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People's Perceptions of Ecosystem Services Provided by Tropical Dry Forests: A Comparative Case Study in Southern Ecuador

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Additional information is available at the end of the chapter

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Abstract

This research explores the perspective of social actors about the ecosystem services (ES) provided by tropical dry forests (TDF) in two protected areas in southern Ecuador that differ in their management schemes. Identifying the ES and understanding the preferences of local communities is seen as a means for improving decision making, especially in the protected areas. Therefore, our goal was to apply social assessment tools in order to have an in depth appreciation of the factors influencing the perception of social actors in a comparative case study. Since the research was conducted in two areas with similar ecosystem, but with different management, it illustrates the potential role that management policies have at shaping the perception of social actors regarding TDF's ecosystem services. The results suggest that people perceive and prioritize ecosystem services differently according to the area and that such perception and prioritization is influenced not only by the management processes but also by the role that social actors play in the protected area.

Keywords: protected areas management, social assessment, stakeholder perception, sustainability, tropical dry forests

1. Introduction

Conservation studies have recently focused on highlighting the benefits of ecosystem services (ES) to human wellbeing as an incentive for people to protect nature. As a result, ES have been

incorporated in the discourse of sustainable resource management and policy making, emerging as the new form of nature commodification to encourage societies to work on conservation.

ES have been defined as the benefits derived from ecosystem functions. The Millennium Ecosystem Assessment (2005) classifies them into four categories: (a) provision services, including the production of raw materials, water and fuels used directly by humans; (b) regulation services, related to processes that influence climate and hydrological cycles; (c) cultural services, referring to educational, scientific, and esthetic benefits; and, (d) supporting services which support other ecosystem services like soil composition, nutrient cycling and primary production [1]. Previous research on ES has been approached mainly from three different perspectives. An ecologic perspective mainly focused on biophysical analyses of the capability of ecosystems to deliver services [2], on the economic valuation of these services [3], and on social methods intended to gauge the values, attitudes and meanings that underline the demand for ES. While economic and ecologic methods have been largely applied in the identification and valuation of ES, a group of researchers pointed out that the social assessment methods have not been fully endorsed. According to Sagie et al. [4] the potential advantage of using such an approach resides in that it helps to understand the importance that local populations place on ES. Moreover, in developing countries, this approach is encouraged as it helps to provide information of ES when scientific knowledge is missing or is difficult to collect [4]. Furthermore, it provides policymakers with information regarding preferences and perspectives of social actors making it easier to tailor specific conservation strategies to suit the realities of local communities [5].

Tropical dry forests (TDF) are ideal ecosystems for studying the importance of ES to local communities as they offer a wide array of services, yet they have been scarcely studied. Some researchers have mentioned that the capacity of TDF to adapt to drought conditions makes them an important genetic reservoir for future restoration projects [6, 7]. For other researchers, TDF occupied the fourth place as carbon sinks [5], while other researchers claimed that these forests offer recreation and tourism services and hold a species richness to provide fodder, timber and non-timber products, climate regulation, and habitat for species [8]. Additionally, these ecosystems support the livelihoods of millions of families worldwide [9, 10]. Despite the importance of these ecosystems, TDF are highly endangered. According to Espinosa et al. [11], there exists a lack of knowledge about the utility of these ecosystems that have led to under-value these forests.

In Ecuador, the best remnants of TDF are located in the South between the provinces of Loja and El Oro [12]. These forests provide a wide array of ES with climate regulation, water provision, risks prevention against flooding and landslides among the most acknowledged services [13]. In the last decade, new ES have been attributed to these forests including nature conservation and tourism [14]. Together, these services have boosted the efforts for protecting TDF by governmental and non-governmental organizations in Ecuador [15]. However, in spite of the efforts to protect these ecosystems, TDF in southern Ecuador are still threatened by unsustainable agricultural activities [16, 17], and illegal practices such as hunting. Because most of the threat drivers come from anthropogenic activities, the analysis of perceptions about the use of natural resources is crucial to identify people's ES demand [18] in order to identify more effective conservation strategies that involve people's needs.

By employing social research methods, namely questionnaires and semi-structured interviews, in this study we looked at exploring the perceptions that local communities have regarding the use of ES. The study was undertaken in southern Ecuador communities living within or nearby two protected areas holding TDF. These protected areas were selected because they differ in their management processes. In pursuing our objective, we will draw from a comparative case study design, with the aim of identifying and characterizing the ES that are more relevant for local people and to associate the functions and services to particular stakeholder interests and their preferences.

