LOCAL BENEFITS OF THE ATLANTIC FOREST: EVIDENCES FROM RURAL COMMUNITIES IN SOUTHERN BRAZIL

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1. Introduction

The economic valuation of environmental goods and services has become an important tool used in environmental planning for more consistent analyses of the trade--offs expected from changes in land use and cover (DAILY *et al.*, 2009). Several methods have been developed to apply this at different scales (NAIDOO; RICKETTS, 2006; NELSON *et al.*, 2009; CARREÑO *et al*, 2012; GOLDSTEIN *et al.*, 2012). However, one criticism of these analyses is that they are essentially based on spatial and ecological data and disregard the values and perceptions of the communities that manage landscapes (POTSCHIN; HAINES-YOUNG, 2012). The inclusion of values and social perception in the process of valuation of environmental goods and services provided by natural and anthropogenic landscapes is considered a complementary strategy to these economic valuation studies (BROWN, 2013).

According to the Millennium Ecosystem Assessment (MEA) (AEM, 2005), incorporating the values and social perception of local communities into environmental planning promotes the empowerment of the communities and increases political support for defining investment priorities for maintaining ecosystem services and biodiversity conservation. Recent studies about the perception of rural communities, regarding the benefits and the environmental services provided by forests, cover different scales focusing on a bundle of services (RAYMOND *et al.*, 2009; MEIJAARD *et al.*, 2013) or only on a specific category (PLIENINGER *et al.*, 2013; ALLENDORF *et al.*, 2014). Studies about the environmental perception of urban or rural communities reveal the values, expectations and imagination derived from the relationships individuals have with their natural environment (HOEFFEL *et al.*, 2008; MARIN; OLIVEIRA; COMAR, 2003; PACHECO;

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SILVA, 2006). In turn, these relationships are influenced by the social, political, economic and cultural context of each subject (PETERSON, 1999; REDCLIFT, 1995).

The analysis of local communities' environmental perception has been applied in studies about the management and use of natural resources and in evaluations regarding the management of protected areas (LIU; OUYANG; MIAO, 2010; MCCLANAHAN *et al.*, 2014; RODRIGUES *et al.*, 2012; SILVA; LOPES, 2015; SINU; KENT; CHANDRASHEKARA, 2012). Del Rio & Oliveira (1996) think that considering how local communities perceive their environment can provide important information when making decisions at the political level. However, most institutions still develop sectorial actions and do not consider the vision of communities as social and ecological variables in constantly transforming landscapes (FOLKE *et al.*, 2011).

Environmental services have become a relatively common topic in the last decade in discussions about environmental conservation, especially after the Millennium Ecosystem Assessment (AEM, 2005). The MEA considers environmental services as the benefits that people obtain from ecosystems, classified as provisioning, regulating, supporting and cultural services. Tropical forests are among the most relevant biomes in relation to the provision of environmental services and are responsible for providing various ecosystem goods, such as food, medicinal plants, fuel, seed fibers, wood, and water. It is estimated that 300 million people depend directly on tropical forest resources (AEM, 2005). The level of dependence of these communities is highly variable, although there is a consensus that poorer populations tend to depend more on these resources. According to the FAO (2011), forest resources correspond, on average, to 30% of the income of populations in rural tropical areas. In poorer rural areas, this dependence can be higher, reaching up to 70% of the family income. Changes in the land cover in areas of tropical forest can significantly impact these communities (AEM, 2005; CHOMITZ *et al.*, 2007). Therefore, local communities' perception should be considered in studies that incorporate this variable.

The valuation of goods and services provided by forests may constitute an alternative in relation to command and control policy and to the creation of protected areas. Ecological corridors provide favorable situations for the implementation and promotion of this strategy because they cover large areas of private land and can potentially connect isolated forest fragments located in conservation units (AYRES *et al.*, 2005; MINISTÉRIO DO MEIO AMBIENTE, 2013). In addition, ecological corridors do not indemnify private areas and their planning should be done considering the participation of the local communities involved (AYRES *et al.,* 2005). The National System of Conservation Unities law defines ecological corridors as portions of natural or semi natural ecosystems that link conservation units to allow the gene flow, the movement of biota, species dispersal to recolonize degraded areas, and to maintain populations that demand larger areas for survival (BRASIL, 2000, p.9). Although the main objective is to increase the connectivity among forest fragments, most ecological corridors in Brazil have been planned and implemented under the premise of territorial management with objectives that go beyond improving landscape connectivity, such as maintaining environmental service provisioning, promoting sustainable use of natural resources, inter-institutional

cooperation and participative management. Nevertheless, implementing ecological corridors on a large scale is at least as difficult as creating conservation units, which means the involvement of local communities in these regions is fundamental to the success of this category of protected area.

Since the 2000s there has been an effort in Brazil to create ecological corridors in strategic areas for biodiversity conservation. Actually, the country has 24 ecological corridors distributed in different biomes (MINISTÉRIO DO MEIO AMBIENTE, 2013). For Santa Catarina State, 10% of the land is under this "protected area" category. The Chapecó Ecological Corridor (Chapecó EC), with approximately 500,000 hectares, is the largest corridor in the state and encompasses highly relevant areas for the conservation of mixed ombrophilous forest (MEDEIROS; SAVÍ; BRITO, 2005). The implementation of the Chapecó EC is being made with resources of the state government and the World Bank, through the Rural Santa Catarina Program (Programa Santa Catarina Rural), and includes payments for environmental services (FUNDAÇÃO DO MEIO AMBIENTE, 2009; ALARCON *et al.*, 2013). The history of land occupation associated with the economic cycles of exploration for natural resources has resulted in a region with wide socioeconomic and cultural diversity, which makes the implementation of this corridor based on the economic valuation of forest resources a major challenge. In this context, understanding the relationship landowners have with forest resources is fundamental to successfully implement this corridor over the long term.

