



“Gheorghe Asachi” Technical University of Iasi, Romania



---

## PERCEPTION AND USE OF CULTURAL ECOSYSTEM SERVICES AMONG THE ANDEAN COMMUNITIES OF CHIMBORAZO RESERVE

Danny Daniel Castillo Vizquete<sup>1,2</sup>, Alex Vinicio Gavilanes Montoya<sup>1,3</sup>,  
Carlos Benjamín Ricaurte Yopez<sup>2</sup>, Carlos Renato Chávez Velásquez<sup>2</sup>  
Marina Viorela Marcu<sup>1</sup>, Stelian Alexandru Borz<sup>1\*</sup>

<sup>1</sup>Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Braşov, Şirul Beethoven No.1, Braşov, RO-500123, Romania

<sup>2</sup>Faculty of Natural Resources, Escuela Superior Politécnica de Chimborazo,  
Panamericana Sur km 1½, Riobamba, EC-060155, Ecuador

<sup>3</sup>Faculty of Sciences, Escuela Superior Politécnica de Chimborazo, Panamericana Sur km 1½, Riobamba, EC-060155, Ecuador

---

### Abstract

Challenges that characterize the relations between humans and environment can be addressed using the concepts and methods of ecosystem services assessment to provide a proper basis for environmental accountability and policy development. While the provisioning ecosystem services received a lot of focus in the science, and based on different cultural values that may be associated to different regions, there are still gaps in understanding how local communities use the ecosystems' cultural services. This study quantified the frequency of use and the perceived capacity to provide cultural services in the view of communities located in the Chimborazo Wildlife Production Reserve (CR), Ecuador, by a questionnaire survey. Based on 356 valid questionnaires and a response rate of 78%, the findings indicate that locals tend to use and place value on cultural services provided by iconic mountains such as Chimborazo. In particular, the locals use cultural services that are associated with recreation (observation of flora and fauna, hiking, rest and relaxation, entertainment and landscaping), while the frequency of use seems to be related to proximity and local beliefs. In the case of perceived capacity, the things were similar, with high ratings given to closest landscapes and touristic attractions, and in particular to the Chimborazo Mountain. Locals tend to perceive differently the capacity of landscapes to provide cultural services based on gender, occupation and level of income. Implications for local environmental management are not serious since the management scope of the CR is not divergent compared to the locals' use of cultural services.

*Key words:* actual use, capacity to provide, Chimborazo, cultural ecosystem services, Ecuador

*Received:* January, 2019; *Revised final:* May, 2019; *Accepted:* June, 2019; *Published in final edited form:* December, 2019

---

### 1. Introduction

Being at the transition of many paradigms, the concept of “environmental management” is still elusive and it may mean different things to different people, depending on the context and the purpose for which is used (Colby, 1991). It is often explained by focusing on the characteristics of environmental managers, environmental management and its challenges (Gomis et al., 2018; Nel and Kotze, 2009).

From the environmental management perspective, it may be seen as a process dealing with human-environment interaction that aims to identify what is environmentally desirable (Barrow, 2006) and to balance the human needs with the environment's ability to meet such needs (Colby, 1989) by non-exclusively integrating ecology, policy making, planning and social development (Barrow, 2006).

Parts of the environment in which the humans are developing their activity are characterized by

---

\* Author to whom all correspondence should be addressed: e-mail: [stelian.borz@unitbv.ro](mailto:stelian.borz@unitbv.ro); Phone: +40 742042455

various types of ecosystems. One way to account for landscape utilization, therefore to manage the environment, which in turn may help in developing policies and strategies for a sustainable use, is that of using the concept of “ecosystem services”. Its use is increasingly important since the humans depend on ecosystems and on their ability to provide services that contribute to their well-being (MEA, 2005). Human well-being, on the one hand, is assumed to be a complex of features that includes the basic material for life, health, good social relations, security and the freedom of choice and action (MEA, 2005). To respond to such needs, on the other hand, the ecosystem services are seen to be the benefits or gifts that people may obtain from the nature for direct consumption, use and enjoyment (MEA, 2005). According to several classification systems (e.g. Haines and Potschin, 2018), ecosystem services belong to categories such as those encompassing provisioning, regulation, cultural and supporting services. Nevertheless, the provision of these services depends to a great extent on the existing biophysical conditions and the changes in space and time due to human-induced land cover change, land use and climatic changes (MEA, 2005; Riitters et al., 2000), with rural people being the most vulnerable to such changes (MEA, 2005). In addition, the increment in use for one type of ecosystem service may result in the degradation or depletion of other ecosystem services (Bennet et al., 2009). At the same time, part of the ecosystem services such as the provisioning ones are, more tangible compared to others. Therefore it is easier to evaluate and model their dynamics by various scenarios, and much research focused on them (Evans et al., 2018). In most of the cases, however, regulation, supporting and cultural services, are not supposing a direct consumption, are less tangible (Wartmann and Purves, 2018), therefore harder to evaluate by their economic importance due to the lack of service production functions (Payudal et al., 2016).

One way to balance the change in provision is that of empowering those dependent on ecosystem services or affected by their degradation, or at least taking into consideration their immediate needs (Payudal et al., 2016). Still, many of the ecosystem services were not monitored and it is difficult to estimate the influence of changes relative to other social, cultural and economic factors. In addition, aggregated information on many of the cultural ecosystem services (*i.e.* the nonmaterial benefits people obtain from ecosystems) is still limited (MEA, 2005). In particular, aesthetic preferences and spiritual values contribute to several features that characterize the human well-being, and there are examples in which such values may act as incentives in landscape conservation (MEA, 2005).

To this end, social perceptions are understood as the way in which given individuals value their environment, acting as key factors for human decision-making relative to the surrounding environment (Fernandez, 2008). The perceptions that people build relative to their environment depend on

the socio-cultural context, pointing out the importance of integrating the awareness of local residents and their perception on ecosystem services in a given territory (He et al., 2018). Therefore, their perceptions are useful, in particular, to understand what services are relevant to local people and what decisions should be made about the regulation of local activities (Paudyal et al., 2016). Perception, on the other hand, may be affected for given individuals as an effect of belonging to different stakeholder groups having different interests in the use of landscapes (Garrido et al., 2017). In short, the perception of ecosystem services can become a useful tool for monitoring, development of scenarios, and as a contribution to political decisions.

Ecuador is considered to be one of the mega diverse countries in the world, having a variety of ecosystems and species, which has allowed it to develop a wide biological diversity (MAE, 2015). The country is directing its efforts to the integral respect of life existence, maintenance and regeneration of life cycles and evolutionary processes, being seen not only as a provider of resources to a more integral and biocentric approach, but also as “the space where life is born” (Arroyo, 2013). By the creation, in 1976, of the National System of Protected Areas (SNAP) (MAE, 2007), Ecuador was promoted as one of the Latin American countries holding the largest territory dedicated to the protection of ecosystems. To this end, 19% of its territory is either under the conservation of ecosystems or environmental management (Elbers, 2015).

The country manages a number of 56 protected areas, which stand out for their protective, scientific, scenic, educational, tourist and recreational values, for their flora and fauna, or because they constitute ecosystems that contribute to maintain the balance of the environment (Junco and De la Rosa, 2017). At the same time, the country is the place of living of 13 indigenous ethnic groups (Elbers, 2015), that make use of the ecosystem services in different types of landscapes. Many of these communities are located in the Andean Mountains and are dependent on the use of local resources for living, by practices in agriculture, livestock breeding and, to a less extent, services such as constructions and tourism (Aragón and Rud, 2013; Fritz et al., 2017).

