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SOCIETAL EVALUATION OF FOREST ECOSYSTEM SERVICES AND THEIR TRADE-OFFS IN CATALONIA

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Abbreviations and acronyms

ANOVA	Analysis of Variance
CC	Climate Change
COVID-19	Corona Virus Disease 2019
DSP	Dominant Social Paradigm
ES	Ecosystem Service/s
FAO	Food and Agriculture Organization
FES	Forest Ecosystem Service/s
HSD	Honestly Significant Difference
MA, 2003	Millennium Ecosystem Assessment, 2003
MEA, 2005	Millennium Ecosystem Assessment, 2005
NTFP	Non -Timber Forest Product/s
POLYFORES	Decision making support for Forest Ecosystem Services in Europe
TEEB	The Economics of Ecosystems and Biodiversity

Declaration

I hereby declare that this thesis paper, **" Societal Evaluation of Forest Ecosystem Services And Their Trade-Offs in Catalonia "** was carried out for the partial fulfillment of Erasmus Mundus Masters Degree Program in Mediterranean Forestry and Natural Resource Manangement (MEDfOR) and is my own work except where acknowledged. All views and opinions expressed herein remain the sole responsibility of myself, and do not necessarily represent those of the university.

I have not submitted it or any of its part to any other academic institutions for any degree.

…….

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Author

Summary

The concept of Ecosystem services (ES), simply defined as "*the benefits people obtain from ecosystems"* has been used widely for various purposes. The benefits from ESs are evaluated by using three value domains i.e., economic valuation, bio-physical/ecologic valuation and socio-cultural/social valuation. Former two value domains have been researched widely while socio-cultural/social valuation are scarce. Without the inclusion of socio-cultural aspects, the evaluation of ES cannot be holistic and realistic. This study is an attempt to understand how people evaluate and perceive the importance of forest ES and add more insights to the social valuation aspect of forest ecosystem services. The level of knowledge and awareness about forest, relative importance of different forest ecosystem services, effect of forest management for boosting one ES on other forest ESs and people's priority to forest management objectives were studied and analysed. In addition, the factors affecting management priorities were also studied and analysed by using data collected from questionnaire survey in four provinces of Catalonia Region. Statistical tests and descriptive analyses were carried out and the results thus obtained were discussed. The results showed that the people were not much aware about the present state of forests, regulating forest ES were more valued than cultural and provisioning forest ES and most people perceived that management of one forest ES had positive effect on all other services (with some exceptions). The results also indicated that people's priority for forest management was towards regulating services and factors such as gender, education, place of residence and ownership typology did make a difference towards management priorities of forest ES. Environmental education for better understanding of forest systems, more focus on forest management for regulating services in Catalonia and further studies with consideration of other factors including factors such as age, education, gender, ownership typology and place of residence are recommended.

Keywords: Social evaluation, Forest ecosystem services, Forest management priorities, People's perception

1. Introduction

The most widely used definition of ecosystem services – *the benefits people obtain from ecosystems* (MEA, 2005) – is extremely simple and easy to understand and may be one of the reasons for its huge success (Barnaud & Antona, 2014). The concept of ES has been used for various purposes including decision making, policy formulation, and preparing management strategies. For fulfilling the objectives of these multiple purposes, it is imperative to obtain the value or the worth of the benefits that these ecosystem services provide. In the evaluation framework, three value domains are widely used and accepted which are: i) Economic value ii) Bio-physical or ecological value and iii) Socio-cultural or social value. Economic valuation is the most widely used method which helps in getting money metrics and numbers that policy makers and managers can use to direct their management strategies. Similarly, bio-physical/ecological valuation methods have been used to assess the ecosystem services at large. Socio-cultural valuation methods, on the other hand, are less commonly used. Although socio-cultural methods were lagging and used less frequently in the past, recently, they are getting more attention. Researchers have now felt the need to integrate all methods of valuation for getting a realistic and holistic view of the values that ES hold. However, research regarding the societal valuation of forest ecosystem services are found to be scanty and the ones that can be found are not holistic in nature.

The societal valuation methods are different from other valuation methods as these methods are related with issues that are beyond the domain of rational choice and are more influenced by the discourse of culture, memory, and language (Manoli et al., 2019). There is a complex set of factors which affect the way an individual gives value to the environmental services but nonetheless, people always tend to have a somewhat fixed and rigid valuation of ES. In case of forest ecosystem services, people tend to have their own opinion on what forests are, what their importance is and whether management for provision of one forest ecosystem service has positive or negative or neutral effect on other forest ecosystem services. This, in an indirect way, gives us an idea of how people view and perceive different forest ecosystem services and how they analyse priorities for forest management objectives. Preference of one forest management objective for a certain forest ecosystem service over another also reveals trade-offs in a tacit way. This study also tries to explore possible factors that shape the preferences and priorities for forest management objectives.

While these type of social methods have significant pros, there are also concerns about whether these methods should augment, complement, or replace methods such as cost–benefit (O'Neill, 1996; Price, 2000; Holland, 2002b; Bebbington et al., 2007; Wegner and Pascual, 2011; Parks and Gowdy, 2013) cf (Kenter et al., 2015). This paper is an endeavour to cover the visible gaps in terms of forest ES evaluation regarding social aspects and should be considered complimentary for further fortification of the ES

concept. Overall, this study tries to bolster the valuation methods of forest ES in a holistic way by incorporating the societal views on forest ES.

In this section, existing problems, the rationale for carrying out this study and the objectives are explained under respective headings.

1.1 Problem statement

To support and inform environmental management and conservation strategies, the concept of ecosystem services has been used widely by academics, researchers and policymakers (Fisher et. al, 2009; Lamarque et. al, 2011) cf (Martín-López et al., 2012). The increasing popularity and the scope of this concept for multitude of objectives including policy making as well as formulation of management strategies have created impetus for attempts to valuate ES. Integrating this concept into policy starts with an ES assessment, including identification, characterization and valuation of ES. Multi-disciplinary approaches should be integrated into ES assessments. However, non-economic social analyses have been lagging behind, resulting in a gap regarding stakeholder perceptions of ES (Orenstein & Groner, 2014).

In the evaluation framework, there are three value domains: ecological, sociocultural, and economic (de Groot et al., 2002; MA, 2003) cf (Shoyama & Yamagata, 2016). Based on this, ES, including goods and/or benefits they provide, can be valued in ecological, economic or social terms. Due to this variation in valuation, integration of diverse disciplinary approaches is needed in the assessment and valuation of ES (Burkhard and Muller, 2008; Collins et al., 2011; Daily et al., 2009; Haberl et al., 2006; Kumar and Kumar, 2007; O'Farrell et al., 2011) cf (Sagie et al., 2013). However, it is seen that most studies have focused either on biophysical or on the economic valuation of ecosystem services (Garcia-Llorente et al., 2011; Nieto-Romero et al., 2014; Plieninger et al., 2013; Schroter et al., 2014; Seppelt et al., 2012) cf (Paudyal et al., 2018).

Economic valuation has been used and widely accepted for planning and formulating management strategies based on cost benefit analysis. This has created significant challenge in achieving the environmental sustainability because if the decision-making is mostly based on economic assessments like the cost–benefit analysis, then the environmental policies would promote monetary valuation studies for getting information to make decisions, which will downplay the other value-domains of ecosystem services (Martín-López et al., 2014). Interestingly, the process of valuing non-material goods and services of forest ecosystem services is shaped not only by economic aspect but also by numerous other sociocultural phenomena which are usually overlooked (Daniel et al. 2012) and are rarely the main consideration in decision making (Milcu et al. 2013) cf (Van Riper et al., 2017). Biophysical and economic valuation methods neglect the crucial aspect of social perception on how people value ES. In a brief literature review, there

were only few authors who considered social aspects for valuation of ES. Fewer studies have been conducted from the perspective of human/social values, attitudes, and beliefs (Chan et al., 2012; Cole et al., 2015; Martin-Lopez et al., 2012; van Riper et al., 2017) cf (Paudyal et al., 2018). Some studies have tried to address social values approach in woodlands and forests (Sherrouse et al., 2014), grasslands (Lamarque et al., 2011), coastal zones and mangroves (Cole et al., 2015),watersheds services (Zagarola et al., 2014) and on a regional scale (Chan et al., 2010; Raymond et al., 2009) cf (Paudyal et al., 2018). However, these studies could not address forest ES from social perspectives in a holistic and efficient way.

Despite the clear demand for social assessments in particular Ecosystem Services, very few studies have assessed them using a social (non-economic) approach leading to a gap in our understanding of the social value of particular ES like forest ES (Sagie et al., 2013). Also, there is a need to investigate social preferences and trade-offs involving ES, including forest ecosystem services. Many studies indicate that there is increased prioritization of forest management objectives for provisioning forest services than other forest ecosystem services. Since ecosystem services come in bundles and optimisation of one service results in reduction of the others, there are obviously inevitable trade-offs. Decision-makers need to make decisions under conditions of uncertainty, without fully knowing about the wider ramifications of their decisions on the ecosystem and on the livelihoods/well-being of people (Berbés-Blázquez et al., 2016). One of the best ways to understand these trade-offs is through societal evaluation, studies on which, are difficult to find.

This knowledge gap of social insights and social prioritization as well as the societal evaluation of forest ecosystem services need to be addressed if we are to evaluate the real value of the forest ecosystem services.

1.2 Rationale of the study

Despite the progress achieved so far in ES evaluation, most of the achievements have been focused mainly on various aspects of economic valuations and ecological changes, with less consideration to the stakeholders' perceptions like preferences or social values for ES (Zoderer et al., 2016; Jaligot et al., 2018) cf (Zhang et al., 2020). A paper by Robert Costanza and his colleagues states that valuation should not be associated with commodification, and market-based instruments might not be the most appropriate method to manage them since many ES are considered common-pool resources or public goods (Costanza et al., 2014) cf (Barnaud & Antona, 2014). Some authors voice that non-economic, social valuation of ecosystem services should also have a role in the decision-making process (Kumar and Kumar, 2008; Peterson et al., 2009) because "*prices are not to be confused with values, and prices are not the only values that are important*" (Cowling et al., 2008) cf (Brown, 2013). This is also consistent with some existing frameworks that advocate the ideas like (1) ecosystem management is a matter of societal choice; (2) societal valuation helps in decentralisation of decision-making; 3) social

choice considers all forms of relevant knowledge; and (4) societal evaluation involves all relevant sectors of society and scientific disciplines (Irvine et al., 2016).

As application of monetary and biophysical valuation for ecosystem services are much frequent, it is also logical to undertake more socio-cultural valuation studies so that new perspectives and diversity of insights are added. Some of the non-economic and non-monetary valuation methods provide insight on intrinsic motivations that underpin the ownership, management, and conservation of natural resources (Chan et al. 2012, 2016, Brown G and Fagerholm 2014, Plieninger et al. 2015) cf (Van Riper et al., 2017). The importance of integrating social perspectives of ecosystem services (ES) has also been promoted as a strategy for sustainable development (Caceres et al., 2015; Chan et al., 2012; Martin-Lopez et al., 2012; Nagendra et al., 2013; Reyers et al., 2013) cf (Paudyal et al., 2018). Socio-cultural or societal valuation has been used to inform stakeholder needs and values and to identify potential conflicting views between stakeholders during landscape management and planning (Castro et al. 2011; Agbenyega et al.2009; Casado-Arzuaga et al. 2013; Pereira et al. 2005) cf (Maestre-Andrés et al., 2015). It should also be acknowledged that understanding social preferences towards the protection of ecosystem services has become a research priority (Anton et. al, 2010) cf. (Martín-López et al., 2012).
Earlier studies focused more on roundwood mobilization while in recent times, the public demand for forest ecosystem services has often been the impetus for many studies (Ficko et al., 2019). Identifying the reasons and motivations for protecting forest ecosystem services helps to understand which services are relevant for different stakeholders and which trade-offs need to be addressed when making decisions regarding land-use management (Seppelt et. al, 2011) cf. (Martín-López et al., 2012). To understand how the society benefits from different ecosystems in a landscape and the multitude of ways in which societies appreciate and perceive ecosystem services is very crucial. It is important especially for assessing sociocultural dimension of ecosystem services by identifying which ecosystem services are highly appreciated and preferable (Martín-López et al., 2012) in order to implement successful conservation planning (Kari and Korhonen-Kurki, 2013) while fulfilling their daily needs cf (Muhamad et al., 2014).

Deliberative and participatory approaches to environmental valuation and appraisal are increasingly advocated as a means to include the multidimensionality of value within decision-making. Strengthening non-economic, social approaches to ES assessment can address some of the ethical concerns and critiques regarding the ES conceptual approach (e.g. Kosoy and Corbera, 2010; Dempsey and Robertson, 2012; Luck et al., 2012) cf (Orenstein & Groner, 2014). Moreover, accounting for diversity in public opinion is instrumental to sustaining livelihoods and cultural identity (Brown and Neil 2011), facilitating broad participation in decision making (Chan et al. 2012a) and incorporating ecosystem services into resource-management plans (Sarukhán and Whyte 2003, Carpenter et al. 2006) cf (Van Riper et al., 2017). In line with this, taking into

consideration stakeholders' perspectives is a useful way to approach ES trade-offs and to explore the potential social conflicts involved in ES management. Understanding people's perception is important in designing effective environmental information and education campaigns. For better consideration of the spatial shifts in people's priorities, local perception of the services derived from the ecosystem is of key importance (Moutouama et al., 2019). The purpose of valuation includes multi-level decision making as well as raising awareness, litigation, or using valuation as a conflict resolution instrument (Baggethun et al., 2013) cf (Pascual et al., 2017).

With growing pressures on ecosystem services throughout the world, the ability to adequately assess the social values of these services alongside their ecological and economic values is not only important but also essential for effective decision-making. Hence, this study tries to fill some of the gaps aforementioned and contribute further to realize the holistic and real evaluation forest ES. Societal evaluation of forest ecosystem services will certainly be helpful in demonstrating how society views and values FES which in turn will be useful in policy planning and taking effective management actions.

1.3 Objectives and research questions

The general objective of this study is to explore how people in Catalonia evaluate forest ecosystem services and how they perceive its importance. The specific objectives are as follows:

1. To assess the level of knowledge and awareness of people regarding forests, its importance and status
2. To find out the relative importance given to different forest ecosystem services by people for themselves and for the society
3. To explore the perceptions of people on applying management objective for boosting one forest ecosystem service to other services and
4. To identify the priorities of people on management objectives (of forest ecosystems) and the factors that influence these prioritizations

The research questions for this study are:

i. How people perceive forests? What is their level of knowledge and awareness about forests?
ii. Do people value and give importance to forest ecosystem services? Does this valuation change when they think of forests for themselves and for the society?
iii. How do people perceive the effect of applying forest management objectives for boosting one forest ecosystem service over other forest ecosystem services?
iv. Which forest management objectives do people prioritize more? Are there any trade-offs? What might be the factors that affect these priorities of forest management?

2. Background

In this section, a short description of what the ecosystem services are and how they started to appear in a mainstream research is provided. Similarly, the trends and methods of evaluating ES (particularly Societal valuation of ES) and the factors affecting social valuation are discussed. A brief description of the meaning and implications of trade-off as well as the theoretical approach behind this study is explained under different headings.

2.1 Literature Review

Ecosystem Services

Human beings have been dependent in nature for their survival and have always acknowledged it. Although humans have interacted with the biophysical environment throughout the history, "environmentalism"emerged as a recognizable social movement in the United States in the late 1960s (Bernstein & Szuster, 2018). The concept of ecosystem services (ES), commonly defined as the benefits supplied to human societies by natural ecosystems (Daily et al., 1997) cf (Barnaud & Antona, 2014), has been enjoying an increasing success in the last decade in both the scientific and political arenas dealing with environmental issues. In modern academic literature, the term "nature's services" and the idea of services provided by ecosystems to people appeared at the end of the 1970s, with authors such as Walter Westman (1977) and then Ehrlich and Mooney (1983) cf (Barnaud & Antona, 2014). The appearance of the terms "nature and nature's services" then triggered meaningful discussions in academia on the topic. With the passage of time, there was a growing understanding of ecology, ecosystems and the non-market and non-use values of nature's services. Consequently, in the 1980s, "ecological economics" was established (Jansson, 1984; Costanza, 1989) and "Ecosystem services" were considered as important part of the research agenda (Costanza et al., 1991) cf (Costanza et al., 2017). The ecosystem functions which were beneficial for human beings were framed as services of ecosystem to gain attention from the general public and these started to appear more in literatures during 1990s. The Millennium Ecosystem Assessment contributed more concretely in placing ecosystem services concept in policy agenda.

The MEA authors distinguished four main types of ES: (i) provisioning services (e.g. food, wood, fresh water, fish), (ii) regulating services (e.g. regulation of climate, floods, water quality…), (iii) cultural services (e.g. aesthetic and recreation values, spiritual enrichment…), and (iv) supporting services (e.g. carbon cycle, soil formation…) that are necessary for the production of the first three categories of services (MEA, 2005) (also cited in Barnaud & Antona, 2014). Whereas the economic valuation of ES was only secondary in the MEA, it gave rise to numerous studies in the field of ecological economics (e.g. Costanza et al., 1997; Gallai et al., 2009; Woodward and Wui, 2001) and it was central to the broad research initiative ''The Economics of Ecosystems and Biodiversity'' (TEEB), launched in 2007 in Europe (TEEB, 2010) cf (Barnaud & Antona, 2014). Ecosystem service (ES) approaches are based on an understanding that ecosystems provide numerous benefits called ecosystem services (ESs) to people and are increasingly

showing promise in moving environmental decision-making processes. Luck et al., (2012) explains that given this potential, the ES concept is increasingly being integrated into decision-making and management in a variety of ways by public institutions, private enterprise, and NGOs (Waage and Kester, 2013a, 2013b) cf (Beery et al., 2016).

Valuation of Ecosystem Services

Valuation method for ecosystem services must identify, acknowledge and accept the fact that irrespective of the choice of methodology used in valuation, individual's identification with nature, his changing preference and dynamic learning, formation and strengthening of ecological identity, play a very important role. Psycho-social models of human behavior (Stern 2000, Kumar and Kumar 2008), anthropological investigations of culture (Satterfield et al. 2013), and the study of politics and institutions (Ostrom 2005, Miller et al. 2015) are several areas of inquiry that can provide insight on how sociocultural phenomena shape ecosystem-service valuation cf (Van Riper et al., 2017).

A way of representing the logic that underlies the ecosystem service is shown in Figure 2.1. The diagram makes a distinction between ecological structures and processes created or generated by living organisms and the benefits that people eventually derive. In the real world the links are not as simple and linear as that. However, the key point is that there is a cascade linking the two ends of a 'production chain' (Haines-Young & Potschin, 2010). The ecosystems perform functions which are of bio-geophysical in nature. These functions produce various services and benefits which are valuable for human society. In other words, the ecosystems constitute structures and processes which yield ecological functions which in turn produce various services and benefits that are valued by people. The word 'value' can refer to a principle associated with a given worldview or cultural context, a preference someone has for a particular state of the world, the importance of something for itself or for others, or simply a measure. These different meanings of 'value' can be linked, for example when ethical principles lead one to assign importance to different aspects of nature's contributions to people, and to have a preference for a specific course of action, which in turn can be measured by an appropriate valuation tool (Pascual et al., 2017).