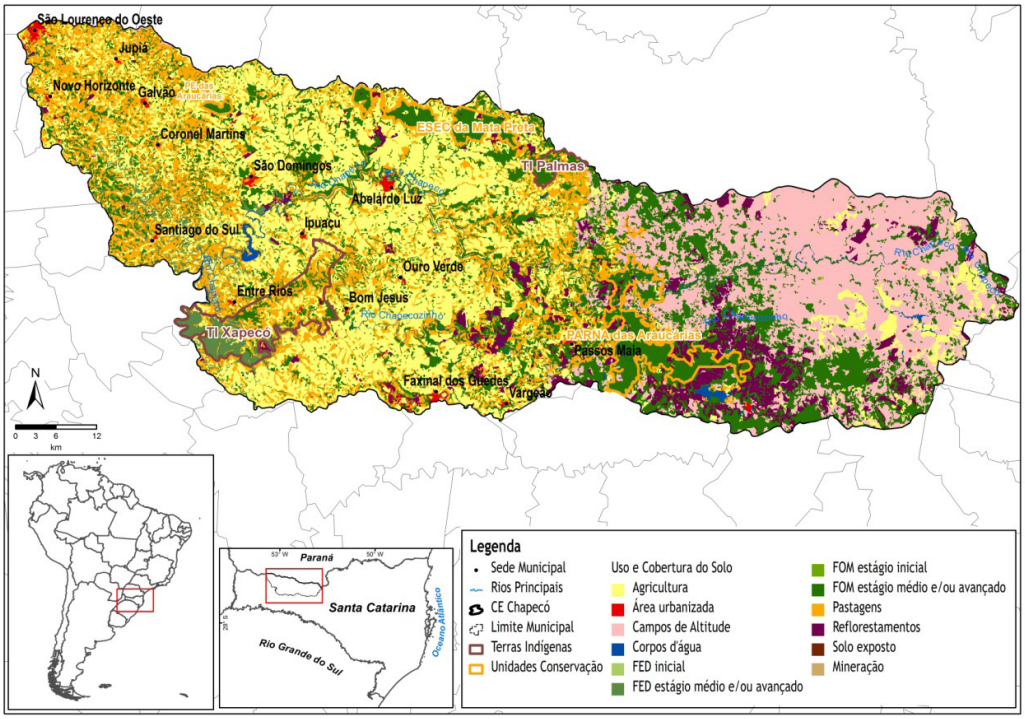
This study aimed to understand the relationship farmers have with the native forest located in the Chapecó EC. Two research questions guided this study: What are the environmental services provided by the native forest that are perceived by the rural landowners in the Chapecó EC? What factors influence the diversity of environmental services perceived, considering the different socioeconomic categories of the farmers? The analyses took into account the social, economic and cultural context of each interviewee through predetermined variables widely discussed in the literature (BLACKMORE; DOOLE, 2013; DOLISCA; MCDANIEL; TEETER, 2007; MEIJAARD *et al.*, 2013; ZANELLA; SCHLEYER; SPEELMAN, 2014). These variables were analyzed qualitatively and quantitatively using statistical models.

2. Method

2.1 *Study site*

The Chapecó EC is located in the western region of Santa Catarina Sate, in the original geographic center of the mixed ombrophilous forest ecosystem (also known as *Araucaria* forest). The boundaries of the corridor encompass the upstream sub-basin of the confluence of the Chapecó and Chapecozinho rivers, and totals 500 thousand hectares in 23 municipalities (Figure 1).

Figure 1: Chapecó Ecological Corridor location and the respective land use and land cover map.



Mixed ombrophilous forest is part of the Atlantic Forest biome, which is one of the World biodiversity hotspots (MYERS *et al.*, 2000). Among the ecosystems associated with this biome, mixed ombrophilous forest is the second largest and the third most fragmented, with less than 13% remaining (RIBEIRO *et al.*, 2009). In the state, the area with this forest ecosystem has only two federally protected areas, Araucárias National Park and the Mata Preta Ecological Station, which are both completely inside the Chapecó EC. Santa Catarina has only one state protected area with this forest type, Araucárias State Park, which is also entirely within the corridor. Two other ecosystems that are also very threatened occur in the Chapecó EC, deciduous forest and grassy-woody steppe (IBGE, 2004). Most of these fragments are small, isolated and located on private property (RIBEIRO *et al.*, 2009).

On the other hand, there are various agricultural activities in the area, which represent approximately half of the land use in the Chapecó EC. One of the greatest concentrations of pig and poultry production in the world is in this region (FAO, 2007). For Santa Catarina, the area of the corridor has some of the largest cattle and pig herds, as well as poultry flocks, and the highest dairy production (CEPA, 2010). The region also has the largest number of agrarian reform settlements in the state, totaling 2,500 families, and two indigenous areas with approximately 5,000 Kaingang, and to a lesser extent

