

The unsustainability of Extractive Reserves in the Amazon: socioeconomic demands versus environmental conservation

Josimar da Silva Freitas¹

Milton Cordeiro Farias Filho²

Alfredo Kingo Oyama Homma³

Armin Mathis⁴

Abstract: The Extractive Reserves (RESEXs) have temporarily lost their Conservation Units of sustainable use identity, as the results are unsustainable. Little past work has evaluated why this is so, and the studies that do exist fail to evaluate sustainable development based on the interrelationships between the state, production systems, and environmental impacts. This study attempts to fill that gap by evaluating the state policies, production systems, and environmental impacts preventing sustainable conservation and development. We conducted our research through the study of association with interference, where some variables depend on others. In addition, we conducted semi-open and free interviews. We conclude that RESEXs are unsustainable because these areas were created for ecosystem conservation, not for the betterment of thousands of families. This unsustainable development occurs to the detriment of state abandonment, repression, and exclusion.

Keywords: Extractivism; Agriculture; Livestock.

A insustentabilidade de reservas Extrativistas na Amazônia: demandas socioeconômicas *versus* conservação ambiental

Resumo: Temporalmente, as Reservas Extrativistas (RESEXs) perdem identidade de Unidades de Conservação de uso sustentável, à medida que os resultados se apresentam insustentáveis. Nestes termos, avaliamos os resultados das políticas estatais, os sistemas produtivos e os impactos ambientais que impedem alcançar conservação e desenvolvimento. Este estudo é importante porque poucas literaturas discutem esta temática, e as que foram enunciadas até o momento não avaliam o modelo a partir da presença Estatal, dos sistemas de produção e dos impactos ao meio ambiente, portanto, oriundos destas inter-relações. Essa pesquisa foi desenvolvida por meio do estudo de associação com interferência, onde algumas variáveis dependeram de outras, e, além do mais, foram aplicados formulários semiabertos e entrevistas livres. Aqui, concluímos que as RESEXs são insustentáveis porque estas áreas foram criadas para conservação ecossistêmica, e não para melhoria de vida de milhares de famílias. De igual modo, a insustentabilidade de conservação e o desenvolvimento acontece em detrimento do abandono, da repressão e exclusão estatal.

Palavras-chave: Extrativismo; Agricultura; Pecuária.

1 Doutor em Desenvolvimento Socioambiental pela Universidade Federal do Pará (UFPA). Graduado em Gestão Pública e Ciências Políticas pelo Centro Universitário Internacional (UNINTER). Pesquisador do Grupo Interdisciplinar em Pesquisas Socioambientais (Grupo IPÊS), Universidade Regional de Blumenau (FURB). Endereço Postal: Rua Félix Gaspar, 3290, Vila Rica, Cruzeiro do Sul/AC. Email: josimarfreitas55@gmail.com

2 Doutor em Desenvolvimento Socioambiental pela Universidade Federal do Pará (UFPA). Graduado em Ciências Sociais pela Universidade Federal do Pará (UFPA). Professor e Coordenador dos Polos de Bragança e Santa Isabel, Centro Universitário Cesumar (UNICESUMAR).

3 Doutor em Economia Aplicada pela Universidade Federal de Viçosa (UFV). Graduado em Agronomia pela Universidade Federal de Viçosa (UFV). Pesquisador da Embrapa Amazônia Oriental e Colaborador do Mestrado em Ciências Ambientais (PPGCA) da Universidade do Estado do Pará (UEPA).

4 Doutor em Ciências Políticas pela Freie Universität Berlin (FUB). Graduado em Ciências Políticas pela Freie Universität Berlin (FUB). Professor Titular do Núcleo de Altos Estudos Amazônicos (NAEA) da Universidade Federal do Pará (UFPA).

1 Introduction

In the world, there was an increase of 10% the number of Conservation Units (CUs), 18% under protection in Brazil, and these percentages of Brazilian territory, 70% are in the Amazon (VIEIRA; PRESSEY; LOYOLA, 2019). In the global scenario, the Amazon Biome plays a role of a carbon sink and reserves of fossil fuels, provisioning of ecosystem services, biological and cultural diversity (CODATO et al., 2019).

The CUs areas allow environmental preservation, achievement scientific research, tourist visitation and, in specific cases, the permanence of traditional communities for the conservation of environmental resources and the improvement in living conditions. The CUs are potential when equipped with operational planning and covers the social, economic and environmental (TEIXEIRA; VENTICIQUE, 2014). Also offer ecological infrastructure at local, national and international, but need investment for establishment of infrastructure (DIAS; CUNHA; SILVA, 2016), and effective actions that meet the goals of creating and maintaining (VITALI; UHLIG, 2009).

Chico Mendes emphasized the creation of RESEXs, which are areas that allow residents to combine environmental conservation with social development. He also said that the CUs would benefit traditional communities with varieties of extractive products the (RAMALHO, 2016), reduce deforestation and/or expansion of pastures (ALLEGRETTI, 1997), and recognize rubber tappers with public policies in education, health, culture, infrastructure and technology [...] (CNS, 1985).

The first RESEXs were formed in 1990, a result of the rubber tappers' movement in the 1980s, who sought to curb farmers' unbridled exploitation. The RESEXs were intended to preserve inhabitants' native culture and customs and to allow for the coexistence of combined extractive activities, agriculture, and animal breeding. Later, the social movements and environmental used much more with the purpose of limiting the expansion of the agricultural frontier, construction of infrastructure works, among others (ALMEIDA; ALLEGRETTI, 2018).