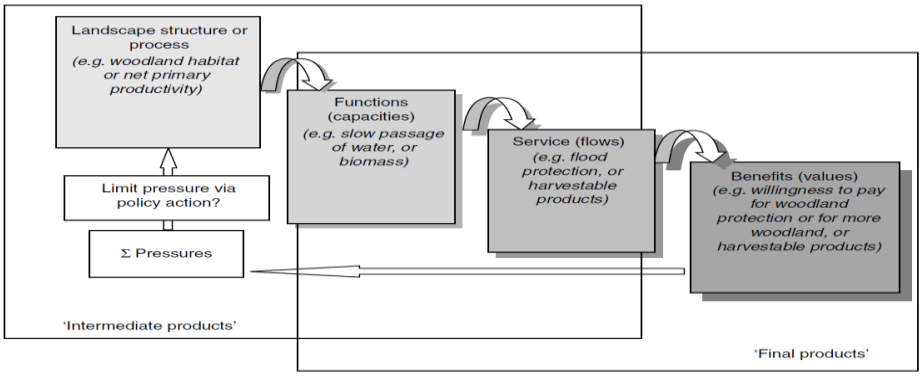


Figure 2. 1: Cascade approach of Ecosystem Services (Haines-Young & Potschin, 2010)

Pascual et al. (2010) mentions valuation approaches, such as biophysical valuation which derives values from measurements of the physical costs (in terms of labour, energy or material inputs) of maintaining a given ecological state and economic valuation through eliciting human preferences using market and non-market techniques of monetary valuation cf (Maestre-Andrés et al., 2015). Environmental economics and ecological economics have both recognized, but in different ways, the complexity and multidimensional nature of the notion of value (Maître d'Hôtel and Pelegrin, 2012, Kenter et al., 2015) cf (Rey-Valette et al., 2017). However, the multiple values that people assign to ecosystems, biodiversity and ecosystem services, i.e., intrinsic, fundamental, relational or flourishing values, cannot be reduced to a single metric of economic value (Sagoff, 1998) cf (Quintas-Soriano et al., 2016). Questions have been raised on how to appraise the value of natural assets, amenities generated and, more recently, goods and services derived from ecosystems (Rey-Valette et al., 2017). Hence, a third valuation approach namely sociocultural valuation approach is widely being integrated which explores human attitudes and perceptions regarding ecosystem services for human well-being through (non-monetary) ranking methods (Martin-Lopez et al. 2014; Maestre-Andres et al. 2012) cf (Maestre-Andrés et al., 2015). It is aimed to capture the multi-dimensional nature of value when referring to ecosystems (Martin-Lopez et al. 2014; Kumar and Kumar 2008), including less tangible social and ethical concerns (associated with non-material benefits) of ecosystems (Chan et al., 2012). The idea behind this approach was suggested some time ago already (e.g., De Groot et al. 2002, 2010) and has been employed by authors such as Martin-Lopez et al. 2012; Calvet-Mir et al. (2012); Oteros-Rozas et al. (2013) cf (Maestre-Andrés et al., 2015). Maestre-Andrés et al., (2015) used sociocultural valuation approach because they were interested in assessing the system as a whole rather than (small) changes in it. The dimensions related to ecosystem service assessment (from the supply to the demand-sides), or the three value-domains of ecosystem services was also used by Martín-López et al., (2014).

In the case of ES valuation, decision makers creating new regulation tools based on ES need values and urge scientists to provide them with numbers, even though valuations are still controversial, and this in turn contributes to reinforcing the controversies (Barnaud & Antona, 2014). The most common and widely employed method of providing such values is economic valuation method using money metrics.The Economic valuation of ES can be defined as the attempt to assign quantitative values to the goods and services provided by ecosystems. The main objective of valuation of ecosystem services is to generally indicate the overall economic efficiency of the various competing uses of functions of a particular ecosystem (Manoli et al., 2019). The utility that an individual derives from a given ecosystem service depends on that individual's preferences. The utilitarian approach, therefore, bases its notion of value on attempts to measure the specific utility that individual members of society derive from a given service, and then aggregates across all individuals, weighting them all equally. Utility cannot be measured directly. In order to provide a common metric in which to express the benefits of diverse

services provided by ecosystems, the utilitarian approach usually attempts to measure all services in monetary terms. It does not mean that only services that generate monetary benefits are taken into consideration in the valuation process. On the contrary, practically all work on valuation of environmental and natural resources has been, in essence, to find ways to measure benefits which do not enter markets and so have no directly observable monetary benefits. The issue of valuation is inseparable from the choices and decisions people make about ecological systems (Manoli et al., 2019).

Ecologists will increasingly have to work alongside economists, geographers and a range of other social scientists to understand the value that biodiversity and ecosystem services have, to assess the costs and benefits of different conservation and management strategies, and to help design the new governance systems needed for sustainable development (Haines-Young & Potschin, 2010).

Societal valuation of ES

The simplest form of definition from MEA, 2005 regarding ES is the "benefits that humans derive from the natural ecosystem" but the public's understanding of ES has become interestingly sophisticated. People nowdays have increased awareness of unequal global resource distribution, perception of climate change as a central issue, and the emergence of radical new ideological environmental groups (Lalonde & Jackson, 2002) cf. (Bernstein & Szuster, 2018). In this context, it is not surprising to see that traditional measures of "environmental concern" are being supplanted by instruments seeking to measure "ecological consciousness" (Ellis & Thompson, 1997), "anthropocentrism" (Chandler & Dreger, 1993), and "anthropocentrism versus ecocentrism" (Thompson & Barton, 1994) cf (Dunlap et al., 2000). Most social scientists view values as deeply rooted, abstract motivations that guide, justify or explain attitudes, norms, opinions and actions (e.g., Halman & de Moor, 1994; Rokeach, 1973; Schwartz, 1992; Williams, 1968) cf (Schwartz, 2003). Values are basic orientations presumed to underlie and influence individual variation on many of the constructs that researchers from different disciplines will want to study through the ES. Values can provide predictive and explanatory power in the analysis of attitudes, opinions and actions. Moreover, values can reflect major social change in societies and across nations (Schwartz, 2003).

More recently, there has been increasing recognition that decision-makers should consider diverse stakeholder values and perspectives about what (and why) ecosystem services are important (Armatas et al., 2018). These social perceptions and values can be assessed through a sociocultural valuation of ecosystem services (Maestre-Andrés et al., 2015). The term ''socio-cultural preferences'' incorporates individual perceptions, knowledge, and associated values (Brown TC, 1984) cf (Martín-López et al., 2012). The importance of socio-cultural analysis in the assessment of ecosystem services has been suggested in the process of evaluation framework development (MA, 2003; Wallace, 2007), and social value has been defined as the perceived, non-market value that the

public can attach to the benefits from ecosystem services (Martín-López et al., 2012; Van Oudenhoven et al., 2012) cf (Shoyama & Yamagata, 2016). The socio-cultural approach using non-economic evaluations based on social interviews and psycho-cultural perspectives attempts to compensate for values that tend to be overlooked by economic valuations of ecosystem services (Kumar and Kumar, 2008; Martín-López et al., 2012, 2014) cf (Shoyama & Yamagata, 2016).

Social values have been mapped to inform the planning and management of conservation areas (Kliskey, 1994; Brown et al., 2004; Raymond and Brown, 2006; Alessa et al., 2008), forestry land (McIntyre et al., 2008), and urban forests and green areas (Tyrväinnen et al., 2007) cf (Bryan et al., 2010). These studies have developed and applied typologies which measure a broad range of values including biodiversity and wilderness, life sustaining, therapeutic, learning and knowledge, historical and intrinsic values (Bryan et al., 2010).

Factors affecting people's evaluation / perception of ES

Concerning ES valuation, if we were in a domain of stabilized knowledge, we would simply value the services in order to decide which one should be preserved in priority, but things are actually more complicated because we need to decide first on which criteria should such valuations be based on (Barnaud & Antona, 2014).

Perceptions are regarded to envelope attitudes and values, which indicate one's feeling either favorably or unfavorably toward nature (Manoli et al., 2019). Perception is influenced by the social and cultural contexts of individuals and society (Muir, 1999), therefore, the same landscape can be perceived differently by different observers according to their interests and feelings (Aretano et al., 2013). Hein et al. (2006) emphasize that different actors will have different interests concerning the services depending on the scale on which they operate cf. (Barnaud & Antona, 2014). People's perceptions also vary along with their interpretations of wellbeing, which further emphasizes the importance of including diverse world views and notions of human wellbeing into conceptual frameworks and assessments of ES (Díaz et al., 2015; Chan et al., 2016; Díaz et al., 2018) cf. (Elwell et. al, 2018). In a study by Shoyama and Yamagata (2016), the perception of value clearly varied depending upon social attributes, especially length of residence, in addition to other basic socioeconomic elements. People tend to perceive things (e.g., endangered species) as more valuable as they become more scarce (Hall et al., 2008) cf (Elwell et al., 2018). Furthermore, and perhaps most importantly, world views shape environmental perceptions (Tuan, 1974) cf (Elwell et al., 2018).

The other major source of variation in perception refers directly to social experience. The common experiences people have because of their shared locations in the social structure (their education, age, gender, occupation, etc.) influence their value priorities (e.g., Inglehart, 1997; Kohn, 1989; Schwartz, 2003; Schwartz & Bardi, 1997) cf (Schwartz, 2003). In addition, individuals have unique experiences (trauma, relations with parents,

immigration, etc.) that affect their value priorities (e.g., Feather, 1985). Hartter (2010), also states that social preferences over specific ecosystem services may vary among respondents due to a complex set of factors, including individual needs, cultural traditions, access to ecosystem services, and sources of household income cf. (Al-Assaf et al., 2014).

People perceive a variety of benefits from ecosystem. These benefits depend on the needs, choices and values of people (subjective perspective of change) and are also place-related since they tend to vary in space (Fagerholm, Käyhkö, Ndumbaro, & Khamis, 2012) cf. (Aretano et al., 2013). Mostly they are based on the personal perception, which is typically place-based, that emerges from everyday embodied experience and accumulated knowledge (Stephenson, 2008; Williams and Patterson, 1996) cf. (Fagerholm et al., 2019). Values associated with the importance of nature are often strongly related to the meanings associated with a particular place (Irvine et al, 2016). Pascual et al., 2017 (also cited by N. Fagerholm, et al., 2019) state that these perceptions develop from the relationships among the people and between people and the landscape.

In addition to individual utility, there are forms of value that are held in common, and that these values are formed and shaped through shared social processes. This put forwards the idea and the power of shared values (Irvine et al, 2016). Some of the values for the ES would have been pre-formed via people's interactions with trees and woodlands, while others may not have existed a priori but have been generated through the local and national debates that arose when the government consultation was published (Irvine et al, 2016). Many studies have revealed that perceptions of ecosystems as sources of particular services vary among respondents as a result of a complex set of factors, including formal education, gender, origin, age, individual needs, cultural traditions, access to ecosystem services, agricultural landownership, spatial patterns, and household income (Campos et al., 2012; Dolisca et al., 2007; Fagerholm et al., 2012; Gunawanetal., 2004a, 2004b; Hartter, 2010; Lewan and Söderqvist, 2002; Martín-López et al., 2012; Poppenborg and Koellner, 2012; Silvano et al., 2005; Sodhi et al., 2010a) cf (Muhamad et al., 2014).

Some of the factors that shape the stakeholders' perceptions of ES are related to the type of knowledge they hold (i.e., experiential or experimental), their place attachment (Lamarque et al., 2011; Lewan and Söderqvist, 2002) and the way in which they interact with their natural surroundings (Russell et al., 2013) cf (Cuni-Sanchez et al., 2019). Multiple factors (location, gender, and age) influenced people’s perceptions of ES, and these factors tended to be associated with the respondent’s livelihoods (Moutouama et al., 2019). Apolitical border and residential characteristics can also define perceptions of ES (Orenstein & Groner, 2014). Van Riper et al., (2017) present a matrix to illustrate a range of disciplinary perspectives on the sociocultural phenomena that underpin ecosystem-service valuation (Box 1).

Box 1: Insights on Valuation of Ecosystem Services (Van Riper et al., 2017)

Table 1. Seven social and behavioral science disciplines that provide insight on the valuation of ecosystem services. Internal processes, external factors, the perceived benefits of nature, and examples of key literary sources are also presented for each discipline.

Example disciplines	Internal processes	External factors	Perceived benefits of nature	Examples of key literary sources
Environmental anthropology	emotion, identity	institutions, culture, history, scale, social structure	cultural preservation, community resilience, justice, traditional ecological knowledge, access and control of resources	(Brosius 1999, West et al. 2006, Satterfield et al. 2013)
Ecological economics	utility	markets, institutions, norms, equity	consumption of goods and services, value, human and natural capital, market stability, sustainability	(Costanza et al. 1997, Daly and Farley 2004)
Geography • **human** • **physical** • **GIScience**	place meanings, familiarity, identity	institutions, scale, culture, landscape function, disturbance	cultural and social protection (prevention of disturbance), access to resources, livelihoods, land use patterns and processes, spatial prioritization	(Tuan 1974, Turner 2002, Urquhart and Acott 2014, Steffen et al. 2004, Sherrouse et al. 2011)
Landscape architecture	various forms of perception	landscape design, scale, function of built and natural environments	aesthetics, cultural maintenance, infrastructure, recreational opportunities, sustainable development	(Helfand et al. 2006, Gobster et al. 2007, Daniel et al. 2012)
Political science	attitudes, utility	institutions, markets, history, power, social norms	formal and informal policy instruments, adherence to policies, conflict resolution, collective action, political engagement	(Ostrom 2000, 2005, Agrawal 2001)
Conservation psychology	attitudes, values, personal norms, identity, mental models	context, social norms	behavior change, sustainability, environmental communication, recreational opportunities	(Kumar and Kumar 2008, Schultz 2011, Clayton et al. 2013)
Environmental sociology	attitudes, beliefs, identity, self-efficacy	institution, social structure, culture, individual agency	social networks, community development, environmental justice, marketing, prevention of deviance	(Kinzig et al. 2005, Flint et al. 2008)

Irvine et al, (2016), also argue that valuation is, by definition a moral and ethical act, as are the decisions that are made on the basis of the values that are elicited and formed. By understanding that ES are valued differently by different cultures and in different contexts it points to the importance of carrying out valuation researches for each culture or context (Sagie et al, 2013). There is a lack of deep analysis on the formation mechanism of environmental behavior (Li et al., 2019) which also indicates the inadequacy in the societal evaluation processes and mechanisms of ES.

Since diverse factors influence human decision making related to valuation and management of ecosystem services, it can be concluded that there is no fixed or final answer to what factors shape people's perception or valuation towards ES. However, it is clear that there are complex sets of factors which are most often difficult to identify and may not always be in accordance with rationalism or institutionalism or any other philosophical trends but ultimately forms a somewhat rigid perception of value of ecosystem services.

Ecosystem service trade-offs

According to Rodríguez et al., (2006), ecosystem service trade-offs arise when management choices made by humans cause optimization of few ecosystem services or a single ecosystem service leading to reduction or deterioration of other services. In some

cases, a trade-off may be an explicit choice; but in others, trade-offs arise without premeditation or even without awareness that they are taking place. In simple terms, a trade-off between ES is characterised by the decrease in the provisioning of one or several ES as a result of increasing the supply or flow of one ecosystem service (Turkelboom et al., 2016) cf (Gonzalez-Ollauri & Mickovski, 2017). Trade-offs in ES can be classified along three axes: spatial scale, temporal scale, and reversibility (Rodríguez et al., 2006) and may be measured by using indicators such as biophysical indicators regarding the ecosystem service delivery (e.g., MA, 2005), socio-cultural preferences (e.g., Martín-López et al., 2012); and monetary values (e.g., Hicks et al., 2009; Martín-López et al., 2011) cf (Martín-López et al., 2014).

Beyond food, fibre, habitation, and recreation, land is also being used to meet demands for carbon sequestration, water purification, biodiversity conservation, and many other purposes. Meeting these multiple demands requires negotiating trade-offs among the choices and differing values placed on them by diverse stakeholders and institutions (Ellis et al., 2019). Management and policy decision-makers increasingly require information about ecosystem services and their trade-offs that is understandable both to the decision makers and the public (Deal et al., 2017; Kline et al., 2013) cf (Armatas et al., 2018). It has become relevant to environmental managers after acknowledging that ES tend to appear in the landscape as ‘‘bundles” – i.e. a given landscape unit provides multiple ES at a given location and time (e.g. Raudsepp-Hearne et al., 2010; Mouchet et al., 2014) cf (Gonzalez-Ollauri & Mickovski, 2017). Furthermore, when ES are subject to interactions between themselves, as a result of natural processes (i.e. ecological drivers) or management decisions (i.e. socio-ecological drivers), ‘‘trade-offs” and ‘‘synergies” may emerge (Bennet et al., 2014) cf (Gonzalez-Ollauri & Mickovski, 2017). Consequently, it is essential to clearly understand which services are important in the eyes of which actors, and why.

There is also a need to investigate how social–ecological trade-offs are resolved. Decision-makers need to choose between alternatives of management strategies under conditions of uncertainty, without having full knowledge of the effects of their decisions on the ecosystem and on the livelihoods of people (Berbés-Blázquez et al., 2016). Hence, it is also imperative to know the preferences and trade-offs of forest ES from the perspectives of the society and the common people.

2.2 Theoretical approach

Researchers started to be aware that people’s behaviour would have an impact on environment (Li et al., 2019). The long history of attempts since the 1970s to measure environmental perceptions produced a plethora of instruments (Manoli et al., 2019). In 1970s, environmental psychology and the measurement of public concern for environmental quality attracted increasing attention. More importantly, environmental behaviour research expanded in a wide range of academic fields. Researchers from the

field of psychology, geography, environmental planning and design, natural resources management, sociology, anthropology and political science all contributed scientific findings to environmental behaviour research (Borden, 1977). Throughout the 1980s to 1990s, acquiring environmental attitudes and environmental behaviour became a hot topic (Liere and Dunlap, 1981; Hines et al.,1987) cf (Li et al., 2019). Grass root researchers laid (philosophical) foundations going back to Dewey, Muir, Leopold and Carson, to name some major pioneers. Later, researchers formulated paradigm messages, for instance, the New Environmental Paradigm, the New Ecological Paradigm, or the Ecological World View. While the latter covered conservational preferences, the Dominant Social Paradigm (DSP) coined anthropocentric views in highlighting our planet as an unlimited resource for human consumption (Pirages and Ehrlich, 1974) cf (Manoli et al., 2019).
There are many views on the definition and philosophical basis of social values towards the environment (Rokeach, 1973; Brown, 1984; Kellert, 1996; Lockwood, 1999; McIntyre et al., 2008; Fisher et al., 2009) cf (Bryan et al., 2010). In this study the concept of assigned values is used which are those values that people attach to things such as goods, activities, and services (Brown, 1984; Lockwood, 1999). Assigned values incorporate a person's perception of the thing under valuation, their held values and associated preferences, and the context of the valuation (Brown, 1984) cf (Bryan et al., 2010). This study focuses on values that people assign to forest ecosystem services. In this study, these place-based, assigned values for forest ecosystem services are termed as social values. As a corollary, forest ecosystem service values in this study are social values, rather than economic or biophysical values similar to the work by Bryan et al., 2010. Following Latour (1987, 2004), a constructivist perspective is adopted, considering that ecosystem services do not exist per se, but are socially constructed. Any claim or knowledge about ES reflects the perception and interests of the individuals that produce that knowledge, in a given social and political context (Barnaud & Antona, 2014).

All three concepts of values; transcendental values, contextual values, and value-indicators as mentioned by Kenter et al., (2015) come into play when people value forest ecosystem services. Transcendental values are often associated with ethics and normative beliefs. Contextual values are more allied with individual attitudes and preferences. Value-indicators are expressions of value in commonly understood units. The most obvious examples are amounts of money, ratings, rankings and indices. Value-indicators can be used to assess the trade-offs that people are prepared to make (Kenter et al., 2015). In sociology the formation of values at both the cultural and individual level is regarded as a socio-cultural phenomenon. This formation refers to "emergent value articulations as they are being shaped, reproduced or changed by social action" (Bachika and Schulz, 2011) cf (Kenter et al., 2015). Individual values are therefore a product of cultural values but are also interpreted through each person's own individual experience (Kenter et al., 2015).

Policy making, while informed by science, is primarily a social process (Cohen, 2006) cf (Orenstein & Groner, 2014). As the social sciences (for example; sociology, anthropology, environmental psychology, and political science) are people-centred disciplines, their research approaches and paradigms can be well suited to defining and integrating stakeholder concerns into policy and planning (Orenstein & Groner, 2014). Within the policy realm, particularly in the European Union, social assessment and valuation is gaining increasing attention. Social approaches to ES assessment are also de facto tools for stakeholder integration into the science and policy process. Through social research, the ES framework becomes a more stakeholder-driven process in so far as their responses to survey questions become the core of the research and subsequent valuation (Menzel and Teng, 2009) cf (Orenstein & Groner, 2014).

Society-based approaches facilitate the evaluation of different management strategies and are important instruments to achieve sustainable forest management and multi-functional forestry objectives. Besides, the analysis of stakeholders' preferences and perceptions is a useful tool for increasing the social acceptance of the decisions and the social sustainability (Kishor and Belle 2004, Paletto et al. 2004) cf (Grilli et al., 2015). More recently, it has been recognized and accepted that the use of participatory approaches is valid and necessary for the evaluation of ecological processes and values (Villamor et al., 2014).