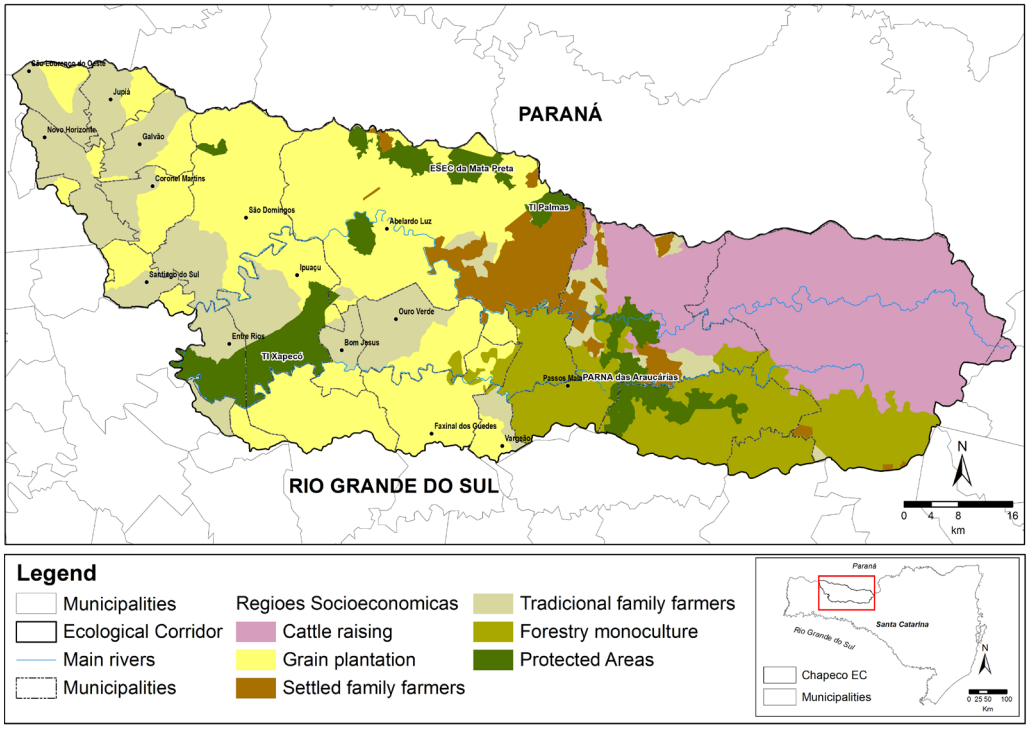
Guarani, which include more than 20,000 hectares (Diretoria de Assuntos Fundiários/ FUNAI, pers. com.).

2.2 Data survey

Structured interviews with questionnaires were conducted with 100 farmers, which were selected by socioeconomic region (SER). The SERs were determined during the preparation of the Chapecó EC Management Plan (Plano de Gestão do CE Chapecó, SOCIOAMBIENTAL CONSULTORES ASSOCIADOS, 2009). The following were among the variables used to delimit the SERs: predominance of land use type, predominance of farmers and farms socioeconomic characteristics, presence of rural outreach agencies assisting the area, and characteristic of the terrain.

These variables were combined resulting in a map of the socioeconomic regions that include the following: SER with predominance of traditional family farming; SER with predominance of family farming of agrarian reform settlements; SER with predominance of large-scale soybean farms; SER with predominance of large-scale livestock farms; and SER with predominance of silviculture farms with exotic species (Figure 2, Supplementary Material) (KARAM; PINTO, 2007).

Figure 02: Chapecó Ecological Corridor Socioeconomic regions, SC. Adapted from Karam & Pinto (2007).



Interview sampling was non-probabilistic. For each SER, 20 producers were interviewed. The interviewees were randomly chosen from a lists provided by the Secretary of Agriculture of the municipality and by COOPTRASC (Cooperativa de Trabalho e Extensão Rural Terra Viva) for family farmers in agrarian reform settlements. The number of interviewees was distributed proportionally among the municipalities within each SER. Only 21 municipalities, which includes more than 30% of the area in the Chapecó EC, were considered.

2.3 *Data analysis*

The difference between the profiles of the farmers by SER (age, education, income, farm size, forest area on the farm, proportion of forest on the farm, legal reserve) was tested using a multivariate analysis of variance (MANOVA) with the *manova* function in the *stats* package of the R language (R CORE TEAM, 2013).

The SERs were evaluated as an explanatory variable of the farmers' perception about the environmental services surveyed. The types of environmental services were quantified by the categories from the MEA (2005) and tested using a redundancy analysis using the *rda* function in the *vegan* package (OKSANEN *et al*., 2013) of the R language (R CORE TEAM, 2013).

The environmental services identified were grouped by category from the MEA (2005) and analyzed using descriptive statistics. The MEA categories (2005) considered were the following: provisioning services, supporting services, regulating services, and cultural services.

The characteristics of the farmers and their properties were evaluated as explanatory variables of the quantity of environmental services perceived. The contribution of these variables was estimated using generalized linear models (GLMs) and compared with model selection methods (BURNHAM; ANDERSON, 2002). The qualitative variable (SER) was coded as 0 and 1. Models with interactions between variables were also considered (Table 1).

The models that best explain the data were based on the second-order of corrected Akaike information criterion (AICc) (BURNHAM; ANDERSON, 2002). For all models, those with an AICc value that differed from the best model by more than two units (Δ AICc$>$ 2) were considered different (BURNHAM; ANDERSON, 2002). A corrected Akaike information criterion (AICc) was used because the sample size (n) was small in relation to the number of parameters (k) [n/K$<$ 40] (BURNHAM; ANDERSON, 2002). The models were created with the function *glm* of the *glmmML* package (BROSTRÖM; HOLMBERG, 2011) and grouped for comparison with the *aictab.glm* function from the AICcmodavg package (MAZEROLLE, 2013) in the R language (R CORE TEAM, 2013).

Farmers of the five SERs were grouped in two categories, family farmers and large-scale farmers, according to the Brazilian law. The difference in the use of forest resources by the farmers according to these categories was determined using the Mann-Whitney test, preceded by the Bartlet and Shapiro-Wilk tests to test the assumptions

Table 1. Explanatory variables for modelling farmers' perception of the environmental benefits provided by the native forest on rural properties in the Chapecó EC, SC.

