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Can multifunctional livelihoods including recreational ecosystem services (RES) and non timber forest products (NTFP) maintain biodiverse forests in the Brazilian Amazon?

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ABSTRACT

In this paper we use large scale spatially explicit modelling and case study based analyses to assess the links between recreational ecosystem services and the benefits for wellbeing of traditional livelihoods in the Brazilian Amazon. Our results show that, at the scale of the Brazilian Amazon, associations between recreational ecosystem services and extractivist activities of Brazil nut and rubber are very weak with no significant differences regarding Brazil nut ($p = 0.61$) and rubber ($p = 0.41$) income across the different tourism development classes. However, qualitative analysis of the case studies reveals that where there are multifunctional livelihoods, recreational ecosystem services are indeed helping to enhance non timber forest product extractivist social values that otherwise would be suppressed by prevailing "cattle ranching" lifestyles. We therefore support innovative ways to make both recreational ecosystem services and non timber forest products extraction not merely a juxtaposition of activities, but integrated into multifunctional livelihoods.

1. Introduction

Although there has been considerable effort to map and value ecosystem services from the Amazon, such as carbon, biodiversity, and water regulation services, the contribution of recreational ecosystems services (RES) has not received so much attention (Balvanera et al., 2012). There is, however, a widespread belief that carefully planned RES, if related to the natural, cultural and social significance of Amazon forests, are indeed important both for those

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undertaking recreation experiences in the biggest tropical forest in the world, and for the wellbeing of the traditional communities living in the Amazon. RES are able to develop local eco-socio-economies and socio-productive arrangements with the potential to contribute to the sustainable development of the Amazon (Sampaio, 2005). Challenging this widespread belief, Hoefle (2016) argued that there is little potential for tourism to foster multifunctional livelihoods, and consequently concluded that "tourism will not save the Amazon forests". However, we argue that the linkages among the extractivist activities associated with non timber forest products (NTFP) and RES particularly in the form of community based tourism (CBT) still need to be fully addressed, explored and mapped. There is thus a need for examining cases where there is (or where not) a multifunctional link across those two activities in the diversity of socio ecological systems in the Brazilian Amazon.

The Amazon forest is well known for its hostile environment, humidity, plagues and diseases that hinder tourism development and the consequent capturing of RES. The Amazon is also a hotspot of biodiversity, holding rich cultural heritage, which can provide unique recreational opportunities. For example, ecotourism has proved successful in Madre de Dios Department of Peru (Kirkby et al., 2010). A body of research has shown that a niche of medium to high class tourists are looking for leisure experiences not only associated with "nature". Critically they also seek contact with traditional communities, aiming at "absorbing" local cultures, eating local food, and experiencing locally-produced knowledge and traditions (Sampaio and Coriolano, 2009; Sampaio, 2005). Community based tourism (CBT) is able to provide such recreational experiences. CBT has evolved from well-known tourism experiences such as cultural tourism, ethnotourism, ecotourism and agrotourism (Sampaio and Coriolano, 2009; Sampaio, 2005). What distinguishes CBT from other types of tourism is that in CBT "entrepreneurs" are people inspired by communitarian ideologies. According to Brazilian Law[1], traditional communities include indigenous tribes, "quilombolas", extractivists, and small agroforestry farmers. In Brazil, there are about 234 indigenous groups encompassing over 605,518 families occupying an approximate area of 106 million ha, plus 54 000 extractivist families living in 12 million ha of extractive reserves (MMA, 2009).

For centuries, these traditional communities have used and traded raw materials from the surrounding forests as part of their livelihoods (Levis et al., 2017; Scoles and Gribel, 2015). Extractivist landscapes can offer tourists a diversified portfolio of "local" food and drinks, of which the anti-oxidant açai, the revigorating cupuaçu and guaraná, and the exquisite Amazon fish pirarucu are but few examples. In addition, the Amazon's cultural traditions provide an important contribution to RES. Appreciating particular cultural experiences, such as sensing the landscape identity of different socio-cultural groups (e.g. rubber tappers), as an element of traditional ecological knowledge of the Amazon forest (Gomes, 2009; Gomes et al., 2012) is one example here. Amazonian mythologies, such as listening to the legendary story of the pink dolphin "boto" believed to be the father of all single mothers' children, or the particular visions of the Santo Daime sect in Acre, are important learning experiences for tourists and native peoples alike. NTFP extractivist activities and RES, particularly CBT, can therefore contribute to the multifunctional use of native forests. These synergies link provisioning (collection of NTFP) and cultural (landscape identity, recreation) ecosystem services (ES). As such, they are not a juxtaposition of activities that occur in parallel (Hoefle, 2016). They need to be explored as a basis for multifunctional livelihoods.

Despite decades of analyses regarding the role of NTFP in sustaining traditional livelihoods, as well as in reducing deforestation, controversies as to their viability remain (Hecht, 2013; Homma, 2008; Humphries et al., 2012; Peters et al., 1989). Traditional extractivist activities, such as rubber tapping, have been discontinued or are progressively declining (Gomes et al., 2012; Hecht, 2013; Jaramillo-Giraldo et al., 2017). To enhance livelihoods associated with NTFP, the primary policy lies in incentivising product market chains. The "products" of extractivist landscapes are regarded in Brazil as outputs of sociobiodiversity (MMA, 2009). The problem is that, even though government guarantees a minimum price for these products, in some areas there is no market (no traders of NTFP). To make matters worse, the market prices offered at the international "commodity" market do not reward extractivists either economically or socially, as there are still unbalanced power relations in the market chains of NTFP (Hecht, 2013). Furthermore, the services provided by non-market cultural attributes, as well as traditional ecological knowledge have not yet being properly valued and included into decision making. Even with support from public policies, the values from NTFP extractivist activities have been decreasing. As a result, a cattle ranching "ideology" has prevailed, profoundly transforming traditional Amazon livelihoods (Gomes, 2009; Gomes et al., 2012). The cattle ranching lifestyle, which generates higher rents, is culturally entrenched in the frontier regions of the Brazilian Amazon (Bowman et al., 2012) (average annual rents per ha of cattle ranching, intensive and extensive systems, range from USD 80 to USD 500, respectively see http://csr.ufmg.br/pecuaria/pdf/contexto.pdf (accessed February 2018)) .

So far, little attempt has been made to find viable solutions for valuing NTFP traditional livelihoods, limiting the scope for assessing one of the most prominent land use issues in the tropics. The conundrum is how to reconcile socio economic development with forest conservation. Creating synergies between RES and NTFP extractivist activities could promote this agenda. RES and extractivist activities build upon the natural and cultural qualities that are intrinsic to the core, biodiverse, Amazon forest.

