minimum amount they are willing to pay is established for the moor.

Figure 5: Design of the Auction-Type Question



Source: Carso and Hanemann 2005

The double limit eliminates the problem of the excessive occurrence of the “I do not know” answer and additionally allows researchers to know both the maximum and the minimum amount the respondent is willing to pay. To avoid bias toward the initial WTP amount, the survey developed for this study had four different versions of the central question.

Due to the difficulty of separating the existence and the bequest values in the questions, it was decided to integrate both into one.

After obtaining the data, a response probability model was used. In this case, as there were two possible valuation questions, there were four possible outcomes: (1) in the first question (Q1) the person answers yes and in the second (Q2) the answer is also (yes, yes); (2) in Q1 the response is yes and in question Q2 the response is negative (yes, no); (3) vice versa (no, yes); and (4) both questions receive a negative answer (no, no).

If A is the initial amount of money in Q1, and if the initial response is positive, then Q2 will be made with a higher amount than A . Otherwise, an amount lower than the initial A will be used. Replacing it in the general formula for the probability of multiple responses is shown below:

$$Q(\text{Answer yes/no}) = \Pr(A_1 \geq C \geq A) \equiv G_c(A_1) - G_c(A) \quad (1)$$

$$Q(\text{Answer no/yes}) = \Pr(A \geq C \geq A_2) \equiv G_c(A) - G_c(A_2) \quad (2)$$

$$Q(\text{Answer yes/yes}) = \Pr(C \geq A_1) \equiv 1 - G_c(A_1) \quad (3)$$

$$Q(\text{Answer no/no}) = \Pr(A_2 \geq C) \equiv G_c(A_2) \quad (4)$$

$G_c(x)$ is the cumulative distribution function of the willingness to pay. For a given individual, $G_c(x)$ specifies the probability that his or her willingness to pay for the resource in question is less than x ($\Pr(C \leq x)$).

For this study, estimates with two of the econometric models used in the contingent valuation literature were used: bivariate probit model and generalized linear model (GLM). The bivariate probit model answers the question of what determines that a person is willing to pay, while the GLM analyzes the amount the individual is willing to pay and allows the results to be extended to the target population.

6.1.1 Bivariate Probit Model

This model finds the probability that an individual with specific characteristics chooses a particular option (i.e., to pay or not to pay for the Páramo de Santurbán to become a regional natural park). Given the way the survey is designed, the question of the initial amount is correlated with the next question, therefore a simple probit model cannot be used, so it is necessary to use the bivariate probit. This model estimates the joint probabilities of the occurrence of accepting or rejecting the proposed second payment, since the initial payment was accepted or rejected.

The probability that an individual is willing to pay for converting the moor into a regional natural park depends on certain characteristics, such as age, sex, education, income, etc., which determine the density function of the model. The bivariate probit uses a normal bivariate distribution function, represented by:

$$Q_i = P(y_1, y_2) = \frac{1}{\sqrt{2\pi(1-\rho)}} e^{[-\frac{1}{2-2\rho^2}(y_1^2 - 2\rho y_1 y_2 + y_2^2)]} \quad (5)$$

Where

$y_1 = 1$ if the individual is willing to pay the initial amount, and 0 otherwise.

$y_2 = 1$ if the individual is willing to pay the amount proposed in the second phase, and 0 if not.

ρ indicates the correlation among error differences.

In this paper, two specifications for the bivariate probit model were presented based on the work of Hanemman and Kaninenn (1996). In both cases the objective is to find the probability that the respondent will pay, depending on the initial amount requested from him or her:

$$\text{Model I: } \alpha - \beta \text{ payment} + \eta \quad (6)$$

$$\text{Model II: } \alpha - \beta \log(\text{payment}) + \eta \quad (7)$$

The payment variable is a dummy variable that takes the values of 1 if the respondent agrees to pay the initial sum and 0 if the respondent answers negatively.

The WTP is determined by applying Hanemann's model (1984). There are two possibilities in this model: use the mean WTP (C^*), or the median (C^+):

$$\text{Model I: } C^* = C^+ = \alpha/\beta \quad (8)$$

$$\text{Model II: } \begin{cases} C^* = (e)^{\alpha/\beta} E \left\{ (e)^{\frac{\eta}{\beta}} \right\} \\ C^+ = (e)^{\alpha/\beta} \end{cases} \quad (9)$$

Where

$$E \left\{ (e)^{\frac{\eta}{\beta}} \right\} = (e)^{\frac{1}{2}\beta^2} \text{ if the model is a probit.}$$

α y β are the coefficients estimated in the initial model.

Subsequently, the explanatory variables are selected based on the t-student criteria, the percentage of correct predictions and the Chi-squared goodness of fit.

As the probit model is non-linear, the parameters that accompany each explanatory variable cannot be interpreted as the variation of probability in face of a change in this variable. In order to properly interpret them it is necessary to calculate the marginal effects.

6.1.2 Generalized Linear Model

A generalized linear model is an extension of a linear model; it uses non-normal distributions of errors and non-constant variances. This model uses a link function that defines the relationship between the systematic (non-random) or linear predictor and the dependent variable. Under a GLM it is assumed that the dependent variable is generated from an exponential distribution function.

The reason for using this model is that the independent variables (income, age and education are correlated) are correlated with the error term; the GLM allows researchers to obtain better estimates when this problem arises.

Moreover, a GLM can narrow predictions through the link function. In this case, data must be positive (starting at zero), since it is necessary to know how many people from Medellín and Bogotá are willing to pay to preserve the moor and under this exercise there is no possibility of a negative response. There are several kinds of link functions (identity, log, logit, reciprocal, square root, and exponential), and since the data are continuous and errors are distributed as a normal, the identity function was used.

6.2. RESULTS

Based on the methodology explained above, a survey was applied to 404⁷ inhabitants in Cundinamarca and Antioquia,⁸ which are regions quite distant from the moor and that consequently do not benefit directly from the services (water) provided to the residents of neighboring municipalities. Respondents were randomly selected and the field work was carried out in several malls in the chosen cities. The survey allowed researchers to understand the effect of three types of determinants on respondents' valuation: socio-demographic determinants; socio-economic factors; and intrapersonal determinants that include knowledge, appreciation, and attitudes about the environment and the moors in particular.

6.2.1 Model Estimates

Before calculating model estimates, researchers considered the problem of individuals whose WTP was zero because they believed that preserving the moor is a government task. Carson

⁷Of which 395 were used, since the remaining pertained to people who had visited the Páramo de Santurbán previously.

⁸ In Cundinamarca surveys were passed only in Bogotá, while in Antioquia, Medellín, Bello, La Ceja, Envigado, Itagüí, Girardota, Caldas, Copacabana, La Estrella, Rionegro, and Sabaneta were included.

(1991) states that it is normal to get a percentage of "protest" responses, or the occurrence of zeros, where individuals are not willing to pay, and that it is typically between 20 percent and 30 percent. In this case, it was 33 percent. Since these zeros are due to the belief that the government should pay, and not because individuals have a zero valuation, these observations were considered missing. To impute the value of protest zeros, however, the estimates obtained under these specifications did not provide any significant results.

Initially, the function to be estimated included all possible independent variables obtained from the survey:

- Age (years)
- Sex: 1=male, 2=female
- Education: last educational level reached
- Income (monthly)
- Level: according to water bill (1 to 6, where 6 is the highest)
- Concern: an index that measures people's interest and concern in preserving the environment, built from the answers to the following questions (see Appendix 11.7):
 - Level of concern for the environment
 - Frequency in which the person separates trash
 - Frequency of times the person closes the faucet while brushing teeth
 - Frequency with which energy efficient bulbs are used
 - Frequency of taking more than five minutes to shower

Next, some initial models are presented, which were estimated including all the variables described above:

Model 1 (Bivariate Probit)

First answer or stage (same for models 1 and 2):

$$payment = \alpha_0 + \alpha_2 * age + \alpha_3 * sex + \alpha_4 * educ + \alpha_5 * income + \alpha_6 * level + \alpha_7 * concern + \varepsilon_1 \quad (12)$$

Second answer or stage

$$payment2 = \beta_0 + \beta_1 * price1 + \beta_2 * age + \beta_3 * sex + \beta_4 * educ + \beta_5 * income + \beta_6 * level + \beta_7 * concern + \varepsilon_2 \quad (13)$$

Model 2 (Bivariate Probit)

First answer or stage (see model 1)

Second answer or stage

$$payment2 = \beta_0 + \beta_1 * \log(precio1) + \beta_2 * age + \beta_3 * sex + \beta_4 * educ + \beta_5 * income + \beta_6 * level + \beta_7 * concern + \varepsilon_2 \quad (14)$$

Model 3 (GLM)

$$WTP = \alpha_0 + \alpha_2 * age + \alpha_3 * sex + \alpha_4 * educ + \alpha_5 * income + \alpha_6 * level + \alpha_7 * concern + \varepsilon_1 \quad (15)$$

The models were recalculated until a more robust specification was obtained. The results of these estimates indicated that being willing or not to pay the initial amount requested depends on income, gender, and the environmental concern of the respondent. The answer to the second question, on the other hand, was determined by the initial price (phase I), income, and level of concern for the environment. The only factor that negatively affects the probability of contributing to the conservation of the moor is the initial price.

Since the bivariate probit model coefficients have no economic interpretation, marginal effects were obtained to determine how much the WTP is affected by the characteristics of individuals. Under Model 1, the probability of willingness to pay increases by 2.9 percent as income rises to the next upper range. Being female increases the possibility of paying by 3 percent, other things being equal. Finally, being more concerned about the environment raises the probability of payment by 2 percent, other things being equal (see Table 7). Marginal effects obtained in Model 2 differ much from those obtained in Model 1.

Table 7: Marginal Effects of the Probit Model

	Bivariate Probit	
	(1)	(2)
	P (payment=1, payment 2=1)	
Price I		-3.88e-06***
	(1.36e-06)	
Natural log of price I		-0.088***
		(0.0289)
Income	0.0296**	0.00299**
	(0.0117)	(0.0117)
Female	0.032**	0.033**
	(0.016)	(0.016)
Concern	0.020***	0.020***
	(0.0072)	(0.0072)

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

On the other hand, moving from a starting price of 10,000 pesos to 20,000, 30,000, and 40,000 pesos increases the final WTP by 11,634, 20,211, and 24,825 pesos respectively. An additional level of education increases the willingness to pay by 2,557 pesos, other things being equal, and a change in one unit in the index of concern generates a variation of 1,113 pesos in the WTP, other things being equal (see Table 9). This estimate also included gender and social level; however, these did not provide a significant result, so they were left out of the results chart.

