Transilvania University of Brasov

INTERDISCIPLINARY DOCTORAL SCHOOL

Faculty of Silviculture and Forest Engineering

Ing. Alex Vinicio GAVILANES MONTOYA

Capacity of the Ecuadorian Amazonian Rainforest to Provide Ecosystem Services: An Evaluation of Plant Uses, Capacity to Provide Products and Services and Perception on the Landscape Management Systems in the View of Local Stakeholders

Capacitatea pădurilor amazoniene ecuadoriene de a furniza servicii ecosistemice: evaluarea utilității plantelor, capacității de a furniza produse şi servicii şi a percepției asupra sistemelor de management al peisajului în viziunea actorilor locali

ABSTRACT / REZUMAT

Scientific supervisor

Prof.dr.ing. Stelian Alexandru BORZ

BRAȘOV, 2020

To Mrs/Mr ....

Reviewing board of the doctoral thesis

Enforced by the Decision of the Rector of the Transilvania University of Brașov
Nr. .... from ....

PRESIDENT:	Prof.dr.ing. Alexandru Lucian CURTU
SCIENTIFIC SUPERVISOR:	Prof.dr.ing. Stelian Alexandru BORZ
OFFICIAL REVIEWERS:	Conf.dr.fiz. Marina Viorela Marcu
	C.Ş.I.dr.ing. Lucian DINCĂ
	Prof.dr.ing. Gheorghe Florian BORLEA

Date, time and place of the public defence of the doctoral thesis:
10th of April, at 10:00, room SP4

Please send us, in time, your eventual comments, appreciations or observations on the content of this thesis, by mail on the following address alex.gavilanes@unitbv.ro

Also, we would like to invite you to take part in the public session of the thesis' defense.

Thank you!

Acknowledgements

At the end of my research and doctoral studies, I want to thank everyone who has been part of this stage of my life. First of all, with much respect and admiration, I would like to thank to prof. Stelian Alexandru BORZ who, with his knowledge, experience, patience and friendship, knew how to guide me, as a father, in the scientific field, and helped me to move towards the future through the development of new academic, professional and personal abilities. I also thank the members of the thesis supervision committee for their invaluable help in carrying on my research and to the members of my evaluation committee for agreeing to evaluate my work. Special thanks I would like to address to prof. Marina Viorela MARCU for her help in carrying on my research. I thank to the rector of the Transilvania University of Brasov, prof. Ioan Vasile ABRUDAN, who granted me the scholarship four years ago and gave me the opportunity to develop my doctoral studies; I thank to the dean of Faculty of Silviculture and Forest Engineering, prof. Alexandru Lucian CURTU for his support and useful teachings. My research was carried out thanks to the Transilvania University of Brasov and the Escuela Superior Politécnica de Chimborazo, through its Rector PhD Byron VACA BARAHONA to whom I am thanking for unconditional support for my professional career and for achieving this objective; my gratitude goes, as well, to the staff of the Pastaza Experimental Station and to its administrator, Daniel FEIJOO. I recognize the support of my students from the Faculty of Sciences in the information gathering phase, and I would like to acknowledge their commitment in helping me in my personal and professional improvement. I thank to my beloved family: my parents Rogelio and Teresita, to my brothers Viviana, Cristian, Carito to my nephews Vivita, Roberto and Valentín and to my grandparents for being the inspiration for my life and for being those who gave me the fundamental support to always move forward. I thank to all those who have been part of my life and have contributed to my training, to my colleagues, and friends: Danny, Mauricio, Nicu, Ciprian, Marius, Diana, Gabi and Eliana who gave me their support at different stages of my life, and to Sandra Fabiola for sharing with me her optimism that helped me to face the challenges.

Thank you all for believing in me, I hope you feel proud today!

The Author

CONTENT

CUPRINS

LIST OF ABBREVIATIONS

AP – Apiarian

BV – Bequest Value

BOD – Biological Oxygen Demand.

C – Croplands

CICES – Common International Classification of Ecosystem Services

CVM – Contigent Valuation Method

DBH – Diameter at Breast Height

DUV – Direct Use Value

EF – Epiphytes

EN – Environmental

ES – Ecosystem services

EV – Existence Value

F* – Function

F – Ferns

FA – Food additive

FAO – Food and Agriculture Organization of the United Nations

FI – Food for invertebrades

FO – Food

FU – Fuel

FV – Food for vertebrades

FV* – Function and value

GIS – Geographical Information System

H – Herbs

HE – Hemi epiphytes

INEC – National Institute of Statistics and Censuses

IUV – Indirect Use Value

L – Lianas

MA* – Millenium Ecosystem Assessment

MA – Materials

MF – Managed forest. The term used to refer to it throughout this short version of the thesis was "secondary forest" to preserve its popular (local) denomination

ME – Medicine

OV – Option Value

P – Pasturelands

PES – Payments for Ecosystem Services

PS* – Pastaza Experimental Station

PS – Parasite shrubs

RP – Revealed Preference

SD – Standard deviation

SNAP – National System of Protected Areas

S*– Structure

S – Shrubs

SF – Structure and function

SFV – Structure, function and value

S-NEG – Shares of negative comments

S-NEU – Shares of neutral comments

SO – Social

SP – Stated Preference

S-POS – Shares of positive comments

SV – Structure and value

T – Trees

TEV – Total Economic Value

TO – Toxic

UF – Unmanaged Forest. The term used to refer to it throughout this short version of the thesis was "primary forest" to preserve its popular (local) denomination

UTM – Universal Transversal Mercator

V – Value

VEP – Visitor-employed photography

WTA – Willingness to accept

WTP – Willingness to pay

INTRODUCTION

Ecosystems ensure a flow of multiple benefits or services (ES) that are useful for mankind, which depends on their state and on a given social context. Assessment by steps such as the identification and evaluation of ES through stakeholders' perception allows assessing different options relating to flow and demand, so the valuation of ES is considered to be an important aspect of planning and management. The evaluation of ecosystem services is usually shaped around the following dimensions or perspectives: ecological, economic and social. Therefore, it allows to identify the main services and the components of ecosystems - or land uses - that provide them (ecological dimension), but it also analyzes the perception of the users or stakeholders (social dimension) and translates (transforms) these benefits in economic terms through application of different methods of economic valuation. The ecosystems and services they provide should be addressed based on the perceptions, necessities and interest of the users or beneficiaries, who perceive the existence and importance of the services differently as an effect of variations of their socio-economic context, familiarity with the ecosystem, belief and religion. Consequently, to ensure a continuous flow of ES, it is necessary to complement land use management systems with information gained through assessment of relevant ES (tangible and non-tangible) by the stakeholders. In this regard, the willingness to pay (WTP) is a reference value that users assign to environmental attributes and/or their improvements such as the conservation or restoration activities; within the environmental improvements, the activities of protection or conservation have a high importance because their implementation ensures a sustainable flow of ES.

In Ecuador, absence of studies related to evaluation of natural resources has prevented the identification of importance level of ecosystems and their services by the users which is a key information for decision-making (laws) and management (operational procedures and rules). As a consequence, the primary (native) forest has decreased in terms of coverage due to indiscriminate logging, change in land use and productive activities (ranching, mining, oil extraction and tourism). In the "Simón Bolívar" parish (Pastaza Province), which covers a representative area of the rainforest, some fragile ecosystems require the implementation of conservation and protection activities, because they provide important services for the local development. Nevertheless, most of the area of this parish is not included in a protection or conservation system, resulting in an acute lack of policies and public funds, a fact that limits a proper management and protection of the native forests and complementary resources. At the parish level, only some fragile ecosystems, environmental components and few ecosystem services have been identified, a situation that has caused serious deficiencies in the few programs of environmental management that are currently implemented, especially by an absence of conservation activities.

The core objectives of an evaluation of natural resources and their services are (i) to shape and implement sustainable land-use systems through the measure of profits that could be derived from the conservation, protection and/or restoration of ecosystems, (ii) to implement policies relating to territorial organization, conservation and sustainability, or even (iii) to establish payments for environmental services. Based on the above arguments, this work aimed to evaluate the capacity of the Ecuadorian Amazonian Rainforest to provide ecosystem services, by the means of evaluating the plant uses, capacity to provide products and services, as well as the perception on the existing landscape management systems in the view of local stakeholders. The obtained information is important in complementing the existing (limited) databases and statistics on the natural capital and ES, and it gives a point of reference for the establishment of policies and local programs to favor the conservation of forests. The core components of this research were the following: (i) identification of ES, (ii) analysis of local population perception on the flow of ES by regular approaches and by visual preferences and (iii) evaluation of commitment of locals to financially support conservation measures using state-of-art techniques.

CHAPTER 1. BACKGROUND ON ASSESSMENT OF ECOSYSTEM SERVICES AND THEIR RELATION TO LANDSCAPE MANAGEMENT SYSTEMS

1.1. Ecosystems. Definition and relation to human well being

In simple terms, an ecosystem stands for a biological community, its (physical) environment and interactions that relate them (Salomon, 2008), whereas these interactions are related with the flow of energy, mass and information (Armenteras et al., 2016; Barber 2018; Salomon, 2008). Ecosystems are important for human society because most of the services and functions that are derived from their structure, processes and functionality are prerequisites for human well-being (Bastian et al., 2012). There is a wide diversity of ecosystems around the world and, at the same time, the ecosystems can be classified according to their functional groups and physical context (Salomon, 2008). Among others, each ecosystem is characterized by its biodiversity, physical conditions and spatial distribution.

1.2. Ecosystem functions

The concept of "*nature function*" was used in the 60s - 70s period to describe "*the work done, space provided, and goods delivered to human society*" (Braat and de Groot, 2012). As such, functions describe the potential of ecosystem processes and their component elements to supply products and services (Agbenyega et al., 2009); it is to say "*ecosystem functions involve interactions between biotic and abiotic system components in achieving any and all ecosystem outcomes*" (Banerje et al., 2013).

Braat and de Groot (2012) have described the following categories of functions: *regulation* which is associated with ecological processes and life support systems (*e.g.* regulation of climate, water, soil, nutrients etc.), *habitat* which is associated with the provision of vital space for plants and animals, contribution to the conservation of genetic resources, species richness and biodiversity, *production* which stands for the ability to generate biomass and, with that, the production of goods like raw materials and *information* which is related to human welfare by interaction with some contexts.

While the regulation functions provide some ecosystem services, most of them are generated through production and information functions. Also, regulation and habitat functions provide inputs for production and information functions (Environmental Protection Agency, 2015).

1.3. Ecosystem services

In simple terms, the ES can be defined as "the benefits" that humans get from ecosystems. These benefits are either direct, indirect or both, arising from the ecosystems structure, processes or functions (Brown et al., 2014; Müller and Burkhard, 2012). As a consequence, the ecosystems are considered to be "*stocks of natural capital*" that provide flows of tangible and intangible benefits that contribute to the human welfare (Calvet et al., 2012).

An ES framework (*e.g.* Bruins et al., 2014) describes the relation between ecosystems, their structure and processes and the human welfare, a process that requires an assessment of services. According to this concept, the final ES are those which are directly valued by people, while the intermediate ES, including processes sustain the flow of final ES, but are not linked directly something valued by society (Sing et al., 2015).

The concept of ES connects people to nature, reflecting the importance of ecosystems for mankind (Grizzetti et al., 2016). The concept also stands for a renewed approach in the decision-making processes related to the conservational management (Castro et al., 2011). Therefore, identifying the mechanisms that govern ecosystem functioning should be a priority given that the ecosystems provide a diversity of services, products or both on which human society depends (Salomon, 2008).

The provisioning of ES depends on the biophysical environment and its temporal variations (Tsonkova et al., 2014). For instance, tropical forests are altered by deforestation, degradation, land use change etc. These factors modify the environment and the flow of ES and may produce unwanted outcomes for the welfare of people that depend heavily on the flow of ES like food, medicines, timber and other products and services (Delgado et al., 2017). Moreover, Sing et al. (2015) have pointed out that the flow of ES depends also on the human resources, at least in terms of knowledge, skills and experience, given the fact that many ES are the result of ecosystems functioning and other inputs such as the labor, transportation or processing.

1.4. Classification systems and categories of ecosystem services

The development of relatively many conceptualizations and classifications of ES has led to a high body of interpretations, terminology, definitions, applications and classes of ES (Haines-Young et al., 2012; Notte et al., 2017). Existing classifications of ES differ in the following aspects: structure and detail level, analysis objectives and definition, with this last difference being the most important (Environmental Protection Agency, 2015). Millennium Ecosystem Assessment (MA*) and the Common International Classification of Ecosystem Services (CICES) frameworks are recognized and generally used at global level, so they are shortly described below.

The Millennium Ecosystem Assessment classifies the ES based on functional groups and describes, for this purpose, the following categories of ES: provisioning, regulating, cultural and supporting services (Brown et al., 2014; Environmental Protection Agency, 2015; MA*, 2003). In this configuration, the first three categories are directly linked to the people and to the supporting services, while the supporting services are those required to maintain the rest of ES (Environmental Protection Agency, 2015).

Provisioning services stand for all the products obtained from ecosystems, under the assumption that they have a utility value for humans. MA* (2003) included in this group the following: food, fuel, genetic resources, biochemical and active compounds, ornamental resources, water etc., with the last product being connected to both, provisioning and regulating services. Provisioning services are commonly measured in terms of production - *i.e.* flow and stock of goods - where the flow indicates the biophysical production measured, most usually, in terms of mass of crop produced per hectare. However, this measurement system may not provide an accurate characterization of these services because ES flows might or might not be sustainable.

Regulating services stand for the benefits arising as the result of the processes regulation and they are understood to operate, typically, on spatio-temporal scales (McCarthy and Morling, 2014). MA* (2003) included in this group services related to the regulation of air quality, climate, water, erosion as well as the biological control, pollination etc. There are strong interactions between regulating services themselves, as well as from the services of this category and those from the other. For instance, soil quality may be affected by other services such as the cycling of nutrients, biomass production, climate etc. that are interconnected with its capacity to filter, transform or buffer. Water regulation is related to the regulating soil qualities and processes and contributes to other final ES such as the regulation of climate, sustenance of crops and other plants (Ashmore et al., 2011). In the attempt to measure the ES from this category, the "*level of production*" cannot be used because the flows depend on the ecosystems' regulation capability (Environmental Protection Agency, 2015).

Supporting services are referred as those needed to sustain the the production of other ES; their main characteristic is that their impacts on humans are indirect and act in a very long time. A good example is that of soil genesis and formation which humans do not use directly; changes in the dynamics of this service, however, would (indirectly) affect the people by impacting, for instance, the provisioning of food (MA*, 2003). Services from this category are often interrelated and they are sustained by many physico-chemical and biological interlinks (Campbell et al., 2011). Campbell et al. (2011) refer to and include in this category services encompassing ecological interactions and evolutionary processes (*e.g.* primary production, nutrient cycling, soil formation and water cycle). In case of supporting services, the normative scale for assessing and measuring their condition to human wellbeing is not always practical, since their link to human benefits is typically indirect (Environmental Protection Agency, 2015).

Cultural services are usually described as the flows of non-material values in the form of, for instance, knowledge or experiences that humans appreciate, consune or enjoy. In general, these services are described to have a less direct contribution to human wellfare compared to those from the previously described categories (Hernández et al., 2013; Plieninger et al., 2013). Nevertheless, there is a a connection between the nature and culture since ecosystems, beliefs, organizations, social norms, knowledge and behaviors converge; therefore, shifts in one component may result in shifts into others (Hirons et al., 2016). MA (2003) describes the following subcategories for these ES: cultural diversity (where the diversity of ecosystems may affect the dieversity of culture), spiritual and religious values (some of practices may be directly linked to different types of ecosystems, some of their features or even processes), knowledge (knowledge systems may be linked to diversity of ecosystems), education (ecosystems give a strong basis for formal and informal education), inspiration (ecosystems sustain the development of art, symbols, architecture and folklore), asestetics (by intrinsic beauty of may places), sense of place (as many people are feeling good within their ecosystem) cultural heritage, recreation and tourism.

Regarding to cultural ecosystem services, Plieninger et al. (2013) have indicated that "*the definitions of most cultural services categories are vague and, for many of them, it is difficult to establish significant relationships between ecosystem structures and functions and the satisfaction of human needs and wants*". While their concept is rather simple, standing for people that obtain mostly non-material benefits from their contact with environment, these benefits should be increasingly recognized in policy and practice. Nevertheless, cultural services are diverse and complex in nature, as an effect of social meanings, relationships and values, which underpin them (Scottish Environment Agency, 2015). Therefore, the perception of pelope in relation to them is more likely to be diverse as an effect of interindividuality and intercommunity compared to the perception on other services (Hirons et al., 2016; MA, 2003).

Cultural services make an important contribution to society and economy, especially through the economic benefits of services such as tourism and sports (Scottish Environment Agency, 2015). Even though cultural services contribute to the development of societies, with some exceptions (*e.g.* recreation activities and tourism), they are often disregarded in the ES assessments. Furthermore, their importance is typically different compared to other categories of ES, exhibiting therefore problems towards their evaluation (Plieninger et al., 2013). In this regard, Ridding et al. (2018) have pointed out that, even if the cultural ecosystem services are of a recognized importance for human wellbeing, their quantification is challenging and they are not often assessed. Such challenges emerge from various things, including the difficulty to measure and monitor them, as well as from the fact that perceptions on their value may differ as a function of the assessment scale (individuals and communities) and time (Chrzanowski and Buijse, 2017). Nevertheless, an integrative approach, that takes into consideration also the evaluation of these services, enables a comprehensive and holistic assessment of the values that ecosystems suply to the human welfare and balances the bias towards other categories of services which is known to affect the trade-offs related to the land systems of management (Plieninger et al., 2013).

The Scottish Environment Protection Agency (2015) describes the following principles as a reference or guideline to be used to guarantee that cultural services are appropriately assessed and considered in decision making:

i) *Do not ignore or forget them*: cultural services are essential to understand the benefits that people get from nature. As a consequence, they should be a key part of any ES evaluation approach;
ii) *Keep it simple and focused*: cultural services are complex and have a wide sub-classification, so to be practical, it is necessary to focus on the most significant cultural services;
iii) *Use available data*: national data could be employed to inform about other ES projects at the national, regional and community level. This data can be complemented by local data (opinions, surveys, community workshops etc.);
iv) *Involve stakeholders*: the assessment of cultural ES requires the participation of local communities, land managers, interest groups, local authorities or potential users of ES;
v) *Consider theyr spatial context and use/value*: ES are understood, mapped and valued if the final services are considered, but for some cultural services, it is possible to get a partial assessment

of their use or value. In this case, information about special qualities of the place that provides ecosystem services is also needed to complement the assessment;

vi) *Consider elements of the cultural heritage which are strongly related to the natural environment*: the consideration of cultural services should explore the linkages between nature, landscapes and cultural heritage.

The Common International Classification of Ecosystem Services (CICES) approach tries to relate ES with the existing classifications of products and services, so that ecosystems services can be better identified and quantified. CICES has proposed eight categories or divisions of ecosystem services (Environmental Protection Agency, 2015), out of which three were framed to describe the provisioning services, three were framed to described services of regulation and maintenance, and two were designed to describe cultural services. CICES classification targets the final outputs and seeks to identify the materials and properties provided by ecosystems that have a beneficial utility for people (Haines-Young at al., 2012).

1.5. Forest ecosystem services

Forest ecosystems supply valuable services to humanity and their ability or potential to provide ES is very much affected or in relation to their geographical context and to the type of used management system (Nguyen et al., 2018; Sing et al., 2015). Around the world, many forests are being degraded by various disturbances such as deforestation, fire, invasive pests etc. and their potential to provide services has been undervalued. It is, therefore, necessary to support forest management by the means of characterizing, assessing and valuing forest ES (Nguyen et al., 2018). This is even more so important as the forest ecosystems host high levels of biodiversity (Roces et al., 2018) as an external exhibition of many interlinked components, which makes biodiversity dependent on the general state of forests in terms of integrity, health and vitality; in addition, a decrease in forest biodiversity will generate losses in its sustainiability, including here its productivity (European Commission, 2018). Some studies have shown that biodiversity is interrelated with many ES, and for given ES, different levels or hierarchies of biodiversity may have different roles. For instance, some regulating and provisioning services are related to microorganisms, while some living components may play important roles in the flow of services from cultural category (McCarthy and Morling, 2014). A synthesis of the ES that forests can provide, by the MA* categories, as well as the flows of forest ES and indicators used to quantify them are included in **Appendix 01**. The indicators of ES, for instance, allow the quantification of different categories of ES (Brown et al., 2014).

Not all the ecosystem services can be provided by all the forest ecosystem types; however, it is considered that a given forest may provide multiple services that have value for people, while the value of these ES depends on the local forest features and especially on the lifestyle and perception of users (SCION, 2017). According to European Commission (2018), the current activities related to the analysis of forest ES encompass the following: assessment, including the geospatial component, of forest ES having as baselines the stocks and flows, assessment of provision dynamics of forest ES as an effect of forest dynamics and other external factors such as changes in climate, policy, management etc., economic valuation and environmental and economic accounting.

1.6. Identification of ecosystem services

The identification of ES is the first step required for their correct evaluation and quantification (Baral, 2014; Magnussen et al., 2014) and some authors pointed out that identifying the important ecosystem services is a rapid assessment process. Baral (2014) has proposed three steps to be undertaken for the identification of ES: (i) identification of the users (stakeholders), (ii) identification of the spatio-temporal scale and (iii) identification of the providers.

Magnussen et al. (2014) have suggested a pre-requisite step consisting of the "*definition of the site of interest and its current state*". According to this step, it is important to describe the physical environment as a base line, followed by the socio-political and economic context. Then, in the identification of ecosystem services, stakeholders' engagement and participation constitute a key feature, because stakeholders are the beneficiaries those who affect the flow of ES (Felipe et al., 2015). To this end, it makes a lot of sense to identify key stakeholders of representative groups, which are also called principal actors and who may be the local leaders or associations (Magnussen et al., 2014) because they are most likely to be involved and know the context of local resources and ES, and they are those who are involved in decision-making related to their management.

A general identification of ecosystems services involves the listing of ecosystem services that a natural source or environment may provide (Magnussen et al., 2014). Previous work has indicated that for the elaboration of ES list it is necessary to carry on a literature review (*e.g.* Dias Carrilho and de Almeida, 2018) and to use as a reference a recognized classification system (*e.g.* MA* system). Later, the list of ecosystem services should be proposed (showed) to stakeholders, so that they could rate the ecosystem services according to some established criteria (Affek and Kowalska, 2017; Zhang et al., 2017). As such, stakeholder participation is very important in the identification of ES and, for doing so, a list of ES, including the concepts behind them should be shown to them (Mc Carthy and Morling, 2014), and often it is useful, to engage in a dialogue about potential ES and their association with land uses, ecosystems or habitats.

1.7. Evaluation of ecosystem services

While concept of ES refers to the benefits that have value to people (Gee and Burkhard, 2010), their evaluation (or valuation) is "*the process of expressing a value for ecosystem goods or services*, *thereby providing the opportunity for scientific observation and measurement*" (Farber et al., 2002), therefore, it quantifies the contribution to human welfare. The quantification may encompass cost-benefit analyses, assignment of values to different indicators and, finally, it translates into policies and decisions (Coscieme and Stout, 2019).

There are many reasons for which evaluation of ES may be required. Among these are: (i) getting information on the scale of human activities in regard to ecosystems, (ii) ensuring sustainability by a correct allocation of resources between generations and (iii) efficiently allocating the resources to guarantee a sustainable social and ecological resilience (Coscieme and Stout, 2019). Value of ES is dependent on the institutional-allocative setting used to express the values (Nuss Girona and Castañer, 2015) and, typically, there is a plurality of important dimensions of values that are associated to ES. Castro et al. (2011) have described that these values encompass ecological, economic and socio-cultural dimensions (Castro et al., 2011). In contrast, authors like Hackbart et al. (2017) have mentioned that the ES valuation spans over five categories or domains: *economic valuation* that stands for the monetization of ES, *ecological valuation* which places value on ES based on their biophysical attributes and features, *socio-cultural valuation* which is based on the criteria and the perception of social and cultural groups, *ethical valuation* which introduces the "*moral and ethical sentiments*" in the valuation of ES and, finally, *mixed valuation* which describes a common value which came from the valuation of two or more domains.

In general, the researchers used an economic or ecological evaluation, or even a combination of them (Hackbart et al., 2017); recent scientific work, however, has suggested that perceptual and preference science can be used to identify and value ES (Cáceres et al., 2015). Social and economic evaluations reflect the importance of ecosystem services to people (Affek and Kowalska, 2017; Dias Carrilho and de Almeida, 2018) and both categories of values are important as the ES flow is typically placed at the boundary between interconnected properties or features such as the ecosystems capacity to supply (aspect related with productivity) and the society's requirements on the provision of given ES. Therefore, valuation seems to be a supply-demand problem in the framework of ES assessment (Affek and Kowalska, 2017).

Nowadays, evaluation and valuation are strongly linked to mapping of ecosystem services, which is dependent on availability of biophysical data, processes and models and requires land cover or use, environmental and socioeconomic information. The first input (land use) allows to aggregate statistics that quantify the demand and production of some ecosystem services (Maes et al., 2016). In relation to ES mapping, Fagerholm et al. (2012) have pointed out that a participatory mapping approach enables empowerment and capacity of stakeholders and also brings local knowledge as a valuable source in palnning and decision.

Nuss Girona and Castañer (2015) have mentioned that the value of ES is linked to the following aspects: (i) capacity and suitability, that are measurements of potential demand and value, (ii) individual activity which influences the demand and value, actual choices and informs the actual demand and (iii) individual roles in the social context. According to Brown et al. (2014), the evaluation and measurement of ES requires indicators which are basically "*information that efficiently communicates the characteristics and trends of ecosystem services, making it possible for policymakers to understand the condition, trends and rate of change in ecosystem services*". The demand of non-material services is difficult to quantify so, at global level, the efforts to value them, were given to tangible ones: esthetical and recreational (Small et al., 2017). Social media databases of photos were an alternative source of information in the attempt to quantify the preferences placed on landscapes and recreational activities, and this kind of information has been used to gain knowledge on the cultural use of ecosystems (Lee et al., 2019). Information extraction from the social media, often means the analysis of the content captured in photos, followed by an assessment of their relevance to the natural environment as well as of the environment's features that are of value for communities from an area (Richards and Tunçer, 2018).

In regard to the use of photos for evaluation of ES, Pan et al. (2014) have evaluated the relationships among travel motivations, image dimensions (145 photos) and quality of places. They found that the image dimensions such as the "*wealth of countryside*", "*flora and fauna*" and "*beaches*" were described as "*arousing*" and "*pleasant*", words that depict feelings associated to a place; at the same time, the cultural image dimensions were qualified as "*pleasant*". Heyman (2012) has analyzed the recreational quality and effects of the management systems in an urban forest by the means of visitor-employed photography (VEP), a technique that allows to evaluate visitors' perceptions. Photo content and participants' comments were analyzed with reference to aspects such as the understory density, dead wood and visible human impact. The main finding of this research was that photos of natural features were perceived as "*liked*", while those depicting human impact were perceived as "*disliked*". The author also pointed out that VEP method allows to evaluate perception on vegetation and its management under a quantitative approach while it could stand for a complementary approach in preference research.

In general, the factors that act as modyfiers on the preferences towards landscape are the familiarity and demographic characteristics. In what regards the familiarity, people are known to prefer environments that they find non-threatening, in other words those environments with which they are familiar due to their experience (Dearden, 1984). In addition, the presence of structural natural elements modifies the preferences, with those landscapes that consist of native forests associated with water resources being the most appreciated by users (Muñoz Pedreros, 2004). For example, Hami and Tarashkar (2018) have evaluated women's perceptions towards plant familiarity through a visual questionnaire that contained native, semi-native and non-native species, and the results indicated that familiarity is related to preferences. Concerning demographic characteristics and their influence on visual preferences, Wang and Zhao (2017) determined that education level and gender influences significantly the preferences. Furthermore, the study realized by Hami and Tarashkar (2018) has shown that there are significant differences in relation to familiarity and preference coming as an effect of some factors such as the income level, education level and age group.

To understand non-material ES and their values requires the investigation of relations that exist among places, people (culture and principal characteristics), and their values derived at organization levels, hence the valuation of non-material services has progressed slower compared to the rest of ES (Small et al., 2017). Cultural ES are typically evaluated through social-cultural valuation techniques (Plieninger et al., 2015). Daniel et al. (2012) have stated that "*All cultural services strongly depend on perceptions and expectations of the respective stakeholders, and considerable conceptual and technical work may be needed to represent and model the complex socio-ecological relationships that define and constrain a given cultural ecosystem service adequately*". In the same time, Van Berkel and Verburg (2014) have pointed out that "*the normative nature of cultural services and the heterogeneity in valuation of societal actors has made their quantification more difficult*", so the majority of valuations of cultural services have been limited to those of tourism and recreation, leaving out important values and relations.

Socio-cultural values of ES reflect the importance that people, assign to ES while the assigned value characterizes the central role of ecosystems in human well-being (Scholte et al., 2015). Different people can recognize different potential services depending on their points of view. In this regard, the perceptions are shaped by social constructs in relation to the landscape, cultural identities, tradition and experiences related with nature and its services (Affek and Kowalska, 2017). Many studies in the field pointed out that social and demographic context described by variables such as gender, education level (Affek and Kowalska, 2017; Pettinotti et al., 2018), age (Allendorf and Yang, 2013) and even the marital status (Hami and Tarashkar, 2018) act as perception modifiers.

There are many reasons to include social and cultural values in landscape management and planning because they help to identify solutions, to set targets and to account for improvements and for progress in reaching the targets (Schmidt et al., 2017). Walz et al. (2016) compared and analyzed four scientific articles dealing with social valuation methods and having as a scope mountainous landscapes and found a significant perception and appreciation of these landcapes' quality to provide vital space for wildlife as well as their regulation quality; their approach provide important information for natural resource management because they allow to account for the social value of ES, to explore the perception and knowledge, and to identify priorities between stakeholders.

Felipe et al. (2015) have proposed a social evaluation framework consisting of several steps. In their view, the first step towards evaluation of ES is that of delimiting the spatial and temporal boundaries. However, it is enough to limit the timeframe and areas that bring influence by biophysical and sociological dimensions (Felipe et al., 2015). The second step consist of an identification of the social context (Felipe et al., 2015), and it is to say, the selection and the involvement of relevant stakeholders (Brander et al., 2010) whose opinions can be collected from an individual, a sample from the community or from the entire population. Then, the opinions can be grouped and analyzed basd on social and cultural features and criteria (Felipe et al., 2015) which act as known factors that modify the perception about ES (Affek and Kowalska, 2017; Allendorf and Yang, 2013). As the social factors shape values and perceptions, it is reasonable to believe and state that the assigned values are the result of a social process (Scholte et al., 2015). The last step is the selection of researching approach that can be used, a selection that depends on the study's scope (Felipe et al., 2015). Some techniques or methods that are used is such research are observation, documentation, expertise, interviews, focus groups and questionnaires (Schimdt et al., 2017).

For such attempts, the methodology proposed by Castro et al. (2011) includes (i) individual face-to-face surveys as a sampling strategy, (ii) clustering techniques for identification and characterization of stakeholders, (iii) exploration of perceptions by ranking to evaluate the preferences and (iv) the use of inferential statistics to analyze the data. For socio-cultural valuation, questionnaires and interview-based methods proved to be appropriate to collect information and to elicit social values because they consider two principal aspects: (i) the sample and (ii) gaining information by tailored questions. As such, they are used get information on the main ES, to rank and to value them based on individual perspectives (Walz et al., 2016).

1.8. Valuation of ecosystem services

Lately, the valuation of ES made the scope of many scientific and practice studies. Starting from the 90s, the number of published studies on valuation of ES has increased, and new theories have been developed (Zhang et al., 2017). For instance, economic valuation established a common monetary metric for some ES and provided a support for the analysis of costs and benefits, as well as for the decision-making (Sing et al., 2015). As such, it has been used as a tool to sustain conservation and to address environmental degradation (Castro et al., 2011). On the other hand, values of ES, expressed in money, can generate some issues when confused with prices (Coscieme and Stout, 2019). To this end, the price is defined to be an outcome of the supply and demand of goods while the value represents the level of satisfaction or contribution to the human welfare. For example, cultural ES have their own values, and they can help in mobilizing the public support for the protection of ecosystems (Daniel et al., 2012). Also, measures of economic value describe the difference that something makes to the satisfaction of human preferences (McCarthy and Morling, 2014). Therefore, estimating an economic value for a natural resource requires the understanding of ES and their contribution to the wellbeing of beneficiaries (Stegarescu, 2014). When valuing cultural ecosystem services, a typical challenge is that of finding a consistent way to define, measure and assign subjective values (Schnegg et al., 2014).

Given the importance of economic valuation of ES in management and planning, scientists have developed valuation methods and, in particular, they have been used preference assessment methods, which can address both, intangible and tangible ES (Barrena et al., 2014; Daly-Hassen, 2016); in this case, the value of ES may reflect the society willing to contribute by payments (WTP) to sustain the flow of these services (Barrena et al., 2014) and payments for ES (PES) are seen as voluntary transactions, in which an ES or a land use that provides it is bought by at least one buyer (Hirsch et al., 2012; Viszlai et al., 2016). Given the above, Viszlai et al. (2016) have mentioned that PES are based on "*user principles*", such as the user of an ES pays for it. Obeng et al. (2018) have pointed out that a limitation of PES mechanism is that it needs to account for certain payment levels. Also, the mentioned authors emphasized that "*some beneficiaries might be willing to pay for some ES and altruistically expect others to free-ride on their payment*". Therefore, the object of economical valuation is not the environment itself, but rather the people preferences towards a given environment or its state (Ogeh et al., 2016). In this sense, the economic value is linked to two aspects: "*Willingness to pay - WTP*" to support a positive change in the environment (improvement or conservation), and "*Willingness to accept - WTA*" for a negative change such as, for example, accepting to dispense with the ecosystem service or its improvement (Daly-Hassen, 2016; Vásquez, 2015). Nevertheless, it is recommended to inquire about WTP and not WTA because the first approach provides moderate values (Vásquez, 2015).

Many studies that used the stated preference methods revealed that demographic characteristics and people attitudes influence their preferences (Huenchuleo and de Kartzow, 2018). For instance, Nicosia et al. (2014) have evaluated the WTP for ES restoration, finding a monthly WTP of $ 11.06 per household which was inversely related to age. In regard to gender, women exhibited a higher WTP than men. Addrssing forest conservation, Yoshada and Chinnappa (2012) have estimated the WTP based on the input provided by general recreationists that visited Basavana Betta State Forest (India) obtaining a mean WTP value of $ 17.63 per visitor, as onetime payment. At the same time, they have evaluated the WTP of resort visitors; it was of $ 49.31 per individual. Their results indicated a positive relation between the level of income and WTP. Solano (2017) has conducted a study aiming to value the cultural ecosystem services (recreation and beauty scene) of "Guayacán" dry forest (Ecuador); the results indicated that 93% of the respondents were committed to contribute by payment for the conservation of forests and to ensure the provision of ES, with a WTP value of $4.18 per visitor per year. The variables that affected the variation of WTP were the income level, travel expenses and marital status.

Another approach consists of the methodology proposed by Lorca et al. (2015) - Total Economic Valuation (TEV) - which is implemented in 3 phases, each of them framed around several steps: (i) socioeconomical and environmental diagnosis as a base line, (ii) identification of ecosystem services, stakeholders and impacts and (iii) prioritization of ecosystem services in Phase I, (iv) selection of ecosystem services for valuation and (v) selection of economic methods and techniques in Phase II, and (vi) estimation of TEV in Phase III, respectively.

Method selection depends on the study's complexity, amount of information (data), availability of time and other resources (Tomasini, 2015) as well as on the context (Saša, 2014). Economic valuation groups of methods that are predominantly used are the revealed (RP) and stated preference (SP) (Daly-Hassen, 2016; Douglas and James, 2014; World Bank Group, 2016). RP approach considers the behavior of people (users of ES), and one of their disadvantages is that they are limited to the actual market behavior of users, therefore they can address a limited range of ES. SP, on the other hand, can be used for the full range of ES because such methods take into account users' behavior relative to conceptual markets and states related to them (Daly-Hassen, 2016; World Bank Group, 2016).

Methods employed to value ES vary depending on the nature of ES (Tolunay and Başsüllü, 2015). The Contingent Valuation Method (CVM) aims at finding the maximum commitment of users to pay and reflects, indirectly, values placed on the resources (Zhang et al., 2012); accordingly, potential changes in social welfare can be evaluated using public preferences (Daly-Hassen, 2016; Tolunay and Başsüllü, 2015).

