

## Article

# Forests, Fields, and Pastures: Unequal Access to Brazil Nuts and Livelihood Strategies in an Extractive Reserve, Brazilian Amazon

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**Abstract:** This article examines access to an economically important forest product (Brazil nuts) and its relationship with livelihood strategies in the Cazumbá–Iracema Extractive Reserve (CIER), Acre, Brazil. The objective is twofold: (i) to clarify how social mechanisms regulating access to Brazil nuts operate and (ii) to analyse the relationship between differential access to Brazil nuts and livelihood diversification in terms of cash income. For this, we conducted 55 semi-structured interviews with household heads in three rubber tapper (*seringueiro*) communities. Our findings indicate that Brazil nuts are important to *seringueiro* livelihoods, although both access to Brazil nuts and livelihood strategies are highly variable between households and communities. Limited access to Brazil nuts is partly overcome through informal arrangements and investment in wage labour, swidden agriculture, and cattle raising, as part of highly diversified livelihood portfolios. However, restrictions to agriculture and cattle raising generate considerable tensions between many *seringueiros* and environmental managers. We highlight the importance of viewing livelihood diversification and adaptability as important components of the long-term viability of the extractive reserve model, particularly in the context of the growing uncertainties and risks associated with accelerating climate and socio-environmental change as well as amidst ongoing political dynamics in Brazil.

**Keywords:** livelihoods; Brazil nuts; extractive reserves; customary governance; cattle raising



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## 1. Introduction

Forest products are integral to rural livelihoods and are central to attempts to reconcile economic development and forest conservation in the lowland tropics [1]. As one of the most economically important internationally traded non-timber forest products and an iconic Amazonian species, Brazil nuts (*Bertholletia excelsa*, *castanha do brasil*), are widely regarded as a “cornerstone” to livelihoods-based conservation, particularly in extractive reserves (ERs) and other protected areas [2,3]. Despite their economic and strategic importance, the overall contribution of Brazil nuts to sustainable development in Amazonia is limited by a number of factors, including their uneven distribution and access [4,5]. The complex yet unclear relationship between unequal access and reliance on other livelihood strategies, most controversially, the raising of cattle, stands out as a question deserving greater attention [6,7].

Access, the “ability to benefit from things—including material objects, persons, institutions, and symbols” [8] (p. 155), is shaped by both ecological factors—namely the distribution and abundance of resources—and by such social factors as property rights and customary institutions, rules, and practices [9]. Instrumental in shaping forest-based livelihoods and, consequently, central to the long-term viability of ERs, access regimes

are nevertheless often poorly understood [2,10]. A better grasp of the role of access and its relationship to patterns of social exclusion and collaboration (both realised and potential), is thus key to understanding and supporting the vital but delicate nexus between conservation, social well-being and rural development [11].

Pioneered in Acre in the late 1980s, the ER model sought to secure the land and resource rights of forest extractivist rubber tappers (*seringueiros*) based on the premise and promise of forest-based extractivism as a model for reconciling conservation and development [12,13]. The suspension of state subsidies and the ensuing collapse of the market for wild rubber (*Hevea brasiliensis*, *seringueira*) at the same time as ERs were being created in Brazil, however, generated an existential dilemma for *seringueiros* and, consequently, for the ER model itself [14]. While Brazil nuts have somewhat helped compensate for this [15], the shift from rubber to Brazil nuts has been extremely uneven, in no small part due to the latter's unequal ecological and social distribution and access, both between and within ERs [5,16].

In those ERs where Brazil nuts occur, the historical legacy of rubber continues to shape access. For instance, *colocações*<sup>1</sup>—the household forest landholding units around which the wild rubber harvest was organised and whose size and distribution reflects the distribution of rubber trees—remain the basis for allocating usufruct rights to other forest resources within many ERs. It is therefore those households whose *colocações* happen to have most Brazil nut trees that are, in principle, in a more favourable economic position, compared to those with no or limited access [17]. The effects of such unequal access are further enhanced by the high variability in Brazil nut yields both in time (annually) and space, with some trees regularly producing little or no fruit and others producing more reliable, abundant yields [18]. At the same time however, as we discuss below, some of the social institutions derived from the rubber economy help alleviate some of the consequences of unequal access and distribution through sharing of access and resources.

Despite the growing demand for Brazil nuts, many *seringueiros* have been forced to adapt to the loss of rubber by diversifying and increasing their reliance on small-scale agriculture, cattle raising, and wage labour [14,19]. Some of these changes, and the growing reliance on cattle in particular, are a source of tension and conflict with environmental managers [20]. Clearing and burning of forests for agriculture and cattle are viewed by many *seringueiros* as key to their economic survival [21], but regarded by others as an existential threat to the ER model [22]. Clearing is discouraged through quotas in the case of agriculture, and outright bans in the case of pastures, with resulting fines sometimes generating sizeable debts and considerable resentment [20,22]. As we discuss later, the national political climate following the election of Jair Bolsonaro as President in 2019 has further complicated the relationship between *seringueiros*, cattle, environmental managers, and environmentalists.

We seek to shed light on this apparent impasse by drawing on data collected from three communities within the *Reserva Extrativista do Cazumbá–Iracema*—Cazumbá–Iracema Extractive Reserve (CIER)—Acre, each representing varying degrees of access to Brazil nuts. Our aim is to analyse some of the dynamics surrounding unequal access to Brazil nuts, including how these shape livelihood strategies. We begin by considering differential access to Brazil nuts at a household (micro) level and then examine the relationship between differential access and livelihood strategies (including investment in other economic activities) at a community level. Our first objective then is to clarify if and how social rules and mechanisms regulating access to Brazil nuts operate within the existing governance framework, assessing the role of local institutions and customary practices in overcoming the effects of unequal access. Our primary concern here is to clarify the relationship between unequal distribution and access regimes. Our community-level analysis, in turn, explores the relationship between differential access to Brazil nuts and livelihood diversification in terms of cash income. Our aim here is to elucidate how differential access to Brazil nuts might help explain the choices made by different households and communities in terms of their livelihood portfolios and investment in other important cash-generating activities. Our focus on cash and income here is explicit and intentional, not because we do

not consider non-monetary dimensions of the household economy to be substantial and crucial to well-being and local livelihoods [23], but because our aims relate specifically to understanding how the need to derive small but critical income shapes livelihood portfolios and market-based activities [24].

Our approach to access draws on the common property literature [25,26], and particularly on Ribot and Peluso's [8] distinction between direct, or "formal" (*de jure*) and indirect, or "informal" (*de facto*) access rules and mechanisms. For the community-level livelihoods analysis we draw on, and seek to contribute to, the literature on forest products and livelihood diversification, amidst the complex historical cycles and fluxes underpinning the commercialization of forest resources in the region and the social management of risk and uncertainty [27,28].

### *The Cazumbá–Iracema Extractive Reserve (CIER)—History, Governance Structure and Settlement Pattern*

The governance structure of the CIER, and of ERs more generally, is in some ways hybrid, with some elements implemented by the state, and others derived or locally adapted from the previous, rubber-based, economy. While the Brazilian State<sup>2</sup> recognizes certain collective, customary, residential, and usufruct rights [29], these are mediated through a complex series of official rules and regulations, including restrictions on agriculture, cattle raising, and the use of fire [22]. The state, moreover, is the legal owner of the land, which is otherwise inalienable and indivisible [30].

