Valuing conservation and socio-environmental services on an Amazon frontier: the Extractive Reserves of the Terra do Meio

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Abstract
In the Brazilian Amazon, forest conservation has relied on the presence of 'traditional communities' and Indigenous peoples to secure legally demarcated protected areas from deforestation and biodiversity degradation. Facing pressures for land-use change from a rapidly encroaching frontier of resource extraction and commodity production, there is no guarantee that Indigenous peoples or traditional communities will continue to occupy these forests or continue to fulfill the role of forest protectors except under certain conditions. In this article, we detail the case of the extractive reserves of the Terra do Meio and consider what conditions would be needed for traditional communities to continue to occupy and protect protected areas. Employing an agrarian political ecology approach, we draw on years of ethnographic research in this area to argue that forest peasant livelihoods, which revolve around the forest areas of use, produce both ecological and cultural diversity in the forest. We term this socio-ecological arrangement the productive system of the *colocação*, the system and geographies of forest peasant livelihoods that upholds and is upheld by diverse socio-ecological relationships. Contemporary forest conservation regimes, however, have largely failed to incentivize and value these forest peasant livelihoods in ways that would sustain them in the face of commoditizing frontier pressures. Any mechanisms that pay for forest conservation should remunerate communities for their entire socio-ecological relationships, those relationships that are upheld through forest peasant livelihoods, not simply their products. We propose an approach to valuing forest communities' socio-environmental services, and we argue that such valuation would be more effective for conservation and cultural/ecological diversity than existing proposals for payments for ecosystem services (PES).

Keywords: Payment for ecosystem services, socio-environmental services, Amazon; frontiers, peasants

Résumé
En Amazonie brésilienne, la conservation des forêts s'est appuyée sur la présence de "communautés traditionnelles" et de peuples indigènes pour protéger de la déforestation et de la dégradation des zones protégées légalement délimitées. Face aux pressions exercées par l'extraction des ressources et la production de matières premières, il n'y a aucune garantie que les peuples indigènes ou les communautés traditionnelles continueront à occuper ces forêts ou à jouer le rôle de protecteurs de la forêt, sauf sous certaines conditions. Dans cet article, nous détaillons le cas des réserves d'extraction de la Terra do Meio et examinons les conditions nécessaires pour que les communautés traditionnelles continuent d'occuper et de protéger les zones protégées. En utilisant une approche de "agrarian political ecology", nous nous appuyons sur des années de recherche

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ethnographique dans cette région pour affirmer que les moyens de subsistance des paysans forestiers, qui tournent autour des zones d'utilisation des paysans forestiers, produisent à la fois de la diversité écologique et culturelle dans la forêt. Nous appelons cet arrangement socio-écologique le système productif de la colocação, le système et les géographies des moyens de subsistance des paysans forestiers qui soutiennent et sont soutenus par diverses relations socio-écologiques. Les régimes contemporains de conservation des forêts n'ont cependant pas réussi à inciter et à valoriser ces moyens de subsistance des paysans forestiers de manière à les maintenir face aux pressions de la frontière de la marchandisation. Tout mécanisme de paiement pour la conservation des forêts devrait rémunérer les communautés pour l'ensemble de leurs relations socio-écologiques, ces relations qui sont soutenues par les moyens de subsistance des paysans forestiers, et pas seulement par leurs produits. Nous proposons une approche pour évaluer les services socio-environnementaux des communautés forestières, et nous soutenons qu'une telle évaluation serait plus efficace pour la conservation et la diversité culturelle/écologique que les propositions existantes de paiements pour les services écosystémiques (PSE).

Mots-clés: Paiement pour les services écosystémiques, services socio-environnementaux, Amazonie, frontières, paysans

Resumen

En la Amazonia brasileña, la conservación de los bosques se ha basado en la presencia de "comunidades tradicionales" y pueblos indígenas para proteger de la deforestación y la degradación de la biodiversidad las zonas protegidas legalmente demarcadas. Frente a las presiones para cambiar el uso de la tierra derivadas de la rápida invasión de la frontera de la extracción de recursos y la producción de materias primas, no hay garantías de que los pueblos indígenas o las comunidades tradicionales sigan ocupando estos bosques o sigan cumpliendo la función de protectores de los bosques, salvo en determinadas condiciones. En este artículo, detallamos el caso de las reservas extractivas de la Terra do Meio y consideramos qué condiciones serían necesarias para que las comunidades tradicionales siguieran ocupando y protegiendo las áreas protegidas. Empleando un enfoque de ecología política agraria, nos basamos en años de investigación etnográfica en esta zona para argumentar que los medios de vida de los campesinos del bosque, que giran en torno a las áreas de uso de los campesinos del bosque, producen diversidad tanto ecológica como cultural en el bosque. Denominamos a este acuerdo socioecológico el sistema productivo de la colocação, el sistema y las geografías de los medios de vida de los campesinos del bosque que sostiene y es sostenido por diversas relaciones socioecológicas. Sin embargo, los regímenes contemporáneos de conservación de los bosques han fracasado en gran medida a la hora de incentivar y valorar estos medios de vida de los campesinos de los bosques de forma que puedan mantenerse frente a las presiones de la frontera de la mercantilización. Cualquier mecanismo que pague por la conservación de los bosques debería remunerar a las comunidades por la totalidad de sus relaciones socioecológicas, aquellas relaciones que se mantienen a través de los medios de vida de los campesinos del bosque, no simplemente por sus productos. Proponemos un enfoque para valorar los servicios socioambientales de las comunidades forestales, y argumentamos que dicha valoración sería más eficaz para la conservación y la diversidad cultural/ecológica que las propuestas existentes de pagos por servicios ecosistémicos (PSE).

Palabras claves: Pago por servicios ecosistémicos, servicios socioambientales, Amazonia, fronteras, campesinos

Resumo

Na Amazônia brasileira a conservação da floresta tem contado com o apoio de povos indígenas e comunidades tradicionais para controlar o avanço do desmatamento e da perda de biodiversidade sobre as áreas protegidas. Frente a pressões por mudanças no uso da terra e o avanço acelerado de fronteiras predatórias, não há garantia que povos indígenas e comunidades tradicionais continuem a ocupar essas áreas, principalmente desempenhando seus papeis na defesa da floresta. Para isso, algumas condições são necessárias. Neste artigo, nós detalhamos o caso das reservas extrativistas da Terra do Meio e indicamos que condições são necessárias para que comunidades tradicionais continuem a ocupar e apoiar a conservação em áreas protegidas. A partir de uma abordagem fundamentada na ecologia política, nos baseamos em anos de pesquisa etnográfica sobre o modelo das *colocações* para defender que os modos de vida e a ocupação do território por camponeses da floresta produzem diversidade ecológica e cultural. No entanto, os atuais regimes de conservação têm falhado em incentivar e valorizar esses modos de vida de camponeses florestais frente ao avanço de fronteiras predatórias. Qualquer mecanismo que pague pela conservação das florestas nessas áreas deveria remunerar as comunidades pelo conjunto de suas relações sócio-ecológicas, e não simplesmente os produtos e mercadorias provenientes dessas áreas. Nós propomos uma abordagem para valorar os serviços socioambientais de

territórios tradicionais e defendemos que tal valoração seria mais eficiente para a conservação e a diversidade ecológica e cultural do que as propostas correntes de pagamentos por serviços ambientais (PSA).

Palavras-chaves: Pagamento por serviços ecossistémicos, serviços sócio-ambientais, Amazônia, fronteiras, camponeses

1. Introduction

In the Brazilian Amazon, forest conservation has relied on the presence of traditional communities and Indigenous peoples to secure legally demarcated protected areas from deforestation and biodiversity degradation (Nepstad *et al.*, 2002; Schwartzman *et al*., 2013; Balée *et al*., 2020). Anthropologists have documented traditional peoples' contributions to socio-biodiversity for decades (e.g. Posey, 1985; de Almeida, 1993), yet in Brazil and in many places across the world, policy makers rarely recognize such contributions. Forest governance policies largely fail to foster the conditions for communities to continue making them. Facing pressures for land-use change from a rapidly encroaching frontier of resource extraction and commodity production, there is no guarantee that Indigenous peoples or traditional communities will continue to occupy these forests or continue to fulfill this role, except under certain conditions. In this article, we detail the case of the extractive reserves of the Terra do Meio and we ask, under what conditions will traditional communities continue to occupy and protect protected areas?

One response that policymakers and scholars have given to this query is marketizing ecosystem services management. Payment for Ecosystem Services (PES) schemes often focus on marketizing individual aspects of ecosystems, from water to trees to carbon. They can be useful for conservation and protection of traditional territories all over the Amazon, and are most impactful in contested forest frontiers (Schmink *et al.* 2019), where ecologically degrading resource extractive activities compete with traditional and sustainable uses of the forest for the control of territory. Building upon the critical insights of recent PES scholarship (e.g. Shapiro-Garza *et al*., 2020), we find that market valuation of the ecosystem services themselves (e.g. trees, clean water, carbon) will be insufficient in maintaining forest diversity on a commoditizing resource frontier. Alternatively, building upon the insights of Amazonian political ecologists (Schmink and Wood, 1987; Hecht and Cockburn, 2011; Moran, 1993; Simmons *et al.*, 2007; Adams *et al*, 2009; Raffles, 2014; Hoelle, 2017; Schmink *et al.*, 2019; Kröger, 2020), in this article we propose valuing forest communities' *socio-environmental services* in ways that could respond to contemporary frontier pressures. We argue that policymakers and globally interested parties should consider creating schemes for payments for socio-environmental services (PSES).

We engage long-standing themes in political ecology scholarship, including nature-society relations in the governance of protected areas (Zimmerer, 2000, 2006), and the notion of community-based conservation (Berkes, 2004). We draw on political ecological scholarship that studies the politics of PES schemes (Kull *et al.*, 2015; Osborne, 2013; von Hedemann & Osborne 2016; Tuijnam *et al.*, 2020) to analyze the valuation of socio-ecological systems that produce socio-biodiversity in the Brazilian Amazon. Political ecological scholarship has long turned to studies of agrarian change to consider the political nature of environmental change (Watts, 1983 [2013]; Blaikie & Brookfield, 1987; Peluso, 1992; Taylor & Bhasme, 2020). We employ an agrarian political ecology approach, bringing insights from peasant studies literatures into conversation with studies of ecosystem services to suggest a novel way to value socio-environmental contributions of forest peasant peoples.

Methodology

Our study is based on ethnographic data from our fieldwork with the *beiradeiros* of the *reservas extrativistas* [extractive reserves, Resex] of *Terra do Meio*, the region between and surrounding the Xingu and Iriri Rivers in Pará State, Brazil, and participant observation and data generated by the Instituto Socioambiental, a Brazilian NGO that has worked in the Terra do Meio since 2002 and with whom we have collaborated since 2011.