2. Study areas

The study area involves two protected areas holding TDF located in southern Ecuador. The Ceiba Reserve (Ceiba) is a private protected forest situated at south-west Ecuador in the province of Zapotillo, bordering with Peru ($4^{\circ}19'58''$ S, $80^{\circ}24'34''$ W) (**Figure 1**). This reserve belongs to an NGO Naturaleza y Cultura Internacional (NCI), who bought the land from local landowners as a mechanism to protect two of the last remnants of dry forest expanding to Peru [17]. It holds 9405.10 ha of relative homogenous dry forest ranging from 200 to 600 masl. In this region two climate seasons occur, the rainy season which extends from January to March, and the dry season that extends for the rest of the year [19]. Moreover, this reserve belongs to the hotspot "Tumbesian Region" [20, 21]. Ceiba sustains 370 families dedicated to goat grazing, corn growing, and apiculture, who work together with NCI to keep sustainable agricultural practices and to protect the local biodiversity [22].

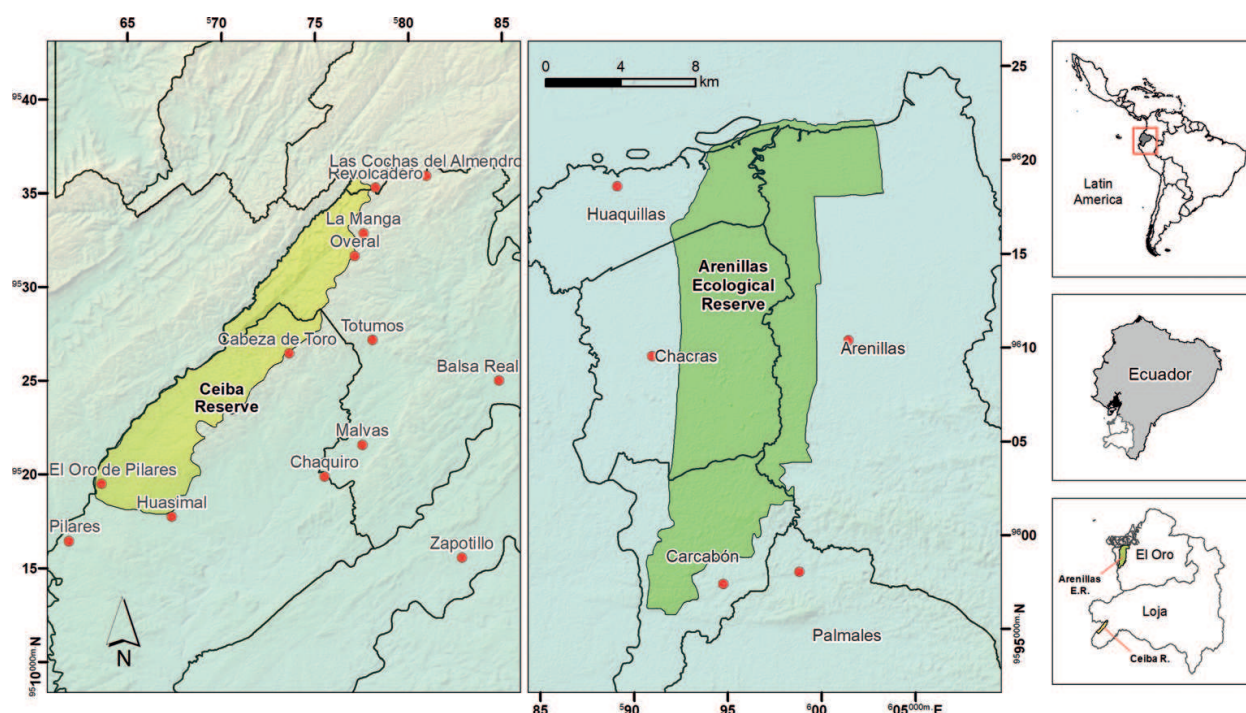


Figure 1. Geographic location of the study area. Red dots represent the places where data was collected.

According to the NCI website [23], Ceiba is managed with the help of local communities who are allowed to maintain sustainable agricultural practices within its territory after obtaining a permission granted by the owners of the area. Moreover, NCI claims to have helped local residents to obtain legal status and rights over the land they have been historically settled in.

The other protected area under study is the Arenillas Ecological Reserve (Arenillas). This protected area was established by the Central Government and is located at south–west between the provinces of Arenillas and Huaquillas ($3^{\circ} 32' 20.4''$ S, $80^{\circ} 8' 45.6''$ W) in the littoral region [14] (**Figure 1**). It holds 13,170 ha of TDF ranging from 0 to 300 m of altitude that also belongs to the hotspot “Tumbesian Region.” The reserve is characterized by its high endemism and presence of species with restricted distribution, especially 55 species of birds considered unique to the dry forests of Ecuador and Peru. Arenillas is under the highest protection category in the country namely Ecological Reserve [13].

Arenillas was always under the custody of the Ecuadorian government since its location between Peru and Ecuador has been strategic for the national security. In 2001, this area was declared as an “Ecological reserve” in the Ecuadorian National System of Protected Areas. This management category has the primary goal of conserving genetic material, ecological diversity as well as scenic beauties. No other activity is permitted within the reserve. According to Briceño et al. [14], the historical management of this reserve has prevented local communities from visiting the area, limiting their knowledge regarding the reserve and the resources it offers.