Brender et al. (2010) have defined the Total Economic Value (TEV) as *"the sum of the values of all service flows that natural capital generates both now and, in the future"*. TEV covers all the components of utilitiy and disutility derived from ES standing for a tool that provides estimation of ES in relation to their contributions to human welfare (Zhang et al., 2017). As such, TEV framework allows to estimate the "use" (UV) and "non-use" (NUV) values (Haines Young and Potschin, 2009; Zhang et al., 2017). UV are classified in "direct" (DUV), "indirect" (IUV) and "option values" (OV), and the NOV are divided in "existence value" (EV) and "bequest value" (BV) (Pak et al., 2010), so the TEV is the sum of DUV, IUV, OV, EV and BV. The UV refers to the benefits that users obtain (directly or indirectly) from the ecosystems (Dlamini, 2012). DUV are those of using a natural resource where consumptive and non-consumptive uses belong to this sub-group; IUV are the values indirectly obtained from the environment such as the soil conservation or flood prevention, while the concept of OV relates to the preservation of natural resources (Pak et al., 2010). The NOV are those obtained from the existance of natural resources without the need to actually enjoy them personally (Rupérez et al., 2015). Also, NOV can be derived from the idea that an ES will also be available to others (bequest value) (McCarthy and Morling, 2014). In the forestry sector, TEV reflects the monetary value of all benefits derived from forests. In other words, it stays within the multi-functionality provided by forests (Sing et al., 2015; Zhang and Stenger, 2015). In the subcategories of UV, DUV covers the benefits arising from the direct use of the forest, which can be associated to both, extractive and non-extractive activities; IUV refers to ES provided by forests of an indirect use (*e.g.* carbon sequestration, habitat provision), while OV is the value that may be placed on preserving forests for future use or enjoyment (World Bank Group, 2016). NUV of a forest refer to those benefits that are intangible, come from the existence of forests and are beyond the current possibilityes of use (Ayenew, 2015), therefore they are potential thought inexistent values for the moment being. Concerning subcategories of NUV, the EV is placed on a natural (forest) resource even if it will never be used by people but for them it is important to know that it sill continue to exist (Pak et al., 2010). BV stands for those peceial cases in which at least one individual is willing and able to pay to maintain a forest for future generations (Dlamini, 2012). As a reference, **Appendix 01** gives examples of features that shape the TEV of a forest ecosystem.

1.9. Classification of ecosystems in Ecuador

Ecuador is characterized by many areas with a huge potential of biodiversity (hot spots) and, for this reason, it is considered as a country with a high priority for conservation. The ecosystems in continental Ecuador were classified based on several factors (**Appendix 02**) and were distributed in some groups of bio-geographical classification (Ecuadorian Ministry of Environment, 2013a).

There are 91 identified ecosystems, of which 65 correspond to forest, 14 to grassland and 12 to shrubland (Ecuadorian Ministry of Environment, 2015). The codes for ecosystems consist of six characters, out of which four are letters that indicate their most relevant characteristics and the last two characters are numbers that reflect the order in which the ecosystems were separated and described (Ecuadorian Ministry of Environment, 2013a). Coastal region of Ecuador holds 24 ecosystems (**Appendix 02**) and two identified bio-geographical provinces: "*Chocó"* (humid climate) and the *Equatorial Pacific* (dry). *Chocó* province encompasses two sectors: Equatorial *"Chocó"* and *"Chocó"* coastal mountain range, while Equatorial Pacific sectors are: *"Jama Zapotillo"* and *Equatorial Pacific* coastal mountain range (Ecuadorian Ministry of Environment, 2013a). Andean region has 45 ecosystems (**Appendix 02**), and a bio-geographical province that is called Northern Andes, which consists of 6 identified sectors: Western mountain range, "Catamayo - Alamor", north of eastern mountain range, South of Eastern mountain range, Highlands and Valleys (Ecuadorian Ministry of Environment, 2013a). Ecuadorian Amazon region hosts 22 ecosystems (**Appendix 02**) and a bio-geographical province - Northwestern Amazonia - that consists of 5 sectors: "*Aguarico - Putumayo - Caquetá", "Napo - Curaray", "Tigre - Pastaza", "Pastaza" and Amazon mountain range* (Ecuadorian Ministry of Environment, 2013a).

Bravo (2014) has pointed out that the huge biodiversity of Ecuador is sustained by the species and ecosystems' richness. This level of biodiversity is sustained by Andes Mountain, interandean alley, sea current and volcanic activity.

1.10. Forest ecosystems in Ecuador

Ecuador hosts 65 native forests that cover 12,631,198 ha (Ponce, 2017). Of this area, only 6,444,850 ha are the subject of conservation and management programs (Ponce, 2017). Typically, the native forests are those exhibited by landscapes such as those from the Amazon Region, the foothills of Andean mountains and the humid and dry zones of Coastal Region (Zúñiga, 2007).

The Amazon Region encompasses about 9.5 million ha of natural forests, a figure which stands for approximately 75% of the total forested area of Ecuador (Bonilla et al., 2018). Forests located in the Amazon Region stand out for their high biodiversity and complexity. In the "Yasuní" National Park, for instance, one can find up to 300 species of trees per hectare, while in the "Cuyabeno" Reserve of Fauna Production a total number of 307 species of trees were reported per hectare (Dezzeo, 2017). Broken on the regions of Ecuador, the vast majority of forest related biomass (80%) is found in the Amazon region, 13% is in the Coastal region and the remaining of 7% in the Highland Region (REDD Community, 2019). Even though Ecuadorian Amazon is highly biodiverse, it is the subject of a high rate of fores loss (Bonilla et al., 2018; Dezzeo, 2017). In Ecuador, the rate of deforestation in the period 2008-2014 was of 0.37%, which is the equivalent to 47,497 deforested hectares per year (Ecuadorian Ministry of Environment, 2015).

Ríos's database (Ríos et al., 2007; Dezzeo, 2017) indicates that there are around 651 native plant species in the Amazon region that are useful for people; these correspond to 115 families and 67 genera. On the other hand, De la Torre's research (De la Torre, 2008; Dezzeo, 2017) pointed out that there are 2270 native species that have certain uses and they correspond to 141 families and 764 genera (Dezzeo, 2017). In both databases, the families with the greatest species richness are the *Leguminosae (Fabaceae), Rubiaceae, Melastomataceae, Araceae, Arecaceae* and *Solanaceae* (Dezzeo, 2017). The "Red Book" of Ecuadorian endemic plants (Valencia, 2018) points out that many tree species have been described in the last 20 years, as well as the fact that there are still many unknown species. For example, in the Yasuní National Park, on a plot of 25 hectares have been found around 25 new species and a new genus in 15 years of taxonomic research (Valencia, 2018).

Pastaza province spreads across 19,859.97 km^2 and it is covered mainly by primary forest (around 90%) (Decentralized Autonomous Government of Sarayaku, 2015). According to Gavilanes et al. (2018), there are 540 identified plants that have certain uses in this province, most of them being native (507) and 12 of them being included in the endemic group.

1.11. Ecosystem services in Pastaza province, "Simón Bolivar" parish

"Simón Bolivar" parish hosts 7 of 91 ecosystems of Continental Ecuador (CDTER, 2015). The main ES supplied by them are, synthetically given in the full text thesis. Piedmountainous evergreen forest in the north of Andes eastern mountain range covers around 53.13% of the total area of the parish, so it is important for the flow of ES, as well as for the reduction of the poverty (CDTER, 2015).

1.12. Problem identification and definition

Ecuador is one of the countries affected by the greatest loss of primary forests (Bonilla et al., 2018). According to Sierra (2013), between 1990 and 2008 approximately 19,000 km^2 of natural forests were destroyed and the forest cover decreased from 69.6% in 1900 to 60.7% in 2008. Changes of land use in Ecuador were mainly the effect of changes in demographics, law and export economy (Koning et al., 1999). Accordingly, Ecuadorian Amazon was the subject of most of deforestation due to changes in land use (Bilsborrow et al., 2004). Discovery of oil in the area during the 1960s has led to the development of communication and transportation infrastructure which, in turn, accelerated the migration of people in this area (Tapia et al., 2015). Even though, the discover of oil was the first cause of forest lost, the agricultural colonization that followed this event is considered as the principal cause of deforestation in the area (Bilsborrow et al., 2004; Tapia et al., 2015). The national policy developed in the mid-20th century with “The First Agrarian Reform” (1964) and subsequent laws (1973-1979: Second Law Reform) led to a rapid population growth in areas close to oil facilities and roads (Andrade, 2004; Tapia et al., 2015; Wasserstrom and Southgate, 2013). Furthermore, population and urbanization development (especially in the 1990s) has generated new migration patterns in the Amazon region, as well as changes in the way of living (Bilsborrow et al., 2004). Between 1965 and 2000, the rate of deforestation in Pastaza province was 7.7% corresponding to 222,800 ha (Wasserstrom and Southgate, 2013). In this province, tropical forest has been replaced by crops of cocoa, naranjilla, bananas and even timber species (*e.g.* teak - *Tectona grandis*).

Deforestation, on the other hand, contributes to change of climate and affects the provision of ES, so it can cause social conflicts (migration of native people and loss of life quality), loss of biodiversity (flora and fauna) (Lindsey and Simmon, 2007), soil erosion, changes in water cycle (Bradford, 2018) etc. Forest state and deforestation rate, on the other hand, depend largely on local people (especially farmers and ranchers), big corporations and the government (Tsakimp, 2013). As an effect, Ecuador made the reduction of deforestation a national priority, and to achieve such a goal, the Socio Bosque Program (SBP) was launched as an incentive tool in 2008 to help conserving natural forests (REDD Community, 2019). As such, the “Socio Bosque” Program is framed on the economic value that conserved or protected forest would generate to society and economy (Ecuadorian Ministry of Environment, 2013b).

There are few studies targeting an evaluation and mapping of ecosystem services in South America and, especially in Ecuador; the few studies that exist for such purposes addressed only some hotspots located in the Amazon and in the highlands. The environmental laws and the “Socio Bosque program”, on the other hand, were designed and implemented with the aim to sustain the native forests, even though these objectives have not been achieved due to the lack of involvement of the stakeholders. Therefore, the local governments should manage the land based also on the opinion of local inhabitants and the suggestions of experts, a fact that, for now, is only written on the management documents and not operationalized. Nevertheless, to enable its operationalization, the ecosystems and the services they are providing at local level should be assessed based on the interests and necessities of their beneficiaries.

Meanwhile, the lack of an objective valuation of forest resources and their flow of ES may be one of the main drivers of deforestation in the Ecuadorian Amazon. In addition, an approach able to produce results and programs based also on the preferences of population towards the state of the forest resource or its use is still lacking in the area, preventing an objective development of policies for forest management and use. Based on the fact that the valuation of ES provided by forests is an important tool in environmental management because it allows to identify the local, national and global benefits derived from the conservation, as well as the fact that, policies for management, valuation and conservation of forests are still needed in the area, the scope of this research was to try to build such data and statistics to support policy and decision-making since these are the main problems for a sustainable forest management in the area.

CHAPTER 2. AIM AND OBJECTIVES

2.1. Research Aim

Due to the absence of studies about valuation of forest ES in the Pastaza province, and by considering the degradation of its forested area, the general research aim of this work was to evaluate the potential of the Ecuadorian Amazonian rainforest to provide ES. In this view and based on context described in the previous chapter, the concept of "*evaluation*" has been understood, in this work, as the approaches undertaken and their related results and interpretation to evaluate the the presence and perception towards the importance and value of the ES provided by natural forests in the area, as well as, the perception on the landscape management systems in the view of local stakeholders. The general approach was that of integrating this kind of forest in the general landscape that contained other types of land uses, an approach that was complemented by a documentation of the species present as well as of their uses in the area.

2.2. Research Objectives

The specific objectives which were approached as methodological steps to get results and to achieve the goal of this work were the following:

i) To identify the ES in relation to main land use types in the "Simón Bolívar" parish;

ii) To identify the local users of the ES provided in the area;

iii) To evaluate the ES supplied by forests in the area based on the perception of beneficiaries towards the potential of ecosystems to provide services in given categories;

iv) To evaluate and analyze the landscapes' values by the means of visual preferences of the population in relation to the primary forest, secondary forest, croplands and pasturelands;

v) To evaluate the commitment of locals to engage in voluntary payments for conservation of local resources by the means of Contingent Valuation Method, based on a scenario according to which the conservation and the continued flow of forest ES will be enabled.

CHAPTER 3. MATERIALS AND METHODS

3.1. Area of study

3.1.1. Geographic location and geo-physical description

Excepting the identification of predominant land uses, the selection of the study sample, application of the surveys (in the field), spatial scaling and the classification of plants' uses, this research was carried out in the area of the Pastaza Experimental Station (hereafter, PS) which is located in the "Simón Bolívar" parish, Pastaza province, eastern Ecuador (**Figure 1**). For the first four steps that were mentioned at the beginning of this paragraph, the study area corresponded to the "Simón Bolívar" parish, which was considered to be the social area of direct influence on the forest; this choice had to be made due to the fact that in the area of PS there were not enough people to be considered as a representative population. Nevertheless, the settlers from the area of PS were used as a main source of information in what regards the ES provided by the natural forest. For any other steps described in this work, the area of study was the Pastaza province. The reasons for this selection are detailed in subchapter 3.2.

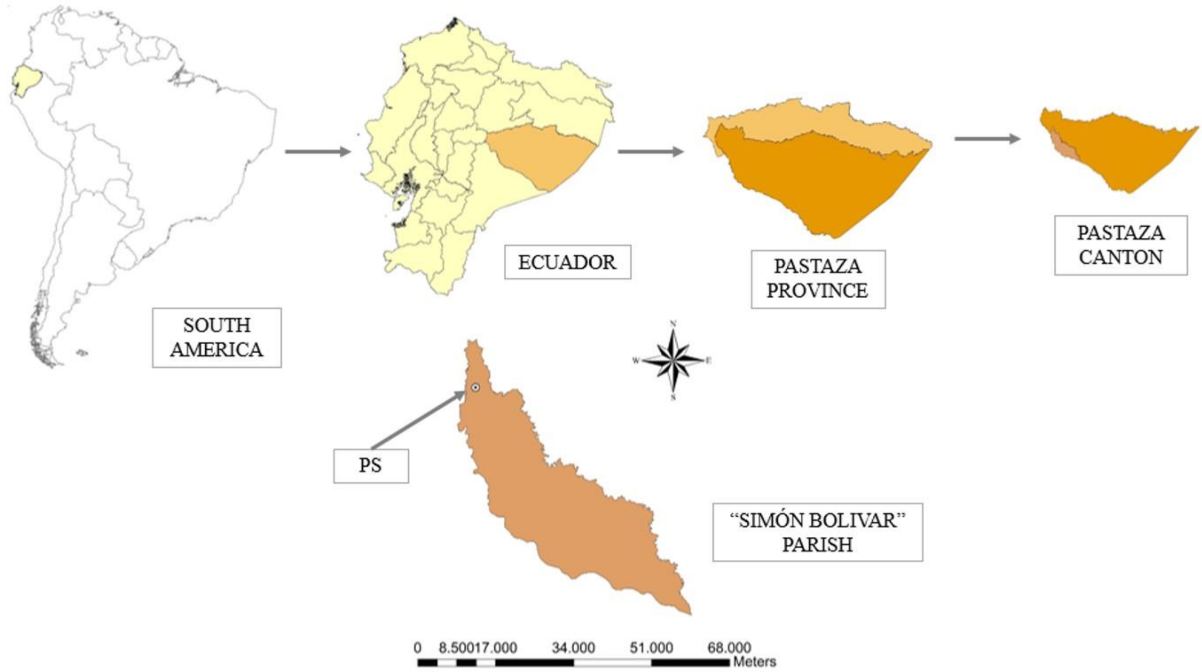

Figure 1. *Location of Pastaza Province in Ecuador and South America*
Source: *developed in ArcGis 10.3 based on Management Plan (2015-2019)*
Legend: *The dot that is inside "Simón Bolívar" parish corresponds to the position of Pastaza Experimental Station.*

Pastaza Experimental Station is located in the "Simón Bolívar" parish - Pastaza Province at 1,090 meters above the sea level (Suárez et al., 1997) being pinpointed by the coordinates 1° 43' 7.644'' S and 77° 50' 42.216'' W (according to UTM WGS 84, 17S). Its total area is of 220 ha, out of which 40% corresponds to natural forest (hereafter, primary forest), 30% is managed forest (hereafter, secondary forest), 1% corresponds to infrastructure and the remaining area is pastureland (Suárez et al., 1997). In the primary forest category is included the area classified as "evergreen forest of lowlands" (Caranqui and Romero, 2011). The choice of this area for study was based on a specific distribution, where the primary forest stands for 90% of Pastaza province and for 84.31% relative to the total area of "Simón Bolívar" parish (CDTER, 2015).

According to the Food and Agriculture Organization of the United Nations (FAO, 2015), and as shown in **Figure 2**, the primary forest is characterized by a high species richness and a development without any significant presence of human activities in the period dating back to 60 to 80 years ago. Due to the stable ecological interactions, this kind of forests reached a balance between gross production and respiration, being also characterized by a high amount of biomass in relation to the flow of energy and, in addition, by a high biodiversity (Pastaza Rainforest Foundation of Ecuador, 2019). On the other hand, the secondary forest (**Figure 3**) is distinct compared to primary forest in features such as the diversity of species, density, height and diameter, with the latter being much lower. In addition, the presence of epiphytes is lower compared to primary forests. The disturbances that occur due to natural or anthropic causes are significant in this kind of forest and affect the height of the understory vegetation. In such forests predominate shrubs that exceed 0.5 m but do not reach 5 m at maturity (Department of "Montes", 2004).

Figure 2. *A depiction of primary forest from the study area*

Figure 3. *A depiction of secondary forest from the study area*

According to the Management Plan of the "Simón Bolívar" parish (CDTER, 2015) and to the Classification System of Continental Ecuador Ecosystems (Ecuadorian Ministry of Environment, 2013), the main ecosystems identified in the study area are those given in **Table 1.**

Table 1. *Description of the main ecosystems in the study area. Source: Myster (2018), Ecuadorian Ministry of Environment (2013), Mogollón and Guevara (2004), Nebel et al., (2001), Palacios et al., (1999), Balslev et al., (1987)*

Ecosystem	Proportion	Description
Evergreen piedmontainous forest of the Northern Oriental Mountain Range from the Andes	53.13%	The trees' height is between 35 and 40 m. The diversity of trees is among the highest in the world and species *Iriartea deltoidea* (Arecaceae) is the most important in the composition of the forests of the high Amazon. The dominant families of trees are *Myristicaceae*, *Fabaceae*, *Meliaceae*, *Euphorbiaceae*, *Rubiaceae*, *Moraceae*, *Vochysiaceae* and *Melastomataceae* (Mogollón and Guevara, 2004).
Evergreen lowland forest of the "Tigre-Pastaza"	28.56%	It is developed on a series of geoforms that include terraces and slopes of the hills.
Floodplain forest of the alluvial plain of the rivers of Andean origin and of the Amazonian Mountain Ranges	15.72%	They are sets of plant communities settled on the floodplains of rivers having an Andean origin. Their structure varies from semi-open to dense, and the tree height oscillates between medium and high. Their diversity is low compared to their counterparts on the mainland. They present variations in the density or abundance of species per hectare, which is typically between 400-600 individuals per hectare (Balslev et al., 1987; Nebel et al., 2001).
Floodplain forest with palms from the alluvial plain of the Amazon	0.57%	Composed of species that developed structures to tolerate water saturation. The presence of hydrophilic plants is a characteristic aspect of this ecosystem which is composed of palms, few trees, rare vines and few epiphytes.
Flooded forest of the alluvial plain of rivers of Amazonian origin	0.42%	Characterized by a low to medium density, located along the floodplain of rivers having an Amazonian origin, such as "Tiputini". Biodiversity is higher than in the flooded areas of Andean rivers, due to the interposition of some species from the adjacent forests of the mainland. As a result of the high content of sediments as well as fulvic and humic acids, the color of the rivers' water is black (Myster, 2018).

Note: Water bodies (1.60%) not included.

The topography of PS is rather irregular, with approximately 80% of the total area having slopes in between 15 to 20% (Caranqui and Romero, 2011). In addition, the area is characterized by a subtropical climate (Suárez et al., 1997), so its relative humidity is very high (around 85%), the monthly mean temperature of the air is 20.62°C and the annual precipitation is of approximately 34,333 mm (Caranqui and Romero, 2011). In the "Simón Bolívar" parish, the monthly temperature varies between 18 and 27°C and precipitation exceeds 4,500 mm (CDTER, 2015).

3.1.2. Identification of types of land use and activities in the study area

The types and systems of land use in the area were defined and evaluated through the analysis of data that was obtained from the Ecuadorian National System of Information (sni.gob.ec). The area for each land use type and its respective share were determined by the use of ArcGIS 10.3 software (ESRI 1995 - 2014, New York, USA). The geographic data was projected in the WGS-1984 coordinate system and the zone specific to Ecuador (17S); the files containing the geometry of the parish and the land use classes (in *.shp* format) were uploaded into the program that was further used to configure the color ramp for the categories of land use, while the information about their area was extracted from the attribute table. Finally, the coverage percentage per land use types was determined by using the area of each category and the total area of the parish.

Field observations are useful to identify key economic activities of local people (Quyen et al., 2017). However, in this research the activities of the economically active population (**Table 2**) were obtained from the Management Plan (2015-2019) of "Simón Bolívar" parish (CDTER, 2015), because it is a primary bibliographic source whose content was structured through the information obtained in focus groups and interviews carried out with the settlers.

Table 2. *Economic activities and the associated population in "Simón Bolívar" parish. Source: CDTER (2015)*

Activity	Population
Agriculture, livestock farming, silviculture and fishing	1152
Education	142
Not defined	103
Manufacturing industries	67
Construction	54
Public administration and defence	39
Commerce	33
Activities of households	31
Health care field	23
Other activities or services	18
Transport	14
Service of accommodation	12
Administrative services	8
Professional, scientific and educational activities	4
Information and communication	3
Supplying of electricity and gas	3
Arts, entertainment and recreation	2
Distribution of water and sewerage systems	1

The changes in land cover depend directly on the human activities (economic framework: activity, inputs and outputs) (Shi et al., 2018). For that reason, and based on the activities described in **Table 2**, the future trends about changes in land uses were analyzed in the studied area.

3.2. Classification of plant uses in the study area

Continental Ecuador encompasses eight biogeographic regions (Armenteras et al., 2016). The Amazon biogeographic region comprises a biogeographic province (Northwestern Amazonia) that consists of 5 sectors (Ecuadorian Ministry of Environment, 2013), with Pastaza being one of them. PS and "Simón Bolívar" parish are located into the Pastaza biogeographic sector. Given that there is not enough information about the local species and both, PS and "Simón Bolívar" parish exhibit a similar vegetation to that of Pastaza province, the plants were identified and classified according to their use at provincial level. In this regard, a total number of 540 plants and their associated uses were identified based on a literature review. A detailed description of the consulted resources is given in the full thesis. The used sources were added in the bibliography of this document.

To identify and classify new plants and their uses, a preliminary database was developed to include the scientific and common names of plant species as well as their habit and origin (native, introduced or endemic). With reference to the habit attribute, the plants were classified in 8 categories that were mentioned in the studies of De la Torre et al. (2008) and Ríos et al. (2007) and which included parasite shrubs - PS, epiphytes - EF, ferns - F, hemi epiphytes - HE, lianas - L, herbs - H, shrubs - S and trees - T. Then, to gain knowledge about the uses of these plants, the database was designed to include 11 potential uses, which are described in detail in the full thesis. Following the detailed documentation of plant utilization, a list of plants' common names and their documented uses was brought in the field to identify new potential uses of the plants using as a basis the experience and traditional customs of the local indigenous people. To this end, five well-experienced local people were chosen as experts to support the identification of new plant uses after a short briefing to get their informed consent to participate. Two of them were selected from the indigenous communities and three were selected from the local government. All of them belong to the "Shuar" ethnic group, which is the dominant ethnic group with the greatest presence in the area, and all of them had a deep knowledge on the utilization of plants and local forests. The selected people were asked to take a look on the plant list and to check their documented uses. Then, for each plant contained in the list they were asked to indicate whether they know other uses in addition to those described. When they had difficulties to identify a plant based solely on its common name, high-quality pictures were shown to help them in the process of identification. Based on their responses, the database was updated with new plant uses which were attributed to the previously described categories by checking a specially designed field in the database.

Following the above-mentioned steps, the database was used to compute the descriptive statistics of plant uses per categories, number and the proportion of uses per category of utilization as well as to differentiate between plant categories and uses categories to be able to see which uses were the most common and what plants belonged to these uses. Statistical analysis, including the normality check when the case, was carried out in Microsoft Excel (Microsoft Office 2013) fitted with Real Statistics ® (Release 6.2) freeware add-in program. Then, depending on the data type, the data was described by the commonly used descriptive statistics or as absolute and relative values.

Worth mentioning that from the perspective of the economic valuation of ES, 9 of the proposed categories of use are linked to the direct use value (consumptive uses and non consumptive use) while the rest of them (2) belong to indirect use value. For many goods or services that have a direct use value, there are well-structured markets (established prices), whereas for few of them there is not a market or, if it exists, it is in an emergent state (Álvarez and Ríos, 2009; Pak, et al., 2010). For instance, there are structured markets for timber products, food of vegetable origin, and some plants that are used as medicines, although for plants that have toxic purposes, such markets do not exist. Therefore, it was necessary to apply a method that would enable the estimation of all direct and indirect use values of the documented plant species, as belonging to the primary forests.

3.3. Identification of the main ecosystem services in relation to the land use types

In subchapter 3.1.2 was described the methodology used to identify the land uses in the "Simón Bolivar" parish by the means of a Geographical Information System - GIS (Software: ArcGIS 10.3). Based on the coverage percentage per land use types that was previously calculated, the predominant land uses were selected. For the "Simón Bolívar" parish the principal land uses are the primary forest, secondary forest, croplands and pasturelands (**Table 3**). This information was verified in the field and compared with the data provided by the Management Plan in force for the period 2015 - 2019 (CDTER, 2015).

Table 3. *Types of land uses in "Simón Bolívar" parish and their description. Source: Adapted from CDTER (2015)*

Type of land use	Description	Activities	Area (Ha)	Share (%)
Primary forest	Native tree species which enable a protective vegetal cover that should be maintained. 7,04% of this forest (11,141.27 ha) is included in protected areas or reserves.	Allowed: recreation and other cultural practices Not allowed: hunting, agriculture, cattle breeding, felling trees and other extractive activities such as mining, oil exploitation etc.	169,402.66	80.47
Secondary forest	There are plant species of a moderate or long vegetative period, of herbaceous or shrub type with protective vegetal cover	Allowed: recreation and other cultural practices, taking parts of the plants for medical or toxic purposes, hunting Not allowed: agriculture, cattle breeding, extracting activities	11,138.19	5.29
Croplands	Areas of moderate yield, temporary crops due to flooding processes	Allowed: agriculture, agro-forestry systems and recreation Not allowed: Cattle breeding, hunting, extracting activities	16,725.74	7.95
Pasturelands	Areas of moderate yield, annual crops will maintain the productive capacity of the land	Allowed: cattle breeding, agriculture, recreation, and agro-forestry systems Not allowed: hunting, extracting activities	13,237.98	6.29

Table 4. *Ecosystem services selected for the area taken into the study. Source: Adapted from MA (2005) and Haines-Young and Potschin (2018)*

Category	Ecosystem services
Provisioning Services	Plant-based foods (fruits, vegetables) Food of animal origin (meat, dairy) Water for human consumption Water for animals (sheep, cattle, pigs, goats) Timber forest products (firewood, wood) Non-timber forest products (medicinal plants, gums, waxes, latex etc.)
Regulating services	Biological control Water purification Water regulation Biodiversity Air purification
Cultural services	Recreation and tourism (hiking, photography, swimming, rest and relaxation) Scientific (research of universities, pharmaceutical companies) Ancestral practices and rituals (religious, ceremonies)

In the ”Simón Bolívar” parish there are some conservation areas, in which the activities that cause a negative impact to forest are not allowed, while in zones of production (croplands and pasturelands) even though certain activities are allowed, they must be linked with sustainability principles (CDTER, 2015). According to the Food and Agriculture Organization of the United Nations (FAO), Ecuadorian forest is affected by the agricultural expansion, wood extraction, the establishment of palm oil, cocoa and banana plantations, mining and road construction (Tapia et al., 2015); these industries are also affecting the state of the native forests in the parish, so it is necessary to implement control and monitoring actions to guarantee that people develop only the allowed activities for each use.

According to the map elaborated in ArcGIS 10.3, the land use of PS corresponds mainly to primary or native forest. To select the ecosystem services of PS, a preliminary list of services was developed based on a literature review (MA - Millennium Ecosystem Assessment, 2005 and CICES - Haines-Young and Potschin, 2018). During a focus group with the principal actors (authorities of local government, representatives of organizations or associations and directors, as well as employees of PS), the list was revised based on the perceived existence and importance of ES. The updated list contained fourteen ecosystem services (**Table 4**) that were selected for this research and were classified according MA* categories. The forest services presented in **Table 4** affect directly the people, an aspect that facilitated their identification by the stakeholders (Affek and Kowalska, 2017). Ojea et al. (2012) indicated that *“When the service valued corresponds to a process and not an output, there is a risk of double counting*”. Supporting services were not considered in the present study because they comprise processes that support the rest of ES (Sing et al., 2015); so, this category is transversal to the others and may be considered as a category of intermediate ecosystem services.

3.4. Identification of the stakeholders

For the identification of stakeholders benefiting from the ES in the study area, the approach proposed by Raum (2018) was applied, consisting from an exploratory qualitative approach using complementary techniques such as the literature review, analysis of websites of the involved organizations and expert interviews. For the present research instead of the last technique, local people who work in PS and who have empirical knowledge were interviewed.

A structured approach to identify the stakeholders and the principal actors include the following steps: initial proposal (includes the institutions, organizations and people who have a role in the project), identification of functions and roles, analysis of the stakeholders (type of relation with the project and their influence) and hierarchical organization (Tapella, 2011). In the present research, first the social area of direct influence of PS was established, and it corresponded to “Simón Bolívar” parish. Then, a preliminary list containing the possible stakeholders was built by means of interviews carried out with local people; it was complemented with the analysis of the organization chart of Pastaza Experimental Station, as well as with the Ecuadorian Legislation because it points out the principal functions (or responsibilities) assigned to different organizations and government levels (COOTAD, 2010). This preliminary list was submitted to the stakeholders who were assumed to hold a high influence in the decision making (local authorities and board of directors of PS), and it was updated based on their suggestions.

The roles (functions) of each stakeholder were addressed in detail (a detailed description is given in the full thesis). The functions of the stakeholders were defined according to their link to the management of natural resources for their conservation or exploitation, their interests, necessities (uses) and political influence (decision-making). These criteria were selected based on other researches that suggest that the identification and analysis of stakeholders comprise aspects like consumption (Felipe-Lucía et al., 2015), power (ability to manage) (Felipe-Lucía et al., 2015; Raum, 2018) and interests regarding use and conservation (Raum, 2018). Moreover, the aims and roles allowed to categorize the stakeholders in two groups: main actors and stakeholders in general (users). These categories were established because, in order to manage the natural resources, the power is necessary, and the strongest power belongs to public institutions, which can promote an adequate management and trade-offs (Felipe-Lucía et al., 2015; Raum, 2018).

3.5. Evaluation of ecosystem services

3.5.1. Field data collection

For the evaluation of ES, a questionnaire survey was implemented based on face-to-face interviews. This technique was selected because it reduces the risk of an incorrect filling of the questionnaires; the information that it provides is more truthful than online surveys and helps to get more information (DeFranzo, 2014). The field phase of the study was carried out on January 12nd 2019 with the help of 30 researchers that were trained in advance and had an academic background in environmental engineering. The surveys were carried on by a door-to-door approach, following a random sampling based on the local housing cadaster. The target population corresponded to the main beneficiaries of ecosystem services, and it was, to say, composed from all residents of "Simón Bolívar" parish. However, the respondents taken into the study were only those over the age of 18 years or the heads of families, because they can value objectively the ES and provide truthful information about the socio-economic situation. The methodological assumptions and procedures described by Affek and Kowalska (2017) were considered to structure the questionnaires. Therefore, as a baseline to develop the questionnaire, the following aspects were taken into consideration:

i) Only the ecosystem services derived from local ecosystems were considered (Affek and Kowalska, 2017);
ii) The flow of ecosystem services was related to direct consumption (Affek and Kowalska, 2017), in other words, only the actual uses were considered;
iii) The questionnaire was developed by considering 5 main sections:
    - *Demographic component*: place of residence, ethnic group, gender, age, civil status, education and occupation;
    - *Local context*: knowledge about the existence of PS, level of importance of conservation of forest and water resources;
    - *Socio-economic component*: family members and income per month;
    - *Cultural and environmental component*: perception about the capacity of forest to provide ES;
    - *Economic valuation*: WTP for conservation and other attributes.

The preliminary version of the questionnaire was tested by personnel from Esquela Superior Politecnica de Chimborazo (ESPOCH) and other external experts (previous to its use in the field data collection). The final version of the used questionnaire is given in the **Appendix 03** of the full thesis. Before to the application of surveys, the size of the sample was estimated. First, an estimate on the current population was developed based on the population of "Simón Bolívar" parish in 2010 (5682 inhabitants) and the population growth rate (4.91%), data that was extracted from the last report of the National Institute of Statistics and Censuses (INEC, 2010). Based on these data, the current population of the parish (2019) was estimated using the exponential method (United Nations Statistics Division Demographic and Social Statistics, 2012). Then, the formula of probabilistic sampling (*e.g.* Zar, 2010) was used to determine the sample size resulting in 368 questionnaires to be implemented, standing for more than 6% of the population size.

3.5.2. Data processing

A database was developed in Excel (Microsoft Office 2013), and it contained all the variables of the different sections of the questionnaire. This step is important because in it all the data are compiled and selected, therefore, it stands for a simple and effective way to systematize the information (Figuereiro and Pereira, 2017). Before data processing, the answers of the surveys were checked, and those surveys that were incomplete were discarded. The remaining surveys were coded by using a numeric scale (from 1 to 451). After that, the data was transferred into the database with the help of the 30 researchers, who participated in the field data collection. The data was organized by taking into consideration the sections of the used questionnaire. In the Excel sheet, excepting the variables of the cultural and environmental valuation, each closed question was itemized in its expected answers (each column was labeled with each of the expected answer); then it was assigned a value of “1” to the column of the answer indicated by the respondents while non-answers were treated as blanks. For open questions (age, family members and DAP for attribute) and for the variables of the cultural valuation, each assigned value was entered in the corresponding column.

3.5.3. Data analysis

Statistical data analysis was implemented by using the Real Statistics® (Release 6.2) which is a freeware add-in for Microsoft Excel. The used data analysis procedures are described in the following sub-chapters.

3.5.3.1. Socio-demographic characteristics

The sociodemographic characteristics were analyzed using the techniques of descriptive statistics such as, for instance, absolute and relative frequency (percentage) (*e.g.* Gorjas, et al., 2011).

3.5.3.2. Capacity of the ecosystems to provide forest services

The importance of services provided by the actual land uses (**Table 4**) was evaluated through the following aspects: 1) analysis of each ecosystem service, 2) data aggregation and 3) relative importance at two scales.

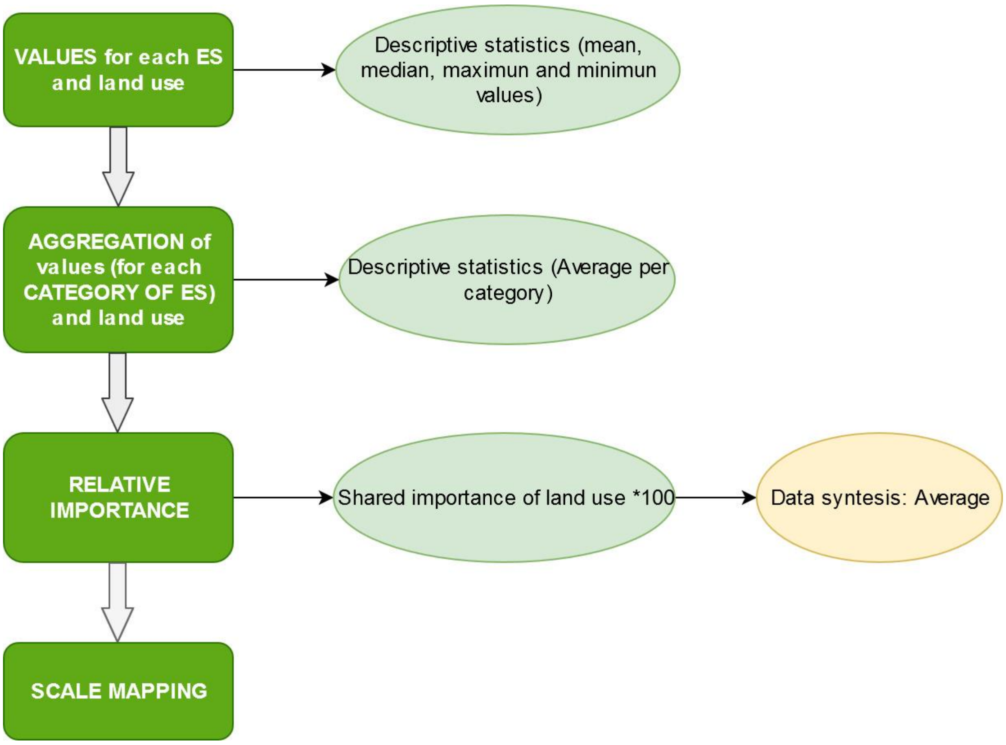

Figure 4. *Flow diagram describing the evaluation of ES*

Very Low	Low	Moderate	High	Very High
0 - 1	1.01 - 2	2.01 - 3	3.01 - 4	4.01 - 5

Figure 5. *Color scale used to visualize and interpret the results*

The first scale was used for aspects 1 and 2 and it consisted of a bipolar numeric (Likert) scale between 1 (low importance) to 5 (high importance) (*e.g.* Pastorella et al., 2016) and it was also linked to a color scale (Affek and Kowalska, 2017).