Beiradeiro communities living in the extractive reserves of Terra do Meio are legally recognized as 'traditional peoples,' a term that in Brazil, as da Cunha and de Almeida (2000) explain, encompasses culturally diverse peoples that have made a trade-off with the state: "in return for control of the territory, they commit

themselves to providing environmental services" (da Cunha & de Almeida, 2000: 3).[2] Although popular narratives depict these communities as guardians of the forest, they live under internal and external pressures to allow, enable or take part in activities that would cause extensive deforestation and under pressures to leave their geographically remote communities. However, since the creation of the reserves, from 2004-2008, Brazilian non-profit organizations, some of them with support from international conservation and development funds, have worked to support these communities to improve their quality of life and enable them to maintain ways of life based on peasant household production and non-timber forest product marketing, as per consensus decisions stated by these communities.[3]

Reviewing non-timber forest product marketing schemes and expanding our analysis to the entirety of forest peoples' livelihoods, in this article we ask how incentive structures can be organized to maintain traditional people in protected areas and enable them to maintain ecosystem functions in them. We first detail the frontier pressures facing forest communities in the Terra do Meio. Then, we demonstrate how *beiradeiro* communities produce socio-ecological diversity. We suggest how investments could be structured to maintain the *colocação*, the territorial unit of forest peasant livelihoods in certain parts of the Brazilian Amazon that sustains people and produces social and ecological diversity.[4] We conclude the article detailing how PES proposals that seek to value individual aspects of ecosystems (e.g. carbon or water or even individual commodity chains, such as Brazil nuts, Bertholletia excelsa) fail to understand a central aspect of our research findings: that is, that what maintains and produces diverse ecological systems in this part of the Amazon (and we indicate this is true elsewhere) are the socio-ecological relations of peoples living in the forest.

2. Market frontiers in the Terra do Meio

In the Terra do Meio region, extractive reserves, which are protected areas designated for sustainable use by traditional peoples such as rubber tappers, border a rapidly advancing front of deforestation. Atop the northern section of the Terra do Meio mosaic of protected areas (see map below, Figure 1), three extractive reserves, alongside with Indigenous lands and other conservation units, act as a buffer to activities that drive deforestation: illegal logging, illicit gold mining, land-grabbing and cattle ranching. Pressures to deforest these territories date back at least to the 1970s, when the military dictatorship opened the Transamazon Highway. Road construction opened a resource frontier for logging, land speculation, petty cattle production and gold mining, with disastrous impacts on ecological systems and genocidal effects for tribal Indigenous populations (Moran, 1976). The roads brought a logging boom and a gold rush in wildcat mines, or *garimpos*, in the 1980s and 1990s (Cariello, 2007).

As land market pressures pushed farther from the highway, in the 1990s the Terra do Meio became a site of intense illicit land-grabbing and illegal logging activities. Most of these activities took place in areas that were not under any state environmental protection nor legal land tenure regimes for the occupant communities. Through the early 2000s, the resource frontier in speculative land claims exploded across the Transamazon into the Terra do Meio, with rampant land-grabbing, or *grilagem* (Schwartzman *et al*., 2010). Several *grileiros*, land grabbers, made claims to massive swaths of forest, logging, clearing land and bringing hundreds of head of

[2] The Terra do Meio is also home to many Indigenous peoples, including the Arara, Araweté, Asurini, Kayapó, Kuruaya, Parakanã, Xipaya and Yudja peoples. Most of the other residents of the territories came to the region to take part in the rubber economy after the turn of the twentieth century (Weinstein, 1983; Dean, 2002).

[3] While a number of Brazilian non-profits and civil society institutions have been involved in the Resex of the Terra do Meio, Instituto Socioambiental is presently one of the few non-profit organizations still involved in this work. The Comissão Pastoral da Terra (CPT) was deeply involved in early efforts to document land grabbing and human rights abuses in the Terra do Meio region. The CPT, ISA and the Movimento pelo Desenvolvimento na Transamazônica e Xingu were important institutions in the creation of the Resex. The Conselho Nacional do Seringueiro (CNS), the National Rubber Tapper's Council, were never very involved in rubber tapping communities in the Terra do Meio, although they were certainly aware and in communication with some people in them (Schwartzman *et al.*, 2013).

[4] The term most used within forest peasant communities to describe household territories of use is *localidade*, which covers the same area as the less frequent, but still common, term *colocação*. We use the latter term because of the incidences of use outside and beyond the Terra do Meio region, including in Resex of the Alto Juruá in Acré, an area some of the authors have studied as well. While we are not familiar with possible other terms used in areas such as the Tapajós region, we find the concept of the *colocação* has relevance beyond our study area.

cattle in to fill new ranches. In some areas along the Xingu and Iriri Rivers, communities were forcibly removed, homes burned, and families threatened with death if they returned (Schwartzman *et al*., 2010; Bratman, 2019).

As part of a struggle against this land-grabbing and illegal logging, traditional peoples in the Terra do Meio, along with international support and Brazilian NGOs, succeeded in securing the demarcation of three extractive reserves beginning in 2004: the Extractive Reserves of Riozinho do Anfrizio, Rio Iriri, and Rio Xingu (Velasquéz, Villas Boas & Schwartzman, 2006; Souza, 2006; Villas-Boas *et al*., 2003). Those living in protected areas are a population of people described in social science literature as 'riverine peasants,' *riberinhos* or *caboclos* (Nugent, 2002); however, they refer to themselves as *beiradeiros* (riverbank peoples).

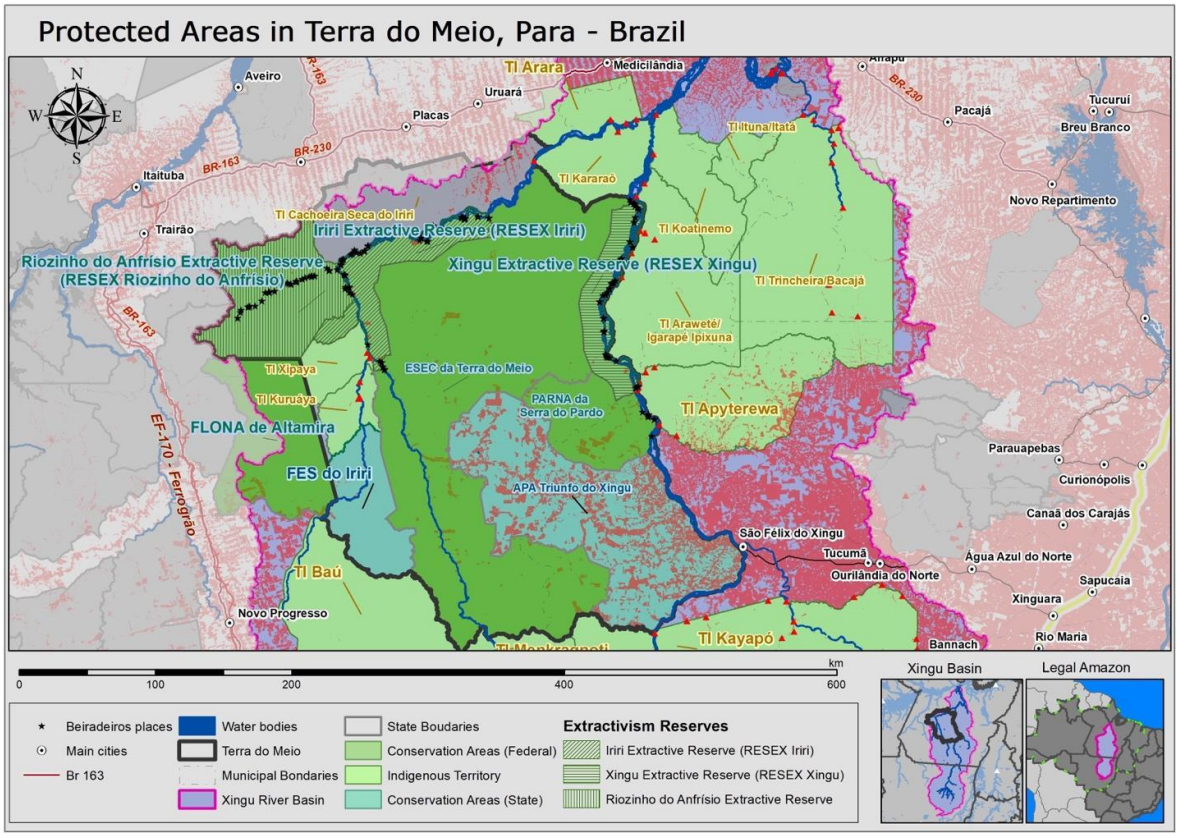

Figure 1: Map of the Terra do Meio: protected areas and deforestation. Source: Instituto Socioambiental, 2019.

Today, new land uses are found across this frontier landscape. Around Altamira, the construction of the Belo Monte dam, a mega-hydroelectric complex that cost US$ 18.5 million to build, brought tens of thousands of short-term construction jobs, massive urban development in Altamira, a huge influx of state capital and ambiguous results for energy production (Fearnside, 2017). The Canadian firm Belo Sun Mining's proposal for a vast gold mining complex similarly promises thousands of short-term jobs and massive ecological restructuring (Tófoli *et al*., 2017). Furthermore, as environmental protections remain largely unenforced, ranchers, farmers and illicit miners push operations further into protected territories, advancing resource frontiers at unprecedented speed; actions the government either encourages or fails to condemn. In the past five years, law enforcement in the vast territory of Terra do Meio has been scant, while deforestation has increased considerably across the whole of the Xingu River basin (see Figure 1).

Traditional communities in the Terra do Meio live amid the pressures of an encroaching 'commoditizing resource frontier' (Kröger & Nygren, 2020), where violent frontier resource extraction activities (e.g. illicit timbering, illegal gold mining, petty cattle production) are paving the way for the expansion of globalized commodity market land uses (e.g. commodity agriculture, industrial mining, and energy production). These pressures arise from internal and external causes. The expanding cattle ranching frontier pushes illegal loggers and illicit land speculators close to and even into protected territory, and loggers and land grabbers often threaten violence against those that stand in their way. At the same time, illegal activity promises residents of the reserve avenues to satisfy basic necessities that the state fails to furnish (e.g. healthcare, transportation and communication connectivity). As those in the Terra do Meio face mounting 'development' pressures, these occupants of protected areas make complicated decisions about how to respond to increasing demand for forest resources and their own desire for improving quality of life in front of an encroaching cattle, logging, and mining frontier and in a moment of state and civil society abandonment.

Scholars have long considered Brazil's Amazon region to be a frontier geography (Schmink & Wood, 1984; Bunker, 1984; Hecht & Cockburn, 2011; Cleary, 1993; Nepstad *et al*., 2002; Hecht, 2005; Thaler *et al*., 2019). Where logging, land grabbing, gold mining, and even marginal cattle ranching are all aspects of a resource frontier (Peluso, 2017) encroaching into the Terra do Meio, the advance of commodity-oriented agriculture, the exploration of highly capitalized mining operations, and construction of the vast energy production complex indicate a commodity frontier (Oliveira & Hecht, 2016). This frontier is following close behind resource frontiers in areas surrounding the Terra do Meio mosaic of protected areas. Additionally, these are also 'frontiers of existence' (Kröger, 2021), where questions of what kinds of life can exist are remade as resource and commodity frontiers advance (Kröger, 2022). As such, the Terra do Meio, like much of the Amazon, is also a 'contested frontier,' where multiple actors, from multinational corporations, global environmental organizations, petty capitalists, smallholding peasants to forest-dwelling communities vie for the control and future of forests, resources, and land tenure (Schmink, 1992; Schmink *et al*., 2019).