Seringueiros' livelihoods are most commonly organised around *colocações*—forest landholding units ranging in size between 300 and 500 ha that were originally allocated according to the distribution of rubber trees and wherein households retain formally recognized usufruct and land-use rights [30]. Each containing between three and five rubber-tapping trails (*estradas de seringa*), *colocações* have constituted the basic unit of residence and economic production since the 19th century rubber boom [31].

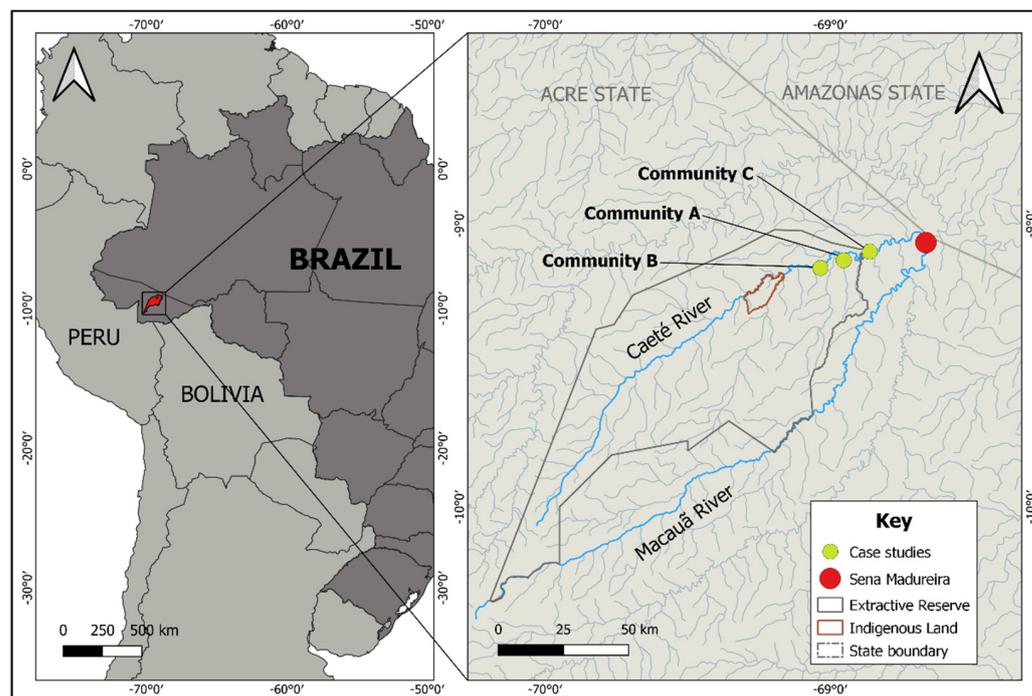
Much of the labour upholding the rubber economy at the turn of the last century was supplied by impoverished peasants who migrated to the region, mostly from northeastern Brazil [32]. Rubber bosses (*patrões*) claimed large tracts of forest, organising rubber-tapping households through a system of advance loans and debt-peonage (*aviamento*) within a network of *colocações* [33]. Seringueiros and their extended families lived in and from their individual *colocação* [34], under conditions of considerable, often coercive, precarity.

The collapse in the international price for rubber in the early 20th century following substitution by cultivated stocks from southeast Asia did not entirely decimate the rubber economy in the Brazilian Amazon. State subsidies allowed rubber tapping to continue, albeit within a much more diversified subsistence economy in which *aviamento* continued to play an important, although less overtly coercive, role [15,35]. As we noted above, the end of these subsidies in the 1990s in effect destroyed the remains of the rubber economy, which although small in absolute terms, was still critically important to the families living in the newly created ERs [36]. Be that as it may, the location, size, and distribution of *colocações* reflects the distribution and labour demands required by the harvest of wild rubber, and not Brazil nuts, whose economic importance has grown and whose abundance and distribution are different than rubber and highly clustered in stands, *castanhais*.

## **2. Materials and Methods**

### *2.1. Study Site*

The CIER covers 750,000 ha in the state of Acre, Brazil (Figure 1). Most of the reserve is covered by old-growth, largely undisturbed, tropical rainforest, with its characteristic lowland Amazonian vegetation and wildlife [37]. A total of 365 households are registered in 11 communities within the reserve. Each community (*comunidade*) consists of a cluster of *colocações* sharing facilities such as schools, churches, and community centres. Most people live along the accessible river margins, more so in areas with adjacent Brazil nut stands.



**Figure 1.** Location of the Cazumbá-Iracema Extractive Reserve (CIER), the three communities and the urban centre of Sena Madureira.

As with Amazonian peasants elsewhere, livelihoods are characteristically diversified and dynamic [38]. The household (*família*) is the local economic unit, and most families practise some combination of swidden agriculture, small-scale cattle raising, forest extractivism, hunting, fishing, and wage labour, in ways that flexibly integrate subsistence and market-based activities and economies. Although sometimes allowed in ERs, there is no *de facto* commercial timber harvesting at the CIER.

## 2.2. Data Collection

We selected three communities (“A”, “B”, and “C”) along the Caeté river (Figure 1) that represent a range of characteristics and conditions, including different access regimes and abundance and reliance on Brazil nuts (Table 1). All share similar vegetation—mostly ombrophilous open upland and alluvial forests—and soils, with argisols and luvisols predominating on the southern and northern margin of the Caeté river, respectively [39]. While the selected communities are broadly representative of the range of abundance of Brazil nuts, livelihood activities and conditions present in the CIER, we do not claim that our findings can be directly extrapolated to other communities in the reserve.

**Table 1.** Key characteristics of the three sampled communities.

Characteristic	Community A	Community B	Community C
Population ( <i>n</i> )	140	165	130
Origin	Seringueiro families	Seringueiro families	Mixed seringueiro and migrant families
Settlement pattern	Nucleated	Traditional units (300–500 ha)	Small units (20–100 ha)
Occupation history	30 years	~95 years	~15 years
Brazil nuts	Abundant	Moderate	Scarce
Access to town	By river (~4 h) with seasonal road access	By river (~6 h) with seasonal road access	By river (~2 h) with seasonal road access

Fieldwork was carried out by the first author between May and June 2015<sup>3</sup> using standard ethnographic methods and following the ethical principles of prior informed voluntary consent, confidentiality, and anonymity. Semi-structured interviews with heads of households were complemented with informal interviews, direct observation, and participant observation, as well as with extended interviews with government managers. We used convenience sampling and chain referral [40] (pp. 149–151) to select a sample of 55 households across the 3 communities, representing between 34–71 per cent of the total number of households and a range of socio-economic characteristics in each community (Table 2). The number of interviews in each community was sufficient to allow thematic saturation [41]. This, coupled with the fact that we sampled between one third to two thirds of all households in each community suggests that our data collection was able to capture some of the key themes within the study sample, even if the sample is strictly speaking perhaps not statistically representative. The overall sample comprised 53 (96 per cent) men and 2 (4 per cent) women<sup>4</sup> [42], between 20 and 70 years old (median = 39)<sup>5</sup>.

**Table 2.** Study populations and sample sizes.

Households	Community A	Community B	Community C	Total
Total	35	41	32	108
Interviewed	25	19	11	55
Percentage	71	46	34	51

We visited households for conducting the semi-structured interviews on their *colocações*, where we also carried out direct observations focusing on the land uses adopted by respondents. The semi-structured interviews were conducted in Portuguese and focused on two key questions: (i) the degree and form of access to Brazil nuts; and (ii) the relative importance of Brazil nuts and other primary sources of cash income<sup>6,7</sup>. Among respondents with access to Brazil nuts, we collected details regarding harvest, including who harvests, production figures, transportation strategy, and sales, among others (Appendix A). Additionally, we explored constraints or issues of concern associated with households' primary sources of income. We also conducted frequent informal interviews and participated in several social gatherings and community meetings, which were part of the social life of *seringueiros* and thus of the researcher immersed in their realities. Whenever possible, we accompanied people in their daily activities (e.g., rubber tapping, *swidden* management), which provided additional and valuable context and data.