For the analysis of each ecosystem service, the maximum and minimum value, the mean and the median were estimated from the scores given by the respondents (Gorjas et al., 2011). These descriptive statistics included measures of central tendency (median and mean) because their calculation is simple and the establishment of a range or scale for the valuation reduces the incidence of outliers, aspect that was corroborated in function of the minimum and maximum values (Gorjas et al., 2011; Patiño, 2002). The values corresponding to the mean and median were linked to a color scale (**Figure 5**) for a better visualization and interpretation of the results. The ecosystem services belonging to the provisioning, regulation and cultural categories were aggregated into a final value (average of the category), resulting in data aggregated for the four ecosystem or land uses as well as in data aggregated on three classes of ES. The relative importance of each category for a given land use system was analyzed as the ratio of the score corresponding to that land use system and the sum of scores coming from all the considered land use systems (importance factor). As such, the importance of a given category within a scale may be easily interpreted as a share of importance if multiplied by 100. This approach allowed to differentiate the outcomes relative to a given category. Following these steps, data was analysed by descriptive statistics: 1) reporting the main statistics for all the scales taken into consideration and 2) data synthesis using the average values. The outcomes of the synthesis were used for spatial scaling (see section 3.5.4).

3.5.3.3. Modifying factors of the social perception

The respondents were clustered in function of the declared social variables (*e.g.* Affek and Kowalska, 2017; Martín-López et al., 2012), then the perception of stakeholders was evaluated in connection to each social factor by the means of statistical inference. Previous to the analysis of data, the database was re-organized in function of each socio-economic variable; each score was broken down into established groups, in order to estimate the average value of the scores assigned to the services of each category by each group.

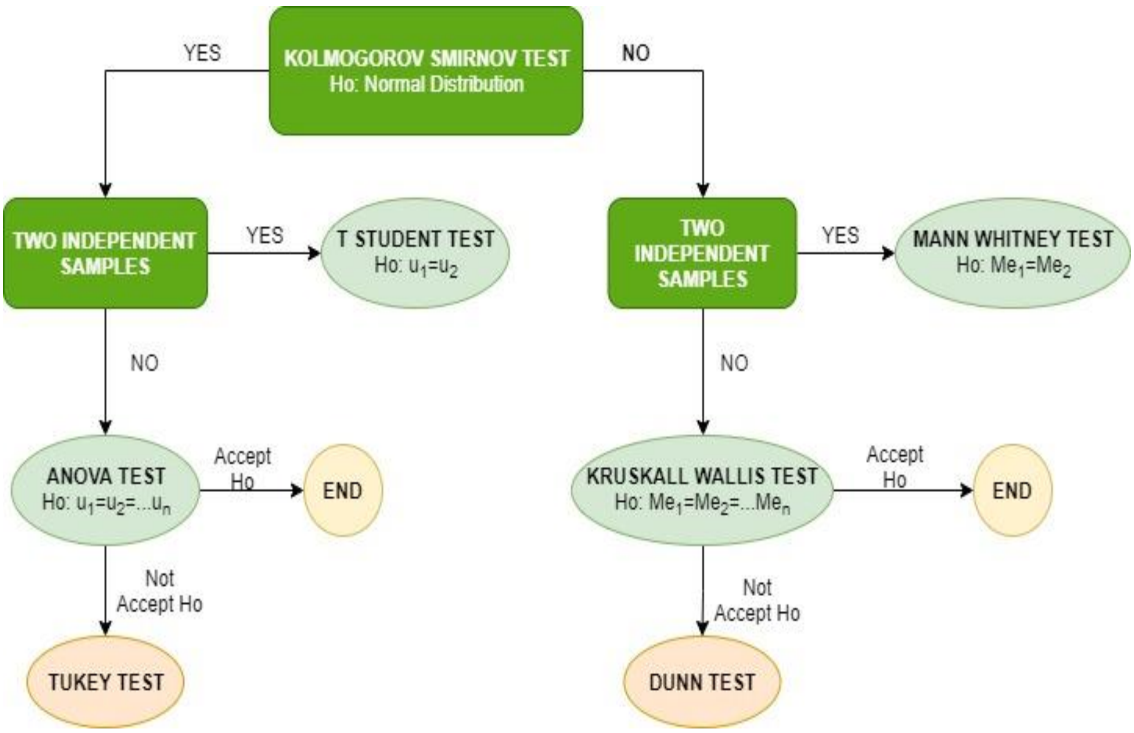

Figure 6. *Flow diagram of inferential statistical analysis used in this work.* Source: *Adapted from Laguna (2014)*

According to **Figure 6**, the first step was that of applying a Kolmogorov-Smirnov test to check the data for normality of the variables taken into analysis (Laguna, 2014). The significance obtained in this test indicated that all the data had a non-normal distribution, so the used statistical methods (or tests) to estimate the variability or difference between the groups were (Laguna, 2014):

i) Mann-Whitney to test the effect of gender on perception, as the gender comprised two groups or independent samples: male and female (Laguna 2014; Gómes et al., 2003);
ii) Kruskall-Wallis to test the effect of age, level of education, occupation (or profession) and income, as these variables comprised more than two groups or independent samples (Laguna 2014; Gómes et al., 2003);
iii) Finally, if the equality between the analyzed groups was rejected (H_0 of Kruskall-Wallis is not accepted), a subsequent test must be undertaken. Dunn's test allows to identify which groups differ significantly with respect to the other (Zaiontz, 2012).

3.5.4. Spatial scaling

In some cases, statistical extrapolation has its limitations (Zar, 2010), while the spatial scaling uses the concepts of area (size), density (related with the level of people's intervention) and extent to understand the state of an ES or a group of ES (category) (Lindborg et al., 2017). Spatial scaling allowed extrapolating the relative importance in the study area. This step was developed by the means of a GIS approach that used special layers of identified land uses (format *.shp*). This layer was updated by the addition of required columns (attributes) to be able to populate them with the data estimated on the relative importance based on the used categories of ES. After that, based on logical functions written in the Field Calculator of QGis 3.4.13 software (2018 Madeira, GNU - General Public License) for geographic information system, the attribute columns were filled with the data of relative importance (non-dimensional index) associated to the all the ES taken altogether (total importance). A similar procedure was used also to populate the spatial databases with the information of the defined ES categories. Then, based on this framework, the principal outcomes were four maps that were designed to show the importance and use of ES in the area of a specific land use management system. These outcomes helped to understand the extent of the phenomenon in the study area and, probably, they could be extended to most of the Ecuadorian rainforest given the characteristics of the population sample taken into study.

3.6. Evaluation of perceived importance

According to the National Institute of Statistics and Census (INEC, 2010), the average population per family in Ecuador is 4.5 inhabitants. As a common rule in the community, the family structure modifies the perception of its members based on their roles in the family (Atiqul Haq et al., 2010). For instance, it is quite typical for the father (husband) to provide the economic resources required to satisfy the needs of the family, so his perception about environmental services is related to this role, while the mother (wife) is the person who administers the resources and generates environmental practices that are transmitted to the other members of the family (Atiqul Haq et al., 2010). The importance on conservation of water and forests in the study area was evaluated by means of a Likert scale that comprised evaluation items designed to describe the level of importance from very low to very high. While this kind of questions were included in the questionnaire (**Appendix 03**, full thesis), at the office, data processing and analysis consisted of couple of steps. The questions about the level of importance on conservation were structured based on other studies about conservation of forest and watersheds (*e.g.* García and Jiménez, 2012; Pastorella et al., 2016; Granda and Yánez, 2017). The variables associated to the conservation were included in the database. Then, the statistical analysis was designed to estimate the absolute frequency of each level of importance, and it took into consideration that importance on conservation was a qualitative variable (categorical) (Orellana, 2001; Gorjas et al., 2011). Finally, a bar chart was built for a better visualization of the results. Zar (2010) and Gorjas et al. (2010) suggested to use this kind of diagram for qualitive variables that have more than two categories.

3.7. Evaluation of preferences towards land uses and management systems

There are several approaches for evaluating landscape attributes, encompassing the points of view of the different disciplines. Nevertheless, these approaches are mainly grouped into two categories: artistic and humanistic sciences and natural sciences. Within the group of natural sciences, the main methodological strategies can be generally associated with: i) holistic landscape concept, ii) biophysical characterization method based on statistical analysis and iii) characterization based on a previous selection of land uses and geo-ecological attributes (Simensen, 2018). The landscapes and their attributes can be valued in terms of visual preferences. Visualization support commonly used for such attempts encompass photos, calibrated pictures or another visual stimulus (Häfner et al., 2018). Showing photographs to the respondents allows obtaining information in an efficient way, since when grouping several images there are different approaches to the elements present, that could specify a holistic view of the landscape (Dupont, 2015), and this method also enables an interpretative approach (Simensen, 2018). One good approach to evaluate the perception on land uses and types of management, which has the main advantage that it can be implemented from the comfort of home, is that consisting of bringing relevant pictures to those asked to evaluate such issues. In this regard, there was a high heterogeneity between the types of land uses and management systems to be evaluated in this work. Such heterogeneity may manifest itself at the same spatial scale mainly as an effect of the type of land use and management system under the visual evaluation as well as a result of field of view for a gived land use and under the evaluation.

To account for this heterogeneity, twelve pictures (given in the full thesis) were selected as being representative to be shown to the respondents and they were complemented by bipolar scales constructed from 1 to 5 where, conceptually, 1 stood for the least visual appeal and 5 stood for the highest one. The images were shown to the respondents in the last part of the survey, in a section that enabled them to assign numerical values that were associated to how much they liked each photograph, using a methodology similar to that described by Hagerhall (2001). The values were defined as follows (Hagerhall, 2001): 1 - not at all, 2 - a little; 3 - pretty good; 4 - well, 5 - a lot. If any individual did not feel able to rate any image, they refrained from doing so, leaving the answer box blank. The whole range of values, from 1 to 5, was conceptually defined, explained to the respondents and implemented in the field survey as a kind of continuous scale in which 1 stood for "*I'm not liking it at all*" and 5 stood for "*I'm liking it a lot*". The pictures were presented in groups of three and arranged sequentially according to the four categories of this study: primary or unmanaged forest, secondary or managed forest, pastureland and croplands. These categories were selected based on the predominant land uses, the main economic activities and occupations of the parish inhabitants, described in the Management Plan (CDTER, 2015).

Concerning the methods used, the scientific literature recommends including certain variations in the content of the pictures or scenes shown to respondents. Such variations may refer, for instance, to light conditions, eye level or position (Xu et al., 2018) and the level of attributes or number of elements (Häfner et al., 2018). The visual logic that follows this order of images is the place of the virtual observer, in terms of distance: far away, intermediate point and within the rated ecosystem or type of land use. Therefore, the perception on species (features) density variation depends on the mentioned positions. The processing and analysis of the visual preferences of each ecosystem included the following steps:

i) Developing of a database in Microsoft Excel, which included the social characteristics of the respondents and the ratings assigned to the pictures;
ii) Based on the ratings of each picture, descriptive statistics were obtained by means of the tool Real Statistics (Release 6.2); for instance, mean, median and standard deviation were taken into account;
iii) The data was dissagregated by the clusters of each socio-demographic variable;
iv) For each cluster, mean and median were estimated.

To complement ratings given by the respondents on each picture from the evaluated set, a specific field was designed to collect descriptions on each figure in the form of short comments. To do so, the respondents were asked to provide for each of the evaluated pictures a short description (comment) explaining their assigned ratings. The aim of collecting this kind of data was that of documenting further the perception of respondents on the visualized pictures. As such, any scene, but especially the perception of individuals on it, may be characterized in terms of structure, function and value of the complex of factors shown by it. For instance, Abdollahi et al. (2012) defined these parameters as follows:

i. *Structure*: is a measure of some physical attributes of the flora, including the density of tree, composition, frequency and biodiversity;
ii. *Function*: is the dependent on the forest structure, multiple ES are included here, such as air pollution and temperature variations in terms of microclimate;
iii. *Value*: is an estimation on the economic worth in relation to the forest values and depends on different forest functions.

These three parameters were taken into account as a primary information to be extracted from the comments provided by the respondents. To do so, the database built into Microsoft Excel (Microsoft Office, 2013) was extended to include this part of data processing, and the part of the field questionnaire corresponding to the visual perception, including here the socio-demographic characteristics of the users, was moved from the field questionnaires into a spreadsheet as an initial version developed in Spanish language. Then, all the relevant features, including the description provided by the respondents were translated into English to support the analysis. Comments provided by the respondents were checked in detail to be able to infer their meaning and to code the most specific parameter that respondents have perceived for each picture. As there were cases in each the information corresponded to one or more categories for each picture, binary codes were used to document such outcomes in different field attributes included in the database. The inferred belonging to one or more categories (parameters) was coded by “1” while its absence was coded by a blank cell in the database. The next step was that to code this primary information in relation to how the respondents perceived such parameters. For this reason, all the comments were reanalyzed in detail to see if the attitude expressed as a comment was positive, neutral or negative, a step that was undertaken in conjunction with the ratings provided by respondents to each of the analyzed pictures. For this, comments were judged to be positive if the ratings were of 4 or 5, neutral, if the ratings were of 3, and negative if the ratings were of 1 or 2. This approach was synergic with the concept used for the evaluation scale construct. Based on this analysis, the database was extended to include codes such as “1” for positive attitudes, “0” for neutral attitudes and “-1” for negative attitudes. Specific fields were built to enclose this new data.

Then, visual indicators of structure as proposed by Martinez et al. (2014) were used to reanalyze the comments and to code the information as specific to these. To this end, the database was extended further to include attributes such as the i) Stewardship, ii) Coherence, iii) Disturbance, iv) Historicity, v) Visual Code, vi) Imageability, vii) Complexity, viii) Naturalness and ix) Ephemera, as described by the mentioned source. Accordingly, the definitions provided by it were used to code and attribute the attitudes to the 9 categories as defined below:

i. *Stewardship*: represents an ideal state in the sense of order and conservation, as well as the landscape care of the human being through management plans. Its main attributes are signs of use or non-use of flora, drainage capacity and waste management. The potential indicators are the presence (or absence) of vegetation in percentage, type of management and frequency, infrastructure conditions;
ii. *Coherence*: is the relationship between the natural conditions of the area and land use, therefore, it is the unit of a scene that considers characteristics such as colour and texture. Attributes such as land use and water can be considered, while this parameter can be evaluated as land use, spatial location of water, presence of colours etc.;
iii. *Disturbance*: is the lack of coherence, being defined as the visual disturbance caused by human constructions and interferences, whether permanent or temporary. The parameters to be evaluated are given by the number of disturbances: natural or infrastructure, quantity, visibility and percentage affected;

iv. *Historicity*: can be considered in two areas: continuity and wealth. The first reflects temporal continuity, while the second relates elements such as condition, quantity and cultural diversity. This parameter is evaluated through the presence or absence of traditional or historical elements;
v. *Visual code*: is related to the visual scale that is maintained in aspects such as: topography, vegetation, landscape shape and size;
vi. *Imageability*: includes the close relationship between the cultural and natural, which make a memorable viewing experience. This is a function of unique and historical elements of the landscape and the presence of bodies of water;
vii. *Complexity*: is defined as the interaction between the characteristics, richness and diversity of the landscape, including the dominance and heterogeneity;
viii. *Naturalness*: is the state closest to the original conditions, is related to the ecological robustness in terms of the presence of water, vegetation cover and intensity of management;
ix. *Ephemera*: is considered for characteristics such as the types of vegetation cover, which change according to the season and climate.

The analysis of common words used to describe the pictures, therefore the land management systems taken into study, was implemented using the free online tool Word Cloud Generator (*https://www.jasondavies.com/wordcloud/).* The comments assigned to each picture were pasted in the space indicated in the website. The modified parameters were: number of words (the 25 most common words per picture) and orientation. On the other hand, the parameters that maintained the predetermined values were: spiral (Archimedean), scale (log n) and font. After these procedural steps, the program was run and the wordcloud was gotten. A wordcloud is a graphical representation of keywords, in general, labels (words) with strong colors and huge size are liked to a high frequency (Muente, 2018). The generated archive (format *.svg*) was downloaded from the website. It is important to mention that this process was repeated for each picture. In addition, a database was developed to contain the first 25 most commonly used words as they were obtained by means the Word Cloud Generator. The information characterizing each picture was joined and organized by considering each group or ecosystem, a procedure that allowed to get the frequency and the percentage of words used to depict the pictures (Gorjas et al., 2011; Patiño, 2002); this information was then structured and presented using bar charts.

Finally, a clustering approach was used to analyze the visual preferences, a procedure that was implemented by using the Orange® software. The used method was "k-means"; it allows to group many items using the following inputs: k - number of groups (clusters) and the data set (items) (Orange group, 2019; Sharman, 2017). For the present analysis, the predetermined value of k was 2, and the input file was the database of the ratings assigned to the twelve pictures. The k-means formed two groups based on similarities of the values of the visual preferences. The output of this method was a dendrogram describing the data hierarchy. It showed the grouping relation of the entered data (groups and sub-groups) and it helped in deducing the factor of grouping for the pictures, which was the level of interview as well as how the picures shown - therefore the land use types - were constructed in groups by the ratings of the respondents. The choice of Orange® software to run this analysis was mainly based on the free availability, intuitive interface and ease in learning.

3.8. Evaluation of commitment to engage in voluntary payments for conservation

Contigent Valuation Method (CVM) is the most used approach to evaluate the willingness to pay (WTP) and the willingness to accept (WTA) (Riera, 1994; Siew et al., 2015); quantifying WTP encourages the beneficiaries to contribute to conservation or restorations funds (Al-Saaf, 2015). To apply this method, Riera (1994) has suggested as important steps the description of the social area of influence, monetary units, the maximum value of the WTP, the organization that should manage the funds and frequency of payment. For this study these parameters were structured based en secondary bibliographical sources (García and Jiménez, 2012; Siew, 2015; Granda and Yánez, 2017; Gordillo et al. 2019). The used parameters were: 1) "Simón Bolívar" parish was the social area of direct influence, 2) the monetary units corresponded to dollars, 3) about maximum value, there were not found studies that valued forest services in Ecuador so there was not a reference value and 4) the frequency of payment corresponded to yearly rate, and was established based on studies about valuation of watersheds in Ecuador (*e.g.* García and Jiménez, 2012; Granda and Yánez, 2017). The used format of CVM was open (Riera, 1994) because there were not used referential values. Moreover, the hypothetical situation presented to the respondents was the conservation of the water and forest, as well as their associated ES.

The questions were structured by considering the parameters detailed before. After that, the survey was implemented in the field, and the data of each variable related to WTP were included in the database. To estimate the WTP, the maximum and minimum values were identified first and, based on them, the classes or categories were defined. Then, the frequency and percentage of importance of each class was determined, and these statistical measures were used to estimate the weighted mean (Gorjas et al., 2011; Patiño, 2002) which corresponded to the WTP in the area. Finally, to estimate the total potential funds, the number of members per family were computed as the weighted average from the data collected in the field; this data allowed to obtain the number of families in the parish because there is a cadaster of the local families. The total funds were estimated based on the WTP ($ per year) and the number of families; these funds were estimated at the family level because during the application of the surveys the respondents pointed out that the amounts should be paid following the framework of the public services, like water or electricity.

Furthermore, the surveys included a subsection about the WTP for other attributes of the area (**Table 5**); this approach allowed to identify which service was valued higher by the respondents based on an economic perspective (World Bank Group, 2016), in other words, the ES were valued individually and not as whole. An individual analysis is useful to establish priorities in the plans or programs of environmental protection and use of resources (management) (Portela and Rivelo, 2019). To evaluate the WTP for the attributes shown in **Table 5**, a question about them was included in the administrated questionnaire. The selection of these attributes involved the following steps: consulting other studies about valuation of ES, validation by the main actors of the project (local authorities), testing during the application of the preliminary version of the surveys, updating and final application of the surveys in the field. After the last step, the database was extended to include information about the amount in dollars to pay yearly for each attribute. Due to the fact that the format of this question was open, a variety of values were indicated by the respondents and all data was registered into the data base (including the outliers).

Table 5. *Valued attributes of the zone*

Attributes	$ per year
Food (fruits, vegetables, seeds and fungi)	
Water conservation	
Forest conservation	
Timber products (fuel wood, timber and fibers)	
Non timber products (Medicinal plants, gums, waxes, latex, roots, leaves, seeds, flowers)	
Biodiversity	
Landscape	

The statistical analysis of this sub-section included descriptive statistics such as the mean and standard deviation (*e.g.* Burneo, 2008; Gorjas et al., 2011). If there are outliers, it is not recommended to delete them from the database; instead, some additional statistical procedures could be used such as, for example, the estimation of the standard deviation (Murphy and Lau, 2008). Finally, the means and the standard deviations were compared to identify the most and the least valued attribute. Due to the character of the question and the collected data, it was not possible to include other statistical analysis in this sub-section.

CHAPTER 4. RESULTS AND DISCUSSIONS

4.1. Types of landscape management and main activities in the study area

The area of "Simón Bolívar" parish is of 1,024.67 Km^2 (CDTER, 2015), and the principal land use corresponds to the native forest. Native (or primary) forest has stable characteristics in the area, being also considered as an ecosystem that has a high conservation priority because it provides many ES that should be used sustainably; to this end, the conservation is progressively promoted in the parish (CDTER, 2015). **Table 6** shows the distribution of land uses in "Simón Bolívar" parish as they have been found after running the GIS analysis.

Table 6. *Types of land uses in "Simón Bolívar" parish. Source: National System of Information (Ecuador)*

Land use	Coverage (%)	Description
Native forest	92,716.38	Corresponds to "humid forest"
Pastureland	6,831.84	Pasture and silvopastoral systems that are used for cattle breeding
Croplands	477.35	In the study area, the agriculture is extensive. The principal crops are cassava, sugar cane, cocoa and banana
Secondary forest	46.44	Includes forest species like bamboo and guadua cane

Note: * Not shown: Area of other land use types (2,000.67 ha)

Following data analysis and aggregation, the main economic activities as present in the in "Simón Bolívar" parish where those associated with agriculture, livestock farming, silviculture and fishing (67.41%), followed by those from education (8.31%), manufacturing industries (3.92%) and construction (3.16%).

The future trends of land use indicate that categories such as the inhabited areas, croplands and pasturelands will increase as a result of population increment and the development of economic activities in the sector, a situation that has the potential to lead to a progressive decrease of the forested area. Mittal and Gupta (2013) have mentioned that the demographic expansion burdens the environment because more population requires more space for infrastructure (*e.g.* houses), availability of additional goods (food, water etc.), and more pollution. The principal threats in regard to the tropical forests are anthropogenic activities; their direct effects on the ecosystems are destruction, fragmentation (land use change) and over-exploitation (Morris, 2010). To this end, there are various perspectives in regard to the main causes of deforestation in Ecuador; according to official reports, the causes are colonization, agricultural expansion, timber extraction, monoculture plantations, weak programs of land legalization and poverty; more detailed studies indicate that deforestation is associated with the presence in an area of larger families, as well as the fact that it depends directly on land quality, accessibility and level of education (Mena, 2010).

4.2. Plant uses in the area

In the Pastaza province (Amazon Region), a number of 540 plants were identified (Gavilanes et al., 2018) having one or more uses. **Figure 7** shows a breakdown on the number of plants per use category. The category of use that had the highest number of registered plants was the materials category (MA=340), followed by medicines (ME=285), food for vertebrates (FV=259), food (FO=251) and social (SO=137) (Gavilanes et al., 2018). Compared to the data available at national level, the results were somehow similar. For instance, based on the identification of 5172 plants, the most important categories of use at national level are the medicine (3118), materials (2834), food for vertebrates (1987), food for humans (1561) and social uses (1016) (De la Torre et al., 2008). The predominant categories of use in Pastaza province followed the tendency at national level, with the unique difference that the most important category in Continental Ecuador is the medicinal use. The most important category of use as found by this work was that of provisioning of materials such as wood, fibers, gums, resins and oils. This is because the majority of studied species were trees characterized by an increased height while the timber is the principal raw material that is commercialized in Pastaza province (Hetsch, 2004) for construction purposes. Dezzeo (2017) indicated that in Amazon Region there are 92 woody species whose unique use is that of wood provisioning, while a number of 77 woody species are used to provide wood and also have 4 or more different uses. With regard to palms, 21 species provide food or materials, while other 25 species exhibit more than 4 uses.

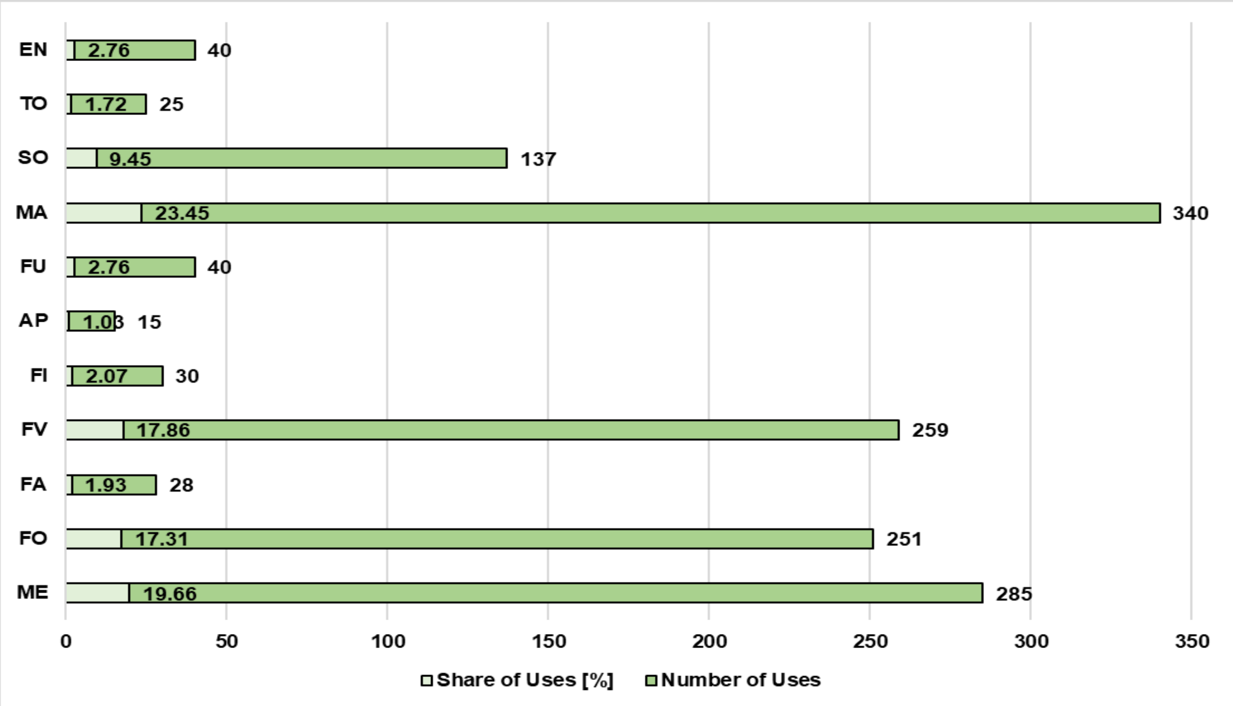

Figure 7. *Number of plants per utilization category. Legend: EN - Environmental, TO - Toxic, SO - Social, MA - Material, FU - Fuel, AP - Apiarian, FI - Food for invertebrates, FV - Food for vertebrates, FA - Food additive, FO - Food, ME - Medicine*

Source: *Adapted from Gavilanes et al. (2018)*

The etno-botanical area complements the ancestral knowledge of ethnic groups of the Amazon region, so medicine is just another important category of use because many plants contain diverse active principles (fito-chemicals). Such plants are mainly used for treatment of stomach pain, inflammations, flu, infections and diarrhea (Abril et al., 2016). The “Huaorani” ethnic group uses the plants for six pathological conditions: fungal infections, snake bites, dental problems, fever, attacks of larvae as well as for other animals’ bites (Valarezo et al., 2016). The relation between biodiversity and Amazon ethnic groups contributes to an increase in terms of biological, ethno-botanical, economic and cultural value of tropical forests (Ríos and Pedersen, 1997). There are hallucinogenic plants such as Ayahuasca (*Banisteriopsis caapi*), that have an enormous impact on the cultural aspects of most of the ethnic groups: “Achuar”, “Wao”, “Cofán”, “Siona-Secoya”, “Shuar”, “Huaorani” etc. (De la Torre et al., 2008), therefore social uses such as rituals or religious practices are important in all provinces of the Amazon Region. The use for food is another important category due to the presence of primary forest cover for most of the Pastaza province. These forests are characterized as having a high productivity (Kormos et al., 2016). Delgado et al. (2017) have mentioned that there is a high dependence of the communities from Amazon Region on the forest to obtain plants, fruits, seeds and animals for their daily diet. In general, plants are used mainly as food for animals and humans; however, the category “food for animals” has had the highest number of plants in Ecuadorian Amazon (Dezzeo, 2017). A number of 540 plants were grouped on 8 categories that defined their habit (parasite shrubs - PS, epiphytes - EF, ferns - F, hemi epiphytes - HE, lianas - L, herbs - H, shrubs - S and trees - T) (Gavilanes et al., 2018), as shown in **Figure 8**. To relate the categories of habit with the uses, it was found that trees had the highest number of entries for most of the analyzed uses; they were predominant in categories such as food for invertebrates (93.33%) and fuels (82.50%) but they had the lowest share in the toxic category (36.00%).

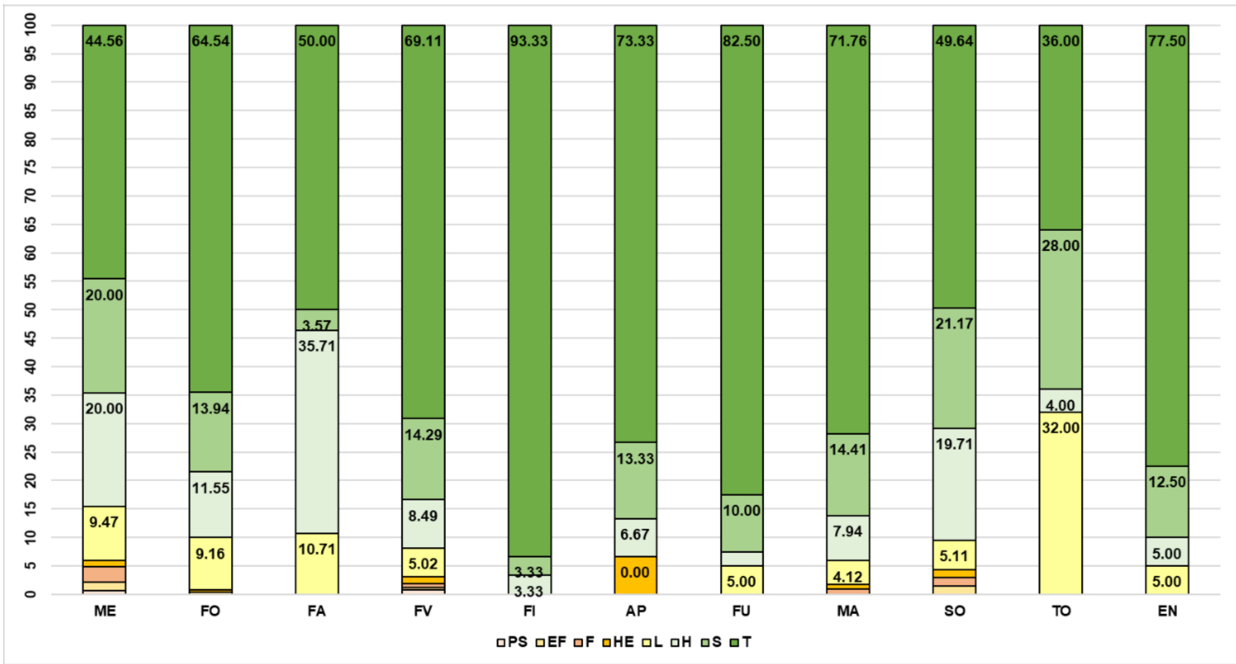

Figure 8. *Number and share of uses per utilization category. Legend: EN - Environmental, TO - Toxic, SO - Social, MA - Material, FU - Fuel, AP - Apiarian, FI - Food for invertebrates, FV - Food for vertebrates, FA - Food additive, FO - Food, ME - Medicine*

In Ecuadorian Amazon Region, a major part of the vegetation is constituted of species such as trees and shrubs which account for a share of 59.2% (Dezzeo, 2017; De la Torre et al., 2008). The herbs stand for 23.2% of all species, lianas for 11.9% while the sub-shrubs, epiphytes and hemi-epiphytes represent only the 2.3% (Dezzeo, 2017). In general, a huge diversity (species richness and composition) is associated with a high use in the region (Dezzeo, 2017; Cleland, 2011), so trees have the greatest number of uses. Macía et al. (2001) have analyzed the share of use of by different categories of habits in three types of forest (flooded plain, swamp and firm land). They have found that, of the total number of lianas, 82 to 87% presented a use, shares that were lower compared to those of trees use (96-100%); they have also found that the categories of useful plants were medicine, construction, fuel and food.

4.3. Main ecosystem services and their stakeholders

The database that was developed using the information collected from research articles and publications suggested that the main services provided by the analyzed ecosystems (primary and secondary forest, croplands and pasturelands) are those presented in **Table 7**. The stakeholders benefiting of ES in "Simón Bolívar" parish are shown in **Table 8**. Concerning the classification of ecosystems services, MA classification was adopted for the present research owing to it is a simple classification system that adopts functional groups and categories of use (Environmental Protection Agency, 2015). The forest ecosystem services presented in **Table 7** were the most likely to affect directly the people, aspect that facilitated their identification by the stakeholders (*e.g.* Affek and Kowalska, 2017).

The mentioned stakeholders (**Table 8**) were used evaluate the natural resources of the study area and their flow of services, because they know the parish (and the environment), the actual needs of locals and the potential uses of the resources. Also, they make decisions about natural resources management based on current laws at national, regional and local level. Felipe et al. (2015) have indicated that population influences the flow of ecosystem services, so "*with a good representation of stakeholders, outcomes are more likely to represent the actual values of the targeted area, avoiding trends of what are important ecosystem services to evaluate*". However, many stakeholders can spatially mismatch the supply and demand of ES, discrepancies that can generate conflicts among stakeholder groups; it is, therefore, important to include and prioritize at an early stage the stakeholders' views in the process of valuation ES and landscape management (Zoderer et al., 2019).

Table 7. *Identified ecosystem services. Source: based on MA (2005) and CICES (Haines-Young and Potschin, 2018)*

Ecosystem services (categories)	Benefits of the nature (ecosystem services)
Provisioning services	Food of vegetable origin (fruits, vegetables)
	Food of animal origin (meat and dairy products)
	Water for human consumption
	Water for animals
	Timber products (fuel wood and timber)
	Non timber products (medicine, gums, waxes, latex, roots, leaves, seeds and flowers)
Regulating services	Biological control
	Water quality (purification of water)
	Droughts and floods (regulation of water level)
	Biodiversity
	Purification of air (climate, carbon sequestration, regulation of atmospheric emissions)
Cultural services	Recreation and tourism (hiking, photography, swimming, rest and relaxation
	Scientific field (in universities, pharmaceutical companies)
	Ancestral practices and rituals (religious ceremonies, cleansing or purification)

Table 8. *Stakeholders of ecosystem services. Source: CDTER (2015); Cárcamo et al. (2014)*

Stakeholder	Responsibilities	Needs, expectations and interests
Authorities of ''Simón Bolívar" parish	Compliance with the laws and activities of Management Plan of ''Simón Bolívar" parish; Development of projects that contribute to social well-being.	Local development. Ensuring an adequate and healthy environment for settlers.
Settlers of the study area	Rational exploitation (or use) of resources.	Holding natural resources for their necessities and economic activities.
Manager of Pastaza Experimental Station	Proper management of the experimental station.	Development of Pastaza experimental station and its surroundings.
Employees of Pastaza Experimental Station	Compliance with the activities that contribute to the maintenance of the study place.	Working in an adequate environment. Knowledge of the place and its operation
Visitors of Pastaza experimental station (students)	Look after the experimental station; Acquisition and diffusion of knowledge.	Realization of their internship and technical visits
Entities related to the environment and forest resources	Control and monitoring; Promoting the environmental protection and conservation.	Compliance with the laws and regulations according their area

The main elements involved in the management of socio-ecological systems are the systems themselves and the governace approach (Paavola and Hubacek, 2013). Therefore, defining the spatial boundaries of ES, their stakeholders, the governance (role and mode of participation), the socio-economic trends and transformations (Paavola and Hubacek, 2013) helps to understand the forest services' framework and involves the participation of key actors; in other words, this approach ensures the interconnection to transfer and share knowledge and information between interested parties (Cárcamo et al., 2014).