Yet, the way and extent to which these communities are preferring and using the ecosystem services provided by their rich cultural landscape is merely unknown, even if some sources indicate the types of possible ecosystem services in the area (Bommarco et al., 2013; Plieninger et al., 2013). In particular, at the borders of provinces of Chimborazo, Tungurahua and Bolívar, lies the Chimborazo Wildlife Production Reserve (hereafter CR), a protected area that covers important territorial extensions of indigenous people (Rivas, 2006) belonging to the Kichwa ethnic group such as Puruháes (Chimborazo), Warankas (Bolívar) and Kichwas de Tungurawa (Tungurahua) (MAE, 2014) and which is a typical territory used by the Andean communities.

In the above-described context, the aim of this study was to document what kind of cultural services are used by the local communities of CR in relation to existent tourist hotspots, what is the perception of local communities on the capacity of related ecosystems to provide cultural services and what are the relevant factors that may affect the perception on the capacity of selected ecosystems to provide cultural services for locals. For this, a quantitative survey was designed and administrated to the local communities of CR.

## 2. Materials and method

### 2.1. Study area

CR is one of the 56 protected areas (PAs) of Ecuador (MAE, 2015), being located at  $-1^{\circ}25'32.86''$  S -  $78^{\circ}50'34.29''$  W, 3,800 to 6,310 m above sea level (Fig.1a-b) and having a total area of 58,560 ha. It was established by Ministerial Agreement No. 437/26<sup>th</sup> of October 1987, having as a main management objective the preservation of natural resources (MAE, 2006) and encompasses a wide range of ecosystems and climates that characterize the Andean landscapes (MAE, 2006), holding a number of 10 tourist attractions (Table 1) directly associated with 5 of the 10 ecosystem types spread across the territory of 35 communities (MAE, 2014). Specifically, these ecosystems present unique plant formations that are valued for their floristic composition and for their evolutionary peculiarities, contributing to the sustenance of life through ecological functions and the supply of goods and services essential for human welfare (Castillo et al., 2017). In addition, the

landscape in the area is purely spectacular, being shaped around one of the highest volcanoes in the world - Chimborazo Mountain (Geophysical Institute, 2016).





The tourist attractions and their associated ecosystem types taken into study are the solely ones documented and used in the area. Their choice was based on the assumption that local traditions, beliefs and practices are related to them. A number of 9 communities (Fig. 1b; Table 2) were selected for this study based on their proximity to tourist attractions, their shared commonalities in using the landscape for provisioning purposes and possibility to include in the sample all the residents from each community.

The main activities in the area are closely related to the type of landscape use. They consist of agriculture, livestock and tourism (MAE, 2014). Therefore, the provisioning services provided by the local ecosystems encompass mainly to the generation of biomass that is used by both wild and domestic animals (MAE, 2014). Nevertheless, the beauty of the local landscapes enables the use of various cultural services (Duo et al., 2019; Oteros et al., 2018).

### 2.2. Survey

A questionnaire was administrated to 9 communities over three months (May to July 2018). The aim of survey was to reach the entire population of the local communities, excluding the minors (age < 18 years old). Due to the presence of children and some locals not willing to participate in the study, the final sample size contained a number of 356 respondents accounting for approximately 78% of the total population size (Table 2).

**Table 1.** Tourist attractions located in CR. Source: adapted from MAE (2014)

<i>Local name</i>	<i>Scene</i>	<i>Short description</i>
Agujas de Whymper		Whymper's Needles. Rock formation located at an altitude of 5,283 m a.s.l. Named after Edward Whymper who climbed Chimborazo (January 4, 1880).
Nevado Chimborazo		Chimborazo Mountain. Volcano, 6,310 m a.s.l. Considered by the actual descendents of Puruháes civilisation to be the Father God. Inspiration for Simón Bolívar to write the poem "The delirium on the Chimborazo". Climbed by Alexander von Humboldt in 1802. One of the most visited tourist destinations of the Province of Chimborazo.
Nevado Carihuairazo		Carihuairazo Mountain. Three-peaked volcano, 5,020 m a.s.l., accessible by four-wheel drive cars or buses. Characterized by the presence of many lagoons created by ice melting.
Templo Machay		Machay Temple. A cave of natural geological formation that the ancients of the region have used as a ceremonial and veneration center for the Chimborazo God. They believed that it is the gateway to enter Chimborazo. Currently used by the mountaineers and the local people to leave thanking offerings for the good behavior of the Chimborazo.

Árbol Solitario		Solitary Tree. A large shrub of 5 m in height and a diameter of 6m surrounded by very little vegetation. Scholars have not identified to which species it belongs, but it is believed that it belongs to the <i>Quishuar</i> family.
Cuartel de los Incas		Fortress of the Incas. The traditional name of the site is Cuartel de Inca, and it was, most likely, a ceremonial center. Could be the place where the Chasqui (long distance messengers/deliverers) family lived, or it could be a place to store food, weapons etc.
Bosque de Polylepis		Polylepis Forest. Remnant of a protected forest vegetating on a rocky formation, providing a visual contrast to the surrounding landscapes characterized by herbaceous vegetation.
Ruta de los Hieleros		Route of the Ice Makers. Attraction related to the local ancestral practice to cut ice blocks from Chimborazo and to deliver them to the local people/market surrounding it. There is only one icemaker in the area - Baltazar Ushca - still living and practicing today.
La Chorrera		Chorrera Canyon. Rocky formation characterized by the presence of a water drop of approximately 25 meters in height. The site presents rock formations used in climbing.
Termas de Kunuk Yaku		Kunuk Yacu Hot Springs. Used for taking hot baths. Thermal water is provided by the surrounding mountain.

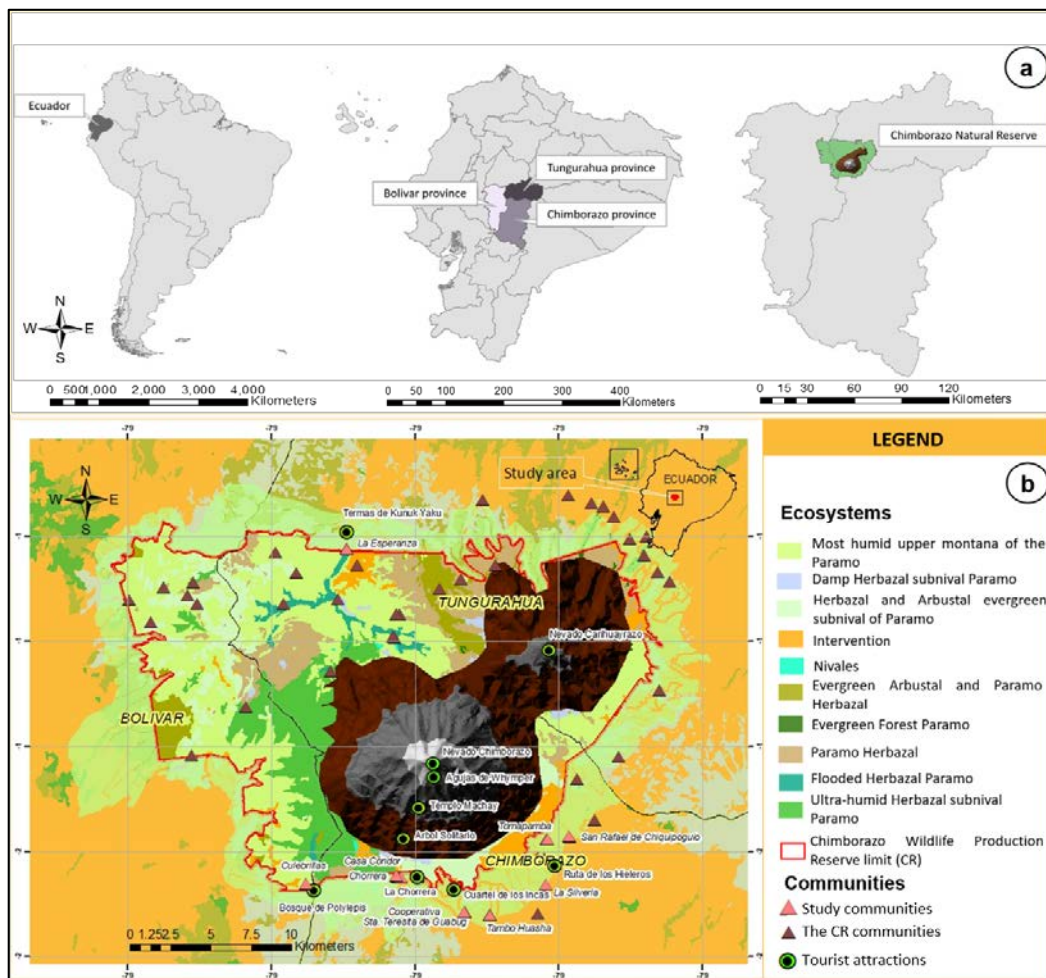


Fig. 1. Map of the study area: (a) location of the CR in South America (left), Ecuador (center) and in the provinces of Bolivar, Chimborazo and Tungurahua; (b) map of the CR showing the of tourist attractions and local communities taken into study