3. Conservation and traditional peoples' presence in the forest

Concern over mounting pressures to open protected lands to agriculture, logging and mining is not new. In fact, since the creation of the reserves after 2004, scholars have been asking how these protected areas can be sustained into the future. Some scholars ask if human presence is effective for conservation at all (e.g. Nolte *et al*., 2013). Studies from the Amazon indicate that protected areas with human presence have been more effective at forest conservation when compared with uninhabited areas (Nepstad *et al*. 2006; Nelson & Chomitz, 2011; Instituto Socioambiental, 2015). Our experience concurs with the work of Nepstad *et al*. We find that protection of traditional territories and stemming deforestation are contingent upon how cultural, political, and social aspects of a particular group interact with external pressures and outside actors.

The question of state capacity for enforcement is key to understanding conservation in the region, as the state enforcement apparatus generally cannot, or will not, reach the protected areas (Instituto Socioambiental, 2015). ICMBio (Instituto Chico Mendes de Conservação da Biodiversidade), the federal agency responsible for managing protected areas, is incapable of upholding legal protection or incentivizing conservation in areas under pressure from development simply because, currently, they do not have enough agents to do so. For example, in the Terra do Meio, in 2021, there were only two agents allocated to more than 200,000 square miles (518,000 km^2). The agents reside one to two days of travel from their field sites, and are equipped with limited resources. Aggravating the situation, from 2019-2022 environmental inspection actions were constrained by speeches and directives from the President of the Republic and the Minister of the Environment.

Despite occasional ICMBio operations in the conservation units, the presence and continuous surveillance of the territory depends on its own inhabitants. When the extractive reserves were created, families' continued occupation of the territory was not guaranteed, as they did not have access to schools, health care, transportation and markets for local products. In fact, many families had moved to Altamira in search of a higher quality of life before the creation of the Resex. Since the rubber crisis, these families had struggled to make a living in the forest. When the rubber bosses abandoned the industry (after the 1970s) rubber tappers were left in the forest, unrecognized by the state, without legal rights to land or services. Struggling to find economic

activities to replace rubber as the main income source, as discussed, the populations were involved in small-scale gold mining (*garimpos*), a feline fur trade, and commercial fishing. By the 2000s, mining and fur trading had been prohibited by federal law and fishing failed to support all of the households, as stocks were depleting (Instituto Socioambiental, 2017a). More than strictly a matter of economic opportunities, from the families' perspective, continued occupation of the territory depended on improvements in their quality of life. Therefore, the challenge became how to promote traditional activities that could improve quality of life and guarantee conservation. One basic step was to build a strong local organization that would be able to respond to outside pressures and make decisions about how resources were used and distributed. That meant that, to support conservation, NGOs and those interested in conservation goals had to support traditional communities in building leadership capacity in local governance and had to respect their customary ways of life. In this way, governance made sense to the communities and engaged them. In order to do so, the Instituto Socioambiental, an organization with a long history working with Indigenous peoples of the upper Xingu and other regions, increased their presence on the ground in Altamira, working to support the *beiradeiros* community organization.

Upon the creation of the extractive reserves, most of the *beiradeiros* did not have access to education, health care, consistent transportation or communication technology. In the 2000s, for example, 80 percent of the Terra do Meio's population lacked legal identification and were illiterate. Since the creation of the conservation units, NGOs and governmental organizations organized and coordinated actions to ensure policies would be implemented in the region to better the quality of life of the local population. In 2007, a network of organizations was formed and able to mobilize different actors for implementing of governmental services in the territory, coordinating leadership development, strengthening the capacities of community associations, and bringing local agrarian and non-timber forest product producers into more direct relationships with national markets and government purchasing agreements (Straatmann, 2014).

Beiradeiros defined their priorities: access to basic schooling; health care services; two-way radios for communication; and, above all, fair prices and markets for non-timber forest products. Therefore, in 2009 Instituo Socioambiental and Imaflora (another Brazilian institution that works with forest economies and certification) conducted a study to evaluate the viability of non-timber forest products and determine prices of products, set to the *beiradeiros'* expectations (Imaflora and Instituto Socioambiental, 2010a, 2010b, 2010c).

Instituto Socioambiental and Imaflora worked to put *beiradeiros* in contact with companies interested in buying local products for a fair price, while respecting traditional ways of life, including the wholefood grains and baked goods company, Wickbold, and the rubber products company, Mercur. Leadership at these companies became invested in the idea of using their supply chains to support traditional ways of life, while the non-profit groups worked with *beiradeiros* and industry representatives to have conferences and meetings in each other's respective geographies. Negotiations involved companies' representatives visiting communities and visits from *beiradeiros* to the companies. During these visits, communities explained to the corporate visitors how traditional economic activities operated and openly discussed the minimum standards needed for prices, products, and quality control. They also set as a condition for their partnership that prices should be fixed for the entire harvest, so that families could better make seasonal plans for their other activities and household economies. At those negotiations, communities were also able to include the maintenance of their traditional practices as part of the agreements, detailing how these economies were related to traditional ecological knowledge systems. The community associations now have more than thirty trade partners, including companies, public schools and hospitals.

Once these first contracts were operational, families needed working capital to get through the rubber and Brazil nut harvests without taking on debt. Rubber tapping and gathering Brazil nuts demand months of labor that only delivers a product at the end of the harvest. Historically, the rubber tappers would get advances of merchandise from rubber bosses or itinerant merchants (*regatões*, or river traders, Weinstein, 1983), the advances coming at high prices, payable with forest products, the prices for which the traders valued very low. Today, *beiradeiros* operate trade posts called cantinas with more than R$600,000 (ca. US$115,000) in a working capital fund that the *beiradeiros'* associations control, centrally housed in Altamira, all of which was donated or came in the form of grant dollars. The cantinas lend out capital in the form of merchandise, repayable, without interest, in the form of forest products, the prices of which are set at the beginning of the harvest. Each

community (or cluster of communities) has control over its own cantina and its own working capital. Community members decide on prices for merchandise and payments for the elected manager, generally set as a percentage of her/his work.

While this system is based on an old patron-client relationship dating back to the era of the rubber bosses (called *aviamento*), where control of capital and decision-making rests in the hands of the patron (*patrão*), in the cantinas each community has control of the capital and decisionmaking. With the decline of rubber economies, forms of *aviamento* continued to take shape in the pelt trade, commercial fishing and even in gold mining camps to some degree, informing river trader's (*regatões*) credit/debit method. They structured people's lives and sustained communities in complicated ways, although not without exploitation. The cantinas reverse some of the fundamental power relations of the patron/client system. As Ney Xipaya, a cantina manager, explained at a meeting in April of 2017: "The cantinas project is just like the old *patrão's* store. Only now, the community is the *patrão*." The cantina offers a solution that fits within the moral economy of peasant communities in the Amazon (Scott, 1977). As a system of production that relies on the extension of credit in the form of merchandise, repayable with non-timber forest products, the cantina aligns with a moral economy developed through patron-client relations with *patrões* It is a part of a broader moral economy of Amazonian forest peasant communities (Rezende, 2016; Kröger, 2020).

Establishing direct sales contracts and the cantinas network has created pathways to improved income and community organization in ways that further improve the quality of life for *beiradeiro* communities (alongside improvements in governmental services, such as education, land tenure, safety and health care, cf. Straatmann, 2014; Instituto Socioambiental, 2017a). Our research indicates that continuing to support the viability of non-timber forest product markets is one important way of supporting communities in their expressed desire to stay in the forest and counter pressures for deforestation. While the communities are able to negotiate higher-than-market prices with these companies, the products of the cantinas are not competitive on the open market. The high prices paid for these products depend on philanthropic investment and NGOs' technical assistance. These forest products cannot, on their own, compete with frontier activities that drive deforestation, such as mining, logging, and even cattle ranching. The challenge in these reserves is how to secure conservation from the starting point of securing diversity, in opposition to market competition. Our research shows that systems that remunerate conservation should carefully consider precisely how non-timber forest products, and the entire year-round productive activities that *beiradeiro* households engage in, produce socio-ecological diversity. When *beiradeiros* produce rubber, Brazil nuts and other forest products, they also produce much more than commodities. They collectively take part in territorial management and produce diversity.

4. Producing socio-ecological diversity and the *colocação*

In this section, we detail how *beiradeiro* households produce socio-ecological diversity through the geographies of the *colocação*. Scholars have argued that traditional peoples in the Amazon, particularly those at times classified as *ribeirinhos* (riverine peoples) or *caboclos* (a racialized term for mixed settler and Indigenous-descendant peoples), can be usefully thought of as Amazonian forest peasant peoples, as they sustain their communities through diverse household productive activities throughout the course of the year (de Almeida, 1993; Nugent, 2002; Rezende, 2016). As several authors have detailed, the peasant household differs from commodity agriculture in that families spend their time neither in the production of goods for market sale, nor for wage labor. Rather, households primarily take part in productive activities for the reproduction of their households (Chayanov, 1966; Scott, 1977). This does not, however, mean that peasant production is detached from market relations or completely subsistence based. Quite on the contrary, peasant production across the world has often been closely tied to marketing goods. The important distinction is that peasant production often involves entire households in an array of activities, and rather than conducting agricultural activities of seeking wages to secure money with which to live, market and cash transactions form one part of complex productive activities that bring resources to household reproduction (Chayanov, 1966; Shanin, 1971).

In the Terra do Meio, the geography in which socio-ecological diversity is produced is the *colocação*. The *colocação* is a basic spatial unit of occupation for between one and three *beiradeiro* families (de Almeida,

2012). In these spaces, across decades, rubber tappers and their descendants cultivated knowledge, techniques, and activities specially developed in these spaces. These territorial units are made up of the residences of the families, a small yard with fruiting trees and plants, containers with herbs, a *casa de farinha* (manioc flour milling house), small fields of a quarter-hectare or so, and an extensive network of trails into the forest and areas for hunting and collecting plants. All together, these extensive areas generally cover around 900 hectares. The trails of a *colocação* include *estradas de seringa* (rubber tapping trails averaging roughly four kilometers connecting the native wild rubber trees [Hevea brasiliensis]); *piques de castanha* (trails in the forest connecting Brazil nut [Bertholletia excelsa] groves); trails to açai palm (Euterpe oleracea) groves, babaçu palm (Attalea speciosa) groves, and diverse other non-timber forest producing plants; trails to hunting grounds; and trails connecting *colocações* with each other.

The maps below display a relatively standard example of the patterns of *beiradeiro* occupation of the *colocação*, and the extensive areas of the forest covered by networks of trails, along with the areas of residences, gardens and fields.