4.4. Use of ecosystem services

4.4.1. Social and demographic features of the respondents

The main social and demographic features of the respondents are detailed in **Table 9**. As shown, 50.44% of the respondents were female and 49.56% were male, a trend that is similar to that presented at the parish level in the census of 2010 (CDTER, 2015).

Table 9. *Description of social and demographic features*

Feature	Total	
	N	%
Gender		
Male	223	49.56
Female	227	50.44
Civil status		
Single	164	37.19
Married	144	32.65
Common law	90	20.41
Divorced	26	5.90
Widow(er)	17	3.85
Age		
≤30 years old	176	40.74
31-40 years old	111	25.69
41-50 years old	64	14.81
51-60 years old	41	9.49
>60 years old	40	9.26
Level of education		
Elementary school incomplete	34	7.57
Elementary school completed	117	26.06
Highschool incomplete	79	17.59
Highschool completed	138	30.73
Third level incomplete	39	8.69
Third level completed	36	8.02
Fourth level incomplete	1	0.22
Fourth level completed	5	1.11
Employment		
Housewife	114	25.33
Employee	114	25.33
Freelancer/entrepreneur	148	32.89
Unemployed	10	2.22
Student	54	12.00
Retired	10	2.22
Other	0	0.00
Level of income		
≤394 $	296	72.37
395-733 $	73	17.85
734-901 $	21	5.13
902-1086 $	6	1.47
1087-1412 $	9	2.20
1413-1760 $	3	0.73
1761-2034 $	1	0.24
Ethnic group		
Indigenous	111	24.61
Mestizo	327	72.51
White	11	2.44
Other	2	0.44

Note: non-declared data is not included in the table

The majority of the respondents were single (37.27%), followed by those married (32.65%); widower respondents represented 3.85% of the sample. In rural areas, at national level, 34.40% of women are married and 32.40% are single, while in the case of men, 39.90% are single and 33.10% are married (Ferreira et al., 2013). In what concerns the age, most of the respondents were young: 40.74% were 30 years old or less, 25.49% were between 31 to 40 years old 14.81% were from 41 to 50 years; less than 10% were 61 years old or more. In the "Simón Bolívar" parish, the predominant population corresponds to 1 to 9 years (31.10%), followed by the group of 15 to 29 years (25.34%) (CDTER, 2015). Regarding the education, the predominant group was that declaring that they completed the second level of education

(30.73%), followed by those declaring the first level completed (26.06%); lower percentages corresponded to those declaring the fourth level incompleted (0.22%) and completed (1.11%). In the Ecuadorian rural areas, most women (67.50%) and men (69.10%) have the first level of education completed (Ferreira et al., 2013). There are around 262 cases (4.61%) of illiterate people in the "Simón Bolívar" parish (CDTER, 2015). In relation to occupation, 32.89% of the respondents declared that they were freelancers or entrepreneurs, followed by the categories of employees and homemakers sharing the same percentage (25.33%). In what regards the level of income, most of respondents (72.02%) declared that they earn the basic salary (394$) or less. According to the Management Plan of "Simón Bolívar" parish (CDTER, 2015), the principal activity in this area is that related to agriculture, livestock farming, silviculture and fishing (1152 registered cases); also, the income per family is low due to the absence of jobs in the area. According to the Central Bank of Ecuador (2017) 1.5 million of Ecuadorians live in families, in which the monthly income is between 350 and 450$.

4.4.2. Importance of forest in the provision of ecosystem services

As shown in **Table 10**, the provision of food of vegetal origin was perceived to have the highest value as being provided by croplands, while the lowest value was assigned to pasturelands. This was probably related to the local customs in which the population bases its food provisioning on a self-consumption economy (Grünberger, 2014). Unmanaged (primary) native forest was found to have the highest average and median values related to the use and importance of environmental services such as the water, timber, timber derivates and other products provided by forest. These findings are in full accordance with the Ecuadorian strategic plan on native forests which analyses the factors that are considered to have a relevant importance for this forest type (Forest Ecuador Group, 2007), recognizing that the uses of forest plant species are vital for the sustainable use of forest ES (Gavilanes et al., 2019). Foods of animal origin such as meat, milk and their derivates were given the highest average and median values in case of pasturelands, recognizing the importance they have as the main source of primary production (5 and 7 species of grass and legumes respectively) in Amazonian ecosystems (González et al., 1997). Indigenous communities, which are the closest located to protection and conservation areas, preserve the forms of management, ancestral knowledge and non-extractive cultural use of their territory and biodiversity (Arias et al., 2012). Part of these are emphasized by the descriptive statistics given in **Table 11** that stand for the use and importance of regulation services in unmanaged forest such as the water quality, biodiversity and purification of air. Biological control is associated with productive plant resources for self-subsistence (grass and crops) so in both cases the value of importance assigned was 4 on a scale from 1 to 5.
The environmental services evaluation lies in the current problems on climate change and biodiversity reduction (MA*, 2005; CONAFOR, 2010; Rands et al., 2010; Herkenrath and Harrison, 2011). It should be noted that, although indigenous communities usually have a worldview that includes the care of the forest (Boege, 2008), this does not mean that they would engage in contemporary conservation initiatives (Velaso, 2014). Nevertheless, formal forest conservation (Martín et al., 2012) is framed around new languages such *as biological conservation, sustainability and ecosystem services allowing* multiple-scale governance schemes to operate (Bray, 2013).

Natural resources from an area contributed to shaping landscapes characterized by high aesthetics, ecological stability and capacity to provide cultural services (Plieninger and Bieling, 2012) that are used by local inhabitants and typically attributed as important to native forests, as shown in **Table 12**. Some typical properties of these services is their evolution dynamics and their interrelation with social systems, shaping, from this point of view, a strong interdependency between the rural communities and local ecosystems (Bugalho et al., 2011; Fischer et al., 2012). Rural communities, on the other hand, hold a their own system of tacit ecological knowledge that enables them to appreciate the ES provided by their landscape and to engage in traditional sustainable management activities (Whiteman and Cooper, 2000; Molnár, 2012; Oteros et al., 2013).

Table 10. *Descriptive statistics on importance and use of provisioning ecosystem services*

Ecosystem services category, subcategories and type of ecosystem	Number of respondents	Minimum value	Maximum value	Average value	Median value
Provision of					
Food of vegetal origin from					
Unmanaged (primary) forest	408	1	5	3.92	4
Managed (secondary) forest	395	1	5	3.04	3
Pasturelands	314	1	5	2.58	2
Croplands	431	1	5	4.16	5
Food of animal origin from					
Unmanaged (primary) forest	347	1	5	3.14	3
Managed (secondary) forest	352	1	5	2.58	3
Pasturelands	439	1	5	4.25	5
Croplands	312	1	5	2.47	2
Water for human use from					
Unmanaged (primary) forest	433	1	5	4.49	5
Managed (secondary) forest	414	1	5	3.40	3
Pasturelands	321	1	5	2.51	2
Croplands	346	1	5	2.79	3
Water for animal use from					
Unmanaged (primary) forest	399	1	5	4.34	5
Managed (secondary) forest	389	1	5	3.36	3
Pasturelands	379	1	5	3.69	4
Croplands	326	1	5	2.90	3
Timber and timber derivates from					
Unmanaged (primary) forest	422	1	5	4.41	5
Managed (secondary) forest	427	1	5	3.94	4
Pasturelands	273	1	5	1.87	1
Croplands	304	1	5	2.31	2
Non-timber products from					
Unmanaged (primary) forest	414	1	5	4.33	5
Managed (secondary) forest	396	1	5	3.37	3
Pasturelands	286	1	5	2.01	2
Croplands	372	1	5	2.98	3

Extremely Low	***Low***	***Moderate***	***High***	***Very High***
0 - 1	***1.01 - 2***	***2.01 - 3***	***3.01 - 4***	***4.01 - 5***

Since the industrial activity in the region is still low, the opportunities for stable jobs are poor and, similar to other regions (Mikulcak et al., 2013), local communities typically practice subsistence farming given the absence of job alternatives at local level. Therefore, most people from the studied area still rely heavily on the traditional provision of ES in their daily lives, as other studies have found (Fischer et al., 2012; Mikulcak et al., 2013). When an ecosystem is modified by human activities, most of the ES are affected (Fu et al., 2015; Li et al., 2019). In agricultural and livestock systems, the production is high, while their capacity to provide regulating services is low; it is so croplands and pasturelands registered high values in provisioning services in comparison to the rest of categories. Li et al. (2019) analyzed the introduction of agro-environmental measures based on the ecosystem services and farmers attitudes, and have determined that the increases of arable land area changed in a positive sense the cultural services and food supply, even tough it caused a decrease of the non-crop habitats area and biodiversity.

Land fragmentation is caused by urbanization and the intensity of human activities (Fu et al., 2015). For example, intensive agriculture and urbanization are known to affect the provision of cultural benefits (especially recreation and tourism) and regulating functions such as carbon sink and biodiversity, due to forest damage (Fu et al., 2015). As a consequence, ecosystem services information (identification and evaluation) is important to sustain land-use planning, environmental management and conservation (Habib et al., 2016). While the agro-ecosystems have been typically seen to be provision systems, the management can change this situation towards enabling them to supply services from the rest of categoies (Power, 2010).

Table 11. *Descriptive statistics on importance and use of regulation services*

Ecosystem services category, subcategories and type of ecosystem	Number of respondents	Minimum value	Maximum value	Average value	Median value
Regulation of (or by)					
Biologic control provided by					
Unmanaged (primary) forest	294	1	5	3.14	3
Managed (secondary) forest	342	1	5	2.90	3
Pasturelands	376	1	5	3.47	4
Croplands	406	1	5	3.77	4
Water quality by					
Unmanaged (primary) forest	401	1	5	4.49	5
Managed (secondary) forest	390	1	5	3.51	4
Pasturelands	328	1	5	2.31	2
Croplands	350	1	5	2.67	3
Water regulation by					
Unmanaged (primary) forest	313	1	5	3.09	3
Managed (secondary) forest	353	1	5	2.93	3
Pasturelands	341	1	5	3.07	3
Croplands	364	1	5	3.35	3
Biodiversity by					
Unmanaged (primary) forest	436	1	5	4.63	5
Managed (secondary) forest	407	1	5	3.62	4
Pasturelands	362	1	5	2.83	3
Croplands	365	1	5	2.90	3
Purification of air by					
Unmanaged (primary) forest	417	1	5	4.63	5
Managed (secondary) forest	402	1	5	3.75	4
Pasturelands	318	1	5	2.43	2
Croplands	357	1	5	2.85	3

Extremely Low	Low	Moderate	High	Very High
0 - 1	***1.01 - 2***	***2.01 - 3***	***3.01 - 4***	***4.01 - 5***

The results of **Table 13** indicate that regulating services got the highest scores for three types of ecosystems (land uses): secondary forest followed by croplands and pasturelands; this last land use type registered the same score for provisioning services. The highest rated capacity of primary forest was that corresponding to the cultural services. Even though regulating services are intangible, the respondents identified and valued quite high the services belonging to this category, probably as an effect of indigenous people understanding the complexity of tropical ecosystems beyond finding many direct and indirect uses of plants (Ríos and Pedersen, 1997).

Concerning the cultural services, the potentials of primary and secondary forest were rated as being very high and high, respectivey; in contrast, the croplands and pasturelands have been seen to have a moderate capacity to provide. Forests are associated to spiritual, recreational, educational, aesthetic and religious purposes (Kalaba, 2016). In addition, based on the obtained results, it has been identified that the analyzed ecosystems (land use types) were rated as being multifunctional given that they can simultaneously supply services belonging to all the categories of ES (Schmidt et al., 2017), and the provisioning of a particular category does not affect to others. In this regard, protected areas are seen to hold a higher capacity to provide regulating and cultural services compared to other land use types (Affek and Kowalska, 2017), therefore, the implementation of local conservation measures could improve the situation in this regard.

Table 12. *Descriptive statistics on importance and use of cultural ecosystem services*

Ecosystem services category, subcategories and type of ecosystem	Number of respondents	Minimum value	Maximum value	Average value	Median value
Cultural services as					
Recreation and tourism used in or provided by					
Unmanaged (primary) forest	404	1	5	4.13	5
Managed (secondary) forest	408	1	5	3.56	4
Pasturelands	322	1	5	2.36	2
Croplands	352	1	5	2.65	3
Scientific ground used in or provided by					
Unmanaged (primary) forest	397	1	5	4.34	5
Managed (secondary) forest	376	1	5	3.34	3
Pasturelands	323	1	5	2.89	3
Croplands	342	1	5	2.99	3
Ancestral and spiritual experiences provided by					
Unmanaged (primary) forest	360	1	5	4.09	5
Managed (secondary) forest	347	1	5	3.14	3
Pasturelands	246	1	5	1.84	1
Croplands	272	1	5	2.21	2

Extremely Low 0 - 1	***Low 1.01 - 2***	***Moderate 2.01 - 3***	***High 3.01 - 4***	***Very High 4.01 - 5***

Table 13. *Aggregated potential of land use types to provide different categories of services*

Category of ecosystem services	Primary forest	Secondary forest	Croplands	Pasturelands
Provisioning services	4.10	3.28	2.94	**2.82**
Regulating services	4.00	**3.34**	**3.11**	**2.82**
Cultural services	**4.19**	3.35	2.62	2.36

Extremely Low 0 - 1	**Low 1.01 - 2**	Moderate 2.01 - 3	High 3.01 - 4	Very High 4.01 - 5

The data analyzed in this section (4.4.2) allowed identifying, in a general way, the potential of the predominant ecosystems in the parish. The next section (4.4.3), analyses the variability in the perspectives on ecosystem services; for this, there were established groups based on the collected social features (4.4.1).

4.4.3. Factors acting as perception modyfiers

Many research works have suggested that there is a set of factors that modify the perception on the capacity of ecosystems to supply services, with most of them resting in the socio-demographic features of the respondents (Affek and Kowalska, 2017; Allendorf and Yang, 2013; Felipe et al., 2015; Hami and Tarashkar, 2018; Sklenicka and Molnarova, 2010). For the present study, the analyzed social and demographic features were the gender, age, education level, occupation and income level. **Table 14** shows the results of non-parametric tests that have taken into consideration the above-mentioned factors and have been statistically interpreted based on the p-values. It was found that age, education level and occupation acted as modifying factors on the use and perception on the capacity to provide ecosystem services. Education level was the most important factor because it modified the perception in regards to all categories of ecosystem services, while age and occupation changed only the perception on regulating services. Kruskal-Wallis and Mann-Whitney tests indicate only if there is variability within the established groups for each feature or variable; however, they do not indicate which of these groups differ significantly in relation to the other (Laguna 2014; Gómes et al., 2003). In the case of Mann-Whitney test, it is not necessary to apply a post-test because it compares two groups only. In contrast, Kruskal-Wallis test analyzes more than two groups (see section 4.4.1.) and to be able to find where the differences are, it requires, in addition, the implementation of a post-test, such as the Dunn test. The positive results of Dunn test in regards to the education level (in which exists difference) are presented in **Table 15**.

Table 14. *Factors that modify the perception on ecosystems capacity to provide services and their significance*

Modifying factor (used test)	Category of Ecosystem Service	p-value	Significance
Gender (Mann-Whitney test)	Provisioning services	0.227	No
	Regulating services	0.057	No
	Cultural services	0.350	No
Age (Kruskal-Wallis test)	Provisioning services	0.139	No
	Regulating services	**0.025**	**Yes**
	Cultural services	0.455	No
Education level (Kruskal-Wallis test)	**Provisioning services**	**0.001**	**Yes**
	Regulating services	**0.009**	**Yes**
	Cultural services	**0.005**	**Yes**
Occupation (Kruskal-Wallis test)	Provisioning services	0.400	No
	Regulating services	**0.004**	**Yes**
	Cultural services	0.405	No
Income (Kruskal-Wallis test)	Provisioning services	0.740	No
	Regulating services	0.823	No
	Cultural services	0.991	No

Table 15. *Variability within the groups of education level. Note: The table contains only the positive results of Dunn tests (in which p value < 0.05)*

Category	Group 1	Group 2	p-value
Provisioning services	Elementary school incomplete	Elementary school completed	0.0039
	Elementary school incomplete	Highschool incomplete	0.0004
	Elementary school completed	Third to Fourth level	0.0490
	Highschool incomplete	Highschool completed	0.0103
	Highschool incomplete	Third to Fourth level	0.0077
Regulating services	Elementary school incomplete	Highschool incomplete	0.0005
	Elementary school incomplete	Highschool completed	0.0184
	Elementary school incomplete	Highschool incomplete	0.0005
	Elementary school incomplete	Third to Fourth level	0.0063
Cultural services	Elementary school incomplete	Elementary school completed	0.0037
	Elementary school incomplete	Highschool incomplete	0.0001
	Elementary school incomplete	Highschool completed	0.0077
	Elementary school incomplete	Third to Fourth level	0.0456

Table 16. *Median values of ratings on the ecosystems capacity to provide services according ecuation level*

Category	Elementary school incomplete	Elementary school completed	Highschool incomplete	Highschool completed	Third to Fourth level
Provisioning services	3.19	3.48	3.60	3.35	3.21
Regulating services	3.00	3.48	3.53	3.40	3.55
Cultural services	2.75	3.33	3.50	3.25	3.08

The comparisons between the different levels of education (**Table 15**) allowed to identify the existence of significant statistical differences among the ratings of all established groups. Based on the median values (**Table 16**), the general trend was that the respondents who declared their belonging to the education group of "primary school incompleted" rated lower the capacity of ecosystems to provide compared to those belonging to groups of higher levels of education. Affek and Kowalska (2017) pointed out that there is a direct relationship between the level of education and the perception of respondents towards the capacity of ecosystems to provide non-material benefits. In addition, the knowledge on the ecosystems and their services are related with the education lavel and familiarity with the surroundings (Allendorf and Yang, 2013), and there is a positive significant relation between the education and the level of commitment to forest management (Ouko et al., 2018).

Table 17. *Variability within the clusters of age (regulating services). Note: The table contains only the positive results of Dunn tests (in which p value < 0.05)*

Group 1	Group 2	p-value
≤30 years old	31-40 years old	0.0203
≤30 years old	41-50 years old	0.0187
≤30 years old	>60 years old	0.0160

Table 18. *Median values of regulating services according age groups*

≤30 years old	≤30 years old	41-50 years old	51-60 years old	>60 years old
3.50	3.40	3.33	3.43	3.20

Regarding the age groups, there were significant rating differences among the following groups (**Table 17**): ≤30 years old versus 31-40 years old, 41-50 years old, and >60 years old. The median values of ratings per regulating category of ecosystem services (**Table 18**) indicated that young people assigned the highest scores and, as age increased, the score of ratings decreased. According to many studies, higher levels of education as well as an increase of age are associated with higher ratings on ecosystem capacity to provide services, especially with those belonging to regulating and cultural categories (Allendorf and Yang, 2013; Quintas-Soriano et al., 2018). The underlying mechanism supporting this behavior is quite simple and consists of the fact that education level and familiarity are immediate consequences of age (Allendorf and Yang, 2013). The results of this study, however, indicated that older respondents gave lower ratings on the capacity to supply services, probably because most of them have not completed their academic training, so they probably had little knowledge about the topics related to ecology and ecosystems. In Ecuadorian rural areas, the percentage of illiteracy is higher in men and women of 65 years or more, being 49.7% and 34.3% respectively (Ferreira et al., 2013). There were significant differences among the following groups of declared occupations in terms of ratings (**Table 19**): housewife versus other occupations, employees versus students and others, unemployed versus students, student versus independent and other, and independent versus other. According **Table 20**, students assigned the highest scores for the regulating ES category.

Table 19. *Variability within the clusters of occupation (Regulating services). Note: The table contains only the positive results of Dunn tests (in which p value < 0.05)*

Group 1	Group 2	p-value
Housewife	Other	0.0111
Employee	Student	0.0021
Employee	Other	0.0462
Unemployed	Student	0.0163
Student	Independent	0.0201
Student	Other	0.0023
Independent	Other	0.0215

Table 20. *Median values of regulating services according occupation groups*

Housewife	Employee	Unemployed	Student	Independent	Retired	Other
3.50	3.39	3.15	3.63	3.41	3.31	2.91

The occupation is related directly with education level; as found in this study, students who were within the academic process assigned higher values because they knew topics related to environment. Marín-Muñiz et al. (2016) indicated that the ecosystem services and environmental characteristics are perceived differently between the productive population and young students owing to their knowledge and interaction with the environment. In general, productive population values high provisioning services, while students recognize all categories of services so they are more interested in the implementation of conservation activities (Affek and Kowalska, 2017; Higuera et al., 2013).

4.4.4. Relative importance and use of ecosystem services in landscapes

Figure 9 shows the specific distribution of data on the relative importance of ES, based on the study sample and the scales taken into study. A first observation was that, irrespective of the scale taken into study, the ecosystem services provided by the native (primary, unmanaged) forests were found to have the highest use and importance based on the data provided by respondents as ratings. Second in line were the managed (secondary) forests, that were followed by the croplands and pasture lands. Another observation was that the primary (native) forests were found to have the highest relative importance in the cultural ecosystem services category, a category that, in the order of relative importance, was followed by provision and regulation ecosystem services categories.

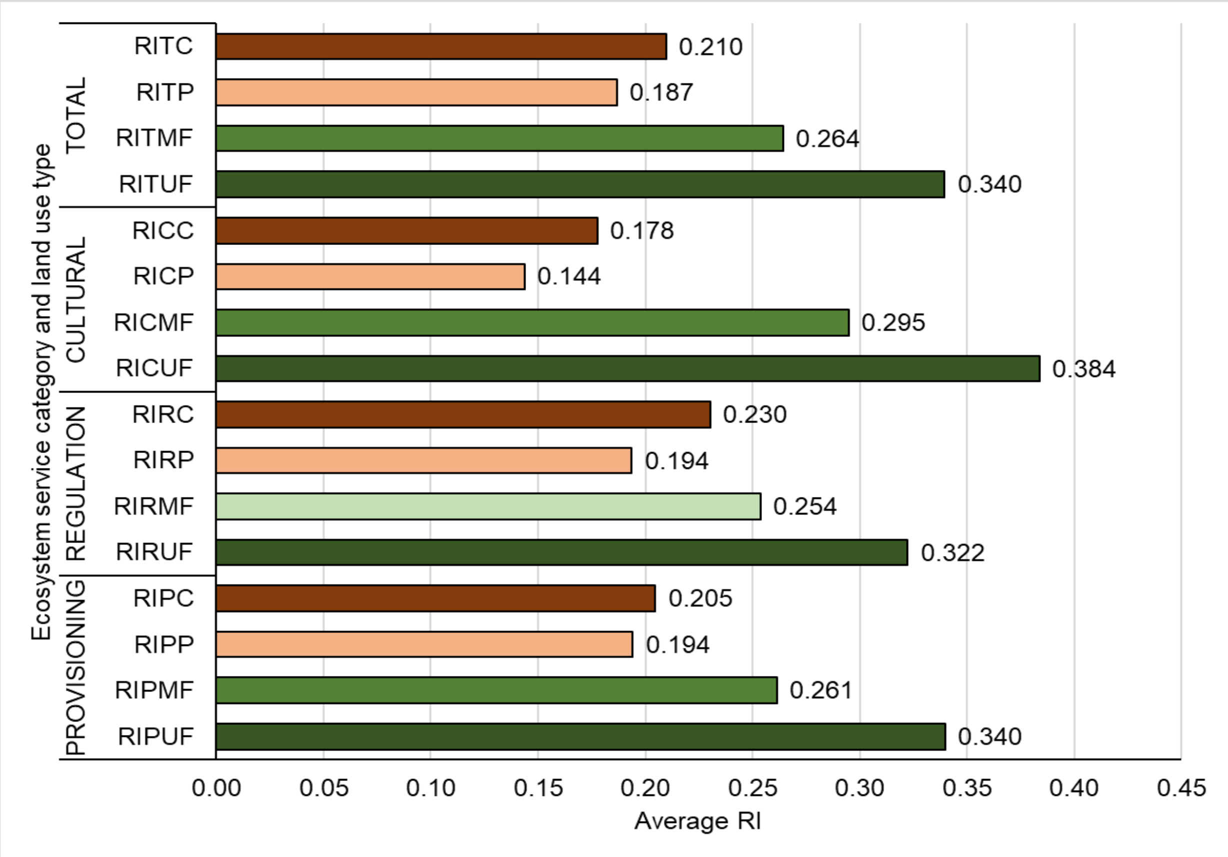

Figure 9. *Relative importance and use per ecosystem services categories and land use types. Legend: RI - Relative Importance of P - Provision, R - Regulation, C - Cultural and Overall (T) services for (UF) - Unmanaged Forests, (MF) - Managed Forests, (P) - Pasturelands, and (C) - Croplands*

At the general landscape level, the most important group was that of primary (unmanaged) forests, accounting for more than one third of the general importance (34%) and being followed by secondary (managed) forests and croplands (26.4% and 21.70% respectively). The lowest importance and use were found in case of pasturelands (18.70%). Nevertheless, in the category of cultural ecosystem services, the native forests were found to have a relative importance of close to 40%, mainly on the expense of crop and pasture lands. Also, taken together, the forests accounted for a relative importance higher than 50% (and higher than 60% by excluding the regulation ES) at all the scales taken into study. Unfortunately, it was not possible to compare these findings with other results, since there are no similar studies considering the relative importance given or attributed to ES. In addition, the ES are dependent on biotic and abiotic factors within a specific study area, a fact that might limit the comparability even in such a case in which similar results would have been available.

4.4.5. Spatial scaling

Results on the scaling of relative importance are given in **Figure 10**, showing a relatively similar pattern in what regards the level of importance of ES, irrespective of the ecosystem service category. Nevertheless, important redistributions of data appeared in the case of cultural ecosystem services which received a higher relative importance (*i.e.* **Table 21**) in the case of primary and secondary forests at the expense of pasture and croplands.

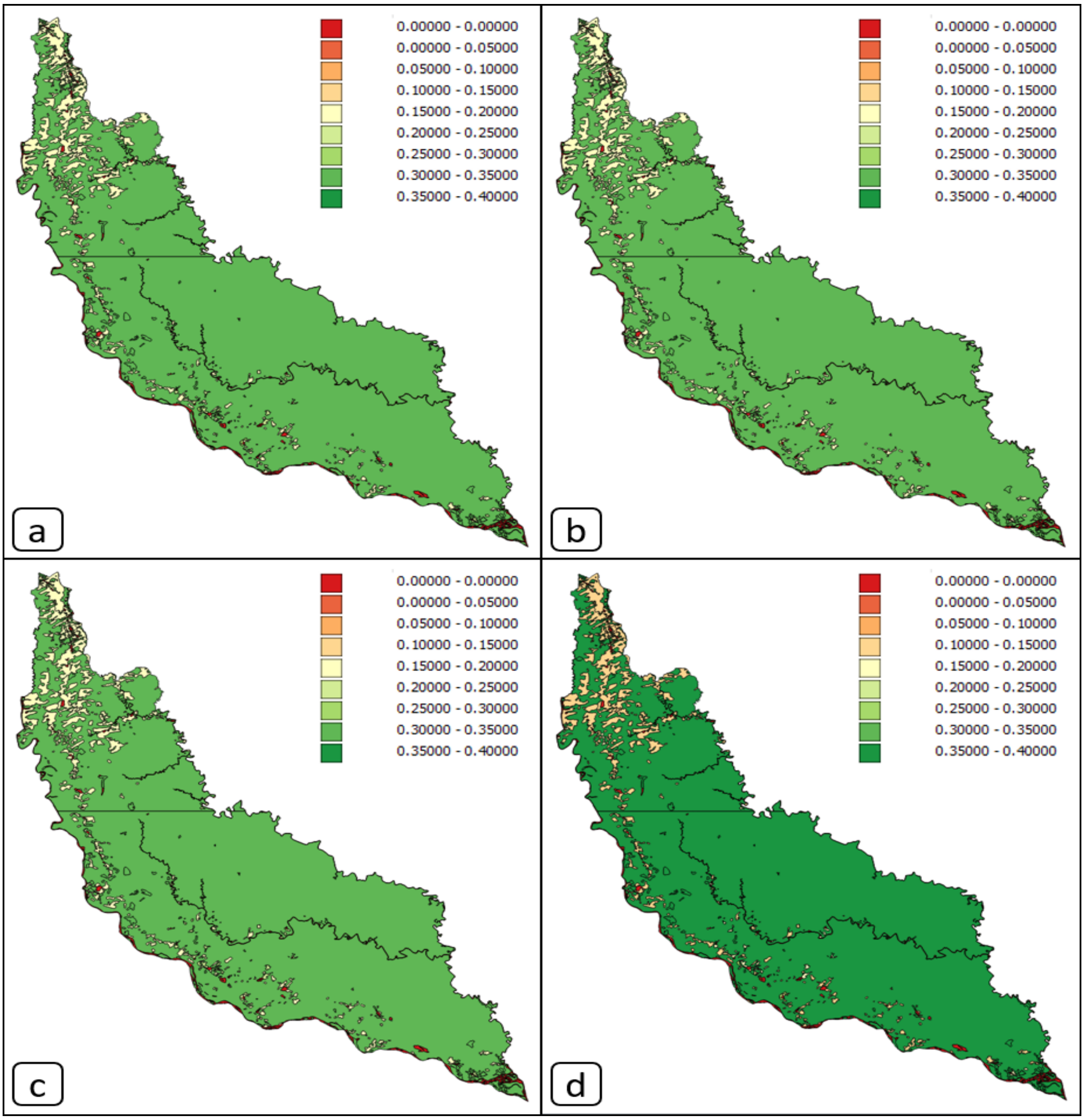

Figure 10. *Importance and use of ecosystem services by spatial scaling. Legend: a) relative importance of ecosystem services irrespective of the ecosystem service category, b) relative importance of provisioning ecosystem services, c) relative importance of regulating on ecosystem services, d) relative importance of cultural ecosystem services (where relative importance may take values between 0.1 and 1)*

Data shows, however, that primary forest, which accounts for most of the territory taken into study, received a relative importance greater than 0.3 (more than 30%) in all the cases: provisioning, regulation and cultural ecosystem services categories as well as at an aggregated level. By scaling the results to the areas of the land use systems described in this work, the results are shown in **Table 21**, excepting here the category of other land use types. As shown, the weighting given by the area covered by land management systems taken into study translated the data in a quite different distribution, with higher ratings associated to the primary forest, which were in range of 0.954 - 0.970 (95.4-97.0%). The secondary forest seemed to lose much from its weighted importance given the fact that area covered by this type of forest was the lowest. Acknowledging the limitations of using an area weighting procedure to show the importance of different land use types, these results are the solely that could be produced given the available data. Even in this case, the ranking of importance kept the primary rainforest at the top. At one glance, interested parties could judge the data based on the relative importance given by the respondents (**Figure 9**), which is important. Nevertheless, people often lack the ability to scale up their ratings when evaluating something bigger that they cannot see during the evaluation, while the relationships that they maintain with landscapes appear to be increasingly important (Giannecchini, et al., 2007) as their knowledge on the services provided by a given area or land management system is growing (Lamarque et al., 2011). Given the above, it is willy important to extrapolate the findings to be able to inver the real importance of the land management systems taken into study.

Table 21. *Importance and use of ecosystem services scaled at study area level by are weighting*

Category of ecosystem services and types of land management systems	Area of land use*	Relative importance	Scaled importance** (%)
General			
Unmanaged (primary) forest	92,716.38	0.340	95.777
Managed (secondary) forest	46.44	0.264	0.037
Pasturelands	6,831.84	0.187	3.882
Croplands	477.35	0.210	0.305
Provisioning			
Unmanaged (primary) forest	92,716.38	0.340	95.645
Managed (secondary) forest	46.44	0.261	0.037
Pasturelands	6,831.84	0.194	4.021
Croplands	477.35	0.209	0.297
Regulating			
Unmanaged (primary) forest	92,716.38	0.322	95.377
Managed (secondary) forest	46.44	0.254	0.038
Pasturelands	6,831.84	0.194	4.234
Croplands	477.35	0.230	0.351
Cultural			
Unmanaged (primary) forest	92,716.38	0.384	97.049
Managed (secondary) forest	46.44	0.295	0.037
Pasturelands	6,831.84	0.144	2.682
Croplands	477.35	0.178	0.232

Note: * Not shown area of other land use types (2,000.67 ha). ** Not shown: the scaled importance of other land use types (assumed to be 0)

In what regards the use of ES, of a great concern is that respondents associated the provision of timber (**Table 21**) with primary (unmanaged) forest meaning that they either use this product from the forest even if it is against the law or just consider that its provision is important. According to Ecuadorian laws, timber harvesting in mangrove and protected areas, or in areas characterized by a scaricity in vegetable cover is punishable (National Congress of Ecuador, 2004); unfortunately, not all of the primary forest area of ”Simon Bolívar” parish is considered to be a protected area (CDTER, 2015). Explanations for that outcome could be the way the people formulated their mind construct about the primary forest when answering in terms of importance or in terms of use. Nevertheless, the growing social demand of timber forest products is covered by an increase in the volume of wood obtained from natural and planted forests (Fregoso et al., 2001). The environmental consequences of the increasing extraction of timber in the area may be, among others, the loss of biological diversity, increased deforestation, and promotion of erosion and contamination of water bodies (IUCN, 1996) which could be avoided by using the latest initiatives aiming to improve the practice of natural resources utilization (Daily et al., 1997). These include the preservation of biological diversity and the maintenance of environmental goods and services that the forest naturally provides (Oliver et al., 1992; Sist et al., 1998; Bocco et al., 2000). On the other hand, the landscape sustains the formation of indigenous communities (Rodriguez, 2018) whose inhabitants can operate as promoters of biological protection (Bocco et al., 2000). In addition, a management that involves a wise use of wood or other forest products has more advantages for conservation over that of a pasture or a crop (Palacios and Malessa, 2010). To summarize, if the responses described the importance, then probably the sustainability of native forest ecosystem will not be affected. If the second option is true, which is also more likely given the distribution of respondents per categories of income and employment, then measures should be taken to ensure sustainability of provision as well as regulation obeying. Since this could be achieved by creating new or better-paid jobs, one option would be that of developing a local economy that should ensure the resilience of local ecosystems (*e.g.* tourism). Another option would be to develop the current economic practices at that extent that would not compromise the resilience of local forest.

4.5. Importance of forest ecosystems conservation in the area

The distributions about the level of importance of the personal and collective (family) opinions were similar. In both cases, the majority of respondents stated that the preservation of water and forests is very important for the maintenance of their lives and the development of their activities (375 responses for personal and 354 for collective opinions). Only three cases were associated to the less important category in case of personal opinions and only five cases in the case of collective opinions. In addition, the responses to these items did not show any relations or clusterings as an effect of the social and demographic features collected by this work. One of the strategic aims of the “Simón Bolívar” parish is the environmental sustainability (CDTER, 2015), so in its territory, there are some protected areas that provide many benefits to settlers (CDTER, 2015). In addition, the ethnic groups from Amazon region conserve and protect their natural and cultural heritage (Ríos and Pedersen, 1997); the predominant etnia of “Simón Bolívar” parish is Shuar (CDTER, 2015).

The Ecuadorian system of protected areas (SNAP) comprises all protected natural areas, with the main goal to guarantee the coverage and connectivity of important ecosystems, their resources, and their major water sources (MAE, 2006). Aiming to limit the deforestation and the damage of natural vegetation coverage, it is considered as being necessary that a major area of “Simón Bolívar” parish to be included into SNAP (CDTER, 2015). In addition, other alternatives should be searched to counteract the negative effects of the rapid population increase and the expansion of the area destined for infrastructure; the notion that multifunctional rural landscapes provide multiple services, contributes to land use planning that optimize the space and develops green infrastructure in inhabited areas, which can deliver ecosystem services (Balzan et al., 2018). Promoting land policies that protect the ecosystems, prioritization of ecosystem services and sustainably balancing trade-off among different categories of services (Quintas-Soriano et al., 2018) are other aspects that should be implemented in the study area. Ouko et al. (2018) have recommended that *“In order to improve forest conservation, it is necessary to ensure community members participation in sustainable forest management”*, hence, the respondents might participate in conservation activities because of their interest in protecting forest and water resources. In addition, a sustainable management of forests requires sustainable actions to be designed and implemented over large spatio-temporal scale (Fisher, 2018). Such management actions include the identification of the ES, the actual state of resources and the threats (current and future), aspects that promote the inclusion of activities of conservation and the participation of population (Marín-Muñiz et al., 2016). To summarize, the results on the importance of conservation of ES from the area for the benefits of local communities, it has been found that the locals as individuals or families think that conservation measures would enable a sustainable flow of ES, and such measures are important for their life and provision of services. These outcomes are supported by the ratings given by the vast majority of the respondents - individual or family opinions - as very important or important, which reached close to 100% of the study sample.