**Table 2.** Communities taken into study, number of inhabitants and sample size

<i>Community names and their abbreviation</i>	<i>Number of inhabitants in community</i>	<i>Number of inhabitants taken into study</i>	<i>Share of sample related to population size (%)</i>
C1. Casa Condor	18	15	83
C2. La Chorrera	18	9	50
C3. Culebrillas	60	48	80
C4. La Esperanza	22	22	100
C5. Tambohuasha	30	20	67
C6. Santa Teresita de Guabug	25	20	80
C7. La Silveria	201	151	75
C8. Tomapamaba	23	17	74
C9. San Rafael	60	54	90
<b>TOTAL</b>	<b>457</b>	<b>356</b>	<b>78</b>

The questionnaire was designed in three parts to account for cultural services derived from touristic attractions and related activities carried out in the associated ecosystems (Fig. 1b). The first part aimed to collect socio-demographic data by variables such as the place of residence, gender, age, level of education, occupation and monthly income. This data was required for various analysis tasks such as those describing the socio-demographic condition of locals and testing the effects of various socio-demographic variables on perceived capacity of local landscapes to provide cultural services. The second part of questionnaire aimed to collect data on the frequency that inhabitants use cultural features provided by local landscape by directly using them in different kind of leisure activities. Responses to this part were interpreted as the demand for such ecosystem services. Acknowledging that people may have a more holistic view on their landscapes, and since a perfect delimitation between the touristic attractions and the associated landscape is difficult to design and implement, this study focused rather on particular, punctual spots of the landscape and on their significance for locals. To this end, a matrix containing two major groups of ecosystem services and 27 related activities describing the use of particular ecosystem services and was built based on the general guidelines of existing ecosystem service classification systems to enclose the 5 types of ecosystem complexes present in the area and their corresponding touristic attractions (Table 3).

In the absence of data documented in detail, expert opinions are valuable in identifying the types of ecosystem services that may be provided by a given area (Garrido et al., 2017). To have an idea on the possible cultural services provided by the area taken into study and to build the questionnaire, a brainstorming workshop was organized to account for the expertise on the subject of CR park rangers and local field experts. The response section of this questionnaire part was constructed in a way similar to that described by Affek and Kowalska (2017), enabling the respondents to evaluate the frequency of self-use based on a 5-point Likert scale (0 to 4, where 0 stands for “have no idea/not applicable”, 1 -

“never”, 2 - “once”, 3 -- “sometimes” and 4 - “frequently”). Anticipating that most of the respondents could have been developing their work in the studied landscape, as well as most of them probably would have been not familiar with the specific terminology of ecosystem services assessment, two measures were designed for a clear understanding. During the field study, the respondents were asked to exclude the time spent at their work when thinking about and evaluating the frequency of use, enabling this way a discrimination between the use of cultural features during the work and leisure time. In addition, all the items enclosed into the questionnaire were translated into Spanish and their meaning was explained to the respondents in full detail. The term of “ecosystem services” was replaced by the Spanish version of the “benefits/gifts of nature” syntagm as generally described in MEA (2005) and argued and explained in Affek and Kowalska (2017). This was necessary to align the used language to the respondents’ understanding and to suggest them that the evaluated features need to be obtained from nature for free.

The last part of the questionnaire was designed to collect data on perception of inhabitants on the capacity of local landscapes to provide cultural ecosystem services. To this end, a more concise matrix containing the ecosystem types, their encompassed tourist attractions and a list of four categories of cultural services (recreation, inspiration for creative work, education & study and spiritual experience) associated to each one was adopted based on the methods used by Affek and Kowalska (2017) to be evaluated in a way similar to the second part of questionnaire. The exception here was that zero values were attributed to those cases in which the respondents felt that the analyzed landscape had no capacity to provide any cultural service attributed to a category in question. Prior to field data collection the questionnaire was checked for consistency then, for testing and refining purposes, it was shown to couple of people working for the Escuela Superior Politécnica de Chimborazo. The refined version was printed in the needed number of copies then it was administrated in the field by a door-to-door approach.

**Table 3.** List of activities related to cultural ecosystem services and their categorization into specific groups

<i>Activities related to ecosystem services</i>	<i>Division / Group</i>
1.1. Observation of flora and fauna	1. Education, inspiration, spiritual life
1.2. Experimental use of flora, fauna and land	
1.3. Creative work inspired by nature (e.g. writing, painting, handcrafting etc.)	
1.4. Visit to places of worship in nature (e.g. roads of Calvary, places of ancestral power, etc.)	
1.5. Praying or meditation near the attractions	
1.6. Science (research activities)	
1.7. Environmental education	
1.8. Environmental interpretation	
1.9. Interpretative talk and exchange of experience	
1.10. Observation of traditional practices	
1.11. Aesthetic values (beauty, balance, harmony)	
1.12. Spiritual and religious values	
1.13. Historical and cultural information	
2.1. Ecotourism	2. Sports and recreation
2.2. Ethnotourism	
2.3. Cultural tourism	
2.4. Experiential tourism	
2.5. Agritourism	
2.6. Hiking	
2.7. Photography	
2.8. Cycling	
2.9. Mountaineering	
2.10. Climbing	
2.11. Visits to archaeological sites	
2.12. Rest, relaxation	
2.13. Entertainment	
2.14. Landscaping	

2.3. Analysis

In this study, most of the data was collected using Likert scales which are the common methods used to measure the respondents' attitudes. Likert (1932) used in his original work a bipolar scale whose underlying psychometric model stood for a continuous latent construct with opposite feelings expressed at the endpoints (Willits et al., 2016). The problem with human perception and its ranking is that one cannot always assume that among a population of individuals the differences between items on a Likert scale are necessarily equal.

Therefore, for scales constructed such as in the second part of this study's questionnaire it could be wrong to assume that the difference between responses is equidistant even if the numbers assigned to them is (e.g. Sullivan and Artino 2013). To balance this, the categories included in that part of the questionnaire were quite specific and explained to the respondents in advance. Then, the third part of questionnaire was built to resemble somehow a continuous scale for rating the capacity of ecosystems to provide cultural services. Nevertheless, the use of numbers produced by Likert scales in statistical analysis is a different thing compared to the psychometric constructs of given respondents, therefore parametric statistics can be used for such data, coming even from very small samples, with unequal variances and non-normal distributions, to build pertinent conclusions (Norman, 2010). At the same time, parametric statistics are more powerful and

robust and they produce similar results when analyzing ordinal data (e.g. Norman, 2010; Murray, 2013).