Law 7.804/1989 (art. 9º, 18º and 225º), which set the RESEXs in place, supported the creation of areas for environmental conservation, preservation of ecosystems, extractive production, agriculture, and animal husbandry. It placed the Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA) in charge of the reserves' management, supervision, and control. Residents were also led to believe that the state would implement social projects (health care, education, retirement programs, etc.) and incentivize production (through offering credit, technical assistance, transportation, and technology), thereby ensuring environmental balance and improving living conditions.

However, since their inception, RESEXs have been anchored in external resources and no government organization taken responsibility for managing them. Conservation Units (CUs) are subject to external oversight and the Brazilian state, although a legal entity, obeyed the decisions of the Pilot Program for the Protection of Brazilian Rainforests (PPG7).

Today, three decades after the founding of the first RESEXs, the state has done little to improve families' well-being and environmental resources in these areas. The families that live in RESEXs are feeding difficulties (MACIEL et al., 2010) and/or subsistence (OSTRY; BERG, 2011), because the primary focus of the institutions is on biodiversity (SPEAK; MIZGAJSKI; BORYSIK, 2015).

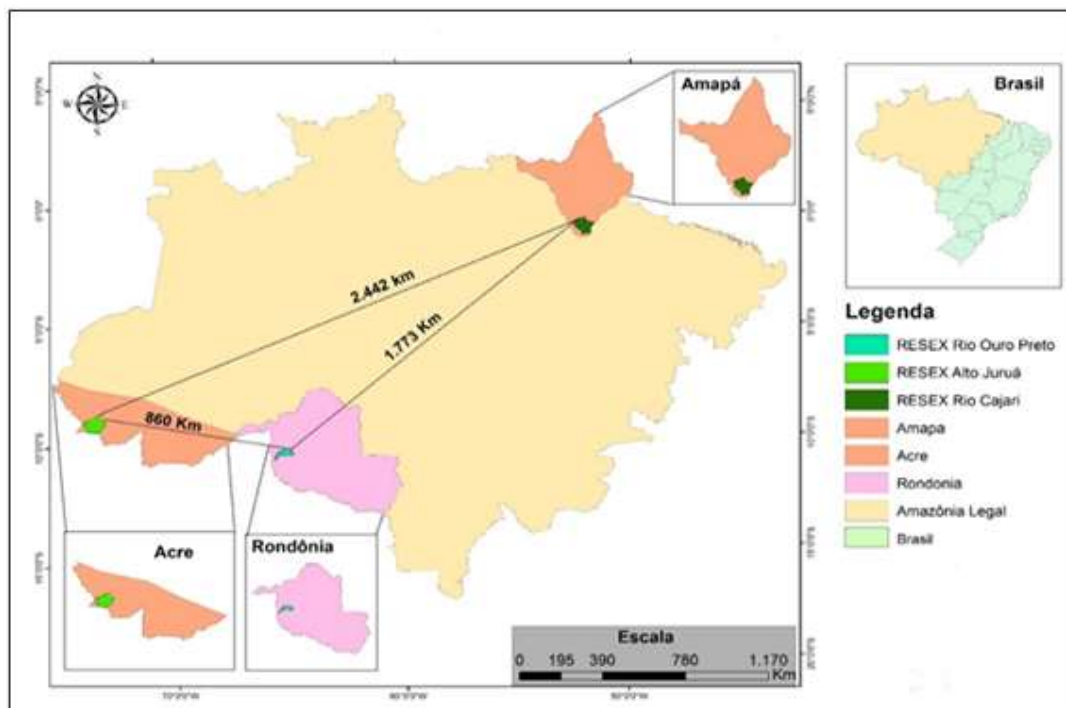
This study, therefore, seeks to comprehend why the legal creation of protected areas failed to drive sustainable development in the Amazon. Our findings are valid 30 years later. The special edition of the magazine “Desenvolvimento e Meio Ambiente”, published in November 2018, as part of the homages of 30 years of the murder of Chico Mendes (1944-1988) is emblematic in this sense (ALLEGRETTI; CUNHA; SCHMINK, 2018). The biggest positive balance was the change of attitude of the development model that the region was treading the improvement of peoples who live in it.

Our central question is as follows: Why are the Amazon RESEXs not sustainable as expected? Previous research on this question does not evaluate RESEXs production models considering the presence of state organizations, their actions, and productive systems in these areas. This study attempts to remedy that gap by incorporating these into our results.

2 Method

The research included three of the largest RESEXs in the Brazilian Amazon, which include several municipalities in the states of Acre, Rondônia, and Amapá (Figure 1). We conducted a survey with residents and environmental analysts responsible for controlling and overseeing the three RESEX. In addition, we conducted field observation and collection in September 2016 and January to March 2017.

Figure 1: Map of the Amazon Region that tells the location and the distances between the RESEXs AltoJuruá, Rio Ouro Preto and Rio Cajari



Source: The authors

By involving three states forming a scalene triangle in which shows the distances of the states of Acre, Amapá and Rondônia, whose logistics of field research and financial strategy for the implementation of 232 questionnaires to survey and its analysis were highly expensive. This field research allowed us to

talk to residents and get a closer look at their difficulties, ways of life, culture, and habits, as well as their labor activities, including collecting chestnuts, producing vegetable oils, handicrafts, hunting, fishing, agriculture, and animal.