4.6. Visual preferences towards the types of land management

Table 22 shows the aggregated visual preferences of the questioned locals of the 12 presented pictures, in the form of main descriptive statistics (mean, median and standard deviation). The highest average (mean) score was that specific to the P1 that corresponded to primary forest (position of the observer: far), and the lowest score belonged to picture 10 that corresponded to the pasturelands (position of the observer: far). It was found, in general, that higher values of ratings were related to the naturalness and abundance of the scenes shown to the respondents. The existing studies about visual preference and quality of scenes pointed out that higher rates of appreciation corresponded to continuous vegetation cover (Nahuelhual et al., 2018) such as the case of native forest, while pasturelands have been rated by lower scores because they more features in common with the agricultural practices (Häfner et al., 2018), so people associate this kind of land use system with anthropogenic disturbance and intensive use of soil. Pan et al. (2014) mentioned that natural resources (*e.g.* water, flora and fauna) cause affective feelings towards a place. In addition, it was found that the photos that showed the ecosystems from a near (P3 - primary forest and P12 - pasturelands) and intermediate (P5 - secondary forest and P8 - croplands) perspective registered the highest scores within the following groups: secondary forest, croplands and livestock areas. The variations on the scene perception allows recognizing some elements (diversity) and their characteristics (shape, density, position) (Rensink, 2000), and a near perspective interlinks the objects and denotes a high density (abundance).

Table 22. *Descriptive statistics of visual preferences on land management systems*

Land management system and perspective of the picture	Code	Mean	Median	Standard deviation
Unmanaged (primary) forest				
Far	P1	3.99	4	1.25
Intermediate	P2	3.93	4	1.04
Close (inside)	P3	3.94	4	1.08
Managed (secondary) forest				
Far	P4	3.05	3	1.11
Intermediate	P5	3.09	3	1.22
Close (inside)	P6	2.91	3	1.29
Croplands				
Far	P7	3.49	4	1.21
Intermediate	P8	3.78	4	1.27
Close (inside)	P9	3.14	3	1.31
Pasturelands				
Far	P10	2.89	3	1.33
Intermediate	P11	3.40	4	1.32
Close (inside)	P12	3.61	4	1.37

The results of this work indicate, therefore, that the native (primary, unmanaged forest) was perceived as most liked by the respondents compared to all the rest of land management systems. These ratings were probably less dependent on the perspective shown to the people and all of them were close to 4. Managed forest (secondary forest) has lost many of its ability to generate positive feelings, maybe due to evident human intervention that were seen by the respondents in the pictures shown to them. As a fact, there was little differentiation between the ratings given to it and those corresponding to croplands and pasturelands, whith the average scores indicating a higher appreciation of the last two land management systems compared to the managed forest. This outcome may very well reflect the attitude of respondents towards conservationism as well as raising feelings on the protection of forest. However, the preception was also the subject of a dualism because it seems that the respondents also appreciated highly the crops ans pasturelands which are land management systems derived from the removal of original forest.

4.7. Visual preferences on categories of socio-demographic factors

Tables 23-26 show a breakdown of the visual preferences on categories of socio-demographic factors. The data included in the development of descriptive statistics stands only for those cases in which a given respondent evaluated at least one picture from the set of 12 shown. Also, the descriptive statistics were computed only for those groups and variables for which there existed at least two respondents. As the data on such perceptions is likely to be non-normally distributed, both, the average and median values are reported. Detailed explanations on the data shown are given in the full tehsis.

Unfortunately, it was not possible to compare widely the results of **Tables 23-26** because there are no similar studies that analyzed the same land uses versus all the social factors considered in this research. However, according to other approaches, among the factors that modify the visual preferences are the social and demographic features of the respondents (observers), such as the gender, education level - environmental knowledge, familiarity, age and occupation (Kalivoda et al., 2014; Campbell et al., 2019). Häfner et al. (2018) have mentioned that women, people of third level completed and those who had knowledge about the environment and its value assigned positive scores to diverse landscapes.

Table 23. *Respondents' preferences for primary forests on social and demographic features and distance of the eye*

Socio-demographics	Far (P1)				Intermediate (P2)				Close (inside) (P3)			
	N	*x*	*M*	*SD*	*N*	*x*	*M*	*SD*	*N*	*x*	*M*	*SD*
Gender												
Male	216	4.11	5.00	1.22	216	3.98	4.00	1.01	216	3.95	4.00	1.05
Female	214	3.80	4.00	1.36	214	3.84	4.00	1.14	214	3.83	4.00	1.24
Civil status												
Single	158	3.87	4.00	1.32	158	3.89	4.00	1.07	158	3.82	4.00	1.20
Married	135	4.12	5.00	1.17	135	3.98	4.00	0.95	135	3.90	4.00	1.11
Common law	87	3.82	4.00	1.42	87	3.90	4.00	1.23	87	3.92	4.00	1.18
Divorced	27	4.41	5.00	0.89	27	4.11	4.00	1.01	27	4.15	4.00	1.06
Widow(er)	15	3.53	4.00	1.77	15	3.27	3.00	1.39	15	4.00	4.00	1.13
Not declared	9	3.67	4.00	1.41	9	3.89	4.00	0.60	9	3.89	4.00	1.05
Age												
≤30 years old	182	3.80	4.00	1.38	182	3.92	4.00	1.08	182	3.86	4.00	1.24
31-40 years old	112	4.03	5.00	1.26	112	3.86	4.00	1.13	112	3.88	4.00	1.05
41-50 years old	58	4.28	5.00	0.99	58	4.17	4.00	0.82	58	4.14	4.00	0.94
51-60 years old	39	4.46	5.00	0.76	39	4.08	4.00	1.01	39	4.18	4.00	0.76
>60 years old	37	3.59	4.00	1.55	37	3.46	4.00	1.14	37	3.43	4.00	1.41
Level of education												
First level incompleted	32	3.25	4.00	1.85	32	3.75	4.00	0.92	32	3.75	4.00	1.34
First level completed	112	3.82	4.00	1.38	112	3.82	4.00	1.07	112	3.84	4.00	1.17
Second level incompleted	72	3.82	4.00	1.31	72	3.92	4.00	1.18	72	3.60	4.00	1.27
Second level completed	133	4.20	5.00	1.10	133	3.95	4.00	1.05	133	4.06	4.00	1.00
Third level incompleted	39	3.87	4.00	1.08	39	3.92	4.00	1.04	39	3.92	4.00	1.13
Third level completed	35	4.43	5.00	0.88	35	4.09	4.00	1.07	35	4.03	4.00	1.04
Fourth level incompleted	-	-	-	-	-	-	-	-	-	-	-	-
Fourth level completed	5	4.20	5.00	1.79	5	3.60	4.00	1.67	5	3.80	5.00	1.79
Not declared	23	3.70	5.00	1.61	23	3.87	4.00	1.22	23	3.43	4.00	1.67
Employment												
Housewife	105	3.76	4.00	1.38	105	3.84	4.00	1.11	105	3.73	4.00	1.28
Employee	109	4.04	5.00	1.38	109	3.91	4.00	1.05	109	4.00	4.00	1.06
Freelancer/entrepreneur	145	4.11	5.00	1.16	145	3.91	4.00	1.09	145	3.99	4.00	0.98
Unemployed	8	3.25	4.00	1.39	8	4.38	5.00	1.06	8	3.88	4.50	1.36
Student	54	3.81	4.00	1.26	54	3.98	4.00	1.07	54	3.76	4.00	1.40
Retired	9	4.11	5.00	1.36	9	3.89	4.00	0.78	9	3.44	4.00	1.33
Other/Not declared	-	-	-	-	-	-	-	-	-	-	-	-
Level of income												
Not declared	23	3.70	5.00	1.61	23	3.87	4.00	1.22	23	3.43	4.00	1.67
No income	2	3.00	3.00	2.83	2	4.00	4.00	1.41	2	4.50	4.50	0.71
≤394 $	292	3.84	4.00	1.36	292	3.83	4.00	1.08	292	3.84	4.00	1.13
395-733 $	70	4.24	5.00	1.03	70	4.06	4.00	1.13	70	4.10	4.00	1.08
734-901 $	21	4.43	5.00	0.68	21	4.19	4.00	0.87	21	4.00	4.00	1.10
902-1086 $	7	4.29	5.00	1.11	7	4.57	5.00	0.53	7	4.57	5.00	0.79
1087-1412 $	10	4.5	5.00	0.71	10	4.10	4.00	0.88	10	3.90	4.00	1.10
1413-1760 $	3	4.33	5.00	1.15	3	4.33	4.00	0.58	3	4.33	5.00	1.15
1761-2034 $	-	-	-	-	-	-	-	-	-	-	-	-

Extremely Low	Low	Moderate	High	Very High
0 - 1	1.01 - 2	2.01 - 3	3.01 - 4	4.01 - 5

Table 24. *Respondents' preferences for secondary forests on social and demographic features and distance of the eye*

Socio-demographics	Far (P4)				Intermediate (P5)				Close (inside) (P6)			
	N	*x*	*M*	*SD*	*N*	*x*	*M*	*SD*	*N*	*x*	*M*	*SD*
Gender												
Male	216	3.14	3.00	1.10	216	3.05	3.00	1.20	216	2.94	3.00	1.32
Female	214	2.89	3.00	1.20	214	2.98	3.00	1.39	214	2.78	3.00	1.36
Civil status												
Single	158	3.03	3.00	1.12	158	3.05	3.00	1.22	158	2.87	3.00	1.27
Married	135	2.96	3.00	1.20	135	2.87	3.00	1.28	135	2.78	3.00	1.30
Common law	87	3.11	3.00	1.13	87	3.29	3.00	1.35	87	2.98	3.00	1.43
Divorced	27	3.19	3.00	1.30	27	3.15	3.00	1.46	27	3.00	3.00	1.44
Widow(er)	15	2.87	3.00	1.19	15	2.60	2.00	1.64	15	3.07	3.00	1.67
Not declared	9	2.33	2.00	1.00	9	2.33	2.00	1.00	9	2.00	2.00	1.32
Age												
≤30 years old	182	2.93	3.00	1.15	182	3.03	3.00	1.29	182	2.83	3.00	1.35
31-40 years old	112	3.15	3.00	1.12	112	2.96	3.00	1.27	112	2.96	3.00	1.32
41-50 years old	58	2.97	3.00	1.12	58	3.02	3.00	1.19	58	2.72	3.00	1.28
51-60 years old	39	3.13	3.00	1.22	39	3.18	3.00	1.34	39	3.13	3.00	1.17
>60 years old	37	2.89	3.00	1.31	37	3.05	3.00	1.63	37	2.73	3.00	1.56
Level of education												
First level incompleted	32	2.91	3.00	1.35	32	3.38	3.00	1.41	32	3.34	3.00	1.29
First level completed	112	3.01	3.00	1.13	112	3.10	3.00	1.34	112	2.92	3.00	1.30
Second level incompleted	72	2.71	3.00	1.27	72	2.78	3.00	1.44	72	2.89	3.00	1.50
Second level completed	133	3.12	3.00	1.01	133	3.06	3.00	1.20	133	2.67	2.00	1.28
Third level incompleted	39	3.03	3.00	1.06	39	2.82	3.00	1.14	39	2.64	3.00	1.29
Third level completed	35	3.29	3.00	1.32	35	3.03	3.00	1.32	35	3.06	3.00	1.35
Fourth level incompleted	-	-	-	-	-	-	-	-	-	-	-	-
Fourth level completed	5	2.60	3.00	1.14	5	2.20	2.00	0.84	5	2.60	2.00	1.34
Not declared	23	3.00	3.00	1.54	23	3.04	3.00	1.49	23	3.26	3.00	1.57
Employment												
Housewife	105	2.83	3.00	1.16	105	3.04	3.00	1.37	105	2.79	3.00	1.36
Employee	109	3.09	3.00	1.04	109	2.94	3.00	1.24	109	2.94	3.00	1.33
Freelancer/entrepreneur	145	3.08	3.00	1.23	145	3.03	3.00	1.33	145	2.83	3.00	1.34
Unemployed	8	3.00	3.00	1.20	8	3.50	3.50	1.20	8	3.38	3.50	1.30
Student	54	3.06	3.00	1.20	54	3.04	3.00	1.29	54	2.81	3.00	1.39
Retired	9	2.89	3.00	1.17	9	2.67	3.00	1.12	9	3.00	3.00	1.22
Other/Not declared	-	-	-	-	-	-	-	-	-	-	-	-
Level of income												
Not declared	23	3.00	3.00	1.54	23	3.04	3.00	1.49	23	3.26	3.00	1.57
No income	2	2.50	2.50	2.21	2	4.00	4.00	0.00	2	4.50	4.50	0.71
≤394 $	292	2.98	3.00	1.12	292	3.06	3.00	1.29	292	2.77	3.00	1.32
395-733 $	70	3.16	3.00	1.07	70	2.87	3.00	1.25	70	3.01	3.00	1.34
734-901 $	21	2.71	3.00	1.19	21	2.76	3.00	1.51	21	2.81	3.00	1.47
902-1086 $	7	3.29	3.00	1.50	7	3.43	3.00	1.51	7	3.29	3.00	0.95
1087-1412 $	10	3.40	3.50	0.97	10	3.20	3.00	0.79	10	3.00	3.00	1.05
1413-1760 $	3	2.67	3.00	2.52	3	1.67	2.00	1.53	3	2.00	2.00	2.00
1761-2034 $	-	-	-	-	-	-	-	-	-	-	-	-

Extremely Low	Low	Moderate	High	Very High
0 - 1	1.01 - 2	2.01 - 3	3.01 - 4	4.01 - 5

Table 25. *Respondents' preferences for croplands on social and demographic features and distance of the eye*

Socio-demographics	Far (P7)				Intermediate (P8)				Close (inside) (P9)			
	N	*x*	*M*	*SD*	*N*	*x*	*M*	*SD*	*N*	*x*	*M*	*SD*
Gender												
Male	216	3.44	3.50	1.22	216	3.62	4.00	1.33	216	3.12	3.00	1.33
Female	214	3.48	4.00	1.29	214	3.92	4.00	1.23	214	3.02	3.00	1.41
Civil status												
Single	158	3.59	4.00	1.17	158	3.88	4.00	1.20	158	3.00	3.00	1.33
Married	135	3.28	3.00	1.25	135	3.65	4.00	1.33	135	2.97	3.00	1.35
Common law	87	3.55	4.00	1.34	87	3.76	4.00	1.39	87	3.33	4.00	1.40
Divorced	27	3.37	4.00	1.21	27	3.67	4.00	1.30	27	3.26	3.00	1.38
Widow(er)	15	3.47	3.00	1.55	15	4.13	5.00	1.06	15	2.87	3.00	1.64
Not declared	9	3.22	3.00	1.48	9	3.44	4.00	1.67	9	3.33	4.00	1.41
Age												
≤30 years old	182	3.60	4.00	1.23	182	3.89	4.00	1.27	182	3.24	3.00	1.32
31-40 years old	112	3.36	4.00	1.24	112	3.63	4.00	1.37	112	3.00	3.00	1.39
41-50 years old	58	3.38	4.00	1.25	58	3.67	4.00	1.33	58	2.78	3.00	1.39
51-60 years old	39	3.26	3.00	1.12	39	3.82	4.00	1.17	39	3.00	3.00	1.43
>60 years old	37	3.30	4.00	1.47	37	3.62	4.00	1.23	37	2.97	3.00	1.38
Level of education												
First level incompleted	32	3.44	3.50	1.39	32	3.94	4.00	1.22	32	3.53	3.50	1.32
First level completed	112	3.38	4.00	1.34	112	3.74	4.00	1.28	112	3.04	3.00	1.34
Second level incompleted	72	3.39	4.00	1.34	72	3.88	4.00	1.41	72	3.04	3.00	1.51
Second level completed	133	3.63	4.00	1.09	133	3.89	4.00	1.21	133	3.25	3.00	1.32
Third level incompleted	39	3.23	3.00	1.16	39	3.46	4.00	1.17	39	2.36	2.00	1.01
Third level completed	35	3.51	3.00	1.27	35	3.49	4.00	1.42	35	3.03	3.00	1.42
Fourth level incompleted	-	-	-	-	-	-	-	-	-	-	-	-
Fourth level completed	5	3.00	3.00	1.58	5	3.20	3.00	1.79	5	2.60	3.00	1.14
Not declared	23	3.83	4.00	0.98	23	4.09	4.00	0.90	23	3.17	3.00	1.44
Employment												
Housewife	105	3.56	4.00	1.34	105	3.97	4.00	1.24	105	3.15	3.00	1.36
Employee	109	3.39	3.00	1.26	109	3.62	4.00	1.37	109	3.13	3.00	1.39
Freelancer/entrepreneur	145	3.33	3.00	1.27	145	3.72	4.00	1.34	145	2.89	3.00	1.40
Unemployed	8	4.13	4.00	0.83	8	4.00	4.00	1.07	8	4.13	4.00	0.99
Student	54	3.69	4.00	1.06	54	3.81	4.00	1.13	54	3.20	3.00	1.26
Retired	9	3.22	3.00	0.97	9	3.44	4.00	1.33	9	2.89	3.00	1.36
Other/Not declared	-	-	-	-	-	-	-	-	-	-	-	-
Level of income												
Not declared	23	3.83	4.00	0.98	23	4.09	4.00	0.90	23	3.17	3.00	1.44
No income	2	3.50	3.50	0.71	2	3.00	3.00	1.41	2	2.50	2.50	0.71
≤394 $	292	3.41	4.00	1.30	292	3.82	4.00	1.31	292	3.16	3.00	1.35
395-733 $	70	3.57	4.00	1.10	70	3.71	4.00	1.23	70	2.86	3.00	1.31
734-901 $	21	3.38	3.00	1.36	21	3.24	3.00	1.37	21	2.90	3.00	1.55
902-1086 $	7	3.86	4.00	1.21	7	3.29	4.00	1.38	7	3.14	3.00	1.07
1087-1412 $	10	3.80	4.00	1.14	10	3.50	4.00	1.58	10	2.80	3.00	1.55
1413-1760 $	3	1.67	2.00	1.53	3	3.33	4.00	1.15	3	0.67	0.00	1.15
1761-2034 $	-	-	-	-	-	-	-	-	-	-	-	-

Extremely Low	Low	Moderate	High	Very High
0 - 1	1.01 - 2	2.01 – 3	3.01 - 4	4.01 - 5

Table 26. *Respondents' preferences for pasturelands on social and demographic features and distance of the eye*

Socio-demographics	Far (P10)				Intermediate (P11)				Close (inside) (P12)			
	N	*x*	*M*	*SD*	*N*	*x*	*M*	*SD*	*N*	*x*	*M*	*SD*
Gender												
Male	216	2.93	3.00	1.30	216	3.44	4.00	1.30	216	3.54	4.00	1.39
Female	214	2.75	3.00	1.45	214	3.30	3.50	1.39	214	3.58	4.00	1.45
Civil status												
Single	158	2.68	3.00	1.34	158	3.34	4.00	1.38	158	3.46	4.00	1.43
Married	135	2.71	3.00	1.27	135	3.29	3.00	1.21	135	3.62	4.00	1.35
Common law	87	3.11	3.00	1.43	87	3.66	4.00	1.38	87	3.61	4.00	1.47
Divorced	27	3.15	3.00	1.61	27	3.37	4.00	1.55	27	3.52	4.00	1.65
Widow(er)	15	3.33	4.00	1.50	15	3.20	4.00	1.52	15	4.40	5.00	0.83
Not declared	9	2.78	3.00	1.79	9	3.00	3.00	1.50	9	3.00	3.00	1.41
Age												
≤30 years old	182	2.74	3.00	1.40	182	3.48	4.00	1.29	182	3.55	4.00	1.38
31-40 years old	112	2.92	3.00	1.31	112	3.34	4.00	1.40	112	3.46	4.00	1.46
41-50 years old	58	2.67	3.00	1.37	58	3.05	3.00	1.39	58	3.29	4.00	1.50
51-60 years old	39	2.95	3.00	1.34	39	3.36	3.00	1.33	39	3.62	4.00	1.55
>60 years old	37	3.08	3.00	1.53	37	3.46	4.00	1.41	37	4.27	5.00	1.02
Level of education												
First level incompleted	32	2.59	2.00	1.54	32	3.25	3.50	1.48	32	4.00	5.00	1.39
First level completed	112	2.97	3.00	1.33	112	3.45	4.00	1.39	112	3.89	4.00	1.32
Second level incompleted	72	2.81	3.00	1.52	72	3.46	3.50	1.33	72	3.56	4.00	1.55
Second level completed	133	2.86	3.00	1.28	133	3.47	4.00	1.27	133	3.60	4.00	1.35
Third level incompleted	39	2.67	3.00	1.42	39	3.10	3.00	1.27	39	2.64	3.00	1.22
Third level completed	35	2.77	2.00	1.40	35	3.03	3.00	1.44	35	3.14	3.00	1.31
Fourth level incompleted	-	-	-	-	-	-	-	-	-	-	-	-
Fourth level completed	5	1.80	2.00	0.84	5	3.00	3.00	1.58	5	2.60	2.00	1.82
Not declared	23	2.91	3.00	1.56	23	3.70	4.00	1.26	23	3.61	4.00	1.47
Employment												
Housewife	105	2.80	3.00	1.40	105	3.41	4.00	1.38	105	3.95	4.00	1.26
Employee	109	2.94	3.00	1.31	109	3.36	3.00	1.28	109	3.55	4.00	1.42
Freelancer/entrepreneur	145	2.77	3.00	1.42	145	3.26	3.00	1.40	145	3.33	4.00	1.51
Unemployed	8	3.75	4.00	1.49	8	4.13	4.50	1.13	8	4.38	4.50	0.74
Student	54	2.72	3.00	1.35	54	3.56	4.00	1.25	54	3.31	3.00	1.37
Retired	9	3.00	3.00	1.12	9	3.44	4.00	1.51	9	4.00	4.00	1.32
Other/Not declared	-	-	-	-	-	-	-	-	-	-	-	-
Level of income												
Not declared	23	2.91	3.00	1.56	23	3.70	4.00	1.26	23	3.61	4.00	1.47
No income	2	3.50	3.50	0.71	2	2.00	2.00	1.41	2	3.50	3.50	2.12
≤394 $	292	2.85	3.00	1.37	292	3.43	4.00	1.33	292	3.67	4.00	1.37
395-733 $	70	2.81	3.00	1.42	70	3.14	3.00	1.47	70	3.37	4.00	1.47
734-901 $	21	2.81	2.00	1.44	21	3.33	3.00	1.39	21	3.14	3.00	1.62
902-1086 $	7	2.86	3.00	0.90	7	3.57	3.00	1.13	7	3.71	4.00	1.38
1087-1412 $	10	2.40	2.50	1.17	10	2.80	3.00	1.14	10	2.90	3.00	1.45
1413-1760 $	3	1.67	2.00	1.53	3	3.00	3.00	1.00	3	1.67	2.00	1.53
1761-2034 $	-	-	-	-	-	-	-	-	-	-	-	-

Extremely Low	Low	Moderate	High	Very High
0 - 1	1.01 - 2	2.01 - 3	3.01 - 4	4.01 - 5

However, in the present study males gave higher scores than females in the case of primary or secondary forest; this is due to the fact that men are involved in forestry work, so the forests, their functions and services are understood by them (Affek and Kowalska, 2017) and, consequently, they valued these ecosystems highly. In what concerns the education level, respondents that completed or belonged to higher education levels valued higher the primary forest while, in contrast, they assigned low values to croplands, facts that are probably explained by their knowledge about ecosystems and their functions, therefore they understand the value of the forests and the importance of its management.

4.8. Visual preferences ratings at landscape and management system level

According to **Figure 11**, which shows the share of responses at landscape level based on the aggregated values at this scale, higher rating values (5 and 4) were given in a higher percentage to primary (or unmanaged) forest and the lowest were attributed to the secondary (or managed) forest. Secondary forest registered the greatest shares in ratings for three (3) - which could be seen as neutral opinions - (32.70%) and two (2) - rather not liking it - (36.11%), while pasturelands (or livestock areas) had the highest percentage for ratings such as 1 - not liking it at all - (36.25%). For intermediate and low values (3-1), the lowest shares corresponded to the primary (unmanaged) forest.

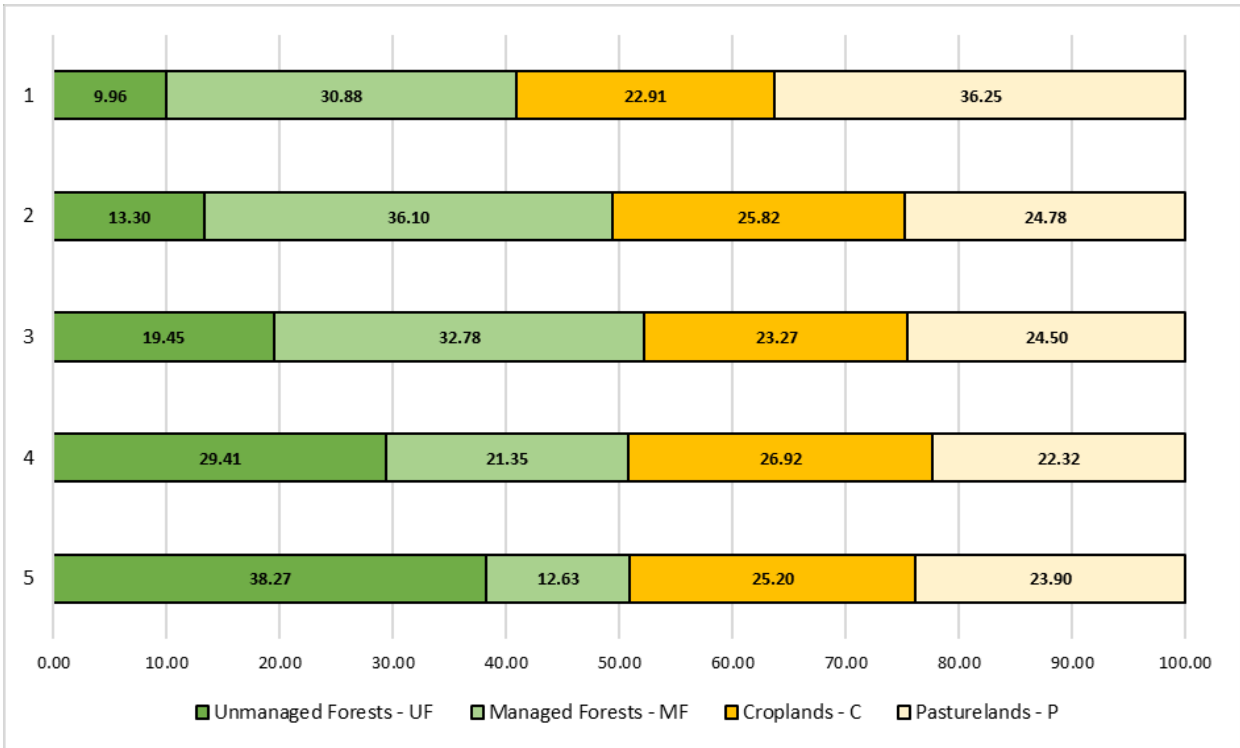

Figure 11. *Shares of respondents per types of landscapes and management sytems and type of responses. Legend: UF - unmanaged (primary) forest, M - managed (secondary) forest, C - croplands and P - pasturelands*

The trend indicated in **Figure 11** is probably related directly with some aspects such as the density (or coverage), structure and diversity (especially floristic composition), with increased density, structure and diversity causing a better rating in terms of perception. To support this, Arriaza et al. (2004) have indicated that the scenic beauty of a picture is related to the percentage of vegetation and the color contrast (low homogeneity). Other studies suggested that visual preferences of forests vary in function to the type, stand age, understory density and diversity (Nielsen et al., 2018; Sklenicka and Molnarova, 2010). To conclude, there was a proportional decreasing trend in the ratings assigned to the primary forest (**Figure 11**), starting from 5 to 1, which was, most likely, at the expense of managed forests (secondary forests) for which ratings exhibited an inverse decreasing distribution from 1 to 5. This is evident if one takes a look at **Figure 11**, where the share ratings for croplands and pasturelands were kept in the range of approximately 50-55% irrespective of the attribute given (1 to 5).

4.9. Perception of structure, value and functions of the evaluated ecosystems

Figure 12 indicates that the majority of the comments of all pictures were associated to the structure, followed by combined features such as the structure and function and structure and value, respectively. The visual preferences analyse the landscapes, which are defined as *"systems of structure-function and value"* (Stahlschmidt et al., 2017). Based on the existence of an ecosystem and its structure (components and elements), the functions (interrelation and services) gain an origin, and in consequence, will generate a value for those landscapes or ecosystems (Fromm, 2000; Stahlschmidt et al., 2017).

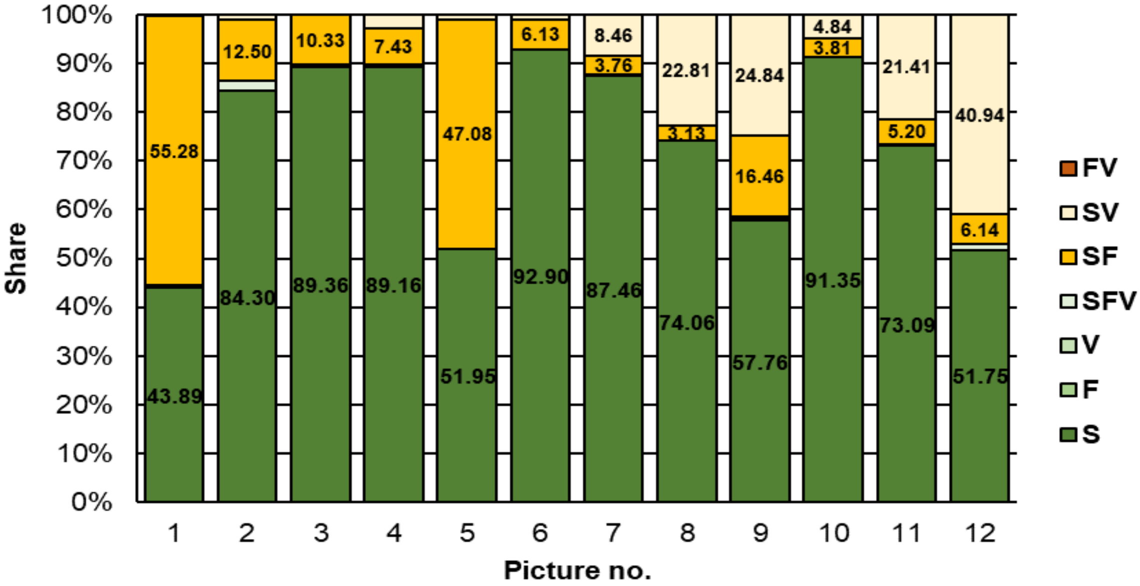

Figure 12. *Shares of of comments indicating the perception on structure (S), function (F), value (V), structure, function and value (SFV), structure and function (SF), structure and value (SV) and function and value (FV)*

According to **Figure 13**, the pictures depicting the primary forest received the highest share of positive comments in relation to the structure, followed by croplands and pasturelands. On the other hand, the negative comments were predominantly associated to secondary forest and croplands. Also, the highest share of neutral comments corresponded to secondary forest. It was identified that negative comments are usually linked to managed areas because the incidence of human activities modifies the ecosystems, an aspect that was observed in the pictures, such as a decrease in the quantity of natural elements. In contrast, positive comments were related to non-managed forest and productive land uses.

Figure 14 shows the results encompassing the type of comments about the functions. As shown, the highest percentaje of positive comments corresponded to primary forest whereas negative comments were distributed in a similar share for the human-impacted ecosystems or land management systems: secondary forest, croplands and pastureland. Regarding the neutral comments, there wasn't a significative amount of them, even though, some of them were assigned to P4 (secondary forest) and P8 (croplands).

The results of **Figure 15**, indicated that the highest percentages of positive comments corresponded to primary forest (P1 - 66.67%, P2 and P3 - 100%), followed by the secondary forest, croplands and pasturelands, while the negative comments on the value were higher in the case of secondary forest (P5 and P6 - 33.33%). Moreover, the neutral comments were linked to all pictures of croplands (P7 - P9) and pasturelands (P10 - P12) and to P1 - 33.33% (primary forest).

According to the results of **Figures 13-15**, there can be deduced a direct relation between structure, function and value in the attitudes and perception of the respondents. Primary forests had the highest share in the aspects mentioned before; in contrast, managed ecosystems exhibited lower shares. While the forest land conversion affects negatively ecological balance, wellbeing and the economy (Alig et al., 2010), for ethnic groups, forests have a high value, because their subsistence depends on goods and services provided by them (Deb, 2014).

Figure 16 shows the results on the features associated to the structure. The picture that exibited the highest percentage of comments associated to ephemera was P12 - 40.74% (pastureland - close perspective). In relation to naturalness, the highest percentage corresponded to P1 - 24.30% (primary forest). Furthermore, the higher values of complexity belonged to primary forest (P1 far - 12.38%, P2 intermediate - 17.62% and P3 close - 16.40%).