3. Methodology

This research involves quantitative method to study societal evaluation of forest ecosystem services in Catalonia. Literature review of methods used by various authors in social valuation of ES and forest ES was carried out. For this study, primary data was collected through a survey using structured questionnaire. Quantitative data collected by survey were subjected to statistical analysis to analyse the perception of people, their preferences and prioritization of forest ecosystem services and factors affecting their prioritization for forest management objectives.

3.1 Study area

Catalonia is a Mediterranean region in Spain, located on the north-eastern triangle of the Iberian Peninsula. It is an autonomous region and exercises its self-governance in accordance with the Constitution and with the Statute of Autonomy. The "Generalitat" is the institutional system around which Catalonia's self-government is politically organised. From an administrative point of view, the region divides into four provinces (Barcelona, Tarragona, Lleida and Girona). The capital of this region is Barcelona. Catalonia has more than seven million inhabitants. Approximately 60% of the population in Catalonia live in the Barcelona metropolitan area. The least populated areas are the regions of the Pyrenees. Catalan and Spanish are the official languages of Catalonia. The region has a notable geographical diversity on a relatively small area of about 32,000 km²

along with about 580 km of coastal strip. The relevant relief features are the Pyrenees, Pre-Pyrenees, the Central or Ebro Depression and the Catalan Mediterranean system, apart from the coastal plains and the Serralada Transversal mountain range. More than 60 % of the total surface of Catalonia (31,930 km²) is forest area i.e, 19,567.91 km². About 75 % of forest land belong to private owners while 20 % forest is owned by local public organizations. Remaining 5 % of the forest land area belongs to Government of Catalonia and Spanish state.

Figure 3. 1: Study area (Catalonia)

3.2 Data collection

A sample of 404 respondents were provided with structured questionnaires to fill via online platform. The respondents were a part of POLYFORES WP3 project who responded to the questionnaires and they were provided with some incentives for doing so by the project. POLYFORES (Decision making support for Forest Ecosystem Services in Europe) is an inter- and transdisciplinary project involving scientists from natural and social sciences with strong expertise in the field of forest ecosystem services (FES) assessment and valuation. It aims to map ecological impacts, provide a holistic approach of value assessment and support decision making processes of FES at different levels (Pan European and EU, national and sub-national). POLYFORES is organised in six work packages (WP) and economic and societal value assessment is included in WP3.

3.2.1 Questionnaire

The questionnaire made use of techniques like open ended questions, multiple choice questions, Likert scale, ranking techniques as well as yes/no questions and consisted of ten blocks from A to J. Block A dealt with the general perception and level of awareness of people on forests. Block B dealt with its values on a Likert scale of 0 to 10. Block C explored about people's perception on importance of forest while block D and E covered the benefits that people obtained from forest ecosystem and their trade-offs (effect of one management objective on other forest ecosystem services). Similarly, block F dealt with topics related to priorities in forest management. Block G tried to get insight on people's knowledge on forest management while block H explored human-nature relationships. Block I and J sought for information about the respondent's characteristics. The questionnaire used for data collection is included in Annex 1.

3.2.2 Sample

A total sample of 404 respondents was taken. Almost half of the questionnaire were given to males (203) and half to females (201) for balancing gender perspective. The questionnaires were distributed among people of age group 18 to 64. Samples were collected from Barcelona (202), Girona (69), Lleida (67) and Tarragona (66). More questionnaires were given to respondents in Barcelona to represent its highly dense population. Similarly, categories were made for people living in different places such as rural areas (130), small city (116), Medium city (66) and large city (92). Respondents with eight different education level were chosen for this study.

3.3 Data analysis

The data was analysed using Microsoft Office Excel and JMP. Several statistical methods of testing were used for significance test and hypothesis testing during the data analysis. Data analysis also involved descriptive analysis. People's perception, knowledge and awareness about forests as well as importance of forests were analysed using descriptive statistics (using bar charts and pie charts). Similarly, descriptive analysis was done to find out the importance of 12 different ecosystem services. To identify whether people gave equal importance to provisioning, cultural and supporting FES, one-way ANOVA and Tukey's HSD were carried out. To find out the perception of people on effects of applying management objective for boosting one FES to other FES, descriptive analysis using tables was done. Similarly, to find out the priorities of management objectives of forest ecosystem services, descriptive statistics and ANOVA together with Tukey's HSD was used. Descriptive statistics and ANOVA together with Tukey's HSD/t-test/Kruskal Wallis test were used as appropriate for finding out what factors were affecting the prioritization for forest management objectives. Throughout this study, level of significance taken was at 5% (α=0.05).

4. Results and Findings

In this chapter the results of the data analysis are presented. In section 4.1, the results of block A which reveals common people's perception of forests and level of awareness regarding forests are given. Section 4.2 talks about results obtained regarding the value or the importance that people give to different types of forest ecosystem services while section 4.3 lists results of effects of managing forest for production of one forest ecosystem service to other services. The prioritization for forest management objectives including the factors that affect those priorities are described in section 4.4.

4.1 People's perception, knowledge and awareness about forests

For understanding people's perception towards forests and their knowledge and level of awareness about forests, respondents were asked to describe what forests meant for them. They were also asked about forest coverage and ownership patterns in Catalonia. Questions regarding knowledge about forest management in Catalonia, importance of forest near where they live, in their region as well as in Catalonia were also asked.

Definition of Forests

The forests as understood and perceived by respondents were broadly categorized into ten definitions. The result obtained from analysing the definitions of "forest" as understood by the respondents indicated that majority of people understood forests as a means to connect themselves with the nature rather than as a resource to use (like timber, fuel, herbs…) or as a group of trees in accordance with many standard definition of forest. Most of the respondents also perceived forests as a source of fresh air indicating that they consider trees and vegetation as forests and acknowledge the oxygen production function of trees and vegetation. However, fewer people seemed to associate forests directly as trees, vegetations or jungle (as in general standard definitions) without mentioning their services. People seemed to understand the importance of forests as a part of nature, environment and something that needs to be preserved. It should be noted that most people did not have just one rigid opinion about forests. They described forests with more than two or three definitions and had multiple answers (Hence the sum of respondents in figure 4.1 is more than 404). It shows that forests are sometimes defined in variety of ways even by a single individual according to their perception, usefulness and convenience and hence cannot be described with a single word. It is even more true for different individuals as perceptions of forest are bound to change from individual to individual.

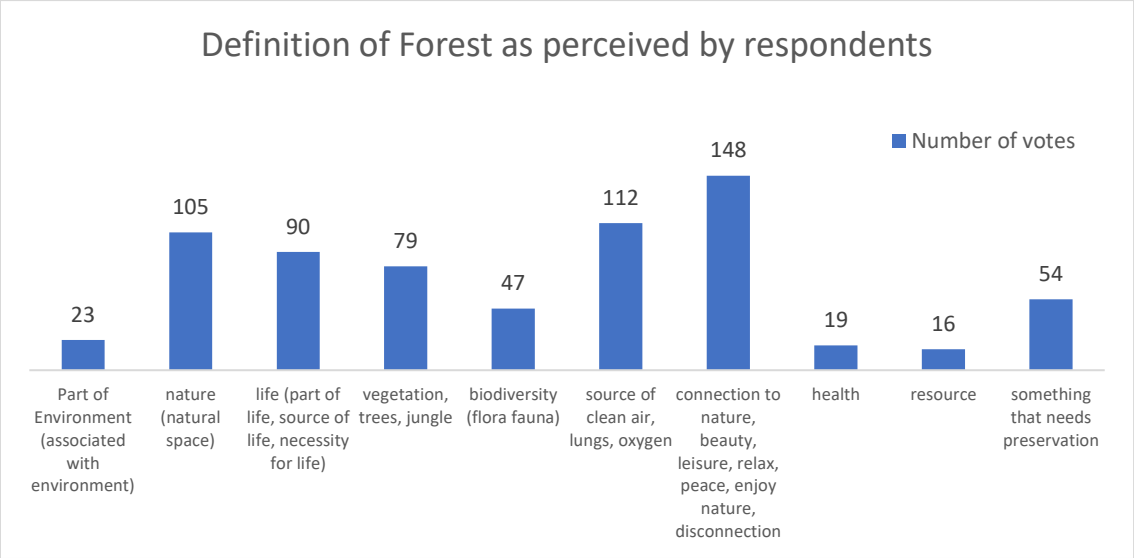


Figure 4. 1: Forests as defined by respondents

Forest area and ownership typology

To assess the knowledge of citizens about forest area of Catalonia, a question with multiple choice was asked and the result thus obtained was analysed (Figure 4.2). It was surprising to find out that most people did not have the correct information regarding forest area in Catalonia. Only 107 out of 404 respondents (26%) were correct about the forest coverage of Catalonia i.e, 60% of Catalonia is covered by forest.

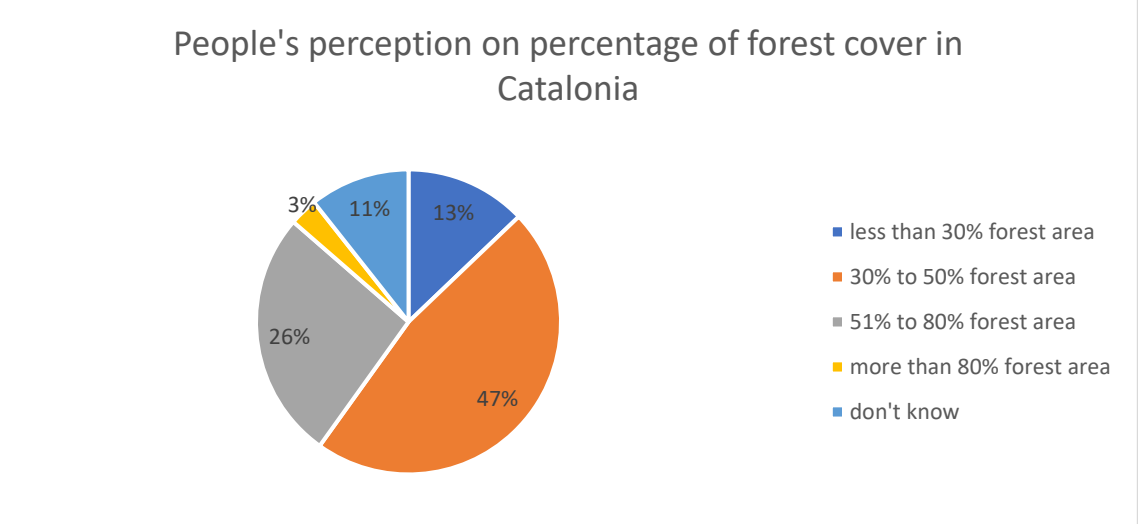


Figure 4. 2: People's knowledge about forest area in Catalonia

Similarly, a multiple-choice question was asked to assess the knowledge of ownership typology of forests and it was found that 38% of the respondents were well informed about the ownership typology of the forests in Catalonia i.e., more than 70% forest owned by private owners. However, almost same percentage (31%) were unaware about it and thought that more than 70% of forest in Catalonia was owned by public (Figure 4.3).

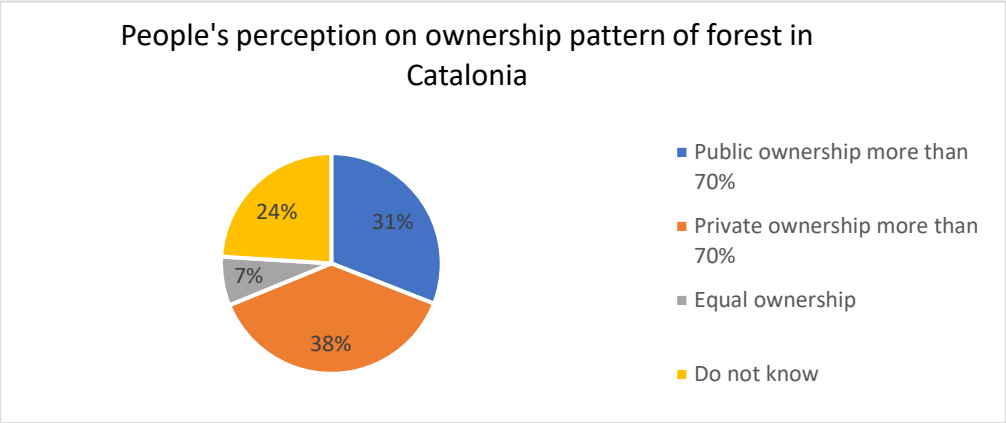


Figure 4. 3: People's perception on Forest ownership

Importance of forests

In the survey, 88.8%, 91.3% and 95.3% respondents answered with a score of more than 5 in questions regarding how important they think forests are for them in their proximity, in their region and in Catalonia respectively in a scale of 10. About 57% respondents (Figure 4.4) gave full score of 10 for importance of forest near where they live while around 55% respondents (Figure 4.5) did so for the importance of forest in their region and 64.1% people for Catalonia (Figure 4.6). It was interesting to find that 3 people who said that forests were not important for them near the place where they lived thought forests to be important in their region and in Catalonia.

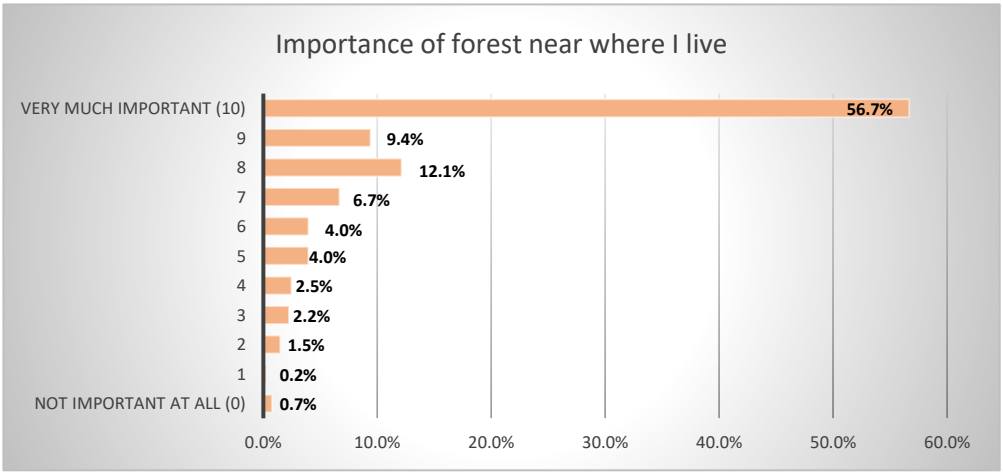


Figure 4. 4: Importance of forests near respondents

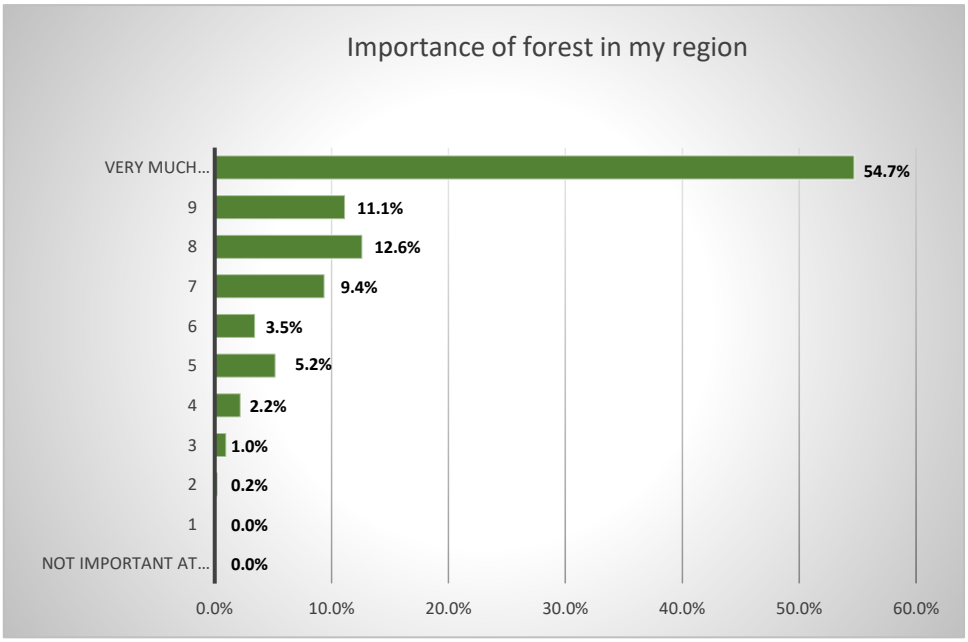


Figure 4. 5: Importance of forests in the region of respondents

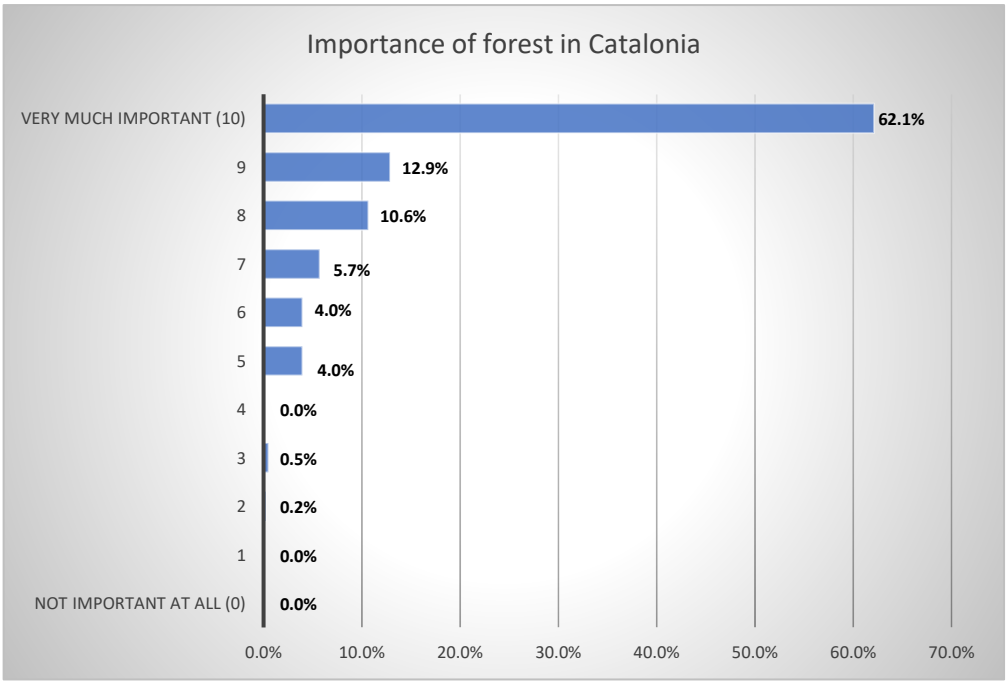
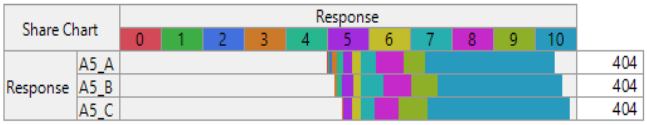


Figure 4. 6: Importance of forests in Catalonia

Aligned Responses(A5_A, A5_B, A5_C)

Freq / Share		Response 0	1	2	3	4	5	6	7	8	9	10	Total Responses
Response	A5_A	3	1	6	9	10	16	16	27	49	38	229	404
		0.7%	0.2%	1.5%	2.2%	2.5%	4.0%	4.0%	6.7%	12.1%	9.4%	56.7%	
	A5_B	0	0	1	4	9	21	14	38	51	45	221	404
		0.0%	0.0%	0.2%	1.0%	2.2%	5.2%	3.5%	9.4%	12.6%	11.1%	54.7%	
	A5_C	0	0	1	2	0	16	16	23	43	52	251	404
		0.0%	0.0%	0.2%	0.5%	0.0%	4.0%	4.0%	5.7%	10.6%	12.9%	62.1%	



A5_A: Importance of forest near where respondents live
A5_B: Importance of forest in respondent's region
A5_C: Importance of forest in Catalonia

Figure 4. 7: People's perception of importance of forest in a scale of 10

From figure 4.7, it can be clearly seen that the majority of respondenets are giving a score of more than 5 in the scale of 10 saying that the forests are important. There are more people with the opinion that the forests are important rather than the ones saying that they are not.

Knowledge of Forest management in Catalonia

Respondents did not seem to consider themselves as having a good knowledge of forest management in Catalonia. Most of the respondents (56.7%) said that they did not have any knowledge at all about forest management in Catalonia. 34.7% (score of 1-5) respondents thought that they had limited knowledge of forest management while just 8.6% (score of >5) thought that they had somewhat good knowledge about forest management in Catalonia (Figure 4.8).