Category	Variable	Description	Unit
Farmer characteristics	Age	Age of interviewee	Years
	Edu	Education	Years of study
	Teprop	Period of residence on the farm	Years
	Use	Forest resources used on the farm	N° of forest resources listed
	Income	Minimum income/month	US$
Farm characteristics	Taprop	Size (area) of the farm	Hectares
	afora	Professional activity outside the farm	1= yes 0= no
	Cop	Opportunity cost	Net income / hectare / year
	Mata	Size (area) of the forest on the farm	Hectares
	AF	SER with predominance of family farms	1= yes 0= no
	ASS	SER with predominance of family farms in agrarian reform settlement	1= yes 0= no
	GRA	SER with predominance of large-scale soybean farms	1= yes 0= no
	CORTE	SER with predominance of large-scale cattle farms	1= yes 0= no
	SILV	SER with predominate of silviculture	1= yes 0= no

SER – Socioeconomic Region

(ZAR, 2010). The analyses were made, respectively, with the *wilcox.test*, *barttlet.test* and *shapiro.test* functions in the *stats* package of the R language (R CORE TEAM, 2013). The farmers were also asked about access to forest resources and the data was analyzed using descriptive statistics.

3. Results

A relation was observed between the farmers' socioeconomic characteristics and the farms with the SER. Only the age and proportion of forest on the farmer variables were not significant with the SER (*Pillai* = 0.95; *g.l.* = 28 to 368; $p < 0.001$) (Table 2).

On the other hand, the SER variable was not very explanatory of the types of perceived environmental services by the interviewees, with a low adjusted coefficient of determination ($R^2 = 0.07$) even though the relationship was significant ($F = 2.013$; $g.l.=5$; $p = 0.02$).

The farmers listed 23 environmental services provided by the native forests. Provisioning environmental services were cited the most (43%), followed by regulating

Table 2. Farmers interviewed in 2011, in the Chapecó EC, according to socioeconomic region (SER). Values correspond to the average by SER. The column "declared legal reserve" shows the percentage of legal reserves per socioeconomic region.

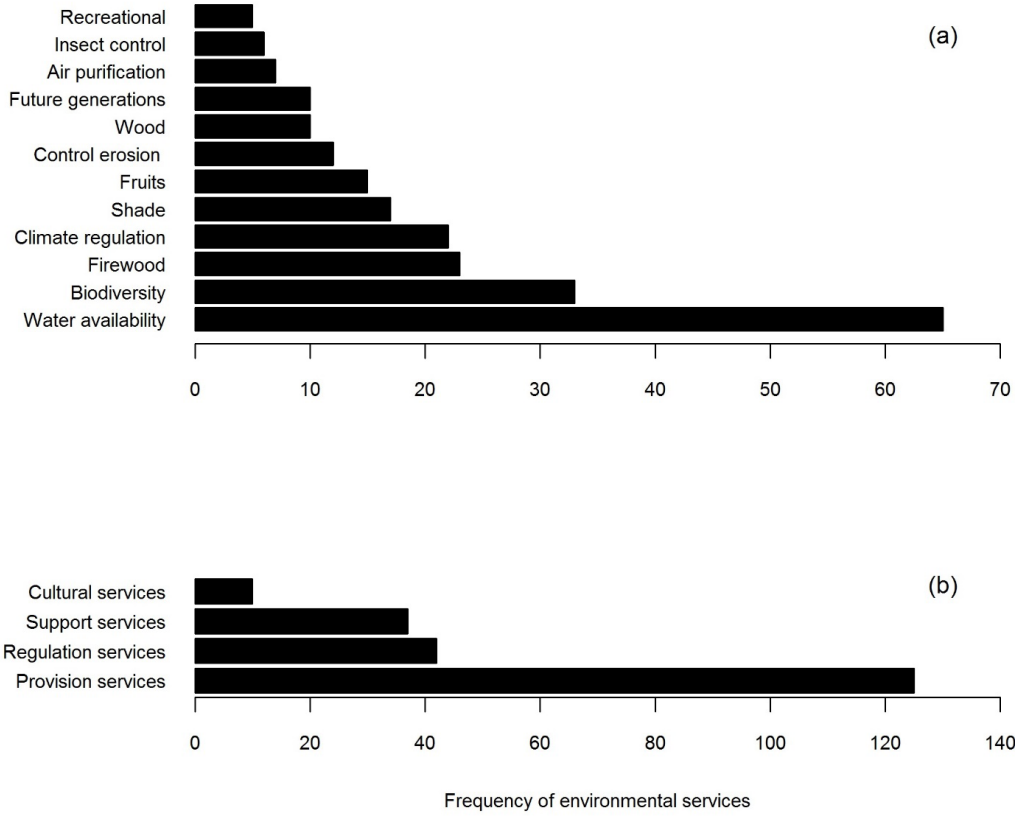
Socioeconomic Region	Education (years of study)	Age (years)	Income*	Property size (ha)	Area of forest (ha)	Percentage of forest on property	Declared legal reserve (%)
Family farming (traditional)	6	48	3	31	5.4	18	30
Family farming in agrarian reform settlements	4	45	2	14	3,0	21	100**
Large-scale cattle farm	11	54	13	368	106.1	27	55
Large-scale soybean farm	11	47	14	537	117.3	16	65
Silviculture	11	48	13	420	87.5	23	60

* Multiple of the minimum income/month in Brazil
**Declared legal reserve for the entire settlement and not by lot.

services (26%), cultural and aesthetic services (13%) and supporting services (4%). Seven farmers (7%) said that the forest does not provide any benefits to the farm (Figure 3a).