We noted several social challenges, including in education (i.e., lack of schools, teachers, snacks, and migration of children and adolescents to urban centers) and health (i.e., sporadic preventive care, nurses, doctors, and dental services and a reliance on private or rented transport). In this sense, this study was developed in four stages: the first is a review of published works on CUs, RESEXs and economic theory. This section allows us to elaborate on the remaining three, which detail our methods, results, and conclusions.

2.1 Selection and characterization of RESEX

We conducted field surveys in the following three RESEXs: Alto Juruá-AC, Rio Ouro Preto-RO, and Rio Cajari-AP. The first is located in the municipality of Marechal Thaumaturgo, state of Acre, and has 4.170 inhabitants. The second is located in the municipalities of Guajará-Mirim and Nova Mamoré (both in Rondônia) and includes 699 inhabitants. The third is in the municipalities of Laranjal do Jari, Mazagão, and Vitória do Jari (Amapá), and includes 2.293 inhabitants (IBGE, 2010).

Our field research includes data on three productive systems in the RESEXs: agriculture (manioc flour, rice, corn, beans, etc.), livestock (cattle and buffalo), and extractivism (Brazil nut, açai, and vegetable oils). The cattle represents the largest proportion of family income, followed by agriculture and, finally, by extractivism. Although the creation of cattle is expressive, the majority of the interviewees did not inform because the herd exceeds the allowable limit.

The three RESEXs present peculiar characteristics related to the origin of the inhabitants, age, level of education, productive activities, products, as well as the percentage of households interviewed that depend on agriculture, extractivism and creation of cattle (Table 1).

Table 1: Profile of the respondents on the basis of the origin, age, schooling and productivity

RESEXs	Habitants	Age	Scholarity	Productive Activities and Products	% Family
Alto Juruá	Acreanos e Nordestinos.	41 a 60 years	-Illiterate: 36,5% -Literate and/or with formation of fundamental to superior: 63,5%.	-Agriculture: cassava flour, corn, rice, bean and tobacco. -Extractivism: vegetable oils. -Catle breeding.	-Agriculture: 77,8 -Extractivism: 1,6 -Catle breeding: 50,8
Rio Ouro Preto	Rondonienses e Nordestinos.	51 a 70 years	-Illiterate: 46,2% -Literate and/or with formation of fundamental to superior: 53,8%.	-Agriculture: cassava flour, corn, rice, bean and coffee. -Extractivism: Brazil nuts, vegetable oils and acai. - Catle breeding.	-Agriculture: 77,6 -Extractivism: 58,2 -Catle breeding: 1,5
Rio Cajari	Quilombolas, Amapaenses e Paraenses.	41 a 70 years	-Illiterate: 36,2% -Literate and/or with formation of fundamental to superior: 63,8%.	-Agriculture: cassava flour, corn, rice and bean. -Extractivism: Brazil nuts and vegetable oils. -Catle breeding.	-Agriculture: 62,7 -Extractivism: 62,7 -Catle breeding: 2

Source: The authors

This information represent the profile of respondents and their relations with the primary and secondary forests. The First Nature (primary areas) matches the extractive activities of collecting Brazil nuts, vegetable oils and acai. The Second Nature (deforested areas) equivalent to the realization of agricultural activities (cassava flour, corn, rice, bean, tobacco and coffee) and cattle breeding (HOMMA, 2010).

2.2 Research techniques

We developed a survey (BABBIE, 2003) using a semi-open questionnaire distributed to all heads of family (male and female) who had lived in the RESEXs for at least 10 years. (This residency criterion was established to ensure experience in the area and respondents' ability to provide relevant information).

We collected data from 232 residents in the three RESEX (102 from Rio Cajari, 67 from Rio Ouro Preto, and 63 from Alto Juruá). We also conducted structured interviews with 12 Chico Mendes Institute for Biodiversity Conservation (ICMBio) Environmental Analysts, four from each RESEX. The managers interviewed were gathered together at the offices of the ICMBio in Brasília-DF, Belém-PA, Macapá-AP, Porto Velho-RO, Guajará-Mirim-RO, and Cruzeiro do Sul-AC. The objective was to understand each respondent's view of the RESEXs based in their institutional experiences and to compare this data with information from RESEXs residents.

The questionnaires covered environmental, demographic, economic, social, and institutional issues. We asked respondents to evaluate the RESEXs model implemented by the state. In order to sufficiently connect our questions to respondents' daily realities, we performed a test survey in a Quilombola community

(in the municipality of Inhangapi-PA), which allowed us to adjust and correct some identified errors.

Once our research instrument was validated, we began the interviews. Interviewees, both residents and community representatives, were not identified by name but by their professional position.

The field survey took place in two stages. In the first (September 2016), we identified subjects and held several conversations with institutional managers and community leaders to obtain information about access, distances, displacements, time for each activity, and disseminating results. In the second (January to March 2017), we carried out structured interviews using a script consisting of 38 questions for residents and 29 for managers. We recorded these interviews because we understood that only in the field we are able to break the boundaries of questions of the forms.

2.3 Data analysis

We developed our research through the study of association with interference, where some variables interfered on others. For example, residents depend on state permission to implement plantations, remove wood, raise animals, hunt, fish, etc. Although this work is rudimentary and it does not involve technology to deforest and burn in primary or secondary areas, residents must still obtain authorization from the ICMBio. This association exists because there is dependence; one or more variables affects the others (VOLPATO, 2015).