### 2.3. Data Analysis

We used NVivo (Version 10<sup>©</sup>) to organise, selectively transcribe, code and identify key themes in the observational and interview data. We then used a spreadsheet software to calculate relative frequencies and visualise data regarding access and livelihood activities. For the livelihood analysis, we relied on participants' accounts of their primary and complementary income sources, which allowed us to characterise and tabulate household livelihood portfolios in a profile matrix. Finally, we collated our household data to characterise community-level patterns.

Depending on their level of access to Brazil nuts, we refer to households as “proprietors” (direct access), “authorised users” (indirect access), or “with no access”<sup>8</sup> [8,26]. We classify Brazil nut harvest as “subsistence” when households consume yields internally and as “commercial” when they sell production, although households partly consume the latter.

## 3. Results

We present our results in two parts. First, we examine access to Brazil nuts at a household level, describing how access is structured in each sampled community, paying particular attention to the informal mechanisms through which barriers to access are socially

negotiated and/or circumvented. We then give a short comparative overview of communities' livelihood profiles, considering the importance of the identified primary sources of income—Brazil nuts, agriculture, wage labour, and cattle—in relation to differential access to Brazil nuts and to each other.

### 3.1. Harvesting and Differential Access to Brazil Nuts

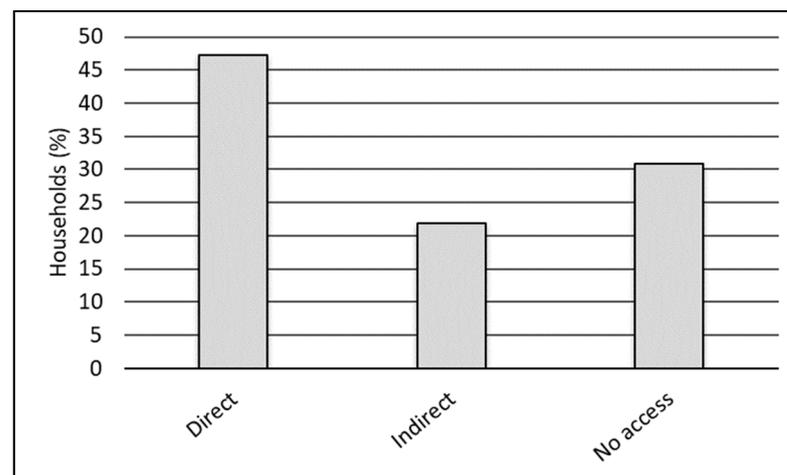
Harvesting starts in the rainy season (*inverno*), between January and February, once all fruit has fallen to the ground. Harvesters, usually men, reach harvesting sites—anywhere between 500 and 5000 m away from their homes—mostly by foot. They first gather the fruit into piles and split them open with machetes. After bagging the released in-shell nuts, harvesters transport the bags to *igarapé* (stream) or river ports by foot or in some cases using pack animals. The nuts are then transported by river<sup>9</sup> to the market, where households sell their production to middlemen.

Overall, Brazil nuts are the most commercially valuable forest product and the centrepiece of the CIER's extractive economy. Despite the short harvesting season—barely two months—about half of sampled households (55 per cent,  $n = 30$ ) derive some income from their harvest, accounting for a total gross value over USD 30,000 annually (Table 3). However, only one household relies on them as a primary income source (2 per cent) and, perhaps more significantly, 31 per cent of all households ( $n = 17$ ) have no access (Figure 2).

**Table 3.** Approximate number of Brazil nut trees, annual production, and gross revenue from harvest per castanhal (Brazil nut stand) in the three communities (C-gr: commercial harvest by a group of households; C-ind: commercial harvest by individual households; S: subsistence harvest by individual households).

Community/Castanhal	Trees ( $n$ )	Production (t)		Gross Revenue (k USD)	
		2014	2015	2014	2015
<b>Community A *</b>					
Castanhal 1—"Reserve"(C-gr)	300	4.5	6.7	3.1	6.6
Castanhal 2 (C-gr)	180	5	10	3.4	9.8
Castanhal 3 (C-gr)	150	0.9	1.5	0.5	1.5
Castanhal 4 (C-gr)	120	0.8	1	0.6	1
Castanhal 5 (C-ind)	90	2.8	2.6	2.4	2.5
Castanhal 6 (C-ind)	55	0.7	1.1	0.5	1
Castanhal 7 (C-ind)	36	0	0.6	0	0.6
Castanhal 8 (C-gr)	25	0.2	0.7	0.2	0.7
<i>Subtotal</i>	956	14.9	24.2	10.7	23.7
<b>Community B *</b>					
Castanhal 1 (C-gr)	120	6.8	7	4.4	6.9
Castanhal 2 (C-ind)	80	0.7	2	0.5	2
Castanhal 3 (C-ind)	32	0.1	0.2	0.1	0.2
Castanhal 4 (C-ind)	20	0.4	0.5	0.3	0.5
Castanhal 5 (S)	10	-	-	-	-
Castanhal 6 (S)	10	-	-	-	-
Castanhal 7 (S)	6	-	-	-	-
Castanhal 8 (S)	2	-	-	-	-
Castanhal 9 (S)	1	-	-	-	-
<i>Subtotal</i>	281	8	9.7	5.3	9.6
<b>Community C *</b>					
Castanhal 1 (C-gr)	18	0.3	0.4	0.2	0.3
Castanhal 2 (S)	5	-	0.1	-	0.1
Castanhal 3 (S)	8	-	-	-	-
Castanhal 4 (S)	4	-	-	-	-
<i>Subtotal</i>	35	0.3	0.5	0.2	0.4
<b>Total</b>	<b>1272</b>	<b>23.2</b>	<b>34.4</b>	<b>16.2</b>	<b>33.7</b>

\* Community A:  $n = 25$ ; community B:  $n = 19$ ; community C:  $n = 11$ .



**Figure 2.** Percentage of households with direct, indirect, and no access to Brazil nuts, aggregated for the three communities (community A:  $n = 25$ ; community B:  $n = 19$ ; community C:  $n = 11$ ).

As we have already previewed, this highly unequal access to Brazil nuts as a primary income source is due to the combined effects of ecological, social, and historical factors. Brazil nuts, similar to most Amazonian forest products, have a highly patchy distribution<sup>10</sup>; in the areas of upland, non-flooded (*terra firme*), mature, closed canopy forest where they grow, densities vary from 1.5 to 3 or more trees per hectare<sup>11</sup>. Only households whose *colocações* happen to include productive stands (*castanhais*) can engage in commercial harvest: remaining households are in effect excluded, unless they come to an informal agreement that allows them a share of the harvest (see below). Overall, 47 per cent ( $n = 26$ ) of the sampled households enjoy direct (*de jure*) access to Brazil nuts, while an additional 22 per cent ( $n = 12$ ) do so through indirect (*de facto*) mechanisms (Figure 2). We now describe these two access regimes and how access and harvesting is organised within them (Table 4).