Table 8: Final Estimates of the Generalized Linear Model

	Generalized Linear Model
Dependent variable: willingness to pay	(3)
Education	2,557** (1,162)
Concern for the environment	1,113*** (430.29)
Income	1,403** (654.33)
Initial price 10,000 pesos	0 (0)
Initial price 20,000 pesos	11,634*** (1,973)
Initial price 30,000 pesos	20,211*** (3,172)
Initial price 40,000 pesos	24,825*** (3,275)
Constant	-8,237 (5,328)
R squared	0.273
Log likelihood	-3240.59
Observations	287

Standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

The willingness to pay under the bivariate probit model was estimated following the Hanemann method (1984), from the models specified in (6) and (7). The WTP under the GLM, however, the mean and median predicted by the selected model were used. Table 9 presents the results obtained under each model, as well as the upper and lower limits of the WTP under the probit model. It can be observed that the willingness to pay once for converting the Páramo de Santurbán into a regional natural park varies between 31,335 and 102,172 pesos.

Table 9: Averages, Medians, Maximum, and Minimum of Estimated Willingness to Pay (in Pesos)

Model	Bivariate Probit				Generalized Linear Model
Specificaiton	Model I		Model II		Willingness to Pay (WTP)
	WTP	Minimum–Maximum	WTP	Minimum–Maximum	
Average	34,760	30,310–41,839	102,172	54,361–761,660	31.335
Median			34,671	28,313–47,868	32.468

The samples taken for Medellín and Bogotá are representative, allowing the study to estimate the aggregated willingness to pay for these two cities. Using the Great Integrated Household Survey, 2011 (GEIH), the minimum aggregate WTP was estimated at 238 billion pesos to convert the Páramo de Santurbán into a regional natural park. The maximum amount was 777 billion pesos (see Table 10). Since these two cities are not representative nationwide, however, the aggregate WTP existence and bequest were not estimated for the country.

Table 10: Aggregate Willingness to Pay for Medellín and Bogotá

	Frequency		Willingness to Pay (WTP)	Total
	(Persons)		(Pesos)	(Million Pesos)
	Medellín	Bogotá		
Minimum WTP	2,447,348	5,154,948	31,335	238,217.95
Maximum WTP	2,447,348	5,154,948	102,172	776,741.79

Source: GEIH 2011

On average, the monthly income per capita of Bogotá and Medellín is 785,160 pesos, according to the Quality of Life Survey (2010). That is 9,421,908 pesos per year and a lifetime income of 78,515,900 pesos. If it is assumed that the WTP for converting the moor into a regional natural park is 31,335 pesos (the most conservative sum obtained), this represents 0.039 percent of the income of the entire life of an individual of these two cities, as it is a one-time payment.

6.3. DISCUSSION OF RESULTS

The contingent valuation method has certain limitations. There is frequently a correlation between the WTP and the initial price requested, despite using different amounts in the first phase of the survey. There may also be unobserved biases generated between the interviewer (e.g., induction of certain answers) and the respondent (i.e., as a hypothetical market, the individual may state a WTP that is higher than true).

Besides the limitations of this methodology, results could also be under- or over-estimated due to a bias in the way the question on WTP was asked. The number of zeros found should have been about 30 percent but only reached 12 percent in our sample.

6.4. CONCLUSIONS

This section showed that people from Bogotá and Medellín, although not directly benefited by the Páramo de Santurbán, are on average willing to pay 30,310 pesos to convert the páramo into a regional natural park to ensure its preservation. This willingness to pay increases as people achieve a higher level of education, greater incomes, and a higher level of concern about the environment.

Additionally, the willingness to contribute to the conservation of the moor increases with higher levels of income, when the respondent is female, and as concern about the environment increases (as evidenced in concrete actions related to environmental awareness). These results suggest that voluntary mechanisms could be established for conservation funding, linked to environmental awareness programs targeting people with higher education levels.

7. TOTAL ECONOMIC VALUE

From the estimates described in the previous sections, it was possible to calculate the total economic value of the services being studied. Using a discount rate of 12 percent, the minimum TEV is 398,311 million pesos and the maximum TEV is 1.6 billion pesos.

The lower level of WTP for the services valued was used to estimate the minimum TEV scenario, along with a price of US\$2 per ton of carbon. For the maximum TEV scenario, the upper level of WTP for the services valued was used, as well as a price of US\$5 per ton of carbon.

Table 11: Total Economic Value of the Páramo de Santurbán

Service	Minimum Value (Million Pesos)	Maximum Value (Million Pesos)
Water provision and regulation	127,165.87	733,547.18
Recreation	9,592.00	18,075.00
Carbon sequestration	23,336.00	58,340.00
Existence and bequest	238,217.95	776,741.79
Total Economic Value	398,311.82	1,586,703.97

8. CONCLUSIONS AND POLICY RECOMMENDATIONS

This paper presents a preliminary assessment of the ecosystem services of the Páramo de Santurbán. The water provision and regulation, recreation, carbon sequestration, and ecosystem existence and bequest services were economically valued. The contingent valuation, travel cost, and transfer of benefits were the methods used to do this.

From this exercise, and using a social discount rate of 12 percent, it was found that the TEV ranged between 398 million and 1.6 billion pesos. It is important to note, however, that this is a lower limit to the value of goods and services provided by the Páramo de Santurbán, because not all services are taken into account (such as other direct use values, biodiversity, option value, water provision and regulation for other communities, and other economic activities) and because the valuation is constrained by limitations in economic valuation methodologies and data collection.

The results generated by this study can serve as input for the design of public policies for the conservation of the Páramo de Santurbán. From the results of the WTP for water provision and regulation services, it is evident that the inhabitants of the towns surrounding the páramo are willing to pay for conservation and that in general, there is a clear relationship between taking care of the ecosystem and the services received.

As for the protest votes that were obtained, it is important to emphasize that they do not imply a zero value from users, but a stand against being asked to pay for something they feel the government should fund. In that sense, it is important to create spaces for dialogue between the government and users, to help them see that the government is fulfilling its responsibility to preserve the environment. In this way those protest votes could become a true willingness to pay.

Taking this study's WTP, a current bimonthly rate of 3,000 pesos can be established for the páramo's conservation. With just the three cities of Bucaramanga, Cúcuta, and Pamplona, resources would amount to 7,393 million pesos annually. With these resources, it would be possible to establish a PES scheme, under which páramo landowners would be compensated for conserving páramo areas outside the areas declared as regional natural park. Unlike a scheme in which the government buys the land or pays the owners from a budget, studies show that a PES scheme is more successful if there is a direct relationship between the provider and the environmental service user. The fact that users themselves pay for conserving the resource makes the scheme more sustainable because it does not depend directly on the political will of the officials on duty or on the government's budget availability.

In addition to finding that people are willing to pay to protect the source areas of streams and rivers that supply water systems, it was found that information and education on the moors can have a positive effect on individuals' willingness to pay. This suggests that information and awareness campaigns help conservation.

Another important finding of the study is that the Páramo de Santurbán is an area with a high potential to attract tourists. Currently, despite the lack of visitor facilities (clear routes of access, services, lodging, food, etc.), a significant number of visitors come to the area. A high percentage of them said they would agree to convert the area into a regional natural park and to pay an entrance fee. Developing the area's potential for low-impact tourism could help the sustainable management of the ecosystem and raise funds for conservation.

Regarding carbon sequestration, it is possible to sell the CO₂ not emitted thanks to conservation. This implies a need to carry out a more-detailed study to establish the exact amount of CO₂ captured in the soil of the Páramo de Santurbán. In addition, it implies a need to establish the extent to which CO₂ would be emitted to the atmosphere if there is no change in the current conservation incentive.

Finally, funding for conservation activities needs to not only come from people living in the region. According to the existence and bequest valuation of this study, it was found that residents of other regions were also willing to pay for the conservation of the Páramo de Santurbán. Again, information and environmental education have a significant effect on individuals' willingness to pay, so all financing schemes must be accompanied by awareness and education programs on the environment.

Regarding mining and the conflict involving the maintenance of water sources from the páramo, there are several possible solutions. The first, and most extreme, is the prohibition of mining in the area. Of course, if this could be implemented, monitored, and controlled, the ecosystem would indeed be preserved and water for the population would be ensured, as would the economic activities that depend on this resource. In this scenario, it would be necessary to identify alternative economic activities and trade-offs for those currently engaged in legal mining activities. These compensations would be a governmental responsibility and could in part be financed with the resources mentioned above. It is important, however, to keep in mind that if there is no proper control and monitoring of mining activities, they could continue illegally and cause harmful effects to the environment.

A second alternative for avoiding the contamination of water sources by mining would be to have the ore processing done outside of the páramo. Once the rocks with gold are extracted, to treat and remove the mineral they should be transported to another place where water sources are not polluted and that is outside a geologically unstable area. This would prevent environmental damage and the economic and social damage of banning this activity. In this case, the costs would be borne by private companies.

A third alternative would be to require the construction of a treatment plant in the area to remove pollutants generated by mining (mainly mercury and cyanide). To the extent that random sampling demonstrates that contaminants are within the established standards, mining could be allowed in the area. Otherwise, the activity should not continue. Again, the costs of the treatment plant would be borne by private companies that internalize the negative externality generated by their activities downstream.

Which of these alternatives is the most appropriate will depend on the specific negotiations taking place among the actors involved, with the aim of seeking the greatest benefit for the parties. The suggestion here is that extreme solutions may be difficult to sustain over time, so it may be best to reach a compromise.

The Páramo de Santurbán ecosystem is vital to Colombia. Not only are the services it provides to communities important, but efforts to preserve it also illustrate the challenges of economic development, such as mining, and reflect the interests of the inhabitants of the area and the needs of the whole region.

To the extent that knowledge increases about the ecosystem and the services it provides to its inhabitants, better conservation and development solutions will be reached. This paper seeks to respond to the need for information, since it is one of the first valuation studies for the region and for this type of ecosystem.

9. SOCIAL AND DEMOGRAPHIC CHARACTERIZATION OF THE INHABITANTS OF THE PÁRAMO DE SANTURBÁN

This section describes the characteristics of the inhabitants of the Páramo de Santurbán. Two hundred and forty nine surveys were carried out in the moor municipalities of Arboledas, Cáchira, Cécota, California, Charta, Cucutilla, Mutiscua, Silos, Suratá, Tona, and Vetas. The questionnaire collected information on demographic features, social and economic activities, income, and housing, among others.

Table 12: Surveys by Municipality

Municipality	Number of Surveys	Percent of Total
Arboledas	30	12
Cachira	20	8
Cécota	20	8
California	25	10
Charta	15	6
Cucutilla	29	12
Mutiscua	20	8
Silos	20	8
Suratá	22	9
Tona	23	9
Vetas	25	10
Total	249	100

9.1. HOUSEHOLD MEMBERS AND THEIR DESCRIPTION

The surveys asked specific questions about the head of household and about other members living in the home. On average, households have four members, slightly above the national average, and

are made up of 2.83 adults and 1.25 children, so it was possible to collect information from 1,017 people.

Regarding household composition, it was observed that 81.4 percent of the household heads were male and that the households were composed mainly of the head of household and spouse, along with children, followed by the parents of the head of household and his grandchildren. The average age of the heads of household was established at 47.6 years and of children at 17.5 years.

Fifty percent of the inhabitants surveyed were male and 30.7 percent children were under age 18. Of the children, 88.2 percent attend school and 89.7 percent are literate. The adult population reported an average monthly income of 1,000,533 pesos, above the minimum wage of 2012 (634,500 pesos), including the transportation allowance.