Data analysis centers on statistical indicators like average, median, and fashion, and we attempt to analyze the data from several angles. We use references that correspond to the environmental, economic, institutional, and social groups to ensure the veracity of respondents' statements and/or testimony in the Results and Discussion section.

3 Results and Discussion

This section analyses our data on agriculture, livestock, extractivism and deforestation, and offers some conclusions as to whether our data confirms or refutes the findings of previous studies.

3.1 Production systems

The ineffectiveness of RESEXs is shown by the income of families engaged in the three productive systems (extractivism, agriculture and livestock). Income from extractive production is the lowest due low production, market difficulties, little attention, and/or scarce investments. The dispersion of the residents, reduced amount per puller, degree of perishability of the product, among other things, reduce the opportunities of access to the market (SIVIERO et al., 2016).

Fearnside (1989) draw attention to the need to prioritize RESEXs as soon as possible in order to improve residents' living conditions. However, his position is not generally held, since data reveals that extractivism is an insufficient source for families' social reproduction and forest maintenance. One survey respondent confirms this:

For us, it is toilsome to talk about and work on RESEXs, because they are areas of high complexity (insufficient financial resources), and every day social and productive demands increase (Environmental Analyst/ICMBio, Belém-PA, March, 2017). The creation of RESEXs should represent autonomy in the management of the territory, however, the current format configures granting of territory by the State to State (DUMITH, 2018).

It is not enough to create sustainable areas: abandoning families to repressive legal regimes without effecting policies for social and productive change does not solve root cause of environmental degradation. Our respondents agreed:

They wanted to exclude the RESEXs, because who collects is park, although the biological reserves are not expensive, are areas of research. At the time of PPG7, the RESEXs worked well, but when the money dried up, it simply stopped working. (Environmental Analyst/ICMBio, Brasília-DF, February 2017). The creation of RESEXs, even that ensures the ownership of the land, did not represent a major change, in terms of quality of life (CAVALCANTE; BATISTA; SOUZA, 2018).

Today, I receive demands for creating RESEXs, but the state does not have resources to create Conservation Units policies. The state has never had an interest in maintaining islands of excellence, only in possessing outside resources (Environmental Analyst/ICMBio, Brasília-DF, February 2017). The RESEXs would bring hopes for the category of extractive, because if supported at ecological prudence, social justice and economic efficiency (MACIEL; ALMEIDA; MENEZES, 2018).

The RESEX recognizes territorial rights, but we create them and let them solve your problems, on the other hand, when we forecast relative resources (green bag, family bag), which is also an appeal, which for me does not mean much, but for them it represents a lot. (Environmental Analyst/ICMBio, Brasília-DF, February 2017). The creation of RESEXs, even though they are fulfilled all the legal formalities can become fiction, stir up conflicts and negatively impact the quality of ecosystems and way of life of the inhabitants (COSTA, 2018).

Arruda (1999) agrees with this situation, arguing that Conservation Units are subject to an external protection regime. The Brazilian state, although a legal entity, must abide by the decisions of the PPG7. State decisions seem to have been made to demarcate the greatest number of areas for preservation without considering the necessary conditions for sustainability, which is to maintain survival conditions compatible with the maintenance of forests.

This demonstrates the fragility of governmental institutions and their inability to establish their mission, i.e., to elaborate policies and strategies for RESEXs (FANTINI; CRISÓSTOMO, 2009), Browder (1992) also draws attention to the need for adequate responses to social demands, a need which goes back to the earliest days of the reserves. Most of the habitants of RESEXs do not have access to the public policies of socioeconomic and support necessary to overcome the challenges of subsistence (LAVOIE; BRANNSTROM, 2019).

3.2 Agricultural production

Our results show that in economic terms only cattle overcomes (small margin) to small-scale agriculture. Figure 2 classifies these results in terms of minimum wage and number of respondents. With the exception of residents of RESEX Alto Juruá and small surrounding producers in the municipality of Cruzeiro do Sul, State of Acre, who specialize in the production of manioc flour for export to Manaus via waterway, whose straight line distance is 1.500km., the other activities have rudimentary productive chains.

The highest income ranges from 0,5× to 1× minimum wage (40,6%). Fifty respondents (30,3%) stated that their incomes are less than 0,5× minimum wage. These wages are insufficient to allow for subsistence, especially in dwellings of more than one family, since these incomes are reported by domicile and not per capita. Therefore, the families in the RESEXs are facing many financial difficulties.

Residents' need to survive explains why they are putting pressure on environmental resources. The precarious living conditions lead to productive activities that cause environmental degradation (RIEMANN; SANTESÁLVAREZ; POMBO, 2011). The interviewees responses reflect their difficulties and discontent with RESEXs:

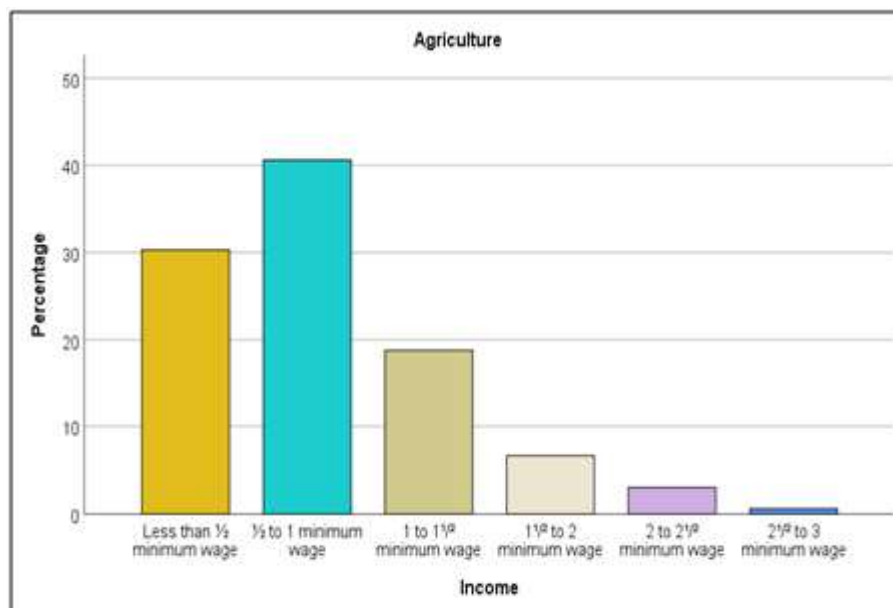
The structure of the ICMBio is low, both in terms of human and financial resources, which makes it difficult to reach environmental goals and improve the lives of RESEXs families. (Analista ambiental/ICMBio, Macapá-AP, março 2017). The RESEXs are compromised by problems of personnel, finance [28], mismanagement, illegal exploitation of timber and burned (COLLINS; MITCHARD, 2017).

The RESEXs ought be viewed from a more pragmatic point of view and should have timely agendas to trigger larger agendas, i.e., not exclude populations from living in a positive way. (Environmental Analyst/ICMBio, Brasília, February 2017). Lest risk increasing problems associated with the struggle for governance of land, logging, cattle ranching and degradation of soils in these areas (MACIEL et al., 2018).

In addition, the state has never been interested in investing in conservation units, in the Lula government (2003-2011) the narrative is that we do not need international resources, we have the ability to collect to maintain. (Environmental Analyst/ICMBio, Brasília-DF, February 2017). This measure inefficient motivated farming growth, and consequently caused fall of extractive activities (FREITAS et al., 2018).

In general terms, reducing the destruction of natural resources in the Amazon depends more on the development of sustainable agricultural activities in deforested areas than on the collection of forest products and the sale of environmental services (HOMMA, 2010). However, the state continues to adopt an authoritarian stance that is biased toward preservation and does not encourage the participation of local populations in management (VIVACQUA; VIEIRA, 2005). It is not enough to prevent residents from participating in agriculture, however; the state must realize viable alternatives for development.

Figure 2: Monthly household income of RESEX residents from agriculture



Source: The authors

To increase the legitimacy of interventions at RESEXs, the State should encourage socioeconomic policies to the inhabitants, in order to maintain cultural identity, food security and environmental conservation (CARMENTA; COUDEL; STEWARD, 2018).

3.3 Bovine and/or buffalo production

The income from livestock production (bovine and buffalo) overcomes the agriculture and exceeds the money earned with the extractivism. The average income from livestock production among RESEXs residents was between 0,5 and 1 minimum wage (38,2%) (Figure3). While 198 of the 232 respondents (85,3%) do not participate in this type of production, the overall income from livestock is still higher than that from extractive production.

The interviewees described livestock husbandry as saving for an “hour of need” (70,6%), market that fetches good price, easy to sell, less toilsome and presents a smaller risk (29,4%). However, state institutions have lost control over this, since it is incompatible with forest maintenance and growth.

Respondents also comments on the low production and income of bovine and buffalo breeders due to the necessity of having 20 animals to participate in ICMBio management plan and/or their reprimanding measures. However, even though the valid numbers are low (34 respondents), the livestock market continues to rise. The ICMBio analysts confirm this:

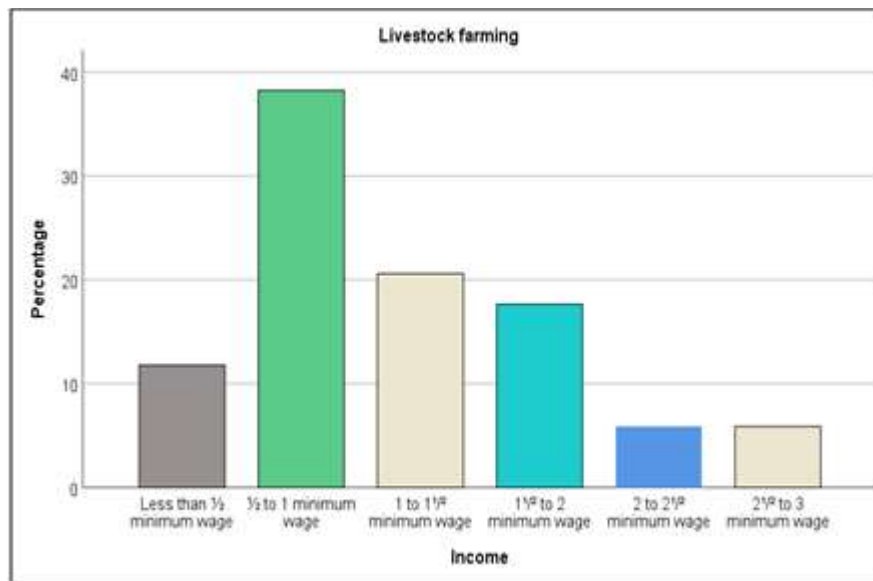
Today, RESEX Rio Ouro Preto has more than 10.000 cattle (data of the vaccine Idaron) and the tendency is to increase. (Environmental Analyst/ICMBio, Guajará-Mirim-RO, January 2017). The livestock gain considerable spaces as best economical option for small production(CAVALCANTE; BATISTA; SOUZA, 2018).