3. Methods and data analysis

As mentioned earlier, we aimed to identify the ES that are more relevant for local people living near Ceiba and Arenillas, as well as to determine if the perception of such services is related to the type of user and the management of each protected area. In doing so, we selected a comparative case study design. This type of design is recommended when looking for similarities and differences between two cases [22], namely protected areas. In the issue of ES, the majority of studies have focused on quantitative studies regarding economic payments for ES [24, 25], neglecting the importance of mixing qualitative and quantitative data gathering instruments to collect data about people’s perception of ES and the relevance of such perception in the management of any protected area. With these conclusions as a backdrop, we draw data from semi-structured interviews and questionnaires as detailed below:

Semi-structured interviews: A total of 32 social actors were identified, 13 in Arenillas, and 19 in Ceiba. The actors were selected according to their interaction with the protected areas either in the use, conservation or management. The social actors interviewed were grouped into the following categories: (i) Public and private managers, (ii) Municipality members, (iii) Local representatives, (iv) Agrarian cooperatives and Associations, and (v) Local Representatives.

Additional influential social actors were identified in each area and were incorporated in the study. For example, in Arenillas, school teachers were included in the study as they regularly

visit the reserve with students and have knowledge about the reserve and its ecosystem. In Ceiba, this group was left out of the analysis as the teachers did not interact with the reserve.

The interviews were valuable to identify the ES perceived by key social actors and to understand the reasons for these actors to prioritize some ES. The interview guide was validated through a pilot test conducted with people from the areas sharing similar demographic characteristics. The interview lasted approximately 40 min. All interviews were tape-recorded under informant's consent and later transcribed. The coding process used the categories provided by the Millennium Ecosystem Assessment for ES and further developed by Groot et al. [26]. The subcodes that emerged from the data followed the steps suggested by Saldaña [27]. By following this process, we were able to highlight the ES that were more valuable and visible to participants constructing thus an ES panel for each study area. The panels constructed were presented to each actor who was asked later to identify the five most important ES according to their perception as well as to assign a value to each of the prioritize services from one to five. Being five the most important and one the least important service.

For the analysis and interpretation of the ES, prioritized by participants in both Ceiba and Arenillas, an average per actor was calculated from the assessment of each prioritized ES. The results of each ES were then normalized between zero and one in order to facilitate their representation and comparison [28]. For comparison purposes, the values were presented as a percentage to improve the visualization of the results (Eq. (1)).

$$x' = \frac{x - x_{min}}{x_{max} - x_{min}} \quad (1)$$

where x' = normalized value, x = value to be normalized, x_{max} = maximum value to normalize, x_{min} = minimum value of group value.

Questionnaires: By using the data of the latest Ecuadorian population census [29], with a standard error of 5% and 95% of confidence intervals, a sample of 240 people was established. Nonetheless, in Arenillas 24 people rejected to participate having a final population sample of 96 people, whereas, in Ceiba 20 people indicated that they did not feel like answering the questions leaving a final population sample of 100 people. In both areas, refusals were based on the grounds of scarce knowledge and acquaintance with the protected areas under study. The final sample included a total of 196 questionnaires that were randomly applied to people living in the surrounding areas of Arenillas and living within and nearby Ceiba. The survey aimed at complementing the information gathered in the interviews. Respondents were approached at their households or at public places such as recreational parks and church gathering. In Arenillas, respondents were mainly men (58%) between 18 and 30 years old (31%), and with a secondary school education (37%). In the Ceiba reserve, respondents were mainly women (57%), over 60 years old (23%), whose primary occupations were housewives (48%) and agriculturalists (37%). The questionnaire was valuable to add data from the general public regarding ES identification and prioritization. The questionnaire was validated through a pilot test conducted with people from the Arenillas reserve sharing similar demographic characteristics. Data obtained from both interviews and questionnaires were analyzed together

to identify similarities and differences between survey and interview participants from both areas. The data were analyzed through descriptive statistics.

4. Results

4.1. Ecosystem services identified and prioritized in each study area

In the first round of questions, both interview and survey participants were asked to state the benefits that they or other community members obtain from the protected areas studied. A total of 13 ES were identified by interview and questionnaire participants in Arenillas, whereas in Ceiba, a total of 12 ES were identified (**Table 1**).

For comparison purposes, we divided the table according to the protected area studied, namely Ceiba and Arenillas. The results were categorized according to the ES classification proposed by the Millennium Ecosystem Assessment. Study participants mostly identified provisioning and cultural services. Regulation services were also mentioned but to a lesser extent while supporting services were hardly mentioned by the participants from both areas.