Table 13: Age, Education, Gender, and Income Statistics

	Age	Gender (Male)	Literate	Attend(ed) School	Income
Under age 18					
Average	11.52	48.2%	89.7%	88.2%	\$600,000
Standard Deviation	4.28	50.0%	30.4%	32.3%	\$346,410
Observations	313	313	311	313	3
18 or older					
Average	44.51	50.7%	96.0% ^a	4.7%	\$1,000,533
Standard Deviation	16.98	50.0%	19.6%	21.2%	\$669,809
Observations	704	704	704	704	375
Total					
Average	34.35	50%	94.1%	30.4%	\$997,355
Standard Deviation	20.91	50%	23.6%	46.0%	\$668,563
Observations	1,017	1,017	1,015	1,017	378

^a The illiteracy rate for persons over 15 years of age is 13.6 percent in rural areas nationwide, according to the 2012 National Life Quality Survey.

The findings on the education level of the population revealed that 33 percent of the adult population had only completed primary education and that 61 percent of the adults had not finished high school. Overall, no significant differences were found between the educational levels of women and men.

Most people over 18 are workers; of these, most are male (78 percent). Of those that are 18 or older, a total of 34.4 percent is dedicated to house chores; of this, over 93 percent are women, indicating that the occupations of women and men differ significantly in the rural population studied. A total of 3.6 percent are unemployed and 3 percent stated that their main occupation

was being a student. In terms of revenue, only workers consistently reported a monthly income, averaging 628,373 pesos for those who reported an income. Of the 242 persons engaged in housework, only 8 reported a monthly income, indicating that, in general, these people do not receive income for their work. In terms of age, the average age is higher among the unemployed. Those who reported another activity are the youngest (Table 14). Of the children, 86.9 percent are students.

Table 14: Main Occupation Statistics

Main Occupation	Percent	Percent Male	Average Age	Number of Persons Who Report an Income	Average Monthly Income (Pesos)	Total Average Monthly Income (Pesos)	Observations
Worker	54.1%	78.0%	44.01	356	628,373	587,141	381
House chores	34.4%	6.2%	45.99	8	612,500	20,248	242
Other	4.5%	53.1%	20.63			0	32
Unemployed	3.6%	60.0%	58.96	8	454,000	145,280	25
Student	3.0%	61.9%	54.29	3	80,000	11,429	21
No response/ Do not know	0.4%	0.0%	54.67				3
Grand total	100.0%	50.7%	44.51	378	621,435	333,668	704

When respondents were asked about the position they held in their last job, the majority of adults were determined to be family workers who receive no remuneration (37 percent), followed by persons who work their own land (19 percent), self-employed (12 percent), and agricultural workers (8 percent). Only 4 percent of the respondents of age reported being an employee or agricultural worker, which indicated that there is a high rate of labor informality in the region. The majority of minors (under 18 years) reported never having worked.

On the other hand, when asked about the activity performed by the company or business they worked for during the previous month, 49.5 percent of respondents stated working in farming and/or livestock activities and 30.7 percent in house chores. Additionally, it was found that 10.4 percent were dedicated to mining activities. Upon analyzing the data disaggregated by municipality, it was found that for all municipalities (with the exception of Vetás and California) the main economic activities are farming and livestock activities. In Vetás and California, mining prevails.

Table 15: Main Activity Performed by the Company/Business Worked for Last Month

Main Activity	Observations	Percent
Agriculture and livestock	280	49.5%
Agronomy	5	0.9%
Trade	35	6.2%
Housework	174	30.7%
Mining	59	10.4%
Transport	1	0.2%
Food preparation	2	0.4%
Health	2	0.4%
Other	8	1.4%
Total	566	100.0%
No response/Do not know	444	100.0%

In the specific questions asked to the heads of household, the survey found that 97 percent of heads of household are affiliated with a social security system and 58 percent are affiliated with the subsidized system. Moreover, 34.5 percent reported contributing to a pension fund. Of those who do not contribute to a pension fund, 66.4 percent reported that the reason for not doing so was the lack of money.

In order to identify whether migration is significant among the inhabitants of the region, heads of household were asked about their place of residence five years ago. The study found that over 80 percent lived in the same municipality at that time in which they currently live.

Heads of household reported having an average income of 1,165,870 pesos/month. Disaggregating the results according to land tenure and land activities, it is evident that those with land devoted to mining production reported higher incomes than the rest and that those without land or productive activities reported the lowest average incomes.

Table 16: Income of the Heads of Household

Economic Activities Carried Out in the Land Plot (If Any)	Average (Pesos)	Maximum (Pesos)	Minimum (Pesos)	Standard Deviation (Pesos)	Number
Other/none	1,010,000	3,000,000	200,000	477,687	107
Agriculture	1,124,051	3,000,000	400,000	523,601	79
Livestock	1,509,091	4,000,000	600,000	913,345	22
Agriculture and livestock	1,412,903	2,500,000	400,000	624,762	31
Mining	1,762,500	2,800,000	800,000	682,302	8
Total	1,165,870	4,000,000	200,000	598,533	247

As for expenses, the surveyed households reported spending an average of 1,120,403 pesos per month. Households that have land and do farming and mining on their properties reported higher spending than households that do not have these features. In total, the main item of expenditure of the households is food (38 percent), followed by costs associated with transport and other expenses. Education and toiletries also play an important role in household spending. Moreover, transport spending of households engaged in farming or mining of their lands is more than twice the spending of those households that are exclusively dedicated to other economic activities. Tona reported the highest average incomes and Charta the lowest incomes.

Fifty-eight percent of households reported having been the beneficiary of a state social program. The programs that have the most beneficiaries are Families in Action (Familias en Accion) (21 percent) and programs for older adults (24 percent) (see Table 17).

Table 17: Transfers from Social Programs

Program	Observations ^a	Percent
<i>Familias en Accion</i>	52	21
<i>Jovenes en Accion</i>	6	2
<i>Sena</i>	12	5
Red Juntos	28	11
Colombian Institute of Family Welfare	4	2
Unemployment subsidy	0	0
Emergency assistance	11	4
Senior citizens assistance	59	24
Displaced populaiton	9	4
Titling of land plots	0	0
<i>Agro Ingreso Seguro</i>	0	0
Other	11	4
None	105	42
Total	297	

^a households may benefit from more tan one program

9.2. HOUSING FEATURES

Questions were asked about the housing characteristics of households, since these characteristics shed light on quality of life and incomes. Fifty percent of households reported that their home was owned and paid for, while in 9 percent of cases the house is still being paid for. Fourteen percent of households rent their house and 15 percent are in usufruct. One percent indicated being de facto occupants.

In terms of access to public services, it was revealed that almost all households have electricity services, but that water is low in the sample of households surveyed compared to the rest of the country .

Table 18: Access to Public Services

Service	Number	Percent	Coverage Rate ^a (Rest of the Country) (Percent)
Energy	247	99.2	89.9
Natural gas	1	0.4	4.0
Water	82	32.9	53.1
Sewage	36	14.5	12.3
Telephone	20	8.0	33.0
Garbage collection	81	32.5	18.3
No response/Do not know	0	0.0	
Total	249	100.0	.

a Source: ECV 2011

The majority (53 percent) of households reported that the water they use for drinking and food preparation is obtained from pipelines or communal aqueducts, but also a significant portion (27 percent) gets water from the rivers or streams. Some (10.4 percent) obtained water from the public water supply and the rest from other sources, including wells, rainwater, rivers, or streams.

The predominant flooring material in homes in the sample is tile and cement, while the material of the walls varies among households: 32 percent of homes have block or brick walls, 33 percent are made of mud or adobe, and the rest of materials are considered of a lower quality.

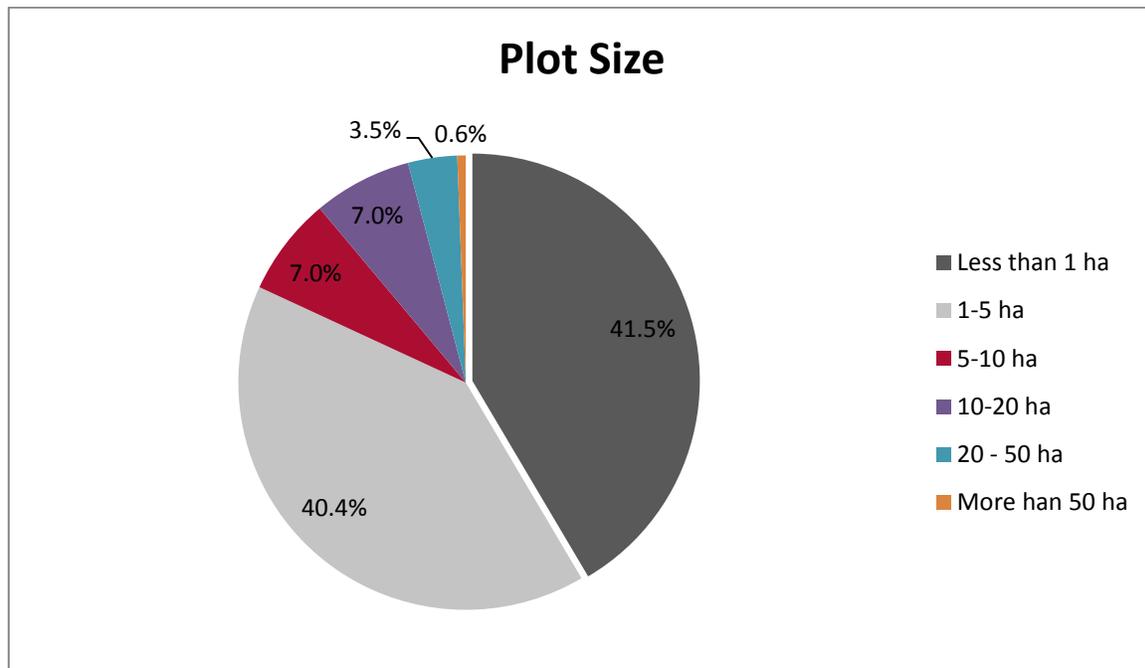
Regarding the effects of natural disasters on housing, 18.9 percent of households reported having suffered some type of damage. The main types of damages recorded were from floods and avalanches. Households most affected by natural disasters live in the municipalities of Cucutilla, Cécota, Mutiscua, and Cáchira, where 72.4 percent, 55 percent, 15 percent, and 15 percent (respectively) of households were affected.

9.3. LAND

9.3.1 Information on Land Plots

Of the 249 households surveyed, 202 reported having at least one farm, property, or land plot. These are distributed in 12 municipalities. Only 171 households reported the size of their land plots. Most of these are small plots: 41.5 percent of the farms have an area equal to or less than one hectare; 89 percent are less than 10 hectares (see Graph 3).

Graph 3: Size of Plots



Seventy-nine percent of households reported owning their plots. When questioned about problems or conflicts related to land tenure, 40 percent of those who answered the question reported some type of problem. Forty-six percent of the problems are associated with inheritance or succession, while 18 percent are due to the fact that the land is located in areas of the park or reserve. Remaining problems are associated with boundaries, disputes with tenants, property titles and other factors. The properties that have problems because they are located in a park or reserve are in the municipalities of Arboledas, Cáchira, Cécota, and Cucutilla.