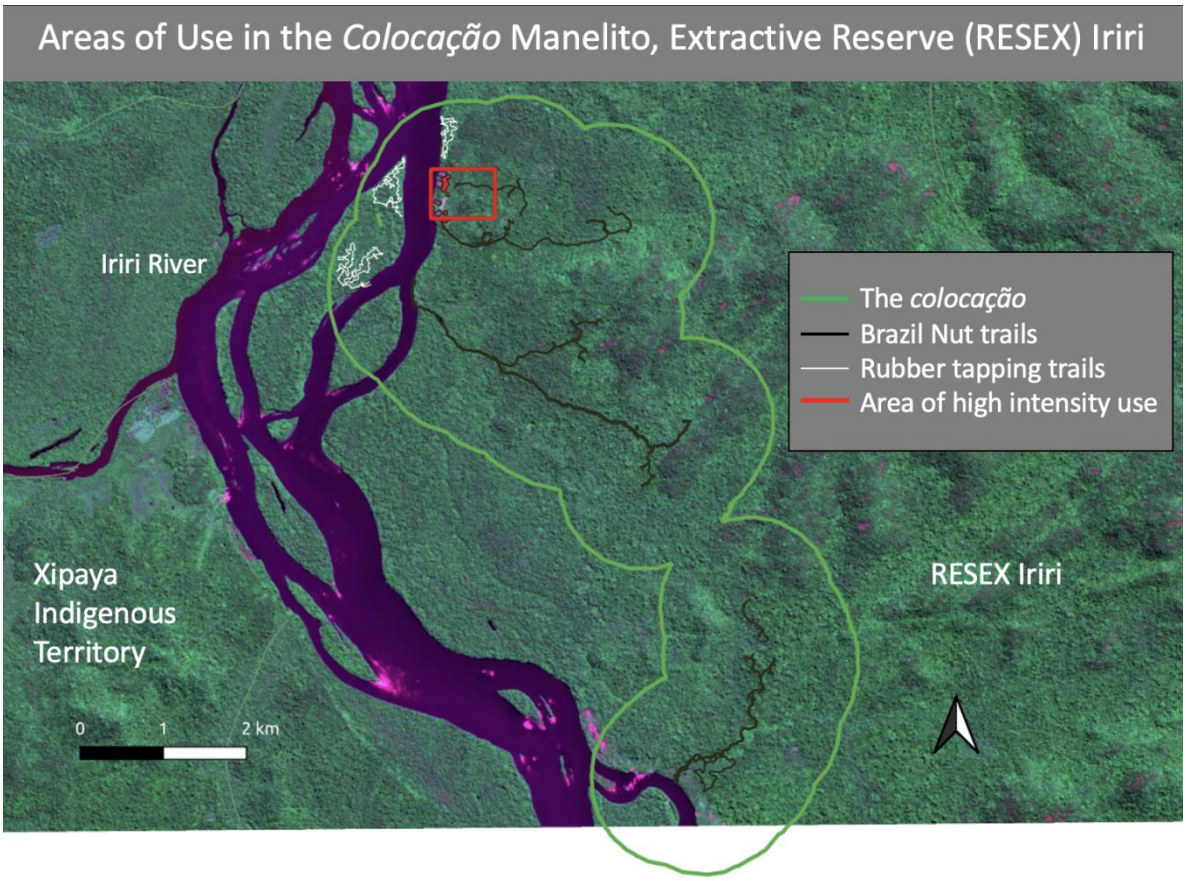

Figure 2: Map of the *Colocação* Manelito, Iriri River. Source: Instituto Socioambiental, 2019. The green solid line demarcates the *colocação*, roughly 900 hectares, comprising a kilometer radius around the main *piques de castanha* (Brazil nut groves, in the black lines); black lines are trails to Brazil nut groves; white lines are rubber tapping trails; and the red box delineates the area of use directly proximate to homes (and the area of the subsequent map).

The first map (Figure 2) illustrates the geographic extent of the *colocação*. The second map (Figure 3) documents the areas of use, such as fields, yards, residences and public buildings that cover only four and half hectares for the three families in the *colocação*. The highlighted red rectangle contains public use buildings (in this *colocação* there is a school, a health post, and a community association house for the greater region), the residences and their ports-of-access to the river, yards and field areas (highlighted in red as irregular polygons), along with surrounding forest.

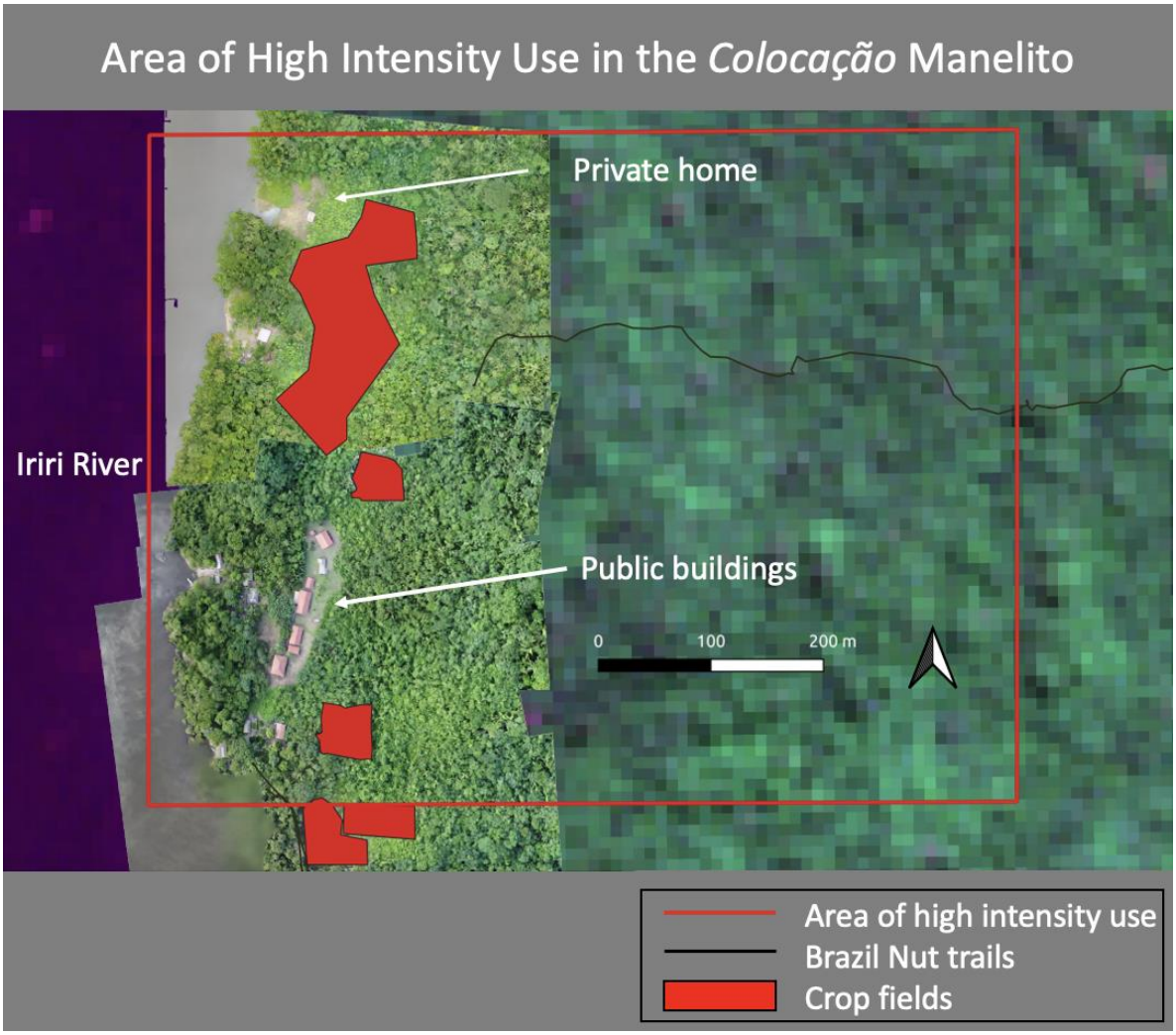

Figure 3: Map of the area of use. The solid red box frames the areas of high intensity of use, including public buildings and family residences; the red blocks are fields. Source: Instituto Socioambiental (2019)

Within the *colocação*, and across an annual cycle, *beiradeiro* families perform various activities. Each season of the year involves different productive activities, each based on knowledge developed about the forest cycles. Here we describe the productive system of the *colocação*, based on our research and the documentation of community researchers. In the *beiradeiros'* calendar, the year is divided between winter (November to April) and summer (May to October), the main distinction between them being the predominance of rain during the

wintertime (Instituto Socioambiental, 2017b, 80). The members of a *beiradeiro* family can carry out more than 50 different productive and household reproductive activities over the course of a year (Soares & Soares, 2018). Collection of Brazil nuts, the main source of income for most households, for example, demands peak labor in the first months of the year, but the preparation for the harvest begins up to five months before the collection, with the observation of flowers and the presence of fruits in the Brazil nut trees, followed by clearing the Brazil nut trails. If a good harvest is predicted, *beiradeiros* prepare to spend weeks breaking Brazil nut pod outer-shells, usually beginning in January. Observation of Brazil nut trees can also indicate low productivity each year, leading families to plan for alternative activities, such as the extraction of *copaíba* oil (Oliveira & Santos, 2018; Instituto Socioambiental, 2017a). When harvesting *copaiba* oil, the *beiradeiros* spend days, weeks and even months up rivers and streams, often deep inside the forest (Soares & Machado, 2019).

Starting in June, the rubber season extends until November, as river waters recede and leave the seasonally flooded river margins dry. There is a break in August, when it is time to intensify work on opening and planting new gardens, and when rubber tree production decreases. Among other traditional activities, hunting and the use of plant species for food, construction, and health practices stand out. Hunting is directly related to the knowledge of the habits and life cycles of animals, knowledge that is not limited to game hunting. As for the use of local plants, in the Riozinho do Anfrísio alone (a tributary of the Iriri River) *beiradeiros* know and manage more than 200 species, similar to the number of useful species known by nearby Indigenous peoples (Silva, 2016) This figure reinforces the deep knowledge these communities have developed about the forest and its cycles.

Planting crops in nearby gardens, fields and in forest clearings is another common activity among *beiradeiro* families, both for household consumption and for commercial production. Along the Iriri River, a single family grows more than fifty types of plants, including species and varieties (Silva, 2019). The main space of cultivation is the fields (*roça*) where families grow various varietals of bitter and sweet manioc, all of which are used in the production of flour, cake, porridge, tapioca and *tucupi* (broth). In addition to a variety of types of *mandioca* (wild or bitter manioc) and some *macaxeira* (also called sweet or tamed manioc), the gardens include corn, squash, maroon cucumber (Cucumis anguria), okra, string bean, fava bean, sweet potatoes (Ipomoea batatas), cará yams (Dioscorea sp.), sugar cane, watermelon, bananas, papaya, rice, peppers, cucumbers and tomatoes. In the Riozinho do Anfrísio, community researchers registered up to eighteen types of plants in a single garden, between species and varieties (Machado, 2018). On the Iriri, researchers registered more than twenty-five known varieties of manioc, between bitter and sweet (Instituto Socioambiental, 2017b, 312), as well as fifty-nine different species in gardens and 102 in fields whose territories are included within the Ecological Station of Terra do Meio (Scoles & Santos, 2018).

It is important to note that the knowledge associated with these traditional activities is part of a cultural heritage that combines social and environmental aspects, and that these cultural practices are not static. These practices continue to be adapted, transformed, and reinvented by the *beiradeiros* families (Instituto Socioambiental, 2017b, 47). Their knowledge is mainly transmitted orally from direct observation and learning by doing, similar to other Amazonian communities (Medaets, 2011; Harris, 2005).