**Table 4.** Types of access to Brazil nuts and associated harvest schemes.

Access Type	Term	Harvest Scheme		Social Relationship
Direct	Proprietor	Division of labour	Division of trees	Kin
Indirect	Authorised user	<i>Meia</i> contract	Subsistence	Kin or friends

### 3.1.1. Direct (*De Jure*) Access

As noted above, access rights to Brazil nuts are most often based on historically allocated rubber *colocações*<sup>12</sup>. These usufruct rights, inherited through both paternal and maternal lines, are largely customary<sup>13</sup> and widely respected. Even though harvesters are usually men, usufruct rights are inherited by children irrespective of their gender, usually upon establishing their own family. The basic unit of economic production and harvesting in the CIER is the household and, as noted earlier, we refer to households who hold direct access as “proprietors”. If a new household inherits access rights from both sides of the family, it will retain access only to the *castanhais* of one side. Moreover, descendants of proprietors who move outside the reserve generally lose their access rights, particularly if they secure other means of income.

Access to the family *colocações* is shared by proprietors and organised in one of two ways. Most often (56 per cent of proprietors,  $n = 9$ ), particularly in the larger *castanhais*, all proprietor households harvest jointly and share the profits equally. In other cases, (19 per cent of proprietors,  $n = 3$ ), usually in the mid-size *castanhais*, proprietors decide to divide up the *castanhal* between households, giving each household access to a similar number of trees, in which case each individual household takes ownership and responsibility for the

harvest in their allotted section (Figure 3). Conversely, 25 per cent ( $n = 4$ ) of proprietors outsource some or all of their harvest to households lacking direct access through a range of flexible, variable, and dynamic arrangements, as we describe next.



**Figure 3.** Direct (a,b) and indirect (c,d) Brazil nut access arrangements. (a) All proprietor households harvest jointly and share the profits equally. (b) Access is shared equally among proprietors, with each individual household taking ownership and responsibility for the harvest in their allotted section. (c) Proprietors outsource harvest of their castanhais to kin or friends entirely or in part. (d) Proprietors give kin or friends a small harvested amount as a gift (more details in text) (illustration: Carolina Guyot).

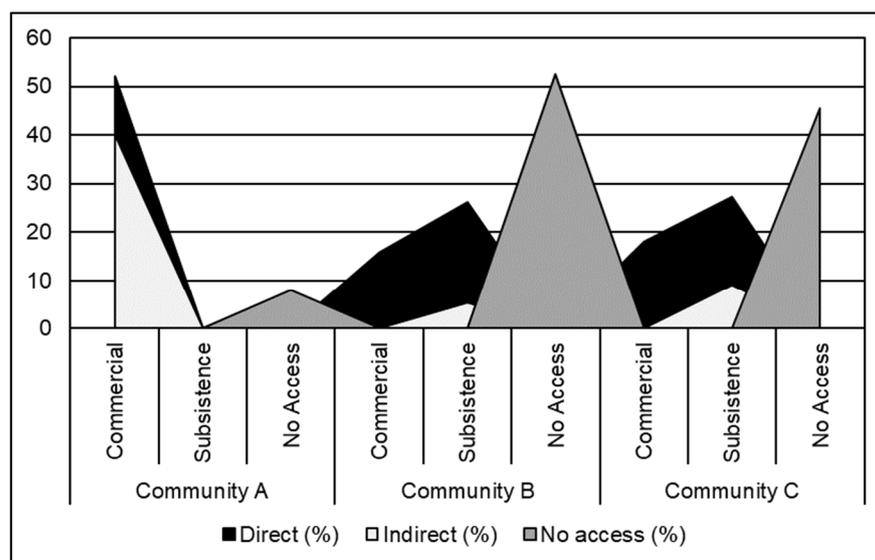
### 3.1.2. Indirect (*De Facto*) Access

There are several “informal” social institutions or mechanisms that help mitigate the effects of highly unequal distribution and access to Brazil nuts between *colocações* and households. We refer to households who receive such indirect, *de facto*, access as “authorised users”. Indirect access rights for commercial harvest are granted by proprietors most often through the *meia* (“half”) labour contract. Here, proprietors outsource partly, occasionally entirely, the harvest of one or more castanhais to kin or friends. Similar to a sharecropping

system, authorised users keep half of their harvest, handing proprietors the other half. The meia system is most commonly employed by proprietor households with abundant access to Brazil nuts or to other significant income streams. Meia contracts can be one-off or consistently used over the years. Alternatively, or additionally, proprietors may also gift a small part of their harvest to households with no access. Again, there is considerable flexibility in how arrangements are made in space and time, as these operate within a larger network of exchanges and are underwritten by an ethos in which sharing, reciprocity, and cooperation are socially valued and publicly exhorted and in ways that allow households to adapt to changing circumstances and opportunities in different communities, and over time.

### 3.1.3. Differences in Access between Communities

Access to Brazil nuts—overall, as well as in the proportions of direct and indirect access—varies considerably between communities (Figure 4). The high natural occurrence of Brazil nuts and the existence of an innovative community participation and sharing scheme in community A<sup>14</sup>, for example, mean that a majority of households (92 per cent) there have some access, either directly (52 per cent) or indirectly (40 per cent), and all of them commercialise their production. Lack of participation in Brazil nut harvest among a few households (8 per cent) in community A is not due to any barrier to entry but, rather, to the existence of alternative income streams, namely state salaries and pensions.

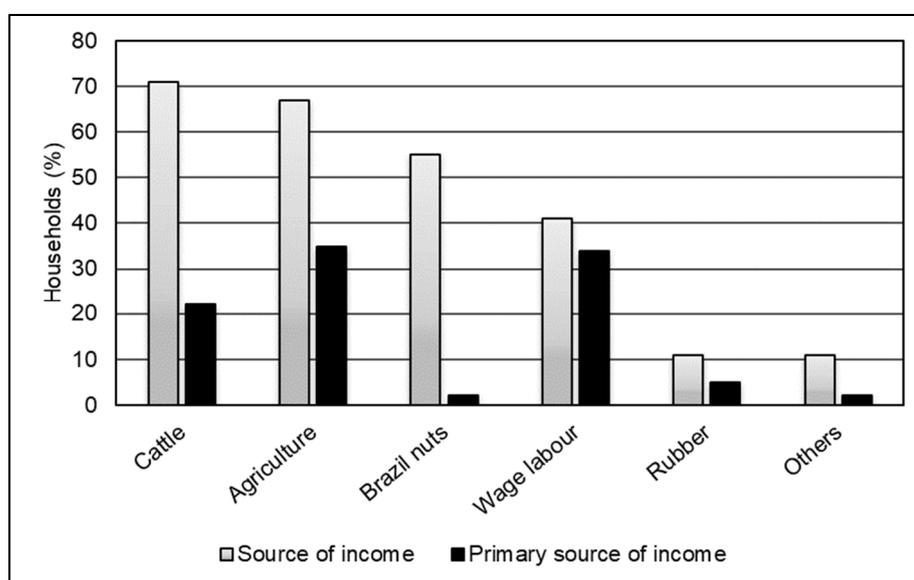


**Figure 4.** Types of access to Brazil nuts in the three communities (community A:  $n = 25$ ; community B:  $n = 19$ ; community C:  $n = 11$ ). Note: part of the “commercial” harvest may be used for local consumption, depending on the year and the need.

In communities B and C, in contrast, only about half of sampled household have some kind of access—mostly direct. Moreover, in both of these communities, there is a high percentage of households with no access at all (53 per cent in community B and 46 per cent in community C) and, in contrast with community A, a considerable proportion of the harvest in these two communities (32 per cent and 36 per cent respectively) is used mainly for subsistence. The importance of subsistence-oriented harvesting in communities B and C compared to A may relate to differences in the distribution and abundance of the resource at a micro scale. In Table 3, we list the size, yields and type of harvest of the main Brazil nut producing stands (castanhais) in each community. These data suggest that castanhais with fewer than ten trees are not used commercially, and only those with over 180 trees are significant enough to become a primary source of income to proprietor households<sup>15</sup>.