Initiatives to promote ecotourism (associated with experiences in the wild), CBT-community based tourism (associated with involvement of tourists in activities of daily lives of communities) and community tourism (providing knowledge on local livelihoods but not embedding tourists into indigenous life styles) in the Amazon have expanded over the past 20 years, involving an increasing number of forest families (Section 3.2). Acquiring meaningful values for these services is problematic because data on RES and tourism development initiatives is scattered across different institutions. Mapping productivity and rents associated with extractivist livelihoods also face similar difficulties. In order to fill in this gap, our study provides both i) a global overview of tourism and extractivist dynamics in the Brazilian Amazon, and ii) a comprehensive review of the relevant case study literature exploring the links between RES and the benefits for human wellbeing in NTFP extractivist landscapes also in the Brazilian Amazon. Our major research questions are:

1. How much are RES/tourism and extractivist activities of rubber and Brazil nut geographically differentiated across the Brazilian Amazon?
2. Are there significant differences between the rents of Brazil nut and rubber across the different types RES/tourism classes?
3. What evidence do we have about the links between RES/tourism and the benefits for human wellbeing in NTFP extractivist landscapes in Brazilian Amazon?

[1] Programa Nacional de Desenvolvimento Sustentável dos Povos e Comunidades Tradicionais (PNPCT) N 6040, 7 Fevereiro 2007.

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2. Methods

Our methodology comprised a broad scale assessment of the RES/tourism and NTFP extractivist activities in the Brazilian Amazon (2.1) followed by a comprehensive review of case study evidence (2.2). Because recreational activities in the Amazon and their associated recreational ecosystem services (RES) are linked to overnight stays we used the concepts of RES and tourism similarly although we are aware they are conceptually different.

2.1. Associations between RES and NTFP extractivist activities

We compiled data available on RES (Section 2.1.1) and on NTFP extractivist activities (2.1.2) in the Brazilian Amazon. We then used spatially explicit modelling for estimating rents or net incomes of these activities, and we conducted statistical analyses to explore whether or not there were associations between tourism categories and income of NTFPs for the whole area of the Brazilian Amazon.

2.1.1. Spatially explicit assessment of the role of tourism in the Brazilian Amazon

We compiled tourism legislation (S1) and available data at the biome scale. We found that there is no data available as to the different types of tourism and we could not, at the biome scale, distinguish between CBT and other tourism segments. We therefore used two main sources to collect data on (undifferentiated) tourism initiatives in the Amazon. The first was the Map of the Brazilian Tourist Regions (http://www.mapa.turismo.gov.br/mapa/) (accessed January 2018), made available by the Ministry of Tourism (MTUR, 2016). This dataset contains information by municipality on tourism according to three variables: number of lodging establishments; number of formal jobs in the hospitality sector, and tourism demand (both national and international). The categorization is composed of five classes (A, B, C, D and E), where each was assigned numbers as attributes (1, 2, 3, 4, and 5). The second data source used is the online database of Tourism Social Information (named Relação Anual de Informações Sociais – RAIS) complied by the Ministry of Labor and Employment (MTE – http://pdet.mte.gov.br/) (accessed January 2018). The information available is divided into three categories: annual rent of employees in the lodging sector, number of employees, and number of establishments. We selected only data associated with rents of employees in the lodging sector, and avoided data that may include daily journeys often done for business. The database was based on "RAIS Establishments" and "RAIS Links", according to the activity sector "Código de Atividade Econômica – CNAE 2.0 Class", starting from 2006. This was calculated through the arithmetic mean of the individual income for the reference month, converted into minimum Brazilian wages of the base year (S2). This estimate was subsequently converted from reais (R$) to dollar (US$), using a conversion factor of 2.36 (base year of 2015).

2.1.2. Spatially explicit assessment of the role of NTFP extractivist activities in the Brazilian Amazon

In the Brazilian Amazon, traditional communities collect and trade a vast number of NTFP products. The Brazilian statistics office, IBGE (Instituto Brasileiro de Geografia e Estatística), systematically collects data on a range of 30 NTFP (Estatística, 2015). Brazil nut collection and rubber extraction are the two main NTFP; together they provide incomes for a large number of forest communities (Ferreira, 2008). We selected these two NTFP because they are marketed, their collection is widespread across the Amazon, and data are available for them from case material in Acre (Jaramillo-Giraldo et al., 2017; Nunes et al., 2012). We coupled biophysical and economic spatially explicit models for estimating incomes or annual rents (US$ $ha^{-1}year^{-1}$) for Brazil nut and rubber collection as follows:

$$\mathrm{Rent_j} = (\mathrm{Q_{xy}} * \mathrm{P_n}) - (\mathrm{Q_{xy}} * \mathrm{CTprd_n}) - (\mathrm{Q_{xy}} * \mathrm{Ctr}_n d_z)) \quad (1)$$

Where: Q_{xy} is the simulated production for a cell with coordinates (x,y) in $kg^{-1}ha^{-1}$; P_n and CT_{prdn} correspond respectively, to selling price and cost of production in US$/kg of product n and cost of secondary transportation (Ctr_n) in US$/kg of product n by means (d_z) from the location (x,y) to the nearest cooperative.

In order to simulate production (Q_{xy}), we first used the weights of evidence (W of E) method (Bonham-Carter, 1994) for estimating the spatial determinants of the productivity of Brazil nut and rubber based on bioclimatic and production data (S3). The output of the W of E is a favorability of productivity map. Favorability was then transformed into yields by applying a probability density function (PDF) transformation, so that the new distribution matched the yield PDF from the case study areas in Acre for rubber (Jaramillo-Giraldo et al., 2017) and Brazil nut (Nunes et al., 2012) (S3).

The price paid to extractivists (P_{xy}) varies greatly depending on the year and season. The price also depends on the market involved, namely whether it is marketed through cooperatives (approximately US$ 1.48) or intermediaries[2] (price varies from US $ 1.06 to 1.90 per kg), and depending on the data source used (*e.g.* IBGE (Estatística, 2015) or CONAB (Companhia Nacional de Abastecimento, 2012). IBGE data are self-stated by producers while CONAB is the observed production at the cooperative gate. It is possible that IBGE data are lower than the actual evidence as extractivists need to pay taxes for their transactions. On the contrary, at the cooperative, CONAB pays the minimum guaranteed price so extractivists are more likely to report real production and prices.

We used the maximum price paid to collectors in the period 2013 to 2014 (Table 1 here) from the CONAB dataset. A detailed description of transport ($Ctr_{n-}d_{z)}$ used to estimate the annual rent per hectare for a specific forest plot is given in Supplementary Material (S4).

2.1.3. Associations between tourism and NTFP extractivist activities

As described in Section 2.1.1 and 2.1.2 we estimated annual net rent (gross rent-costs of production) thereafter called income, for tourism and NTFP extractivist activities. While annual income from tourism is based on average per household (US$/ household), annual income from Brazil nut and rubber are provided on a per ha basis (US$. $ha^{-1}year$). For exploring whether or not there were differences of incomes from NTFP across the municipalities from different tourism development classes we conducted non parametric statistical test (Kruskal Wallis).

2.2. Reviewing case study data on RES and extractivist livelihoods in Brazilian Amazon

We reviewed the literature on tourism initiatives and on extractivist experiences in the Brazilian Amazon by compiling a database of 17 case studies (S5). In each case study we looked for: i) evidence about the links between RES and benefits to human wellbeing of traditional communities and tourists, ii) major challenges that those extractivist communities face when developing recreational activities. A reference for community-based tourism (CBT) in Brazilian Amazon is the state of Amazonas. We used this state for a deeper analyses of case studies. The case study analysis was based on data drawn from the management plans of the

[2] A local merchant that goes to the collectors villages to buy the nuts and works as intermediate agent in the chain.