The quality and availability of water were the most frequently mentioned services (65%), followed by maintenance of habitat for biodiversity (34%). Firewood and wood used For other purposes were cited with a frequency of 23% and 8%, respectively. The temperature regulation service was mentioned by 20% of the farmers. Fruits, leaves and medicinal herbs were mentioned by less than 10% of the interviewees and only 3% considered that the native forest was a recreational space (Figure 3b).

Figure 3: Environmental services associated with the presence of native forest listed by the farmers interviewed in 2011 in the Chapecó Ecological Corridor, SC. a) Frequency of the types of environmental services. b) Frequency of environmental service based on the Millennium Ecosystem Assessment categories (AEM, 2005).



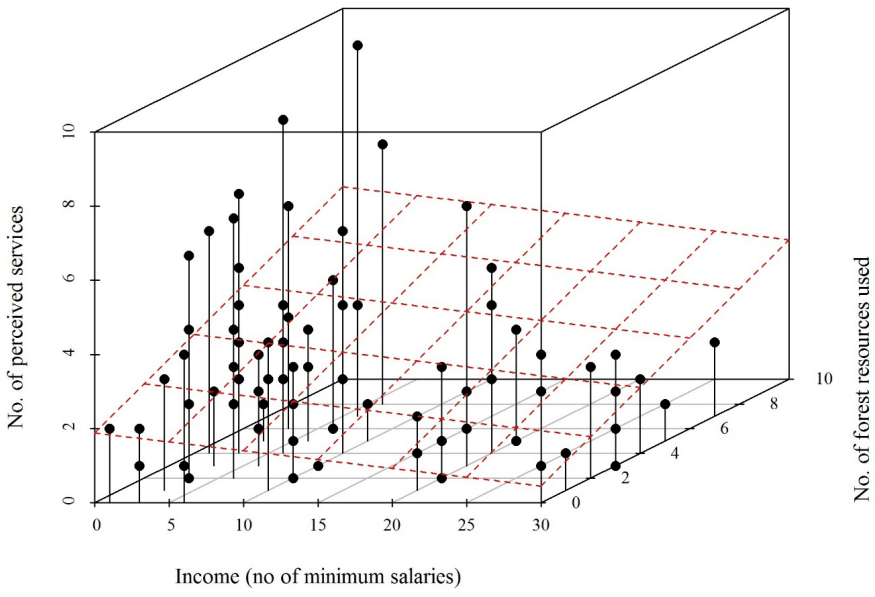
Income and use of forest resources were the variables with the most weight in the model selection (> 78% weight) (Table 3). The best models were composed of income, use and the respective interactions between these variables (AICc>2) (Table 3). The use of forest resources and income had different sizes of effect and signals (regression coefficient [b]) in relation to the number of environmental services identified; the first was directly ($b_{recursos}$ = 0.33 ± 0.09, g.l.=97, t=3.74, p<0.01) and the second was indirectly (b_{renda} = -0.047± 0.02, g.l.=97, t= -2.62, p<0.05) proportional. That is, the larger the number of resources used and the smaller the income, the larger the number of perceived environmental services (Figure 4).

Table 3: Summary of the model selection of variables that influenced the perception of the farmers about the benefits provided by native forests.

Models	k	AICc	Δ AICc	AICcWt	LL
Servicos~renda+uso	4	390.80	0	0.49	-191.19
Servicos ~renda+ uso +renda* uso	5	391.85	1.05	0.29	-190.60
Servicos ~AF+ASS+GRA+CORTE+renda+ uso	8	394.26	3.46	0.09	-188.34
Servicos ~AF+ASS+GRA+CORTE+ uso	7	394.35	3.56	0.08	-189.57
Servicos ~ uso	3	395.47	4.68	0.05	-194.61
Servicos ~renda	3	402.10	11.30	0.00	-197.93
Modelo~global	14	405.13	14.33	0.00	-186.10
Servicos ~AF+ASS+GRA+CORTE	6	407.08	16.29	0.00	-197.09
Servicos ~taprop	3	408.91	18.11	0.00	-201.33
Servicos ~mata	3	409.62	18.82	0.00	-201.69
Servicos ~cop	3	410.44	193.64	0.00	-202.10
Servicos ~esc	3	410.55	19.75	0.00	-202.15
Servicos ~afora	3	410.56	19.76	0.00	-202.16
Servicos ~teprop	3	410.87	20.07	0.00	-202.31

Note: Model Selection by the corrected Akaike information criterion (AICc): number of parameters (K); difference in relation to lower AICc value (Δ AICc); weight of AICc for each model (AICcWt); natural logarithm of the likelihood (LL). The global model includes all variables.

Figure 4. Number of perceived environmental services in relation to the number of forest resources used and the income of the farmers in the Chapecó Ecological Corridor, Santa Catarina, Brazil.



In total, the farmers interviewed declared that they used 11 wood and non-wood forest products. Water was the most frequently used resource, for animal (78%) and human (55%) consumption. Among the wood products, firewood was in first place (68%), followed by wood used for other purposes (25%). Among the non-wood products, there was native *erva-mate* (40%), fruits (30%), *pinhão* (30%) and bee honey (20%). Fodder, shade and medicinal herbs were mentioned with a frequency of less than 5%.

Regarding the use of forest resources, it was found that family farmers used more resources than large-scale farmers ($W = 1428$, $p < 0.01$). Eighty percent of the interviewees confirmed they had some type of difficulty accessing forest resources on the farms. Among the difficulties, environmental agencies prohibiting access was the most frequently mentioned cause by the interviewees, followed by excessive bureaucracy required to liberate the use of the resources and the restrictions specifically imposed on forest management.