Forest product markets not only support conservation and forest diversity, but also a set of knowledges about biodiversity and the interaction between biophysical forest processes (Instituto Socioambiental, 2017a; Instituto Socioambiental, 2017b). Studies indicate that human presence in Amazon forests can also enhance the production of ecological diversity (Posey, 1985; Baleé, 1994, 2013). The depth of traditional knowledge and the biological diversity associated with knowledge and knowledge practices has been the subject of research in recent decades. These studies have documented the growing effort to identify and recognize the contributions of Indigenous and traditional peoples in the reproduction of biological diversity and the conservation of forest natures (da Cunha, 2012; Elbroch *et al*., 2011; Emperaire, Velthem & Oliveira, 2012; Emperaire, 2013; Klenk *et al*., 2015; Lyver *et al*., 2015). Archaeological and historical ecology research has also shown that traditional peoples and Indigenous communities have made significant contributions to forest diversity over centuries. These studies have found that the current diversity of the Amazon rainforest results from the careful management carried out by Indigenous people, which involves the selection of varieties and species, and the creation of small disturbances in the forests that open the possibility of species diversification (Balée, 2006; Clement *et al.*, 2015; Balée *et al*., 2020) This practice continues to be carried out not only by Indigenous peoples,

but also by *beiradeiros*, *quilombolas*, and other contemporary traditional peoples. Such findings challenge traditional definitions of what a forest is (González & Kröger, 2020).

5. Valuing socio-environmental services

Traditional communities' customary activities produce more than just subsistence and income-generating commodities. *Beiradeiro* communities in the Terra do Meio produce socio-ecological diversity, a characteristic we suggest should be valued not in its end result (e.g. more diverse forests, forest products or handicrafts or artwork, etc.) but as a set of socio-ecological relationships maintained by *beiradeiros* labor. As noted above, *beiradeiros* use their territories in ways that generate diversity. Most of their products are not competitive in a strict market sense, and most products and services related to the *beiradeiro* livelihood and territorial management are not recognized as part of a market. PES schemes, as currently organized, are insufficient for remunerating these activities. We suggest that payments for socio-environmental services (PSES) that remunerate traditional communities should focus on the recognition of products and services that result from traditional uses of the territories. Securing conservation and diversity in these protected areas relies upon supporting the forest-based livelihoods and the *colocações* system.

In the Terra do Meio, non-timber forest product economies support more-than-market values in the sense that 'values' are what people define as important (Graeber, 2001, 2006; Sousa, 2019), and not only the price paid for a commodity. This does not mean, however, that protecting these other values leads to either the non-existence or rejection of market relations. On the contrary, peasant societies are marked by their partial relations with the state and the market, and particular views on how to maintain those relationships (Chayanov, 1966; Scott, 1977; Rezende, 2016). As explained, to continue to occupy these territories in ways that support conservation, these forest peasant communities require improved quality of life conditions and economic incentives that account for the breadth of the values that their livelihoods produce. Such incentives can counter the pressures of advancing commoditizing resource frontiers. These conclusions have important implications for conservation policies on a global scale, especially for the conservation of territories of traditional peoples and communities. The successful experiences in the Terra do Meio serve as a model for such a system. Thus far, the Instituto Socioambiental and other partners have raised funds and organized negotiations with investors in forest product value chains and territorial management. Long-term public investments could be substituted for these private and philanthropic donations and investments for the promotion of forest livelihoods and the production of the system of the *colocação.*

Incentive structures that maintain *beiradeiros* livelihoods are vital because other PES schemes that are fully market-based are unable to accurately value standing forests and the socio-ecological relations and diversity of the forest. For instance, some REDD Readiness programs in Acre that have resulted in funding for larger development projects, such as road construction, have demonstrated that existing PES schemes fail to value the socio-ecological systems that produce diversity (Kröger, 2020).

The system of production associated with the *colocação* at present produces less cash income and profit than commodity agriculture. Commodity agriculture, however, also creates massive wealth inequality and brings destitution and violence to many people in the region. The establishment of 'cattle capitalism' (Kröger, 2020) and other agro-industrial productive systems often violently expropriate people from the land and result in few individuals retaining real profits, relying on the complete devastation of ecological diversity and the forest. The production system of the *colocação*, instead, maintains social well-being, while producing diversity and maintaining conservation. It is not focused on specialization, competition and maximization. Its efficiency comes from its capacity to produce diversity over a vast territory. For such systems to continue to exist, they must be protected and encouraged, especially in frontier landscapes, like the Terra do Meio.

One route to protecting these landscapes would be PES. The concept of ecosystem services has recently gained economic and political interest (Wunder, 2005, 2015; Wunder *et al*., 2018). Many PES schemes propose the transformation of an element of nature – carbon, water, forest cover – into a commodity to be traded on the market. Such a model is insufficient to account for forms of production and life not accounted for in the commodity form. For example, mechanisms such as the Reduced Emissions from Deforestation and Degradation Readiness (REDD+), in their implementation tests as REDD Readiness projects, have at times had

incomplete outcomes when implemented with Indigenous peoples and in traditional people's territories (Federação de Órgãos para Assistência Social e Educacional, 2013; Faustino & Furtado, 2015). When treating carbon as a metric for conservation systems, some programs have started to remunerate local communities in such a way that shifts resource management practices so that communities do not continue the management and extensive use of forest areas (Greenleaf, 2020). This risks the loss of ecological diversity and of the territorial protection from illegal deforestation. These changes also have potentially negative implications for cultural rights and the transmission and reproduction of traditional knowledge between generations. The drive to separate nature and culture, inherent to the inability to see forests as anthropogenic constructions despite extensive documentation (Balée, 2006; Ishikawa & Soda, 2020), is a central feature of market-economic systems that rely on false divisions between the natural and the social.

Critics of PES have identified that few programs worldwide are able to adhere to the principles of ecological economics (de-Blas *et al.*, 2016; Wunder *et al.*, 2018), and equally fail to 'get the science right' (appropriately intervene in ecological systems), when designing programs (Naeem *et al.*, 2015). Other critics argue that market-based environmental solutions and PES programs in particular are a result of neoliberal policy regimes (Heynen *et al.*, 2007; Castree, 2008). These policies have driven the privatization of land and natural resources, propelling resource and commodity frontiers forward, which often results in the dispossession of Indigenous peoples and traditional users from land and resources (Kosoy & Corbera, 2010; Fairhead, Leach & Scoones, 2012; Osborne, 2013; von Hedemann & Osborne, 2016).

Across Brazil, PES programs that are intended to support forest peoples have had limited success. The *Bolsa Verde* program, which was terminated in 2018, paid cash stipends to impoverished households to maintain forest cover, which Wong *et al*. (2019) find had a 4.72% reduction in deforestation in participating areas. The *Bolsa Floresta* program, operating through a philanthropy in Amazonas state since 2008, pays for conservation outcomes in communities in protected areas (Bakkegaard & Wunder, 2014). Both *Bolsa Verde* and *Bolsa Floresta*, however, remain quite different from our case. People in territories receiving *Bolsa Floresta* payments are generally under less pressure to deforest, limiting the additional impact of the investments (Cisneros *et al.*, 2022). Furthermore, both programs are direct cash payments for forest cover, a strategy that risks incentivizing further integration with cash-based market activity, not forest-based livelihoods. As its monitoring report indicates, *Bolsa Verde* was designed as a cash-transfer program and it had a greater impact on income than on promoting local productive systems and socio-ecological relations (CIEDS, 2016).

In 2021, the Brazilian congress passed a law, the *Política Nacional de Pagamento por Serviços Ambientais*, or National Policy for Payment for Environmental Services, which sets out a series of policies that would govern a market (to be created in the future) for ecosystems services, such as water, carbon, conservation of standing native forests. The policy will be funded entirely through payments from private business and philanthropy (Bezerra, 2021; Amaral, 2021). While the precise outcomes of this legislation remain unclear, it defines Indigenous people and local communities as priorities for PES schemes. While these are promising beginnings, our research indicates that if the forthcoming market puts value on individual aspects of ecosystems (e.g. water, carbon) and discretely defined conservation outcomes, it will not adequately value socio-environmental systems that maintain and produce diversity.

In a wider Latin American context, Guatemala, Costa Rica, Peru, and Mexico have PES programs that directly remunerate Indigenous communities for conservation services (FAO & FILAC, 2021). Studies have shown that Ecuador's Socio Bosque program and Peru's National Forest Conservation Program both discouraged invasions of Indigenous territories and had limited social benefits alongside conservation outcomes (Jones *et al*., 2020; Kowler *et al*., 2020). These are promising models that deserve closer examination as their results become clearer.

Shapiro-Garza *et al.* propose that scholars and policy makers understand PES programs as unable to conform to market logic and, therefore, should reject commoditization as the central logic for PES programs. Doing this will allow Global South actors to "adapt these initiatives to local development pathways and needs" (Shapiro-Garza *et al.*, 2020, 19; see also McElwee, 2017; Greenleaf, 2020). In line with this argument, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) has stopped using the idea of ecosystem services in favor of a concept that documents "nature's contributions to people and quality

of life" (IPBES, 2018, 10), which is more culturally inclusive (Diaz *et al.*, 2018). A recent IPBES assessment of the valuation of nature outlines steps for policymakers to begin to incorporate 'sustainability aligned' values across society (IPBES, 2022, 4). This is a reorientation that allows an understanding of non-Western approaches to nature, in addition to ecosystems, such as biodiversity, *Pachamama* or *Mother Earth*. We suggest that a similar movement should be made in relation to mechanisms to encourage Indigenous and traditional peoples' forest management practices: livelihood-based systems that can fight global warming and the loss of biodiversity.

We support the IPBES approach as a more inclusive concept, but we also recognize the need for concepts similar to 'environmental services,' as proposed by the Food and Agriculture Organization (FAO) of the United Nations, which could be legible to the *Política Nacional de Pagamento por Serviços Ambientais* and other PES initiatives. We consider ecosystem services to describe the contributions made by nature to the well-being of humans, while environmental services are human actions that protect or increase the provision of ecosystem services by nature (such as reforestation actions or the generation of biodiversity in traditional agricultural systems). This definition for environmental services is, therefore, in alignment with the FAO's proposal for payments for environmental services, in which such payments could account for the contributions of farmers in generating positive externalities within the ecosystems they manage. Environmental services are positive externalities of human activities, and they may be unintentional and have off-site impacts (FAO, 2007). In the case of Indigenous people and traditional communities, however, we propose the concept of socio-environmental services, a concept that stresses the links between biological and cultural diversity over vast territories, and which illustrates one formulation of environmental services.

More than a conservation mechanism, payments for socio-environmental services are, therefore, a matter of how to differently structure valuation. While traditional peoples require the forest as a condition of existence, market agents and their interlocutors tend to look at these territories as resources and sources of potential profit. This situation results in conflicts over the use of forests and the fate of biodiversity and raises the question of who has the power to determine the value of these elements (Martinez-Alier, 2003; de Almeida, 2013). Because capitalist systems of value allow and incentivize capitalist resource extraction without accounting for socio-ecological externalities, valuation of socio-environmental services require more than simply market mechanisms to value their socio-ecological contributions. Traditional activities and diverse forest-product production systems depend on incentives to continue (e.g. Jaramillo-Giraldo *et al*., 2017).

Therefore, state support for socio-environmental valuation is necessary because markets cannot in themselves intercede in defense of the diffuse benefits generated by traditional management and in defense of values that are alternative to those of the market. Without state intervention it is likely that market conservation schemes may once again fail to account for their externalities (if in new and reworked ways) and fail to adequately incentivize traditional peoples' livelihoods in the full breadth and diversity of their activities and socio-ecological relationships (Soares-Filho *et al*., 2005; de Almeida, 2016). A livelihood-based systems approach that values socio-environmental services should combine incentives for certain forest-product value chains (influencing individual choices), and the provision of state services with the goal of maintaining livelihoods (supporting community well-being). The outcomes are not, therefore, measured in ecosystem calculations, but in terms of how well a suite of policies, subsidies, and investments support the socio-ecological relationships that uphold conservation.