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Table 1
Market price (paid to extractivists) for Brazil nut and rubber.

State	Market price (US$) per kg	
	Brazil Nut	Rubber
Acre	1.42	0.80
Amapá	1.42	1.09
Amazonas	1.77	1.09
Pará	1.85	1.21
Maranhão	0.85	1.09
Mato Grosso	0.85	1.25
Tocantins	0.85	1.09
Rondônia	0.85	1.12

conservation units in the State of Amazonas as well as institutional and governmental reports and nongovernmental organizations, such as the Amazon Sustainable Foundation (FAS, 2016) and the Institute of Sustainable Development Mamirauá (IDSM, 2011) (S5).

3. Results

3.1. Broad scale analysis of the association between RES/tourism and NTFP extractivist activities in the Brazilian Amazon

We conducted the analysis in all the 9 States of Brazilian Amazon over an area of 4.182.473.415 km^2 comprising 551 municipalities. From these only 309 municipalities (56%) were classified by the Ministry of Tourism (MTUR) (Table 2). Major tourism activities consistent with nature conservation in the Brazilian Amazon are: 1) ecotourism-accommodation in "eco-lodges", often in proximity to parks or sustainable development reserves, where major activities compose tracking, birdwatching; 2) cruises on the Amazon river and its tributaries; 3) sports fishing (often in combination with 1) and 2); and 4) community based tourism- promoting contact with traditional communities, participation in cultural events (e.g., folk festivals). Although these are the principal categories, we were not able to find quantitative estimates of the representativeness of each one of the tourism segments (ecotourism vs CBT) in governmental databases (e.g. MTUR). Thus we were not able to assess at the scale of the Brazilian Amazon differences amongst tourism types. This was only assessed through the case studies (Section 3.2). We know that CBT is considered an alternative tourism segment because tourism in Amazon has been mainly associated with ecotourism (May, 2015). While a considerable number of tourism initiatives focus on ecotourism (May, 2015), the undertaking of CBT has been slow despite its potential to value the human aspects of the extractivist landscapes and to fulfill growing niche markets of tourists that value traditional ecological knowledge and traditional cultures.

Those undifferentiated tourism segments are classified by the Ministry of Tourism according to development stages ranging from well established (A-category 1) to the incipient (E-category 5) (Table 2). In total, MTUR reports 309 cases of tourist initiatives in legal Amazon, the majority (95%) in the less developed stage (classes C, D e E).

Classes 1 and 2 of tourism development involve large numbers of people employed in the sector, and large numbers of tourism establishments. These are able to attract national and international tourists, implying that tourism has strong representativeness in the local economy. The municipalities where tourism is well-established have lower representativeness in the Northern Amazon (4.9%). On the other hand, class 3 and 4, in which tourism makes a medium to low contribution to the local economy, have the largest representation (approximately 85%). Finally, class 5 tourism is barely present as an economic activity; this is found in only 10% of the cases in the Amazon.

Table 2
Class of tourism development and its representativeness in Northern Amazon.

Category	Classes of tourism development	N	N / total classified (%)
A	1	8	2,3
B	2	8	2,6
C	3	48	15,5
D	4	212	68,9
E	5	33	10,7
Total		309	100

The spatial distribution of tourism initiatives from the MTUR database shows that the higher classes of tourism development are located around the cities of Manaus and Belem, since these regions have better access and infrastructures for accommodating tourists (Fig. 1). Accessibility and the presence of local capacities and skills are fundamental for determining whether tourism can contribute to reducing deforestation and promoting social inclusion in one of the poorest and environmentally problematic regions of Brazil (Hoefle, 2016). An exception is four municipalities where tourism average rents range from US$ 800 to US$1100 per household. In the remainder municipalities across the 9 states of Amazon average rents from tourism vary from US$ 200 to US $400 per household (Figs. 2 (A, B) and 3).

As for NTFP extractivist activities, the models show that in areas with higher productivity of Brazil nut (hotspots) with yields ≈30 kg ha^{-1}year^{-1}, rents may reach up to US$ 46 ha^{-1}year^{-1}, while the average rent is US$ 5.05 ± 7.49 ha^{-1}year^{-1} (Fig. 1). On other hand, in rubber extraction areas with yields above the mean (yields ≥ 3.53 kg ha^{-1}year^{-1}), and where there are governmental subsidies, rents average US$ 0.56 ± 0.7 ha^{-1}year^{-1}. This means that, in the actual circumstances, and for these two products whose prices for commodities are established in global markets, extractivist livelihoods are barely possible.

Fig. 1 shows that, at a broad scale of analysis, tourism and NTFP extractivist activities rarely spatially overlap, suggesting that synergies between tourism and extractivism are scarce.

We further assessed if there were significant differences on rents across the tourism development classes. We found that only rents from tourism are statistically significant ($p \leq 0.001$) in such comparisons, while there is no significant differences of Brazil nut rents ($p = 0.41$) and rubber ($p = 0.61$) (Fig. 2) this reinforcing that in the Brazilian Amazon synergies between tourism and NTFP extractivist activities are extremely rare.

3.2. Review of case studies

In order to further disentangle the association between tourism and NTFP extractivist activities we undertook a qualitative analysis of the different case studies. This review of the management plans of 17 conservation units (UC- *Unidades de Conservação*) in the state of Amazonas (S5) showed that activities such as tourism and NTFP extractivist activities coexist in different socio productive arrangements. We found that about 35% of the conservation units (UCs) currently develop community tourism alongside extractivist activities. Also 25% of the communities studied believed that CBT could be a more valuable activity in the near future (RDS Rio Amapá, RDS Purunga – Conquista, Maués State Forest, RDS Piagaçu-Purus, RESEX Catuá-Ipixuna and APA Rio Negro). 25% of the conservation units (UCs) do not make any mention of CBT or any other type of tourism in their management plans (RDS Rio Madeira, RDS do Juma, RDS Canumã, RDS Cujubim, RESEX Uacari and RESEX Rio Gregório). Finally, 15% of the UCs rely exclusively on NTFP extractivist activities (RDS Rio Madeira, RESEX Uacari and RESEX Rio Gregório).