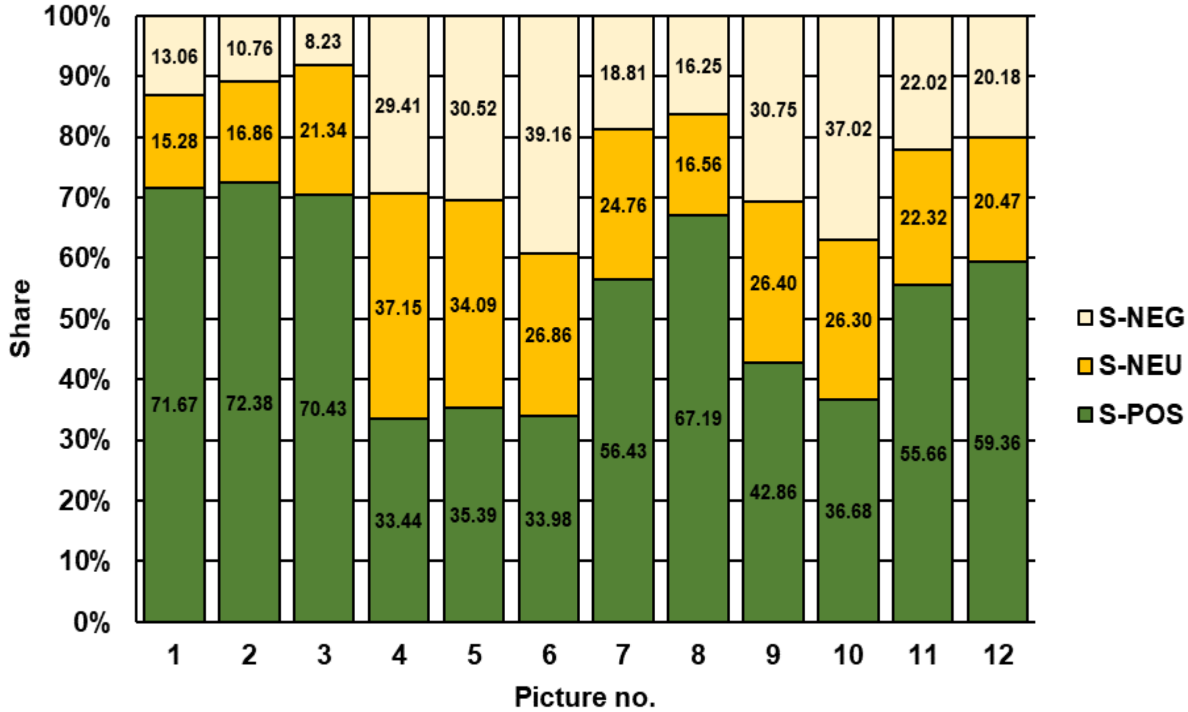

Figure 13. *Shares of comments indicating positive (S-POS), neutral (S-NEU) and negative (S-NEG) attitudes and perceptions on the structure of evaluated pictures*

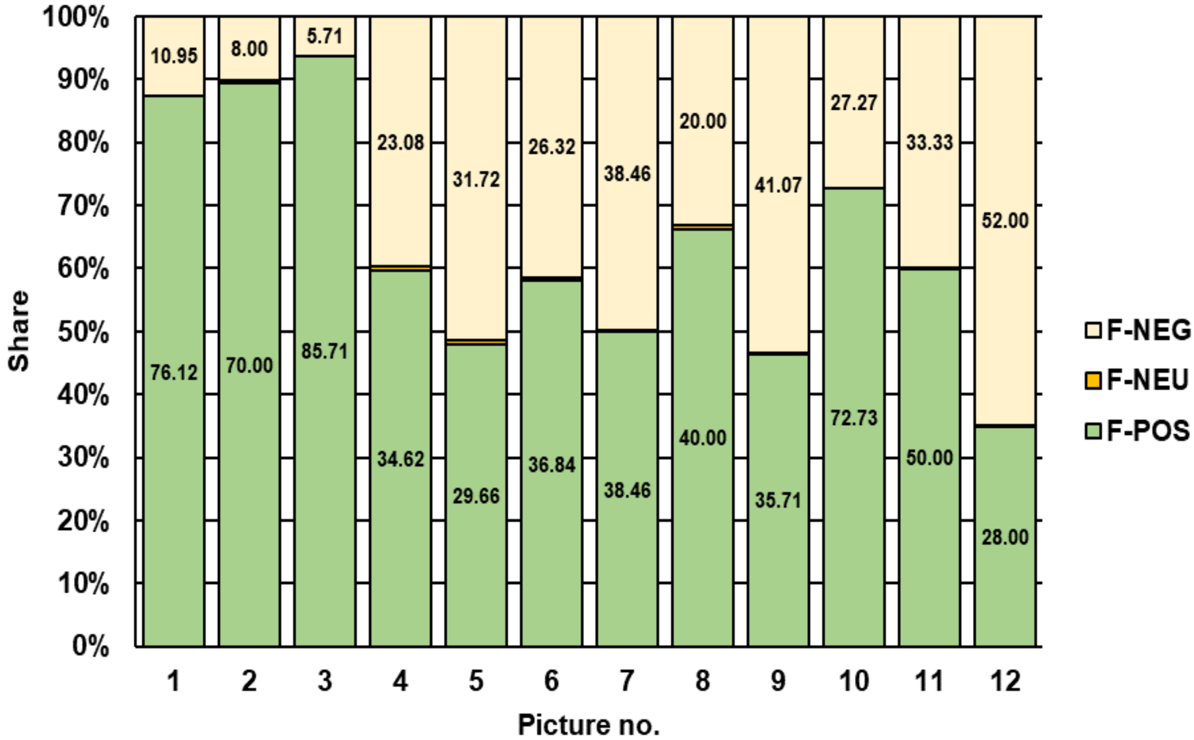

Figure 14. *Shares of of comments indicating positive (F-POS), neutral (F-NEU) and negative (F-NEG) attitudes and perceptions on the function of evaluated figures*

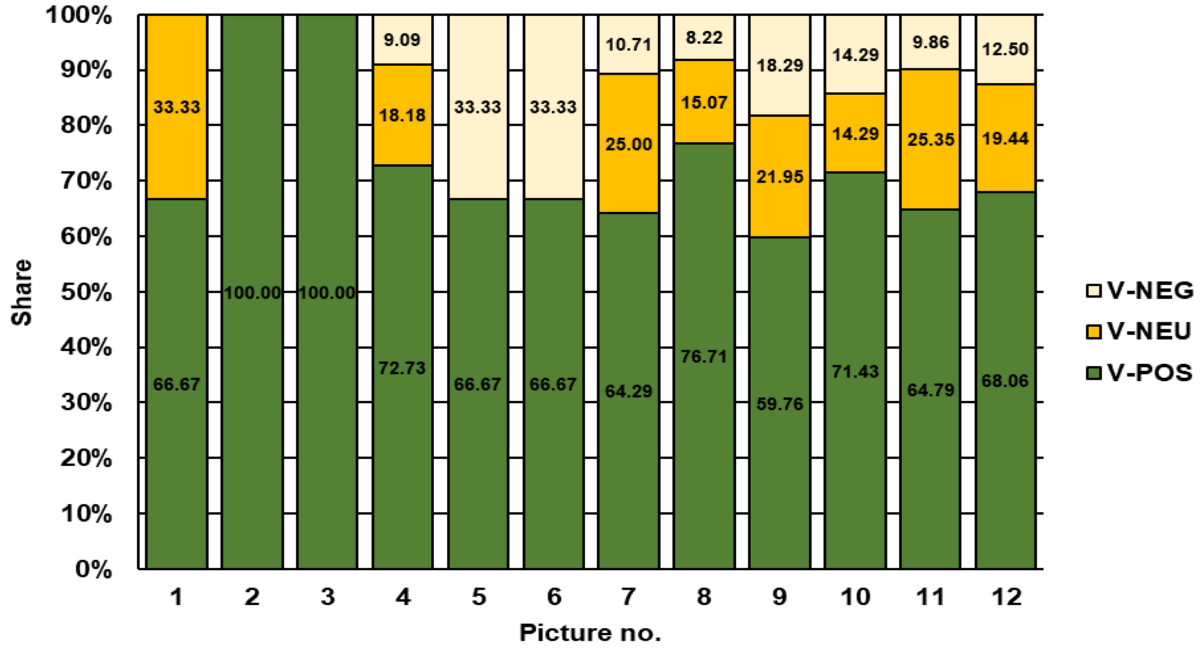

Figure 15. *Shares of of comments indicating positive (V-POS), neutral (V-NEU) and negative (V-NEG) attitudes and perceptions on the value of evaluated figures*

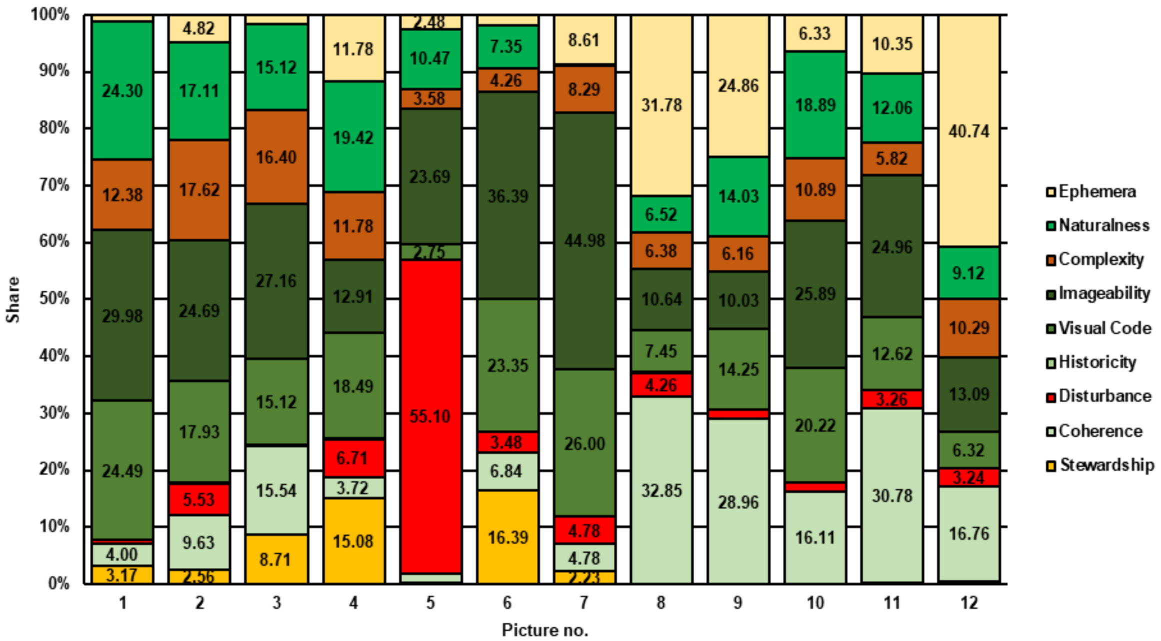

Figure 16. *Shares of of comments indicating different types of features associated with the structure of the analyzed ecosystems and land use types*

Features such as imageability and visual code were predominant in P7 - croplands far perspective (44.98% and 26.00% respectively). Historicity did not register a significat amount of responses. About disturbance, the highest percentage was placed on P5 - 55.10% (secondary forest - intermediate position of the observer) while for coherence, P11 (pastureland-intermediate position) registered the highest value (30.78%). Finally, regarding the stewardship, P6 (secondary forest-close perspective) had the highest percentage (16.39%). Due to the lack of research that analyses structural features as a function of the type of ecosystems and the position of the observer, this section could not be discussed in more detail.

4.10. Share of structural features, length of comments and the frequency of words

Share of comments on the structure and its components, as aggregated on the types of land management systems, is given in **Figure 17**; in the case of ephemera features, the highest percentage (45.02%) was found in the case of croplands that were followed by pasturelands (35.86%), while the lowest percentage (6.96%) was that specific to primary (unmanaged forest). This may be related very well, even if in this work it was not the case, to the fact that pasturelands and croplands can be modified by humans depending on the season (Martínez et al., 2014). For naturalness (N) and complexity (C), the highest percentages were those describing the primary forest (43.87% - N and 48.73% - C) and the lowest corresponded to croplands (12.62% - N and 15.10% - C). Naturalness is related to complexity because in a non-disturbed ecosystem there is a huge biodiversity (Martínez et al., 2014), so the relations between biotic and abiotic beings are numerous and complex (Roces et al., 2018).

For imageability (I) and visual code (VC), the lowest share was found for croplands (19.38% - I) and pasturelands (19.11% - VC) respectively, while the primary forest registered the highest percentage in both cases (37.94% - I and 37.43% - VC). Both aspects are related to experiences in the landscapes, therefore the natural elements (vegetation, topography, water etc.) cause positive emotions in visitors (Nahuelhual et al., 2018; Martínez et al., 2014). Historicity was assigned by comments in a great share (50%) to primary forest, a fact that may be the effect of local customs according to which many components of primary forests are used as cultural elements in some religious practices (Sing et al., 2015; Power, 2010). In what regards the disturbance, the highest share (59.59%) was that associated to the secondary forest, followed by croplands (15.71%) and pasturelands (12.04%). On the other hand, the lowest share of responses related to disturbance (12.65%) was that corresponding to the primary forest. In relation to coherence, the highest share (37.37%) was for croplands, while the lowest (6.69%) was for secondary forest; this aspect (feature) is related with the colors and patterns in the scenes (Martínez et al., 2014).

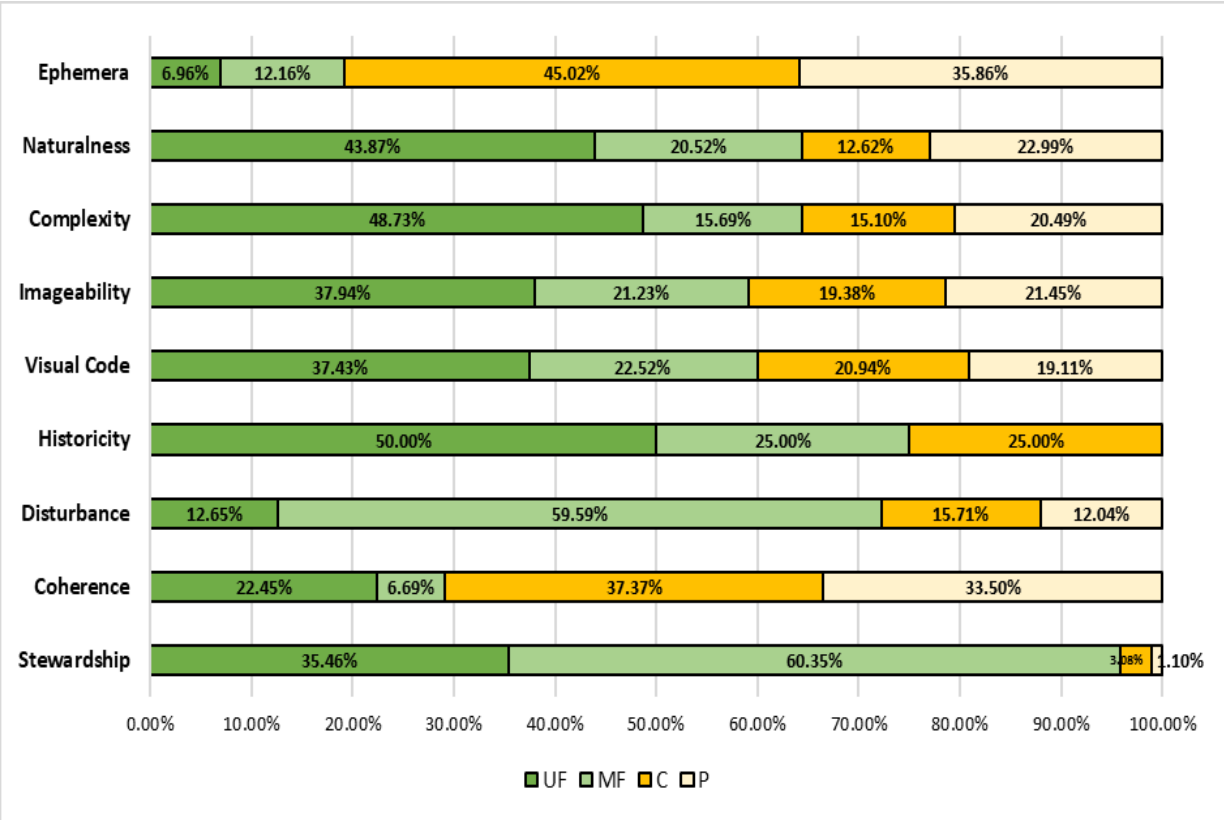

Figure 17. *Structure components versus groups of pictures (or ecosystems). Legend: UF - unmanaged (primary) forest, M - managed (secondary) forest, C - croplands and P - pasturelands*

For stewardship, the highest share (60.35%) was associated with the secondary forest, followed by the primary forest (35.46%). In constrast, the lowest one (1.10%) was that associated to pasturelands; in this regard, worth mentioning that stewardship reflects a careful management (order and care) and, generally, forests may be seen to exhibit such features, so their protection and conservation for this kind of values are important for society (Nguyen et al., 2018; Roces et al., 2018; Sing et al., 2015).

4.11. Individual interpretations and clustering on different types of land management

The words used for the four types of ecosystems (land management systems) described their principal elements or components or they were related to the tangible or intangible benefits or services. There were some common and specific words for the types of analyzed ecosystems. For the primary forest, the specific words were “air”, “conservation”, “jungle”, “walk”, “mountain” and “virgin”; these words refer to the naturalness of the ecosystem and some of its services: air - regulating service and walk - cultural category. Among the specific words for secondary forest were “lack”, “without”, “deforestation”, “clear” and “low”, which relate to the human impact on this ecosystem. For croplands and pasturelands, the specific words corresponded to elements presented in the scenes and are related to the productivity of these ecosystems; for croplands they were “planting”, “good”, “rainbow”, “cultivation”, “croplands” and “palms”, and for pasturelands “food”, “production”, “cows”, “grass”, “animals” and “livestock”. In general, the natural scenes are linked to the concepts of wealth, living beings, and they are perceived as being pleasant (Pan et al., 2014). Aesthetic quality comprises the following features: heterogeneity, complexity, diversity, landscape, visual and scenic quality (Dronova, 2017). Heyman (2012) analyzed cultural values in urban forests, and found that (i) pictures that had a human impact are considered as “disliked scenes”, (ii) dense and open forests are described as “liked”, (iii) pictures showing dead wood were distributed between “liked” and “disliked” with a slight trend towards negative feeling (disliked) while people that understood the importance of deadwood in ecosystems valued the images in a positive way. Individual interpretations on different types of land management may be seen through the frequency of words assigned to a given picture as comments. The common words used to describe the pictures by the respondents are given as relative frequencies in **Figures 18-21**.

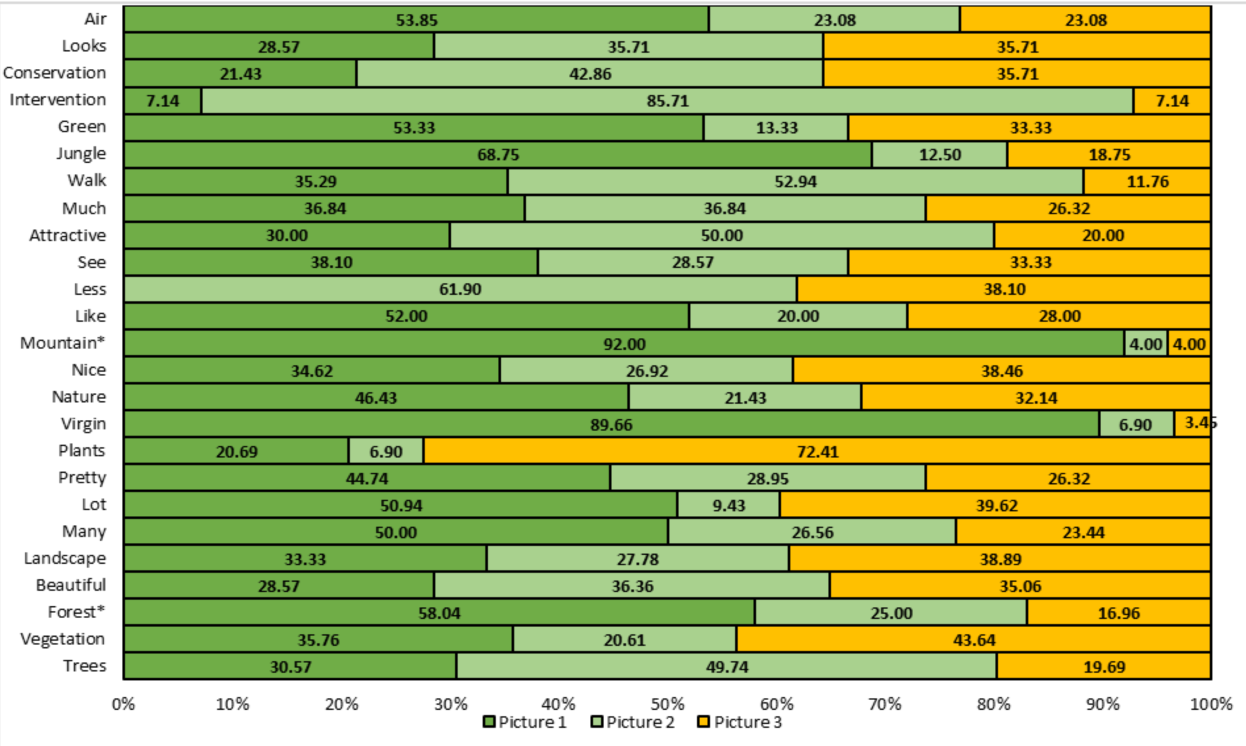

Figure 18. *Common words used to comment the photographs showing primary (unmanaged) forest. Legend: Picture 1 - far perspective, Picture 2 - intermediate perspective, Picture 3 - close (inside) perspective*

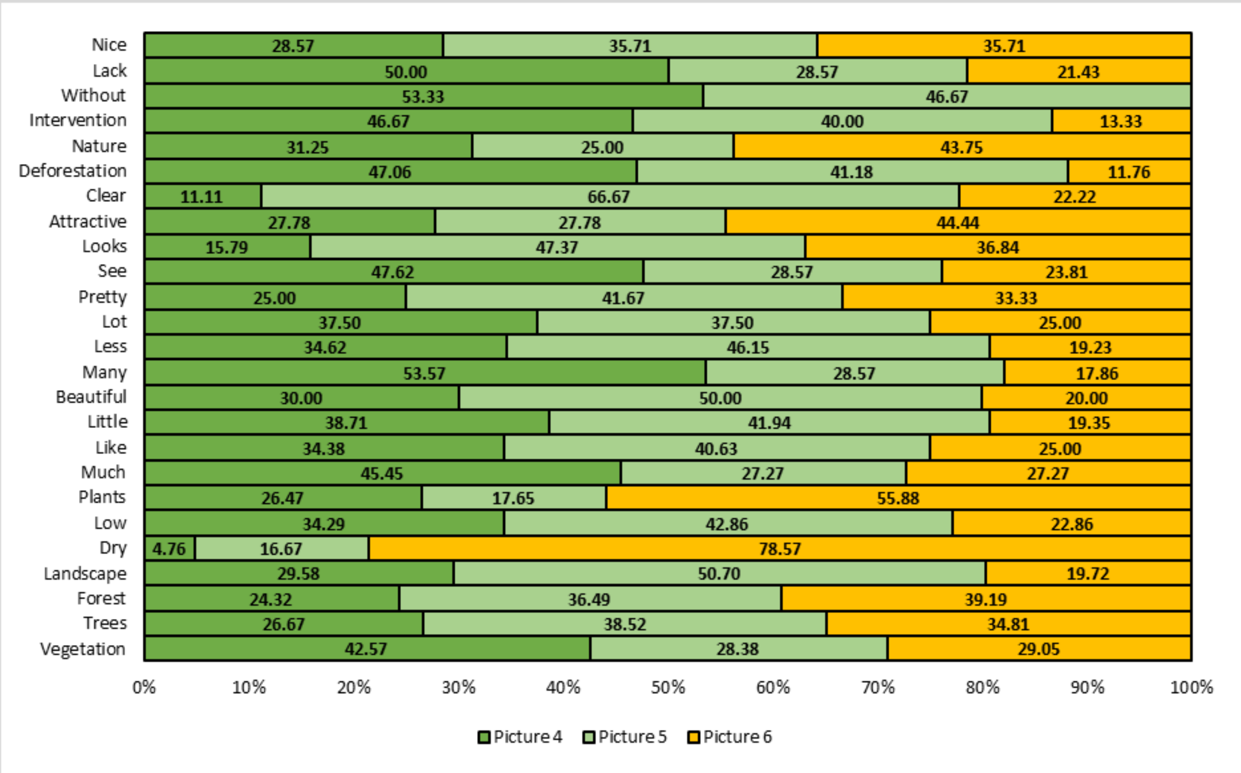

Figure 19. *Common words to comment the photographs showing the managed forest. Legend: Picture 4 - far perspective, Picture 5 - intermediate perspective, Picture 6 - close perspective*

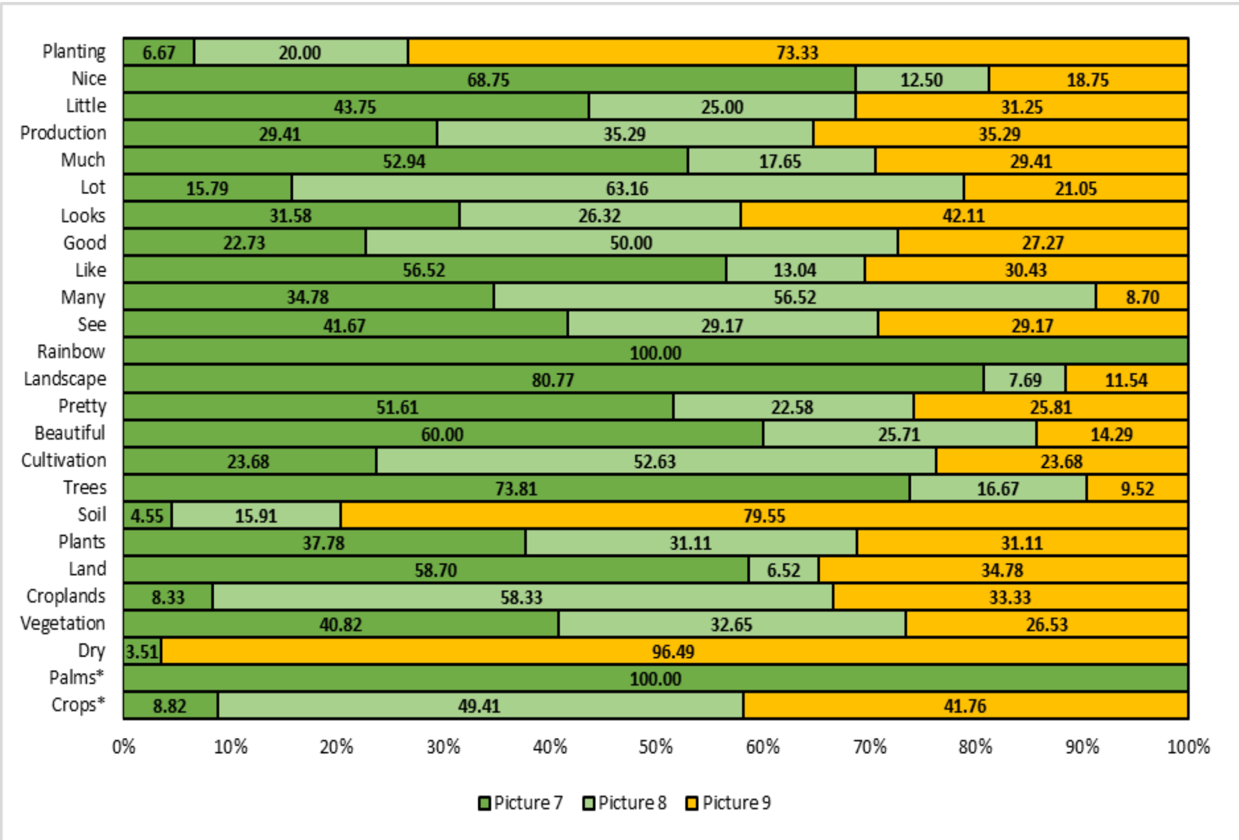

Figure 20. *Common words used to comment the photographs showing croplands. Legend: Picture 7 - far perspective, Picture 8 - intermediate perspective, Picture 9 - close perspective*

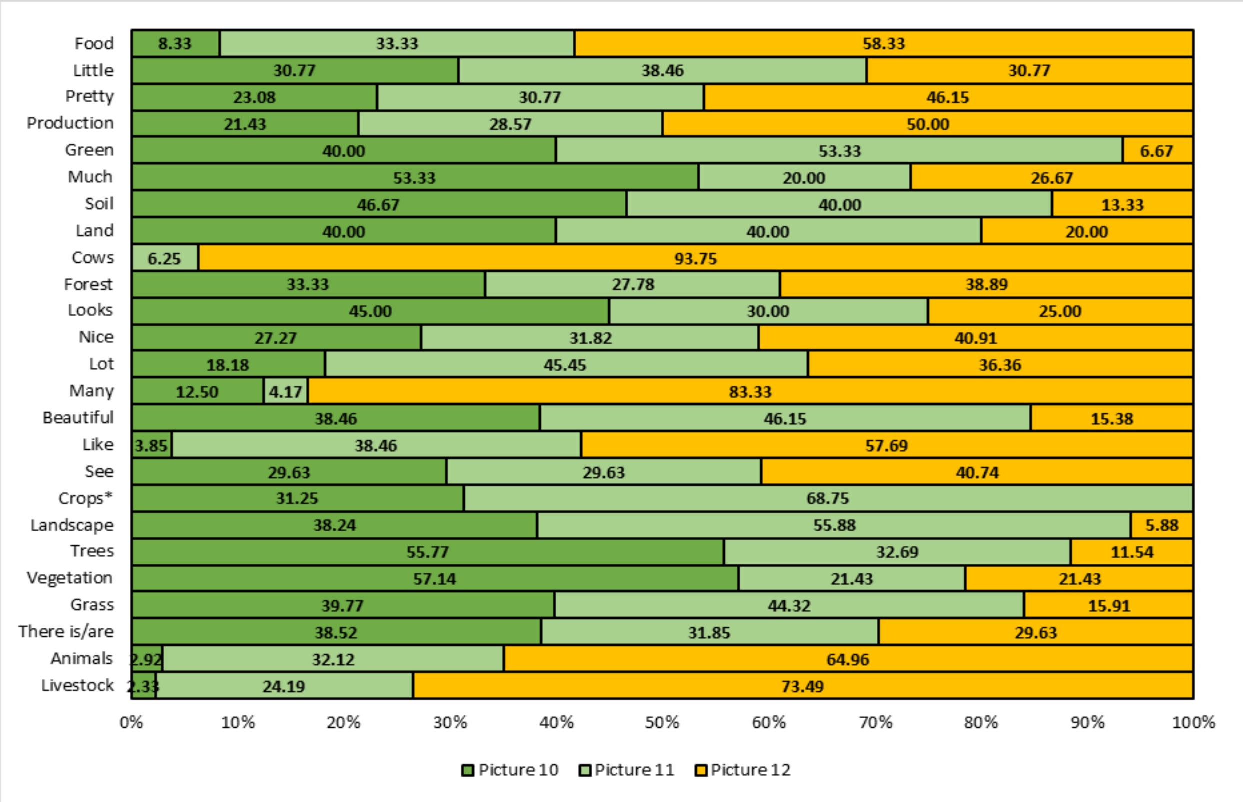

Figure 21. *Common words used to comment the photographs showing pasturelands. Legend: Picture 10 - far perspective, Picture 11 - intermediate perspective, Picture 12 - close perspective*

Following the cluster analysis (a detailed description is given in the full thesis) for a k=2 solution, one could find that the primary (unmanaged) forest stands apart compared to the other types of landscapes and management systems in the view of respondents. Another group that could be easily identified was that of managed forests that could have been stand apart in a k=3 solution. Nevertheless, for a k≥4 solution, the data would have been disaggregated in terms of similarity and logic. That was the reason for which the k=2 solution was held as final, as well as the fact that this arrangement of data provided also the highest score of silhouettes, which is know to stand for a good measure of similarity (Rousseeuw, 1987). As such, for k=2, the unmanaged (primary) forest formed a distinct group compared to the managed (secondary) forests, croplands and pasturelands. In addition, it seems that perceptions and attitudes of the respondents on the visual features of the scenes have not formed distict groups for croplands and pasturelands, as P7, for instance, grouped itself with P10 and P11. From these points of view, unmanaged forests stood apart in the perception of respondents, and especially P1 that formed a cluster with P2 and P3 at a higher Euclidian distance.

4.12. Willingness to engage in voluntary payments for conservation

Following the analysis of data on willingness to pay, 56.00% of the respondents stated that they would like to contribute by payments for conservation, while the rest did not expressed their intention to do so (44.00%). Nevertheless, a relation between the willingness to pay and the importance given to a specific type of landscape was not possible to establish. 170 respondents indicated the reason for which they are not willing to contribute by voluntary payments for conservation (**Figure 22**). As the results are showing, the principal factor for not accepting to pay for conservation was the low economic possibilities. The lack of reliability in the proper use of money (distrust) and the absence of interest had similar frequencies which were of 45 and 47 respondents, respectively. The results obtained were similar to those reported by others, that have found as a main reason wich limited the willingness to pay the scarcity of economic resources (Barrantes and Flores, 2013; Huarcaya and Porras, 2008). In what regards the amounts willing to allocate for conservation, most of the questioned people responded that they would be willing to pay between 5.01 to 20$ per year; next in line were those willing to contribute between 1.1 - 5$ (72 cases).

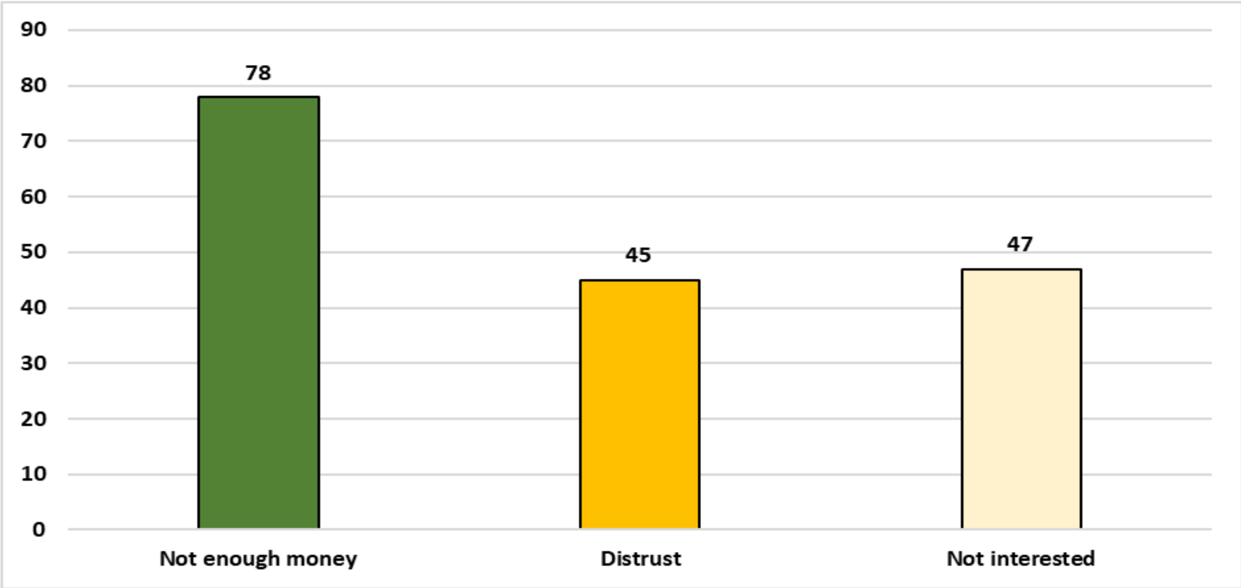

Figure 22. *Frequency of responses on factors related to the non-willingess to pay*

The preservation for utilitarian values of the natural resources justifies the payment for the protection and maintenance of the ecosystems that have a high productivity and biodiversity (Sabogal et al., 2013) and which enable sustainable flows of such ES. Therefore, the scenario presented to the respondents for the estimation of WTP was that enabling the conservation of the ES flow in the "Simón Bolívar" parish; the obtained values on the respondents' potential commitment were got through a weighted averaging procedure (**Table 27**) that took into consideration the class centeres of the amount ranges included as items in the questionnaire.

Table 27. Estimates on the WTP for conservation of forest

WTP ($)	Class mark	Frequency	Percentage (%)	Weighted average
0.01 - 1	0.505	28	11.38	0.06
1.01 - 5	3.005	72	29.27	0.88
5.01 - 20	12.505	79	32.11	3.85
20.01 - 50	35.005	46	18.70	6.54
50.01 - 100	75.005	15	6.10	4.58
100.01 - 500	300.05	6	2.44	7.32
Total ($ per year)		**246**	**100**	**23.23**

Table 28. Evaluation of annual value for conservation based on the willingess to pay

Population (2019)	# Members of family (weighted average)	# of families	# of families that accepted to pay	WTP ($/year)	Total ($)
8839	5	1768	990	23.23	22,997.7*

Note: *the final value was calculed based on the proportion of the sample willing to commit to voluntary payment which was of 56%

The weighted average of the WTP for conservation corresponded to an amount of 23.23$ per year. This value is important as it characterizes the population of respondents form the area taken into study and it would be helpful in estimating the potential amounts for larger areas from the Ecuadorian Amazon that one could count on, if the exact number of inhabitants would have been taken into consideration for the respective areas. Nevertheless, the scope of this study and the calculations made are limited to the area of study and the population strictly characterized by the sample used to infer this amount. In Ecuador, there are several studies about the conservation of watersheds and forests with the aim of providing water services. In the Ibarra province, for instance, a tariff of 0.16$ for one m^3 of water was established in order to ensure the environmental protection; in addition, a monthly payment of 0.5 and 1$ per hectare was established for the protection of managed and non-managed forests and moors, respectively (Burneo, 2008). Therefore, payment for ecosystem services (PES) schemes depend to a great extent on the total number of beneficiaries or users, and on the annual value for conservation that can be calculated based on the current number of families in the study area (**Table 28**).

Table 29. Valued attributes in the study area as WPT to pay in addition per year for their conservation

Attributes	Mean ($ per year)	Standard Deviation
Food (fruits, vegetables, seeds and fungi)	18.10	29.49
Water conservation	16.94	46.96
Forest conservation	14.29	47.96
Timber products (fuel wood, timber and fibers)	**22.46**	57.61
Non timber products (medicinal plants, gums, waxes, latex, roots, leaves, seeds, flowers)	16.23	67.14
Biodiversity	17.23	47.10
Landscape	**11.51**	25.30

As such, the annual value estimated based on the sample taken from the ”Simón Bolívar” parish was of approximately 23,000 $, and it could be used used in several activities. In Ecuador, the proportion of the environmental budget allocated to conservation in protected areas varies between 10.1% and 20% (FAO, 2008); in this context, the WTP is an approach that allows determining the factability of projects about ecosystem services and their conservation (Charry and Delgado, 2015). **Table 29**, on the other hand, shows the mean values (per year) and the standard deviations of other attributes which raised a potential support by WPT in addition to the amount given above. The provision of timber products registered the highest value as WTP, followed by the provision of food; the lowest value corresponded to the landscape conservation. Pettinotti et al. (2018) have shown that if the ES are consumed and they contribute to the survival, the users could identify and value them more easily; this situation is usually related to tangible outputs, such as is the case of provisioning services. The demand and willingness to commit in voluntary payments for ES can be increased by raising awareness about the value of a particular service (FAO, 2008); therefore, the WTP for the attributes described in **Table 29** can vary depending on the diffusion of information.