4. Discussion

Socioeconomic characteristics of farmers and farms

The Chapecó EC comprises a diversity of types of farmers and farms, however they seem to be concentrated in certain areas based on the SER, which was expected. In this sense, defining SERs as a socio-environmental zoning strategy to plan actions for the implementation of the Chapecó EC was relevant, as observed for other protected areas in Brazil (SANTOS; RANIERI, 2013). However, the present study demonstrated that actions related to the valuation of environmental services provided by native forest should not be developed with a specific focus on SER categories because the farmers interviewed demonstrated a certain view about the benefits of the forests independent of the SER where they lived.

The homogeneity in the perception about the environmental services among the SERs studied reflects the relatively narrow vision of the interviewees about the diversity of environmental services the native forests provide. Even though a total of 23 environmental services were mentioned by the interviewees, the average number of services mentioned per farmer was 2.6. This situation was also observed by Martín-López *et al.* (2012), who did not encounter a significant difference between the set of environmental services recognized by rural populations in different regions of Spain. Most studies that evaluated the perception of environmental services have focused on different social groups in relation to rural verses urban (KROLL *et al.*, 2012; MARTÍN-LÓPEZ *et al.*, 2012)or the spatial distribution of interviewees in relation to protected areas (DOLISCA; MCDANIEL; TEETER, 2007; FAGERHOLM *et al.*, 2012; MUHAMAD *et al.*, 2014). Studies that evaluated the perception of the benefits of forests, considering socioeconomic groups in rural environments, were not found. In the case of the Chapecó EC, the socioeconomic differences found in the SERs did not influence the views of the farmers about the benefits of the native forests.

Perceptions of goods and services of native forests

The predominance of provisioning environmental services among those mentioned by the interviewees was expected (FAGERHOLM *et al.*, 2012; MUHAMAD *et al.*, 2014). Generally, provisioning services provided by native forests are important for the maintenance of farms themselves and the farmers social reproduction in rural areas, and at the same time can generate sporadic or continuous income (SUNDERLIN *et al.*, 2005).

In our study, the provision of water was very relevant to the interviewees, in that many of them depended on river water and springs, protected by the forests, for human and animal consumption. Nevertheless, the importance attributed to the provision of water did not influence the farmers' attitude in relation to the conservation of riparian forests, which can be explained by the fact that less than 50% of the rivers and springs in the Chapecó EC are covered by native vegetation (ALARCON, 2013). A similar result was observed by Silvano *et al.* (2005) in the state of Rio de Janeiro. Although firewood is an extremely relevant forest benefit to rural populations, especially in developing countries (GODOY *et al.*, 2002; VEDELD *et al.*, 2007; MEIJAARD *et al.*, 2013), in our study firewood was mentioned as a forest environmental service by less than a third of the interviewees. This fact could be associated with the low use of this resource that could, in turn, lead to a lower level of perception of its importance. However, firewood was the second most used forest resource (68%), which evidences a difference between perception and use.

Provisioning services, such as fruits, leaves and medicinal herbs, were also expected to be mentioned more frequently because of the high diversity of native species with potential food and medicinal uses in the South Region of Brazil (CORADIN *et al.*, 2011). According to Justen (2012), only a small portion of the farmers interviewed in the Forest Inventory of Santa Catarina (Inventário Florístico Florestal de Santa Catarina) used native plants for food and medicine.

Several studies related the low recognition of these services as forest benefits to the loss of ecological knowledge by new generations of farmers (ZUCHIWSCHI *et al.*, 2010; SIMINSKI *et al.*, 2011; JUSTEN *et al.*, 2012; MEIJAARD *et al.*, 2013; ALLENDORF *et al.*, 2014) and to the predominance of communities with greater access to infrastructure that use more processed or purchased commercial products in urban areas (GODOY *et al.*, 2002; ABRAM *et al.*, 2013).

The two conditions apply to the Chapecó EC. The prohibition of the use of forest resources, considered as a loss factor of ecological knowledge to the new generations, was one of the main reasons listed by the interviewees for the difficulty in accessing forest resources. As for urbanization, despite some of the more remote areas, in general the study area has a good infrastructure of roads and diverse urban centers (11 municipal centers). Nonetheless, there is a large potential for the rational use of these resources, which could be the subject of environmental education or rural outreach actions aimed at connecting rural communities with forest provisioning services (FOLKE *et al.*, 2011).

Supporting services are generally highlighted less in studies about the perception of environmental services by rural communities (FAGERHOLM *et al.*, 2012; MARTÍN-

-LÓPEZ *et al.*, 2012; MUHAMAD *et al.*, 2014; RAYMOND *et al.*, 2009). Habitat for biodiversity was the only environmental service listed by the interviewees in this category. Only a third of the interviewees related the forest to maintenance of habitat for plants and animals. Muhamad *et al.* (2014) encountered a similar proportion in a study conducted in rural communities in Indonesia. According to these authors and Fagerholm *et al.* (2012), the proximity of forests constitutes a determining factor of the diversity of perceived environmental services, especially indirect services. In our study, 96% of the interviewees had native forest fragments on their properties, with proportions that varied between 4% and 70%. Although the forest fragments were under different levels of intervention and degradation, legal restrictions of the use of the fauna and flora may reflect the low perception of this environmental service.