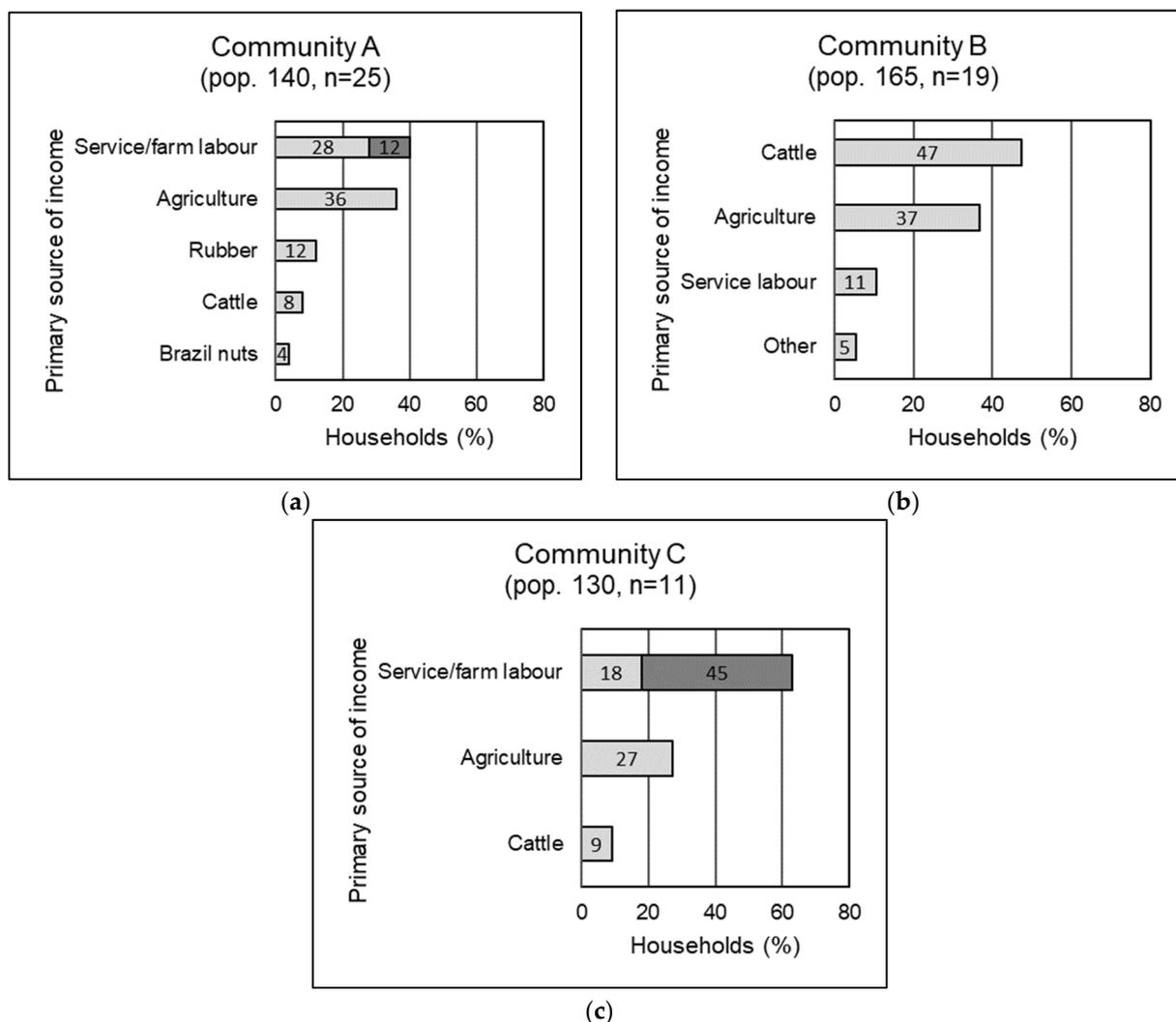
### 3.2. Comparison of Livelihood Profiles in the CIER

As with access to Brazil nuts, there are considerable differences in the livelihood profiles of the three communities. We summarise our findings by aggregating income distribution and livelihood portfolios by activity (Figure 5) and then by community (Figure 6). While Brazil nuts are present in the income portfolios of about half of all households (55 per cent), they rarely constitute a primary source of income (2 per cent). Overall, cattle raising and agriculture are most important, both in terms of their presence in household livelihood portfolios (71 per cent and 67 per cent, respectively) and as primary sources of income (22 per cent and 35 per cent, respectively). Direct income through employment as teachers, drivers, external farm workers or through pensions has a lower distribution (41 per cent) than cattle, agriculture and Brazil nuts in the income portfolio of all communities as a whole, but among those households in which it is present, it tends to also represent the primary source of income (34 per cent).



**Figure 5.** Relative frequency of the primary sources of income performed by households in the three communities (Wage labour: teachers, drivers, farm workers, and retirees; others: sporadic local work, government cash transfer programs *Bolsa Família* and *Bolsa Verde*; community A:  $n = 25$ ; community B:  $n = 19$ ; community C:  $n = 11$ ).

Our results indicate considerable differences in the sources of primary income between communities (Figure 6). The only relative constant among the three communities is the sale of agricultural produce, namely manioc flower (*farinha*), which accounts for about 30 per cent of all primary income in all cases. Wage labour, disaggregated into service labour (state pensions and salaries, boat drivers) and farm labour (manual labour on farms outside the reserve), provides the most important source of income in two communities (40 per cent in community A, 64 per cent in community C). Cattle seems to have an inverse relationship with wage labour as a primary source of income: it serves as a primary source of income for barely 10 per cent of the households in communities A and C, whereas in community B, it serves as the primary income source for almost half of households (47 per cent), again in contrast to wage labour (11 per cent).



**Figure 6.** Relative frequency of the three primary sources of income for individual households in communities A (a), B (b), and C (c) (Service labour: teachers, drivers, and retirees; Farm labour: labour on farms outside the reserve; community A:  $n = 25$ ; community B:  $n = 19$ ; community C:  $n = 11$ ).

#### 4. Discussion

While Brazil nuts are clearly important to the regional subsistence economy and to the identity of both the ER model and extractivists [43], in monetary terms, their relative importance in CIER and elsewhere [44,45], is rather uneven and mostly complementary. The finding that Brazil nuts, and forest extractivism in general, play a unequal—and at times minor—role in allowing households within ERs to engage in a sustainable manner with the market economy falls short of the expectations originally projected, perhaps unrealistically, on forest products, at least in so far as the cash-based dimensions of livelihoods and the local economy are concerned [46,47]. Similar to other forest products, and despite their global economic value and importance, the local economic importance of Brazil nuts is constrained by their unequal access, distribution, and yields, among other factors [5,18].