Despite this, the absence of the government has provoked the construction of pastures and cattle breeding that grows every year, unfortunately this situation is unbelievable. (Environmental Analyst/ICMBio, RESEX Alto Juruá, Cruzeiro do Sul-AC, February 2017).The low offer of environmental policies, economic and social is associated with the growth of bovine livestock in Resexs (SOUZA; OLIVEIRA, 2018).

The tendency of livestock is increase through breeding, but we try to control it due to judicial and territorial limits. (Environmental Analyst/ICMBio, Brasília-DF, February 2017).The advancement of livestock is established by the devaluation of the extractive activity (MASCARENHAS; BROWN; SILVA, 2018).

We need massive investments, RESEXs policies are very overdue and cabinet speech does not solve the problem. (Environmental Analyst/ICMBio, Cruzeiro do Sul-AC, March 2017).The reality of the inhabitants of the Amazon Resexs is characterized by scenarios of injustice, social exclusion and low human development (BERNARDES; COSTA; BERNARDES, 2018).

The extensive cattle farming in RESEXs indicates the need for additional research and policies to preserve the dynamism and heterogeneity of land use.Small-scale livestock farming has become an income-generating alternative that meets local needs and desires (SALYSBURY; SCHMINK, 2007). In addition, livestock are easy to sell and provide guarantees of security. This is not the case with extractivism, which fetches very low prices in the market (GOMES; VADJUNEC; PERZ, 2012). Therefore, many families in the RESEXs sell cattle as they are a less risky return (VADJUNEC; ROCHELAU, 2009).

Figure 3: Monthly household income of RESEX residents from livestock farming

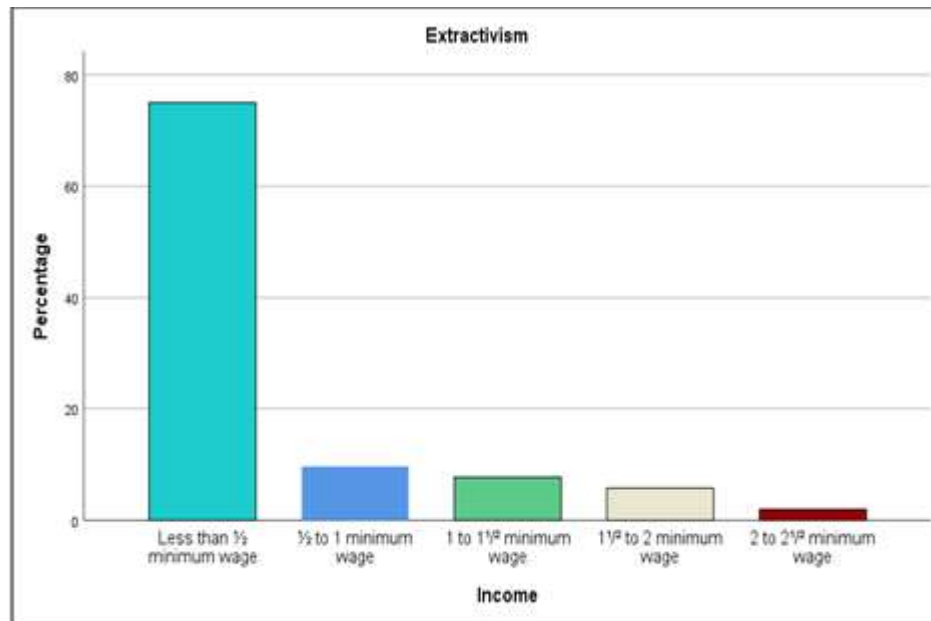
Source: The authors

Both the inhabitants to live in RESEXs and live in the Amazon outside those areas to invest at the cattle because they understand that the return is faster (KRÖGER, 2019). We emphasize that these activities are developed with low technological standard leading to degradation of pastures and continuous incorporation of new areas.

3.4 Extractive production

Extractivism was the strongest argument for the creation of RESEXs, however, its economy did not remain competitive. The low productivity of land and labor of the extractive collection, the low price of the product and the possibilities of obtaining government transfers puts these activities in a secondary plan (HOMMA, 2018). The data show that extractivism has become a complementary income to agriculture and livestock. What should be a mainstream activity has become secondary. Most residents' (70%) income derived from extractivism (Brazil nut, açai and vegetable oils) is below 0,5× minimum wage. In addition, 128 (55,2%) of the 232 interviewees answered that they did not engage in this activity (Figure 4).

Figure 4: Monthly household income of RESEX residents from extractivism



Source: The authors

The data indicate that the necessary resources for extractivism are running out, and that this industry is collapsing. The efforts by the state, nongovernmental organizations, and environmentalists have had no effect. Therefore, the economic impact of extractivism has continued in the face of growing agriculture and mining (CLEMENT, 2006). ICMBio agree that extractivism may be quickly exhausted:

Production and the extractive market are weak because they do not have the initiative and investments capable of structuring a production chain, such as the collection of oils and pharmaceutical essences. (Environmental Analyst/ICMBio, Brasília-DF, February 2017). The low prices of extraction of the chestnut impossible strengthening of activity and improvement in the living conditions of the extractivists (SILVA; PARAENSE, 2019).