A total of 42.8 percent of respondents said that their land has its own water sources and that they use it mainly for domestic use and irrigation.

Regarding the investments made in the land, 65 percent of respondents made some investments between 2008 and 2012. Most of those who made an investment did so in irrigation systems (73 percent) and housing (49 percent), with lesser amounts in permanent and semi-permanent structures and fruit and timber trees. Furthermore, 20 percent of the households reported investments in soil conservation and/or water supply.

9.4. ECONOMIC PRODUCTION

Of the households that reported having a farm or lot, 52 percent performed agricultural activities, 25.7 percent livestock activities, and 4 percent mining (see Table 19).

Table 19: Main Economic Activities in Household Lands

Economic Activities in Household Lands	The Household Owns Some Type of Farm or Lot					
	No		Yes		Total	
	Number	Percent ^a	Number	Percent ^b	Number	Percent ^c
Agriculture	6	50.0	105	52.0	111	51.9
Livestock	0	0.0	52	25.7	52	24.3
Mining	0	0.0	8	4.0	8	3.7
None	6	50.0	37	18.3	43	20.1
Total	12	100.0	202	100.0	214	100.0

a Percentage based on households that responded not having land.

b Percentage based on households that responded they had land.

c Percentage based on households that responded to the question on land.

9.4.1 Agricultural Production

A total of 111 households reported performing agricultural activities in their lands. When asked about the main agricultural products grown in the last 12 months (in terms of area), 22.4 percent of households surveyed reported that the main product was potatoes, 17.9 percent berries, and 13.4 percent onions. Table 20 shows the share of each product in the total number of responses, and lists the municipalities where these products are grown. It is important to note that coffee and strawberry products were also reported, among others that are not grown in wilderness areas, indicating that some properties reported by households are not located in the highlands of the municipalities. In the field visit, it was found that in the moorlands, the main crops cultivated are potatoes and onions.

Onions are harvested quarterly, while potatoes are an annual harvest as reported by respondents. Cultivation of these products was carried out in small plots of land; the average cultivated area for onions is 3.1 ha and 1.53 ha for potatoes.

Table 20: Main Agricultural Products

Product	Number	Percent	Municipality
Potato	21	18.8	Cáchira, Cécota, Cucutilla, Mutiscua, Silos, Suratá, Tona, Vetas
Berry	20	17.9	Arboledas, Cécota, Charta, Cucutilla, Suratá
Onion	15	13.4	Tona, Vetas
Peach	13	11.6	Cécota, Cucutilla, Mutiscua, Silo, Suratá
Curuba	10	8.9	Arboledas, Cécota, Mutiscua, Silos
Strawberry	7	6.3	Arboledas, Cécota, Silos
Lulo	7	6.3	Arboledas
Vegetables	5	4.5	Mutiscua
Yellow potato	4	3.6	Cécota, Silos
Tree tomato	4	3.6	Arboledas, Cucutilla
Coffee	3	2.7	Arboledas, Suratá
Beans	2	1.8	Cáchira
Carrot	1	0.9	
Total	112	100.0	

Strengthening agricultural production statistics in terms of productivity, income, and employment is a difficult task, since these variables depend on factors such as climate, soil quality, fertilizer use, the ability of the producer, and crop loss, among many others, and show a large variance. Furthermore, when the activity is carried out by small producers who do not keep records or accounts of their production and who use different units to measure and market their products, it is difficult to report annual statistics on production figures. However, the survey asked farmers a few questions about their crops. Table 21 and Table 22 below show statistics for potato and onion acreage per household, crop yield, quantities consumed by the household, and quantities sold. They also report information on incomes from harvesting and the amount of labor employed. It is very important to note that these figures are not statistically significant and that inferences about agricultural production in the moor at a general level cannot be made. These figures do, however, serve to illustrate some particular cases.

Table 21: Potato Cultivation Statistics

Potato	Lot Area (Ha)	Cultivated Area (Ha)	Production (Kilograms)	Yield (Tons/ha)	Consumption (Kilograms)	Percent Consumption	Sales (Kilograms)	Percent Sales	Income of Previous Year (Pesos)	Wages (Pesos)	Persons
Average	3.85	1.53	1,261.87	6.26	151	11.97	1,110.87	88.03	1,789,652	50	5
Standard Deviation	5.66	1.46	9,83.85	10.46	155		1,223.62		4,293,001	38	4
Observations	22	23	23	23	21	21	23	23	23	23	22

Table 22: Onion Cultivation Statistics

Onion	Lot Area (Ha)	Cultivated Area (Ha)	Production (Kilograms)	Yield (Tons/ha)	Consumption (Kilograms)	Percent Consumption	Sales (Kilograms)	Percent Sales	Income of Previous Year (Pesos)	Wages (Pesos)	Persons
Average	6.2	3.1	32,404.41	7.44	786	2.43	31,961.03	98.63	21,600,000	59	8
Standard Deviation	5.8	3.4	39,686.73	4.53	2,654	.	39,361.20		24,600,000	90	5
Observations	17	17	17	17	14	14	17	17	17	17	17

Farmers' own capital was the main source of funding for potato cultivation (71.4 percent) and onion cultivation (40 percent). However, they also reported using other sources of funding such as commercial or family loans.

All the potato and onion growers surveyed reported using fertilizers, and 44 percent reported using some type of machinery in their crops. Thirty-six percent reported having some type of irrigation system.

9.4.2 Livestock Production

Cattle and sheep are the predominant livestock products in the Páramo de Santurbán. Many of the households with a farm or lot that also have cattle use them to produce milk for home consumption and sometimes for sale. In some areas of the páramo, particularly in Cáchira, households have sheep that are used primarily for wool production. In livestock production, it is important to note that homes often not only use their land area for grazing their animals, but they also graze in areas outside their boundaries.

Table 23: Livestock Production Income and Employment

	Total Income (Last 12 Months, Pesos)	Wages (Last 12 Months, Pesos)	Persons Participating in Production	Use of Fortified Food (Percent)	Use of Machinery (Percent)
Average	16,500,000	371.5	4.5	63	4
Standard Deviation	30,300,000	521.0	4.3	-	-
Maximum	168,000,000	2,400	20	-	-
Observations	51	45	51	54	54

9.4.3 Mining Production

Of all households surveyed, eight reported carrying out mining activities on their lands, all of them located in the municipalities of Vetás or California (Santander) and all extracting gold. As reported by surveyors who conducted the fieldwork in these municipalities, a significant portion of land was sold in 2007 to gold mining companies. From that year, the sale of land has remained stable and new landowners have begun exploration and development works.

On average, 17 grams of gold per day is extracted from each land plot (1.2 grams per day per hectare). Annual sales of the eight properties amounted to 16.2 kg registered annually, which generated total revenues of 1,735,000,000 pesos; 118 people were associated with the production (Table 24). In terms of employee wages, there was confusion by some of the respondents and wage data appears inconsistent with data on the number of employees. Nevertheless, numbers can be interpreted as indicating that each miner works almost every day in mines (approximately 350 days of labor per year).

Table 24: Gold Mining Production Statistics

Household	Municipality	Lot Size	Daily Extraction (Grams)	Extraction (Grams/ha)	Sales of Last Year (Grams)	Total Income (Pesos)	Days of labor	Number of Persons Working in Mining
1	California	30	20	0.7	3,000.0	400,000,000	350	20
2	Vetas	2	3	1.5	870.0	61,000,000	840	3
3	California	35	6	0.2	1,814.4	280,000,000	360	30
4	Vetas		5		1,360.8	120,000,000	360	2
5	Vetas	15	80	5.3	5,000.0	400,000,000	360	25
6	Vetas	4	4	1.0	1,152.0	86,000,000	1,080	4
7	California	5	4	0.8	1,170.0	88,000,000	1,120	4
8	California	22	16	0.7	1,814.4	300,000,000	350	30
TOTAL		113	138	1.2	16,181.6	1,735,000,000	4,820	118
Average		16.1	17.3	1.1	2,022.7	216,875,000	602.5	14.8
Standard Deviation		13.3	26.1	2.0	1,371.0	144,114,476	349.7	12.7

The most common sources of funding to develop mining activities are loans from financial institutions and respondents' own resources. In addition to mining on household grounds, two households reported extracting gold from rivers.

9.4.4 Other Economic Activities

Households were asked about other activities or businesses they are engaged in outside farming and mining; 110 households reported doing other activities, of these 45.5 percent also engage in farming or mining. Among the activities reported by households are equipment rentals, leasing of land, trade in agricultural products, educational services, labor, shops, bakeries and food sales, "chance," and sales of cell phone minutes and gasoline. For households that do farming or mining activities, the other economic activities reported yield an average income of 6,736,364 pesos per year, while for the rest the figure is 15,386,120 pesos.

As shown in this section, the population living in the Páramo de Santurbán is primarily a rural population engaged in agricultural activities and, in some areas, in mining.

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II. ANNEXES

II.1. DESCRIPTIVE STATISTICS OF WATER USERS' SURVEY

Sample Features

A total of 712 surveys were conducted in the cities of Bucaramanga, Cúcuta, and Pamplona. They were collected from a simple random sampling by neighborhood and social level in each of the three cities. In turn, districts where polling firms had developed fieldwork incorporated it order to streamline processes and facilitate access to neighborhoods with security issues.

Results: 99.3 percent of respondents were Colombians. 29.9 percent of them lived in Bucaramanga; 37.5 percent in Cúcuta; and 14.4 percent in Pamplona. In terms of gender, 56.7 percent were women, while the remaining 43.3 percent were men, with ages ranging between 17 and 85 years. The average age was 39 years (with a significance level of 99 percent), with a distribution concentrated in social levels two and three: 69.1 percent (30.5 percent and 38.6 percent respectively).

Regarding the distribution by income level, 61.24 percent of respondents receive a monthly salary of less than or equal to 600,000 pesos. Regarding schooling levels, most respondents were at the secondary level (48.2 percent), followed by the primary level (19.2 percent), and technical level (14.5 percent). The following table describes the information presented.

Description of the Sample by Occupation, Social Level, Education Level and Income Range (Percent)

Occupation	Percent	Social Level	Percent	Education Level	Percent	Income Range (Pesos)	Percent
Employed	28.93	1	15.73%	Primary	19.24%	0 to 600,000	61.24%
Unemployed	3.65	2	30.48%	Secondary	48.17%	600,001 to 1,000,000	19.10%
Independent	41.29	3	38.62%	Technical	14.47%	1,000,001 to 1,500,000	7.16%
House chores	15.73	4	13.62%	Professional	14.04%	1,500,001 to 2,000,000	2.25%
Student	16.15	5	0.28%	Post-graduate	1.26%	2,000,001 to 2,500,000	1.12%
Other	3.23	6	0.00%	None	2.39%	2,500,001 to 3,500,000	0.70%
Retired	1.83	NR*	1.26%	NR*	0.42%	3,500,001 to 5,000,000	0.14%
						NS/NR	8.29%%

* No response/Do not know

Regarding the questions associated with the valuation of the páramo, as well as the WTP for water, the results were statistically significant at 99 percent. Regarding the WTP for the páramo to be declared a regional natural park, the majority stated they were not willing to pay. They accounted for 67.4 percent of the sample (480 respondents). Among these, 63 percent said the government should bear the cost, and 29 percent said they were not able to make the payment. The remaining 32.6 percent of respondents (232 respondents) agreed to pay an average of 46,043

pesos (with a significance level of 99 percent, with a standard deviation of about 95,000 pesos, and a minimum value close to the average and maximum value 1 million pesos).