In the Terra do Meio, incentive structures that work to maintain *beiradeiro* livelihoods are crucial, as is law enforcement in the territories. As previously discussed, under the Bolsonaro regime, although a product of longer processes of hollowing out of federal bureaucracies, the government's environmental agencies are effectively unable to monitor and protect the areas. Incentive structures will necessitate the state's willingness and capacity to respond to illegal invasions. Historically, collaboration with ICMBio (the Chico Mendes Institute for Biodiversity Conservation, the enforcement agency in human-occupied protected areas) was fundamental in establishing the extractive reserve and maintaining the protected areas in the Terra do Meio. From 2010 to 2015, government agents realized the near-complete expulsion of all land grabbers and illegal land-users in the territory (Torres *et al.*, 2017). This relationship has eroded over the years, and has worsened considerably under the Bolsonaro regime. Without state structures and public policies that guarantee the security

of the territories and the provision of basic rights for *beiradeiro* families, the ability of these families to provide socio-environmental services will be compromised.

6. Conclusion

In this article we argue that traditional people's livelihoods are a form of Amazonian forest peasant household production, a unique cultural and economic form that exists through the proliferation of ecological diversity, what we term the productive system of the *colocação*. We argue that traditional peoples maintain and produce ecological biodiversity through their livelihoods; and that these ecological functions are valuable for local, regional and global climatic stability. Yet, while it is these *beiradeiro* communities that not only police and protect protected areas, but produce the biodiversity in these forests, the continuation of this set of communities providing these ecological functions is not guaranteed. Years of engaged research and work with these communities has made abundantly clear to us that their members want education for their children, the provision of healthcare, and access to transportation, communication and technology. To guarantee their presence over time, these communities need to see improvements in the quality of life and provisions of these fundamental state services. These are services that, in the Amazon, have historically followed frontiers of resource extraction and commodification: widespread deforestation, expropriation of Indigenous and traditional peoples from their land, and establishment of land-as-property markets. This has followed the seemingly insatiable drives of logging, gold mining and cattle ranching into forested land, what some people would call 'development.' In order to maintain traditional communities in these areas and to incentivize them not to participate in logging or mining, they require external economic support for their modes of production and livelihoods.

As we have detailed in this article, one successful route to incentivize people not to participate in these predatory economic activities has been to secure direct purchase contracts for non-timber forest products with various companies and the establishment of the cantinas network. Forest product markets not only support conservation and forest diversity, but also a set of knowledges about biodiversity and the interaction between biophysical forest processes. Further support is needed.

Appropriately valuing and pricing goods resulting from traditional management requires state-mediated valuation of the systems that produce these various social and environmental contributions. Rather than asking ourselves what the price of each ton of carbon or each liter of water should be that comes from traditional communities' territories, we can ask ourselves how much it costs to keep traditional peoples working in the forest, taking part in activities that generate diversity; or we can ask how much all the time and effort dedicated to tending gardens, rubber trails and Brazil nut trails costs. It would be possible, for example, to further research the labor involved in each productive activity, the management techniques and the associated knowledge, in order to calculate necessary subsidies for the amounts of work that traditional peoples have already expended and continue to expend in products and services that have value but not market price. Remunerating this labor at a level that local communities consider fair would be one way to value these activities in ways that traditional commodity markets fail to do.

For example, and as a comparison, we might ask ourselves: how much does it cost for any research institution to maintain twenty-five varietals of manioc on a research farm, as in the Terra do Meio? And how much does it cost to train a specialist that knows the usages for more than 200 Amazonian plants? Alternatively, how much would it cost to keep 300 security guards in an area of five million hectares surrounded by illegal activities and under constant threat of invasion? *Beiradeiros* provide such services when they harvest *copaiba* or hunt. There are many possible comparisons, and unpaid labor, but our point is that payments for socio-environmental services should begin to consider these calculations and consider investments in these very systemic aspects, not simply the fruits of their labor.

In conclusion, our examination of peasant economies and their relationship to the production of biodiverse ecologies of Amazon forests indicates that incentives for conservation should focus on upholding Amazonian forest peasant ways of life, not making payments for commodified aspects of the ecology. As our case suggests, the ability to maintain protected areas as diverse forest ecologies depends upon the presence of traditional peoples, because they are the main or the only people monitoring and enforcing laws in the territory,

and equally because their traditional management of the forests maintain and produce forest biodiversity. It is through the management of the *colocação* as the geography of a forest peasant household production that this bio-cultural diversity is produced. The continued presence of traditional peoples in these forests, however, will be predicated upon improving the quality of life in the protected areas, which will provide incentives for young people to stay in these communities and for people to choose not to take part in illegal activities.

Furthermore, we believe there are similar conditions across other Amazonian extractive reserves. Various extractive reserves face internal and external pressures to operate logging operations. Despite being launched as sustainable development initiatives, two examples from the Chico Mendes Extractive Reserve (CMER) and the Tapajós National Forest (FLONA) illustrate that so-called sustainable logging operations can bring widespread deforestation and conflicts over land use, especially in areas with pressure to open lands for cattle raising within the reserves (Kröger, 2018; 2020). Such pressures to allow logging (legally or illegally) in the reserves are at the forefront of community dynamics in the reserves of the Terra do Meio. Unlike, however, the CMER that Kröger discusses, less pressures exist for young people to enter the economy of cattle and ranching, as ranchlands continue to remain outside the Terra do Meio extractive reserves. Yet, education of young people remains a pressing concern as existing educational infrastructure does not extend to the full school year and does not teach a locally-based curriculum that might support young people staying in these communities. In the case of the Alto Juruá Extractive Reserve, in Acre state, local policies induced riverine families to move from *colocações* to very few communities on the riverbanks to have access to schools, health care, and communication. The state provided this series of direct services that were very limited by cost-cutting and small budgets, without attention to the effect upon traditional livelihoods. The result has been the dissolution of the *colocação* system in those communities (Rezende, 2010).

As more national and global actors become interested in supporting the maintenance of global climatic and ecological services, which we fully support, it is important to differentiate between valuing ecological services as such and valuing the systems and relations that produce the ecological benefits that we socially value. For this reason, we propose developing systems for valuing the socio-environmental services produced by peoples in the forest. For forest-based ways of life to continue, and to enable these families to stay in the territory, communities need remunerative systems that value their entire productive activities and outputs for the whole calendar year.

References

Adams, C., Murrieta, R. S. S., Neves, W., & Harris, M. (2009). *Amazon peasant societies in a changing environment*. Springer.

Amaral, R. (2021). Brazil: National policy of payments for environmental services is implemented. 2021. *Global Compliance News.* Retried February 20, 2021, from https://www.globalcompliancenews.com/2021/02/20/brazil-national-policy-of-payments-for-environmental-services-is-implemented-082021

Bakkegaard, R. Y., & Wunder, S. (2014). *Bolsa Floresta, Brazil*. In Sills, E. O., Atmadja, S., Duchelle, S. C. de A. E., Kweka, D., Resosudarmo, I. A. P., & Sunderlin, W. D. (eds.). *REDD+ on the ground: A case book of subnational initiatives across the globe*. (pp. 51-67). Center for International Forestry Research. https://www.cifor.org/knowledge/publication/5263/

Balée, W. (1994). *Footprints of the forest*. Columbia University Press.

Balée, W. (2006). The research program of historical ecology. *Annual Review of Anthropology*, 35, 75-98. http://doi.org/10.1146/annurev.anthro.35.081705.123231

Balée, W. (2013). *Cultural forests of the Amazon: Historical ecology of people and their landscapes.* University of Alabama Press.

Balée, W., de Oliveira, V. H., dos Santos, R., Amaral, M., Rocha, B., Guerrero, N., Schwartzman, S., Torres, M., & Pezzuti, J. (2020). Ancient transformation, current conservation: traditional forest management on the Iriri River, Brazilian Amazonia. *Human Ecology*, 48(1), 1-15. https://doi.org/10.1007/s10745-020-00139-3

Berkes, F. (2004). Rethinking community-based conservation. *Conservation Biology* 18(3), 621–630. https://doi.org/10.1111/j.1523-1739.2004.00077.x

Bezerra, G. (2021). *Politica nacional de pagamento por servicos ambientais publicada lei no. 141192021*. Retrieved February 20, 2021, from https://www.mayerbrown.com/en/perspectives-events/publications/2021/01/politica-nacional-de-pagamento-por-servicos-ambientais-publicada-lei-no-141192021

Blaikie, P. M. & Brookfield, H. C. ([1987] 2015). *Land degradation and society*. Routledge.

Bratman, E. (2019). *Governing the rainforest: Sustainable development politics in the Brazilian Amazon*. Oxford University Press.

Bunker, S. G. (1984). Modes of extraction, unequal exchange, and the progressive underdevelopment of an extreme periphery: The Brazilian Amazon, 1600–1980. *American Journal of Sociology*, 89, 1017–1064.

Carriello, F. (2007). Terra do meio: análises de desflorestamento antes e após a decretação das Unidades de Conservação e de Terras Indígenas–Resultados Preliminares. *Simpósio Brasileiro de Sensoriamento Remoto*, 13.

Castree, N. (2008). Neoliberalising nature: The logics of deregulation and reregulation. *Environment and Planning A: Economy and Space*, 40(1), 131–152. https://doi.org/10.1068/a3999

CIEDS - Centro Internacional de Estudos para o Desenvolvimento Sustentável (2016). *Relatório final do monitoramento amostral do programa Bolsa Verde – Ano base 2015.* Ministério do Meio Ambiente.

Cisneros, E., Börner, J., Pagiola, S., & Wunder, S. (2022). Impacts of conservation incentives in protected areas: The case of Bolsa Floresta, Brazil. *Journal of Environmental Economics and Management* 111(January), 102572. https://doi.org/10.1016/j.jeem.2021.102572

Chayanov, A. V. (1966). *On the theory of peasant economy*. Manchester University Press.

Cleary, D. (1993). After the frontier: Problems with political economy in the modern Brazilian Amazon. *Journal of Latin American Studies*, 25(2), 331–349.

Clement, C., Denevan, W., Heckenberger, M., Junqueira, A., Neves, E., Teixeira, W., & Woods, W. (2015). The domestication of Amazonia before European conquest. *Proceedings of the Royal Society B: Biological Sciences*, 282(1812), 20150813. https://doi.org/10.1098/rspb.2015.0813

da Cunha, M. C. D., & de Almeida, M. W. (2000). Indigenous people, traditional peoples, and conservation in the Amazon. *Daedalus*, 129(2), 315-338.

da Cunha, M. C. D. (2012). Questões suscitadas pelo conhecimento tradicional. *Revista de Antropologia*, 55(1), 439-464. https://doi.org/10.11606/2179-0892.ra.2012.46971

de Almeida, M. W. B. (1993). *Rubber tappers of the upper Juruá river, Brazil: The making of a forest peasant economy*. PhD dissertation. University of Cambridge.

de Almeida, M. W. B. (2012). As colocações: Forma social, sistema tecnológico, unidade de recursos naturais. *Mediações-Revista de Ciências Sociais*, 17(1), 121-152. https://doi.org/10.5433/2176-6665.2012v17n1p121

de Almeida, M. W. B. (2013). Caipora e outros conflitos ontológicos. *Revista de Antropologia da UFSCar*, 5(1), p.7-28. https://doi.org/10.52426/rau.v5i1.85

de Almeida, M. W. B. (2016). Desenvolvimento entrópico e a alternativa da diversidade. *RURIS-Revista do Centro de Estudos Rurais*, 10(1). https://doi.org/10.53000/rr.v10i1.2635

de-Blas, E. D., Wunder, S., Ruiz-Pérez, M., & del Pilar Moreno-Sanchez, R. (2016). *Políticas culturais e povos indígenas*. Cultura Acadêmica.