CHAPTER 5. CONCLUSIONS, RECOMMENDATIONS, ORIGINAL CONTRIBUTIONS, DISSEMINATION OF RESULTS AND RESEARCH ROADMAP

5.1. Conclusions

The conclusions of this study were systematized in the following sections:

i.) Stakeholders' perception towards ES provided by forest ecosystems:

a.) In what regards the socio-demographic characteristics of the study area, according the Management Plan (2015-2019) of "Simón Bolívar" parish the predominant groups are females, young (< 30 years old) and indigenous people. Most of the population has a basic level of education and the main activities in the area are related to agriculture, livestock farming, silviculture and fishing industries. As such, the importance of evaluating the principal characteristics and activities of the beneficiaries or stakeholders rests in the capability of such factors to modify the perception towards the existence and the importance of ES;

b.) Fourteen ES were identified in relation to main land use types and management systems and they were classified according MA categories; six ecosystem services corresponded to provisioning category, five to regulating category and three to cultural category;

c.) In relation to the evaluation of importance and use of ecosystem services, primary forests were rated to hold the highest potential to provide ES (regulating and cultural categories mainly). The factors that modified the perception on the importance and use of ES, as they have been identified in the present study, were the education level, age and occupation, with the most important variable being the education level because it acted as a modifier on all the categories of services and it is related to the other socio-demographic factors;

d.) The visual preferences are linked to the structure, function and value and there is a direct relation between them, so an ecosystem (*e.g.* primary forest) with a high structure and a wide range of functions, is likely to be perceived as having also many values; the results of this work in relation to these aspects indicate that people have seen structure in all of the land management systems taken into study. Nevertheless, an important share of the questioned people has seen both structure and function in the case of forests as well as structure and value in the case of croplands and pasturelands. However, the greatest shares of positive interpretations in relation to these features were found in the case of forests and, in particular, in the case of primary forest. As such, this work brings evidence on what people see in the types of land use management systems, therefore the results are important to shape the measures needed to balance the land use types in the region;

e.) In what concerns the visual preferences of population regarding the primary and secondary forests, crops and pasturelands, a positive trend was associated with scenes that have depicted a greater naturalness and productivity of the land use type under question, so the highest scores were assigned to primary forest. As such, and based on the fact that the shares of responses were somehow equal for the croplands and pasturelands across the range of items (1 to 5), the trend in share of ratings was identified to proportionally decrease from 5 to 1 in the case of primary forest while in the case of secondary forest the trend has shown an inversed behavior. To conclude, people disliked somehow the managed forests while they still preserved the same attitude on the croplands and pasturelands in the range of responses from 1 to 5. In addition, the cluster analysis has shown that while the primary (and probably the secondary) forest stood apart in terms of ratings placed on them, the rest of land use and management systems did not follow a logic from this point of view. As such, the preferences of individuals questioned in this study helped to shape also the boundaries in perception on the land use and management systems;

f.) In what regards the analysis of common words used to comment the responses on visual preference, the specific words that described primary forests were related to their characteristics and services, while for the other types of land use and management systems they depicted only attributes or characteristics;

g.) Depending on the gender, education level, income, age and occupation, the visual preferences of the landscapes can change. This study has identified two trends in regard to the variations caused by factors mentioned above. For both types of forest (primary and secondary), higher values were given by females (gender), married, common law and divorced groups (marital or civil status), older people (31 years old or more - age) having a high level of education, employees and freelancers (occupation) and those who earn more than the basic salary - 395$ (income); for the croplands and pasturelands, there were not significant differences in relation to gender and age. Here, the groups that valued higher were those divorced or widow (marital status) and unemployed (occupation), while, in contrast, the lower values were given by people who had a high level of education and high incomes;

h.) The conservation of forests and water resources in the "Simón Bolívar" parish was found to be very important for both, families and individuals, as they recognized that the maintenance and protection of ecosystems may enable a sustainable flow of ES; therefore, strategic aims in the area should be focused on environmental sustainability and the protection of natural areas.

ii.) Valuation of the services and products provided by forests:

a.) In general, the majority (56%) of beneficiaries accepted to commit themselves in voluntary payments for conservation; however, the rest (44%) did not accepted this option; the principal reason that caused the non-acceptance of payment was the lack of economic possibilities, therefore the socio-economic characteristics are determining factors that can act as enablers or disablers of voluntary commitment. Another factor that should be addressed carefully in the future was that related to distrust;

b.) The weighted value depicting the potential commitment as voluntary payments in the "Simón Bolívar" parish was estimated at 23.23$ per family and per year. This surplus for conservation can generate an annual amount estimated at approximately 23,000 $, that could not be sufficient to promote and enable conservation as the management activities involve the acquisition of materials, infrastructure, as well as the employment of professionals to lead the management program, aspects that should be complemented with the diffusion of information to induce an active participation of the settlers. In addition, the amount found stands only for an informal commitment to pay, but in the practice, not all people would actually engage to pay for conservation. Furthermore, it was found that respondends assigned high values to tangible services, such as the provision of timber products and supply of food. As found also by other studies, this is related to the tangibility of the products and services which is also intuitive in the mind of the respondents in what regards their level of contribution to society;

c.) A total number of 540 plants and their uses were evaluated by expert opinions in the Pastaza province. The most important category of use was found to be that associated to materials, followed by medicine and food purposes. Also, there was a positive direct relation between the number of responses found per categories of uses and the value placed on such ES, so the materials category (*i.e.* timber) was found to have the most uses (high frequency) and raised the highest commitment to support its conservation by additional voluntary payments;

d.) In what regards the relative importance of the land use types and management systems in the flow of ES, and based on the responses of the questioned sample, primary forest was found to hold the highest use and importance, followed by secondary forest, croplands and pasturelands. The highest relative importance of ES categories for primary forest was placed on the cultural category, followed by provision and regulation categories.

5.2. Recommendations

Following the experience gained by this work, as well as based on the documentary research carried out in the first steps and on the results of this work, some recommendations may be formulated for future attempts in this kind of research. As such:

i. For the identification of the stakeholders (or beneficiaries), it is recommended to review the information of similar projects and to analyze the stakeholders' position, area of influence and expectations in the assessment and valuation of ES;
ii. For the identification of ES, it is important to develop a list based on a previous literature review about forest services;
iii. For the implementation of surveys, it is necessary to consider two aspects: a) exceeding the sample size calculated by the formula of random sampling to avoid data loss due to inadequate or incomplete filling, and b) the field researchers must be trained on the topics related to ecosystems services and they should hold the skills needed to avoid inducing the responses. In addition, it is necessary to define the ranges for WTP before the application of the surveys; this will reduce the dispersion and will help avoiding possible outliers. It is recommendable to use other studies as reference;
iv. In relation to the results of this study, it is further recommended to analyze which socio-economic variables affected the WTP, aspect that will be considered in future research;
v. For local decision makers and people in charge of land planning, strategy formulations and policy, it is necessary to identify and quantify all ecosystem services and people's necessities (demand) to establish potential sources of goods and services, critical points (fragile ecosystems), as well as protection and conservation actions. In the case of structuring a payment mechanism for conservation, it is important to define or establish which organization or institution would administer the funds and will manage the conservation programs.

5.3. Original contributions

In Ecuador, there are few studies about the flora in the Amazon region and valuation of natural resources; therefore, the lack of awareness on such potentials has led to a progressive loss of biodiversity and ecosystem services by destruction of highly productive ecosystems such as forests.
The main contributions of the present work are:

i. The documentation of new plant uses in the Pastaza province based on the consultation of local experts and an analysis extended for more that 500 plants which revealed new uses for some as well as a classification of uses on relevant categories. This effort complements and extends the knowledge on such things given the fact that information gathering on such issues is rather difficult due to the language barriers and limitations found by others in gaining knowledge from indigenous populations;
ii. The four addressed ecosystems (or land use types) were predominant in the "Simón Bolívar" parish, and representative for the Ecuadoriand Amazon region, so the results of this study stand as a reference point at local, provincial and regional levels; as such, the approach taken in this study can be replicated in other parishes located in the Amazon region and some of the results found and methods used hold the potential for extrapolation to other areas;
iii. The perception analysis of the different social groups based on their actual necessities and preferences in relation to the ES and predominant land use types revealed important trends; as such, the information obtained through the evaluation of ecosystem services and the analysis of visual preferences can be used as a tool in decision-making, because it considered the opinions and the interests of the settlers;
iv. Few studies carried out in Ecuador approached the analysis and mapping of ES based on the perception of the direct users. As such, this work evaluated the relative importance of ES in relation to the land management systems by considering two aspects: the land use (coverage) and the ecosystem services (scores that were linked to the use and importance). The methods

used also enabled the scaling of results and inferring the real importance and use of ES, as a first attempt, at least for the area considered in this study;

v. At global level, many studies referred to the valuation of landscapes (urban areas, agroforestry systems, water resources and forest) based on the visual preferences, and the ecosystems were analyzed from a unique perspective (a determined distance). In this context, one of the merits of this study is that it analyzed four ecosystems (land use types) from different perspectives or positions of the observers: far, intermediate and close. The results of each perspective allowed getting the value of each land use and, besides other things, the approach used helped in including the eventual variability that could be brought by factors such as the distance of the eye and other features contained in the scenes. As such, by the approach of the study, results could be presented both, at scene level as well as at an aggregated level pinpointing the preferences that respondends placed on these kinds of land use and management systems;

vi. The factors that modified the visual preferences on landscapes were formally identified and grouped for a better interpretation even though the differences from a statistical point of view were not tested. For that, all the social variables were organized in groups and their results were used to depict the differences that were found to be high in some cases. By doing so, the obtained results and the associated databases are standing for a point of reference for further assessments on wether the differences in relation to social and demographic features are relevant or significant in relation to the visual preferences given;

vii. The visual preferences also included the analysis of what the respondends have seen in the pictures shown to them, enabling a differentiation on features such as the structure, function and value in their view, by the means of words linked to each picture and land use in the form of comments. These words (positive, negative and neutral comments) were associated to the mentioned features and, furtheron, the structure feature was itemized in sub-features such as ephemera, naturalness, complexity, imageability, visual code, historicity, disturbance, coherence and stewardship. This approach has helped to informally relate the content of scenes shown to the respondents to an in-depth conceptual depiction of their features. In our knowledge, this approach stands for the first attempt on such issues, at least for the area taken into study;

viii. This research contributed to the development of a new methodology to identify the common words used by the respondents on their discourse to complement their perception on the land use management systems. As such, this work combined the capabilities of an online freely available tool with those of Microsoft Excel and techniques of frequency analysis to produce statistics on the words used, their meaning and interpretation; the attempt described involved a detailed analysis of discourse (commnets) based on classical and artificial text mining techniques;

ix. The estimated tariffs (WTP for conservation) as presented in this work in the form of potential commitment for voluntary payment, can be used as a starting point for the establishment of a fund for the conservation in the studied area. As they are purely theoretical and there is not a certainity that people will actually contribute them, more research is probably needed to evaluate the relation between such commitments and actual payments. Neverhteless, the obtained figures depict something which is crucially important for the conservation of forests in the area, namely the willingness to people to move from informally acknowledging this issue to a proactive involvement in actually doing it. Also, they reflect which of the products, processes, functions or services that the local landscapes may provide are important for them in terms of a monetary ranking;

x. Last but not least, the present work involved a complete valuation process, because it encompassed all of the three key perspectives: ecological, social and economic. As such, and by including the results of the preference analysis this work stands for a reference in designing and establishing parts of the guidelines and measures needed for the local territorial organization.

5.4. Dissemination of results

5.4.1. Results produced within the frame of the PhD thesis

A. Papers published in BDI journals

1. Gavilanes A.V., Castillo D.D., Ricaurte C.B., Marcu M.V., 2019. Known and newly documented uses of 540 rainforest plant species in the Pastaza Region, Ecuador. Bulletin of the Transilvania University of Brasov. Series II. Forestry, Wood Industry, Agricultural Food Engineering, 12 (1): 35 - 42.

2. Gavilanes, A.V., Castillo, D.D., Morocho, J.M., Marcu, M.V., Borz S.A., 2019. Importance and use of ecosystem services provided by the amazonian landscapes in Ecuador - evaluation and spatial scaling to a representative area. Bulletin of the Transilvania University of Brasov. Series II. Forestry, Wood Industry, Agricultural Food Engineering, 12 (61): 1-26.

5.4.2. Results produced by participation in research teams external to the PhD thesis scope

A. Papers published in BDI journals

1. Salas D.B., **Gavilanes A.V.**, Araús A.B., Castillo D.D., Borz, S.A., 2017. Determination of ecological indexes to support the conservation of forest species in "Jacarón" natural forest. Revista Pădurilor, 132(3): 3-12.

2. Castillo, D.D., Carrasco, J.C, Quevedo, L., Ricaurte, C., **Gavilanes, A**.**V.**, Borz, S.A., 2017. Diversity, composition and structure of Andean high forest in Ecuador, South America. Bulletin of the Transilvania University of Brasov. Series II. Forestry, Wood Industry, Agricultural Food Engineering, 10 (2): 1-16.

B. Papers published in journals indexed by Clarivate Analytics (former ISI Web of Science)

1. Borz, S.A., Talagai N., Cheţa M., **Gavilanes A.V.**, Castillo D.D., 2018. Automating data collection in motor-manual time and motion studies implemented in a willow short rotation coppice. BioResources, 13(2): 3236-3249. **Journal classified in quartile 1 (Q1)**

2. Borz S.A., Talagai N., Cheţa M., Chiriloiu D., **Gavilanes A.V.**, Castillo D.D., Marcu M.V., 2019. Physical strain, exposure to noise and postural assessment in motor-manual felling of willow short rotation coppice: Results of a preliminary study. Croatian Journal of Forest Engineering, 40(2): 377 - 388. **Journal classified in quartile 1 (Q1)**

3. Castillo, D.D., **Gavilanes, A.V.**, Ricaurte, C.B., Chávez, C.R., Marcu, M.V., Borz, S.A., 2019. Perception and use of cultural ecosystem services among the Andean communities of Chimborazo Reserve. Environmental Engineering and Management Journal, 18 (12): 2705-2718. **Journal classified in quartile 3 (Q3) by Web of Science**.

C. Papers presented at international conferences and symposiums

1. Talagai, N., Cheţa, M., **Gavilanes, A.V.**, Castillo, D.D., Borz, S.A., 2019. Predicting time consumption of chipping tasks in a willow short rotation coppice from Global Positioning System and acceleration data. In: Proceedings of the Biennial International Symposium "Forest and Sustainable Development" 8th Edition, Brasov 25-27 October 2018, 1-12.

5.5. Research roadmap

The valuation process of ecosystem services that involve the social perception is very important in decision making as it shapes the actual demand of services and the future uses of natural resources. The present study analyzed the perception of stakeholders towards the importance of forest ES, the social factors acting as modifyiers of perception and the visual preferences of population, which are important aspects within the management of forest and land planning.

In Ecuador, there are governamental and non-governamental programs that were shaped to protect or restore fragile ecosystems such as the case of primary forest. However, their coverage and effectiveness are limited, given the absence of public funds and non-linking of the main local actors. The perception of environmental damage and the importance of ecosystem services have a high incidence in the acceptance of payment. This research is a referential study in the valuation of forest services in Ecuadorian Amazon region and the estimated tariffs might be used as a baseline for the establishment of a fund for the conservation of forest in “Simón Bolívar” parish, and thus they might contribute to the objectives of sustainability detailed in its Management Plan.

The development of research in other rural parishes of the Amazon Region (North or South) about the presented issues will be very useful to identify the trend about the valuation of ES and the visual preferences in this Ecuadorian Region and can be seen as a logical continuation of this research to be able to produce results and outcomes able to be extended to larger areas. At the same time, the results of this kind of studies should be used to update the Management Plan of the parishes. Other proposals are the development of the following research projects: “Sustainable tourism products as a strategy in the rural parishes of Riobamba Canton, Chimborazo Province”, and “Marketing of wood in the Amazon region as a proposal to regulate the laws in the country”, which should include many aspects related to social valuation and visual preferences and have been indentified as key issues for the local welfare as the timber has been found to be highly valued by locals while the tourism development could be one way of improving the welfare of locals.

REFERENCES

1. Abdollahi, K., Ning, Z., Legiandenyi, T., Puskar K., 2012: Urban forest ecosystem structure, function and value. DOI: 10.13140/rg.2.2.31065.36967.
2. Abril, R., Ruiz, T. E., Alonso, J., Torres, V., Cabrera, G., 2016: Prospecting of plant species in Pastaza province, Ecuador. Cuban Journal of Agricultural Science, 50, 649-671.
3. Abril, R., Ruiz, T. E., Lazo, J. A., Banguera, D. V., Ríos, P. D., Aguinda, J. K. A., Vega, I., 2016: The use of medicinal plants by rural populations of the Pastaza province in the Ecuadorian Amazon. Acta Amazónica, 46(4), 355-366, DOI: 10.1590/1809-439220160030.
4. Affek, A. N., Kowalska, A., 2017: Ecosystem potentials to provide services in the view of direct users. Journal of Ecosystem Services, 26, 183-196, DOI: 10.1016/j.ecoser.2017.06.017.
5. Agbenyega, O., Burgess, P. J., Cook, M., Morris, J., 2009: Application of an ecosystem function framework to perceptions of community woodlands. Land Use Policy, 26(3), 551-557, DOI: 10.1016/j.landusepol.2008.08.011.
6. Alig, R., Stewart, S., Wear, D., Nowak, D., 2010: Conversions of forest land: Trends, determinants, projections, and policy considerations. Advances in Threat Assessment and Their Application to Forest and Rangeland Management, 1-26.
7. Allendorf, T. D., Yang, J., 2013: The role of ecosystem services in park–people relationships: The case of Gaoligongshan Nature Reserve in southwest China. Biological Conservation, 167, 187-193, DOI: 10.1016/j.biocon.2013.08.013.
8. Álvarez, L., Ríos, S., 2009: Valoración económica de bienes y servicios en ecosistemas de bosques inundables y de altura de la Amazonía peruana: Marco conceptual y propuesta metodológica. Instituto de Investigaciones de la Amazonía Peruana (IIAP).
9. Andrade, K., 2004: El papel del ECORAE en la Región Amazónica Ecuatoriana. Un ejemplo de crisis de gobernabilidad democrática en el Ecuador (Facultad Latinoamericana de Ciencias Sociales (FLACSO). Available online in: https://docplayer.es/91624900-Facultad-latinoamericana-de-ciencias-sociales-flacso-sede-ecuador-programa-de-estudios-socio-ambientales-r-lfr-1-s-o-sede-academica-de-ecuador.html.
10. Arias R., Tapia, A. et al., 2012: Evaluaciónde la biodiversidad en cinco comunidades kichwa de la zona de colonización de la alta amazonía ecuatoriana. Revista Amazonica Ciencia y Tecnología, 1(3), pp. 157-172.
11. Armenteras, D., González, T. M., Vergara, L. K., Luque, F. J., Rodríguez, N., Bonilla, M. A., 2016: A review of the ecosystem concept as a "unit of nature" 80 years after its formulation. Ecosistemas, 25(1), 83-89, DOI: 10.7818/ECOS.2016.25-1.12.
12. Arriaza, M., Cañas-Ortega, J. F., Cañas-Madueño, J. A., Ruiz-Aviles, P., 2004: Assessing the visual quality of rural landscapes. Landscape and Urban Planning, 69(1), 115-125, DOI: 10.1016/j.landurbplan.2003.10.029.
13. Ashmore, M., Black, H., Burguess, P., Evans, C., Hails, R., Potts, S., Quine, T., Thomson, A., 2011: Chapter 14: Regulating services. Ecosystem services. K National Ecosystem Assessment.
14. Atiqul Haq, S. M., Vanwing, T., Hens, L., 2010: Perception, Environmental Degradation and Family Size Preference: A Context of Developing Countries. Journal of Sustainable Development, 3, DOI:10.5539/jsd.v3n4p102.
15. Autonomus Descentralized Government of Sarayaku, 2015: Flora y Fauna. Available online in: http://gadsarayaku.gob.ec/Flora-y-Fauna.php.
16. Ayenew, B., 2015: Economic Valuation of Forest Ecosystems Service's Role in Maintaining and Improving Water Quality. Economics, 4(5), 71, DOI: 10.11648/j.eco.20150405.11
17. Banerjee, O., Crossman, N., Groot, R., 2013: Ecological Processes, Functions and Ecosystem Services, DOI: 10.1002/9781118506271.ch2.
18. Baral, H., 2014: Identifying, quantifying and valuing ecosystem services in the context. Presented in the International Seminar on land reclamation technologies for Sustainable Land Use.
19. Balslev H., Luteyn J.L., Ollgaard B., HolmNielsen L.B, 1987: Composition and structure of adjacent unflooded and floodplain forest in Amazonian Ecuador. Opera Botanica 92, 37-57.
20. Balzan, M. V., Caruana, J., Zammit, A., 2018: Assessing the capacity and flow of ecosystem services in multifunctional landscapes: Evidence of a rural-urban gradient in a Mediterranean small island state. Land Use Policy, 75, 711-725, DOI: 10.1016/j.landusepol.2017.08.025.
21. Barber, R. T., 2018: Upwelling Ecosystems. In Reference Module in Earth Systems and Environmental Sciences, DOI: 10.1016/B978-0-12-409548-9.11630-6.
22. Barrena, J., Nahuelhual, L., Báez, A., Schiappacasse, I., Cerda, C., 2014: Valuing cultural ecosystem services: Agricultural heritage in Chiloé Island, southern Chile. Ecosystem Services, 7, 66-75, DOI: 10.1016/j.ecoser.2013.12.005.
23. Bilsborrow, R. E., Barbieri, A. F., Pan, W., 2004: Changes in population and land use over time in the Ecuadorian Amazon. Acta Amazónica, 34(4), 635-647, DOI: 10.1590/S0044-59672004000400015.
24. Bocco G., Velázquez A., Torres A., 2000: Ciencia, comunidades indígenas y manejo de recursos naturales: Un caso de investigación participativa en México. Interciencia, 25(2), 64-70.
25. Boege-Schmidt E., 2008: Patrimonio Biocultural de los pueblos indígenas de México. Hacia la conservación in situ de la biodiversidad y agrodiversidad en los territorios indígenas, Instituto Nacional de Antropología e Historia: Comisión Nacional para el Desarrollo de los Pueblos Indígenas, México.
26. Bonilla, S., Estrella, A., Molina, J. R., Herrera, M. Á., 2018: Socioecological system and potential deforestation in Western Amazon forest landscapes. Science of the Total Environment, 644, 1044-1055, DOI: 10.1016/j.scitotenv.2018.07.028.
27. Braat, L. C., de Groot, R., 2012: The ecosystem services agenda: bridging the worlds of natural science and economics, conservation and development, and public and private policy. Ecosystem Services, 1(1), 4-15, DOI: 10.1016/j.ecoser.2012.07.011.
28. Bradford, A., 2018: Deforestation: Facts, Causes & Effects. Available online in: https://www.livescience.com/27692-deforestation.htm.
29. Brander, L., Gómez, E., Martín, B., Verma, M., 2010: Chapter 5: The economics of valuing ecosystem services and biodiversity. Economics of Ecosystems and Biodiversity.
30. Bravo, E., 2014: La biodiversidad del Ecuador. Editorial Abya Yala, Quito, Ecuador.
31. Bray D.B., 2013: When the state supplies the commons: Origins, changes and design of Mexico´s common property regime. Journal of Latin American Geography, 12(1), 33-55.
32. Brown, C., Reyers, B., Ingwall-King, L., Mapendembe, A., Nel, J., O Farrel, P., Dixon, M., Bowles-Newark, N., 2014: Measuring ecosystem services.
33. Bruins, R., Canfiel, T., Duke, C., Kapustka, L., Nahlik, A., Schäfer, R., 2014: Key attributes of ecological production functions.
34. Bugalho M.N., Cladeira M.C., Pereira J.S., Aronson J., Pausas J.G., 2011: Mediterranean cork oak savannas require human use to sustain biodiversity and ecosystem services. Frontiers in Ecology and the Environment, 9(5), 278-286.
35. Burneo, D., 2008: Propuesta Sistema Tarifario: Proyecto de manejo integrado de los Recursos hídrico en la Hoya de Quito. Available online in: http://infoagua-guayllabamba.ec/images/PDF/agua_cuenca/14SistemaTarifario.pdf.
36. Cáceres, D. M., Tapella, E., Quétier, F., Díaz, S., 2015: The social value of biodiversity and ecosystem services from the perspectives of different social actors. Ecology and Society, 20(1), DOI: 10.5751/ES-07297-200162.

37. Calvet, L., Gómez, E., Reyes, V., 2012: Beyond food production: Ecosystem services provided by home gardens. A case study in Vall Fosca, Catalan Pyrenees, Northeastern Spain. Ecological Economics, 74, 153-160, DOI: 10.1016/j.ecolecon.2011.12.011
38. Campbell, C., Emmett, B., Jenkins, A., Whitmore, A., 2011: Chapter 13: Supporting services.Ecosystem Services, UK National Ecosystem Assessment.
39. Campbell, C., Cox, A., Darby, H., Roberts, D., Torrance, L., 2019: Landscape preference and perception. Available online in: https://macaulay.webarchive.hutton.ac.uk/visualisationlitrev/chap2.html.
40. Caranqui, J., Romero, F., 2011: Composición y estructura del Bosque Siempre Húmedo Tropical en la Estación Experimental Pastaza, Escuela Superior Politécnica de Chimborazo, Ecuador.
41. Cárcamo, P. F., Garay-Flühmann, R., Squeo, F. A., Gaymer, C. F., 2014: Using stakeholders' perspective of ecosystem services and biodiversity features to plan a marine protected area. Environmental Science & Policy, 40, 116-131, DOI: 10.1016/j.envsci.2014.03.003.
42. Castro, A. J., Martín, B., García, M., Aguilera, P. A., López, E., Cabello, J., 2011: Social preferences regarding the delivery of ecosystem services in a semiarid Mediterranean Region. Journal of Arid Environments, 75(11), 1201-1208, DOI: 10.1016/j.jaridenv.2011.05.013.
43. CDTER, 2015: Plan de Desarrollo y Ordenamiento Territorial de la Parroquia Simón Bolívar 2015-2019, GADPR Simón Bolivar, Ecuador.
44. Central Bank of Ecuador, 2017: Reporte de Pobreza, Ingreso y Desigualdad.
45. Charry, A., Delgado, W., 2015: Disponibilidad a pagar por un plan de conservación en la cuenca del río Tunjuelo Bogotá, Colombia.
46. Chrzanowski, C., Buijse, T., 2017: Cultural Ecosystem Services - Freshwater information. Available online in: http://fis.freshwatertools.eu/index.php/infolib/ecoservices/cultural-ess.html.
47. Cleland, E, 2011: Biodiversity and Ecosystem Stability. Available online in: https://www.nature.com/scitable/knowledge/library/biodiversity-and-ecosystem-stability-17059965.
48. CONAFOR., 2010: Visión de México ante REDD+. In: CONAFOR-SEMARNAT, México. Available online in: http://www.conafor.gob.mx:8080/documentos/docs/7/1393Visi%C3%B3n%20de%20M%C3%A9xico%20sobre%20REDD_.pdf.
49. Constitución de la República del Ecuador, 2008: Asamblea Constituyente.
50. COOTAD (Código Orgánico de Organización Territorial, Autonomía y Descentralización), 2010: Asamblea Nacional.
51. Coscieme, L., Stout, J. C., 2019: Ecosystem Services Evaluation. Encyclopedia of Ecology, Second Edition, 288-293, DOI: 10.1016/B978-0-12-409548-9.10967-4.
52. Daily G.C., Alexander S., Ehrlich P., Goulder, L., Lubchenco, J., Matson, P., Mooney, H., Postel, S., Schneider, S., Tilman, D., Woodwell, G., 1997: Ecosystem Services: Benefits Supplied to Human Societies by Natural Ecosystems. Issues in Ecology, 1(2), 1-18
53. Daly-Hassen, H., 2016: Assessment of the socio-economic value of the goods and services provided by Mediterranean forest ecosystems/ Regional synthesis (FAO).
54. Daniel, T. C., Muhar, A., Arnberger, A., Aznar, O., Boyd, J. W., Chan, K. M. A., Costanza, R., Elmqvist, T., Flint, C., Gobster, P., Gret-Regamey, A., Lave, R., Muhar, S., Penker, M., Ribe, R., Schauppenlehner, T., Sikor, T., Soloviy, J., Spierenburg, M., Taczanowska, K., Tam, J., von der Dunk, A., 2012: Contributions of cultural services to the ecosystem services agenda. Proceedings of the National Academy of Sciences of the United States of America, 109(23), 8812-8819, DOI: 10.1073/pnas.1114773109.
55. Dearden, P., 1984: Factors influencing landscape preferences: An empirical investigation. Landscape Planning, 11(4), 293-306, DOI: 10.1016/0304-3924(84)90026-1.
56. Deb, D., 2014: The Value of Forest: An Ecological Economic Examination of Forest People's Perspective Debal Deb. DOI: 10.1007/978-94-007-7076-8_7.
57. De la Torre, L., Navarrete, H., Muriel, P., Macía, M., Balslev, H., 2008: Enciclopedia de plantas útiles en el Ecuador (Herbario QCA y Herbario AAU), Aarhus.
58. Delgado, Ma. J., Konold, W., Schmitt, C. B., 2017: Community mapping of ecosystem services in tropical rainforest of Ecuador. Ecological Indicators, 73, 460-471, DOI: 10.1016/j.ecolind.2016.10.020.
59. Department of "Montes", 2004: Actualización de la evaluación de los recursos forestales mundiales. Términos y definiciones, 33-34.
60. Dezzeo, N., 2017: Especies Forestales Nativas de la Amazonía Ecuatoriana con potencial para uso en sistemas agroforestales. Available online in: http://repositorio.educacionsuperior.gob.ec/bitstream/28000/4863/1/Anexo%201.%20EspeciesUtiles_Amazonia.pdf.
61. Dias Carrilho, C., de Almeida Sinisgalli, P. A., 2018: Contribution to Araçá Bay management: The identification and valuation of ecosystem services. Ocean & Coastal Management, DOI: 10.1016/j.ocecoaman.2018.03.02.
62. Dlamini, C. S., 2012: Types of values and valuation methods for environmental resources: Highlights of key aspects, concepts and approaches in the economic valuation of forest goods and services. Journal of Horticulture and Forestry, 4, 181-189, DOI: 10.5897/JHF12.011.
63. Douglas, I., James, P., 2014: Urban Ecology: An Introduction. Routledge.
64. Dronova, I., 2017: Environmental heterogeneity as a bridge between ecosystem service and visual quality objectives in management, planning and design. Landscape and Urban Planning, 163, 90-106, DOI: 10.1016/j.landurbplan.2017.03.005.
65. Dupont, L., Antrop, M., Van Eetvelde, V., 2015: Does landscape related expertise influence the visual perception of landscape photographs? Implications for participatory landscape planning and management. Landscape and Urban Planning, 141, 68-77, DOI:10.1016/j.landurbplan.2015.05.003.
66. Ecuador Forest Group, 2007: Planificación estratégica bosques nativos en el Ecuador, Quito. Available online in: https://ecuadorforestal.org/wp-content/uploads/2013/03/PE_BN.pdf.
67. Ecuadorian Ministry of environment, 2003: Norma de Calidad del Aire Ambiente. Texto Unificado de la Legislación Ambiental Secundaria (Libro VI de la Calidad Ambiental, Anexo 4, Quito.
68. Ecuadorian Ministry of environment, 2006: Sistema Nacional de Áreas Protegidas del Ecuador.
69. Ecuadorian Ministry of Environment, 2013a: Sistema de Clasificación de Ecosistemas del Ecuador Continental. Retrieved from http://app.sni.gob.ec/sni-link/sni/PDOT/NIVEL%20NACIONAL/MAE/ECOSISTEMAS/DOCUMENTOS/Sistema.pdf
70. Ecuadorian Ministry of Environment, 2013b: Socio Bosque: Programa de protección de bosques. Available online in: http://www.ambiente.gob.ec/wp-content/uploads/downloads/2015/07/SOCIO-BOSQUE.pdf.
71. Ecuadorian Ministry of Environment, 2015: Estadísticas de patrimonio natural. Available online in: http://suia.ambiente.gob.ec/documents/10179/346525/ESTADISTICAS+DE+PATRIMONIO+FINAL.pdf/b36fa0a7-0a63-4484-ab3e-e5c3732c284b.
72. Environmental Protection Agency, 2015: National Ecosystem Services Classification System (NESCS). EPA-800-R-15-002, 188.
73. European Commission, 2018: Forest Ecosystem Services. Available online in: http://forest.jrc.ec.europa.eu/activities/forest-ecosystem-services/.
74. Fagerholm, N., Käyhkö, N., Ndumbaro, F., Khamis, M., 2012: Community stakeholders' knowledge in landscape assessments – Mapping indicators for landscape services. Ecological Indicators, 18, 421-433, DOI: 10.1016/j.ecolind.2011.12.004.
75. FAO, 2015: Evaluación de los recursos forestales mundiales 2015 ¿Cómo están cambiando los bosques del mundo?, Segunda edición, 1-54.
76. FAO, 2008: Informe de avance N 1: pago por servicios ambientales y áreas protegidas.