Starting from these considerations, the statistical analysis of this study used parametric statistics. First, the field-collected data was transferred into a Microsoft Excel® sheet. Then the socio-demographic data was analyzed using the number of respondents (N) and their share per communities (C) and per gender (G), age (A), level of education (L), occupation (O) and monthly income (I). This was necessary to characterize the sample size at study and community level and it was done after recoding the items of each socio-demographic feature. The community abbreviations were extracted from Table 2, gender was coded as M for male and F for female, age was categorized in classes (1 for 18-28, 2 for 29-40, 3 for 41-51, 4 for 52-63 and 5 for 64-75 years old) following the recommendations of INEC (2016), level of education was coded as NE - no education, PI and PC for primary incomplete and complete respectively, SI and SC for secondary incomplete and complete respectively, BI and BC for bachelor incomplete and complete respectively, S for specialization, MA and DO for master and PhD respectively, and O for others by assuming the local learning system (MAE, 2014). Occupation was categorized as agriculture and livestock - AS, Commerce - CO, Tourism - TO, construction - CT and other - OT based on the provisions of INEC (2016). Finally, the income was categorized in classes based on AE (2018), and INEC (2016) in six categories: 1 for income of 386-708 \$, 2

for 709-1030 \$, 3 for 1031-1353 \$, 4 for 1354-1676 \$, 5 for 1677-2000 \$ and 6 for those not willing to declare any income. The frequency of using ecosystem services was analyzed as the share of ratings per types of activities and per tourist attractions. Then the data was aggregated and analyzed as the means per types of activities and communities and as aggregated uses per tourist attractions and communities. The perceived capacity to provide cultural ecosystem services was analyzed by data aggregation as means on categories of cultural services at community and tourist attraction level, then by data aggregation at sample level on tourist attractions and communities. Following the analysis of ratings on frequency of use and perceived capacity, parametric statistical tests such as Student's t and ANOVA ( $\alpha=0.05$ ,  $p<0.05$ ) were carried out to explore which of the socio-demographic variables affected the perceived capacity to provide cultural ecosystem services. Since the previous analyses revealed the greatest ratings in the case of Chimborazo Mountain, the mentioned tests were carried out for the data covering this tourist attraction.

All the tasks related to statistical analysis were carried out in Microsoft Excel (version 2013) fitted with the Real Statistics ® addin. The same software was used to produce the graphics needed in this study.

### 3. Results

#### 3.1. Socio-demographic characteristics

As shown in Table 2, the total population size in the analyzed communities amounted 457 inhabitants and the aggregated response rate was of approximately 78% resulting in a number of 356 valid questionnaires. The inter-community response rate varied between 50 and 100% (Table 4).

Females dominated in the sample size (218, 61%) compared to males (138, 39%) because six out of 9 communities had a female share greater than 50%. More than half of the respondents (199, 56%) were aged between 18 and 40 years and given the self-employment practice in the area, probably more than 90% (age up to 63 years) of the respondents were still active in their work at the field survey time.

Most of the respondents declared that they had completed the primary school (31%). Still, an important share of the respondents did not finalize their first level of education (39%). Completion of higher education was almost absent in the sampled population with only 5% of the respondents indicating that they are following or have finalized a bachelor level.

**Table 4.** Socio-demographic characteristics of respondents at community and study level

Feat.	C1		C2		C3		C4		C5		C6		C7		C8		C9		TC		
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	
<b>G</b>																					
M	4	27	9	100	22	46	13	59	11	55	7	35	50	33	4	24	18	33	138	39	
F	11	73	-	-	26	54	9	41	9	45	13	65	101	67	13	76	36	67	218	61	
<b>A</b>																					
1	4	27	-	-	20	42	4	18	-	-	-	-	50	33	4	24	17	31	99	28	
2	4	27	2	22	12	25	7	32	7	35	-	-	48	32	2	12	18	33	100	28	
3	2	13	2	22	7	15	4	18	4	20	4	20	31	21	4	24	7	13	65	18	
4	4	27	4	44	7	15	6	27	6	30	9	45	15	10	4	24	4	7	59	17	
5	1	7	1	11	2	4	1	5	3	15	7	35	7	5	3	18	8	15	33	9	
<b>E</b>																					
NE	2	13	-	-	11	23	4	18	4	20	7	35	28	19	7	41	11	20	74	21	
PI	6	40	4	44	6	13	4	18	7	35	-	-	22	15	6	35	9	17	64	18	
PC	4	27	4	44	11	23	11	50	7	35	11	55	41	27	2	12	21	39	112	31	
SI	2	13	-	-	9	19	3	14	-	-	2	10	20	13	-	-	6	11	42	12	
SC	-	-	1	11	11	23	-	-	2	10	-	-	24	16	2	12	7	13	47	13	
BI	1	7	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	3	1	
BC	-	-	-	-	-	-	-	-	-	-	-	-	14	9	-	-	-	-	14	4	
S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
MA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
DO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
O	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<b>O</b>																					
AS	13	87	9	100	44	92	20	91	16	80	20	100	95	63	17	100	50	93	284	80	
CO	-	-	-	-	2	4	-	-	-	-	-	-	7	5	-	-	2	4	11	3	

TO	2	13	-	-	-	-	-	-	2	10	-	-	2	1	-	-	-	-	6	2
CO	-	-	-	-	-	-	-	-	-	-	-	-	4	3	-	-	-	-	4	1
OT	-	-	-	-	2	4	2	9	2	10	-	-	43	28	-	-	2	4	51	14
<b>I</b>																				
1	13	87	7	78	37	77	15	68	15	75	16	80	102	68	9	53	38	70	252	71
2	-	-	-	-	-	-	-	-	-	-	-	-	6	4	-	-	-	-	8	2
3	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	2	1
4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	2	13	2	22	11	23	5	23	5	25	4	20	41	27	8	47	16	30	94	26

Based on the collected data, the occupations in the area of study seem to be strongly focused on the typical land use such as agriculture, cultivation and cattle breeding. In fact, 80% (284) of the questioned inhabitants declared that they are working in this category and 63 to 100% of them were included in this category at the community level as well. Taken together, occupations from commerce, tourism and construction accounted for only 6% of the data pool. The rest of 14% was shared between different kind of occupations such as being employees in the public and private sector outside the study area. In what concerns the income level, more than 71% of the respondents declared that their income was in between 386-708 US\$ while a share of 26% were not willing to declare their income.

### 3.2. Frequency of use

The frequency of cultural services use was analysed both, in terms of responses shares per item types, type of ecosystem service-related activity and tourist attraction, as well as in terms of aggregated data which considered the average responses per types of activities and tourist attractions. Fig. 2 shows the share of responses per types of activities related to the cultural ecosystem services. Almost 70% of the responses were rated by “0” meaning that those respondents had no idea about a given type of cultural ecosystem service. This feature was related to the non-attendance of part of the respondents in some of the analysed areas. Excepting the observation of flora and fauna (1.1.), hiking (2.6.), rest and relaxation (2.12.), entertainment (2.13.) and landscaping (2.14.) which were the most rated as being used more than once, the rest were mostly rated either as non-used or not having any idea about them (87-99%). Even if ratings like “sometimes” and “frequently” seemed to be very low in terms of share in the analysed sample, apparently the locals are enjoying more to observe the flora and fauna (15.1%), hike (15.8%), use the landscape (15.5%), entertain (16.3%) and, most of all, to relax in the nature (16.7%).

The place in which they are frequently enjoying such ecosystem services (Fig. 3), however, seems to be strongly associated with iconic mountains, in particular with the Chimborazo Mountain (14.7%). To a less extent (0.5-6%) were other places found to be frequented for cultural ecosystem services.

A community-level breakdown of the aggregated frequency of use and frequented tourist attractions is shown in Fig. 4-5 respectively. While some variability was found in the data specific to different communities, the general trend remained the same, indicating a more frequent use related to items 1.1., 2.6., and 2.12. to 2.14. It appears also that the most frequented tourist attractions were the Machay Temple, iconic mountains (*i.e.* Chimborazo and Carihuairazo), and the Polylepis relict forest.