Finally, in terms of the entrance fee to the Páramo de Santurbán, in the hypothetical case that it were declared a regional natural park, unlike the rest of the questions, 59.9 percent of the sample of water users of the sources of the páramo accepted to make a payment, which on average should be 8,000 pesos (with a significance level of 99 percent and a standard deviation of 8,200 pesos).

As it relates to the knowledge of the respondents, the following questions were asked:

Do you know where the water that you use in your home comes from?

Do you know what a moor is?

Have you heard of the Páramo de Santurbán?

Do you know what environmental services are offered by the moors?

Have you heard about the gold mining extraction projects at the Páramo de Santurbán?

Regarding the question about where the water used at home comes from, 68.1 percent of the sample reported knowing the answer, while 31.3 percent said they did not know. With regard to knowing what a moor is, 82.7 percent of people answered affirmatively, of which 65 percent also know about the Páramo de Santurbán. The following table shows the combination of these two questions.

Question on knowing about the Páramo de Santurbán and moors in general

		Have you heard about the Páramo de Santurbán?			Total
		Yes	No	No response/ Do not know	
Do you know what a moor is?	YES	462	116	11	589
	NO	50	73	0	123
Total		512	189	11	712

Regarding the question about the knowledge of the environmental services offered by the moors, 51.4 percent said they had knowledge about them, while 27.7 percent reported not knowing. Finally, it is important to note that for the question on knowledge about the gold mining projects in the páramo, 77.7 percent answered affirmatively, similar to the number who know what the Páramo de Santurbán is.

Upon disaggregating knowledge questions by department, (Santander and Norte de Santander), the most notable difference is that the respondents from Norte de Santander have a proportionally greater understanding of the moors than the respondents in Santander. However, when it comes to the questions associated with Páramo de Santurbán, the opposite is true.

Questions on the knowledge about the moors

Department	Do you know where the water you use at home comes from?		Do you know what a moor is?		Do you know about the environmental services provided by the moors?		Have you heard about the Páramo de Santurbán?		Have you heard about the gold extraction mining projects in Páramo de Santurbán?	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent
NORTE DE SANTANDER										
Yes	284	71.4%	347	87.2%	205	51.5%	259	65.1%	245	61.6%
No	113	28.4%	51	12.8%	135	33.9%	133	33.4%	153	38.4%
Do not know/ no response	1	0.3%	0	0.0%	58	14.6%	6	1.5%	0	0.0%
Total	398	100.0%	398	100.0%	398	100.0%	398	100.0%	398	100.0%
SANTANDER										
Yes	201	64.0%	242	77.1%	161	51.3%	253	80.6%	266	84.7%
No	110	35.0%	72	22.9%	62	19.7%	56	17.8%	48	15.3%
Do not know/ no response	3	1.0%	0	0.0%	91	29.0%	5	1.6%	0	0.0%
Total	314	100.0%	314	100.0%	314	100.0%	314	100.0%	314	100.0%
TOTAL										
Yes	485	68.1%	589	82.7%	366	51.4%	512	71.9%	511	71.8%
No	223	31.3%	123	17.3%	197	27.7%	189	26.5%	201	28.2%
Do not know/ no response	4	0.6%	0	0.0%	149	20.9%	11	1.5%	0	0.0%
TOTAL	712	100.0%	712	100.0%	712	100.0%	712	100.0%	712	100.0%

Furthermore, regarding the questions on the environmental services provided by the moors, the difference, although in favor of Norte de Santander (0.2 percent) is not significant. For questions about knowledge of the mining projects in Páramo de Santurbán, the differences are more pronounced, with 15.5 percent and 23.2 percent respectively in favor of Santander. Of the three questions about the moors, the question asking if the respondent knows what a moor is shows the greatest differences in favor of Norte de Santander (10.1 percent), since 87.2 percent stated having knowledge, while in Santander 77.1 percent answered affirmatively.

The following tables disaggregate the information by city.

Do you know where the water you use at home comes from?

Options	Bucaramanga		Cúcuta		El Zulia		Florida Blanca		Giron		Los Patios		Pamplona		Piedecuesta		Villa del Rosario		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Yes	172	81	176	66	0	0	5	15	1	100	18	69	87	87	23	34	3	100	485	68
No	38	18	90	34	2	100	28	85	0	0	8	31	13	13	44	66	0	0	223	31
Do not know/No response	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1
Total	213	100	267	100	2	100	33	100	1	100	26	100	100	100	67	100	3	100	712	100

Do you know what a moor is?

Options	Bucaramanga		Cúcuta		El Zulia		Florida Blanca		Giron		Los Patios		Pamplona		Piedecuesta		Villa del Rosario		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Yes	183	86	225	84	1	50	19	58	1	100	25	96	93	93	39	58	3	100	589	83
No	30	14	42	16	1	50	14	42	0	0	1	4	7	7	28	42	0	0	123	17
Do not know/No response	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	213	100	267	100	2	100	33	100	1	100	26	100	100	100	67	100	3	100	712	100

Do you know about the environmental services provided by moors?

Options	Bucaramanga		Cúcuta		El Zulia		Florida Blanca		Giron		Los Patios		Pamplona		Piedecuesta		Villa del Rosario		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Yes	137	64	137	51	1	50	8	24	1	100	16	62	49	49	15	22	2	67	366	51
No	32	15	86	32	0	0	11	33	0	0	9	35	39	39	19	28	1	33	197	28
Do not know/ No response	44	21	44	16	1	50	14	42	0	0	1	4	12	12	33	49	0	0	149	21
Total	213	100	267	100	2	100	33	100	1	100	26	100	100	100	67	100	3	100	712	100

Have you heard about the Páramo de Santurbán?

Options	Bucaramanga		Cúcuta		El Zulia		Florida Blanca		Giron		Los Patios		Pamplona		Piedecuesta		Villa del Rosario		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Yes	184	86	170	64	1	50	26	79	1	100	20	77	65	65	42	63	3	100	512	72
No	24	11	93	35	1	50	7	21	0	0	6	23	33	33	25	37	0	0	189	27
Do not know/No response	5	2	4	1	0	0	0	0	0	0	0	0	2	2	0	0	0	0	11	2
Total	213	100	267	100	2	100	33	100	1	100	26	100	100	100	67	100	3	100	712	100

Have you heard about the gold extraction mining projects in the Páramo de Santurbán?

Options	Bucaramanga		Cúcuta		El Zulia		Florida Blanca		Giron		Los Patios		Pamplona		Piedecuesta		Villa del Rosario		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Yes	187	88	159	60	1	50	29	88	1	100	19	73	63	63	49	73	3	100	511	72
No	26	12	108	40	1	50	4	12	0	0	7	27	37	37	18	27	0	0	201	28
Do not know/No response	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	213	100	267	100	2	100	33	100	1	100	26	100	100	100	67	100	3	100	712	100

Regarding the question about awareness about the source of the water used by household, the city that shows greater knowledge is Pamplona, with 87.0 percent; followed by Bucaramanga (80.8 percent), Cúcuta (65.9 percent), and Piedecuesta (34.3 percent). On the other hand, the city with the highest percentage of positive answers to the question about knowledge of what a moor is was Pamplona (93.0 percent), followed by Bucaramanga (85.9 percent), Cúcuta (84.3 percent), and finally Piedecuesta (58.2 percent).

In terms of the question about environmental services, the highest score was in Bucaramanga, where 64.3 percent of people reported knowing about them, followed by Cúcuta (51.3 percent), and then Pamplona (49.0 percent) and Piedecuesta (28.4 percent).

Concerning the question on knowledge of the Páramo de Santurbán, Bucaramanga had the highest level of affirmative responses (86.4 percent), while affirmative answers in Cúcuta, Pamplona, and Piedecuesta were around 60 percent (Pamplona at 65.0 percent, Cúcuta at 63.7 percent, and Piedecuesta at 62.7percent).

Finally, the question on the knowledge of gold mining projects in the Páramo de Santurbán showed a greater understanding in the municipalities of Bucaramanga and Piedecuesta (87.8 percent and 73.1 percent, respectively), followed by Pamplona and Cucuta (63 percent and 59.6 percent, respectively).

In conclusion, Pamplona and Bucaramanga have higher levels of knowledge compared to the other municipalities. In Cúcuta, although the majority of the population has knowledge about the moors, the percentage is lower than in Pamplona and Bucaramanga. Pamplona has the highest proportion of people with knowledge about the source of their water and what a moor is, while Bucamaranga has the highest proportion of people who know about the Páramo de Santurbán and mining projects.

In terms of perceptions, respondents were asked how likely it would be for the town in which they live to have water supply problems in the future. In general, most respondents see it as a possibility. A total of 88 percent of respondents see it as somewhat likely or very likely, while 9 percent think it is somewhat or very unlikely.

Question about the perception of future risk: How likely do you think it is for your municipality to have drinking water supply problems in the next twenty years?

Options	Observations	Percentage
Very likely	333	46.77%
Likely	299	41.99%
Not very likely	54	7.58%
Not at all likely	13	1.83%
Do not know/No response	13	1.82%
Total	712	100.00%

Disaggregating the data by department, risk perceptions are lower in Santander than in Norte de Santander. In Santander, 84.4 percent believes the risk is likely or very likely, compared to 92.2 percent in North Santander. The following table breaks down the information by response and department.

Question about the perception of future risk by department

Options	Norte de Santander		Santander	
	Observations	Percentage	Observations	Percentage
Very Likely	196	49.25%	137	43.63%
Likely	171	42.96%	128	40.76%
Not very likely	19	4.77%	35	11.15%
Not at all likely	3	0.75%	10	3.18%
Do not know/No response	9	2.26%	4	1.27%
Total	398	100.00%	314	100.00%

In Bucaramanga, 97.2 percent of respondents believe it is likely or very likely to have water supply problems in the future. Pamplona and Cúcuta follow with 92.0 percent, and Piedecuesta with 59.7 percent.

Regarding the valuation and attitude of respondents, the following questions were asked:

In the last 24 months, have you travelled to a natural recreational site, natural reserve zone, national natural park, or carried out eco-tourism activities?

Do you agree that the Páramo de Santurbán be declared a National Natural Park?

A question posed the dilemma between the benefits and risks of the mining project in the Páramo de Santurbán ecosystem and on the water resources of the Páramo de Santurbán.

The majority of the surveyed population (67.4 percent) had not visited any natural recreation site. Importantly, of the total number of questions on attitudes toward the environment, this one scored the lowest percentage of responses associated with a positive attitude towards the environment.