Moreover, the results indicate that participants from both areas prioritize similar ES. However, the order in which they prioritized the services differed slightly in each area. The most prioritized ES in Ceiba were provisioning services, particularly agriculture and goat and deer husbandry. Based on these responses, we assert that participants valued the TDF mainly in terms of the services provided by agro-ecosystems. Accordingly, the most valued services included food production, irrigation water, climate regulation, and habitat provision for deer and goats. Contrasting these results, Arenillas residents prioritized mostly cultural services, which are embraced as an opportunity for recreation as well as tourism (**Figure 2**).

Additionally, interview data suggest that the participants from Ceiba and Arenillas appreciated ES differently. In Ceiba, participants prioritized TDF's ES as a collective benefit for agricultural purposes, whereas residents from Arenillas prioritized TDF as individual benefits such as fuel wood or poaching. Although hardly mentioned, Arenillas' residents more often cited regulation services and showed a better understanding of the indirect services provided by TDF.

4.2. Provisioning services

In Ceiba, the provision of food was ranked highest in the prioritization of ES (96%), being the production of crops such as onions, corn and rice of vital importance to the economy of the families along with the husbandry of goats and deer. According to Benítez and Medina [30], agriculture and husbandry are critical for local people of Ceiba, as 70% of the territory of the province of Zapotillo where Ceiba is located is dedicated to goat grazing. It is not a surprise then that for people living within or nearby Ceiba, food provision and fodder for husbandry were the most prioritized services. In Arenillas, food provision was also prioritized but to a lesser extent than in Ceiba (54%). According to the development plan (2002–2012) [31], the main economic activities in the region are agriculture (49.6%), followed by service activities

Ecosystem Services (ES)	Specific (ES)	CEIBA RESERVE		ARENILLAS ECOLOGICAL RESERVE	
		Indicator	%	Indicator	%
Provision services	Food	Agriculture (Onion, rice and corn)	96	Lemon growing	54
		Husbandry (Goats and deer)		Deer and squirrel poaching	
		Apiculture (Melipona)			
	Raw material	Food hunting / gathering			
		Fodder (<i>Prosopis juliflora</i>)	52	Fuel wood (Guayacán, hualtaco) for brick manufacturing.	43
		Timber (Hualtaco/ Guayacán)			
		Construction (Barbasco, hualtaco)			
Regulation services	Water regulation	Firewood(Algarrobo)			
		Water provision	19	Water provision	5
	Life cycle maintenance	Water infiltration			
		Habitat provision	14	Habitat provisioning	34
		Carbon sequestration	16	Air quality	40
	Climate regulation	Air quality		Protective barrier, shade	21
		Climate regulation			
	Erosion prevention	Desertification protection	9	Desertification protection	31
	Pest control	Pest control	1	unidentified	
	Pollination	Pollination	5	unidentified	
Cultural services	Opportunity for Recreation and tourism	Nature tourism, trees blooming	8	Nature tourism, trees blooming	64
		Gastronomy tourism (<i>Chivo al hueco</i> , Goat cheese, milk, and custard)			
		Community tourism principles			
	Aesthetical information	Landscape, Guayacan blooming season, waterfall (Coronel)	9	Landscape, photography	5
	Research	Scientific knowledge developing	6	Scientific knowledge developing	11
				environmental education	
	Inspiration for culture		11	unidentified	
		Traditional knowledge			
	Spiritual experience	unidentified		Spiritual experience	1
	Existence value	unidentified		Existence value	3

Table 1. Social perception of the main ecosystem services.

(23.9%) and commerce (10.7%). The diversification of the economic activity in this area and the presence of urban population suggest lower levels of appreciation towards the provisioning services in comparison with the rural population of Ceiba.

Prioritization of ecosystem services

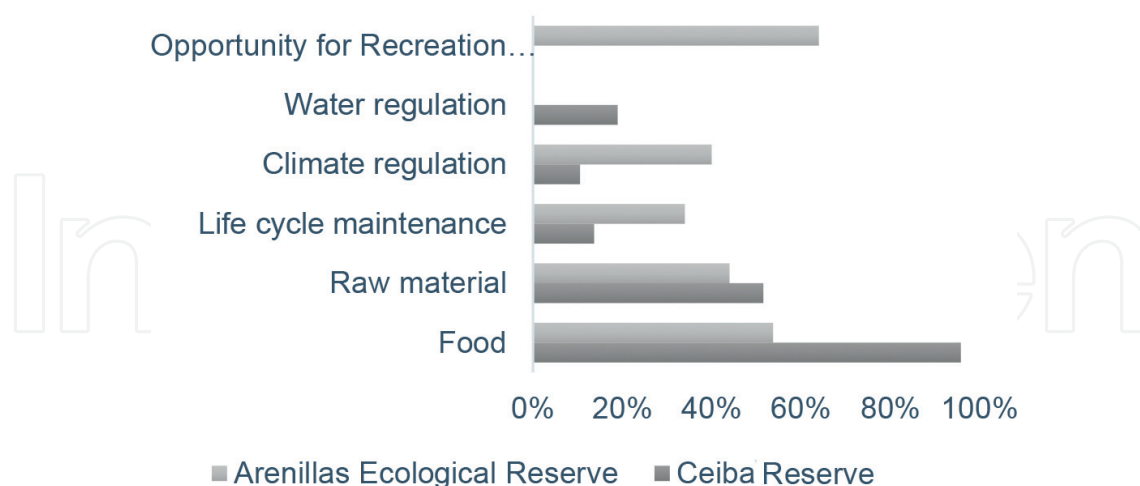


Figure 2. Prioritization of ecosystem services (n=196).