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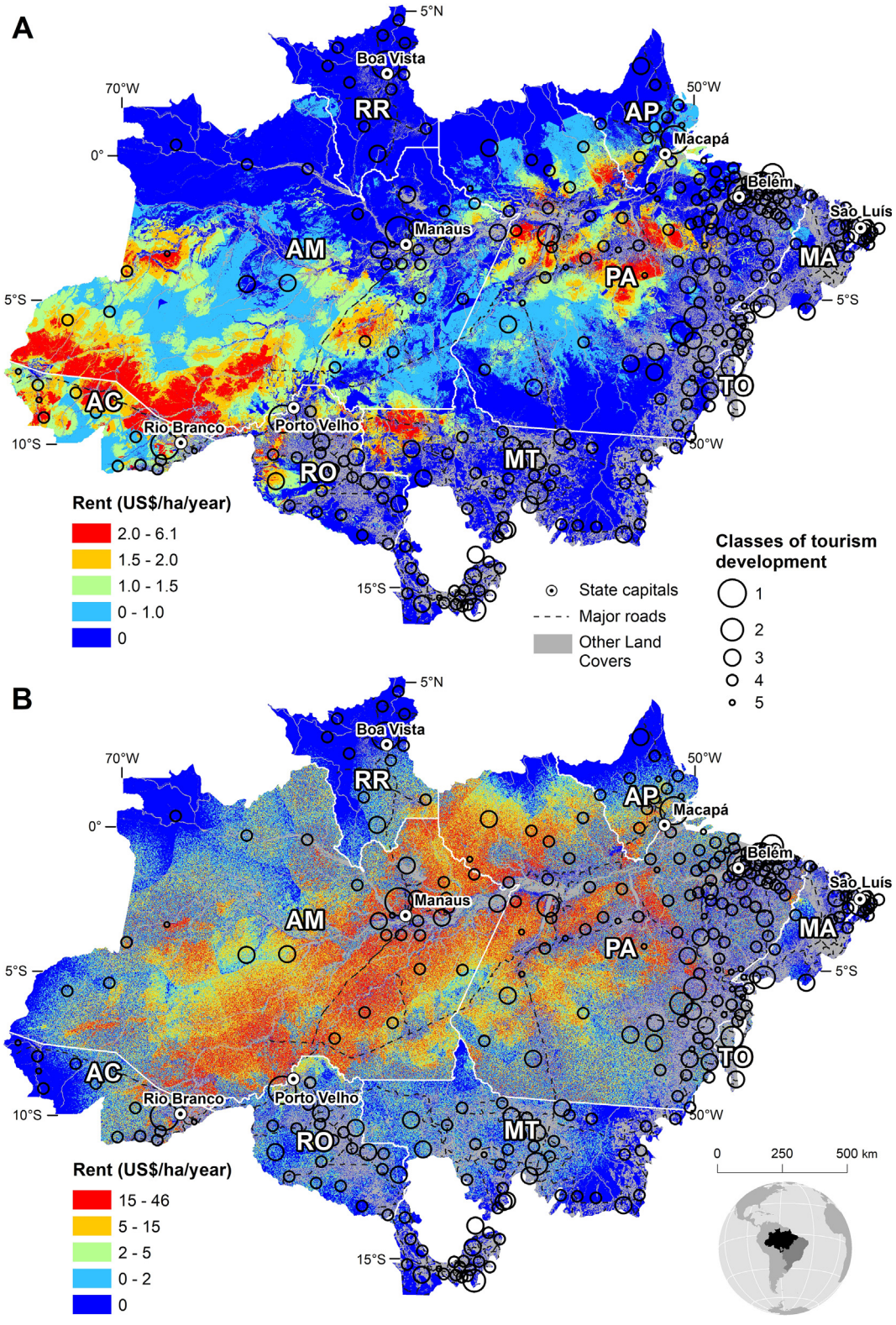

Fig. 1. Associations between rents from rubber (A) and Brazil nut (B) and tourism development classes.

This review of case studies show that activities such as tourism and NTFP extractivism can coexist in the Brazilian Amazon municipalities either though multifunctionality or segregation. Fig. 3 shows one case where there is multifunctionality (Tefé), and one example of segregation (Novo Aripuana) of activities (see Fig. 4).

In the municipality of Tefé, the headquarters of the lodging *Uacari*, average monthly rents from tourism range from US$ 250 to 280 year^{-1}, while from rubber ranges US$ 1 to 2 ha^{-1}.year^{-1} and nut range from US$ 0 to 15 ha^{-1}.year^{-1}. In other municipalities, such as Novo Aripuanã, the local economy is mainly based

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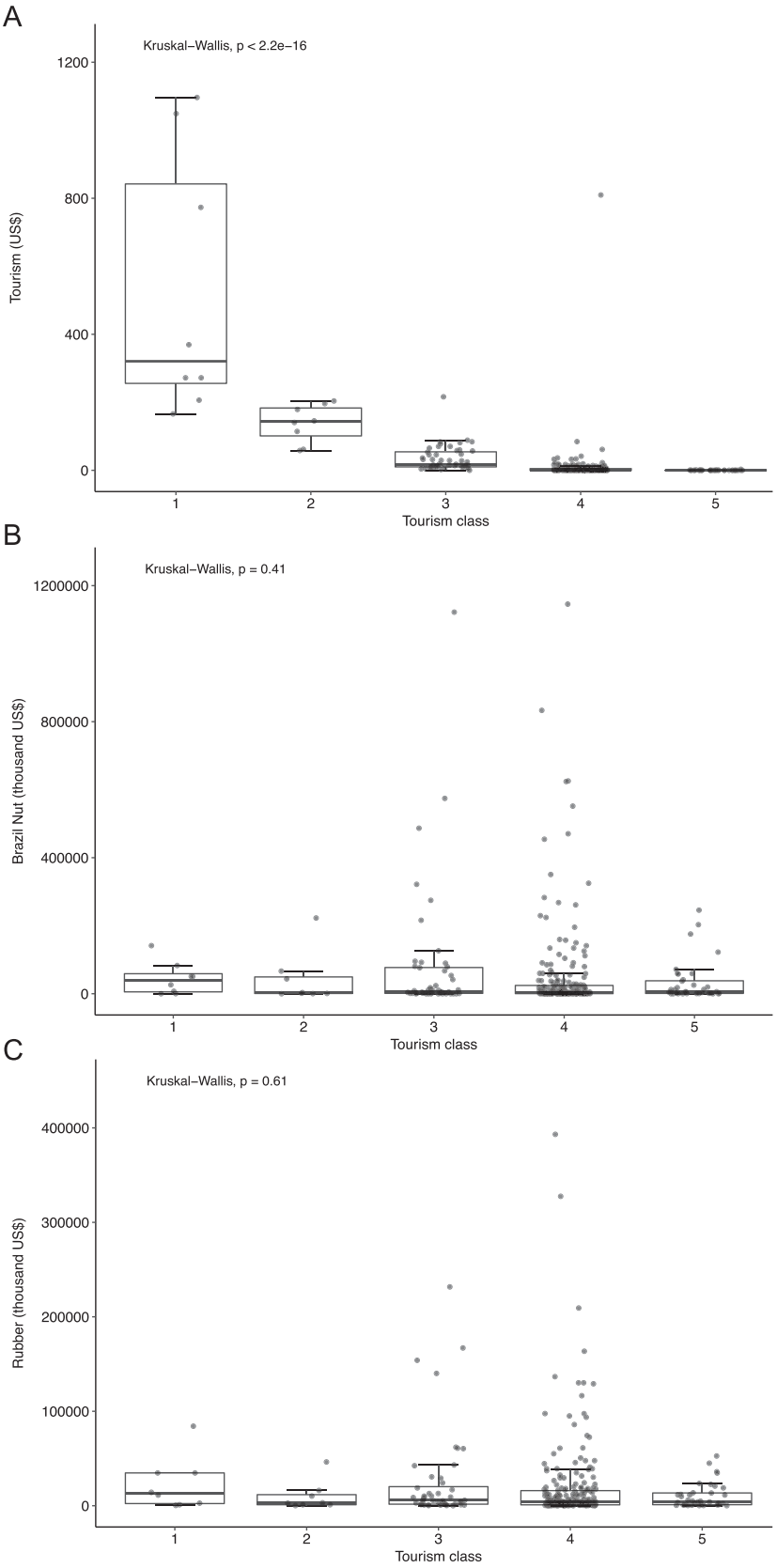

Fig. 2. Associations between rents from Tourism (A), Brazil nut (B) and rubber (C) across different tourism development classes.

on extractivist activities. These two municipalities, Tefé and Novo Aripuanã, are analysed in detail. The former is an example of a successful approach to tourism and extractivism as a common livelihood strategy, while in the latter focuses on extractivist activities.