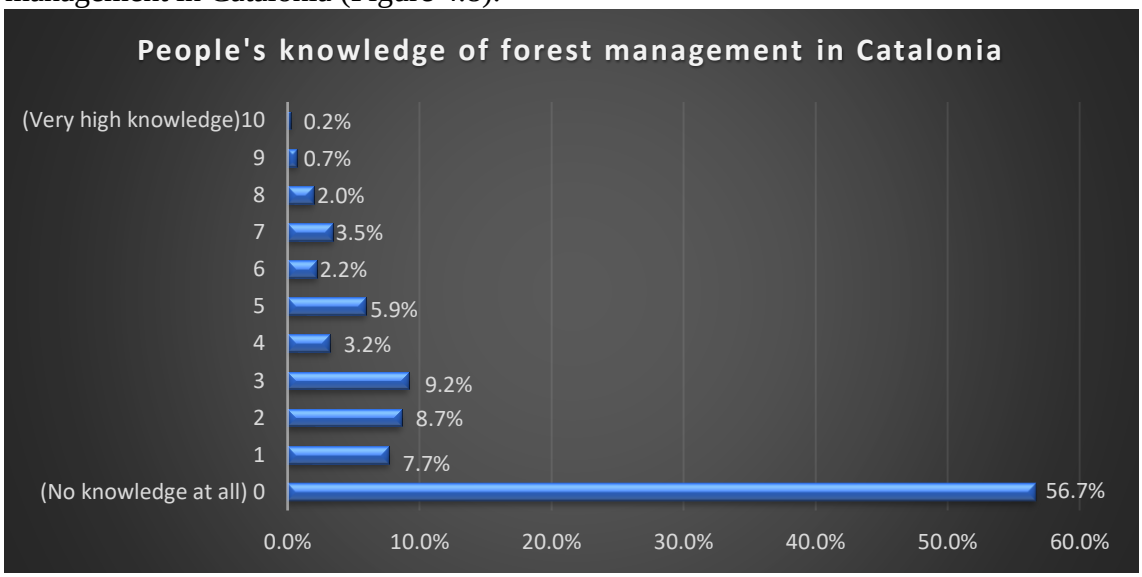


Figure 4. 8: Respondent's knowledge of forest management in Catalonia

Knowledge of forest problems and possible solutions

Out of most common 16 forest problems in Catalonia, majority of the respondents agreed that the most important forest problems were habitat loss (82.9%) and high wildfire risks (81.6%). Other significant forest problems were pollution (78.9%), urban pressure (72%), erosion and climate change (69%), lack of forest management aids (69%), public ignorance of forest benefits (64.1%) and so on. Interestingly, people did not consider low productivity, low wood price and lack of market as a very important forest problem which could indicate that people are well aware of their forests which have low productive capacity and usually are not managed for the production of wood or this may simply be due to absence of productive perspective/mindset of people. There could be other reasons as well which need to be further prodded in future studies.

Similarly, out of the 14 most commonly applied measures to tackle previously mentioned problems, respondents agreed that most important measures were environmental education (78.46%), followed by forest management aid for fire prevention (77.72%), more resource in fire-fighting (76.9%) and regulation for sustainable forest management (72.52%).

4.2 Value and Importance of different forest ecosystem services

Value of forests for different purposes:

Twelve forest ecosystem services (Table 1) were listed and people were asked to value them in a scale of 0 to 10 (0 being not valuable at all and 10 being highly valuable). It was seen that majority of the respondents gave a score higher than 5 indicating that people valued forests for all purposes mentioned in the questionnaire (Figure 4.9). It was interesting to see that some respondents also gave a lower score to ecosystem services such as provision of employment, fuel source and wood source which is a indication that those people do not value forests much for these purposes. However, it was noteworthy that majority of people (more than $^{2}/_{3}^{rd}$ respondents) perceived all forest ecosystem services to be valuable.

Table 1: Symbol for type of forest ecosystem services

S.N.	Symbol	Type of Forest Ecosystem Services
1	B1_1	Access to knowledge
2	B1_2	Source of employment
3	B1_3	Protection from natural hazards (avalanches, floods...)
4	B1_4	Clean water and air source
5	B1_5	Providing fuel sources
6	B1_6	Source of non-wood forest products (mushrooms, herbs, fruits)

7	B1_7	Places of great beauty
8	B1_8	Mitigation of climate change through carbon absorption and storage
9	B1_9	Places for the conservation of animals and plants
10	B1_10	Source of wood (construction, furniture….)
11	B1_11	Part of culture and traditions
12	B1_12	Opportunities for leisure and spirituality

Aligned Responses(B1_1, B1_2, B1_3, B1_4, B1_5, B1_6, B1_7, B1_8, B1_9, B1_10, B1_11, B1_12)

		Response											
Freq / Share		0	1	2	3	4	5	6	7	8	9	10	Total Responses
Response	B1_1	0 0.0%	0 0.0%	2 0.5%	1 0.2%	5 1.2%	19 4.7%	30 7.4%	56 13.9%	73 18.1%	68 16.8%	150 37.1%	404
	B1_2	3 0.7%	1 0.2%	5 1.2%	11 2.7%	18 4.5%	57 14.1%	57 14.1%	83 20.5%	58 14.4%	34 8.4%	77 19.1%	404
	B1_3	0 0.0%	1 0.2%	1 0.2%	3 0.7%	5 1.2%	19 4.7%	19 4.7%	46 11.4%	73 18.1%	54 13.4%	183 45.3%	404
	B1_4	0 0.0%	0 0.0%	0 0.0%	1 0.2%	0 0.0%	5 1.2%	6 1.5%	21 5.2%	49 12.1%	63 15.6%	259 64.1%	404
	B1_5	4 1.0%	6 1.5%	11 2.7%	21 5.2%	24 5.9%	47 11.6%	49 12.1%	65 16.1%	63 15.6%	35 8.7%	79 19.6%	404
	B1_6	0 0.0%	0 0.0%	1 0.2%	2 0.5%	2 0.5%	13 3.2%	24 5.9%	65 16.1%	83 20.5%	63 15.6%	151 37.4%	404
	B1_7	0 0.0%	0 0.0%	0 0.0%	0 0.0%	1 0.2%	6 1.5%	15 3.7%	29 7.2%	57 14.1%	61 15.1%	235 58.2%	404
	B1_8	1 0.2%	1 0.2%	1 0.2%	2 0.5%	5 1.2%	12 3.0%	11 2.7%	27 6.7%	45 11.1%	65 16.1%	234 57.9%	404
	B1_9	0 0.0%	0 0.0%	0 0.0%	0 0.0%	2 0.5%	3 0.7%	3 0.7%	17 4.2%	42 10.4%	61 15.1%	276 68.3%	404
	B1_10	14 3.5%	7 1.7%	11 2.7%	29 7.2%	18 4.5%	57 14.1%	57 14.1%	66 16.3%	51 12.6%	26 6.4%	68 16.8%	404
	B1_11	1 0.2%	1 0.2%	0 0.0%	8 2.0%	4 1.0%	23 5.7%	34 8.4%	74 18.3%	74 18.3%	58 14.4%	127 31.4%	404
	B1_12	0 0.0%	0 0.0%	3 0.7%	3 0.7%	9 2.2%	13 3.2%	11 2.7%	52 12.9%	78 19.3%	79 19.6%	156 38.6%	404

Figure 4. 9: Score of respondents for value of different purposes of forest

Importance of different forest ecosystem services

When asked to rank top five reasons out of 12 mentioned in the questionnaire, indicating how important forests were for different services (benefits) they provide for themselves, most people included reasons such as (see Table 2)

(i) forests are a source of clean air and water,
(ii) forests serve as a place for conservation of animals and plants,
(iii) forests as a tool to mitigate climate change (absorbing and storing carbon),
(iv) forests provide protection against natural hazards (such as avalanche, floods, erosion)
(v) forests function as a place for leisure and spirituality

The options which were widely left out by the respondents while considering the importance of forest in the survey were

i) forests as source of wood
ii) forests as a source of employment
iii) forests as a source of fuel (firewood, biomass…)
iv) forests as a part of culture and tradition and
v) forests as a source of access to knowledge (research, innovation)

Since same service was considered important in different ranks (1-5) by different respondents, top 5 ranks of a service were taken and summed to find out the total number of respondents who considered a particular service to be important. Then, the resulting sum of all services was ranked to find out the service that was thought to be highly important. The result obtained in ranked order is as follows:

1. FES for conservation of animal and plants
2. FES for providing source of clean air and water
3. FES for mitigating climate change
4. FES as a source of beauty
5. FES for protection against natural hazards

Table 2: Importance of forest ecosystem for different services for respondents themselves

S.N.	Why are forests important to you? Reasons	Rank 1	2	3	4	5	Sum of Rank 1-5	Rank of sum	Left blank	Rank of blank options
1	Access to knowledge	4	19	15	33	37	108	8	296	5
2	Source of employment	2	0	6	12	16	36	11	368	2
3	Protection against natural hazards	21	40	51	55	32	199	5	205	8

4	Source of clean air and water	112	86	69	34	31	332	2	72	11
5	Source of fuel	4	8	14	16	21	63	10	341	3
6	Non timber forest products	7	25	21	53	49	155	7	249	6
7	Beauty	43	33	45	44	46	211	4	193	9
8	Mitigation measures for Climate Change	71	77	59	37	35	279	3	125	10
9	Conservation of animal and plants	111	78	64	49	38	340	1	64	12
10	Source of wood	0	2	9	9	15	35	12	369	1
11	Culture and tradition	9	9	14	21	29	82	9	322	4
12	Leisure/ spirituality	20	27	37	41	55	180	6	224	7

Interestingly, when asked same question about how important forests were for different services that they provide to society instead of for themselves, people included reasons such as (see Table 3):

(i) forests are a source of clean air and water,
(ii) forests serve as a place for conservation of animals and plants,
(iii) protection against natural hazards such as avalanche, floods, erosion…,
(iv) source of non-wood forest products (mushrooms, herbs, fruits),
(v) forests as a source of access to knowledge (research, innovation)

The options left out mostly were as follows:

i) forests as part of culture and tradition,
ii) forests as a source of employment,
iii) forests as source of wood,
iv) forests as a source of fuel (firewood, biomass…), and
v) forests as a source of access to knowledge (research, innovation)

Since same service was considered important in different ranks (1-5) by different respondents, top 5 ranks of a service were taken and summed to find out the total number of respondents who considered a particular service to be important. Then, the resulting sum of all services was ranked to find out the service that was thought to be highly important. The result obtained in ranked order is as follows:

1. FES for providing source of clean air and water
2. FES for conservation of animal and plants
3. FES for mitigating climate change
4. FES for protection against natural hazards
5. FES as a source of non-timber forest products

Table 3: Importance of forest ecosystem for different services as perceived by respondents for the society

S.N.	Why are forests important to society? Reasons	Rank 1	2	3	4	5	Sum of Rank 1-5	Rank of sum	Left blank	Rank of blank options
1	Access to knowledge	9	13	30	32	41	125	8	279	5
2	Source of employment	11	24	19	29	24	107	11	297	2
3	Protection against natural hazards	25	46	48	38	35	192	4	212	9
4	Source of clean air and water	90	68	52	42	32	284	1	120	12
5	Source of fuel	19	23	26	30	26	124	9	280	4
6	Non timber forest products	21	26	38	46	43	174	5	230	8
7	Beauty	28	28	26	42	39	163	6	241	7
8	Mitigation measures for Climate Change	88	48	35	30	34	235	3	169	10
9	Conservation of animal and plants	57	59	65	42	31	254	2	150	11
10	Source of wood	17	25	19	28	27	116	10	288	3
11	Culture and tradition	16	17	9	20	34	96	12	308	1
12	Leisure/ spirituality	23	27	37	25	38	150	7	254	6

In both cases, people gave more value and higher rank to the forests for providing clean air and water and for conserving animals and plants while they did not give high values to forests for services such as provision of wood, fuel and employment. Here, it was observed that people give more importance to regulating and supporting services of forest ecosystem rather than provisioning services. From figure 4.10 below, it can be clearly seen that people give almost equal importance to all ecosystem services for the society while their individual preferences incline towards regulating services. Although the score is more evenly distributed for all forest ecosystem services for society and less evenly distributed for individual benefits, the end result are similar for both individual benefits and for the social benefits i.e, people think that source of clean air and water, conservation of animal and plants, and mitigation measures for climate change are the most important forest services.

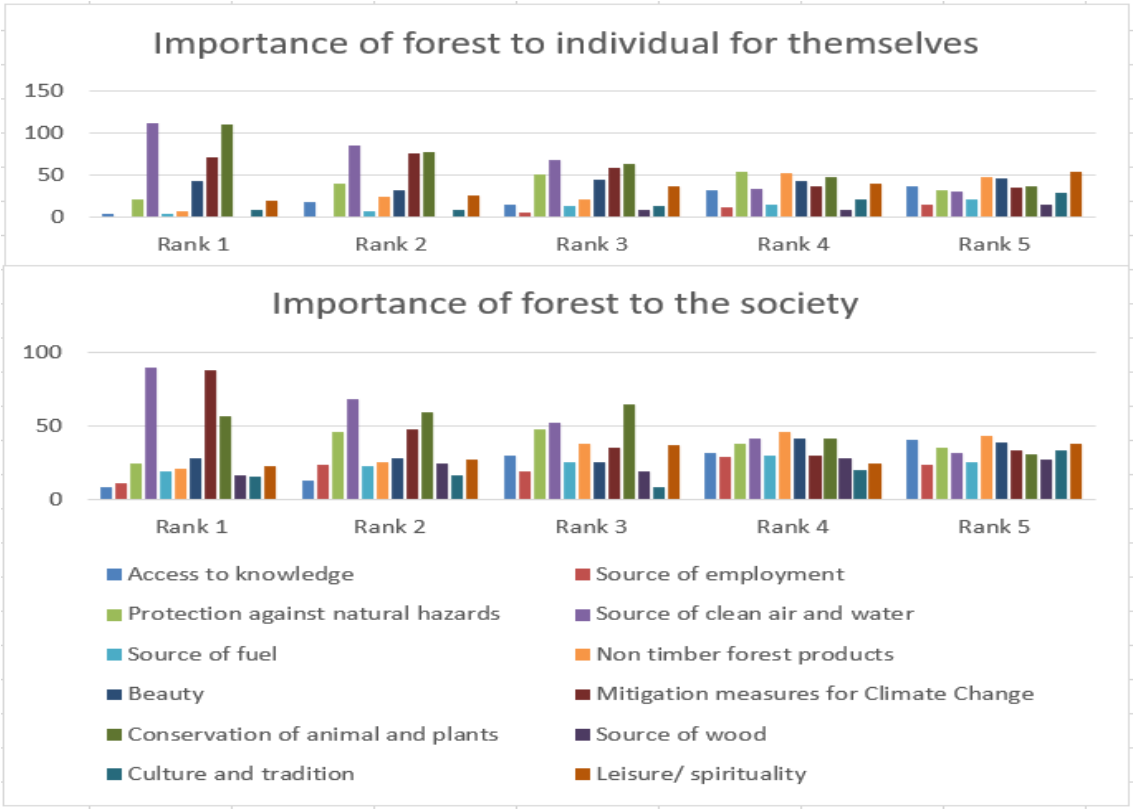


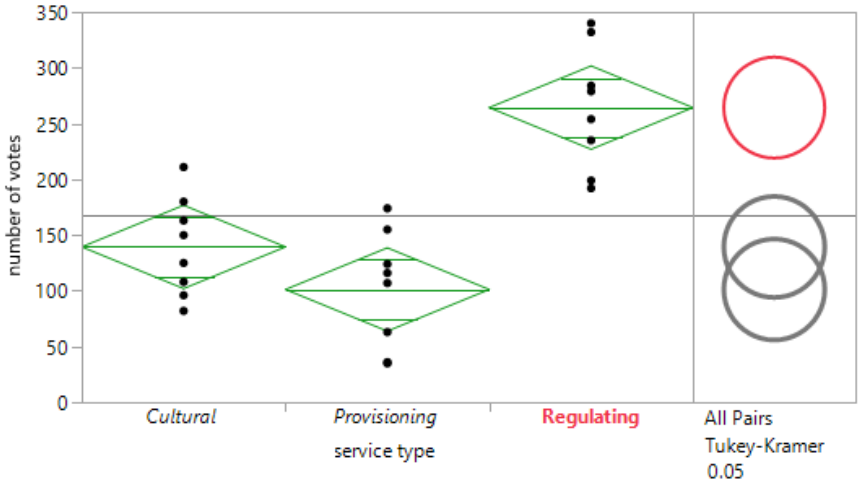
Figure 4. 10: Importance given by people for various FES for individual use (upper graph) and for the use of society (Lower graph)

It should also be noted that some of the reasons why people considered forests to be important were also repeatedly voted for other ranks. Hence, the options that were left out gives a very important clue about which forest services were not much appreciated. These top five options that were left out in both the cases were: importance of forests as a source of employment, as a source of wood, as a source of fuel, importance of forest for cultural and traditional aspects and importance of forest for access to knowledge.

Considering the votes within top five ranks for each ecosystem services to be important in the eyes of the respondents, it was summed under each ecosystem service headings from table 2 and 3. The headings of ecosystem services were then classified as follows into provisioning, regulating and cultural services (Based on MEA, 2005).

- Provisioning services: Clean air/water, Non timber forest products, Fuel, Wood, Source of employment
- Regulating services: Protection against natural hazards, Mitigation for Climate Change, Conservation of animal and plants
- Cultural services: Access to knowledge, Beauty, Culture and tradition, Leisure/Spirituality/Recreation

A hypothesis that people give equal importance to provisioning, supporting and cultural services was formed and tested. From Table 2 (questionnaire C1), value for importance of forests for respondents on individual basis, was counted and summed for rank 1 to 5 (considered as important) for each forest ecosystem service. Twelve services were categorized into provisioning, regulating and cultural services (as described above) and values were assigned respectively. From Table 3 (questionnaire C2), value for importance of forests to the society, was also counted and summed for rank 1 to 5 for each ecosystem services. Thus obtained tables were combined and was analysed in JMP software. Statistical analysis using one way anova at α=0.05 showed significant difference between the means. The data followed normal distribution and hence, we conducted all pairs Tukey HSD test which yielded following results.



Ordered Differences Report

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
Regulating	Provisioning	163.1250	25.41308	99.0695	227.1805	<.0001*
Regulating	Cultural	125.0000	25.41308	60.9445	189.0555	0.0002*
Cultural	Provisioning	38.1250	25.41308	-25.9305	102.1805	0.3110

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
service type	2	116502.08	58251.0	22.5491	<.0001*
Error	21	54249.25	2583.3		
C. Total	23	170751.33			

Figure 4. 11: Statistical test of significance for different forests services

From this, it can be clearly said that we cannot accept the null hypothesis as ANOVA results show that there is significant difference between regulating and cultural services as well as regulating and provisional services. Regulating forest ecosystem services were voted as more important than any other forest services.

4.3 Perception of people on effect of applying management objective for boosting one forest ecosystem service to other services

Ten forest ecosystem services were chosen, and respondents were allowed to score whether one ecosystem service had positive, negative or neutral effect on other ecosystem services. An option of "I don't know" indicating that "they did not have any idea about

the effect" was also made available. Using this method, preference and trade-offs were tacitly assessed hoping to capture real scenario without any bias from the respondent's side. For example, in table 7, managing forest for provision of leisure and spirituality has negative impacts on wood and fuelwood provision according to the understanding of the people. If people choose to apply the same management strategy for provision of leisure and spirituality, then they will have to incur trade-off of wood and fuelwood production. If they do choose this management strategy, then it also clarifies that they prefer forest ecosystem services of leisure and spirituality over production of wood and fuelwood.

In the following tables (Tables 4-10), the highest two scores of positive and negative effects according to people are highlighted in yellow while the negative effects surpassing the positive effects are coloured both in red and yellow.