The main factor of deforestation was the decline of extractivism, which motivated and intensified deforestation for cattle breeding, buffalo, and irregular sale of timber. (Environmental Analyst/ICMBio, Rio Ouro Preto/ICMBio, Guajará-Mirim-RO, February 2017). Without significant financial support for the activities of rubber, chestnut and açaí, the extractivists prioritize bovine livestock as the main economic activity, even in reserves of sustainable use (LOPESA et al., 2019).

The model can fail, because we are not building a long-term model, there is no policy of valuing people, of extractive labor, credit opening, and societal recognition. (Environmental Analyst/ICMBio, Porto Velho-RO, February 2017). The RESEXs are gradually losing the preservation of environmental resources, and the creation of these areas does not warrant the native standing forests (SANTANA; PEDROSO, 2019).

These results contradict, argument that RESEXs was socially successful because it secured livelihoods for current and future generations. Our results suggest that extractivism has failed to become a primary income-generating activity due to the low productivity of land and labor and the fact that it is based on the collection of natural resources (HOMMA, 2011).

Hall (2004) believes that there are serious problems with RESEXs, including limited markets for forest products, vulnerability to price fluctuations, and high transaction costs, which makes economic self-sufficiency unrealistic. Extractivism is inefficient and will not survive for long because of the loss of competitiveness vis-à-vis other economic alternatives and urban-rural migration. The low prices of extractivism of the chestnut make it impossible for the improvement of the living conditions of the

extractivists, strengthening and verticalization of activity (SILVA; PARAENSE, 2019, p. 73).

Agriculture and livestock were meant to be small-scale with low participation. However, both have become main income-generators, increasing deforestation rates (INPE, 2019). Our results indicate that the arguments defending the creation and maintenance of Resexs in the Amazon are fallible and that these reserves do not support themselves [FEARNSIDE, 1989, p. 40; ALLEGRETTI, 2008]. The idea of short chains, very defended by social movements, connecting producers and consumers, suitable for perishable products it is unworkable in the context of the Resexs due to the distance and the lack of scale (HOMMA, 2018, p. 79; SCHNEIDER; GAZOLLA, 2017).

3.5 Deforestation

As shown in Table 2, deforestation in RESEXs areas increased every year between 1990 (year of creation) and 1999. RESEXs were created to reduce environmental impacts, but residents and managers are facing increasing environmental challenges. The inhabitants' precarious living conditions, for example, lead to the development of productive activities that cause environmental degradation (RIEMANN; SANTESÁLVAREZ; POMBO, 2011, p. 6).

Among the time periods we examined, 2–4 have more temporal proportionality, but deforestation oscillations occur at higher and lower levels. This implies that the RESEXs are continuing to be deforested due to residents' needs and the low effectiveness of state public policies.

Table 2: Deforestation in RESEX areas

RESEXs	Total area (ha)	Time period	Deforested land (ha)	%
Chico Mendes (AC)	931.537	Before 1999	19.430	2,09
		2000–2005	21.543	2,31
		2006–2012	5.404	0,58
		2013–2018	12.580	1,35
			58.957	6,33
Alto Juruá (AC)	537.946	Before 1999	6.540	1,21
		2000–2005	4.969	0,92
		2006–2012	4.204	0,78
		2013–2018	1.413	0,26
			17.126	3,17
Rio Ouro Preto (RO)	204.631	Before 1999	7.730	3,78
		2000–2005	8.966	4,39
		2006–2012	1.957	0,95
		2013–2018	1.375	0,67
			20.028	9,79
Rio Cajari (AP)	532.397	Before 1999	7.720	1,45
		2000–2005	1.454	0,27
		2006–2012	2.215	0,41
		2013–2018	1.112	0,20
			12.501	2,33

Source: Adapted from Inpe (2019).

During the second period (2000-2005), the RESEXs Chico Mendes and Rio Ouro Preto overcame the first period, the others showed a reduction. In the third period (2006-2012) there was a fall in relation to the second, except at the RESEX Rio Cajari, which accumulated percentage of 52%. The same phenomenon occurred in the fourth period (2013-2018), once the RESEX Chico Mendes accumulated deforestation of 133% in relation to third.

Peres (2011) presents similar data, finding that 6,3% of the RESEX Chico Mendes 931.537 hectares have been deforested since the reserve was created in 1990 to accommodate 10.000 head of cattle, this is, 11 times the original deforested area. The deforestation of RESEXs affects the maintenance of stocks of carbon and climate benefits (FEARNSIDE; NOGUEIRA; YANAI, 2018), and has received considerable attention in the international arena, because their destruction can intensify the “greenhouse effect” and considerably reduce the reserves of the Earth’s biodiversity (CARDOSO, 2018).

Another example is the RESEX Alto Juruá, which increased permanent per capita marginal deforestation from 0,49 ha to 1,1 ha between 1989 and 2000 (RUIZ-PÉREZ et al., 2005), a change associate with small-scale agriculture. Homma (2016) reinforces these conclusions, confirming that much of deforestation is due to the livestock and agriculture. The recent increase in deforestation in areas of conservation requires empirical investigation of the causes and consequences of this worrying situation (KRÖGER, 2019, p. 11).

At the global level, public policies must be analysed more broadly in order to reduce deforestation and forest fires in the Amazon’s primary (BROW; ROSENDO, 2000). This will allow deforested areas in the region to be used more productively region (HOMMA, 1996) and contribute to a better understanding of the problems with RESEXs (LEVEY, 2002). It is necessary to question the mistaken opinions regarding the success of RESEXs (ALLEGRETTI, 2008, p. 46) and inappropriate environmental priorities that push back improving living conditions to a later date (FEARNSIDE, 1989, p. 42). The RESEXs did not reach the targets of sustainability three decades after its creation.