Dean, W. (2002). *Brazil and the struggle for rubber: A study in environmental history*. Cambridge University Press.

Díaz, S., Pascual, U., Stenseke, M., Martín-López, B., Watson, R.T., Molnár, Z., Hill, R., Chan, K.M., Baste, I.A., Brauman, K.A., & Polasky, S. (2018). Assessing nature's contributions to people. *Science*, 359(6373), 270-272. https://doi.org/10.1126/science.aap8826

Elbroch, M., Mwampamba, T. H., Santos, M. J., Zylberberg, M., Liebenberg, L., Minye, J., Mosser, C., & Reddy, E. (2011). The value, limitations, and challenges of employing local experts in conservation research. *Conservation Biology*, *25*(6), 1195-1202. https://www.jstor.org/stable/41315417

Emperaire, L.,Velthem, L. H. V., & de Oliveira, A. G. (2012). Patrimônio cultural imaterial e sistema agrícola no médio Rio Negro, Amazonas. *Ciência e Ambiente*, 44, 141-154.

Emperaire, L. (2013). Patrimônio agricultural e modernidade no Rio Negro (Amazonas). In Da Cunha, M. C., Cesarino, P. (eds.). *Políticas culturais e povos indígenas*, p. 59-89. Cultura Acadêmica.

Fairhead, J., Leach, M., & Scoones, I. (2012). Green grabbing: A new appropriation of nature? *Journal of Peasant Studies* 39(2): 237–261. https://doi.org/10.1080/03066150.2012.671770

FAO - Food and Agriculture Organization (2007). *The state of food and agriculture: Paying farmers for environmental services*. Agricultural Development Economics Division, United Nations.

FAO (2021). *Forest governance by Indigenous and tribal peoples. An opportunity for climate action in Latin America and the Caribbean*. Food and Agriculture Organization. https://doi.org/10.4060/cb2953en

Federação de Órgãos para Assistência Social e Educacional (2013). Visões alternativas ao pagamento por serviços Ambientais. *Caderno de Debates* [White paper]. Retrieved February 20, 2021, from https://fase.org.br/pt/acervo/biblioteca/visoes-alternativas-ao-pagamento-por-servicos-ambientais

Faustino, C., & Furtado, F. (2015). Economia verde, povos da floresta e territórios: violações de direitos no estado do Acre. Relatório da missão de investigação e incidência. *Plataforma de direitos humanos, econômicos, sociais, culturais e ambientais.* Retrieved February 20, 2021, from http://www.plataformadh.org.br/files/2015/08/economia_verde_relatorio.pdf .

Fearnside, P. M. (2017). Belo Monte: Actors and arguments in the struggle over Brazil's most controversial Amazonian Dam. *Erde*, 148(1), 14–26. https://doi.org/10.12854/erde-148-27

González, N. C., & Kröger, M. (2020). The potential of Amazon Indigenous agroforestry practices and ontologies for rethinking global forest governance. *Forest Policy and Economics*, 118(September), 102257. https://doi.org/10.1016/j.forpol.2020.102257

Graeber, D. (2001). *Toward an anthropological theory of value: The false coin of our own dreams*. Springer.

Graeber, D. (2006). Value: Anthropological theories of value. In Carrier, J. G. (ed.). *A handbook of economic anthropology*. Edward Elgar.

Greenleaf, M. (2020). Rubber and carbon: Opportunity costs, incentives and ecosystem services in Acre, Brazil. *Development and Change*, 51(1), 51–72. https://doi.org/10.1111/dech.12543

Harris, M. (2005). Riding a wave: embodied skills and colonial history on the Amazon floodplain. *Ethnos*, 70(2), 197-219.

Hecht, S. (2005). Soybeans, development and conservation on the Amazon frontier. *Development and Change* 36(2), 375–404. https://doi.org/10.1111/j.0012-155X.2005.00415.x

Hecht, S., & Cockburn, A. (2011). *The fate of the forest: Developers, destroyers, and defenders of the Amazon*, Updated Edition. University of Chicago Press.

Heynen, N., McCarthy, J., Prudham, S., & Robbins, P. (eds.) (2007). *Neoliberal environments: False promises and unnatural consequences*. Routledge.

Hoelle, J. (2017). Jungle beef: consumption, production and destruction, and the development process in the Brazilian Amazon. *Journal of Political Ecology*, *24*(1), 743-762. https://doi.org/10.2458/v24i1.20964

Imaflora and Instituto Socioambiental (2010a). *Avaliação econômica das principais cadeias de produtos da sociobiodiversidade da Resex Riozinho do Anfrísio.* Retrieved December 10, 2021, from https://www.imaflora.org/downloads/biblioteca/Relatorio_Anfrisio.pdf

Imaflora and Instituto Socioambiental (2010b). *Avaliação econômica das principais cadeias de produtos da sociobiodiversidade da Resex Rio Iriri.* Retrieved December 10, 2021, from https://www.imaflora.org/downloads/biblioteca/Relatorio_Iriri.pdf

Imaflora and Instituto Socioambiental. (2010c). *Avaliação econômica das principais cadeias de produtos da sociobiodiversidade da Resex Rio Xingu.* Retrieved December 10, 2021, from http://www.euvotopiracicaba.org.br/downloads/biblioteca/relatorio_xingu_terradomeio_imaflora_isa.pdf

Instituto Socioambiental (2015). *Rotas do saque: violações e ameaças à integridade territorial da Terra do Meio (PA).* Retrieved on May 25, 2022, from https://www.socioambiental.org/sites/blog.socioambiental.org/files/nsa/arquivos/rotasdosaque_digital02_0.pdf

Instituto Socioambiental (2017a). *Xingu: histórias dos produtos da floresta.* Retrieved on May 25, 2022, from https://acervo.socioambiental.org/sites/default/files/publications/xingu_historias_produtos_floresta.pdf

Instituto Socioambiental (2017b). *Terra do Meio/Xingu: os saberes e práticas dos beiradeiros do Rio Iriri e Riozinho do Anfrísio*. Retrieved on May 25, 2022, from https://www.socioambiental.org/pt-br/blog/blog-do-xingu/livro-registra-saberes-e-praticas-dos-beiradeiros-da-terra-do-meio

IPBES (2018). *The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services regional assessment report on biodiversity and ecosystem services for the Americas.* Rice, J., Seixas, C. S., Zaccagnini, M. E., Bedoya-Gaitán, M., & Valderrama, N. (eds.). Secretariat of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. 656 pages. https://doi.org/10.5281/zenodo.3236252

IPBES (2022). *Methodological assessment of the diverse values and valuation of nature of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.* Balvanera, J., Pascual, U., Christie, M., Baptiste, B., & González-Jiménez, D. (eds.). IPBES secretariat. https://doi.org/10.5281/zenodo.6522522

Ishikawa N., & Soda R. (2020). Commodification of Nature on the Plantation Frontier. In Ishikawa N., & Soda R. (eds). *Anthropogenic Tropical Forests. Advances in Asian human-environmental research*. Springer. https://doi.org/10.1007/978-981-13-7513-2_1

Jaramillo-Giraldo, C., Soares Filho, B., Ribeiro S.C., & 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. *Ecological Economics*, 134, 186-197. https://doi.org/10.1016/j.ecolecon.2016.12.035

Jones, K. W., Etchart, N., Holland, M., Naughton-Treves, L., & Arriagada, R. (2020). The impact of paying for forest conservation on perceived tenure security in Ecuador. *Conservation Letters*, 13(4), e12710. https://doi.org/10.1111/conl.12710

Klenk, N. L., Meehan, K., Pinel, S. L., Mendez, F., Lima, P. T., & Kammen, D. M. (2015). Stakeholders in climate science: Beyond lip service? *Science*, *350*(6262), 743-744. https://doi.org/10.1126/science.aab1495

Kosoy, N., & Corbera, E. (2010). Payments for ecosystem services as commodity fetishism. *Ecological Economics*, 69(6), 1228–1236. https://doi.org/10.1016/j.ecolecon.2009.11.002

Kowler, L., Pratihast, A. K., Ojeda del Arco, A.P., Larson, A.M., Braun, C., & Herold, M. (2020). Aiming for sustainability and scalability: Community engagement in forest payment schemes. *Forests*, 11(4), 444. https://doi.org/10.3390/f11040444

Kröger, M., & Nygren, A. (2020). Shifting frontier dynamics in Latin America. *Journal of Agrarian Change*, *20*(3), 364-386. https://doi.org/10.1111/joac.12354

Kröger, M. (2018). The new 'sustainable communitarian' logging schemes and their critique inside multiple-use conservation areas in the Brazilian Amazon: Preliminary notes. *Globalizations*, 15(5). https://doi.org/10.1080/14747731.2018.1474032

Kröger, M. (2020). Deforestation, cattle capitalism and neodevelopmentalism in the Chico Mendes Extractive Reserve, Brazil. *The Journal of Peasant Studies*, 47(3), 464–482. https://doi.org/10.1080/03066150.2019.1604510

Kröger, M. (2021). Frontiers of existence: Redefining who can exist and how at resource frontiers. *Suomen Antropologi: Journal of the Finnish Anthropological Society*, 46(1), 77–96. https://doi.org/10.30676/jfas.v46i1.99900

Kröger, M. (2022). *Extractivisms, existences and extinctions: Monoculture plantations and Amazon deforestation*. Routledge.

Kull, C. A., de Sartre, X. A., & Castro-Larrañaga, M. (2015). The political ecology of ecosystem services. *Geoforum*, 61, 122-134. https://doi.org/10.1016/j.geoforum.2015.03.004

Lyver, P., Perez, E., da Cunha, M. C., & Roué, M. M. (eds.). (2015). *Indigenous and local knowledge about pollination and pollinators associated with food production: Outcomes from the global dialogue workshop*. United Nations Educational, Scientific and Cultural Organization, United Nations.

Machado, D.S. (2018). *Relatório da pesquisa de agrobiodiversidade nas Roças, realizada na Resex Riozinho do Anfrísio. Research report.* Associação dos Moradores da Reserva Extrativista Riozinho do Anfrisio.

Martinez-Alier, J. (2003). *The Environmentalism of the poor: A study of ecological conflicts and valuation*. Edward Elgar.

McElwee, P. (2017). The metrics of making ecosystem services. *Environment and Society*, 8(1), 96–124. http://doi.org/10.3167/ares.2017.080105

Medaets, C. (2011). *Tu garante? Reflexões sobre a infância e as práticas de transmissão e aprendizagem na região do Baixo-Tapajós* [Conference presentation]. XI Congresso Luso-Afro-Brasileiro de Ciências Sociais 2011, Salvador, Brazil.