Table 4: Wood production vs. other forest ecosystem services

1.	Effect of management carried out for boosting wood production?				
S.N.	Effect on…	Positive	Neutral	Negative	No idea
1	Source of fuel	183	95	102	24
2	Source of employment	233	109	33	29
3	Protection against natural hazards	252	49	77	26
4	Leisure/ spirituality	179	127	75	23
5	Conservation of animal and plants	267	26	94	17
6	Beauty	222	68	95	19
7	Non timber forest products	216	77	88	23
8	Source of clean air and water	258	46	75	25
9	Mitigation measures for Climate Change	236	44	91	33

Table 5: Clean air and water vs. other forest ecosystem services

2.	Effect of management carried out for boosting clean air and water?				
S.N.	Effect on…	Positive	Neutral	Negative	No idea
1	Source of fuel	143	146	78	37
2	Source of employment	190	158	26	30
3	Protection against natural hazards	286	88	5	25
4	Leisure/ spirituality	284	94	12	14
5	Conservation of animal and plants	365	27	5	7
6	Beauty	341	44	8	11
7	Non timber forest products	296	79	14	15
9	Mitigation measures for Climate Change	325	54	9	16
10	Source of wood	148	131	91	34

Table 6: Conservation of animals and plants vs. other forest ecosystem services

3	Effect of management carried out for boosting conservation of animals and plants ?				
S.N.	Effect on…	Positive	Neutral	Negative	No idea
1	Source of fuel	117	137	104	46
2	Source of employment	209	128	41	26
3	Protection against natural hazards	275	98	10	21
4	Leisure/ spirituality	269	92	26	17
6	Beauty	349	40	10	5
7	Non timber forest products	291	64	32	17
8	Source of clean air and water	335	52	7	10
9	Mitigation measures for Climate Change	298	64	16	26
10	Source of wood	125	132	112	35

Table 7: Leisure and spirituality vs. other forest ecosystem services

4	Effect of management carried out for boosting leisure and spirituality ?				
S.N.	Effect on…	Positive	Neutral	Negative	No idea
1	Source of fuel	83	191	91	39
2	Source of employment	213	119	43	29
3	Protection against natural hazards	182	145	41	36
5	Conservation of animal and plants	231	81	69	23
6	Beauty	282	66	38	18
7	Non timber forest products	202	120	58	24
8	Source of clean air and water	235	91	56	22
9	Mitigation measures for Climate Change	181	142	44	37
10	Source of wood	84	177	108	35

Table 8: Mitigation of Climate Change vs. other forest ecosystem services

5	Effect of management carried out for boosting mitigation measures for CC ?				
S.N.	Effect on…	Positive	Neutral	Negative	No idea
1	Source of fuel	190	88	82	44
2	Source of employment	187	136	37	44
3	Protection against natural hazards	239	94	31	40
4	Leisure/ spirituality	177	137	48	42
5	Conservation of animal and plants	271	58	40	35
6	Beauty	235	94	38	37
7	Non timber forest products	226	94	42	42
8	Source of clean air and water	278	53	35	38
10	Source of wood	169	100	88	47

Table 9: Protection against natural hazards vs. other forest ecosystem services

6	Effect of management carried out for boosting protection against natural hazards ?				
S.N.	Effect on…	Positive	Neutral	Negative	No idea
1	Source of fuel	167	130	69	38
2	Source of employment	231	122	21	30
4	Leisure/ spirituality	225	126	24	29
5	Conservation of animal and plants	302	63	17	22
6	Beauty	265	97	20	22
7	Non timber forest products	240	110	23	31
8	Source of clean air and water	286	82	9	27
9	Mitigation measures for Climate Change	295	67	17	25
10	Source of wood	169	118	77	40

Table 10: Production of fuel vs. other forest ecosystem services

7	Effect of management carried out for boosting production of fuel ?				
S.N.	Effect on…	Positive	Neutral	Negative	No idea
2	Source of employment	260	80	35	29
3	Protection against natural hazards	140	84	151	29
4	Leisure/ spirituality	91	140	140	33
5	Conservation of animal and plants	121	75	187	21
6	Beauty	114	102	164	24
7	Non timber forest products	125	101	145	33
8	Source of clean air and water	135	87	153	29
9	Mitigation measures for Climate Change	140	76	156	32
10	Source of wood	247	58	74	25

From the results above, it is quite clear that most respondents consider any kind of management activities carried out in forests have somehow positive effect in all other ecosystem services, exception being table 7 and 10. In table 7, it can be observed that people think if management is carried out for the enhancement of leisure and spiritual activities, there will be more negative impacts than positive on production of wood and fuel wood. Similarly, from table 10, it is obvious that people think boosting fuelwood production has negative impacts on all other forest ecosystem services except wood production and employment. It can be observed that in all the results displayed above, there are significant number of people who believe that all other management strategies have negative effect on production of wood and fuel wood but interestingly, when forests are managed for wood production, there are lesser negative impacts in all other services. Forest management for production of fuelwood to have negative effect on protection

against natural hazards, leisure and spiritual activities, beauty, conservation of animals and plants, production of NTFP, source of clean air and water and mitigation measures against climate change tells us about the trade-offs if we opt this management objective. Similar conclusions can be obtained from other tables as well.

4.4 Priorities for the management objectives of forest ecosystems and the factors that influence these prioritizations

Respondents were asked to distribute a total of thirty points among six forest management objectives. 10 points would mean total priority and 0 point would mean no priority at all. Two separate questions were asked, one for the management objectives of nearby forests and another for distant forests. The sum of total points for both questions was 60 (30 points for each question) for each respondent. Since respondents were asked to distribute points for forest management priorities for nearby forests as well as for distant forests, total points for 404 respondents for nearby forest and for distant forest were first summed separately and then averaged. Thus obtained result is shown in figure 4.12 which shows that the pattern of giving points for nearby and distant forests does not differ much.

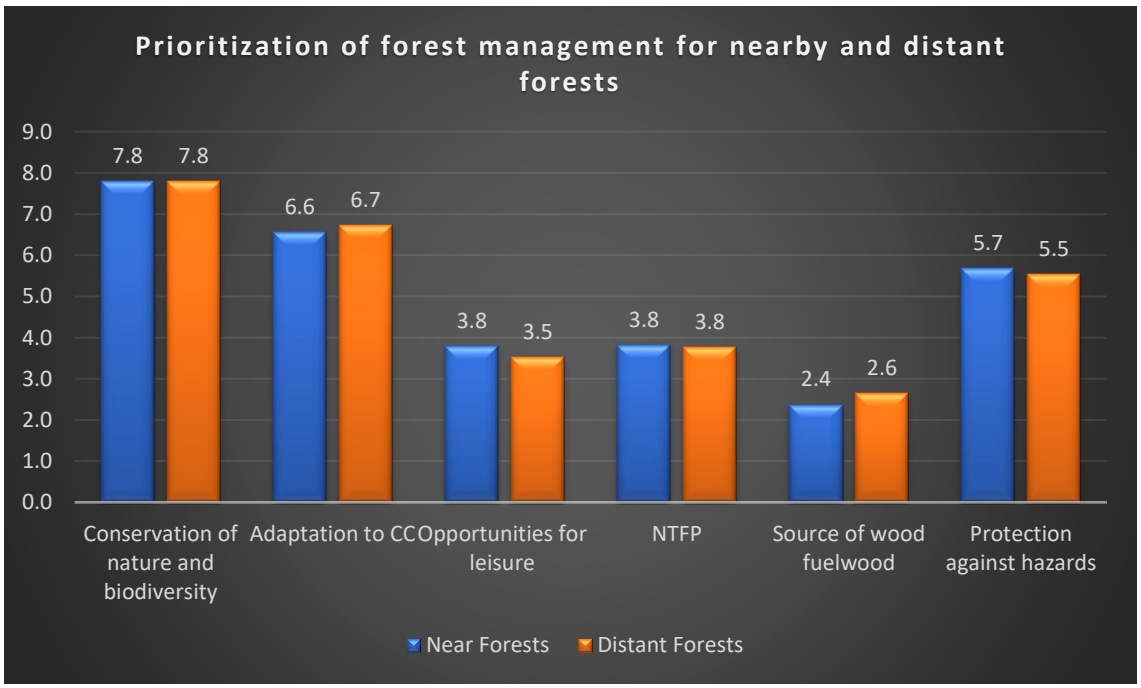


Figure 4. 12: People's priority for forest management for nearby forests and distant forests

Then total sum of points for each of the management objectives for both questions were calculated and averaged to obtain a final score for each objective in a scale of 10 which was as follows (Figure 4.13). From general descriptive analysis, it is clear that the respondents considered management of forests for conservation of nature and biodiversity

including animals and plants as their topmost priority while management of forests for production of wood and fuelwood were ranked with least priority.

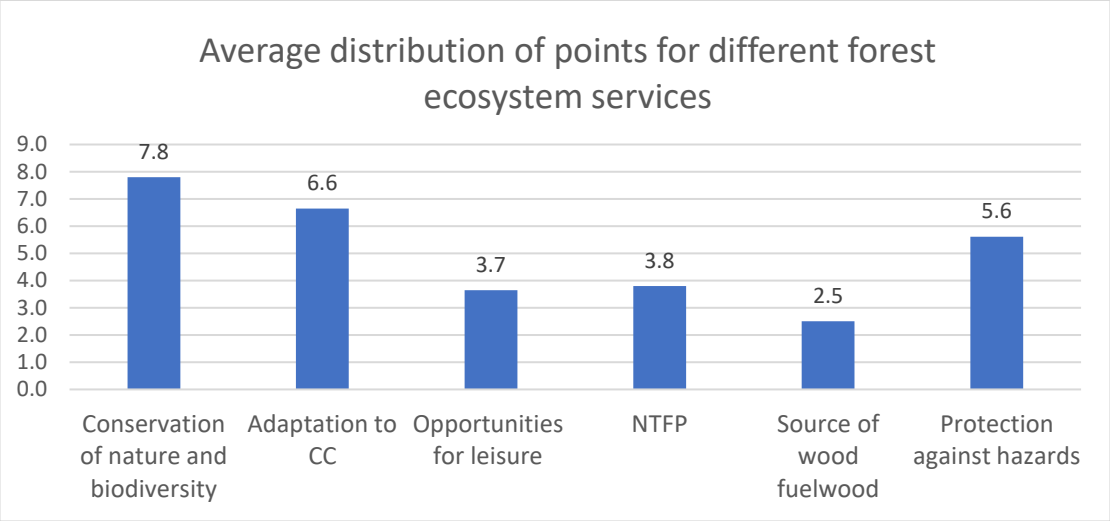
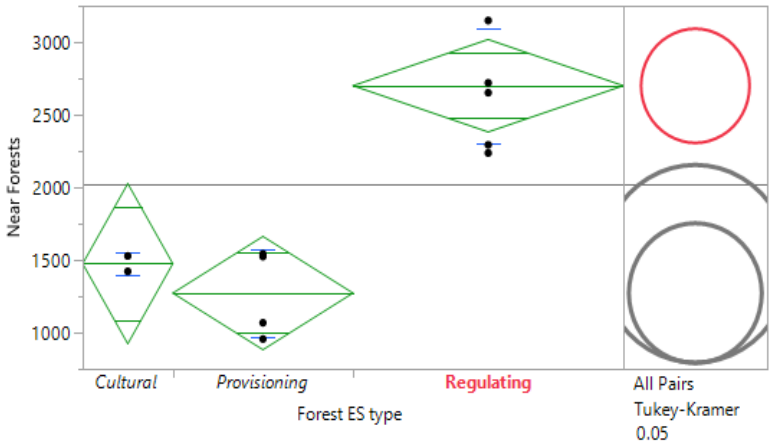


Figure 4. 13: Priorities of objectives for the management of forest ecosystem services

Forest management priorities based on people's perception

It was hypothesized that there are no significant differences among provisioning, regulating and cultural services as a management priority of forests in people's perception. From questionnaire, the points for F1 (priority for forest management for nearby forest) was counted for each forest ecosystem service. Six services were categorized into provisioning (NTFP, source of wood and fuelwood), regulating (conservation of nature and biodiversity, Adaptation to CC and protection against natural hazards) and cultural services (opportunities for leisure and recreation) and points assigned respectively. Same process was repeated also for F2 (points for priority for forest management for distant forest). Thus obtained final table was analysed in JMP, first for normality and equal variance test, and then for ANOVA and Tukey's HSD which yielded following results (Figure 4.14).



Ordered Differences Report

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
Regulating	Provisioning	1427.500	222.5085	806.254	2048.746	0.0003*
Regulating	Cultural	1225.000	281.4535	439.179	2010.821	0.0047*
Cultural	Provisioning	202.500	298.5265	-630.989	1035.989	0.7815

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Forest ES type	2	5603475.0	2801738	23.5789	0.0003*
Error	9	1069417.0	118824		
C. Total	11	6672892.0			

Figure 4. 14: ANOVA and Tukey's HSD test for testing hypothesis

From this, it can be clearly said that we cannot accept the null hypothesis at 5% level of significance as the ANOVA shows significant difference from null hypothesis and Tukey's HSD shows the difference is in between regulating and cultural services as well as regulating and provisional services. The regulating forest ecosystem services are voted as more important service than any other services.

Factors affecting priorities for forest management objectives for provision of different ecosystem services

It was hypothesized that socio-demographic factors (such as age, gender, level of education, place of residence and ownership typology) have significant effect on people's prioritization of forest management objectives.

- **Gender:**

  General descriptive analysis

  From the general graph (Figure 4.15) obtained by plotting average and normalized data from both nearby and distant forests, there does not seem to be any distinct effect of gender on giving points for priorities of forest management. Irrespective of whether respondents are male or female, they were observed to have similar priorities regarding forest ecosystem services which they feel as important and need to be managed.

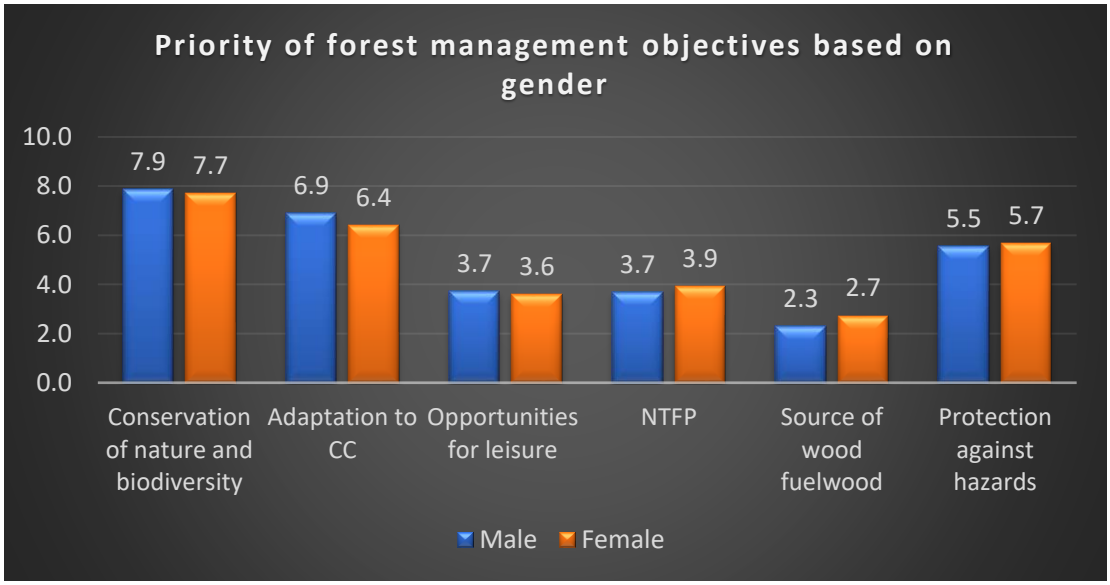


Figure 4. 15: Priority of forest management objectives based on gender

However, statistical analysis of data obtained by following the process mentioned below reveals that there is a significant difference between male and female for managment of forests for NTFP provisioning objective where female gave a higher score than male respondents.

Statistical analysis

The points scored by male and female for question number F1 (management priority for nearby forest) was normalized by dividing with the number of male and female respondents respectively for each of the six forest ecosystem service types. Similar process was done for F2 (management priority for distant forest). The combined table thus obtained was analysed for the test of normality and equal variance and after that ANOVA and student's paired t test were carried out. In cases where the data was not normal, non-parametric Kruskal Wallis test (rank sums) was carried out. Null hypothesis that gender has significant effect on prioritization could not be accepted as there was no significant difference between male and female for management of forests for all other services except for NTFP production at 5% level of significance. For NTFP production, null hypothesis could not be rejected as female gave more priority than male.

- **Age Group:**

General descriptive analysis

From table 11 and figure 4.16 below, it can be observed that there is no any clear effect of the age-group of respondents on priority of forest management objectives as the points given by the number of respondents in each age-group, when normalized and averaged, gives a similar score.

Table 11: Average score for forest management objectives according to age-group

S.N.	Age-group / Forest Management Objectives	18-24	25-34	35-44	45-54	55-64
1	Conservation of nature and biodiversity	8.0	7.9	7.9	7.7	7.4
2	Adaptation to CC	6.2	6.7	6.7	7.0	6.4
3	Opportunities for leisure	3.2	4.0	3.7	3.5	3.7
4	NTFP	4.1	3.8	3.7	3.5	4.1
5	Source of wood fuelwood	3.0	2.4	2.3	2.5	2.6
6	Protection against hazards	5.4	5.3	5.7	5.7	5.8

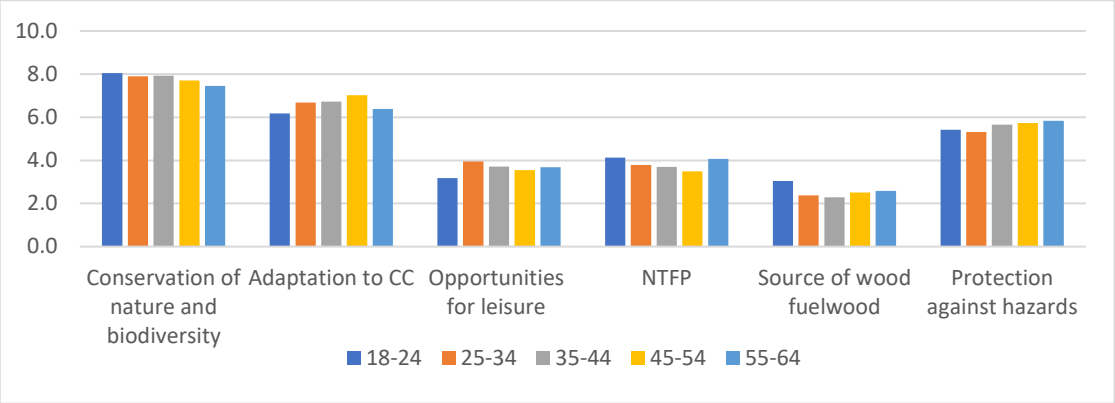


Figure 4. 16: Particular forest management objective has similar scores from all age-groups

Statistical analysis

The points scored by respondents of different five age groups for question number F1 (management priority for nearby forest) was normalized by dividing with the number of respondents in their respective age group for each of the 6 forest ecosystem service types. Similar process was done for F2 (management priority for distant forest). The combined table thus obtained was analysed for the test of normality and equal variance and after that ANOVA and Tukey's HSD test were carried out. In cases where the data was not normal, non-parametric Kruskal Wallis test (rank sums) was carried out. Null hypothesis that age group has significant effect on prioritization could not be accepted as there was no significant difference between respondents of different age groups for management of forests for all other services at 5% level of significance.

- **Education**

  General descriptive analysis

  From figure 4.17 below, it can be said that the level of education did not make much difference for the choice of "conservation of nature and biodiversity" as a management objective. Although people with no studies and with only first grade education (about 10 years of formal education) had given lower score for conservation of nature and biodiversity, overall score was from around 6 to 8 and did not fluctuate too much. Similarly, for adaptation to CC, the overall score was in the range of 4.3 to 7.3. Here again people with no studies and with only first grade education gave lower score than people with higher level of education. Interestingly, people with no studies and with only first grade education gave higher score for opportunities for leisure and recreational activities (above 5) whereas other respondent's score ranged from 2.7 to 3.8. However, for NTFP, there was a visible difference between respondents with no education and other education levels. Other respondent's score ranged from 2.7 to 5 while the score of respondents with no studies was 7.5 which tells us that those

respondents have significantly different priority regarding forest management objective. There wasn't much fluctuation in score for prioritization of forest management for provision of wood and fuelwood (score ranged from 1.5 to 4). The result was similar for protection against hazard (score ranged from 4.5 to 6.8).