Question: Have you visited a natural recreational site?

Options	Observations	Percentage
Yes	232	32.58%
No	480	67.42%
Total	712	100.00%

Disaggregating the information per department, the most outstanding fact is the great difference in answers among respondents from Santander and Norte de Santander, since the former stated having traveled to a natural recreational site (54.8 percent yes; 45.2 percent no), while 84.9 percent of the

inhabitants of Norte de Santander said they had not. This situation can be explained by the fact that Santander is recognized for its efforts to promote eco-tourism.

At the level of municipalities, the cities that have participated the most in eco-tourism are Bucaramanga (59.2 percent of surveyed citizens) and Piedecuesta (41.8 percent). In Cúcuta, only 19.1 percent responded positively, a situation that becomes more acute in Pamplona, with only 2.0 percent of answers positive.

The second question asked whether the respondent would agree with the declaration of the Páramo de Santurbán as a regional natural park. A total of 86.5 percent of respondents said they agreed.

Question: Would you agree with the declaration of Páramo de Santurbán as a regional natural park?

Options	Observations	Percent
Yes	616	86.52%
No	61	8.57%
Do not know/No response	35	4.92%
Total	712	100.00%

The following table presents the overall results for questions about the relationship between a potential gold mining project and its implications for the páramo ecosystem and water quality.

Question: Do you think that these projects (mining):

Options	Observations	Percent
a. Bring more benefits than risks to society and the moor ecosystem?	21	2.95%
b. Bring more risks than benefits to society and the moor ecosystem?	472	66.29%
c. Do not change the well-being of society and the environment, and do not cause damages to the moor ecosystem?	11	1.54%
d. Do not know/No response	208	29.21%

Question: Regarding the impact of these projects on the quality of water, do you believe that:

Options	Observations	Percent
a. They put water quality of rivers, watersheds, and streams of Páramo de Santurbán at irreparable risk?	394	55.34%
b. They put water quality of rivers, watersheds, and streams of Páramo de Santurbán at moderate and reparable risk?	44	6.18%
c. They put water quality of rivers, watersheds and streams of Páramo de Santurbán at risk?	69	9.69%
d. Do not know/No response	205	28.79%

The most outstanding feature of both questions is that over 55 percent of respondents believe that mining brings risks to the moor and also to the quality of water. This percentage is more pronounced in the case of the moor ecosystem, where 66.3 percent believe that mining brings more risks than benefits for society and the moor ecosystem.

Regarding the impact of mining on water quality, it is noteworthy that the option chosen was *a* rather than *b*, the first being more radical than the second. A reported 55.3 percent of the sample respondents believed that mining poses an irreparable threat to water quality of rivers and streams of the Páramo de Santurbán.

Another element worth highlighting from aggregate information is the great weight of the option Do not know /no response, which may have two explanations. There could be a group of people who do not want to take a risk by giving an opinion, given the sensitivity of the issue in the region, or it could be because there was a problem understanding the question.

An analysis of the data by department shows a difference between the proportion of those who answered option *b*, since it is smaller than the percentage of those who believe in the possibility of more risks than benefits in Santander (78 percent) than in Norte de Santander (57.0 percent). This is due to the greater number of respondents who answered Do not know/No answer in the department of Norte de Santander (39.7 percent).

Question: Do you believe that these mining projects (disaggregated by department):

Options	Norte de Santander		Santander	
	Observations	Percentage	Observations	Percentage
a. Bring more benefits than risks to society and the moor ecosystem?	7	1.76%	14	4.46%
b. Bring more risks than benefits to society and the moor ecosystem?	227	57.04%	245	78.03%
c. Do not change the well-being of society and the environment, and do not cause damages to the moor eco system?	6	1.51%	5	1.59%
d. Do not know/No response	158	39.70%	50	15.92%
Total	398	100.00%	314	100.00%

On the other hand, it is interesting to observe how in Bucaramanga none of the respondents agreed with the possibility that the mining project would bring more benefits than risks to the environment of the moor, which is explained by the wide dissemination that this issue has had citywide. This same explanation is valid for Pamplona as well. Another item to note is the high level of those do not know or gave no response in cities like Cúcuta (41.6 percent) and Pamplona (38 percent).

Finally, by breaking down the information for the question on the problem of the mining project and its effects on water quality in the Páramo de Santurbán, the analysis of data by department further shows

that the population of Santander believes that there is some risk of affecting the water quality of the moor: 75.8 percent against 39.2 percent of Norte de Santander. However, the proportion in both departments of people who answered that the effect would be moderate and reparable does not exceed 8 percent.

On the other hand, it is important to note the high percentage of respondents of the department of Norte de Santander who answered do not know/no answer (40.5 percent), compared to 14.0 percent in Santander, which largely explains the result for the aggregated data.

Question (Disaggregated by Department): Regarding the impact of these projects on water quality, do you think that:

Options	Norte de Santander		Santander	
	Observations	Percentage	Observations	Percentage
a. They put water quality of rivers, watersheds, and streams of Páramo de Santurbán at irreparable risk?	156	39.20%	238	75.80%
b. They put water quality of rivers, watersheds, and streams of Páramo de Santurbán at moderate and reparable risk?	32	8.04%	12	3.82%
c. They put water quality of rivers, watersheds, and streams of Páramo de Santurbán at risk?	49	12.31%	20	6.37%
d. Do not know /no response	161	40.45%	44	14.01%
Total	398	100.00%	314	100.00%

Bucaramanga, on the question about: mining risk/impact on the ecosystem, scored the highest in perceived risk of the project on water quality (86.9 percent). Percentages in Cúcuta, Pamplona, and Piedecuesta are much lower: 34.8 percent, 51.0 percent and 46.3 percent respectively. This is explained by the fact that a significantly higher number of respondents answered Do not know/No response.

The final set of questions were aimed at investigating the uses of water resources from the moor and the quality of drinking water, under the hypothesis that those who use water for multiple purposes and receive a better quality of service will give a high value the water from the moor. Regarding uses, the following table breaks down the respondents by number of uses given to water resources from other nearby sources, such as lakes, streams, or ponds.

Number of uses declared by water users

Number of uses	Observations	Percentage
0	1	0.1%
1	662	93.0%
2	45	6.3%
3	3	0.4%
4	1	0.1%
Total	712	100%

In general, most people just state one single use for water, mainly for household consumption and other activities permitted by the water from the aqueduct (85.5 percent of respondents). Finally, quality was assessed in three ways: first, in terms of the amount of days a week that the service is received; secondly, for the number of hours a day in which the service is received; and finally, by giving a rating of 1 to 5 on the quality of the water supplied by the water company. The table below presents the information.

Quality of water from the aqueduct

Question	Mean	Standard Deviation
Number of days a week that the water service is received by the household	6.315*** (0.0547)	1.455021
Number of hours a day that the water service is received by the household	21.57*** (0.209)	5.537128
Rating of the quality of the water supplied by the aqueduct company	2.131*** (0.0374)	.9984887

Figure in parenthesis is standard error. *** p<0.01, ** p<0.05, * p<0.1

The fact that on average, citizens are supplied with water most week days is worth highlighting, as is the fact that they receive it for about 21 hours daily. However, the water was rated from fair to good, with an average rating of 2.1 (with a significance level of 99 percent).

11.2. BUILDING OF THE KNOWLEDGE OF THE MOOR INDEX

The Knowledge of the Moor Index was built from four questions that inquire about: (1) the knowledge of a moor, (2) the Páramo de Santurbán, (3) environmental services, and (4) knowledge of the water sources that supply homes. These questions have a dichotomous YES/NO structure, which allowed scoring a YES with a dot, and a NO with a zero (0). Thus, by adding the four questions, the index gives a score between zero (0) and four (4).

After associating a score to each observation, quantiles that divide the sample into three equal parts were defined, in order to build a scale on which to read the results in the best possible manner—high/medium /low. The following table shows the relationship between scale and levels of knowledge.

Knowledge Index on the Moor: knowledge levels and scale

ICP Index	
Knowledge levels	Scale
Low	[0-2)
Moderate	[2-4)
High	4

11.3. BUILDING OF THE ENVIRONMENTAL ATTITUDES INDEX

The Attitudes toward the Environment Index (IAA) seeks to measure the level of disposition of respondents towards the environment. The methodology for the construction of this index is similar to the ICP: the score is calculated on four questions using a scale of high/medium/low, based on two

quantiles under a minimum score of minus two (-2) and a maximum score of six (6). The negative score corresponds to the inclusion of two questions that, unlike the ICP, scored negatively.

First, respondents were asked whether they had visited a natural recreation site:

During the past 24 months, have you traveled to a natural recreation site (nature reserve area, National Natural Park, undertaken ecotourism activities)?

The question scored one (1) or zero (0), depending whether the answer was positive or negative.

Second, a question that highlighted the dilemma between the benefits and risks of the mining project on water resources from the Páramo de Santurbán was built:

Question: Regarding the impact of these projects (gold extraction mining projects in the Páramo de Santurbán) on the quality of water, do you believe that:

QUESTION	Score
Regarding the impact of these projects on water quality, do you believe that:	
They put water quality of rivers, watersheds and streams of Páramo de Santurbán at <u>irreparable risk</u> ?	2
They put water quality of rivers, watersheds and streams of Páramo de Santurbán at risk?	2
They put water quality of rivers, watersheds and streams of Páramo de Santurbán at <u>moderate and reparable risk</u> ?	1
Do not know/ no response	0

This question was written as a reward, giving a positive score to any conscious attitude on a risk posed by mining projects on water resources, and a zero (0) on those with a misinformed or reserved opinion—Do not know/No response.

The next two questions included a kind of penalty. They inquired whether the respondent agreed with declaring the Páramo de Santurbán a regional natural park, which was scored as one (1) if the answer was Yes, a zero (0) if the answer was Do not know/No response, and a minus one (-1) if the answer was No. The following text corresponds to the question:

Would you agree that the Páramo de Santurbán should be declared a regional natural park?

The first question posed the dilemma between the benefits and risks of the mining project on the páramo ecosystem. The question was structured as a reward/penalty; it was scored positively if there was a minimal response indicating a reflection on the issue, and a maximum score of (2) for an attitude that values environmental resources as opposed to the other benefits of the project (where economic benefits stand out). In turn, a score of minus one (-1) was given to an attitude that valued the environmental risks of the mining project to a lesser extent than other benefits. Finally, a score of zero (0) was awarded to the Do not know/No response answer, since it shows a misinformed opinion that denotes a lack of interest on the subject, ignorance, or a reserved opinion that for various reasons cannot be rewarded or punished.

Question: Do you believe that these projects (gold mining extraction projects at the Páramo de Santurbán):

QUESTION. Do you believe that these projects:	Score
Bring more risks than benefits to society and the moor ecosystem	2
Do not change the well-being of society and the environment, and do not cause damages to the moor eco system.	1
Do not know/ no response.	0
Bring more benefits than risks to society and the moor ecosystem.	-1

The following table presents the ratio between scale and levels of knowledge.