There are also notable differences in the use of provisioning services in both areas. Both Ceiba and Arenillas residents use timber from Guayacan trees due to its suitability for construction. While Ceiba residents use the wood for fodder, fences construction and firewood (52%), Arenillas' residents mentioned its use for brick manufacturing and sometimes the construction of fences (43%). These differences may be explained by their views on extracting natural resources. Ceiba residents seemed very much aware of the benefits that TDF provide and expressed their use of timber in sustainable narratives. As some of the interviewees expressed:

"Nowadays this area has changed since we ourselves look after it, instead of logging, we have planted. We have been even working 8 years for the palo santo project. We collect the fruits in winter time and send them later to Loja for extracting the oil" Cabeza de Toro settler.

Overall, individuals from Ceiba acknowledged that the NGO had a positive impact on their lives, indicating that their behavior and attitudes towards the forest have changed, as expressed in the following quotation:

*"We thank NCI for giving us the vision and the path to look after the forest. There used to be logging including Peruvians invading to cut down Guayacan [*Tabebuia chrysantha*]. We are organized as a group now and keep going forward, one can see the change"* Ceiba settler.

In Ceiba, the NGO owners had created a Community Organization called "2 de Febrero" with the aim of including inhabitants from neighboring areas in the management of the protected area. "This management is based on community needs," claimed an NCI member. The current management had encouraged production, enabling the establishment of small enterprises of goat dairy products such as cheese, milk and liquid toffee [*natilla*], as expressed by this community member "We have been trained to venture in different activities such as beekeeping and farm animal management."

The management has also reorganized a pre-existing patrol group which is accountable for enforcing the zoning established for goat grazing. Members of this group graze their own

goats but also look after grazing areas, an activity that makes NGO members proud. *"Ceiba has the luxury of having 70 volunteers that make constant circuits around the area. We have only one ranger hired by the institution."*

Community members share this pride, who acknowledge that the NGO has improved their agricultural practices, which in turn has increased their income and has decreased the negative impact on biodiversity, as expressed by this community member *"At first we thought they [NGO] came to kick us out, and that we were not going to be able to graze our animals, but it was the opposite."*

In Arenillas, people seemed hesitant to express openly their use of timber, as they acknowledged the strict protection the Reserve was under. The provisioning services, indicated in Arenillas, involved poaching and fuel wood, both critical for local communities. According to Briceño et al. [14], local people used to hunt animals, particularly deer and squirrel, for subsistence. However, since this protected area is owned by the Central Government, these activities are considered 'illegal'. The conservation status held by this Reserve, however, did not prevent local people from hunting and collecting fuel wood which is used for brick manufacturing, one of the main economic activities in the area as one of the informants offered:

"People generally sneak into the reserve and cut Guayacan, Palo Santo [Bursera graveolens] and Ceibo [Ceibo trichistandra] trees. These are usually used to build fences... Some people pile the trees until they have 50 logs and then they sell them to brick manufactures. We also hear about people getting into the reserve to hunt deer to eat it."

4.3. Regulation services

The regulation services prioritized in Ceiba were water regulation (19%), climate regulation (16%) and habitat provision (14%), being agriculture and husbandry the main source of maintenance for the communities living near or surrounding the reserve, it's no surprise that the regulation services mentioned were associated with inputs to production (fulfilling water requirements for agriculture, and presence of shrubs for husbandry). One of the residents expressed the regulation services in the following terms:

"The main benefit of the forest is mainly for animals, the refuge, the shrubs for goats, especially in winter when the mountain lush with vegetation, it attracts winter, because before this was a dry terrain" Resident of La Manga.

Favorable climate conditions are also essential for the growth of crops and maintenance of agroecosystems. The influence of the NCI on the perception of the local community is evident in the narratives expressed by the study participants.

"...The forest provides a natural climate that benefits the provision of oxygen and fodder for animals. Without the forest, the sun would burn us. Where the forests are there is rain..."

As Daniel et al. [32] explains while regulation services are more complex to be perceived, they have been brought to public attention by discussions of climate change and recent natural disasters. According to Peñaranda [15], Ceiba owners promoted regulation services to gain the

acceptance of community members to adhere to conservation strategies. One of the personnel of NCI expressed.