Given the distribution of rating shares shown in Figs. 2-3, the results shown in Fig. 5, as aggregated average values, need to be interpreted with caution. For instance, an overall value of 1.1 could be interpreted somewhere between “never” and “once” but probably it stands more for “never” at the community level. In comparison, a value of 1.6 stands for ratings placed between “once” and “sometimes”, indicating rather the latest rating at community level.

### 3.3. Perception on the capacity to provide cultural ecosystem services

The data characterizing the aggregated perception on the capacity to provide cultural ecosystem services was characterized by a high variability which was probably related to the communities’ proximity to certain tourist attractions, the frequency of use characteristic to different types of ecosystem services and the general believes of locals in relation to their residence landscapes. One good example on how the proximity and frequency of use probably affected the perceived capacity to provide cultural ecosystem services is that of “La Chorrera” respondents that rated very high the potential of “La Chorrera” tourist attraction to provide cultural ecosystem services (Fig. 1a).

Another example which probably covers the local believes on iconic mountains and the proximity is that of “Casa Condor” and “La Chorrera” communities who rated the capacity to provide services as very high for the mountains located in their proximity (Chimborazo and Agujas de Whymper) but very less to Carihuairazo. In fact, Carihuairazo Mountain is quite far away of most of the communities taken into study, therefore its proximity and probably its less reputation compared to other mountains in the area may have been affected the perceived capacity to provide cultural ecosystem services.



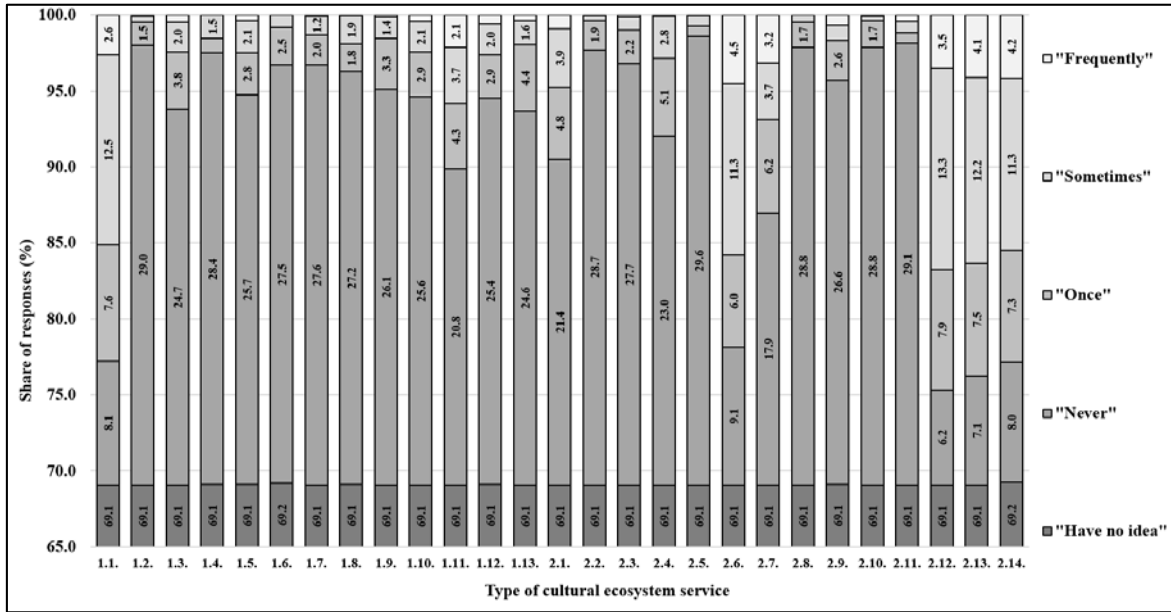


Fig. 2. Share of ratings per activities related to cultural ecosystem types

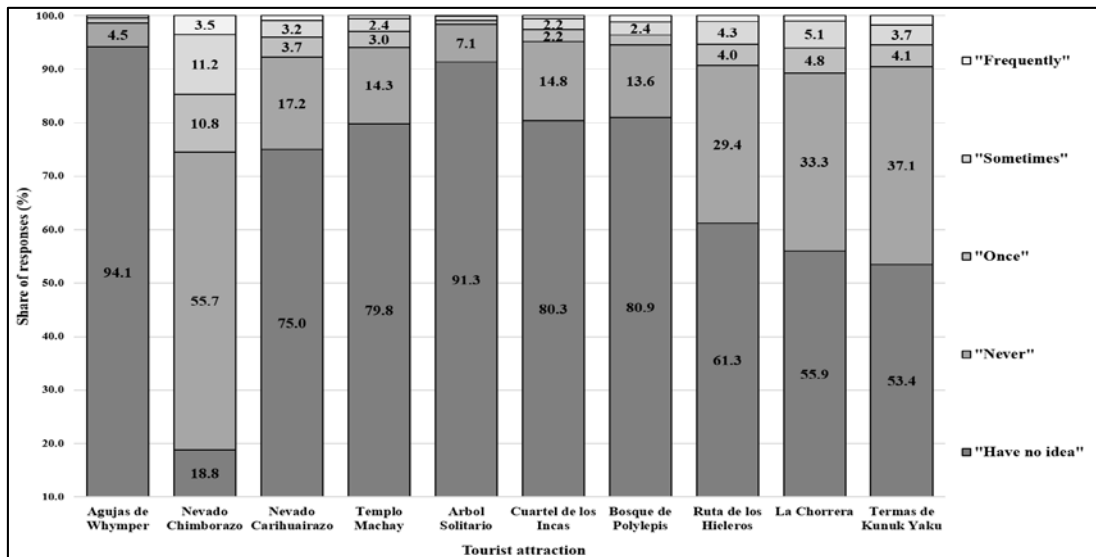


Fig. 3. Share of ratings per tourist attractions

Excepting the community of “La Esperanza”, which is located at the farthest distance from Chimborazo Mountain, it seems that the latter was also consistently perceived as having a medium-high to very high capacity to provide recreation, inspiration, education and science services but not spiritual experiences (Fig. 6a-d), which were attributed to the closest Aguja de Whymper by two communities. At the study level, Chimborazo Mountain was perceived to have the greatest capacity to provide cultural services (Fig. 7).

### 3.4. Factors affecting the perception on capacity to provide cultural services

As the centrepiece in terms of high ratings was found to be the Chimborazo Mountain, the analysis on the factors that may affect the perception was carried

out for this tourist attraction. Significant differences in perception were found only in the case of recreational services (Table 5).

The significant socio-demographic factors affecting the perception to provide recreational ecosystem services were found to be the gender, occupation and level of income. Male respondents tended to rate higher the capacity to provide recreational services compared to women.

The respondents working in tourism and other undeclared economic sectors tended to place more value on the capacity to provide recreational services. In fact, those working in tourism rated the capacity to provide recreational services as being close to very high. In what concerns the level of income, the first category, having a less income, tended to better rate the capacity to provide recreational services.