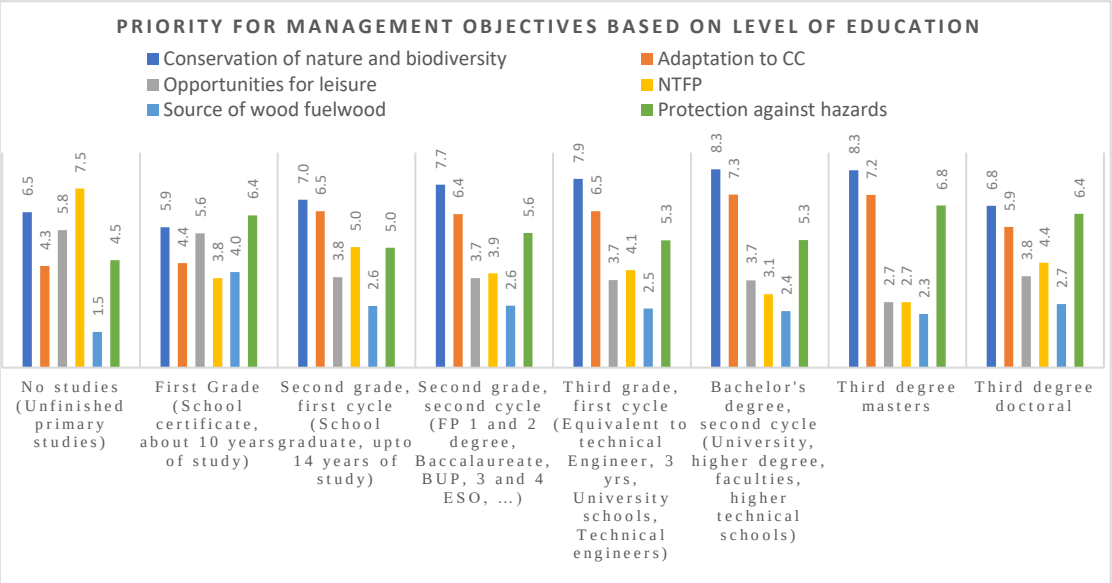


Figure 4. 17: Effect of level of education on prioritization of forest management objectives

People who did not finish their primary education chose provision of NTFP as their first management priority while people with first grade education chose protection against natural hazards as their first management objective. All other respondents with higher level of education agreed on conservation of nature and biodiversity as a priority in forest management objective.

People of all education levels except no studies and first grade chose conservation of nature and biodiversity, adaptation to CC and protection agaisnt natural hazards as their top three priorities for management of forests. Almost all group of respondents gave least priority to the management objectives of forests for production of wood and fuelwood. More educated groups gave higher importance to adaptation to climate change and lesser importance to opportunites for leisure whereas groups with lower education level gave lesser priority to CC adaptation and prioritized more for provision of opportunities for leisure activities.

Statistical analysis

The points scored by respondents of 8 different level of education for question F1 (management priority for nearby forest) was normalized by dividing with the number of respondents in their respective education level for each of the 6 forest ecosystem service types. Similar process was done for F2 (management priority for distant forest). The

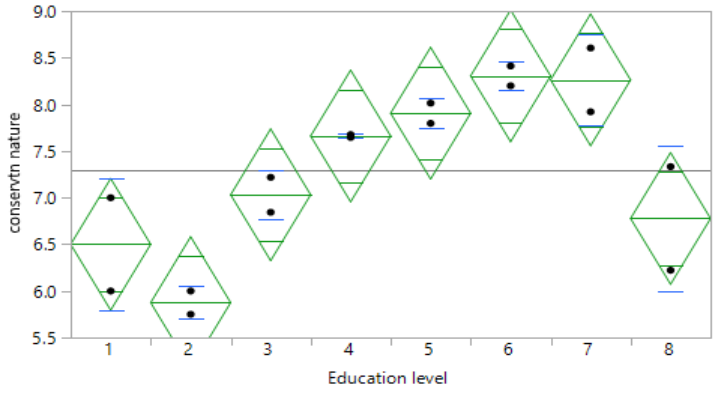
combined table thus obtained was analysed for the test of normality and equal variance and after that ANOVA and Tukey's HSD test were carried out. In cases where the data was not normal, non-parametric Kruskal Wallis test (rank sums) was carried out. The results are explained as follows:

Table 12: Level of education and their corresponding symbol

symbol	level of education	Number of respondents
1	No studies (Unfinished primary studies)	2
2	First Grade (School certificate, EGB first stage, about 10 years)	4
3	Second grade, first cycle (School graduate, or EGB 2nd stage, first and second ESO, first cycle upto 14 years)	32
4	Second grade, second cycle (FP 1 and 2 degree, Baccalaureate, BUP, 3 and 4 ESO, …)	170
5	Third grade, first cycle (Equivalent to technical Engineer, 3 yrs, University schools, Technical engineers)	69
6	Bachelor's degree, second cycle (University, higher degree, faculties, higher technical schools)	80
7	Third degree masters	38
8	Third degree doctoral	9

Effect of level of education for conservation of nature and biodiversity

The ANOVA showed significant difference (0.0039) and hence Tukey's HSD test was done which showed that there were differences between respondents with education level 1 and respondents with education level 6 and 7. Similarly respondents with education level 2 differed from respondents with education level 4,5,6 and 7 (Figure 4.18).



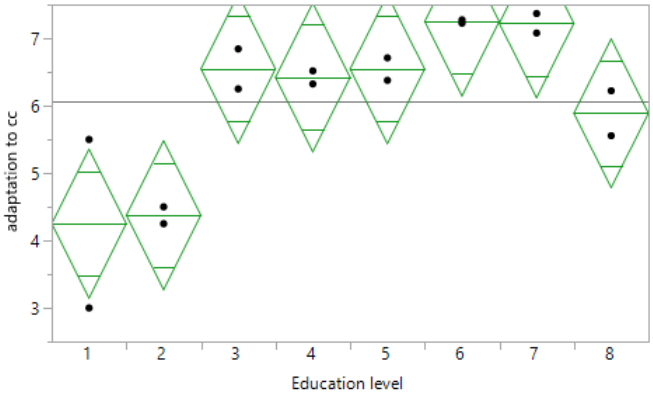
Ordered Differences Report

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
6	2	2.431250	0.4329490	0.71803	4.144474	0.0069*
7	2	2.388158	0.4329490	0.67493	4.101382	0.0077*
5	2	2.030797	0.4329490	0.31757	3.744021	0.0201*
6	1	1.806250	0.4329490	0.09303	3.519474	0.0381*
4	2	1.786765	0.4329490	0.07354	3.499989	0.0404*
7	1	1.763158	0.4329490	0.04993	3.476382	0.0432*

Figure 4. 18: Graphical representation of data and Tukey's test result for test of significance for conservation of nature and biodiversity

Effect of level of education for adaptation of CC

The data was not normal. So, Kruskal Wallis test was carried out which showed no significant difference but it was marginal (0.054). Hence, Tukey's test was carried out to have an idea of which would be significantly different in case ANOVA was considered significantly different. The result showed that the respondents with no studies (1) and first grade (2) level of education differed significantly from respondents with bachelors degree (6) and masters degree (7) (Figure 4.19).



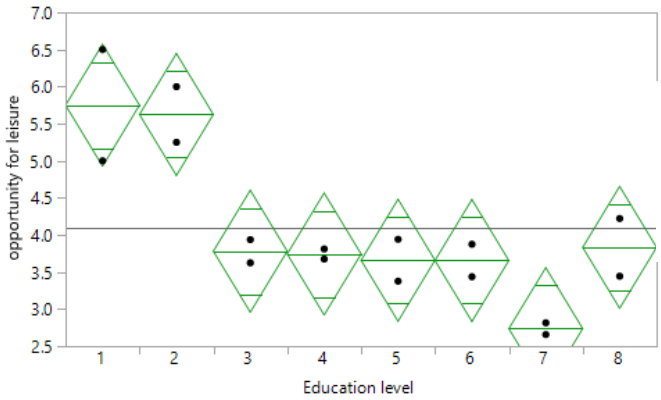
Ordered Differences Report

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
6	1	3.000000	0.6775217	0.31898	5.681024	0.0277*
7	1	2.973684	0.6775217	0.29266	5.654708	0.0291*
6	2	2.875000	0.6775217	0.19398	5.556024	0.0349*
7	2	2.848684	0.6775217	0.16766	5.529708	0.0366*

Figure 4. 19: Graphical representation of data and Tukey's test result for test of significance for adaptation of CC

Effect of level of education for opportunities for leisure and recreation

The ANOVA showed significant difference (0.0036) and hence Tukey's HSD test was carried out which revealed that there were significant difference between respondents with education level 1 with respondents of education level 4, 5, 6 and 7. Similarly respondents with education level 2 differed significantly with education level 7 (Figure 4.20).



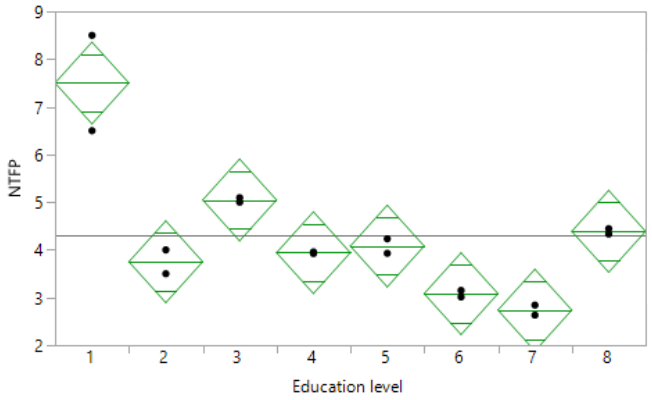
Ordered Differences Report

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
1	7	3.013158	0.5043069	1.01756	5.008753	0.0046*
2	7	2.888158	0.5043069	0.89256	4.883753	0.0061*
1	6	2.093750	0.5043069	0.09816	4.089345	0.0391*
1	5	2.090580	0.5043069	0.09498	4.086175	0.0394*
1	4	2.005882	0.5043069	0.01029	4.001477	0.0487*

Figure 4. 20: Graphical representation of data and Tukey's test result for test of significance for opportunities for leisure and recreation

Effect of level of education for NTFP

The data was not normal. So, Kruskal Wallis test was carried out which showed significant difference with value of 0.0469. Tukey's test was carried out to have an idea of which education levels were significantly different. The result showed that the respondents with no studies (1) level of education differed significantly from respondents with all other levels of education. It was also seen that respondents with level of education (3) differed significantly from level of education (7) (Figure 4.21).



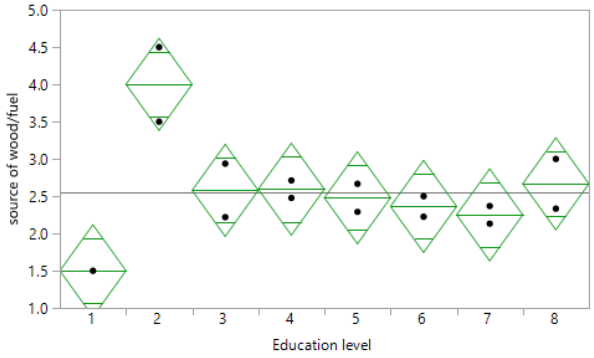
Ordered Differences Report

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
1	7	4.763158	0.5260843	2.68139	6.844928	0.0003*
1	6	4.418750	0.5260843	2.33698	6.500520	0.0005*
1	2	3.750000	0.5260843	1.66823	5.831770	0.0014*
1	4	3.558824	0.5260843	1.47705	5.640594	0.0021*
1	5	3.420290	0.5260843	1.33852	5.502060	0.0027*
1	8	3.111111	0.5260843	1.02934	5.192882	0.0050*
1	3	2.453125	0.5260843	0.37135	4.534895	0.0208*
3	7	2.310033	0.5260843	0.22826	4.391803	0.0290*

Figure 4. 21: Graphical representation of data and Tukey's test result for test of significance for NTFP

Effect of level of education for source of wood/fuelwood

The ANOVA showed significant difference (0.0078) and Tukey's HSD test showed that there were significant difference between respondents with education level 2 with respondents of education level 1, 5, 6 and 7 (Figure 4.22).



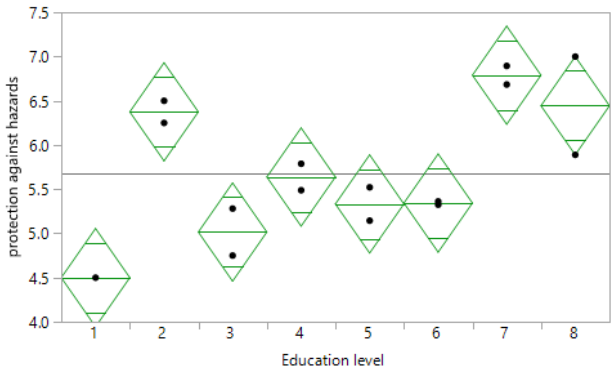
Ordered Differences Report

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
2	1	2.500000	0.3783282	1.00292	3.997084	0.0024*
2	7	1.750000	0.3783282	0.25292	3.247084	0.0218*
2	6	1.637500	0.3783282	0.14042	3.134584	0.0314*
2	5	1.521739	0.3783282	0.02466	3.018823	0.0460*

Figure 4. 22: Graphical representation of data and Tukey's test result for test of significance for source of wood/fuelwood

Effect of level of education for protection against natural hazards

The ANOVA showed significant difference (0.0016) and Tukey's HSD test showed that there was significant difference between respondents with education level 1 with respondents of education level 2, 7 and 8. Similarly, significant difference was observed between education level 3 with 2, 7 and 8. It was also seen that respondents with education level 5 and 6 differed significantly from respondents of education level 7 (Figure 4.23).



Ordered Differences Report

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
7	1	2.289474	0.3406803	0.94137	3.637581	0.0021*
8	1	1.944444	0.3406803	0.59634	3.292552	0.0062*
2	1	1.875000	0.3406803	0.52689	3.223107	0.0078*
7	3	1.773849	0.3406803	0.42574	3.121956	0.0109*
7	5	1.456140	0.3406803	0.10803	2.804248	0.0336*
7	6	1.445724	0.3406803	0.09762	2.793831	0.0349*
8	3	1.428819	0.3406803	0.08071	2.776927	0.0371*
2	3	1.359375	0.3406803	0.01127	2.707482	0.0479*

Figure 4. 23: Graphical representation of data and Tukey's test result for test of significance for protection against natural hazards

Null hypothesis that education level has significant effect on prioritization could not be rejected as there was significant difference between different education level for management of forests for all services at 5% level of significance. Respondents with no studies and first grade study usually differed in their opinion with other respondents having higher level of education.

- **Place of residence of respondents**

  General descriptive analysis

  From graph below (Figure 4.24), it can be seen that there is not much difference for prioritization of forest management objectives based on place of residence. All respondents living in different places voted conservation of nature and biodiversity as their first priority for forest management followed by adaptation to climate change and protection against natural hazards. The least priority of forest management was given for management of forest as a source of wood and fuelwood by all groups of respondents.

  For the purpose of this study, rural area means area with less than 10,000 residents, small city means area with more than 10,000 but less than 100,000 residents, medium city means area with more than 100,000 but less than 500,000 residents and big city means area with more than 500,000 residents.

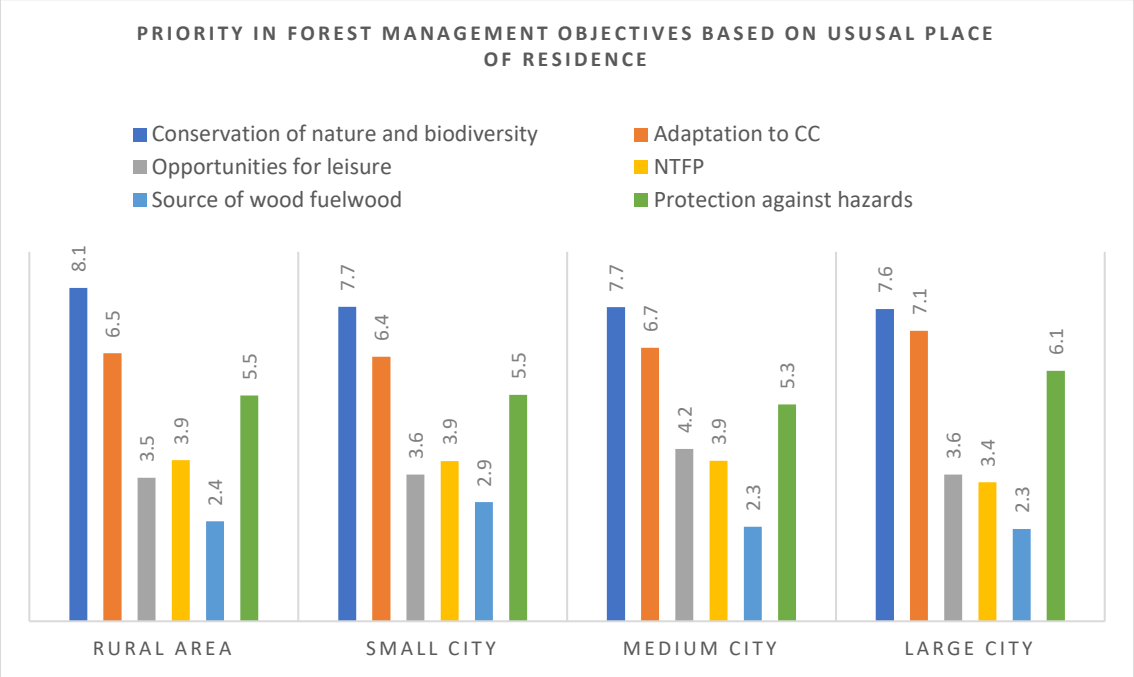
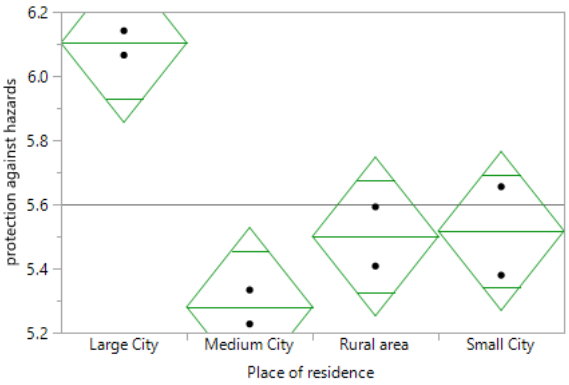


Figure 4. 24: Priority in forest management objectives based on usual place of residence

Statistical analysis

The points scored by respondents living in four different categories of places for question F1 (management priority for nearby forest) was normalized by dividing with the number of respondents in their respective places of residence for each of the 6 forest ecosystem service types. Similar process was done for F2 (management priority for distant forest). The combined table thus obtained was analysed for the test of normality and equal variance and after that ANOVA and Tukey's HSD test were carried out. In cases where the data was not normal, non-parametric Kruskal Wallis test (rank sums) was carried out. Null hypothesis that place of residence of respondents has significant effect on prioritization could not be accepted as there was no significant difference between respondents living in different places for management of forests for all other services at 5% level of significance except for the protection against natural hazards. For protection against natural hazards, the ANOVA showed significant differences (0.0113) and Tukey's HSD test showed that there was difference between respondents living in large cities and respondents in other places (Figure 4.25). People living in large cities were giving more points for FES of protection against natural hazards as compared to people living in small areas.



Ordered Differences Report

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
Large City	Medium City	0.8229578	0.1261055	0.309601	1.336315	0.0098*
Large City	Rural area	0.6032609	0.1261055	0.089904	1.116618	0.0293*
Large City	Small City	0.5860195	0.1261055	0.072662	1.099377	0.0323*
Small City	Medium City	0.2369383	0.1261055	-0.276419	0.750296	0.3615
Rural area	Medium City	0.2196970	0.1261055	-0.293660	0.733054	0.4114
Small City	Rural area	0.0172414	0.1261055	-0.496116	0.530599	0.9989

Figure 4. 25: Graphical representation of data and Tukey's test result for test of significance for people living in different places

- **Ownership of forests**

  General descriptive analysis

  From figure 4.26 below, it can be seen that there is no significant difference for prioritization of forest management objectives based on ownership of forests. However, respondents who own forests give lesser priority to management of forests for opportunities of leisure and recreation compared to respondents who do not own forests. On the contrary, people owning forests give higher priority to management of forests as a source of wood and fuelwood.