“we worked a lot in training people about the benefits of Dry forests. People now know that if they chop trees, it will not rain. Now they understand the magnitude of the damage they commit when they act against nature.”

In Arenillas, the regulation services such as air quality and habitat provisioning were related to the pristine services a protected area provides as a habitat for provision for fauna and flora, air quality and climate regulation. This intangible and indirect use of the Arenillas coupled with the limited access to the reserve helped shape this perception among residents. The following quotation reflects the grounds on which people prioritize these services:

“When I pass with my vehicle, I open the window and breathe the air of the reserve [Arenillas]. I fill my lungs with oxygen and my organs with pure air. This should be charged, give added value to what trees produce” Resident Arenillas.

Desertification barrier was more mentioned in the responses provided by Arenillas settlers. Being near the frontier of Peru and its arid coastal ecosystem, residents valued the reserve for being a barrier that diminishes the further expansion of desert. As expressed by one of the settlers.

“The Reserve creates the environmental conditions so that it rains in Arenillas. The reserve supplies water and supplies it to two populations with 90 thousand inhabitants. In addition, the Arenillas Ecological Reserve cleans the air and is slowing down the desert that comes from the north of Peru.”

4.4. Cultural services

As we mentioned earlier, in the Arenillas reserve it is not possible to use fodder, fuel wood, or practice any productive activity such as agriculture, only tourism and research activities are allowed. This conservation status may explain participant's prioritization of tourism in Arenillas. One of the informants offered:

“People from outside [from other regions] visit the Arenillas reserve in order to feel the tranquility that they experience there, especially during the flowering of Guayacán” Resident Arenillas.

In 2015, the Regional Division of the Ministry of Environment started promoting tourism and recreational activities in the area in response to the so-called annual flowering of the *T. chrysantha* (Guayacán) which was being promoted as a national tourist attraction [15]. This event awakened the interest of social actors regarding cultural ES as following quoted by a Municipal employee: *“We are starting to promote tourism, but we need to strengthen it. For example, the flowering of the Guayacan is something spectacular that we must pay attention to and make it known at a cantonal and provincial level.”*

Notwithstanding Ceiba holds a similar ecosystem with a vast territory of Guayacan forests, participants from this area did not share the view of Arenillas residents about promoting tourism activities. Some of the reasons for this difference are explained a technical staff

member of NCI: "*our objective as NCI is not to promote tourism.*" Ceiba participants also expressed that this event was promoted in nearby communities but not in the Private Reserve la Ceiba. Additionally, participants around Ceiba claimed that they do not count with the equipment or the capacity to attract tourists to the area. Despite their lack of enthusiasm towards tourism activities, respondents from the Ceiba reserve expressed their appreciation towards the flowering of Guayacan as a landscape esthetic value. Moreover, participants from Ceiba perceived TDF as spaces of cultural heritage and places of local traditions, customs and legends.

4.5. Identification of ES by type of social actor

The results of the prioritization by type of social actor can be viewed in **Table 2**.

4.5.1. Public and private managers of the protected areas

In Arenillas, public managers placed a greater importance on cultural services particularly on the facilities that TDF offer to conduct education and research (75%). The second most mentioned ES by these participants was the capacity of TDF to provide shade (41%) followed by medicinal uses (40%). Special importance was highlighted to the Algarrobo tree (*Prosopis pallida*) to heal stomach diseases. This group of participants, however, did not attribute any value to the regulation service of water provision nor the cultural services related to landscape, existence value, or spiritual experience.

On the contrary, for the private managers of Ceiba the most important services provided by TDF involve their capacity to reduce desertification (100%), to provide habitat for plants and animals (85%), and to provide water (39%). This group gave the lowest scores to the pollination service, the value of the landscape, and the development of scientific knowledge.

4.5.2. Municipality members

In the Arenillas reserve, municipality members showed a better understanding of the ES provided by TDF indicating nine types of services including medicinal services and a source of Fuelwood. They described ES as a concept applied principally to agro-ecosystems whereby the main benefits are obtained from raw material (49%), and medicinal resources (60%). Water regulation (50%) was also viewed as an important ES. Contrasting the general prioritized results, this group did not assign any value to some cultural services such as existence and spiritual values.

In Ceiba, municipality members were the most enthusiastic group at implementing tourism activities in the area. They ascribed a substantial level of importance to the Guayacan flowering event (100%) and to developing nature tourism (62%). The ability of TDF to regulate water cycles was also mentioned (39%). This group of social actors seemed to be less aware of the regulation services provided by TDF such as habitat provision and desertification.