The unequal access to Brazil nuts presents several interconnected and layered existential challenges to the governance and viability of the CIER and its extractivist model. First, it contributes to a widespread and corrosive sense of injustice among those households with no access—about a third of all sampled households in our study—particularly in communities where others have direct, extensive, access and where *de facto* access regimes

fail to mitigate the effects of such inequality. Respondents describe what they feel is an unfair arrangement and a limited, or lost, important economic opportunity:

“We don’t have Brazil nuts. And the money we make from Brazil nuts is little, tiny. And it’s only once a year. So, the problem with Brazil nuts is this: we don’t have Brazil nuts.” (Authorised user from community A)

“The Brazil nut is not everywhere. Here in this area, we have little, little. In some places there is none. Here on my land, there are only four Brazil nut trees. I use them only for my own consumption.” (Proprietor from community C)

Second, households, and especially communities, with limited access to Brazil nuts necessarily become more dependent on other income streams. For instance, households without any access rely primarily on cattle raising (44 per cent), wage labour (38 per cent), and the selling of manioc flour (19 per cent), the first and latter which as we have seen are discouraged by environmental managers and reserve regulations. Thus, the grievance due to lack of access to Brazil nuts compounds with a feeling of inability to pursue basic livelihood activities and the sense that state interventions are punitive rather than supportive:

“We can’t even clear an area. We can only clear a small area for a tiny field. For pasture, nobody can clear nor use fire. If we burn, we get a fine that we can’t even pay for.”

“After rubber and *farinha* came to nothing, we started to live off the income from cattle. So, the sustenance that we have today is from these cattle, and they want to take away our cattle.”

Even those households with some access to Brazil nuts rely on these additional income streams as a way of attaining some level of economic security and resilience amidst variable annual yields (that is, the unequal access over time), particularly in those years where production is practically zero (Table 3).

We now focus on each of these aspects and dimensions of unequal access. First, we examine the specific issues surrounding Brazil nut harvest at an intra-community level, particularly in terms of Ribot and Peluso’s theory of access [8]. We then focus on the relationship between Brazil nut access and distribution and other income-generating streams—cattle and agriculture especially—within broader inter-community dynamics and household economic security. Third, we consider the complex, contentious and fraught relationship between cattle raising, Brazil nut harvesting, livelihoods, and the Reserve. We conclude with some remarks on the broader and policy implications of our findings amidst ongoing, and likely increasing, social, economic, and environmental risks and uncertainties.

#### 4.1. Understanding Unequal Access to Brazil Nuts in the CIER

The various formal and customary rules operating within the reserve have different effects on the unequal distribution of Brazil nuts in space and their variable yields in time. Usufruct rights associated with rubber-oriented *colocações* do little, and in some ways compound, the effects of unequal distribution on access. Conversely, customary rules and practices relating to inheritance and sharing of usufruct rights broaden social access and reduce inequalities between households. The apparent absence of crop theft [17], violations of access [48], or conflicts of access with other social groups [49], may be indicative of the effectiveness of such informal access mechanisms in the CIER, and is consistent with the generally cooperative way households tend to interact with each other, particularly within large extended family groups. The benefits afforded by indirect access through such practices as *meia*, moreover, extend beyond those related to the market economy, as Brazil nuts also play an important role in the subsistence, non-monetary economy, providing a safety net and contributing to food security and the resilience of households during times of need [50,51].

Conversely, the variability in production between years and the low productivity of trees in some years—at times close to zero (Table 3)—presents a considerable challenge to all households, including those with direct access [18,52]. Such yield inconsistencies may be one factor accounting for the fact that Brazil nuts rarely constitute the primary income source for households, even for those with considerable access, a risk which appears to be mitigated through the investment in the alternative income streams, as we discuss in the next section.

On a theoretical level, Ribot and Peluso's "A Theory of Access" [8] and their distinction between rights (property, *de jure*) and abilities (*de facto*, access) provide a useful lens through which to consider "the constellations of means, relations, and processes that enable various actors to derive benefits from resources" (p. 153). Unlike many other commercially important forest products however [27,53], barriers to entry to Brazil nuts in CIER are not multiple and complex and are mostly determined by physical access to the natural resource, a barrier which we have seen is the result of geographic and historical circumstances and that results in considerable differences in access between and even within communities. Such inequality creates a moral, and hence political, dilemma given the general ethos of sociality and reciprocity and the distaste towards individual accumulation of wealth and power that pervades in many Amazonian caboclo, indigenous and seringueiro networks of social and economic exchange. Unequal access to Brazil nuts in the CIER not only generates a sense of grievance and resentment among those who are excluded, but maybe also a complementary sense of unease among those who are included, perhaps especially so because barriers to entry are arbitrary and recent:

"There is a gentleman there, he is the only person, and his son, who doesn't have much access. I said to him: "Come harvest my castanhal in meia." And I do this to help. So, he is grateful because he benefits. And this is the way we can help each other."

As Ribot and Peluso [8] remind us, "Benefits are important because people, institutions, and societies live on and for them and clash and cooperate over them" (p. 155). Seringueiro social and economic relations are intrinsically dialogic *sensu* Morin [54]; that is, they are simultaneously complementary, competitive and antagonistic in nature and, moreover, bear importantly on how access to Brazil nuts is mediated among the seringueiros in CIER. This is not only because proprietors have a moral obligation towards those with no access, but also because the manner in which access to Brazil nuts is negotiated is itself part of a much larger, complex, network of exchanges and relations, including marriage and descent, all of which are enmeshed within deeply embedded Amazonian notions of sociality and conviviality [55,56]. This obligation to share in this case is an example of what Ribot and Peluso [8] term a "structural and relational mechanism of access" (p. 170) based on social identity, one that arguably transcends the property-access binary, as it at once constitutes a form of "moral law" and part of the bundle of rights relating to usufruct of natural resources, and a framework to socially broaden the ability to access Brazil nuts beyond the strict confines granted by the historically inherited and state-validated social institution of *colocações*.

#### 4.2. Integrating Brazil Nut Access and Livelihood Strategies

The role of income and cash is somewhat circumscribed within the hybrid extractivist economy of the CIER, particularly given the prevalence and importance of non-market subsistence and non-market-mediated exchanges. Although perhaps small in absolute terms, cash-based incomes are critically important—perhaps increasingly so—in order to purchase essential and desired manufactured goods or services, including those relating to health and education. Crucially, access to cash also helps overcome shocks and surprises—a sudden illness or death in the family or a flood that destroys crops, for instance. It is within this larger context of the household economy and, in particular within its resilience and security, that we attempt to clarify the role and constraints of Brazil nuts, specifically in relation to other income-generating streams, notably cattle raising, agriculture and wage labour.

The degree of access to market can help account for some of the main differences in the livelihoods and income generating portfolios of the three communities (Table 1) [57,58]. It was the combination of abundant Brazil nut reserves and a strategic proximity to the local town and market that led to the migration of many rubber tapping families into community A in the 1990s, and to an internal decision to parcel out the land into a series of allotments that included a formal prohibition of clearing forests for pasture, for instance. The simultaneous access to Brazil nuts and to the market in community A may also help explain the limited adoption of cattle, particularly given the way in which *de facto* mechanisms help extend access to the least privileged households (Figure 4). The ready access of community C to town and market (Table 1) has arguably mitigated the challenges presented by a lack of Brazil nut stands by allowing households to derive income from wage labour. We note that it is precisely in community B, which has a more limited access to town and to Brazil nuts, where cattle raising has acquired greater prominence (Figure 6).

Although also a crucial factor for forest product marketing in Amazonia [24], most respondents did not mention access to transportation routes as a major concern and barrier to entry for Brazil nut commercialization. Despite the important aforementioned accessibility distinctions between the three communities, they are relatively near each other and the market (Figure 1; Table 1), which may mean transportation costs for a high-value product such as Brazil nuts is not overwhelming. Moreover, despite the challenges of terrestrial transportation, the widespread presence of seasonal streams provide easy access to aquatic routes to the market during the rainy season.