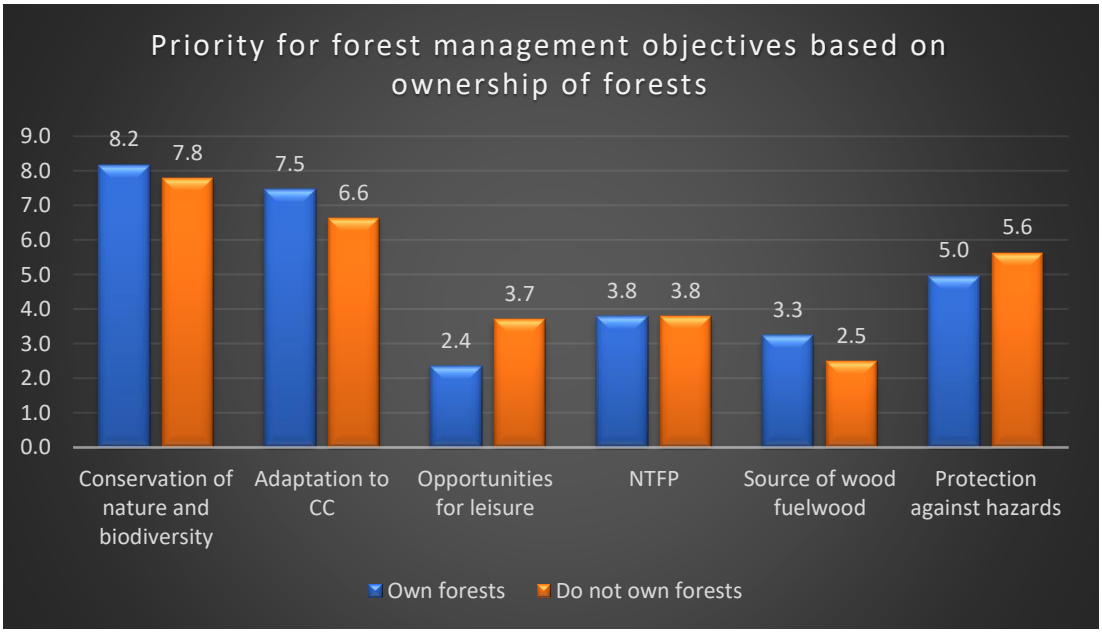


Figure 4. 26: Priority of forest management objectives based on ownership typology

Statistical analysis

The points scored by respondents who owned forest and who did not own forest were noted for question F1 (management priority for nearby forest) was normalized by dividing with the number of respondents respectively for each of the 6 forest ecosystem service types. Similar process was done for F2 (management priority for distant forest). The combined table thus obtained was analysed for the test of normality and equal variance and after that ANOVA and student's paired t test were carried out. In cases where the data was not normal, non-parametric Kruskal Wallis test (rank sums) was carried out.

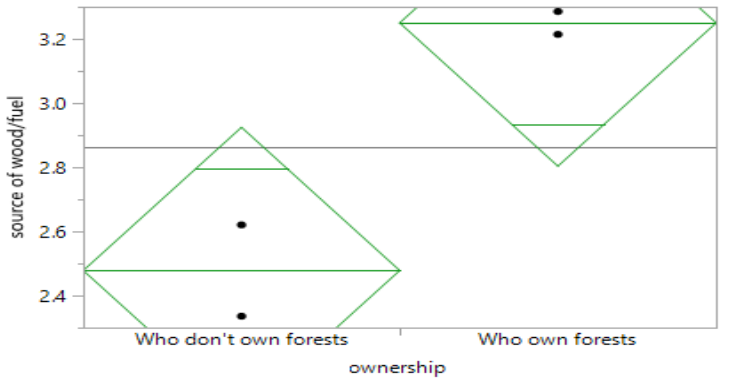
Ordered Differences Report

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
Who don't own forests	Who own forests	1.340293	0.1936718	0.5069907	2.173595	0.0202*

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
ownership	1	1.7963854	1.79639	47.8924	0.0202*
Error	2	0.0750175	0.03751		
C. Total	3	1.8714029			

Figure 4. 27: Graphical representation of data and paired t- test result for test of significance for opportunity of leisure/recreation based on ownership typology



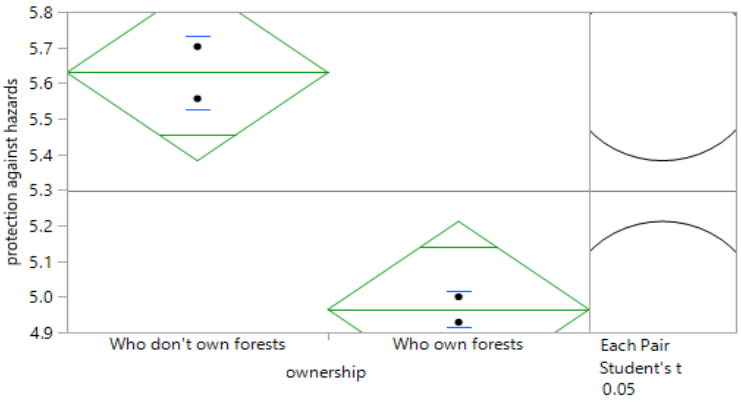
Ordered Differences Report

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
Who own forests	Who don't own forests	0.7717949	0.1467208	0.1405063	1.403083	0.0343*

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
ownership	1	0.59566732	0.595667	27.6707	0.0343*
Error	2	0.04305398	0.021527		
C. Total	3	0.63872130			

Figure 4. 28: Graphical representation of data and paired t- test result for test of significance for source of wood/fuelwood based on ownership typology



Ordered Differences Report

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
Who don't own forests	Who own forests	0.6652015	0.0813372	0.3152356	1.015167	0.0146*

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
ownership	1	0.44249299	0.442493	66.8848	0.0146*
Error	2	0.01323149	0.006616		
C. Total	3	0.45572448			

Figure 4. 29: Graphical representation of data and paired t- test result for test of significance for protection against hazards based on ownership typology

There was no significant difference between respondents who owned forests and who did not own forests for management of forests for all other services except for opportunities for leisure, source of wood and protection against natural hazards at 5% level of significance (Figure 4.27, 4.28 and 4.29).

5. Discussion

In this chapter, the theoretical implications of the findings of this study is discussed first, accompanied by providing the plausible explanations to the findings produced in this study. Consequently, the discussions about implications for the management are followed up. The last section identifies the limitations in this study and the recommendations for further research are presented in the following text.

5.1 Theoretical implications

Understanding how people perceive the importance of different ES may help to define which ES matter most and to whom. Analysts may then enter ES identified as priorities into models that estimate the provision of those ES under different management scenarios and given biophysical constraints. In this way, analysts could focus on ES perceived as priorities.

- **People's perception, knowledge and awareness about forests**

People defined forests as a means to connect themselves to nature and disconnect from humdrum busy life. They also acknowledged forests for their services of oxygen production and defined forests as lungs of nature. But there were comparatively fewer respondents who defined forests as trees and vegetation. This somehow indicates that

people perceive forests as a service provider rather than just an aggregation of trees. People associated forests with the services or benefits that they received or thought to have received from them rather than what forests exactly are according to standard definitions. This shows that common people's definitions of forests are more on the abstract side rather than on technical or academic side. Only around 13% people defined forests as group of trees or jungle or vegetation while rest defined forests on the basis of their feelings (not the same definition of forest according to Spanish law or FAO definition). This indicates that people need to be made more informed and aware about forests.

Less than 50% respondents in Catalonia were aware about the forest area cover in Catalonia and the ownership typology. This shows that people are not well informed about the status of forests in their region. However, despite being misinformed, majority of the respondents agreed that forests in this region are important. Majority of respondents considered forests to be important near where they lived, in their region and in Catalonia. Majority of people involved in the survey also said that they did not have much knowledge about forest management in Catalonia however they seemed to understand the forest related problems and their probable solutions in Catalonia.

- **Value and Importance of different forest ecosystem services for respondents individually and for the society**

  People value forests for different purposes. Out of twelve purposes (access to knowledge, source of employment, protection against natural hazards, source of clean air and water, source of fuel, source of non-timber forest products, beauty, mitigation of climate change, conservation of animal and plants, source of wood, culture and tradition, and opportunities for leisure/spirituality/recreation) listed in the questionnaire for which people could value forest and consider them to be important, it was found that majority of the people thought forests to be important and valuable for all purposes while few respondents did not think forests to be much valuable for the purpose of source of employment, source of fuelwood and source of wood. This clearly displays the mindset of people which tells us that people do not think forests in Catalonia are much productive and capable of giving employment opportunities or producing good lumber and fuelwood.

  Controversies about ES economic valuation tend to be heated because they involve profound differences about the intrinsic values and motivations of people towards the environment. Works on environmental ethics has shown that long-term preservation of the environment may result from egoistic (preserve nature for oneself), altruistic (preserve nature for others) or bio-centered (preserve nature for itself) values and motivations (Stern and Dietz, 1994) cf (Barnaud & Antona, 2014). Besides, as Kergreis (2009) describes, how consensual collective values (in particular, environmental protection) clash with several individual values (e.g. fulfillment, autonomy, conformism, safety). The issue of ES maintenance relates therefore to fundamental societal choices and to the balance between individual and collective choices (Barnaud & Antona, 2014). In this study,

people did not differ much in their opinions when they considered the importance of forests for themselves and for the society. They chose forests to be important as a source of clean air and water and as a place for conservation of animals and plants. Similarly, forests were appreciated as a tool to mitigate climate change (absorbing and storing carbon) and as a protection against natural hazards such as avalanche, floods, erosion. The respondents also valued forests as a place for leisure, recreation, and spirituality.
It was found that people gave more importance to regulating forest ecosystem services than cultural and provisioning services. Previous studies have concluded that personal priorities for ES focus first on provisioning services, followed by regulating services and cultural services (Iftekhar & Takama 2008; Agbenyega et al. 2009; Hartter 2010) cf (Al-Assaf et al., 2014).Similar statements were given by Rodriguez et al., (2006) saying that the selected case study examples showed a preference for provisioning, regulating, and cultural services (in that order).
The result in this study could have been different from the statements given by Rodriguez et al., (2006) and others because they were giving generalized versions (of all ecosystem services and not only forest ecosystem services). Even when considering only forest ecosystem services, we could have obtained these results because of the low productive nature of forests in Mediterranean region and people's perception that other forest services are more important than provisioning services in this region.

- **Effect of applying management objective for boosting one forest ecosystem service to other services**

From the results section, it can be said that most respondents considered all kind of forest management activities have positive effect in all other ecosystem services with some exceptions. One of the exceptions is that if management is carried out for the enhancement of leisure and spiritual activities, there will be more negative impacts on production of wood and fuel wood. Similarly, another exception is that if forest is managed for the purpose of boosting fuelwood production, then it has negative impacts on all other forest ecosystem services except wood production and employment. It can be observed that there are significant number of people who think that all other forest management objectives have negative effect on production of wood and fuel wood. However, when forests are managed for wood production, there are lesser negative impacts in all other services. From this, it can be said indirectly that people think that if they choose to manage forests for the enhancement of leisure/spiritual/recreational activities, then they will have to incur trade-offs of wood and fuel-wood production. Similarly, if they wish to manage forests for fuel-wood production, then they will have to trade all other forest ecosystem services except wood production and employment opportunities. Trade-offs occur when an improvement in one ES results in a decline in another (Howe et al., 2014) or among stakeholders when a particular ES is prioritised by one stakeholder at the expense of the preference of others (McShane et al., 2011) cf (Paudyal et al., 2018). Synergies and trade-offs create opportunities and conflicts, and their study can provide decision-makers with

information to maximise benefits and transparently address conflict (Bennett et al., 2009; Crouzat et al., 2016; Hicks et al., 2013) cf (Paudyal et al., 2018). However, in this study, people did not choose the management objectives which would incur them trade-offs, instead they chose to select synergistic management objectives.

- **Priorities for the management objectives of forest ecosystems and the factors that influence these prioritizations**

  Some authors including Rodriguez et al., (2006) mentioned that the selected case study examples showed a preference for provisioning services for all ecosystem services. But the results in this study show otherwise. Here, the analysis of the data collected showed that respondents considered management of forests for conservation of nature and biodiversity including animals and plants as their topmost priority while management of forests for production of wood and fuelwood were ranked as lowest priority. Most people chose regulating services as their top priority for forest management objective and then cultural services. Provisioning services were least prioritized management objective. The reason could be because of the unproductive nature of forests in Catalonia, which does not yield much commercial timber and fuelwood as in other Nordic countries or tropical regions. The growth of the trees in this region is very slow and other provisioning services are less appreciated by the locals as compared to the regulating and cultural services provided by forest ecosystems.

  In this study, the factors that were considered for being influential in prioritizing forest management objectives were age, gender, level of education, place of residence and ownership type. The analysis showed that not all the factors were highly influential and significant in making people prioritize one forest ecosystem service over another but, nonetheless, almost all factors had some effect. There was no significant effect from gender perspective except for provisioning of NTFP where female gave higher priority than male. Age group had no significant effect on the way people prioritized forest management objectives. However, there was a visible difference between respondents of different education levels for management of forests for all the six forest ecosystem services. People with lower level of education differed in their opinion for forest management objectives with well-educated people. The results also showed that there was difference in opinion between respondents living in large cities and respondents living in other places regarding forest management priorities for protection against natural hazards. People living in large cities prioritized protection against natural hazards more than rural people and people in small cities. This might be because of the respondents in large cities being more apprehensive and being more affected by incidents of natural hazards or might be because they are more well informed. Our result was contrasting to the results of some of the authors who argue that rural residents mention regulating and cultural ES more frequently than provisioning ES, because they possess ecological knowledge of the importance of the environment and the forest ES (e.g., Muhamad et al., 2014) cf (Lhoest et al., 2019). In our result, rural people were giving more stress on provisioning services like NTFP, wood and fuelwood while giving less interest for

regulating service like protection against natural hazards and cultural services like opportunities for leisure and recreation. Likewise, there was also significant effect of ownership pattern in prioritizing forest management objectives where forest owners gave less priority to forest management for providing opportunities for leisure and protection against natural hazards while more priority as a source of wood. Non owners gave higher score for objectives such as leisure and recreation and protection against natural hazards which shows that non-owners and owners differ in their views on how to manage forests and for what purposes.

In the literature, it can be seen that variables such as age, gender, education and political ideology tend to have reasonably robust effects on environmental concerns—with younger, female, better educated, and politically liberal segments of the public expressing higher levels of concern than their counterparts (e.g. Jones and Dunlap 1992; Diamantopoulos et al. 2003; Strapko et al. 2016) cf. (Xiao et al., 2019). Jones & Dunlap (1992), have offered theoretical explanations for these findings. One would expect to find people with such characteristics more likely to endorse an ecological worldview (Dunlap et al., 2000). This was found to be somewhat true in our case.

5.2 Managerial implications

The findings of the study raise several managerial implications some of which are worthy to be addressed here. The first managerial implication is based on the perception of common people towards the definition and meaning of forests and their awareness and knowledge towards status of forest. Majority of people did not truly understand what forest meant in accordance with the law or the general standard definition. Similarly, there were many respondents who did not have correct information about the forest status in Catalonia, their ownership typology and the way they are managed. This implies that people need to get informed well and made aware for better management of forests and for better addressing forest related problems. They need to have basic knowledge so as to have a stand and reality backed reasonings when they are consulted for their perspectives (by government or other agencies). The second managerial implication involves people's valuation of different forest ecosystem services. Here, people valued regulating services more than cultural and provisioning services. This indicated that people give first importance to regulating services and then to cultural services and then, at last, to provisioning services. Hence, while formulating any plans or strategies related with forests, these need to be kept in mind. It should also be noted that the value and importance of forest do not change drastically when people think of forests resources for their own use (themselves) or for the society. Another managerial implication is that people view almost all forest management objectives to be positive for better flow of other forest ecosystem services (with some exceptions). This need to be kept in mind when planning and providing people with management options. For instance, if the forest is being managed for opportunities for leisure/recreation/ spiritual activities, people

believe that it has negative effects on wood and fuelwood production. On the contrary, forest management for wood production has no significant negative effects on all other services. Similarly, people think that forest management for production of fuelwood has positive effects only on employment opportunities and wood production. Hence, while bringing management plans and strategies, it should be noted what people consider beneficial and what they consider detrimental. It should also be thought of for the trade-off that people may be willing to make. For example, since the productive capacity of Mediterranean forests are low, people may be willing to trade wood production with opportunities for leisure/recreation/spiritual activities. Fourth implication of this study from managerial point of view is that according to this study people give higher priority and preference to regulating services rather than cultural and provisioning services and hence forest management strategies should also be more focused on these regulating objectives for better response from the public. Also, the factors such as age, gender, place of residence, level of education, ownership typology and so on should always be taken into consideration as these factors can have significant effect on the way people perceive forest ecosystem services. If possible, other factors could/should be added for better results but at least these factors need to be considered while analysing social views and perceptions.

5.3 Limitations and recommendations for future research

Limitations

There are several limitations in this study. The most prominent one being the timeframe within which there was (still is) an outbreak of COVID-19 pandemic which limited the movement and possible addition of data and other insights. Another limitation is that of a small sample size and fewer number of responses from the respondents (as it was not mandatory and collected voluntarily), which could have been enlarged for better accuracy of the study. These types of studies are case sensitive and have limited application of generalization in other parts of the world. It is also true that sometimes people feel that they are not meaningfully able to identify their values without carefully considering impacts, ethics and wider policies and contexts, and deliberating on these topics with others (Irvine et al, 2016). People consider and discuss their transcendental, ethical and cultural values as well as considerations such as equity, fairness, rights and responsibilities, alongside discussions of costs, benefits and trade-offs, uncertainties and risks, in order to come to a more meaningful formation of their contextual values. Changes in values are most likely to occur where people re-evaluate the assumptions that underlie their positions, leading to changes in attitudes that may in some cases lead to a shift in their values in relation to the environment (Fazey et al., 2005; Keen and Mahanty, 2006; Reed et al., 2010) cf (Irvine et al, 2016).

Recommendations

The key challenge in developing comprehensive assessment frameworks for forest ecosystem services is the proper integration of biophysical, socio-cultural, and economic values of forest ecosystem services. As mentioned previously, this study is an attempt to further fortify and strengthen the forest ecosystem services assessment and valuation. Assumptions of valuation methodologies and economic science in general must also learn and interact with disciplines like psychology, sociology and other allied social sciences to make the valuation of ecosystem services a comprehensive and wholesome field of inquiry (Manoli et al., 2019). A single measure can never capture the full suite of ecological values or social values (Bryan et al., 2010).

From the results and discussions in this study, it is recommended that people should be given environmental education and updated on basic knowledge about forest ecosystem services. Since regulating forest ecosystem services are more valued and prioritized by people in this case, the forest management objectives and strategies should be more focused on regulating services. The factors such as age group, gender, level of education, place of residence and ownership typology should be investigated and studied carefully because they can influence the way people prioritize and value forest ecosystem services. Although this study deals with social perceptions and perspectives of people regarding forest ecosystem services valuation, future research needs to be more elaborate and inclusive of various other factors which could not be included in this study. The results from a study by Iniesta-Arandia et al., (2014) indicates that socio-cultural valuation is a case sensitive (detects differences in perceptions in different areas) and stakeholder-sensitive tool (detects differences in perceptions among stakeholder groups), hence it is recommended to carry out further studies in other parts of the world as well.

6. Conclusions

The exclusive valuation of economic and biophysical aspects of ecosystem services do not give a realistic and holistic picture. Similarly, only inclusion of people and stakeholders may not always lead to ideal ecological outcomes. For instance, stakeholders may decide to consistently favour economic and infrastructure development over nature conservation (Orenstein & Groner, 2014). This study attempts to further strengthen the valuation method of forest ecosystem services through societal valuation and be complementary in making a realistic and holistic valuation of forest ecosystem services.

From data analysis, results and discussion, it can be concluded as follows:

- The people from Catalonia had their own way of defining forests which can be different from the standard definition of forest (area with trees). The definitions of forest in this study indicated that people understood forests as a means to connect to nature and relax and enjoy leisure. People also perceived the forests as a source of fresh air and defined forests based on the services that forest ecosystem provide. However, people were not much aware and knowledgeable about the

status of the forests in their region although they considered forests to be important for them.