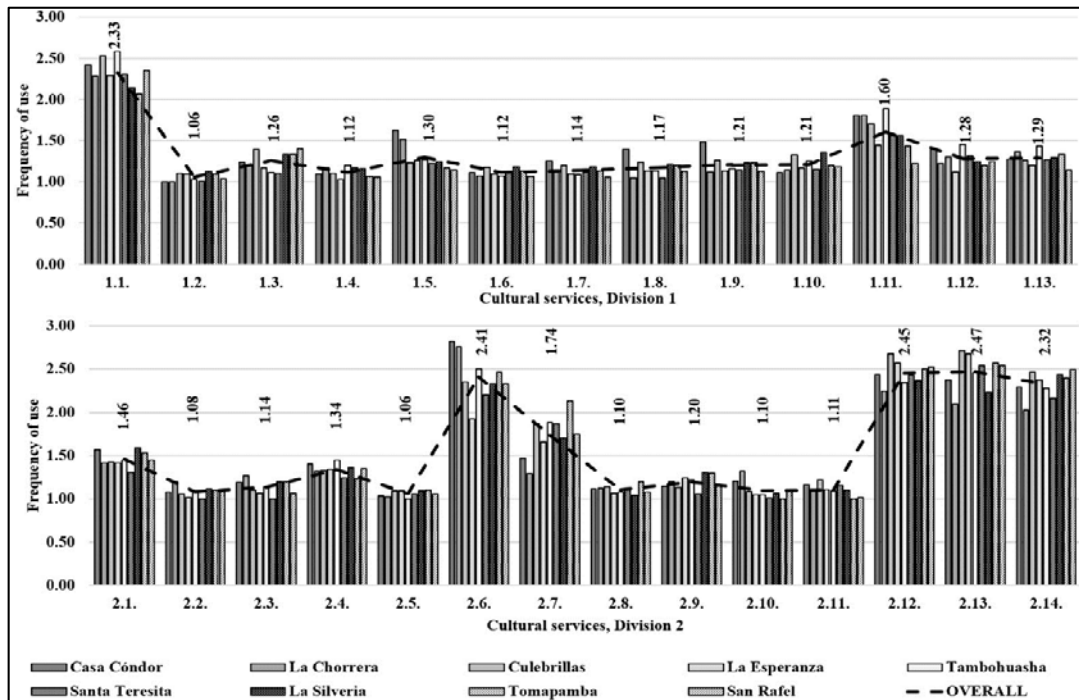


Fig. 4. Aggregated frequency of use per activities and communities

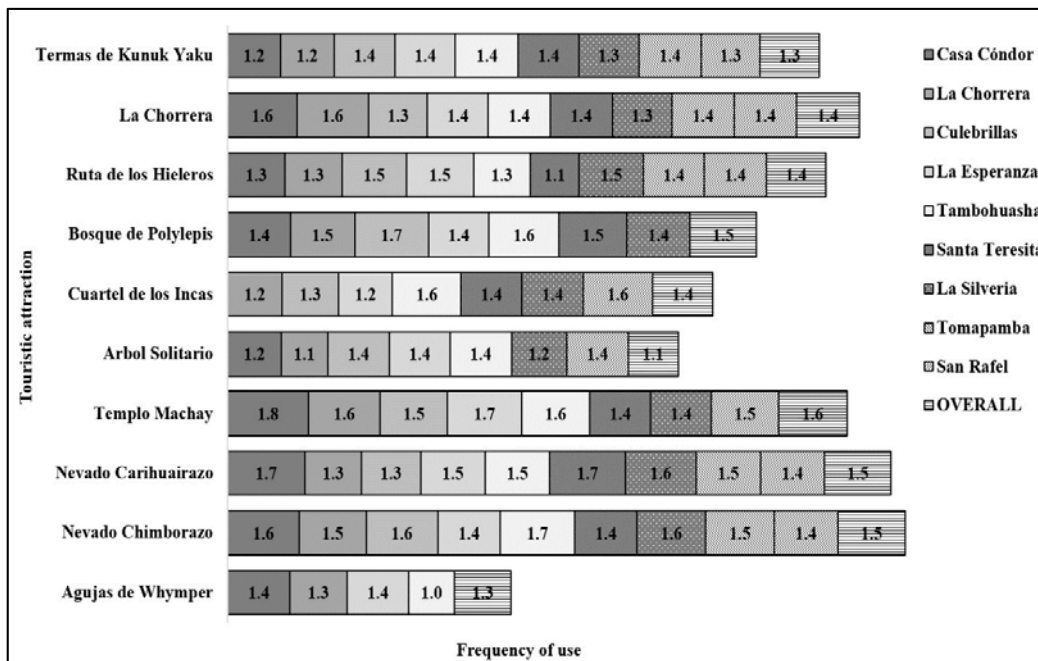


Fig. 5. Aggregated frequency of use per tourist attractions and communities

Therefore, male respondents those working in tourism and those having the lowest income in the area attributed the highest potentials for recreational services to the Chimborazo Mountain.

**4. Discussion and implications for the local management**

The body of knowledge on ecosystem services assessment is very large but there is a general consent that information on ecosystem services is still lacking

(Eigenbrod et al., 2009; MAE, 2006). This situation is hindering the attempt to scale the results, and probably distorts the image of full range of ecosystems services in a given area (Eastwood et al., 2009). In particular, data on cultural ecosystem services is scarce while the assessments should take in consideration the local culture and beliefs. While the protected areas are assumed to provide more cultural ecosystem services compared to managed land (Eastwood et al., 2009), in some regions there is a tendency to prefer provisioning services (He et al., 2018).

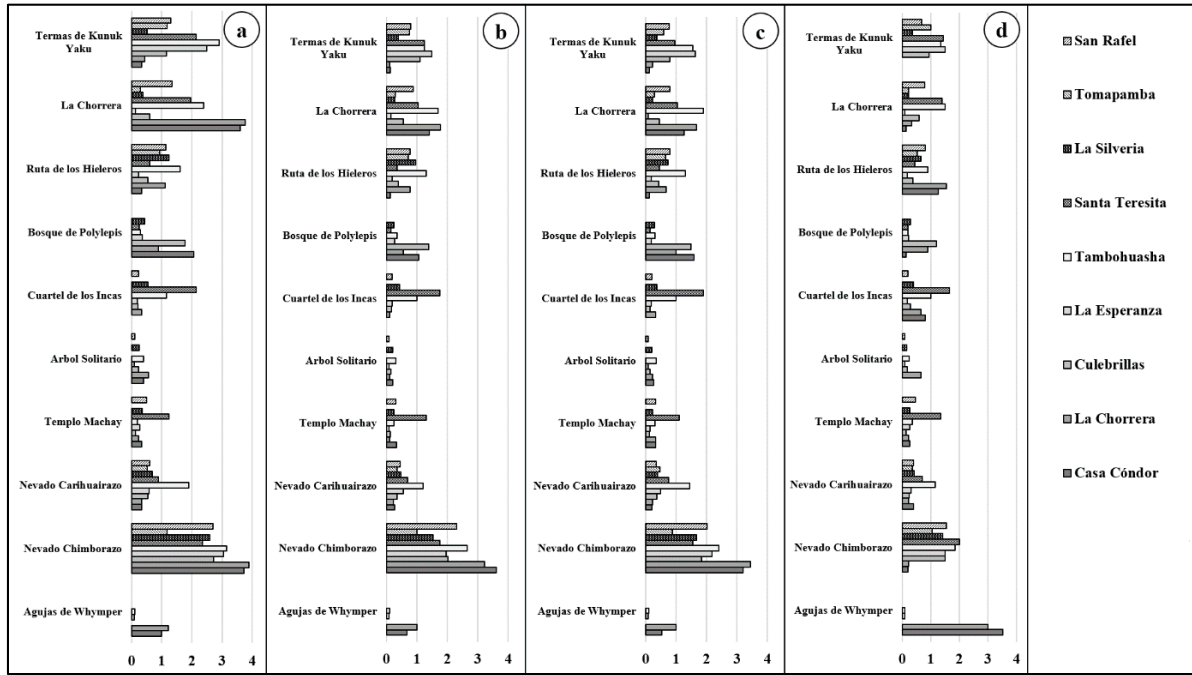


Fig. 6. Aggregated perceived capacity to provide cultural ecosystem services on categories of services: (a) recreational, (b) inspiration, (c) education and study, (d) spiritual experience