For its part, the dual value of manioc as a subsistence staple and a commodity makes it an extremely valuable asset within the diversified and flexible livelihood portfolio of forest dwellers [59]. This may explain its high and consistent economic relevance across the three communities—about one third of households primarily rely on manioc trade—in contrast to cattle, whose contribution varies greatly between communities. The lower barrier to entry for agriculture compared to cattle—households are allowed to clear one hectare of forest annually for agriculture, but none for cattle—is likely another factor explaining the consistent reliance on agriculture across the three communities. Agriculture is the most important economic activity in community A, where Brazil nuts are most abundant. However, the high variability of local *farinha* prices, in contrast to cattle but in some ways akin to Brazil nuts, somewhat constrains its economic importance and thus carries some uncertainty in so far as its ability to provide a safety net in times of unexpected need.

Access to land may be another factor shaping differential investment in cattle across communities [34,60]. The aforementioned land redistribution and nucleated pattern in community A restricts access to land for new residents, particularly for pasture development. The combined effects of scarcity of Brazil nuts and the presence of large *colocações* in community B, in contrast, may have made investment in cattle more desirable. In contrast, small landholdings in community C critically limit herd expansion with the necessarily smaller herds (up to 15 heads) for use in the case of emergencies.

#### 4.3. Re-Assessing the Role of Cattle in the CIER and in Extractive Reserves

Similar to other Amazonian smallholders [7,10] and *seringueiros* in other ERs [20,34], households in the CIER rely on cattle as a way of building their savings and capital and achieving some measure of economic security, with small herds playing a key role in the *seringueiro* household economy and contributing to socio-ecological resilience. A respondent explains:

“For us to live from extractivism alone, it would be necessary for it to be valued. And it is not. If there is something to substitute cattle, we would abandon it at once. But if there isn’t, what can we do?”

Steady, if not increasing, prices for beef help mitigate the effects of unsteady yields or prices for Brazil nuts or *farinha* and provide some protection against unexpected costs relating to health or education. The fact that today cattle raising is most important where

Brazil nuts are scarce suggests that cattle are helping to fill a gap left in forest extractivism following the collapse of rubber and amidst the limitations of Brazil nuts.

In contrast to other studies [44,61], our findings do not support the notion that greater access to income through Brazil nut harvesting necessarily translates into greater investments into farm-based activities: greater access to Brazil nuts in community A appears to have restricted, not increased, investment in, and support for, cattle [34,62]. For their part, many seringueiros see no competition or antagonism between cattle and agriculture as they practise it and Brazil nuts. People are adamant that they do not clear areas with Brazil nuts for crops or pastures, ensuring that castanhais remain in conserved tracts of upland forest. Such a choice makes sense from both a cultural as well as an economic, pragmatic point of view, and concurs with the seringueiros' outrage to felling a Brazil nut tree, which in any case is protected [50].

While Brazil nuts and other forest products (with rubber as a notable exception) have lacked government subsidies, loans, or programs to incentivize production (e.g., [63]), cattle raising in the region has long been supported through state investment in disease control, infrastructural development and a sleuth of financial incentives such as credits and subsidies [7,64]. The growing cultural and social affinity to cattle in rural Acre is reflected in the identification among seringueiros, particularly younger men, with cattle and cattle culture, as evidenced in their appreciation of *sertaneja* (country) music, cowboy food and clothing, and perhaps most importantly, in their positive attitudes towards cattle raising and its association with wealth, prestige, and success [64,65].

As we have noted earlier, cattle raising is a source of tension between seringueiros and environmental managers in the CIER, and a matter of contention and debate with regard to the conservation, development and future of ERs [20,22,66]. The aversion to cattle by environmental managers and environmentalists is understandable given cattle's emblematic role in Brazil's post-1960s aggressive modernization program and State-sponsored colonisation of the Amazon [67], as well as its ongoing and increasing contribution to deforestation [68]. Large-scale conversion of forest to pasture and the associated displacement and violence towards seringueiros in the 1970s and 1980s fuelled social resistance to large-scale cattle ranching, unifying and mobilising seringueiros and consolidating their presence as a regional political force [29]. Nevertheless, and this is not necessarily contradictory, the fact remains that many if not most seringueiro households have effectively integrated cattle into their livelihood portfolios and cultural repertoires [20,64], in ways that arguably supports their ability to maintain their extractivism-based lifestyles and remain in the ER.

Ongoing broader political and economic changes have further complicated the issue and polarised positions around cattle. Since the election of Jair Bolsonaro in 2019, the federal government has been actively dismantling environmental policies and defunding environmental protection agencies such as the *Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio)* while supporting forest clearance and large-scale commercial development in the Amazon [69]. Of greater concern to many is a new draft bill submitted by the Bolsonaro government in 2020 and currently undergoing parliamentary review, to lift the ban on cattle raising in ERs<sup>16</sup>. Together with the aforementioned measures, this has intensified conflicts with environmentalists and human rights and indigenous activists, nationally and internationally [70].

As cattle ranching continues to be the main driver of deforestation in the region [71], encroachment as well as clearing in ERs have spiked [72], with many ERs experiencing increasing rates of deforestation. The average rates of deforestation in the CIER, for instance, increased forty per cent in 2018–2019 relative to 2017 [72]. In the neighbouring and iconic Chico Mendes Extractive Reserve (CMER), clearing during this time increased by as much as 131 per cent and is fifteen times that of the CIER (9831 ha and 644 ha, respectively) [72]. The high rate of forest clearing in the CMER is driven by pasture development even though, as we report in this study, Brazil nuts and extractivism seem to help limit the adoption of cattle [34,73]. There are some key differences between the CMER and the CIER which may help explain the higher rates and levels of deforestation and the expansion of cattle raising

in the former: the CMER has six times more inhabitants and a higher demographic density than the CIER, it has a higher density of roads and perimeter to area ratio, it is nearer large urban centres and, perhaps most importantly, there is an ongoing informal land market and land rentals for pasture to outsiders [66,74]. Although overall deforestation in the CMER remains below 6 per cent [74], the presence of large cattle herds contradicts the objectives of the ER model, contrasts with how cattle are generally raised in the CIER, and is reasonable cause for concern. The contrast between CIER and CMER illustrates the complexity of the issue and of the way in which different variables and factors can produce quite different outcomes and, especially, reliance on cattle and agriculture across different communities and ERs. These dynamics, as we discuss below, have some important repercussions and pose difficult questions and dilemmas to both managers and seringueiros.

## 5. Conclusions

Despite the centrality of Brazil nuts to the extractivist model and to the social identity of seringueiros in the CIER, Brazil nuts are—in terms of their contribution to household income at least—quite uneven and are a source of social and institutional tension and angst. Similar to other Amazonian ERs in Brazil, the CIER operates within what could be described as a historical paradox, insofar as it was created shortly after the time when rubber—the centrepiece of the extractivist lifeways and identity—became economically irrelevant. This paradox translates into several problems and dilemmas for environmental managers and seringueiro households, of which we have highlighted two. First, the need to identify adequate substitutes—forest products and forest-based activities which provide a source of income and which are compatible with the ideals espoused by the ER model, which in principle rules out logging and clearing of the forest. As we have seen, Brazil nuts have become, in this context, the centrepiece of the ER model, despite a lack of formal subsidies or support. Yet, as an important source of income, Brazil nuts are limited to a few communities and families. The unequal distribution and access to Brazil nuts, the main object of this study, illustrates the second aspect of the aforementioned historical paradox, whereby the distribution of landholding units and access rights—as evidenced by the rubber-oriented *colocações*—is misaligned when it comes to other forest products and their different spatial distributions.