Regulating services were the second most cited service type by the interviewees, notably temperature regulation. Although provisioning services are recognized more often by rural communities, some studies have reported regulating services more than other categories (MARTÍN-LÓPEZ *et al.*, 2012; MEIJAARD *et al.*, 2013; SODHI *et al.*, 2010). The perception of the role of forests in the regulation of the microclimate has been the subject of many studies, especially with the intention to subsidize actions of climate change adaptation (BECKEN; LAMA; ESPINER, 2013; BLENNOW, 2012; HARTTER *et al.*, 2012). In the last decade, higher temperatures during the summer and periods of intense drought in western Santa Catarina have influenced local farming practices (ALVEZ *et al.*, 2013; BALBINO *et al.*, 2011; WENDLING, 2012). In the case of the Chapecó EC, it would be interesting to understand if improved perception about the importance of forests in the regulation of climate would result in actions of use and management of the land that could lead to forest conservation within the agricultural establishments.

Only three interviewees listed the forest as a recreational space and no one listed other cultural or spiritual relationships. This behavior could be related to the landscape, which lacks infrastructure, such as access trails, lookouts, areas to eat and clean water (PLIENINGER *et al.*, 2013). In addition, most of the forest areas are private and the use by a third party requires permission. The areas of forest in the protected areas still lack the infrastructure for tourism (DICK *et al.*, 2009; APREMAVI, 2010) and the water quality around the few recreational areas with public access on the Chapecó and Chapecozinho rivers is poor (MPB ENGENHARIA, 2009).

Factors influencing the perception about environmental services and the use of forest resources

In the last decade, there has been an increase in the number of studies dedicated to understanding what factors explain the types and the diversity of environmental services perceived by urban and rural communities, especially in relation to native forest remnants. Factors such as gender, age, education, income, proximity to areas of forest, religion and cultural characteristics have demonstrated to be determinants in perception about services provided by native forests (ABRAM *et al.*, 2013; DOLISCA; MCDANIEL;

TEETER, 2007; FAGERHOLM *et al.*, 2012; MARTÍN-LÓPEZ *et al.*, 2012; MEIJAARD *et al.*, 2013; MUHAMAD *et al.*, 2014).

The variables that best explained the number of perceived services were income and the number of forest resources used. The proportional inverse relationship between income and perception about benefits of native forests has also been found in other studies (BABULO *et al.*, 2009; CHOMITZ *et al.*, 2007; DOLISCA; MCDANIEL; TEETER, 2007; GODOY *et al.*, 2002). Vedeld *et al.* (2007) analyzed 51 case studies and found that poorer rural farmers depended more on forest products compared to richer farmers and, therefore, tended to equally value them more. Moreover, Poppenborg & Koellner (2013) observed that farmers with more infrastructure and higher incomes were more aware of maintaining the provision of environmental services. However, Poppenborg & Koellner (2013) evaluated the level of awareness regarding the provision of environmental services considering their attitudes towards the types of planting techniques used. In the Chapecó EC, most family farmers were poorer and used forest resources more than large-scale farmers.

Some studies point to age as a relevant factor in the perception of environmental services, revealing that older farmers tend to perceive more services than younger ones (DOLISCA; MCDANIEL; TEETER, 2007; SODHI *et al.*, 2010). In the case of the Chapecó EC, the age of the interviewees had little variation and this variable had a low weight in the model selection. In relation to gender, even though some authors have found this to be important, in our study only three interviewees were women, which made this variable not useful. Similarly, religion was not included as an explanatory variable of the perception of farmers in the model selection because all of the interviewees were Christians.

The proximity of native forest remnants was identified as an important variable in studies by Dolisca, Mcdaniel and Teeter (2007), Fagerholm *et al.* (2012) and Muhamad *et al.* (2014). We tried to capture the importance of the presence of forests by considering the percentage of remnants on each farm. However, although this percentage varied significantly among the SERs and, consequently, among the farms, the presence of forest was not an important variable.

Finally, no studies were found that evaluated the number of resources used as an explanatory variable about the perception of environmental services provided by forests. Nevertheless, several authors highlighted the use of forest resources as an important factor in the maintenance of livelihoods and social reproduction of families in rural areas (ADAMS, 2000; HANAZAKI, 2003; SIMINSKI; FANTINI, 2010; SIMINSKI *et al.*, 2011). In addition, studies differ significantly and suggest two trends: use leading to the overexploitation and exhaustion of resources (REDFORD, 1992; TABARELLI *et al.*, 2005); and use leading to a conflict of interest that, in turn, results in the development of a community management process where the resources are managed over the long term (HANAZAKI, 2003; OSTROM, 2005). This topic is not part of the scope of this work, although the results of the present study point to the fact that use may influence conservation because it can lead to greater awareness of the benefits of forests.

The results of our study suggest that only one out of three people using a forest resource perceives it as a forest benefit. This clearly demonstrates that perceiving envi-

ronmental services provided by native forests can be difficult, even when they are used intensely, such as firewood, *erva-mate*, *pinhão*, honey and possibly wood for different uses. Some authors highlighted the fact that education influences the perception of environmental services, especially in relation to the diversity of the types of services perceived (direct or indirect, such as regulating and supporting) (DOLISCA; MCDANIEL; TEETER, 2007; SODHI *et al*., 2010). However, this was not an important variable in the model selection. Probably, this relationship reflects the lack of appreciation of the native forest, which we observed for many of the farmers interviewed. For example, in the Chapecó EC there were various conflicts around the protected areas (PAs) that were recently created in the region (MEDEIROS; SAVÍ; BRITO, 2005). The process of creating these PAs, associated with the intensification of environmental enforcement in the last decades and discussions about the Forest Act (Código Florestal), have resulted in some farmers with negative views in relation to native forest (ALARCON; DA-RÉ; RAMPINELLI, 2011), which might have been reflected in the responses of the interviewees. Nevertheless, the implementation of the Forest Act is resulting in the conversion of farmed areas for forest regeneration along the margins of streams and rivers. As most properties in the region have rich hydrography (MPB ENGENHARIA, 2009), there was a general expectation of economic loss because of environmental conservation. This fact, in association with the agricultural practices fostered in the region and the low prices of the forest products in the local and regional markets, probably influenced the indifference and even unwillingness of the farmers to see the benefits of these forests.