Attitude Index towards the Environment: knowledge levels and scale

IAA Index	
Knowledge Levels	Scale
Low	[-2-3)
Moderate	[3-5)
High	[5-6]

It is important to note that although the scale establishes the possibility of negative values, the sample used for this survey had zero (0) as the minimum scale.

11.4. WILLINGNESS TO PAY AS A PROPORTION OF THE WATER BILL BY SOCIAL LEVEL

Percent of WTP on an average bimonthly payment for water services, according to social level: Bucaramanga

Social level	Fixed charge – (Pesos)	Basic consumption	Complementary consumption	Average bimonthly payment	WTP/Average Monthly Payment (Pesos)			
		-M³≤20- (Pesos per M³)	-M³>20- (Pesos per M³)	Fixed charge +pesos M³* bi-monthly Consumption (Pesos)	3,066	6,180	11,461	17,686
1	3,331.7	635.56	1,271.12	41,465.30	7.4%	15%	28%	43%
2	4,664.37	889.78	1,271.12	47,882.37	6.4%	13%	24%	37%
3	6,330.22	1,207.56	1,271.12	55,903.82	5.5%	11%	21%	32%
4	6,663.39	1,271.12	1,271.12	57,508.19	5.3%	11%	20%	31%
5	9,995.09	1,906.68	1,906.68	86,262.29	3.6%	7%	13%	21%
6	10,661.42	2,033.79	2,033.79	92,013.02	3.3%	7%	12%	19%

Source: Calculations by authors.

Percent of WTP on an average bimonthly payment for water service, according to social level: Cúcuta

Social level	Fixed charge (Pesos)	Basic consumption	Complementary consumption	Average bi-monthly payment	WTP/Average monthly payment (Pesos)			
		-M ³ ≤20- (Pesos per M ³)	-M ³ >20- (Pesos per M ³)	-Fixed charge +Pesos M ³ *bi-monthly Consumption (Pesos)	3,066	6,180	11,461	17,686
1	3,331.70	783.32	1,447.91	47,956.3	6.4%	13%	24%	37%
2	4,664.37	836.89	1,447.91	50,360.37	6.1%	12%	23%	35%
3	6,330.22	1,447.91	1,447.91	64,246.62	4.8%	10%	18%	28%
4	6,663.39	1,447.91	1,447.91	64,579.79	4.7%	10%	18%	27%
5	9,995.09	2,173.31	2,173.31	96,927.49	3.2%	6%	12%	18%
6	10,661.42	2,173.31	2,296.38	100,055.22	3.1%	6%	11%	18%

Source: Calculation by authors

11.5. DESCRIPTIVE STATISTICS OF THE PÁRAMO DE SANTURBÁN'S VISITORS

A total of 140 visitors were surveyed in the district of Berlin (Tona) and the municipalities of Pamplona, Cúcuta, Cúchira, Cucutilla, Veta, and Suratá. These areas were chosen for being moorlands or close to and having access to one. They were also the most visited due to the presence of lakes and other attractions. A total of 140 surveys were carried out.

The survey included a module that characterizes the individual by asking for the place of residence, age, monthly income range, education, and main occupation. In a second module, the respondent is asked about the cost of travel. This section inquires about the number of visits in the last two years, the starting point of the visit, the type of transport used to visit the moor, the time traveled from the place of origin, and the number of people traveling together. It also inquires about the duration of the visit, the main reason for the trip, and the activities carried out at the Páramo de Santurbán (see 11.8 for more complete descriptive statistics).

The vast majority of the population surveyed is Colombian (88 percent), followed by Venezuelan (11 percent). Of the Colombian respondents, 73 percent are residents of the region.

Of the 140 respondents, 56 percent were men and the average age of the sample was 34. A total of 86 percent of respondents have higher education and only 1 percent had not completed secondary education. Most belong to the middle class (87 percent are in social strata 3 and 4). By observing the social strata by place of origin of the visit, it is found that in general, visitors from areas more distant to the moor belong to a higher social stratum, which is to be expected because the greater the distance, the higher the cost of the visit.

For the vast majority (82 percent) of respondents, it was the first time visiting the recreational site. For 52 percent, the main destination of the trip was the Páramo de Santurbán, which implies that the remaining 48 percent considered the visit to the Páramo de Santurbán as a complement to a visit to their main destination, but not the primary reason for the trip.

When visitors were asked about the number of people with whom they traveled, including themselves, the answer was an average of 3.64. Regarding the duration of the stay, visitors stayed an average of 2.22 days at the moor; the duration of the stay was on average one day longer when the main destination was the Páramo de Santurbán.

There was a large variance in the cost of the trip per person: the maximum cost reported was 550,000 pesos and the minimum was 30,000 pesos. Visitors reported that the main reason for their trips was the holidays (70 percent); the second most common reasons were work and research (9 percent each). When visitors were asked if they were traveling as part of an organized tour or with a travel agency, 41 percent responded positively, while 59 percent traveled independently. With regard to the activities undertaken by visitors, the most important were the observation of flora and fauna, hiking, and fishing. In general, visitors carried out more than one activity. When asked about payment for activities, 37 percent reported having paid for their activities.

The visitor survey includes a module that asks visitors about conservation, to make a diagnosis on visitors' interest in preserving the moor ecosystem, particularly the Páramo de Santurbán. Visitors were asked if they knew of the environmental services provided by the Páramo de Santurbán; 62 percent answered affirmatively. When asked about the importance of moorland conservation, 74 percent believed it is "very important" and 26 percent said "important." It is noteworthy that none responded "somewhat important" or "not important".

Ninety-two percent of visitors agreed that the Páramo de Santurbán should be declared a regional natural park. However, when asked about the willingness to pay an entrance fee in the hypothetical case that the declaration were actually made, the percentage of respondents willing to pay the entrance fee was lower than the percentage who claimed to agree to declare it a regional natural park.

Under the hypothetical scenario of having the entire Páramo de Santurbán (80,000 ha) declared a regional natural park, 63 percent agreed to pay an entrance fee. The average willingness to pay the fee was estimated at 21,176 pesos.

Age of survey respondents

	Average age	Standard Deviation	Minimum	Maximum	Number
Female	33.70	8.479	19	64	61
Male	34.36	9.146	18	56	79
Total	34.08	8.839	18	64	140

Educational level of respondents

	Female	Male	Total	Percent
No response/ Do not know	1	0	1	1%
Graduate studies	6	13	19	14%
Primary	1	0	1	1%
Professional	38	35	73	52%
Secondary	4	3	7	5%
Technical	11	27	38	27%
Total	61	79	140	100%

Monthly income and average social stratum per income of respondents

Income Range (Pesos)	Average Social Level	Observed	Participation (Percent)
Between 0 and 600,000	3.0	4	3%
600,000 – 1,000,000	2.8	22	19%
1,000,000 – 1,500,000	3.4	37	32%
1,500,000 – 2,000,000	3.7	34	30%
2,000,000 – 3,500,000	3.8	16	14%
3,500,000 – 5,000,000	4.0	1	1%
5,000,000 – 10,000,000	6.0	1	1%
Total	3.4	115	100%

Main occupation of respondents

Main occupation	Female	Male	Total	Participation (Percent)
Employee	30	36	66	47%
Independent	15	24	39	28%
Household	3	0	3	2%
Student	10	15	25	18%
Unemployed	1	3	4	3%
No response/Do not know	2	1	3	2%
Total	61	79	140	100%

First visit to the Páramo de Santurbán, for respondents

Is it the first time you have visited the Páramo de Santurbán?	Observed	Participation (Percent)
Yes	115	82%
No	25	18%
Total	140	100%

Number of visits in the last two years, for respondents

Number of visits in the last two years	Observations	Participation
1	118	86
2	12	9
3	5	4
4	3	2
Total	138	100

Place of origin and main destination of respondents

Place of origin	Páramo de Santurbán is the main destination (Percent)	Total number of visitors per place of origin
Barranquilla	0%	1
Betulia	0%	1
Bogota	70%	20
Bucaramanga	54%	41
Cali	0%	3
Caracas	100%	2
Cúcuta	87%	23
Duitama	0%	1
El Zulia	0%	1
Ibague	0%	1
Los Patios	0%	1
Medellín	67%	3
Monteria	100%	1
Pamplona	77%	13
Pereira	0%	1
Puerto Wilches	0%	1
San Antonio	100%	1
San Cristobal	100%	5
Sogamoso	0%	1
Tunja	0%	13
Urena	100%	4
Velez	0%	1
Villa del Rosari	0%	1
Total	57.9%	140

Statistics reported per visitor according to area of origin

Zone	Total cost reported (Pesos)	Cost/day (Pesos)	Main destination is the Páramo de Santurbán (Percent)	Travel time reported (Hours)	Observed	Percent of responded surveys
Bucaramanga	252,250	157,666.7	37	4.82	41	29.3%
Cúcuta	394,500	149,208.3	87	8.00	23	16.4%
Bogotá	567,500	247,368.4	55	10.17	20	14.3%
Tunja/Vélez	294,286	169,285.7	0	9.56	14	10.0%
Pamplona	189,167	105,000	77	9.00	13	9.3%
San Cristóbal/San Antonio/Ureña	533,333	317,129.6	100	6.00	10	7.1%
Medellín	416,667	283,333.3	67	6.50	3	2.1%
Cali	330,000	165,000	0	13.50	3	2.1%
Caracas	600,000	200,000	100	14.00	2	1.4%
Duitama/Sogamoso	310,000	155,000	0	11.50	2	1.4%
Los Patios/Villa del Rosario	600000	300,000	0	5.00	2	1.4%
Ibagué/Pereira	300,000	120,833.3	0	10.50	2	1.4%
El Zulia	600,000	300,000	0	5.00	1	0.7%
Montería	150,000	50,000	100	9.00	1	0.7%
Barranquilla	280,000	280,000	0	16.00	1	0.7%
Betulia	260,000	130,000	0	10.00	1	0.7%
Puerto Wilches	280,000	280,000	0	13.00	1	0.7%
Total	373,983	200,578		10	140	100.0%

Means of transportation of respondents

Means of transportation	Means of transportation to Páramo de Santurbán when it was the main destination		Transportation to main destination when other than Páramo de Santurbán		Transportation from main destination to Páramo de Santurbán	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Car	29	36%	29	44%	13	20%
Airplane	2	3%	3	5%	0	0%
Bus	37	46%	31	47%	21	32%
Other	1	1%	0	0%	5	8%
Car and airplane	0	0%	1	2%	2	3%
Car and bus	4	5%	1	2%	1	2%
Car and other	1	1%	0	0%	7	11%
Airplane and bus	2	3%	0	0%	1	2%
Airplane and other	3	4%	0	0%	0	0%
Bus and other	1	1%	1	2%	16	24%
Total	80	100%	66	100%	66	100%

Travel time according to main destination of respondents (Hours)

Variable	Average	Standard Deviation	Minimum	Maximum
When main destination is Páramo de Santurbán	5.51	4.1	2	16
From main destination when it is not Páramo de Santurbán	7.75	3.69	2	16