77. Farber, S. C., Costanza, R., Wilson, M. A., 2002: Economic and ecological concepts for valuing ecosystem services. Ecological Economics, 41(3), 375-392, DOI: 10.1016/S0921-8009(02)00088-5.
78. Felipe, M., Comín, F., Escalera, J., 2015: A framework for the social valuation of ecosystem services. AMBIO, 44, 308-318, DOI: 0.1007/s13280-014-0555-2.
79. Ferrerira, C., García, K., Macías, L., Pérez, A., & Tomsich, C., 2013: Hombres y Mujeres del Ecuador en cifras II (serie información estratégica) (INEC).
80. Fischer, A. P., 2018: Forest landscapes as social-ecological systems and implications for management. Landscape and Urban Planning, 177, 138-147, DOI: 10.1016/j.landurbplan.2018.05.001.
81. Fischer J., Hartel T., Kuemmerle T., 2012: Conservation policy in traditional farming landscapes. Conservation Letters, 5(3), 167-175.
82. Fredericksen T., 2000: Aprovechamiento forestal y conservación de los bosques tropicales en Bolivia. In: Documento Técnico, 95/2000.
83. Fregoso A., Velázquez A., Bocco G., Cortéz G., 2001: El enfoque de paisaje en el manejo forestal de la comunidad indígena de Nuevo San Juan Parangaricutiro, Michoacán, México. In: Investigaciones Geográficas, Boletín del lnstituto de Geografía, UNAM Núm. 46, 58-77.
84. Fromm, O., 2000: Ecological Structure and Functions of Biodiversity as Elements of Its Total Economic Value. Environmental and Resource Economics, 303-328.
85. Fu, B., Zhang, L., Xu, Z., Zhao, Y., Wei, Y., Skinner, D., 2015: Ecosystem services in changing land use. Journal of Soils and Sediments, 15(4), 833-843, DOI: 10.1007/s11368-015-1082-x.
86. García, N. S., Jiménez, C. del R., 2012: Valoración económica de Bienes y Servicios Ambientales del Recurso Hidrico de la Parroquia Quimiag y su incidencia en los sectores productivos en el período 2007-2009, Universidad Nacional de Chimborazo, Ecuador.
87. Gavilanes, A., Castillo, D., Ricaurte, C., Marcu, M., Borz, S., 2018: Known and newly documented uses of 540 rainforest species in the Pastaza region, Ecuador. Bulletin of the Transilvania University of Braşov, 11(20).
88. Gee, K., Burkhard, B., 2010: Cultural ecosystem services in the context of offshore wind farming: A case study from the west coast of Schleswig-Holstein. Ecological Complexity, 7(3), 349-358, DOI: 10.1016/j.ecocom.2010.02.008.
89. Giannecchini M., Twine E., Vogel C., 2007: Land-cover change and human -environment interactions in a rural cultural landscape in South Africa. The Geographical Journal, 173(1), 26-42.
90. Gomes, L. F., dos Santos Bento, J. M. R., Arede Correira Cristovão, A. F., Baptista, F. O., 2015: Exploring the effect of land use on ecosystem services: The distributive issues. Land Use Policy, 45, 141-149, DOI: 10.1016/j.landusepol.2014.12.008.
91. Gómez, M., Danglot, C., Vega, L., 2003: Sinopsis de pruebas estadísticas no paramétricas. Cuándo usarlas. Revista Mexicana de Pediatría, 70(2).
92. González R., Anzúlez A., Vera A., Riera L., 1997: Manual de pastos tropicales para la amazonía ecuatoriana, Manual N° 33, Editorial INIAP, Estación Experimental Napo Payamino, Programa de Ganadería Bovina y Pastos.
93. Gorjas, J., Cardiel, N., Zamorano, J., 2011: Estadistica básica para estudiantes de ciencias, Universidad Complutense de Madrid, Spain.
94. Granda, M. J., Yánez, P. Y., 2017: ESTUDIO SOBRE LA PERCEPCIÓN DE LOS BENEFICIOS DEL PROGRAMA SOCIO BOSQUE EN LA REGIÓN AMAZÓNICA ECUATORIANA. Revista de Ciencias de la Vida, 26(2), 28-37.
95. Grizzetti, B., Lanzanova, D., Liquete, C., Reynaud, A., Cardoso, A. C., 2016: Assessing water ecosystem services for water resource management. Environmental Science and Policy, 61, 194-203, DOI: 10.1016/j.envsci.2016.04.008.
96. Grünberger K., 2014. Estimating food consumption patterns by reconciling food balance sheets and household budget surveys, Editorial FAO, Rome.
97. Hackbart, V., De Lima, G., dos Santos, R., 2017: Theory and practice of water ecosystem services valuation: Where are we going? Ecosystem services, 23, 218-227.
98. Habib, T. J., Heckbert, S., Wilson, J. J., Vandenbroeck, A. J. K., Cranston, J., Farr, D. R., 2016: Impacts of land-use management on ecosystem services and biodiversity: An agent-based modelling approach. PeerJ, 4, DOI: 10.7717/peerj.2814.
99. Häfner, K., Zasada, I., Zanten, B. T. van, Ungaro, F., Koetse, M., Piorr, A., 2018: Assessing landscape preferences: A visual choice experiment in the agricultural region of Märkische Schweiz, Germany. Landscape Research, 43(6), 846-861, DOI: 10.1080/01426397.2017.1386289.
100. Hagerhall, C. M., 2001: CONSENSUS IN LANDSCAPE PREFERENCE JUDGEMENTS. Journal of Environmental Psychology, 21(1), 83-92, DOI:10.1006/jevp.2000.0186.
101. Haines-Young, R., Potschin, M., 2009: Methodologies for defining and assessing ecosystem services. Centre for Environmental Management University of Nottingham.
102. Haines-Young, R., Potschin, M., Fish, R., 2012: Classifying Ecosystem Services: An Ecosystems Knowledge Network Briefing Paper.
103. Hami, A., Tarashkar, M., 2018: Assessment of women's familiarity perceptions and preferences in terms of plants origins in the urban parks of Tabriz, Iran. Urban Forestry & Urban Greening, 32, 168-176, DOI: 10.1016/j.ufug.2018.04.002.
104. Herkenrath P., Harrison J., 2011: The 10th Meeting of the Conference of the Parties to the Convention on Biological Diversity a breakthrough for biodiversity. In: Fauna & Flora International, 45(1).
105. Hernández, M., Plieninger, T., Bieling, C., 2013: An empirical review of cultural ecosystem service indicators. Ecological Indicators, 29, 434-444, DOI: 10.1016/j.ecolind.2013.01.013.
106. Hetsch, S., 2004: La Comercialización de Madera en la Provincia de Pastaza. Available online in: http://www.sfa-ecuador.com/Assets/Comercializaci%C3%B3n-Pastaza.pdf.
107. Heyman, E., 2012: Analyzing recreational values and management effects in an urban forest with the visitor-employed photography method. Urban Forestry & Urban Greening, 11(3), 267-277, DOI: 10.1016/j.ufug.2012.02.003.
108. Higuera, D., Martín-López, B., Sánchez-Jabba, A., 2013: Social preferences towards ecosystem services provided by cloud forests in the neotropics: Implications for conservation strategies. Regional Environmental Change, 13(4), 861-872, DOI: 10.1007/s10113-012-0379-1.
109. Hirons, M., Comberti, C., Dunford, R., 2016: Valuing Cultural Ecosystem Services. Annual Review of Environment and Resources, 41(1), 545-574, DOI: 10.1146/annurev-environ-110615-085831.
110. Hirsch, F., Clark, D., Vihervaara, P., Primmer, E., 2012: Payments for Forest –related Ecosystem Services: What role for a Green Economy?
111. Huenchuleo, C., de Kartzow, A., 2018: Valoración económica de servicios ecosistémicos en la cuenca del río Aconcagua, Chile. Tecnología y Ciencias del Agua, 09(2), 58-85, DOI: 10.24850/j-tyca-2018-02-03.
112. IUCN, 1996: Communities and forest management, a report of the IUCN working group on community involvement in forest management. Available online in: UK.https://portals.iucn.org/library/sites/library/files/documents/1996-054.pdf.
113. Jenkins, M., Schaap, B., 2018: Forest Ecosystem Services. United Nations Forum on Forests.
114. Kalaba, F., 2016: Forest Cultural Ecosystem Services in Zambia's Forest Ecosystems. Presented in Copperbelt University, Jacksonville, Florida
115. Kalivoda, O., Vojar, J., Skřivanová, Z., Zahradník, D., 2014: Consensus in landscape preference judgments: The effects of landscape visual aesthetic quality and respondents' characteristics. Journal of environmental management, 137C, 36-44, DOI:10.1016/j.jenvman.2014.02.009.
116. Koning, G. H. J. de, Veldkamp, A., Fresco, L. O., 1999: Exploring changes in Ecuadorian land use for food production and their effects on natural resources. Journal of Environmental Management, 57(4), 221-237, DOI: 10.1006/jema.1999.0305.

117.Kormos, C., Mittermeier, R., Jaeger, T., Mackey, B., 2016: What is a Primary Forest? Available online in: http://www.cemexnature.com/excerpt/what-is-a-primary-forest/.
118.Laguna, C., 2014: Inferencia no paramétrica. Available online in: http://www.ics-aragon.com/cursos/salud-publica/2014/pdf/M2T09.pdf.
119.Lamarque P., Quetier F., Lavorel S., 2011: The diversity of the ecosystem services concept and its implications for their assessment and management. In: Comptes Rendus Biologie, 441-449.
120.Lee, H., Seo, B., Koellner, T., Lautenbach, S., 2019: Mapping cultural ecosystem services 2.0 – Potential and shortcomings from unlabeled crowd sourced images. Ecological Indicators, 96, 505-515, DOI: 10.1016/j.ecolind.2018.08.035.
121.Li, P., Chen, Y., Hu, W., Li, X., Yu, Z., Liu, Y., 2019: Possibilities and requirements for introducing agro-environment measures in land consolidation projects in China, evidence from ecosystem services and farmers' attitudes. Science of the Total Environment, 650, 3145-3155, DOI: 10.1016/j.scitotenv.2018.10.051.
122.Lindborg, R., Gordon, L. J., Malinga, R., Bengtsson, J., Peterson, G., Bommarco, R., Deutsh, L., Gren, A., Rundolf, M., Smith, H. G., 2017: How spatial scale shapes the generation and management of multiple ecosystem services. Ecosphere, 8(4), DOI:10.1002/ecs2.1741.
123.Lindsey, R., Simmon, R., 2007: Tropical Deforestation. Available online in: https://earthobservatory.nasa.gov/features/Deforestation/deforestation_update.php.
124.Lorca, P., Soley, R., Boyando, D., 2015: Diagnóstico, identificación y valoración económica de servicios ecosistémicos, municipios de San Juan Nepomuceno y Santa Rosa de Cauca.
125.MA, 2003: Ecosystems and Human Well-being: A Framework for Assessment.
126.MA (Millennium Ecosystem Assessment) (Ed.), 2005: Ecosystems and human well-being: Synthesis. Washington, DC: Island Press.
127.Macía, M., Romero, H., Valencia, R., 2001: Patrones de uso en un bosque primario de la Amazonía ecuatoriana: Comparación entre dos comunidades Huaorani.
128.Maes, J., Crossman, N., Burkhard, B., 2016: Mapping Ecosystem Services.
129.Magnussen, K., Hasler, B., Zandersen, M., 2014: Ecosystem services: In Nordic freshwater management. Nordic Council of Ministers.
130.Marín-Muñiz, J. L., Hernández Alarcón, M. E., Silva Rivera, E., Moreno-Casasola, P., 2016: Percepciones sobre servicios ambientales y pérdida de humedales arbóreos en la comunidad de Monte Gordo, Veracruz. Madera y Bosques, 22(1), DOI: 10.21829/myb.2016.221477.
131.Martín-López, B., Iniesta-Arandia, I., García-Llorente, M., Palomo, I., Casado-Arzuaga, I., Amo, D. G. D., Gómez, E., Oteros, E., Palacios, I., Villaarts, B., González, J., Santos, F., Onaindia, M., Lópex, C., Montes, C., 2012: Uncovering Ecosystem Service Bundles through Social Preferences. PLoS ONE, 7(6), DOI: 10.1371/journal.pone.0038970.
132.Martínez, E., Martín, S., García, A., 2014 : Quantitative Techniques in Participatory Forest Management.
133.McCarthy, D., Morling, P., 2014: A Guidance Manual for Assessing Ecosystem Services. Natura project.
134.Mena, C., 2010: Deforestación en el Norte de la Amazonía Ecuatoriana: Del patrón al proceso, Universidad San Francisco de Quito, Ecuador.
135.Microsoft Corporation, 2016 : Microsoft Excel (Professional Plus 2016) [software], Santa Rosa, California, USA.
136.Mikulcak F., Newig J., Milcu A.I., Hartel T., Fischer J., 2013: Integrating rural development and biodiversity conservation in central Romania. In: Environmental Conservation, 40(2), 129-137.
137.Mittal, R., Gupta, C., 2013: Impact of population explosion on environment. Weschool Knowledge builder - the national journal, 1(1).
138.Mogollón, H., Guevara J.E., 2004: Caracterización Vegetal de la Bioreserva del Cóndor. Fundación Numashir para la Conservación de Ecosistemas Amenazados y Ecociencia, 1-84.
139.Molnár Z., 2012: Classification of pasture habitats by Hungarian herders in a steppe landscape (Hungary). Journal of Ethnobiology and Ethnomedicine, 8(28), 1-18.
140.Morris, R. J., 2010: Anthropogenic impacts on tropical forest biodiversity: A network structure and ecosystem functioning perspective. Philosophical Transactions of the Royal Society B: Biological Sciences, 365(1558), 3709-3718, DOI: 10.1098/rstb.2010.0273.
141.Myster, R., 2018: Igapó (black water flooded forest) of Amazon basin. Springer Nature Switzerland.
142.Muente, G., 2018: Nube de palabras: ¿qué es y para qué sirve? . Available online in: https://rockcontent.com/es/blog/nube-de-palabras/.
143.Müller, F., Burkhard, B., 2012: The indicator side of ecosystem services. Ecosystem Services, 1(1), 26-30, DOI: 10.1016/j.ecoser.2012.06.001.
144.Muñoz-Pedreros, A., 2004: La evaluación del paisaje: Una herramienta de gestión ambiental. Revista chilena de historia natural, 77(1), DOI: 10.4067/S0716-078X2004000100011.
145.Murphy, T., Lau, A., 2008: Manejo de valores atípicos. ASTM International - Standards Worldwide. Available online in: https://www.astm.org/SNEWS/SPANISH/SPND08/datapoints_spnd08.html.
146.Nahuelhual, L., Laterra, P., Jiménez, D., Báez, A., Echeverría, C., Fuentes, R., 2018: Do people prefer natural landscapes? An empirical study in Chile. Bosque (Valdivia), 39(2), 205-216, DOI: 10.4067/S0717-92002018000200205.
147.National Congress of Ecuador, 2004: Ley forestal y conservación de áreas naturales y vida silvestre.
148.Nebel, G., Kvist, L, Vanclay J.K., Christensen H., Freitas L., Ruiz J., 2001: Structure and floristic composition of flood plain forests in the Peruvian Amazon. Forest Ecology and Management, 150, 27-57.
149.Nguyen, M. D., Ancev, T., Randall, A., 2018: Forest governance and economic values of forest ecosystem services in Vietnam. Land Use Policy, DOI: 10.1016/j.landusepol.2018.03.028.
150.Nicosia, K., Daaram, S., Edelman, B., Gedrich, L., He, E., McNeilly, S., Shenoy, V., Velagapudi, A., Wu, W., Zang, L., Barvalia, A., Bokka, V., Chan, B., Chiu, J., Dhulipalla, S., Hernández, V., Jeon, J., Kanukollo, P., Kravets, P., Mantha, A., Miranda, C., Nigam, V., Patel, M., Praveen, S., Sang, T., Upadhyay, S., Varma, T., Xu, C., Yalamanchi, B., Zharova, M., Zheng, A., Verma, R., Vasslides, J., Manderson, J., Jordan, R., Gray, S., 2014: Determining the willingness to pay for ecosystem service restoration in a degraded coastal watershed: A ninth grade investigation. Ecological Economics, 104, 145-151, DOI: 10.1016/j.ecolecon.2014.02.010.
151.Nielsen, A. B., Gundersen, V. S., Jensen, F. S., 2018: The impact of field layer characteristics on forest preference in Southern Scandinavia. Landscape and Urban Planning, 170, 221-230, DOI: 10.1016/j.landurbplan.2017.10.005.
152.Notte, A. L., D'Amato, D., Mäkinen, H., Paracchini, M. L., Liquete, C., Egoh, B., Geneletti, D., Crossman, N. D., 2017: Ecosystem services classification: A systems ecology perspective of the cascade framework. Ecological Indicators, 74, 392-402, DOI: 10.1016/j.ecolind.2016.11.030.
153.Nuss Girona, S., Castañer, M. (Eds.), 2015: Ecosystem services: Concepts, methodologies and instruments for research and applied use.
154.Obeng, E. A., Aguilar, F. X., Mccann, L. M., 2018: Payments for forest ecosystem services: A look at neglected existence values, the free-rider problem and beneficiaries' willingness to pay. International Forestry Review, 20(2), 206-219, DOI: 10.1505/146554818823767528.
155.Ogeh, K. T., Jimoh, S. O., Ajewole, O. I., 2016: Willingness to Pay for Environmental Service Functions of Mangrove Forest in Uzere, Delta State, Nigeria. Journal of Resources Development and Management, 16.
156.Ojea, E., Ortega, J., Chiabai, A., 2012: Economic Valuation of Ecosystem Services: Conflicts in Classification. Basque Centre for Climate Change (BC3), 10.
157.Oliver C.D., Berg D.R., Larsen D.R., O'Hara K.L., 1992. Integrating Management Tools, Ecological Knowledge, and Silviculture. In: Naiman R.J. (eds) Watershed Management. Springer, New York, NY, cap.13, 361-382.

158.Orange group, 2019: K-means. Available online in: https://orange3.readthedocs.io/en/3.4.0/widgets/unsupervised/kmeansclustering.html.
159.Orellana, L., 2001: Estadística Descriptiva.
160.Oteros-Rozas E., Martín-López B., López C.A., Palomo I., González J.A., 2013: Envisioning the future of transhumant pastoralism through participatory scenario planning: a case study in Spain. Rangeland Journal, 35(3), 251-272.
161.Ouko, C., Mulwa, R., Kibugi, R., Owuor, M., Zaehringer, J., Oguge, N., 2018: Community Perceptions of Ecosystem Services and the Management of Mt. Marsabit Forest in Northern Kenya. Environments, 5(11), 121, DOI: 10.3390/environments5110121.
162.Paavola, J., Hubacek, K., 2013: Ecosystem Services, Governance, and Stakeholder Participation: An Introduction. Ecology and Society, 18(4), DOI: 10.5751/ES-06019-180442.
163.Pak, M., Fehmi, M., Öztürk, A., 2010: Total economic value of forest resources in Turkey. African Journal of Agricultural Research, 5(15), 1908-1916, DOI: 10.5897/AJAR10.018.
164.Palacios W., Cerón C.E., Valencia R., Sierra R., 1999: Las Formaciones Naturales de la Amazonía del Ecuador. En Propuesta Preliminar de un Sistema de Clasificación de Vegetación para el Ecuador Continental, Ed. Sierra R. pp. 109-119, Proyecto INEFAN/GEF-BIRF y Ecociencia, Quito, Ecuador.
165.Palacios W., Malessa U., 2010: Situación de las comunidades productoras forestales de la Amazonía Ecuatoriana: obstáculos y oportunidades para comercializar madera legal.In: TRAFFIC América del Sur and VERIFOR. Available online in: http://www.infobosques.com/descargas/biblioteca/51.pdf /.
166.Pan, S., Lee, J., Tsai, H., 2014: Travel photos: Motivations, image dimensions, and affective qualities of places. Tourism Management, 40, 59-69, DOI: 10.1016/j.tourman.2013.05.007.
167.Pastorella, F., Giacovelli, G., Maesano, M., Paletto, A., Vivona, S., Veltri, A., Pellicone, G., Scarascia Mugnozza, G, 2016: Social perception of forest multifunctionality in southern Italy: The case of Calabria Region. Journal of Forest Science, 62(8), 366-379, DOI:10.17221/45/2016-JFS.
168.Patiño, R., 2002: Medidas de posición. Available online in: http://iqcelaya.itc.mx/~roosph/pye/u2/eu2t3.pdf.
169.Pettinotti, L., de Ayala, A., Ojea, E., 2018: Benefits from Water Related Ecosystem Services in Africa and Climate Change. Ecological Economics, 149, 294-305, DOI: 10.1016/j.ecolecon.2018.03.021.
170.Plieninger T., Bieling C., 2012: Resilience and the cultural landscape: understanding and managing change in humanshaped environments. In: Cambridge University Press, Cambridge, UK.
171.Plieninger, T., Bieling, C., Fagerholm, N., Byg, A., Hartel, T., Hurley, P., López, C., Nabaghatla, N., Oteros, E., Raymond, C., van der Horst, D., Huntsinger, L., 2015: The role of cultural ecosystem services in landscape management and planning. Environmental Sustainability, 14, 28-33, DOI: 10.1016/j.cosust.2015.02.006.
172.Plieninger, T., Dijks, S., Oteros-Rozas, E., Bieling, C., 2013: Assessing, mapping, and quantifying cultural ecosystem services at community level. Land Use Policy, 33, 118-129, DOI: 10.1016/j.landusepol.2012.12.013.
173.Ponce, C., 2017: Sistema Nacional de Monitoreo de Bosques. Available online in: http://redd.mma.gov.br/images/gttredd/carlosponce_equador.pdf.
174.Portela, L., Rivero, A., 2019: Economic Valuation of Goods And Ecosystem Services In Mountains of Guamuhaya, Cienfuegos, Cuba. Universidad y sociedad, 11(3), 47-55.
175.Power, A. G., 2010: Ecosystem services and agriculture: Tradeoffs and synergies. Philosophical Transactions of the Royal Society B: Biological Sciences, 365(1554), 2959-2971, DOI: 10.1098/rstb.2010.0143.
176.Proaño, N., 2019: Biofin dice que El 50% de los bosques tropicales en el mundo se han perdido. Available online in: https://www.metroecuador.com.ec/ec/noticias/2019/02/18/biofin-50-por-ciento-bosques-tropicales-mundo-se-han-perdido.html.
177.Quintas-Soriano, C., Brandt, J. S., Running, K., Baxter, C. V., Gibson, D. M., Narducci, J., Castro, A. J., 2018: Social-ecological systems influence ecosystem service perception: A Programme on Ecosystem Change and Society (PECS) analysis. Ecology and Society, 23(3), DOI: 10.5751/ES-10226-230303.
178.Rainforest Foundation Pastaza del Ecuador, 2019: Rainforest Foundation. Available online in: http://www.rainforest-foundation-ecuador.org/es/fundacion.
179.Rands M.RW, Adams W.M., Bennun L. et al., 2010: Biodiversity conservation: Challenges Beyond 2010. Science, 329(5997), 1298-1303.
180.Raum, S., 2018: A framework for integrating systematic stakeholder analysis in ecosystem services research: Stakeholder mapping for forest ecosystem services in the UK. Ecosystem Services, 29, 170-184, DOI: 10.1016/j.ecoser.2018.01.001.
181.REDD Community, 2019: Ecuador the REDD Desk. Available online in: https://theredddesk.org/countries/ecuador.
182.Rensink, R., 2000: Scene perception. Oxford University Press.
183.Reyers, B., O'Farrell, P., Cowling, R., Egoh, B., Le Maitre, D., Vlok, J., 2009: Ecosystem Services, Land-Cover Change, and Stakeholders: Finding a Sustainable Foothold for a Semiarid Biodiversity Hotspot. Ecology and Society, 14(1), DOI: 10.5751/ES-02867-140138.
184.Richards, D. R., Tunçer, B., 2018: Using image recognition to automate assessment of cultural ecosystem services from social media photographs. Ecosystem Services, 31, 318-325, DOI: 10.1016/j.ecoser.2017.09.004.
185.Ridding, L. E., Redhead, J. W., Oliver, T. H., Schmucki, R., McGinlay, J., Graves, A. R., Morris, J., Bradbury, R., King, H., Bullock, J. M., 2018: The importance of landscape characteristics for the delivery of cultural ecosystem services. Journal of Environmental Management, 206, 1145-1154, DOI: 10.1016/j.jenvman.2017.11.066.
186.Riera, P., 1994: Manual de valoración Contingente. Instituto de Estudios Fiscales.
187.Ríos, M., Pedersen, H., 1997: Uso y Manejo de Recursos Vegetales. Memorias del Segundo Simposio Ecuatoriano de Etnobotánica y Botánica Económica (Abya Yala). Quito, Ecuador.
188.Ríos, M., Koziol, M., Pedersen, H., Granda, G., 2007: Useful Plants of Ecuador: Applications, challenges and perspectives. Abya Yala.
189.Roces, J. V., Vayreda, J., Banqué, M., Cusó, M., Anton, M., Bonet, J. A., Brotons, L., Cáceres, M., Herrando, S., Aragón, J.M., de Miguel, S., Martínez-Vilalta, J., 2018: Assessing the distribution of forest ecosystem services in a highly populated Mediterranean region. Ecological Indicators, 93, 986-997, DOI: 10.1016/j.ecolind.2018.05.076
190.Rodriguez J., 2018: Amazonia Brasileña: La Desarticulacion de los Paisajes Culturales.In: Revista Eletrônica Casa de Makunaima, 1(2), 9-22
191.Rousseeuw, P. J., 1987: Silhouettes: A graphical aid to the interpretation and validation of cluster analysis. Journal of Computational and Applied Mathematics, 20, 53-65, DOI: 10.1016/0377-0427(87)90125-7.
192.Rupérez, C., Pérez, J., Senent, J., Flores, M., 2015: The economic value of conjoint local management in water resources: Results from a contingent valuation in the Boquerón aquifer. Science of the Total Environment, 532, 255-264, DOI: 10.1016/j.scitotenv.2015.05.028.
193.Sabogal, C., Guariguata, M., Broadhead, J., Lescuyer, G., Savilaakso, S., Essoungou, N., 2013: Manejo forestal de uso múltiple en el trópico húmedo: Oportunidades y desafíos para el manejo forestal sostenible, Vol. 173.
194.Salomon, A. K., 2008: Ecosystems. En B. Fath (Ed.), Encyclopedia of Ecology (Second Edition), 350-360, DOI: 10.1016/B978-0-444-63768-0.00482-0.
195.Saša, S., 2014: Forest Ecosystem Services (FES), Valuation of FES, Implementation of the Valuation: Serbian experience. Presented in Belgrade.

196.Schmidt, K., Walz, A., Martín-López, B., Sachse, R., 2017: Testing socio-cultural valuation methods of ecosystem services to explain land use preferences. Ecosystem Services, 26(Pt A), 270-288, DOI: 10.1016/j.ecoser.2017.07.001.
197.Schnegg, M., Rieprich, R., Pröpper, M., 2014: Culture, Nature, and the Valuation of Ecosystem Services in Northern Namibia. Ecology and Society, 19(4), DOI: 10.5751/ES-06896-190426.
198.Scholte, S. S. K., van Teeffelen, A. J. A., Verburg, P. H., 2015: Integrating socio-cultural perspectives into ecosystem service valuation: A review of concepts and methods. Ecological Economics, 114, 67-78, DOI: 10.1016/j.ecolecon.2015.03.007.
199.SCION, 2017: Forest ecosystem services. Available online in: https://www.nzfoa.org.nz/resources/file-libraries-resources/environment/factsheets/613-ecosystems/file.
200.Scottish Environment Protection Agency, 2015: Cultural Ecosystem Services – towards a common framework for developing policy and practice in Scotland.
201.Sharma, H., 2017: K-means Clustering Algorithm: Know How It Works. Edureka. Available online in: https://www.edureka.co/blog/k-means-clustering-algorithm/.
202.Shi, G., Jiang, N., Yao, L., 2018: Land Use and Cover Change during the Rapid Economic Growth Period from 1990 to 2010: A Case Study of Shanghai. Sustainability, 10(2), 426. DOI:10.3390/su10020426.
203.Sierra, R., 2013: Patrones y factores de deforestación en el Ecuador continental, 1990-2010 y un acercamiento a los próximos 10 años.
204.Simensen, T., Halvorsen, R., Erikstad, L., 2018: Methods for landscape characterisation and mapping: A systematic review. Land Use Policy, 75, 557-569, DOI:10.1016/j.landusepol.2018.04.022.
205.Sing, L., Ray, D., & Watts, K., 2015: Ecosystem services and forest management. Forestry Commission.
206.Sist P., Nolan T., Bertault J., Dykstra D., 1998: Harvesting intensity versus sustainability in Indonesia, In: Forest Ecology and Management, 108(3) (3), 251-260.
207.Sklenicka, P., Molnarova, K, 2010: Visual Perception of Habitats Adopted for Post-Mining Landscape Rehabilitation. Environmental Management, 46(3), 424-435, DOI: 10.1007/s00267-010-9513-.
208.Small, N., Munday, M., Durance, I., 2017: The challenge of valuing ecosystem services that have no material benefits. Global Environmental Change, 44, 57-67, DOI: 10.1016/j.gloenvcha.2017.03.005.
209.Solano, M., 2017: Valoración económica de los servicios ecosistémicos culturales de recreación y belleza escénica del bosque seco del guayacán en su etapa de florecimiento, en la parroquia Mangahurco. Universidad Técnica Particular de Loja, Loja -Ecuador.
210.Stahlschmidt, P., Swaffield, S., Primdahl, J., Nellemann, V., 2017: Landscape Analysis: Investigating the potentials of space and place. Taylor & Francis.
211.Stegarescu, G., 2014: Quantification of Ecosystem Services. Técnico Lisboa.
212.Suárez, L., Chávez, G., Cordero, M., Álvarez, N., Espinoza, F., Paz y Miño, C., Vogel, J.H., Bravo, E., Vásquez, L., Chiriboga, J., Pocaterra, F., Beltrán, R., López F., 1997: Biodiversidad, bioprospección y bioseguridad (A. Varea, Ed.). Quito.
213.Tapella, E., 2011: El mapeo de actores claves. Available online in: https://planificacionsocialunsj.files.wordpress.com/2011/09/quc3a9-es-el-mapeo-de-actores-tapella1.pdf.
214.Tapia, M. F., Homeier, J., Espinosa, C. I., Leuschner, C., de la Cruz, M., 2015: Deforestation and Forest Fragmentation in South Ecuador since the 1970s – Losing a Hotspot of Biodiversity. PLoS ONE, 10(9), DOI: 10.1371/journal.pone.0133701.
215.Tolunay, A., Başsüllü, Ç., 2015: Willingness to Pay for Carbon Sequestration and Co-Benefits of Forests in Turkey. Sustainability, 7(3), 3311-3337, DOI: 10.3390/su7033311.
216.Tomasini, D., 2015: Valoración económica del Ambiente. Revista Economía y Desarrollo. Available online in: http://www.keneamazon.net/Documents/Publications/Virtual-Library/Economia-Desarrollo/122.pdf.
217.Tsakimp, S., 2013: PLAN DE MANEJO DEL BOSQUE SHUAR (Universidad de Cuenca). Retrieved from http://dspace.ucuenca.edu.ec/bitstream/123456789/22879/1/tesis.pdf
218.Tsonkova, P., Quinkenstein, A., Böhm, C., Freese, D., Schaller, E., 2014: Ecosystem services assessment tool for agroforestry (ESAT-A): An approach to assess selected ecosystem services provided by alley cropping systems. Ecological Indicators, 45, 285-299, DOI: 10.1016/j.ecolind.2014.04.024.
219.United Nations Statistics Division Demographic and Social Statistics, 2012. Available online in:: https://unstats.un.org/unsd/demographic/meetings/wshops/Morocco/2012/list_of_docs.htm.
220.Valarezo, C., Abril, D. J., Djibeyan, P. D., Andrade, P. V., Ontaneda, F. F., 2016: La amazonia ecuatoriana y sus saberes ancestrales; el uso del extracto de corteza del árbol de Piwi (Pictocoma discolor) un saber singular en el accidente ofídico. Rev Mex Cienc Farm.
221.Valencia, R., 2018: Libro rojo de las plantas endémicas del Ecuador. Available online in: https://bioweb.bio/floraweb/librorojo/amazonia/
222.van Berkel, D. B., Verburg, P. H., 2014: Spatial quantification and valuation of cultural ecosystem services in an agricultural landscape. Ecological Indicators, 37, 163-174, DOI: 10.1016/j.ecolind.2012.06.025.
223.Vásquez, F., 2015: Valoración Económica de Bienes ambientales. Presented in Cambio Climático, Economía Ambiental y Estilos de Desarrollo, Universidad Nacional de Colombia.
224.Velaso Murguia A., Durán Medina E., Medina R., Rivera Y., Barton D., 2014: Cambios en la cobertura arbolada de comunidades indígenas con y sin iniciativas de conservación, en Oaxaca, México. In: Investigaciones Geográficas, Boletín del Instituto de Geografia, núm. 83, Instituto de Geografía, UNAM, México, 83, 55-73
225.Viszlai, I., Barredo, J., San Miguel -Ayanz, J., 2016: Payments for forest Ecosystem services- SWOT Analysis and Possibilities for Implementation, DOI: 10.2788/957929.
226.Walz, A., Grêt-Regamey, A., Lavorel, S., 2016: Social valuation of ecosystem services in mountain regions. Regional Environmental Change, 16(7), 1985-1987, DOI: 10.1007/s10113-016-1028-x.
227.Wang, R., Zhao, J., 2017: Demographic groups' differences in visual preference for vegetated landscapes in urban green space. Sustainable Cities and Society, 28, 350-35, DOI: 10.1016/j.scs.2016.10.010.
228.Wasserstrom, R., Southgate, D., 2013: Deforestation, Agrarian Reform and Oil Development in Ecuador, 1964-1994. Natural Resources, 04(01), 31-44, DOI: 10.4236/nr.2013.41004.
229.Wealth Accounting and the Valuation of Ecosystem Services, 2015: Forest accounting sourcebook Policy applications and basic compilation.
230.Whiteman G., Cooper W.H., 2000: Ecological embeddedness. In: Academy of Management Journal, 43(6), 1265-1282.
231.World Bank Group, 2016: Valuing water resources in Turkey: A methodological overview and Case Study. N AUS10650, p. 68, Turkey.
232.Xu, W., Zhao, J., Huang, Y., & Hu, B., 2018: Design intensities in relation to visual aesthetic preference. Urban Forestry & Urban Greening, 34, 305-310, DOI: 10.1016/j.ufug.2018.07.011.
233.Yoshada, Chinnappa, B. V, 2012: Recreationists Willingness to Pay for Conservation of a Forest ecosystem: An Economic study of Basavana Betta State Forest, Karnataka state, India. International Association of Agricultural Economists (IAAE) Triennial Conference, 20.
234.Zaiontz, C., 2012: Dunn's Test after KW | Real Statistics Using Excel. Available online in: https://www.real-statistics.com/one-way-analysis-of-variance-anova/kruskal-wallis-test/dunns-test-after-kw/.
235.Zar, J., 2010. Biostatistical analysis (5tn ed). In: Uppeer Saddle River, NJ

236. Zhang, D., Stenger, A., 2015: Value and valuation of forest ecosystem services. Journal of Environmental Economics and Policy, 4(2), 129-140, DOI:10.1080/21606544.2014.980852.
237. Zhang, L., Yu, X., Jiang, M., Xue, Z., Lu, X., Zou, Y., 2017: A consistent ecosystem services valuation method based on Total Economic Value and Equivalent Value Factors: A case study in the Sanjiang Plain, Northeast China. Ecological Complexity, 29, 40-48, DOI:10.1016/j.ecocom.2016.12.008.
238. Zhang, T., Haiming, Y., Jinyan, Z., 2012: Economic Valuation of Forest Ecosystem Services in Heshui Watershed using Contingent Valuation Method. Procedia Environmental Sciences, 13, 2445-2450.
239. Zoderer, B. M., Tasser, E., Carver, S., Tappeiner, U., 2019: Stakeholder perspectives on ecosystem service supply and ecosystem service demand bundles. Ecosystem Services, 37, 100938, DOI: 10.1016/j.ecoser.2019.100938.
240. Zúñiga, T., 2007: Situación actual de la forestación y reforestación en el Ecuador. Available online in: http://www.fao.org/docrep/007/ad102s/AD102S08.htm.

Abstract

The rates of deforestation in Ecuadorian Amazon Region have increased noticeably in the last years, as result of changes in the land uses and irrational exploitation of forest resources (timber mainly). The identification and evaluation of land uses and of all the ES categories allow understanding the functioning of a set of ecosystems in a given area and the incidence of these ecosystems in the human well-being. The aim of the present research was to evaluate the capacity of Ecuadorian Amazonian Rainforest to provide ecosystem services, so it involved the identification of the natural capital (plants and their uses), analysis of the capacity to provide products and services and perception on the landscape management systems in the view of local stakeholders (visual preferences and the importance of conservation as a tool that guarantee the flow of services). The first step of this study was realized through a literature review complemented by enquiring of the inhabitants in the area, whilst, the other steps were carried out by means of a questionnaire survey. The collected information was processed in a database and analyzed through descriptive (frequency, percentages, central tendency and dispersion measures) and inferential statistics (non-parametric tests).The results were as follows: i) there were analyzed 540 vegetable species and their predominant use was found to be related to medicine, ii) primary forest was evaluated to have the highest capacity to provide ES in comparison to the other three land uses (secondary forest, croplands and pasturelands), iii) the factors that modify the perception on the capacity to provide were the education level, age and occupation, iv) the highest scores were assigned to primary forest following a visual perception exercise and v) the WTP for conservation of water and forest in the study area was 23.23$ per family and per year. The study concludes that forests are productive ecosystems (in terms of goods and services provided), and are preferred by local stakeholders due to their naturalness; therefore, it is necessary to find funds and implement programs for their conservation.

Scurt rezumat

Reducerea suprafeţei împădurite în regiunea amazoniană a Ecuadorului a crescut simţitor în ultimii ani ca rezultat a schimărilor apărute în folosinţa terenurilor şi a exploatării iraţionale a resurselor forestiere (în principal lemn). Identificarea şi evaluarea categoriilor de folosinţă a terenurilor precum şi a tuturor serviciilor ecosistemice permite înţelegerea modului de funcţionare a unui set de ecosisteme dintr-o regiune dată precum şi a incidenţei acestor ecosisteme în bunăstarea umană. Scopul prezentei cercetări a fost acela de a evalua capacitatea pădurilor amazoniene din Ecuador de a furniza servicii ecosistemice, prin urmare lucrarea a presupus identificarea capitalului natural (plante şi modul de folosinţă al acestora), analiza capacităţii de a furniza produse şi servicii precum şi a percepţiei asupra sistemelor de management al teritoriului în viziunea localnicilor (preferinţe vizuale şi importanţa conservării ca unealtă care să garanteze fluxul de servicii). Primul pas al acestei lucrări a constat dintr-o documentare bibliografică completată de chestionarea localnicilor, în timp ce următorii paşi au vizat implementarea unui studiu de teren pe baza unor chestionare. Informaţiile colectate au fost prelucrate într-o bază de date şi analizate prin statistici descriptive (frecvenţă, procentaje, măsuri ale tendinţei centrale şi ale dispersiei) şi inferenţiale (teste non-parametrice). S-au obţinut următoarele rezultate: i) 540 de specii de plante au fost luate în analiză constatându-se faptul că utilizarea predominantă a acestora este relaţionată cu medicina, ii) pădurile native (primare) au fost evaluate a avea cea mai mare capacitate de a furniza servcii ecosistemice prin comparare cu pădurile gestionate (secundare), terenurile agricole şi păşuni, iii) factorii care au influenţat modificarea percepţiei asupra capacităţii de a furniza servicii ecosistemice au fost nivelul de educaţie, vârsta şi ocupaţia, iv) pe baza unui exerciţiu de percepţie vizuală, cele mai mari scoruri (preferinţe) au fost atribuite pădurilor primare şi v) intenţia de angajare în plăţi voluntare pentru conservarea resurselor de apă şi a pădurilor din zona de studiu a fost evaluată la suma medie de 23,23$ pe familie şi pe an. Lucrarea concluzionează că pădurile sunt ecosisteme productive prin prisma bunurilor şi serviciilor furnizate, fiind preferate de localnici datorită naturaleţii specifice; prin urmare este necesară găsirea de fonduri şi implementarea de programe specifice pentru conservarea lor.