Our work shows that most of the case studies where multifunctionality of tourism and extractivist activities occur are included in the upper classes of tourism development (1, 2 and 3). At the case study scale we can see that where rents from NTFP are low,

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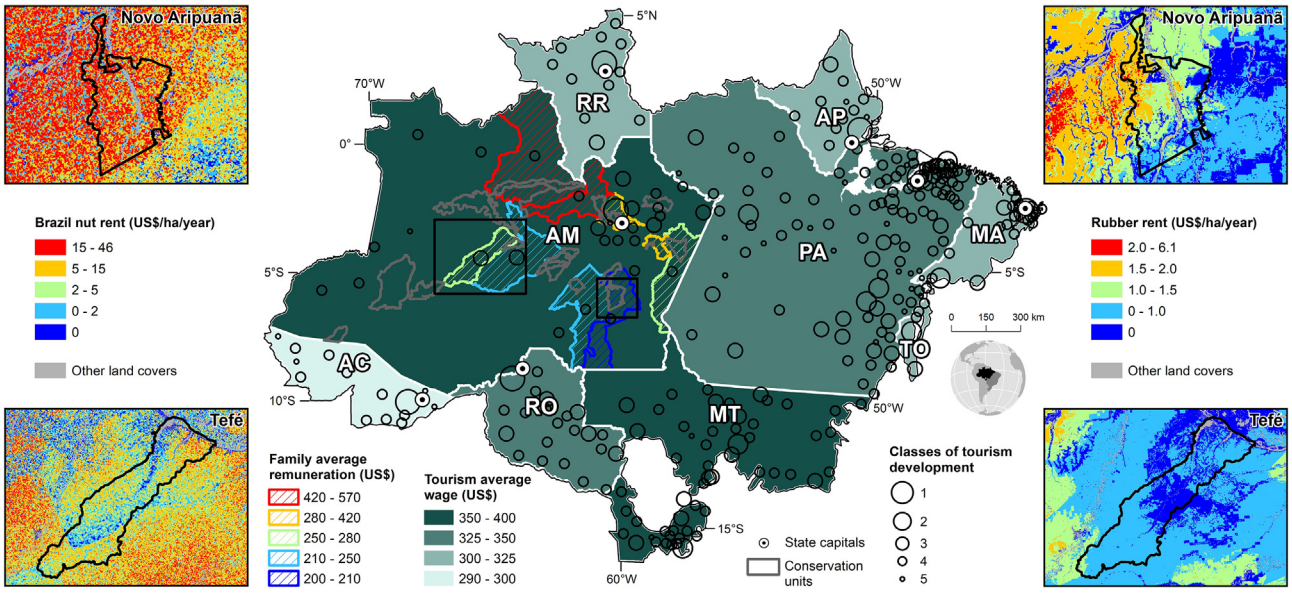

Fig. 3. Two case studies: Tefé and Novo Aripuanã, rents from Brazil nut, rubber and tourism.

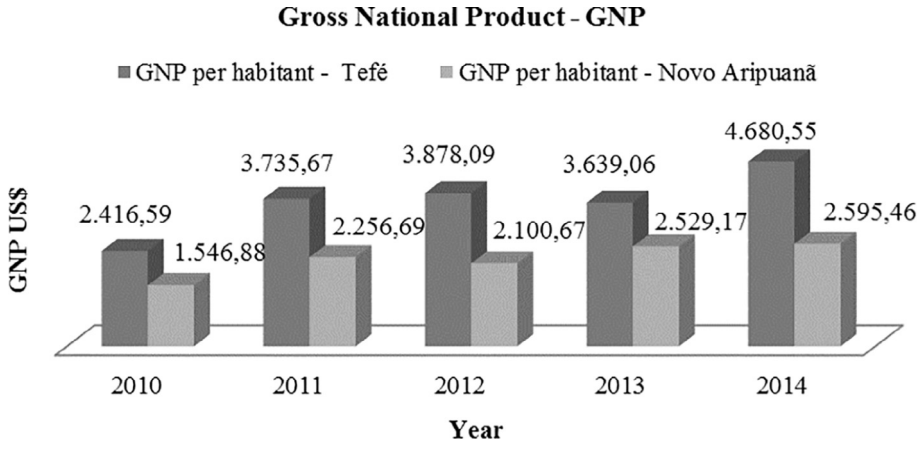

Fig. 4. Gross National Product of Tefé and Novo Aripuanã municipalities from 2010 to 2014.

communities are more likely to develop tourism initiatives to complement income. Alongside the RDS Amanã, the RDS Mamirauá, in the municipality of Tefé, is the Mamirauá Institute of Sustainable Development (MISD), created more than 20 years ago. MISD is located at the confluence of the Japurá and Solimões rivers. The MISD is a non-profit social organization considered a model of community based tourism in Brazil. Many members of the local association work in *Uacari*, embracing the tourist sector through accounting, marketing and sales. Tourism forms the basis of the economy of the 177 communities (FAS, 2016), which make up the RDS Mamirauá. Alongside community based tourism, income is also created from activities such as fishing, wood extraction and agriculture. RES offered in this lodge include packages from 3 to 7 days for about 20 people (10 private suites). The visitor is offered experiences of the traditional lifestyles including how to live in a flooded area. According to the case study data, in contrast to what is registered in national accounts (RAIS) and shown in Fig. 3, the rent here is US$ 753 (Peralta, 2012). Major extractivist activities are fishery and collection of NTFPs (andiroba and copaiba). In this case often tourism and extractivist activities enjoy a temporal multifunctionality. One occurs in the rainy season and the other in the dry season.

In comparison, the RDS Juma, in the municipality of Novo Aripuanã, is co-managed by the State of Conservation Units of the Secretary of State for Environment and Sustainable Development of Amazonas and the Sustainable Amazonas Foundation (FAS). The mindset behind the administration of the RDS is based on socio-ecological systems, in which agriculture, fishing, fruit collection, extractivism of Brazil nuts and the oil of Copaíba are the main economic activities developed in the reserve. In 2008, the main extractive product was the Brazil nut with a production of 1,086 tons, placing the municipality of Novo Aripuanã as the third largest producer of this resource in the Amazon state. In this reserve around 600 kg of rubber was collected annually (FAS, 2010). For these two municipalities, we compared both Human Development Index (HDI) and Gross National Product (GNP) *per capita*.

The municipality of Tefé, has the highest GNP *per capita* around US$ 3700. This is in comparison with the municipality of Novo Aripuanã, with a mean around US$ 2,200. Here we note that an economy based on more than one income activity can enhance local economy. This development has effects also on Human Development Index (HDI) encompassing three basic dimensions of human development: income, education and health (PNUD, 2017). HDI in Tefé is medium while in Novo Aripuanã is low.