- The people in Catalonia felt that forests were important and valuable for themselves individually as well as for the society and they did not differ much in their opinion regarding forests in this matter. They also gave higher importance and value to regulating services of forest ecosystems (protection against natural hazards, source of clean air/water, mitigation to climate change and conservation of animal/ plants/ biodiversity) than cultural (access to knowledge, source of beauty, part of culture and tradition and opportunities for leisure/ spirituality/ recreation) and provisioning services (source of employment, source of wood, source of fuelwood and source of non-timber forest products). This could be because of the low productive nature of forests in the study area.
- The people of the study area believed that management of forests for boosting any of the forest ecosystem services had positive effect on all other forest ecosystem services with some exceptions. The exceptions were that if forests were managed for boosting enhancement of leisure/recreation and spiritual activities, there will be more negative impacts on production of wood and fuel wood. Similarly, another exception was that if forest was managed for the purpose of boosting fuelwood production, then it had negative impacts on all other forest ecosystem services except wood production and employment. Majority of the people also thought that any kind of management activities of forest would result in lesser production of wood and fuel wood. Despite this, people were prioritizing management options which would result in lower production of wood and fuelwood, hinting that these were the trade-offs they were willing to make.
- The people in Catalonia were prioritizing regulating services rather than cultural and provisioning forest ecosystem services for forest management objectives. Highly prioritized management objectives were for conservation of nature/biodiversity, adaptation to climate change and protection against natural hazards. The factor mostly affecting these prioritizations was level of education while place of residence, gender, and ownership typology somewhat affected these prioritizations. Age group did not make much difference in prioritization of management objectives but as mentioned earlier, these social prioritizations and valuations are case sensitive and hence in future, all of these factors (including additional other factors) need to be studied carefully and in detail.

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Website:

http://www.futureforest.eu/uploads/basic_document_catalonia_v2.pdf

Annexes

Annex 1 - Questionnaire

Quantitative survey for the assessment of attitudes and values associated with forest ecosystem services

Dear participant,

With this questionnaire, we aim to know in what ways citizens /residents appreciate and relate to the forests of Catalonia. A better understanding of how people value forests is useful information for politicians and managers in their decision-making. Our questionnaire will take around 30 minutes of your time and will help us in better understanding how people value forest ecosystem services. The data collected will be anonymous and will be strictly used only for research purposes only. Thank you.

BLOCK A: General perception of forests and values

1. Please make a brief description of what forests are to you

2. What forest area do you think is in Catalonia?
    1. Less than 30% of the area of Catalonia (more than 321,053 ha)
    2. Between 30% and 50% of the area of Catalonia (between 321,053 and 1,605,267 ha)
    3. Between 51% and 80% of the area of Catalonia (between 1,605,267 and 2,568,427 ha)
    4. More than 80% of the area of Catalonia (More than 2,568,427 ha)
    5. I don't know

3. Of this forest area, what percentage do you think is public and which percentage is private?
    1. The majority of forest area (more than 70%) it's public
    2. The majority of forest area (more than 70%) belongs to forest owners
    3. The forest area is also distributed among public and private entities.
    4. I don't know

4. Do you often visit the forests*?

0 Never	1	2	3	4	5	6	7	8	9	10 Continuously

** Forest definition: surface covered with at least 20% of trees. There are many types of forest; for example, natural, coniferous or deciduous forests, next to a river, semi-natural forests, or planted forest. Everything is considered forest minus parks or urban gardens.*

5. How important do you consider forests to be?
   It values each response between 0 and 10 depending on the forest we refer to:
   a. Forests **near where I live are** important

0 Nothing	1	2	3	4	5	6	7	8	9	10 A lot

   b. The forests **of my province or region** are important

0 Nothing	1	2	3	4	5	6	7	8	9	10 A lot

   c. The forests **in Cataloniaña are** important

0 Nothing	1	2	3	4	5	6	7	8	9	10 A lot

BLOCK B: The value of the forests

The forest provides us with goods such as wood, mushrooms, or wild fruits and services such as clean air, plant and animal shelter and a recreation place. We value* the *goods and services we consider desirable, regardless of whether or not they have a monetary price.* Evaluate the following statements by surrounding the number that best suits your opinion:

1. How valuable you consider forests to be as...
   ..... access to **knowledge** (e.g. scientific research or environmental education)

0 Nothing	1	2	3	4	5	6	7	8	9	10 A lot

   .... source of **employment** (e.g. (jobs in the wood, tourism or nature conservation sector)

0 Nothing	1	2	3	4	5	6	7	8	9	10 A lot

..... protection against **natural hazards** (e.g. avalanche, floods...)

0 Nothing	1	2	3	4	5	6	7	8	9	10 A lot

..... clean air and water source

0 Nothing	1	2	3	4	5	6	7	8	9	10 A lot

..... fuel source (wood and biomass for heating or producing energy))

0 Nothing	1	2	3	4	5	6	7	8	9	10 A lot

..... source of non-wood forest products (mushrooms, herbs, fruits)

0 Nothing	1	2	3	4	5	6	7	8	9	10 A lot

..... a place of great beauty

0 Nothing	1	2	3	4	5	6	7	8	9	10 A lot

..... a tool to mitigate climate change (e.g. by absorbing and storing carbon from the atmosphere in the trunk and roots)

0 Nothing	1	2	3	4	5	6	7	8	9	10 A lot

..... a place for the conservation of animals and plants

0 Nothing	1	2	3	4	5	6	7	8	9	10 A lot

..... wooden fountain (for construction, furniture...)

0 Nothing	1	2	3	4	5	6	7	8	9	10 A lot

..... part of our culture (traditions)

0 Nothing	1	2	3	4	5	6	7	8	9	10 A lot

.... a place for recreation (walking, cycling, spirituality))

0 Nothing	1	2	3	4	5	6	7	8	9	10 A lot

BLOCK C: The importance of forest benefits

1. How important do you think forests are to you?
   Choose the top five reasons why you think forests are important and sort them in order of importance

Forests like ...	They're very important **for me**
- access to knowledge (research and disclosure)	
- source of employment (jobs)	
- protection against natural hazards (avalan s/ floods...)	
- clean air and water source	
- fuel source (wood and biomass)	
- source of non-wood forest products (mushrooms, herbs, fruits)	
- a place of great beauty	
- a tool to mitigate climate change (absorbing and storing carbon)	
- a place for the conservation of animals and plants	
- wooden fountain (construction, furniture...)	
- part of our culture (traditions)	
- a place for leisure and spirituality	

2. How important do you consider the forests **to society?**?
   Choose the top five reasons why you think forests are important and sort them in order of importance

Forests like ...	They're very important **for society**
- access to knowledge (research and disclosure)	
- source of employment (jobs)	
- protection against natural hazards (avalan s/ floods...)	
- clean air and water source	
- fuel source (wood and biomass)	
- source of non-wood forest products (mushrooms, herbs, fruits)	

- a place of great beauty	
- a tool to mitigate climate change (absorbing and storing carbon)	
- a place for the conservation of animals and plants	
- wooden fountain (construction, furniture...)	
- part of our culture (traditions)	
- a place for leisure and spirituality	

BLOCK D&E: Forests and their benefits

Forest management can serve to enhance various forest functions. Sometimes managing to achieve a specific goal can influence in a positive, negative or neutral way the other benefits we get from forests. Here's your choice about what impact it can have to boost certain benefits we get from the forest over others. This impact could be positive, neither positive nor negative, or negative on the rest.

1. What effect do you think it can have to enhance greater use of wood in forests such as...?

	Positive	Neither positive nor negative	Negative	I don't know
1.Providing fuel sources				
2.Source of employment				
3.Protection of natural hazards (avalan s, floods...)				
4.Opportunities for leisure and spirituality				
5.Places for the conservation of animals and plants				
6.Places of great beauty				
7.Source of non-wood forest products (mushrooms, herbs, fruits)				
8.Clean water and air source				
9.Mitigate climate change through carbon absorption and storage				

2. What effect do you think it can haveto boost the **source of clean** air and water in forests like...?

	Positive	Neither positive nor negative	Negative	I don't know
1.Providing fuel sources				
2.Source of employment				
3.Protection of natural hazards (avalanche, floods...)				
4.Opportunities for leisure and spirituality				
5.Places for the conservation of animals and plants				
6.Places of great beauty				
7.Source of non-wood forest products (mushrooms, herbs, fruits)				
9. Mitigate climate change through carbon absorption and storage				
10. Provision of wood				

3. What effect do you think it can have to enhance the protection of **animals and plants** in forests such as...?

	Positive	Neither positive nor negative	Negative	I don't know
1.Providing fuel sources				
2.Source of employment				
3.Protection of natural hazards (avalanche, floods...)				
4.Opportunities for leisure and spirituality				
6.Places of great beauty				
7.Source of non-wood forest products (mushrooms, herbs, fruits)				
8.Clean water and air source				

9.Mitigate climate change through carbon absorption and storage				
10.Provision of wood				

4. What effect do you think it can have to enhance **opportunities for leisure and spirituality** in forests such as...?

	Positive	Neither positive nor negative	Negative	I don't know
1.Providing fuel sources				
2.Source of employment				
3.Protection of natural hazards (avalan s, floods...)				
5.Places for the conservation of animals and plants				
6.Places of great beauty				
7.Source of non-wood forest products (mushrooms, herbs, fruits)				
8.Clean water and air source				
9.Mitigate climate change through carbon absorption and storage				
10.Provision of wood				

5. What effect do you think it can have to boost the management of those to **fix and store carbon** in forests like...?

	Positive	Neither positive nor negative	Negative	I don't know
1.Providing fuel sources				
2.Source of employment				
3.Protection of natural hazards (avalan s, floods...)				
4.Opportunities for leisure and spirituality				
5.Places for the conservation of animals and plants				

6.Places of great beauty				
7.Source of non-wood forest products (mushrooms, herbs, fruits)				
8.Clean water and air source				
10.Provision of wood				

6. What effect do you think it can have to enhance protection against natural **disasters** in forests such as...?

	Positive	Neither positive nor negative	Negative	I don't know
1.Providing fuel sources				
2.Source of employment				
4.Opportunities for leisure and spirituality				
5.Places for the conservation of animals and plants				
6.Places of great beauty				
7.Source of non-wood forest products (mushrooms, herbs, fruits)				
8.Clean water and air source				
9.Mitigate climate change through carbon absorption and storage				
10.Provision of wood				

7. What effect do you think it can have to boost the **production of fuels (wood, biomass)** in forests such as...?

	Positive	Neither positive nor negative	Negative	I don't know
2.Source of employment				
3.Protection of natural hazards (avalan s, floods...)				
4.Opportunities for leisure and spirituality				

5.Places for the conservation of animals and plants				
6.Places of great beauty				
7.Source of non-wood forest products (mushrooms, herbs, fruits)				
8.Clean water and air source				
9.Mitigate climate change through carbon absorption and storage				
10.Provision of wood				

BLOC F: Priorities in forest management

Below, we would like to hear from you about your priority target(s) for the near forest you live to. Please distribute a total of 30 points among the following forest management objectives. Giving 10 points to an option means that, in your view, all management efforts should be concentrated on this objective (total priority). Giving 0 points to an option means that you do not consider it appropriate to invest human and economic resources in this objective (no priority). In the end, the total points spread across the 6 options has to add up to 30.

a. Conserving nature and biodiversity (e.g. dead wood, trees of different age and size, diverse composition)

0 No priority	1	2	3	4	5	6	7	8	9	10 Total priority	I don't know

b. Adaptation to climate change by fixing and storing carbon

0 No priority	1	2	3	4	5	6	7	8	9	10 Total priority	I don't know

c. Pgnawing opportunities for leisure (e.g. infrastructure, adequacy and road signage...)

0 No priority	1	2	3	4	5	6	7	8	9	10 Total priority	I don't know

d. Pgnaw products other than wood (e.g. mushrooms, berries, medicinal and aromatic herbs, cork)

0 No priority	1	2	3	4	5	6	7	8	9	10 Total priority	I don't know

e. Pwood spray (for construction as well as fuel or firewood)

0 No priority	1	2	3	4	5	6	7	8	9	10 Total priority	I don't know

f. I would focus on Protection against natural disasters (avalan s, fires...)

0 No priority	1	2	3	4	5	6	7	8	9	10 Total priority	I don't know

ADD SCORE OF ALL OPTIONS (IS IT EQUAL TO 30? : _____

1. Then, on the priority objective for the distant forests <u>to where you live, we ask you to distribute a total of thirty (30)</u> points among the following forest management objectives. Giving 10 points to an option means that, in your view, all management efforts should be concentrated on this objective (total priority). Giving 0 points to an option means that you do not consider it appropriate to invest human and economic resources in this objective (no priority). In the end, the total points spread across the 6 options has to add up to 30.

   a. Conserving nature and biodiversity (e.g. dead wood, trees of different age and size, diverse composition)

0 No priority	1	2	3	4	5	6	7	8	9	10 Total priority	I don't know

   b. Adaptation to climate change by fixing and storing carbon

0 No priority	1	2	3	4	5	6	7	8	9	10 Total priority	I don't know

   c. Provide opportunities for leisure (e.g. infrastructure, adequacy and road signage...)

0 No priority	1	2	3	4	5	6	7	8	9	10 Total priority	I don't know

d. Pgnaw products other than wood (e.g. mushrooms, berries, medicinal and aromatic herbs, cork)

0 No priority	1	2	3	4	5	6	7	8	9	10 Total priority	I don't know

e. Pwood spray (for construction as well as fuel or firewood)

0 No priority	1	2	3	4	5	6	7	8	9	10 Total priority	I don't know

f. Protection against natural disasters (avalan s, fires...)

0 No priority	1	2	3	4	5	6	7	8	9	10 Total priority	I don't know

ADD SCORE OF ALL OPTIONS (IS IT EQUAL TO 30?) : _____

BLOCK G: Knowledge and forest management

1. Do you own a forest?
   - Yes
   - No
2. Does anyone in your family own a forest?
   - Yes
   - No
3. Do you manage forests?
   - Yes
   - No
4. Do your studies have any relationship with forests?

0 Nothing	1	2	3	4	5	6	7	8	9	10 Completely

5. Does your job have any relationship with the woods?

0 Nothing	1	2	3	4	5	6	7	8	9	10 Completely

6. Do you have any knowledge of forest management in Catalonia?

0 Nothing	1	2	3	4	5	6	7	8	9	10 Completely

7. In your opinion, how important are the following aspects when making decisions affecting the forests of Catalonia?

	Very important	Relatively important	Unimportant	Nothing important
The knowledge and experience of public administration managers				
The knowledge and experience of forest owners				
The advice of forest scientists and technicians				
Public opinion				

8. In your opinion, the **decisions affecting public forests in Catalonia, would need to be made based on....** – point out only one statement.

- More based on the vision of Catalan society in general than on the opinion of local people
- Based both on the vision of the local people and on the opinion of Catalan society
- More based on the opinion of local people than on the vision of Catalan society in general

9. In your opinion, what is the importance of the following problems for the forests of Catalonia?

	Very important	Relatively important	Unimportant	Nothing important
The low productivity of forests				
The high risk of wildfire				
Habitat loss for native wildlife and plants				
Rural depopulation				
Pests (e.g. processionary)				
Urban pressure				
The development of leisure structures and communication routes				

The change from forest to agricultural use				
Erosion and climate change issues				
Pollution				
The poor political relevance of forests				
The disconnection of today's society with forests				
Lack of forest management aid				
The lack of markets				
The low price of wood in Catalonia				
Public ignorance of forest benefits				

10. In your opinion how important are the following measures to respond to the forest problems

	Very important	Relatively important	Unimportant	Nothing important
More regulations that favor sustainable forest management				
More regulations to ensure forest protection and biodiversity (e.g. Natura 2000)				
More forest management aid for fire prevention				
More resources in firefighting				
More compensation and private property subsidies to encourage sustainable forest management				
Custody Agreements: Property Contracts to Secure Forest Services				

Boosting the forestry industry and opening up new timber-based markets				
Promotion and marketing of forest products				
More forest planning (both on public and private farms)				
Provide technical support and train private property				
More tools for the resolution of social conflicts (different demands on the forest)				
Promoting citizen participation tools to decide the future of forests				
More environmental education and classrooms in the forest				
Promoting forest associationism				

BLOCK H: Human-Nature Relationships

1. Here is what kind of relationship you build with your natural environment. For example, there are people who consider the forest from an ecological point of view, while others put people at the center and how they can make proper use of natural resources. Therefore, point out the box that best represents your degree of agreement or disagreement in each statement:

	I totally agree	I agree	I'm not sure	Disagreeing	No agreement
We are approaching the population limit that the Earth is able to maintain					

Natural balance is strong enough to overcome the impacts of modern industrial nations					
Humans will end up learning enough about how nature works to be able to control it					
Humans are made to control nature					
If we continue as before, we will soon experience a great ecological catastrophe.					
Humans are severely abusing the environment					
Plantss and animals have the same right to exist as humans					
Humans have the right to modify the natural environment to meet their needs					
The balance of nature is very delicate and easily disturbing					
The Earth has many natural resources, we just need to learn how to develop them					
Earth is like a spacecraft with very limited capacity and resources					
Human naivety will ensure that we don't make the Earth uninhabitable					
Although we have special abilities, human beings continue to be subject to the laws of nature					
When humans interfere with nature, disastrous consequences often occur					
The so-called "ecological crisis" facing humanity has been greatly exaggerated					

BLOCK I: Information about respondent I

1. Please read the following statements, which describe different types of personalities, and indicate which statement you feel most identified with

	Totally like me	Like me	Somehow like me	A bit like me	Not like me.	Nothing like me
It's important to think about new ideas and be creative. I like to do things in my own way						
It's important to be rich. I want to have a lot of money and expensive things						
It is important that all the people of the world are treated equally. I think everyone should have the same opportunities in life						
It's important to show off your skills. I want people to admire what I do						
It is important to live in a safe environment. I avoid anything that could jeopardize my safety						
I like surprises and I'm always looking for new things to do. I think it's important to do a lot of different things in life						
I think people have to do what they're told. I think people should follow the rules at all times, even when there's no one watching						
It's important to listen to people who are different from me. Even when I disagree with them, I still try to understand them						
It's important to be humble and modest. I try not to draw attention						

Having a good time is important to me. I like to pamper myself						
It's important to make my own decisions about what I do. I like to be free and not depend on others						
It's very important to help the people around me. I want to take care of your well-being						
It's very important to succeed. I expect recognition for what I've achieved						
It is important for the government to secure my security against all threats. I want the state to be strong so that it can defend its citizens						
I'm looking for adventures and I like to take risks. I want to have an exciting life						
It's important that I always behave properly. I don't want to do anything that anyone says is wrong.						
It's important that others respect me. I want people to do what I say.						
It is important to be loyal to my friends. I want to dedicate myself to the people close to me						
I firmly believe that people should take care of nature. Environmental care is important to me						
I try to follow the customs inherited by my religion or my family						
I'm looking for all the possibilities I can to have fun.						

It's important to do things that give me pleasure						

BLOCK J: Information about respondent II

1. Where do you usually reside?
   - In a village or rural area (less than 10,000 inhabitants)
   - In a small city (between 10,001 and 100,000 inhabitants)
   - In a medium-sized city (between 100,001 and 500,000 inhabitants)
   - In a large city (more than 500000 inhabitants)

2. How many kms would you say the forest* is closest to where you live?
   _____ km (Prog: min.0 and max. 999km)
   ** Forest definition: surface covered with at least 20% of trees. There are many types of forest; for example, natural, coniferous or deciduous forests, next to a river, semi-natural forests, or planted forest. Everything is considered forest minus parks or urban gardens.*

3. What is your current occupation?
   1. Autonomous
   2. Hired
   3. Student
   4. Pensioner
   5. Unemployed
   6. Other/s

4. What level of education have you achieved?
   1. No studies (Unfinished Primary Studies)
   2. First Degree (School Certificate, EGB 1st stage, about 10 years old)
   3. Second Grade. 1st Cycle (School Graduate, or EGB 2nd stage, 1st and 2nd ESO-1st cycle- up to 14 years)
   4. Second Grade. 2nd Cycle (FP Io and II, Higher Baccalaureate, BUP, 3rd and 4th ESO (2nd cycle) COU, PREU, 1st and 2nd Baccalaureate, up to 18 years)
   5. Third Grade. 1st Cycle (Equivalent to Technical Engineer, 3 years, University Schools, Technical Engineers, Technical Architects, Experts, Teaching, ATS, University Diplomas, 3 Years of Career, Social Graduates, Social Assistants, etc.)
   6. Bachelor's degree, Bachelor's degree. 2nd Cycle (University, Higher Degrees, Faculties, Higher Technical Schools, etc.
   7. Third Degree (Master)
   8. Third grade (Doctoral)

5. How old are you? _____ years
6. What is your gender
   - Male
   - Female
   - Other
   - I'd rather not say it.

THANK YOU VERY MUCH FOR YOUR TIME AND EFFORT!!!