4.5.3. Local representatives

Local representatives in Arenillas assigned a greater value to spiritual experiences related to the reserve (100%), followed by air quality regulation (44%) and the ability of TDF to

CEIBA RESERVE	E	n=120	5%		8%	15%	0%	0%	60%	0%		0%	10%	
	D	n=4	18%		22%	85%	11%	100%	0%	0%		0%	30%	
	C	n=5	27%		16%	0%	36%	0%	0%	0%		67%	0%	
	B	n=6	32%		39%	0%	45%	0%	20%	0%		17%	30%	
	A	n=4	18%		14%	0%	7%	0%	20%	100%		17%	30%	
	ES Indicator		Agriculture (Onion, rice and corn)		Fodder (<i>Prosopis juliflora</i>)	Habitat provision	Carbon sequestration	Desertification protection		Landscape, Guayacan blooming season, waterfall (Coronel)		Scientific knowledge developing	Cultural Heritage	
	Mapped ecosystem service		(P)Food		(P)Raw material	(R)Life cycle maintenance	(R)Climate regulation	(R)Erosion prevention	(R)Pollination	(C)Aesthetical information		(C)Research	(C) Inspiration for culture	
ARENILLAS ECOLOGICAL RESERVE	f	n=96	3%	0%	0%	17%	0%	0%	0%	10%	75%	0%	0%	100%
	e	n=3	26%	18%	40%	29%	0%	41%	4%	10%	0%	75%	0%	0%
	d	n=2	3%	13%	0%	13%	16%	18%	28%	8%	0%	0%	0%	0%
	c	n=2	3%	22%	0%	21%	19%	0%	12%	8%	0%	0%	0%	0%
	b	n=4	17%	24%	0%	0%	44%	6%	32%	29%	0%	25%	100%	0%
	a	n=5	49%	22%	60%	21%	22%	35%	24%	35%	25%	0%	0%	0%
	ES Indicator		Fuel wood (Guayacán, hualtaco) for brick manufacturing,	Lemon growing	Deer and squirrel poaching	Algarrobo use for stomachic diseases,	Habitat provisioning	Pure air, oxygen	Protective barrier, shade	Desertification protection	Nature tourism, trees blooming	Landscape, photography	Scientific knowledge developing	environmental education
	Mapped ecosystem service		(Provision)Raw materials	(Provision)Food	(Provision)Medicinal resources	(Regulation) Life cycle maintenance	(R)Air quality regulation	(Regulation) Climate regulation	(Regulation) Erosion prevention	(Cultural) Opportunity for Recreation and tourism	(Cultural) Aesthetical information	(Cultural)Research	(Cultural) Spiritual experience	(Cultural) Existence value
a—municipality, b—local representatives, c—cooperatives, d—local teachers, e—ministry of the environment, f—survey. A—municipality, B—local representatives, C—association, D—Naturaleza y Cultura Internacional (NCI), E—survey,														

Table 2. Perception of environmental services by social actors in the Arenillas Ecological Reserve and Ceiba Reserve.

prevent desertification processes (32%). On the contrary, Ceiba local representatives rated highly the capacity of the TDF to sequester carbon (45%). They referred to this service in the following terms "provide oxygen" and "pure air." Within this group, agriculturalists more frequently mentioned provision services such as fodder (39%) and agriculture (32%).

4.5.4. Agrarian cooperatives and associations

The participants pertaining to this group were dedicated to agricultural activities in both areas. It was therefore not a surprise that they both assigned higher values to provisioning and regulation services related to their activities. Food production was the most mentioned ES by both groups, in Arenillas (22%), and in Ceiba (27%). Water provision was also mentioned by both groups, in Arenillas (25%) and to a lesser degree in Ceiba (6%). The main difference between participants in this group is rooted in that social actors in Ceiba perceived research development as an important ES (67%), while stakeholders in Arenillas did not attribute value to any cultural service.

4.5.5. Local residents

Among local residents, we were able to identify substantive differences. In Arenillas, surrounding communities were more keen on the cultural services provided by TDF and mostly prioritized the existence value (100%), followed by landscape photography (75%). As we mentioned earlier, this appreciation is linked with the more urbanized population residing near Arenillas, who prefer to use the reserve for tourism purposes. Contrasting these results, populations surrounding Ceiba attributed a higher value to regulation services such as pollination (60%) and habitat provision (15%).

Additionally, survey results suggested that local residents not only differ in their perception of the ES provided by TDF, but also in their knowledge about the managers of the reserve. While in Arenillas, the majority of respondents declared not knowing who currently manages the reserve (68%) in Ceiba the majority of respondents knew it (65%). These results are explained by historical processes related to local communities' involvement with the management of the area. According to Briceño et al. [14], in Arenillas, the historical isolation of local communities from the reserve has influenced on resident's familiarity with the area and on the type of ES prioritized. In this respect, Boyd and Boyd [33], indicated that only when ES are incorporated into the production of goods and services they are valued by different social actors. Consequently, since residents of Arenillas are not allowed to use provisioning services should not be a surprise that this group of social actors prioritized cultural services.