The use of forest resources could improve the perception about the benefits of forests as farmers realize that no control could lead to forest degradation (VIBRANS *et al.*, 2012). However, what is happening in Santa Catarina and a large part of the Atlantic Forest region is a vicious cycle where secondary forest remnants, many of which are degraded, are not enriched, managed or exploited because of limitations imposed by Brazilian environmental legislation (SIMINSKI, FANTINI, 2007, 2010; ZUCHIWSCKI *et al.*, 2010; SIMINSKI *et al*., 2011). Supposedly, the goal of the legal restrictions imposed by the Forest Act, the Atlantic Forest Law (Lei da Mata Atlântica) and other regulations was to prevent forest remnants from becoming further degraded or replaced by more profitable land uses. Conversely, the possible achievements of these command and control policies have resulted in a notorious widespread sentiment of repulsion to native forests because the use of native forest resources has become expensive and bureaucratic (ALARCON; BELTRAME; KARAM, 2010; SIMINSKI *et al*., 2011; ZUCHIWSCHI *et al.*, 2010). In this context, these conservation measures might be degrading the relationship of the farmers with the forest resources and, consequently, their perception about the immense range of benefits that forests provide for free.

5. Conclusions

The results of this study suggested that the farmers in the Chapecó EC, independent of their socioeconomic characteristics, predominantly perceive few environmental services provided by forests. Provisioning services appeared to be the most important benefits; however, with exception to water they are underused. The availability and quality of water was the most important environmental service, indicating that the farmers recognize the role of the forest in this provision. In this sense, conservation efforts in the Chapecó EC should include strategies related to maintaining the quality and availability of water.

The disclosure of the diverse services provided by the native forest is fundamental to their valorization. In particular, encouraging the valorization of cultural services should be a priority because this could give the rural communities in the Chapecó EC new perspectives about native forest.

Income and use of forest resources were the factors that best explained the perception of the environmental services provided by the forests. However, difficulty in accessing these resources was one of the main threats to the valorization of the forest in the Chapecó EC by the rural communities studied. There is a great potential for the rational use of these resources, which could be the subject of environmental education and rural outreach actions aimed at connecting rural communities with the forest environmental services.

Finally, any intervention to implement the Chapecó EC should work with the valorization of the native forests so there is an awareness about their important role in maintaining rural properties and the conservation of the entire watershed over the long term.

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LOCAL BENEFITS OF THE ATLANTIC FOREST: EVIDENCES FROM RURAL COMMUNITIES IN SOUTHERN BRAZIL

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***Abstract*:** Environmental services provided by forests are essential to the social reproduction of populations in rural areas. Perceptions about the services provided by forests play an important role in the planning of landscapes; however, few studies have investigated this issue. This study aimed at understanding how farmers perceive the role of forests in maintaining environmental services. One hundred farmers from the Chapecó Ecological Corridor – SC were interviewed. Provisioning and regulating services were mentioned most often. Water availability ranked first (65%), followed by the maintenance of habitat for biodiversity (34%) and firewood (23%). Income and local use of forest resources were the variables that best explained farmers' perceptions of forest benefits. Nevertheless, the use of forest resources has been limited by restrictions imposed by environmental legislation, which is affecting the perception of farmers about the wide range of environmental services provided by forests.

Keywords: environmental perception, environmental services, forests, farmers, environmental legislation

***Resumo*:** Os serviços ambientais providos pelas formações florestais são fundamentais para a reprodução social das populações do meio rural. A percepção destas populações sobre os serviços providos pelas florestas tem fornecido subsídios para o planejamento de paisagens. No entanto, poucos trabalhos se dedicam a investigar este tema. Este estudo teve como objetivo compreender como produtores rurais percebem o papel da floresta na manutenção de serviços ambientais. Foram aplicados questionários com 100 produtores rurais do Corredor Ecológico Chapecó -SC. Serviços de provisão e regulação foram mencionados com maior frequência. Disponibilidade hídrica ocupou o primeiro lugar (65%), seguido pela manutenção de hábitat (34%) e lenha (23%). A renda e o uso de recursos florestais foram as variáveis que melhor explicaram a percepção dos produtores sobre os benefícios da floresta. Contudo, o uso de recursos florestais tem sido limitado pela legislação ambiental, afetando sua percepção sobre os serviços providos pelas formações florestais.

Palavras-chave: percepção ambiental, serviços ambientais, florestas, produtores rurais, legislação ambiental

Resumen: Los servicios ambientales providos por los bosques son fundamentales para la reproducción social de poblaciones rurales. Su percepción acerca de estos servicios ha proporcionado subsidios para la planificación del paisaje. Sin embargo, pocos trabajos se dedican a investigar este tema. Este estudio tuvo como objetivo comprender cómo agricultores perciben el papel de los bosques para los servicios ambientales. Fueron aplicados encuestas con 100 agricultores en el Corredor Ecológico Chapecó - SC. Servicios de provisión y regulación se mencionaron con mayor frecuencia. La disponibilidad de agua ocupo el primer lugar (65%), seguido por la provisión del hábitat (34%) y leña (23%). La renta y el uso de los recursos forestales fueron las variables que explican mejor la percepción de los agricultores sobre los beneficios de los bosques. Sin embargo, el uso de recursos forestales se ha visto limitado por la legislación, afectando su percepción acerca de los servicios ambientales.

Palabra clave: percepción ambiental, servicios ambientales, bosques, agricultores, legislación ambiental