Our article sought to understand and frame extractivist choices and strategies at the household and community level within these two broad challenges, and it is within this paradox that we see ongoing conflicts and tensions emerging between seringueiro households and environmental managers and within the ER model more generally. Despite the somewhat limited sample, our study illustrates the extent to which locally devised rules and mechanisms are able to partially mitigate the effects of unequal access and distribution, broadening access and drawing on the complex bundle of rights, obligations, means, relations and processes [8] that underwrite seringueiro social, political and economic relations and society.

In so far as they adapt, respond to, and reflect the conditions of heterogeneity, diversity, and dynamism that characterise the larger ecological, economic, and political landscape—with its embedded uncertainties—such local institutions and mechanisms would appear to contribute to the broader resilience of the socio-ecological system [28,75]. Such flexibility in time and space, however, is often hard to reconcile with the rigidity of the legislative framework [76], raising questions as to the effectiveness of centralised forms of state control and governance [77], and supporting calls for more nuanced, multi-dimensional, multi-level forms of resource governance and control [78,79].

Despite the mitigating effects of *de facto* access regimes through such social institutions as *meia*, the fact remains that many households and some communities face considerable challenges and uncertainties. The challenges imposed by unequal access to Brazil nuts may foreseeably continue to intensify through time, especially in light of accelerating and dangerous regional and local climate and environmental change [80,81], and should therefore be duly prioritised in policy making and livelihood-focused interventions [5].

Our study also illustrates the extent to which investment in different economic activities, including both cattle raising and Brazil nut harvesting, are made as part of complex decisions involving a heterogeneous set of economic activities, constraints, and opportunities. In order to fully understand—and therefore promote—Brazil nuts and forest extractivism more generally as a tool for generating forest-based, sustainable income and conservation outcomes, it is necessary to also consider the important role played by other economic activities in allowing seringueiros to remain in the Reserve. Seringueiros' livelihoods consist of integrated, complex systems—which comprise access arrangements that are shaped and rendered more flexible and adaptable through kin and social relations [10,75]—and these also need to be understood and considered as such. The challenges for science and policy to reflect, represent, and respond adequately to these complex and shifting realities, particularly considering accelerating social and environmental change, are significant, which again suggests the need to include more flexible, context-specific responses.

While our study did not directly address the level of diversification of individual households, our observations and preliminary results suggest that small-scale manioc agriculture and cattle raising might not be necessarily antagonistic, and might even potentially complement Brazil nut harvesting and support the extractivist model, in so far as (1) areas for the former do not overlap with the latter, (2) agricultural fields and pastures remain at a small scale, and (3) they may contribute to the economic security of seringueiros and, in that sense, to the long-term social viability of supporting forest-based incomes and lifeways.

As Supplementary Materials, we provide a full translation of this study to Portuguese (Translation S1).

**Supplementary Materials:** The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/land11070967/s1>.

**Author Contributions:** Conceptualization, M.A. and B.U.; methodology, M.A. and B.U.; formal analysis, B.U. and M.A.; investigation, B.U.; data curation, B.U.; writing—original draft preparation, B.U. and M.A.; writing—review and editing, M.A. and B.U.; supervision, M.A. All authors have read and agreed to the published version of the manuscript.

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**Institutional Review Board Statement:** The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of the School of Anthropology and Conservation, University of Kent (approved 11 May 2015). This research was also approved by ICMBio through the Brazilian Biodiversity Information System (SISBIO) under the authorization number 49953.

**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement:** Part of the data presented in this study is openly available in the Open Science Framework (OSF) at <https://doi.org/10.17605/OSF.IO/TPE9X>, accessed on 22 June 2022.

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## Appendix A. Brazil Nut Interview Question Guide

### Harvest

1. Who owns the *castanhal* you harvest?
2. How is harvest organized (in terms of division of labour and benefits)? Do women harvest?
3. How do you transport the nuts?

### Production

4. How many castanhais/trees do you harvest?
5. Is there any variability in production (e.g., between trees or years)?
6. How much did you harvest this year (2015)? How much did you harvest last year (2014)?

### Sales

7. Do you sell your Brazil nut production? If so, to whom?
8. For how much did you sell your production this year (2015)? For how much did you sell your production last year (2014)?
9. Do you sell your production individually or collectively?
10. Do you get any cash advances before harvest?

## Notes

<sup>1</sup> Singular: *colocação*.

<sup>2</sup> The most important state actor in the area is the *Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio)*—Chico Mendes Institute for Biodiversity Conservation—a federal institution within the Ministry of the Environment.

<sup>3</sup> The first author has since returned to the area for a total of four months.

<sup>4</sup> The gender bias in our sample reflects the fact that men are generally regarded as heads of households but also that the gender of the first author made it harder to interview women, although women, usually the wife of the household head, were often present and intervened during interviews. Still, our study may have failed to capture important intra-household dynamics, including women's access to resources, vast knowledge and use of plants, as well as income generating activities (e.g., [42]). We hope that further studies will be able to explicitly address women's roles and accounts regarding the topics studied.

<sup>5</sup> The range and median age (in years) of respondents in each of the three communities are: A (minimum = 20, maximum = 70, median = 40); B (minimum = 23, maximum = 75, median = 45); community C (minimum = 20, maximum = 57, median = 30).

<sup>6</sup> The questions related to harvest figures, products' prices, and activities' economic importance refer to the years 2015 and 2014. Monetary values in Brazilian Reais (BRL) were converted to US Dollars (USD) using the rate of 23 May 2015: USD 1 = BRL 3.07.

<sup>7</sup> By using such indicators as "presence in livelihood portfolio" and "primary source of income", we sought to provide a basic description of livelihood portfolios in order to focus on the relationship between differential access to Brazil nuts and livelihood diversification.

<sup>8</sup> The local terms are: *dono de castanha* ("Brazil nut owner", that is, proprietor), *pessoa que quebra castanha de meia* ("person who harvests meia Brazil nuts", that is, authorised user), and *pessoa que não tem castanha* ("person who has no Brazil nuts", that is, no access).

<sup>9</sup> Roads are inoperative during the inverno due to high rainfall. Conversely, high water levels in streams and rivers in the same period allow easy navigation.

<sup>10</sup> Few households plant Brazil nuts because most think the trees take too long to produce.

<sup>11</sup> There are also considerable productivity differences between trees and stands.

<sup>12</sup> Community A in our sample is an exception to this general trend. For reasons that are elaborated in the discussion, productive areas of forest were parcelled out to extended families as part of an internally led land reform process in the 1990s.

<sup>13</sup> Although rights to the land (*colocações*) and its resources are formally registered with the environmental body (ICMBio), arrangements about Brazil nut harvest are performed informally between households.

<sup>14</sup> The scheme allows a group of 17 harvesters to participate and share in the harvest of Brazil nuts owned by three proprietors through the *meia* system. Requests for access to this specific scheme by households are discussed and decided by consensus in meetings between harvesters and an appointed coordinator. Proprietors or individuals with reliable income streams, such as teachers, are excluded from the scheme.

<sup>15</sup> This does not mean that the smaller castanhais are "unimportant" or under-valued; precisely because they are not commercialised, they are important for local consumption, sharing and subsistence.

- <sup>16</sup> Bill Draft (*Projeto de Lei*) 313, 2020 (<https://www.camara.leg.br/proposicoesWeb/fichadetramitacao?idProposicao=2237320>, accessed on 20 June 2022), last updated on 18 August 2021. The bill draft must go through several levels of parliamentary analysis before it is submitted for approval by the president.

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