Moran, E. F. (1976). Agricultural development in the Transamazon Highway. *Latin American Studies Working Papers.* Indiana University.

Moran, E. F. (1993). Deforestation and land use in the Brazilian Amazon. *Human Ecology*, 21(1), 1-21.

Naeem, S., Ingram, J. C., Varga, A., Agardy, T., Barten, P., Bennett, G., Bloomgarden, E., *et al*. (2015). Get the science right when paying for nature's services. *Science*, 347 (6227), 1206–1207. https://doi.org/10.1126/science.aaa1403

Nelson, A., & Chomitz, K. M. (2011). Effectiveness of strict vs. multiple use protected areas in reducing tropical forest fires: a global analysis using matching methods. *PLoS One*, *6*(8), e22722. https://doi.org/10.1371/journal.pone.0022722

Nepstad, D., Mcgrath, D., Alencar, A., & Barros, A. (2002). Frontier governance in Amazonia. *Science*, 295 (5555), 629–631. https://doi.org/10.1126/science.1067053

Nepstad, D., Schwartzman, S., Bamberger, B., Santilli, M., Ray, D., Schlesinger, P., & Rolla, A. (2006). Inhibition of Amazon deforestation and fire by parks and Indigenous lands. *Conservation Biology*, 20(1), 65-73. https://doi.org/10.1111/j.1523-1739.2006.00351.x

Nolte, C., Agrawal, A., Silvius, K. M., & Soares-Filho, B. S. (2013). Governance regime and location influence avoided deforestation success of protected areas in the Brazilian Amazon. *Proceedings of the National Academy of Sciences*, 110(13), 4956-4961. https://doi.org/10.1073/pnas.1214786110

Nugent, S. (2002). Whither *o campesinato*? Historical peasantries of Brazilian Amazonia. *The Journal of Peasant Studies*, 29 (3-4), 162-189.

Oliveira, G., & Hecht S. (2016). Sacred groves, sacrifice zones and soy production: globalization, intensification and neo-nature in South America. *Journal of Peasant Studies*, 43(2), 251-285. https://doi.org/10.1080/03066150.2016.1146705

Oliveira, E. C., & dos Santos, R. R. (2018). *Pesquisa colaborativa no rio Iriri e riozinho do Anfrísio: porque as castanheiras estão diminuindo a sua produção?* [Conference presentation]. XII Simpósio Brasileiro de Etnobiologia e Etnoecologia, 2018, Belém, Brasil.

Osborne, T. (2013). Fixing carbon, losing ground: Payments for environmental services and land (in)security in Mexico. *Human Geography*, 6(1), 119–133. https://doi.org/10.1177/194277861300600108

Peluso, N. (1992). *Rich forests, poor people: Resource control and resistance in Java*. University of California Press.

Peluso, N. (2017). Plantations and mines: Resource frontiers and the politics of the smallholder slot. *The Journal of Peasant Studies*, 44(4), 834–869. https://doi.org/10.1080/03066150.2017.1339692

Posey, D. A. (1985). Indigenous management of tropical forest ecosystems: The case of the Kayapó Indians of the Brazilian Amazon. *Agroforestry Systems* 3**,** 139–158.

Raffles, H. (2014). *In Amazonia*. Princeton University Press.

Rezende, R. (2010). *Das colocações à vila: processos de urbanização no Alto Rio Tejo, Acre*. Masters dissertation. Social Anthropology. IFCH/Unicamp.

Rezende, R. (2016). *Camponeses da bacia do rio Tejo: economia, política e afeto na Amazônia*. PhD dissertation in Social Anthropology. IFCH/Unicamp.

Schmink, M. (1992). *Contested frontiers in Amazonia*. Columbia University Press.

Schmink, M., Hoelle, J., Valério, C., Gomes, A., & Thaler, G. (2019). From Contested to 'green' frontiers in the Amazon? A long-term analysis of São Félix Do Xingu, Brazil. *The Journal of Peasant Studies*, 46(2), 377–399. https://doi.org/10.1080/03066150.2017.1381841

Schmink, M., & Wood, C. H., (1987). The political ecology of Amazonia. In Litter, P. (ed.) *Lands at risk in the Third World: Local-level perspectives*. (pp. 38-57). Routledge.

Schmink, M., & Wood, C. H. (1992). *Contested frontiers in Amazonia*. Columbia University Press.

Schwartzman, S., Alencar, A., Zarin, H., & Santos Souza, A. P. (2010). Social movements and large-scale tropical forest protection on the Amazon frontier: Conservation from chaos. *The Journal of Environment and Development*, *19*(3), 274-299. https://doi.org/10.1177/1070496510367627

Schwartzman, S., Boas, A. V., Ono, K. Y., Fonseca, M. G., Doblas, J., Zimmerman, B., & Torres, M. (2013). The natural and social history of the Indigenous lands and protected areas corridor of the Xingu River basin. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *368*(1619), 20120164. https://doi.org/10.1098/rstb.2012.0164

Shanin, T. (1971). *Peasants and peasant societies.* Penguin.

Scoles, R, & dos Santos, R.R. (2018). *Avaliação do impacto ambiental das populações residentes na Estação Ecológica da Terra do Meio.* Instituto Socioambiental. Laudo pericial sobre a situação das famílias residentes no interior da Estação Ecológica da Terra do Meio.

Scott, J. C. (1977). *The moral economy of the peasant: Subsistence and rebellion in Southeast Asia*. Yale University Press.

Shapiro-Garza, E., McElwee, P., Van Hecken, G., & Corbera, E. (2020). Beyond market logics: Payments for ecosystem services as alternative development practices in the Global South. *Development and Change*, 51(1), 3–25. https://doi.org/10.1111/dech.12546

Simmons, C. S., Walker, R.T., Arima, E.Y., Aldrich, S.P., & Caldas, M.M. (2007). The Amazon land war in the south of Pará. *Annals of the Association of American Geographers*, 97(3), 567–592. https://doi.org/10.1111/j.1467-8306.2007.00564.x

Silva, F. A. (2016). *Usos tradicionais da flora nativa na Resex Riozinho do Anfrísio*. Master's thesis. Universidade Federal do Pará.

Silva, M. A. (2019). *Agrobiodiversidade* [White paper]. Associação dos Moradores da Reserva Extrativista Rio Iriri.

Soares, E. N., & Soares, L. N. (2018). *Pesquisa colaborativa sobre cotidiano da localidade Branca de Neve* [White paper]. Associação dos Moradores da Reserva Extrativista Riozinho do Anfrisio.

Soares, R. S., & Machado, D. da Silva (2019). A produção de copaíba na Reserva Extrativista Riozinho do Anfrísio, Terra do Meio, Pará. *Aru: Revista de pesquisa intercultural da bacia do Rio Negro, Amazônia*. FOIRN.

Soares-Filho, B. S., Nepstad, D. C., Curran, L., Cerqueira, G. C., Garcia, R. A., Ramos, C. A., Voll, E., McDonald, A., Lefebvre, P., Schlesinger, P., & McGrath, D. (2005). Cenários de desmatamento para a Amazônia. *Estudos Avançados*, 19, 137-152. https://doi.org/10.1590/S0103-40142005000200008

Sousa, E. (2019). Os valores dos povos da floresta. *Aru: revista de pesquisa intercultural da bacia do Rio Negro, Amazônia*. FOIRN.

Souza, A. P. (2006). *O desenvolvimento socioambiental na Transamazônica*: *a trajetória de um discurso de muitas vozes.* PhD dissertation. Universidade Federal do Pará.

Straatmann, J. (2014). *Redes voltadas para produtos florestais não madeireiros: análise da influência de redes de cooperação nas cadeias de valor da Terra do meio no Pará*. PhD dissertation. Universidade de São Paulo, São Carlos. https://doi.org/10.11606/T.18.2014.tde-31102014-141722

Taylor, M., & Bhasme, S. (2021). Between deficit rains and surplus populations: The political ecology of a climate-resilient village in South India. *Geoforum*, 126, 431-440. https://doi.org/10.1016/j.geoforum.2020.01.007

Thaler, G. M., Viana, C., & Toni, F. (2019). From frontier governance to governance frontier: The political geography of Brazil's Amazon transition. *World Development*, 114, 59–72.

Tófoli, R.M., Dias, R. M., Zaia Alves, G. H., Hoeinghaus, D. J., Gomes, L. C., Baumgartner, M. T., & Agostinho, A. A. (2017). Gold at what cost? Another megaproject threatens biodiversity in the Amazon. *Perspectives in Ecology and Conservation*, 15(2), 129–131. https://doi.org/10.1016/j.pecon.2017.06.003

Torres, M., Doblas, J., Guerrero, N., Postigo, A., & Salazar, M. (2017). *Rotas do saque: Violações e ameaças á integridade territorial de Terra Do Meio (PA).* Instituto Socioambiental.

Tuijnman, W., Bayrak, M. M., Hung, P. X., & Tinh, B. D. (2020) Payments for environmental services, gendered livelihoods and forest management in Vietnam: a feminist political ecology perspective. *Journal of Political Ecology*, 27(1), 317-334. https://doi.org/10.2458/v27i1.23643

Velásquez, C., Villas Boas, A., & Schwartzman, S. (2006). A challenge for integrated environmental management in agricultural frontier territory in western Pará, Brazil. *Revista de Administração Pública*, *40*(6), 1061-1075.

von Hedemann, N., & Osborne, T. (2016). State forestry incentives and community stewardship: A political ecology of payments and compensation for ecosystem services in Guatemala's highlands. *Journal of Latin American Geography*, 15(1), 83–110.

Villas-Boas, A., Sanches, R. A., & Scaramuzza, C. A. M. (2003). *Estudos preliminares e formulação de uma proposta técnica para a implantação de um mosaico de Unidades de Conservação no Médio Xingu*. Instituto Socioambiental.

Watts, M. J. (1983). *Silent violence: Food, famine, and peasantry in northern Nigeria*. University of California Press.

Weinstein, B. (1983). *The Amazon rubber boom, 1850-1920.* Stanford University Press.

Wong, P. Y., Harding, T., Kuralbayeva, K., Anderson, L., & Pessôa, A. (2019). Pay for performance and deforestation: Evidence from Brazil. Retrieved on December 25, 2021, from https://www.semanticscholar.org/paper/Pay-For-Performance-and-Deforestation%3A-Evidence-Wong-Harding/3f312259ae76cdf969304400c851895d00e873c0.

Wunder, S. (2005). *Payments for Environmental Services: some nuts and bolts* [White paper]. Center for International Forestry Research.

Wunder, S., Brouwer, R., Engel, S., Ezzine-de-Blas, D., Muradian, R., Pascual, U., & Pinto, R. (2018). From principles to practice in paying for nature's services. *Nature Sustainability*, 1(3), 145–150. https://doi.org/10.1038/s41893-018-0036-x

Wunder, S. (2015). Revisiting the concept of payments for environmental services. *Ecological Economics*, 117, 234–243. https://doi.org/10.1016/j.ecolecon.2014.08.016

Zimmerer, K. S. (2006). Cultural ecology: At the interface with political ecology - the new geographies of environmental conservation and globalization. *Progress in Human Geography*, 30(1), 63–78. https://doi.org/10.1191/0309132506ph591pr