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Other remarkable examples of RES-extractivist activities multifunctional livelihoods are the RESEX Pedras Negras managed by the Association of Rubber Tappers of the Aguapé Valley and other nongovernmental organizations. Jointly collecting rubber and tourism activities, 14 families in this RESEX increased their income by approximately US$80 per year (Peralta, 2012). The lodging Pousada dos Lagos, in the municipality of Silves about 300 km from Manaus, is a community-based ecotourism enterprise that was built in 1994 based on a project by a nongovernmental organization called *Associação de Silves para a Preservação Ambiental e Cultural*, with technical support from World Wildlife Foundation (WWF_Brasil), sponsored by Government of Austria. This initiative was one of the first to implement community based tourism in the Brazilian Amazon (Turismo, 2012). The main goal is to preserve the lakes and the riverside livelihoods. Major extractivist activities are fishery and the collection of the essence of "Pau Rosa", a fixer in the well known perfume "Chanel n. 5". Annual income from communities that are involved with tourism (US$ 1.180) are above the ones based on extractive livelihoods alone (US$ 830) (Becker and Lena, 2002).

The survey of case studies also reveals that communities combining community tourism jointly with NTFP extractivist activities are not restricted to the conservation units (UCs). About 15 communities (e.g. Iranduba, Careiro da Várzea, Rio Preto da Eva, Silves) of the Metropolitan Region of Manaus (MRM)), recognize tourism as an important income generating activity alongside handcrafts (30%), fishing (28%) and agriculture (24%). This case study analysis allows us to assess the challenges and opportunities for tourism activity in extractivist landscapes (Table 3).

4. Discussion and conclusions

Tourism is a major economic player for sustainable development. It is also inherently linked to cultural values that provide well-being to the local community. Our results show that, there is a very weak association between rents from tourism and NTFP extractivist activities at the biome scale (Figs. 1 and 2). The analysis of case studies further suggests that in the few cases where there are multifunctional livelihoods (most of the cases involve temporal multifunctionality as one activity is on the rainy and other in the dry season) tourism and NTFP extractivist activities complement each other (Fig. 3). The review of the 17 land management plans of conservation units in the Amazonas (S5) show that so far tourism is seen as a complement to increase extractivist rents. However we found that one of the bigger contributions of tourism in extractivist landscapes is likely to be the recreational ecosystem services which foster the cultural values of traditional livelihoods. These have been fighting against the steady expansion of the cowboy imagery and lifestyle.

Our study suggests that although associations between tourism and extractivist activities are weak at the Brazilian Amazon scale (where there are no significant differences of rents of Brazil nut and rubber across the tourism development classes (Fig. 2)), at the case study level the development of new tourism opportunities can promote positive changes in the social and economic local structures of forest people, particularly in the context of extractivist landscapes. Contrary to the conclusion of Hoefle (2016), who claimed that "tourism will not save Amazon forests", we argue that segments such as community based tourism might become embedded in a multifunctional livelihoods and as such could add value to the Amazonian extractivist landscapes. For example, value can be added to the Brazil nut chain, since its processing, such as cereal bar, oil and chestnut milk, can contribute to a variety of consumer benefits. The process itself has the potential to become a commercialized product.

Likewise, when coupling community based tourism and extractivism, some communities can sell the product and welcome the consumer of the product as a tourist. In addition to this double gain, benefits can be triple when it reduces the costs of moving product to retail outlets (S4), as well as quadruple when extractivists are not subject to extortionist inroads of traders making unreasonable profits as presently prevails in the rubber and

Table 3
Major challenges and opportunities for tourism segments in extractivist landscapes.

Segment	Possible Contribution Of Tourism	Links Between RES And Benefits Human Well Being		Major Challenges			Source
		Communities	Tourists	Communities	ONGs	Governmental bodies	
Eco tourism	Increase and diversify income; Environmental and cultural preservation; Economic growth	Value "Standing Forests"; Adding value to the territorial environmental and intangible values of forests	Close to nature experiences; Environmental education and value.	Ability to diversify activities;	Establishing business administration practices.	Dealing with the problem "The more popular eco-toourism becomes, the less likely it is to protect the resources that are the object of visitation	(May, 2015; May et al., 2013) (Sampaio, 2005)
Community Based Tourism	Opportunity to modify and renew social systems enhancing self esteem of communities	Landscape Identity; Empowerment; Creates living spaces and human relations; Recognize traditional knowledge and ways of life; and embrace those ways of life and keep the traditions	Learning values skills, practices and local knowledge; Life in community and exchange of experiences; Stimulate culturally and spiritually leisure activities	Requires alternative forms of tourism management and planning to be efficient; Organization inside the community; Families' adherence to the programs; Maintain tourist benefits at the local level; Develop shared business partnerships	Expansion of knowledge and conceptions about planning and empowerment of local communities and the union of different actors; Guiding communities in preparation to receive tourists; Capacity building education and community network	Focusing on the Social organization of traditional communities and populations; Partnerships as public–private and ONGs dedicated to the empowerment of the communities through forest management and the practice of tourism	(Hernández-Morcillo et al., 2013; Lapan, 2014; Alhroot, 2012; Ruiz-Ballesteros and Hernández-Ramírez, 2010; Sampaio and Coriolano, 2009; Coutinho et al., 2015)

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Brazil nut NTFP chain (Gomes, 2009; Gomes et al., 2012; Hecht, 2013; Homma, 2008).

Yet even in cases where there are company community arrangements, where "higher" prices are paid to communities (Morsello, 2006; Morsello et al., 2014), outcomes from NTFP market chains are mixed and reveal complex economic and social patterns. If extractivist activities and tourism can be coupled multifuntionally, we believe local communities will have an incentive to go beyond the cattle ranching ideology.

Our broad scale analysis reveals that the evidence of joint livelihoods is scanty. We expose an urgent need to forge new livelihood options that complement forest conservation. Tourism, particularly CBT and extractivism, can complement each other as a part of a contribution to sustainable development. But this needs to be implemented through a spatially explicit targeted approach. As we showed in Fig. 1, even in the areas shaded in red that already have well established market chains of NTFP and access to markets, the positive connections between tourism and extractivism are not in place and remains difficult to develop. In our opinion, efforts should be devoted to nurture multifunctional livelihoods in places where rents from extractivism are lower (shaded from blue to yellow) where tourism dynamics can add value to traditional livelihoods. In these places we need to be aware that when placing community based tourism into the dynamics of forest peoples gains are likely to be more social (e.g. self-esteem) rather than economic.

There are few studies assessing the economic benefits of tourism in Brazilian Amazon. A global study sponsored by the program on forests (PROFOR) and the Waves program from World Bank, using meta-analysis and a spatially explicit regression, estimates that tourism average rents in forest areas in Brazil is of US$14 ha^{-1} yr^{-1} (estimating that 10% of the forests are used to recreation purposes), while according to the same study rents for NTFPs are of US$ 6.5 ha^{-1} yr^{-1} (PROFOR, 2015). Other estimates vary widely. For example Andersen (1997) cited by May et al. (2013) estimated that the recreational value of Amazon rainforests biome range from US$ 53 per ha (discount rate of 6%) to US$ 160 per ha (discount rate 2%). Other studies report rents from tourism in Ecuador to be US$ 0.66 ha^{-1} yr^{-1} (May, 2015). While there are data from case studies in Peru (Kirkby et al., 2010), for Brazil, we could only find a broad estimate that the contribution of nature tourism to the Brazilian GDP is as modest as 0.3% (May, 2015).