On the contrary, in Ceiba some local social groups are involved in the management of the area and prioritized more regulation services such as pollination. Again, these results should be expected since they are working closely with the reserve managers as offered by a community member: *"thanks to NCI we have a new vision of what is the best way to manage the forest... we have trained on working with bees... we shifted from trees to bee boxes."*

5. Discussion

The findings of this research revealed that local residents living nearby or within Ceiba and Arenillas perceive and appreciate a wide range of ES provided by TDFs in southern Ecuador. The social actors in both areas mentioned provisioning services and cultural services, and to a lesser degree regulation services but hardly mentioned any supporting services. Supporting services were difficult to identify by social actors' especially those who are not familiar with ecological and biophysical processes. This finding supports conclusions from other studies suggesting that supporting services are harder to identify by the people [4].

Our results suggest that there are two underlying forces that influence how people perceive their ecosystem: (1) the management strategies undertaken in each protected area, and, (2) the involvement of the different social actors with the reserves. Regarding the management strategies, we argue that the perceptions of ES provided by TDF are influenced by the models applied in the management of the protected areas. While in both areas the access to resources such as timber or pastures is restricted and regulated, in Ceiba sustainable activities, including agriculture, are allowed inside its territory if the owners permit it, whereas in Arenillas any production activity is banned by the Ministry of Environment.

The exclusionary model applied in Arenillas follows the trend applied in protected areas whereby these areas are set aside for recreation and restricted from other uses [34]. This conservation approach, as Pimbert et al. [35] pointed it out, seeks to exclude local communities from all forms of participation. Because conservation initiatives, namely protected areas, have mainly focused on protecting the regulation services and promoting the cultural services, it is not surprising that in Arenillas the ES that were most highly rated were cultural services. On the contrary, in terms of conservation, the inclusive management approach developed in Ceiba has positively influenced in that people perceive and value provisioning services as well as being aware of the impacts they have on the ecosystem.

While these results are promising for the conservation purposes, it is worthy to note that we have not analyzed how this inclusive management is influencing on the access to natural resources and on the people's livelihoods.

Regarding the second force, some authors have argued that the perception of ES and its further conservation depends on the beneficiaries of such services [9, 14, 36]. For instance, Benez et al. [37], and Verón et al. [38] indicated that ES are appreciated according to cultural values wherein the same service, namely water provision, could be perceived as human consumption or as hydroelectric power. Likewise, Reid et al. [39] suggested that ES are valued according to the level of urbanization and modernity wherein food supply is perceived differently in urban or non-urban areas. For example, mammals' abundance in the Arctic is highly valued as a food source whereas in urban environments meat suppliers may be less critical to the well-being of metropolitan populations given the wide array of protein substitutes and therefore are less valued.

Against the conclusions of these studies, we argue that the perception and prioritization of ES is also influenced by the extent to which a person or community is involved with the protected area. Prior studies [40–42], mentioned that regulation services are commonly perceived by populations whose members are not directly involved in agricultural activity. The results of our study indicate that municipality members, governmental officials and protected area managers, including community members contributing with the protected area, perceived more commonly regulation and support services whereas agriculturalists perceive more provisioning services. This suggests that the occupation and personal involvement with the management of the area inform the services that are perceived and prioritize. Moreover, while we agree that regulation services are hard to identify [43, 44], we argue that this is true for populations whose livelihoods depend on provisioning services. Indeed, the results of our study suggest that social actors perceiving and prioritizing regulation services were municipality members, protected area managers, and teachers. Finally, in Arenillas, people living nearby the reserve recognized the potential of developing tourism activities that would, in turn, generate an additional source of income for the communities. In Ceiba, cultural services were cited by municipality members and members of associations, but the cultural services were related to the intrinsic value of the TDF and the recognition of this ecosystem as an important area to transmit knowledge to different sectors. It was not associated with any economic benefit.

6. Conclusions and future challenges

This study is a first step to build on the knowledge of TDF in an Ecuadorian context. It highlights the necessity to incorporate people's voices in the management of protected areas to achieve better conservation results. The integration of local people in policy making leads to a better compliance with conservation objectives [45–48], the results of our study also confirm these findings. This is especially important in developing countries where the stakeholders have not been fully integrated in the management process and where policymakers tend to prefer a top-down organization system. We argue that while this approach to conservation might be useful to conserve the natural environment, it doesn't necessarily guarantee the acquiescence of local communities with conservation policies on the long run, as the case of Arenillas showed us. We suggest that local governments should double their efforts in promoting a truly inclusive decision-making process.

The findings of this research also revealed that social assessment methods are useful in the initial phase of studying ecosystem services as it permits managers to have an in-depth knowledge of the values, needs, preferences, and strains of the different stakeholders involved in a protected area. However, it fails to reveal some important supporting and regulation ecosystem functions and services that are invisible to local communities. Further studies should be carried out from an economic and ecologic point of view to obtain more rigorous assessments.

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