Number of persons traveling together, as reported by respondents

Number of persons traveling together (including you)	Observations	Percent
1	5	3.60%
2	28	20.00%
3	39	27.90%
4	37	26.40%
5	15	10.70%
6	13	9.30%
7	1	0.70%
9	1	0.70%
14	1	0.70%
Total	140	100.00%
Average	3.64	

Reason for the trip, as reported by respondents

Main reason for the trip	Frequency	Percent
Vacations	98	70%
Research	13	9%
Work	13	9%
Vacation and research	8	6%
Work and research	4	3%
Other	2	1%
Work and vacations	2	1%
Total	140	100%

Determining factors for selecting the Páramo de Santurbán, as reported by respondents

Determinant factors for the visit	Landscape	Distance	Cost	Work	Other
Yes	105	65	46	25	5
No	35	75	94	115	135
Percent	75%	46%	33%	18%	4%

Knowledge of environmental services reported by respondents, according to education level

Highest educational level	Knows environmental services of the Páramo de Santurbán (Percent)	Observed
Primary	100%	1
Secondary	14%	7
Technical	40%	35
Professional	72%	71
Graduate level	78%	18
No response/Do not know	.	6
Total	61%	138

Importance awarded to the moors as strategic ecosystems, by respondents

Importance of conserving the moors	Frequency	Participation
Very important	101	74%
Important	35	26%
Not very important	0	0%
Not at all important	0	0%
Total	136	100%

Opinion on the declaration of Páramo de Santurbán as a regional natural park, by respondents

	Agree with the declaration of Páramo de Santurbán as a regional natural park	Observed
Antioquia	100%	3
Atlántico	0%	1
Boyacá	93%	15
Caracas	100%	1
Cordoba	100%	1
Cundinamarca	100%	21
Norte de Santander	94%	36
Risaralda	100%	1
Santander	86%	44
Táchira	91%	11
Tolima	100%	1
Valle	100%	2
Venezuela	100%	1
Total	92%	138

11.6. DESCRIPTIVE STATISTICS OF EXISTENCE AND BEQUEST SURVEYS

The sample was distributed in such a way that 50.1 percent of respondents were male and 49.9 percent female, between the ages of 17 and 80 years. The average age of persons in the sample was 40; 49.3 percent belonged to social stratum 3. A total of 61.52 percent had a university degree (technician, undergraduate, graduate), while the majority (70.9 percent) earn more than 600,000 pesos a month.

Descriptive statistics: occupation, social level, education and income.

Occupation	Percent	Social Stratum	Percent	Education	Percent	Income level (Pesos)	Percent
Employee	45.32	1	1.77	Primary	7.09	0 a 600,000	29.11
Unemployed	7.09	2	22.03	Secondary	30.63	600,001 to 1,000,000	18.48
Independent	22.03	3	49.37	Technician	14.68	1,000,001 to 1,500,000	12.41
House chores	6.33	4	17.22	Undergraduate	34.43	1,500,001 to 2,000,000	17.22
Student	12.66	5	5.32	Post-graduate	12.41	2,000,001 to 2,500,000	5.82
Other	1.27	6	3.04	NS/NR	0.76	2,500,001 to 3,500,000	3.54
Retired	5.32	No response/Do not know	1.27			3,500,001 to 5,000,000	4.3
						5,000,001 to 10,000,000	3.54
						No response/Do not know	5.57

The table below shows the main answers to the module on attitudes regarding the environment. Of the respondents, 53.9 percent stated that they had been at a recreational site in the last 24 months, with an average of 1.6 visits to similar sites. Regarding concern for the environment, 49.62 percent stated being very concerned. This figure increases as the level of education rises.

Distribution of the concern for the environment according to the level of education

Level of concern	Distribution per level of education (Percent)				
	Primary	Secondary	Technical	Professional	Graduate
Very concerned	25.00	45.45	51.72	52.94	61.22
Concerned	42.86	42.98	44.83	41.18	20.41
Not very concerned	28.57	6.61	3.45	1.47	4.08
Not at all concerned		0.83			
Don't know/didn't respond	4.55	4.13		4.41	14.29

Consistent with the answers above, the majority of respondents stated that they always separate garbage, turn off the faucet when brushing their teeth, and use efficient light bulbs. However, 49.4 percent never use reusable bags to buy groceries, and 28 percent take more than five minutes to take a shower.

Distribution of the frequency of certain activities related to the concern for the environment

Action	Always (Percent)	Almost always (Percent)	Sometimes (Percent)	Never (Percent)	No response/Do not know (Percent)
a) Separate garbage	51.65	11.39	14.94	20.51	1.52
b) Turn off the faucet when brushing teeth	85.06	10.13	3.04	0.25	1.52
c) Use low energy bulbs	76.96	7.59	9.62	3.29	2.53
d) Take reusable bags to buy groceries	20.51	4.56	22.78	49.37	2.78
e) Take more than 5 minutes in the shower	28.1	22.53	25.06	22.78	1.52

Finally, the willingness to pay to convert the Páramo de Santurbán into a regional natural park was 24,555 pesos; 61 percent of respondents stated that they would be willing to pay a fee to preserve the moor. Besides, the majority of persons stated their disagreement with paying a fee to save the moor. The main reason cited for their unwillingness to pay is a belief that the government should bear the expense of declaring the Páramo de Santurbán to be a regional natural park.

The tables below illustrate the distribution of the willingness to pay according to the initial fee for the preservation of the moor:

When the answer to the initial question is Yes

Form	Initial Sum (Pesos)	Percent of affirmative answers	Next Sum (Pesos)	Percent of Yes answers
1	10,000	80.2	20,000	81.5
2	20,000	61.9	40,000	73.3
3	30,000	60.4	60,000	60.3
4	40,000	42.6	80,000	58.1

When the answer to the initial question is No

Form	Initial sum (Pesos)	Percent of No answers	Next sum (Pesos)	Percent of Yes answers
1	10,000	20	5,000	20.0
2	20,000	38	10,000	8.1
3	30,000	40	15,000	18.4
4	40,000	57	20,000	13.8

Distribution of reasons for unwillingness to pay for conservation of Páramo de Santurbán

Response	Percent
The government should pay	59.74
Does not know/ did not respond	28.87
Cannot pay	8.44
Would prefer to protect the area	1.95

11.7. BUILDING THE CONCERN INDEX

To build the index on the concern and interest of individuals in preserving the environment, a score of 0 to 3 was awarded to the answers to the following questions:

Question	Answer	Score
How concerned are you about the environment?	Very concerned	3
	Concerned	1
	Not very concerned	1
	Not at all concerned	0
How frequently do you separate the garbage?	Always	3
	Almost always	1
	Sometimes	1
	Never	0
How frequently do you turn off the faucet when you wash your teeth?	Always	3
	Almost always	1
	Sometimes	1
	Never	0
How frequently do you use low energy bulbs?	Always	3
	Almost always	1
	Sometimes	1
	Never	0
How frequently do you take reusable bags to buy groceries?	Always	3
	Almost always	1
	Sometimes	1
	Never	0
How frequently do you take more than 5 minutes in the shower?	Always	0
	Almost always	1
	Sometimes	2
	Never	3

Subsequently, the concern variable was added, which is equal to the sum of the scores of each question. In this way, the highest score possible would be 18, which would reflect the greatest level of concern and interest for the environment (consciously or unconsciously). The lowest score is equal to zero, which would display no interest in natural resources.

The answers No response/Do not know were not taken into account in determining the score for each individual within the index.

11.8. DESCRIPTIVE STATISTICS OF THE INHABITANTS OF PÁRAMO DE SANTURBÁN

Income reported according to activity performed by the company or business in which the person works, by municipality⁹

MUNICIPALITY	Average income reported (Pesos)	Observations
ARBOLEDAS	520,938	103
AGRICULTURE	510,714	39
TRADE	600,000	4
STUDENT		28
FIELD WORK	570,000	1
HOUSE CHORES		8
NA		1
NO RESPONSE/DO NOT KNOW		21
HEALTH		1
CACHIRA	712,500	77
AGRICULTURE	760,000	21
TRADE		1
STUDENT		25
COMMUNITY MOTHER	550,000	1
NO RESPONSE/DO NOT KNOW	400,000	29
CACOTA	616,667	85
FARM MANAGEMENT	600,000	2
AGRICULTURE	610,000	14
TRADE	683,333	6
STUDENT		28
LIVESTOCK		2
FIELD WORK	600,000	9
HOUSE CHORES		9
NO RESPONSE/DO NOT KNOW		9
SEVERAL OCCUPATIONS	566,667	3

⁹ The list of activities includes “Student” and “Retired.” This indicates the reason why some respondents are unemployed.

MUNICIPALITY	Average income reported (Pesos)	Observations
RETIRED	600,000	3
CALIFORNIA	592,500	115
AGRICULTURE	347,143	8
TRADE	200,000	1
STUDENT		35
LIVESTOCK		3
HOUSE CHORES		32
MINING	768,333	30
NA		4
NO RESPONSE/DO NOT KNOW		2
CHARTA	578,750	75
AGRICULTURE	554,615	21
TRADE	300,000	1
STUDENT		29
HOUSE CHORES		19
MINING	875,000	3
NA		1
NO RESPONSE/DO NOT KNOW		1
CUCUTILLA	691,667	102
AGRICULTURE	757,143	17
TRADE	575,000	6
STUDENT		21
FIELD WORK	700,000	18
HOUSE CHORES		20
NA		7
FAMILY BUSINESS	800,000	1
NO RESPONSE/DO NOT KNOW		9
VARIOUS OCCUPATIONS	800,000	1
RETIRED		1
FOOD PREPARATION	400,000	1
MUTISCUA	761,538	76
AGRICULTURE	763,636	22
TRADE	900,000	4
STUDENT		16
LIVESTOCK		3
FIELD WORK	600,000	2
HOUSE CHORES		11

MUNICIPALITY	Average income reported (Pesos)	Observations
NA		2
NS/NR		14
RETIRED		1
FISHERY		1
SILOS	583,333	79
AGRICULTURE	600,000	26
TRADE	500,000	5
STUDENT		19
HOUSE CHORES		11
NA		2
NO RESPONSE/DO NOT KNOW		15
RETIRED	500,000	1
SURATA	647,619	97
FARM ADMINISTRATION	700,000	1
AGRICULTURE	620,000	26
AGRONOMY	800,000	5
TRADE	600,000	2
STUDENT		25
FIELD WORK	800,000	1
HOUSE CHORES		19
MINING		1
NA		3
NO RESPONSE/DO NOT KNOW		11
VARIOUS OCCUPATIONS		2
HEALTH		1
TONA	583,636	95
AGRICULTURE	503,333	32
TRADE	500,000	3
STUDENT		27
FIELD WORK	725,000	5
HOUSE CHORES		12
NA		4
NO RESPONSE/DO NOT KNOW		11
FOOD PREPARATION		1
VETAS	626,071	113
AGRICULTURE	460,000	9
TRADE	125,000	2

MUNICIPALITY	Average income reported (Pesos)	Observations
UNEMPLOYED		1
STUDENT		35
HOUSEHOLD		1
HOUSE CHORES		33
MINING	812,500	25
NA		6
TRANSPORT	600,000	1
GRAND TOTAL		1,017