CBT, even as a small-scale economic activity carried out by indigenous or riverside communities, enhances recreational ecosystem services provided by the forest. Such tourism, can embrace the ways of life of the local Amazonian population without taking advantage of cultural norms. This may have a beneficial impact on the extractive activities of the recipient communities. This type of tourism is associated with environmental education, where the values and ways of life, production and knowledge of the communities, are better understood and respected (Sampaio and Coriolano, 2009; Sampaio, 2005). This is already occurring in the state of Amazonas, where environmental preservation and cultural values of the riverside communities are being combined. In these cases reported beneficial changes include heightened self-esteem and greater community organization. The participation of more families into such programs can surely lead to overall improved management of the forest.

In the literature review we also found cases in which tourism may not be environmentally friendly (May, 2015). The more popular tourism becomes, the lesser it is likely to protect the resources that are the attraction. In a study of three Amazon ecotourism projects, May (2015) looks at how local leaders viewed changes associated with ecotourism for their communities. Economic benefits were mentioned, but so were new restrictions on time, decreased personal and communal reciprocity, and social conflict.

CBT, ecotourism and community tourism are established practices in the Brazilian Amazon. Yet their contribution to wellbeing is limited to a small set of successful case studies that do not extend beyond the municipalities involved. The rich body of knowledge gathered in the last 20 years by nongovernmental organizations and government institutions offers the basis for a more effective participatory approach. Poignantly, around the corner is an ominously expanding cattle economy which in the short run provides tantalizing incomes well above the typical mix of more sustainable activities studied here. We urge a more proactive action towards our findings to show that effective multifunctionality on a sustainable basis can better the livelihoods of Amazons across the biome.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.ecoser.2018.03.016.

References

Alhroot, A.H., 2012. An evaluation of social marketing in humanitarian tourism requirements by using social networking sites. Int. J. Marketing Stud. 4, 8.

Balvanera, P., Uriarte, M., Almeida-Leñero, L., Altesor, A., DeClerck, F., Gardner, T., Hall, J., Lara, A., Laterra, P., Peña-Claros, M., Silva Matos, D.M., Vogl, A.L., Romero-Duque, L.P., Arreola, L.F., Caro-Borrero, Á.P., Gallego, F., Jain, M., Little, C., de Oliveira Xavier, R., Paruelo, J.M., Peinado, J.E., Poorter, L., Ascarrunz, N., Correa, F., Cunha-Santino, M.B., Hernández-Sánchez, A.P., Vallejos, M., 2012. Ecosystem services research in Latin America: The state of the art. Ecosystem Services 2, 56–70.

Becker, B., Lena, P., 2002. Pequenos empreendimentos alternativos na Amazônia. Setembro, 2002. Disponível em: http://www.ie.ufrj.br/redesist/NTF2/NT%20Bertha-Philippe.PDF. Acesso em: 4/dez/2017.

Bonham-Carter, G., 1994. Geographic Information Systems for Geoscientists: Modelling with GIS. Pergamon, Oxford, UK.

Bowman, M.S., Soares-Filho, B.S., Merry, F.D., Nepstad, D.C., Rodrigues, H., Almeida, O.T., 2012. Persistence of cattle ranching in the Brazilian Amazon: a spatial analysis of the rationale for beef production. Land Use Policy 29, 558–568.

Companhia Nacional de Abastecimento, M.d.A.P.e.A.C., 2012 Castanha do Brazil, conjuntura mensal.

Coutinho, G.C.T.P., Sampaio, C.A.C., Rodrigues, L.d.P., 2015 Fatores Motivacionais e Impactos Sociais do Turista Comunitário Revista Iberoamericana de Turismo – RITUR 4, 77-87.

Estatística, I.B.d.G.e., 2015 Produção da Extração Vegetal e da Silvicultura

FAS, F.A.S., 2010. Plano de Gestão da Reserva de Desenvolvimento Sustentável do Juma, Novo Aripuanã, Amazonas p. 228.

FAS, F.A.S., 2016. Relatório de Atividades 2015, Relatórios de Gestão da FAS, Manaus, p. 120.

Ferreira, L.T., 2008. A seringueira no brasil. Biotecnologia Ciência & Desenvolvimento.

Gomes, C.V.A., 2009. Twenty years after Chico Mendes:Extractive Reserves's Expansion, catle adoption and evolving self definition among rubber tappers in the Brazilian Amazon UNIVERSITY OF FLORIDA.

Gomes, C.V.A., Vadjunec, J.M., Perz, S.G., 2012. Rubber tapper identities: Political-economic dynamics, livelihood shifts, and environmental implications in a changing Amazon. Geoforum 43, 260–271.

Hecht, S., 2013. In the realm of rubber, The scrumble for the Amazon and the lost paradise of Euclides da Cunha. The University of Chicago Press, Chicago.

Hernández-Morcillo, M., Plieninger, T., Bieling, C., 2013. An empirical review of cultural ecosystem service indicators. Ecolog. Indicators 29, 434–444.

Hoefle, S.W., 2016. Multi-functionality, juxtaposition and conflict in the Central Amazon: will tourism contribute to rural livelihoods and save the rainforest? J. Rural Stud. 44, 24–36.

Homma, A.K.O., 2008. Extrativismo, Biodiversidade e Biopirataria na Amazônia. EMBRAPA, Texto para Discussão 27, ISSN 1677-5473.

Humphries, S., Holmes, T.P., Kainer, K., Koury, C.G.G., Cruz, E., de Miranda Rocha, R., 2012. Are community-based forest enterprises in the tropics financially viable? Case studies from the Brazilian Amazon. Ecolog. Econ. 77, 62–73.

IDSM, I.d.D.S.M., 2011. Protocolo para Gestão de Recursos Turísticos Baseado na Experiência do IDSM junto à Pousada Uacari e à Associação de Auxiliares e Guias de Ecoturismo de Mamirauá – AAGEMAM – RDS Mamirauá – AM. Tefé – AM, dezembro de 2011.

Jaramillo-Giraldo, C., Soares Filho, B., Carvalho Ribeiro, S.M., Gonçalves, R.C., 2017. Is it possible to make rubber extraction ecologically and economically viable in the Amazon? The southern acre and chico mendes reserve case study. Ecolog. Econ. 134, 186–197.

Kirkby, C.A., Giudice-Granados, R., Day, B., Turner, K., Velarde-Andrade, L.M., Dueñas-Dueñas, A., Lara-Rivas, J.C., Yu, D.W., 2010. The market triumph of ecotourism: an economic investigation of the private and social benefits of competing land uses in the peruvian Amazon. PLoS ONE 5, e13015.

Lapan, C.M., 2014. Communitarian Micro-entrepreneurship and Gender in the Maya Touristscape, Graduate Faculty. North Carolina State University, Raleigh, North Carolina, p. 172.