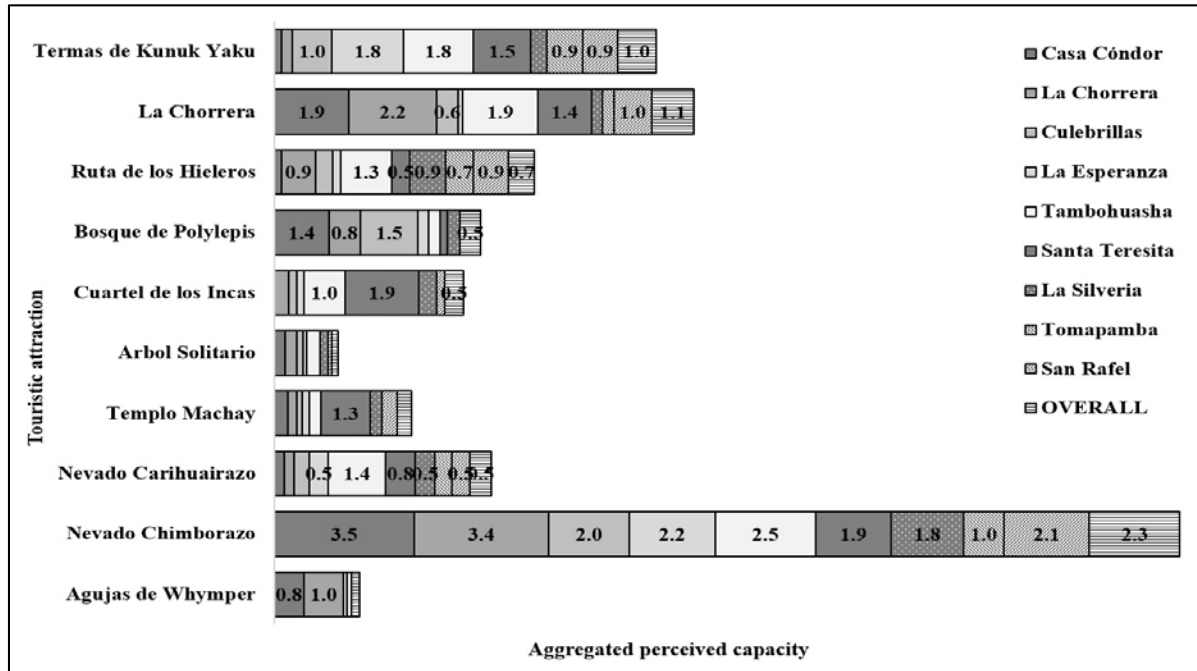


Fig. 7. Perceived capacity to provide cultural ecosystem services on tourist attractions

In other regions the locals place similar values on both, provisioning and cultural services (Garrido et al., 2017), while in other regions cultural services such as recreation may be underrepresented (Anderson et al., 2009; Eigenbrod et al., 2009). In relation to the above-mentioned, this study showed that communities located near CR are using and are aware of the potential of local cultural ecosystem services. However, proximity to a given landscape seemed to affect both, preferences and perception on the capacity of landscapes to provide cultural ecosystem services,

which is readily a known social behaviour (He et al., 2018).

Perception on the landscapes' capacity to provide recreation services was affected by the gender, occupation and income.

Male respondents placed more value on the recreation services a fact that is probably related to the local family-related habits according to which females are assuming a strong role in housekeeping while males are undertaking jobs that are related to landscape use (Rodríguez et al., 2018).

**Table 5.** Factors affecting the perceived capacity to provide cultural ecosystem services

Category of service	Feature	Item	Perceived capacity	Test	Confidence level
Recreation	Gender	Male	3.0*	t	$\alpha=0.05$
		Female	2.5		
	Occupation	Agriculture and livestock	2.3	ANOVA, t	$\alpha=0.05$
		Commerce	2.5		
		Tourism	3.8*		
		Construction	2.0		
		Other	3.1*		
	Level of income	386-708\$	2.8*	ANOVA	$\alpha=0.05$
		709-1030\$	2.3		
		1031-1353\$	2.0		
Not declared		2.3			

Note: \* denotes significant differences compared to each other values in a group

A greater perceived capacity given by those working in tourism, may be seen as a limitation of this study design. Nevertheless, the subsample containing the respondents working in tourism was very low (2% of the total number of respondents).

Another key behaviour of the communities taken into study was their value placement on iconic landscapes and their dominant features. As an example, many of the locals still believe that Chimborazo Mountain is a God, and many of the locals still use to give offerings for the mountain in the tourist attraction known as Machay Temple. Therefore, it was not surprising to find that respondents placed most of the value on the Chimborazo Mountain. In fact, people, including those from completely different regions and cultures, still tend to place value on rather mythical or religious connotated values of the landscapes (Irvine and Herret, 2018). A potential limitation of this study was that related to the practical impossibility to design the study to an extent able to clearly delimitate the perception of respondents in relation to particular spots compared to their encompassing landscapes. To balance the perceptual constructs of respondents, they were informed on the meaning of each evaluated feature prior to the response giving phase. Possibility to proactively inform and give advices on the interpretation of items is one of the advantages of door-to-door face-to-face surveys. At the same time, the statistical design of this study tries to balance the shortcomings of using non-parametric statistical descriptors such as the median values which, in given cases, stand for the middle values of a data set, therefore they are characterized by a less powerful outcome when describing the data.

In terms of policy, and since the management of CR provides a structured framework on the land use and emphasizes the conservation measures (MAE, 2014), it is likely and probable that the enjoyment of cultural ecosystem services will not be hindered by other human activities. Still, a more adapted stewardship to increase the accessibility of the landscape could bring benefits by mobilizing more people near the tourist attractions, including tourists that could further support the conservation of the area

### 5. Conclusions

This study brings evidence on the use and perception of cultural benefits among the Andean communities from CR. Local people enjoy and place value on recreation services, with their opinions probably being influenced by at least the proximity to the studied landscapes.

Among the 10 selected tourist attractions, Chimborazo Mountain dominated the preferences in use and it stands also for the greatest capacity to provide cultural services, as evaluated by respondents. Gender, occupation and level of income were factors that affected the perception on capacity to provide.

Besides documenting such trends, the results of this study opened new ways for adapting the local environmental management of CR to increase the added value of local landscapes, advancing, at the same time, the knowledge on how local people use and perceive the cultural ecosystem services.

### Acknowledgements

The authors would like also to thank to Transilvania University of Braşov and Escuela Superior Politécnica de Chimborazo for logistically and financially supporting this study. The authors acknowledge the help of the Polylepsis Project Team, and would like to thank to Maribel Parra, Gaby Román, Jenny Morocho and Sarahí Castro. Finally, the authors would like to thank to the Environmental Ministry of Ecuador for their permission to carry on this study under Scientific Research Authorization No. 009-IC-DPACH-MAE-20.

### References

AE, (2018), Assembly of Ecuador, Labor Code of Ecuador, Codification 17, Official Registry Supplement 167 of Dec 16, On line at: <http://servicios.agricultura.gob.ec/transparencia/2018/Abril%202018/literal%20a2/Codigo%20de%20Trabajo.pdf>.

Affek A., Kowalska A., (2017), Ecosystem potentials to provide services in the view of direct users, *Ecosystem Services*, **26**, 183-196.