Until more sustainable technological and economic alternatives emerge, the forest transition will take time, denoting high social and environmental cost of lacking greater investments in science, technology and provision of public goods, rather than governmental transfers.

3.6 Frost of the Resex model

The RESEXs demarcation policy aimed to reduce human pressure in these areas. In addition, it was precipitated when it did not take environmental policy to the extent it left it under external control in the 1990s. The rubber tappers’ proposal in the 1980s emphasized a different agrarian reform than that created by the National Institute of Colonization and Agrarian Reform (INCRA).

Among the RESEX proposal’s points, the most prominent confirmed the need for harmonious living with nature and the interrelationship between conservation and development. However, in reality families living in RESEXs areas have become politically isolated, have a hard time earning a living, and have little ability to influence land planning and management (SANTOS; BRANNSTROM, 2015, p. 49).

Today, RESEXs areas have shifted their priorities. Producers are trying to green activities due to market impositions, not because of environmental pressure or legal imposition. The demarcation of conservation areas has served the goals of NGOs and environmental movements, as well as generated many scientific and political debates. However, there is still a need to: a) improve the socioeconomic conditions of inhabitants in the RESEXs areas; b) reduce deforestation in these areas; c) increase efficient planning and management of organizations responsible for environmental policies in the Amazon; d) integrate credit policies (i.e., Pronaf), settlements (i.e., INCRA), and the supervision and management of IBAMA and ICMBio; e) implement policies to combat poverty, since, as Siraj-Blatchford, Mogharreban and Park (2016) argue, forests offer the world's poor a way to make a living through illegal practices. In failing to meet these needs, the state has failed to live up to the promise of RESEXs areas even 30 years after their foundation.

4 Conclusions

Social and productive policies proved ineffective 30 years after their creation. The trend is to demarcate conservation territories, but this does not result in improved living conditions for the thousands of families in those areas. Government-approved land use does not respect how RESEXs inhabitants actually need to use the land to survive (FREITAS; RIVAS, 2014).

The state abandonment of families living in these areas is visible and seems to occur intentionally, as a strategy to reduce the number of residents. As the state does not have the legal support to withdraw these families, the instead simply fail to allocate social and productive resources. We emphasize that the shortage of supply of public goods is not privilege of the RESEXs, but of the whole of almost all small producers in the Amazon region. Many NGOs and social movements, prioritize the extractive cause supported with external funds, not always with altruistic intentions.

Resident families tend to earn a similar amount of income from both agriculture and livestock—between $\frac{1}{2}\times$ and $1\times$ minimum wage—while they are only able to earn less than $\frac{1}{2}\times$ minimum wage through extractivism. Both the growth in agriculture and livestock as well as the decrease in extractivism are due to the state's lack of effective action. In addition, they lead to an increased rate of deforestation, which is associated with a growing need for food, clothes, drinking water, medicines, school supplies, transportation, etc.

Why did the state create RESEXs to protect environmental resources and not to meet human social and economic needs? The residents' high social demands, the low profitability of extractive activities, the high maintenance costs of RESEXs lands, and a low investment in infrastructure have made it difficult to create sustainable RESEXs.

Our results reveal that RESEXs are unsustainable because they were created with an emphasis on conservation and without consideration of sustainable human development. The migration of children and young people from RESEXs to urban areas will also affect sustainability over the medium and long term, because these areas may become without inhabitant in the future. As of now, while it is certain that these areas are become more unsustainable, we cannot know if the scarcity of human and financial resources is intentional.

Some argue that an alternative is to promote low-technology agriculture in degraded areas, thereby using Conservation Units for sustainable use. This idea to take advantage of deforested areas and use them for crops more profitable than extractivism is not recent. Thus, it is possible to build policies aimed at the economic viability of a just and efficient RESEXs if there is investment in less complex productive processes and chains targeting traditional populations, which are not always viable (NEGRET, 2010).

The Amazon 4.0 released in 2016 proposes a new paradigm of development that combines in-depth knowledge of Amazonian biodiversity based on the economy of the standing forest, preserved and productive (NOBRE; NOBRE, 2019). It is based on the example of the acai in Pará State but that errs by generalization extend to other extractive products or potential, by reduced supply, dispersal of resources, lack of economies of scale, perishability, long distances and lack of technology of domestication. The examples of condoms made from native rubber trees and vegetable leather recommend caution with the magnitude of this proposal for the Amazon region.

The challenge is to transform at least part of the “Second Nature,” represented by deforested areas, to a “Third Nature” with more sustainable productive activities that generate income and employment (HOMMA, 2014). (The pristine forest is the “First Nature.”) In the first instance, there will be a need for strong and democratic relations of trust, as well as the inclusion of viable economic alternatives combined with an ecological balance.

Further research may reveal evidence in other areas and regions of the country and show whether our results are part of a trend or unique to our study area in the Amazon. Future studies could also compare RESEXs and Sustainable Development Reserves (RDS). It is possible to demonstrate that, in order to achieve sustainable development and conservation of these areas, it is necessary to reformulate current public policies, giving primary attention to its residents. The reversal of priorities is indispensable.

This study advances because it demonstrates that prioritize the conservation of environmental resources as a strategy for sustainability is not the best way, because it does not guarantee the standing forest and improvement in the living conditions of the inhabitants.

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