Levis, C., Costa, F.R.C., Bongers, F., Peña-Claros, M., Clement, C.R., Junqueira, A.B., Neves, E.G., Tamanaha, E.K., Figueiredo, F.O.G., Salomão, R.P., Castilho, C.V., Magnusson, W.E., Phillips, O.L., Guevara, J.E., Sabatier, D., Molino, J.-F., López, D. C., Mendoza, A.M., Pitman, N.C.A., Duque, A., Vargas, P.N., Zartman, C.E., Vasquez, R., Andrade, A., Camargo, J.L., Feldpausch, T.R., Laurance, S.G.W., Laurance, W.F., Killeen, T.J., Nascimento, H.E.M., Montero, J.C., Mostacedo, B., Amaral, I.L., Guimarães Vieira, I.C., Brienen, R., Castellanos, H., Terborgh, J., Carim, M.d.J.V., Guimarães, J.R.d.S., Coelho, L.d.S., Matos, F.D.d.A., Wittmann, F., Mogollón, H.F., Damasco, G., Dávila, N., García-Villacorta, R., Coronado, E.N.H., Emilio, T., Filho, D.d.A.L., Schietti, J., Souza, P., Targhetta, N., Comiskey, J.A., Marimon, B.S., Marimon, B.-H., Neill, D., Alonso, A., Arroyo, L., Carvalho, F.A., de Souza, F.C., Dallmeier, F., Pansonato, M.P., Duivenvoorden, J.F., Fine, P.V.A., Stevenson, P.R., Araujo-Murakami, A., Aymard C., G.A., Baraloto, C., do Amaral, D. D., Engel, J., Henkel, T.W., Maas, P., Petronelli, P., Revilla, J.D.C., Stropp, J., Daly, D., Gribel, R., Paredes, M.R., Silveira, M., Thomas-Caesar, R., Baker, T.R., da Silva, N.F., Ferreira, L.V., Peres, C.A., Silman, M.R., Cerón, C., Valverde, F.C., Di Fiore, A., Jimenez, E.M., Mora, M.C.P., Toledo, M., Barbosa, E.M., Bonates, L.C.d.M., Arboleda, N.C., Farias, E.d.S., Fuentes, A., Guillaumet, J.-L., Jørgensen, P.M., Malhi, Y., de Andrade Miranda, I.P., Phillips, J.F., Prieto, A., Rudas, A., Ruschel, A. R., Silva, N., von Hildebrand, P., Vos, V.A., Zent, E.L., Zent, S., Cintra, B.B.L., Nascimento, M.T., Oliveira, A.A., Ramirez-Angulo, H., Ramos, J.F., Rivas, G., Schöngart, J., Sierra, R., Tirado, M., van der Heijden, G., Torre, E.V., Wang, O., Young, K.R., Baider, C., Cano, A., Farfan-Rios, W., Ferreira, C., Hoffman, B., Mendoza, C., Mesones, I., Torres-Lezama, A., Medina, M.N.U., van Andel, T.R., Villarroel, D., Zagt, R., Alexiades, M.N., Balslev, H., Garcia-Cabrera, K., Gonzales, T., Hernandez, L., Huamantupa-Chuquimaco, I., Manzatto, A.G., Milliken, W., Cuenca, W.P., Pansini, S., Pauletto, D., Arevalo, F.R., Reis, N.F.C., Sampaio, A.F., Giraldo, L.E.U., Sandoval, E.H.V., Gamarra, L.V., Vela, C.I.A., ter Steege, H., 2017. Persistent effects of pre-Columbian plant domestication on Amazonian forest composition. Science 355, 925-931.

May, P., 2015. Tourism Contribution to forest benefits in the Amazon Basin. In: Bank, W. (Ed.), Peter H. May, PhD, Consultant, The World Bank, UPI No. 00053410.

May, P., Soares Filho, B., Strand, J., 2013. How Much Is the Amazon Worth? The State of Knowledge Concerning the Value of Preserving Amazon Rainforests. Policy Research Working Paper 6668, The World Bank Development Research Group, Environment and Energy Team, http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.1018.5013&rep=rep1&type=pdf (accessed February 2018).

MMA (2009) National plan for Sociobiodiversity chains Plano Nacional de Promoçao das Cadeias da Sociobiodiversidade (PNPSB). Ministry of Environment- MMA Ministerio Meio Ambiente (Brazil).

Morsello, C., 2006. Company–community non-timber forest product deals in the Brazilian Amazon: a review of opportunities and problems. Forest Policy Econ. 8, 485–494.

Morsello, C., Delgado, J.A.d.S., Fonseca-Morello, T., Brites, A.D., 2014. Does trading non-timber forest products drive specialisation in products gathered for consumption? Evidence from the Brazilian Amazon. Ecolog. .omics 100, 140–149.

MTUR, M.D.T., 2016. Categorização dos Municípios das Regiões Turísticas do Mapa do Turismo Brasileiro.

Nunes, F., Soares-Filho, B., Giudice, R., Rodrigues, H., Bowman, M., Silvestrini, R., Mendoza, E., 2012. Economic benefits of forest conservation: assessing the potential rents from Brazil nut concessions in Madre de Dios, Peru, to channel REDD+ investments. Environ. Conservation. https://doi.org/10.1017/S0376892911000671.

Peralta, N., 2012. Ecoturismo de base comunitária na Amazônia: uma análise comparativa Community-based ecotourism in the Amazon: a brief comparative analysis. Observatório de Inovação do Turismo – Revista Acadêmica 2, 16.

Peters, C.M., Gentry, A.H., Mendelsohn, R.O., 1989. Valuation of an Amazonian rainforest. Nature 339, 655–656.

PNUD, 2017. Atlas do Desenvolvimento Humano no Brasil

PROFOR, 2015. Global Assessement of Non Wood Forest Ecosystem Services Spatially explicit meta-analysis and benefit transfer to improve the World Bank's forest weatlh database. In: Siikamäki, J., Santiago-Ávila, F.J., Vail, P. (Eds.).

Ruiz-Ballesteros, E., Hernández-Ramírez, M., 2010. Tourism that Empowers? Commodification and appropriation in Ecuador's Turismo Comunitario. Critique Anthropology 30, 29.

Sampaio, C.A.C., 2005. Turismo como fenômeno humano: princípios para se pensar a socioeconomia e sua prática sob a denominação turismo comunitário. EDUNISC, Santa Cruz do Sul.

Sampaio, C.A.C, Coriolano, L.N.M.T, 2009. Dialogando com experiências vivenciadas em Marraquech e America Latina para compreensão do turismo comunitário e solidário. Revista Brasileira de Pesquisa em Turismo 3, 4–24.

Scoles, R., Gribel, R., 2015. Human Influence on the Regeneration of the Brazil Nut Tree (Bertholletia excelsa Bonpl., Lecythidaceae) at Capanã Grande Lake, Manicoré, Amazonas. Brazil. Human Ecology 43, 843–854.

Turismo, A., 2012. Turismo comunitário na Amazônia. Central de turismo Comunitário da Amazonia. Manaus-AM: ICEI Brasil, 40p.

Please cite this article in press as: Carvalho Ribeiro, S.M., et al. Can multifunctional livelihoods including recreational ecosystem services (RES) and non timber forest products (NTFP) maintain biodiverse forests in the Brazilian Amazon? Ecosystem Services (2018), https://doi.org/10.1016/j.ecoser.2018.03.016