Anderson B., Armsworth P., Eigenbrod F., Thomas C., Gillings S., Heinemeyer A., Roy D., Gaston K., (2009), Spatial covariance between biodiversity and other

- ecosystem service priorities, *Journal of Applied Ecology*, **46**, 888-896.
- Aragón F., Rud J., (2013), Natural resources and local communities: evidence from a Peruvian gold mine, *American Economic Journal: Economic Policy*, **5**, 1-25.
- Arroyo G., (2013), Towards an environmental legal culture in Ecuador, *Administration and Development*, **42**, 89-100.
- Barrow C., (2006), *Environmental Management for Sustainable Development*, 2nd Edition, Taylor and Francis e-Library, New York.
- Bommarco R., Kleijn D., Potts S., (2013), Ecological intensification: harnessing ecosystem services for food security, *Trends in Ecology and Evolution*, **28**, 230-238.
- Castillo D., Carrasco J., Quevedo L., Ricaurte C., Gavilanes A., Borz S., (2017), Diversity, composition and structure of Andean high forest in Ecuador, South America, *Bulletin of the Transilvania University of Brasov, Forestry, Wood Industry, Agricultural Food Engineering, Series II*, **10**, 1-16.
- Colby M., (1989), Environmental management in development: the evolution of paradigms, *Strategic Planning and Review*, On line at: <http://documents.banquemondiale.org/curated/fr/552371468913746182/pdf/multi-page.pdf>.
- Colby M., (1991), Environmental management in development: the evolution of paradigms, *Ecological Economics*, **3**, 193-213.
- Eastwood A., Brooker R., Irvine R., Artz R., Norton L., Bullock J., Ross L., Fielding D., Ramsay S., Roberts J., Anderson W., Dugan D., Cooksley S., Pakeman R., (2016), Does nature conservation enhance ecosystem services delivery?, *Ecosystem Services*, **17**, 152-162.
- Eigenbrod F., Anderson B., Armsworth A., Jackson, S., Parnell M., Thomas C., Gaston K., (2009), Ecosystem service benefits of contrasting conservation strategies in a human-dominated region, *Proceedings of the Royal Society B: Biological Sciences*, **276**, 2903-2911.
- Elbers J., (2015), The protected areas of Latin America. Current situation and perspectives for the future, IUCN, Quito, On line at: [http://www.bivica.org/upload/areas-protegidas\\_america\\_latina.pdf](http://www.bivica.org/upload/areas-protegidas_america_latina.pdf).
- Evans A., Lamine S., Kalivas D.P., Petropoulos G.P., (2018), Exploring the potential of eo data and gis for ecosystem health modeling in response to wildfire: a case study in central Greece, *Environmental Engineering and Management Journal*, **17**, 2165-2178.
- Fernandez Y., (2008), Why study environmental perceptions?, A review of Mexican literature with emphasis on Natural Protected Areas, *Espiral (Guadalajara)*, **15**, 179-202.
- Fritz N., Tahirindaza S., Stoll S., (2017), Local people's knowledge with regard to land use activities in Southwest Madagascar-conceptual insights for sustainable land management, *Journal of Environmental Management*, **199**, 126-138.
- Garrido P., Elbakidze M., Angelstam P., Plieninger T., Pulido F., Moreno G., (2017), Stakeholder perspectives of wood-pasture ecosystem services: a case study from Iberian dehesas, *Land Use Policy*, **60**, 324-333.
- Geophysical Institute, (2016), Franco-Ecuadoriano team placed a GPS on the top of the Chimborazo volcano, On line at: <http://www.igepn.edu.ec/servicios/noticias/1268-equipo-franco-ecuadoriano-coloco-ungps-en-la-cimadel-volcanchimborazo8>.
- Gomis F.J.D., Torres A.M.A., Baeza J.A., Lluch D.B.L., Ferrandez R.I., (2018), Perception about the application of environmental management systems at golf courses in Spain, *Environmental Engineering and Management Journal*, **17**, 53-62.
- Haines-Young R., Potschin M., (2018), Common International Classification of Ecosystem Services (CICES) V5.1 and Guidance on the Application of the Revised Structure, Fabis Consulting Ltd., Nottingham, UK, On line at: <https://cices.eu/content/uploads/sites/8/2018/01/Guidance-V51-01012018.pdf>
- He S., Gallagher L., Su Y., Wang L., Cheng H., (2018), Identification and assessment of ecosystem services for protected area planning: A case in rural communities of Wuyishan national park pilot, *Ecosystem Services*, **31**, 169-180.
- INEC, (2016), National Institute of Statistics and Census, Statistical Compendium, On line at: <http://www.ecuadorencifras.gob.ec/documentos/web-inec/Bibliotecas/Compendio/Compendio-2016/Compendio%202016%20DIGITAL.pdf>
- Irvine K., Herret S., (2018), Does ecosystem quality matter for cultural ecosystem services?, *Journal for Nature Conservation*, **46**, 1-5.
- Junco C., De la Rosa R., (2017), Legal-methodological foundations for a system of payments for ecosystem services in forests of Ecuador, *Scientific Journal Agroecosystems*, **5**, 109-117.
- Likert R., (1932), A technique for the measurement of attitudes, *Archives of Psychology*, **22**, 5-55.
- MEA, (2005), Millennium Ecosystem Assessment. Ecosystems and human well-being: wetlands and water, On line at: <https://sci-hub.tw/10.1016/b978-0-12-409548-9.09206-x>.
- MAE, (2006), Ministry of the Environment, General Plan Wildlife Production Reserve Chimborazo, Quito-Ecuador, On line at: <http://suia.ambiente.gob.ec/documents/10179/242256/35+PLAN+DE+MANEJO+CHIMBORAZO.pdf/d116d0db-aefc-477b-8188-f4a627af486d>.
- MAE, (2007), Environmental Ministry of Ecuador, Strategic Plan of the National System of Protected Areas of Ecuador 2007-2016, Final Consultancy Report, GEF Project: Ecuador National System of Protected Areas (SNAP-GEF), On line at: <http://suia.ambiente.gob.ec/documents/10179/369324/11.-PLAN+ESTRAT%C3%89GICO+DEL+SNAPResumen+Ejecutivo.pdf/72b6c299-cb55-4be4-8aa4-70591adf23a1>.
- MAE, (2014), Environmental Ministry of Ecuador, Update of the Management Plan for the Chimborazo Wildlife Production Reserve, Final consulting report, Quito-Ecuador.
- MAE, (2015), Environmental Ministry of Ecuador, Info SNAP: National System of Protected Areas of Ecuador, Quito-Ecuador, On line at: <http://areasprotegidas.ambiente.gob.ec/info-snap>.
- Murray J., (2013), Likert data: what to use, parametric or non-parametric?, *International Journal of Business and Social Science*, **4**, 258-264.
- Nel J., Kotzé L., (2009), Environmental management: An introduction, *Fuggle and Rabie's Environmental Management in South Africa*, **2**, 1-33.
- Norman G., (2010), Likert scales, levels of measurement and the "laws" of statistics, *Advances in Health Sciences Education*, **15**, 625-632.
- Oteros E., Martín B., Fagerholm N., Bieling C., Plieninger T., (2018), Using social media photos to explore the relation between cultural ecosystem services and

- landscape features across five European sites, *Ecological Indicators*, **94**, 74-86.
- Paudyal K., Baral H., Keenan, R., (2016), Local actions for the common good: Can the application of the ecosystem services concept generate improved societal outcomes from natural resource management?, *Land Use Policy*, **56**, 327-332.
- Plieninger T., Dijks S., Oteros E., Bieling C., (2013), Assessing, mapping, and quantifying cultural ecosystem services at community level, *Land Use Policy*, **33**, 118-129.
- Riitters K., Wickham J., Vogelmann J., Jones K., (2000), National land-cover pattern data, *Ecology*, **81**, 1-15.
- Rivas A., (2006), Governance of the National Systems of Protected Areas in the Tropical Andes: Regional diagnosis and comparative analysis, UICN, Quito-Ecuador, 68.
- Rodríguez E., Castro A., Chamizo S., Quintas C., Garcia M., Cantón Y., Weber B., (2018), Ecosystem services provided by biocrusts: from ecosystem functions to social values, *Journal of Arid Environments*, **159**, 45-53.
- Sullivan G., Artino A, (2013), Analyzing and interpreting data from Likert-type scales, *Journal of Graduate Medical Education*, **5**, 541-542.
- Wartmann F., Purves R., (2018), Investigating sense of place as a cultural ecosystem service in different landscapes through the lens of language, *Landscape and Urban Planning*, **175**, 169-183.
- Willits F., Theodori G., Luloff A., (2016), Another look at Likert scales, *Journal of Rural Social Sciences*, **31**, 126-139.