

Valuation and Payment for Socio-Environmental Services in the Chico Mendes Extractive Reserve, Amazon, Brazil

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Abstract

In the contemporary world, there are three interconnected global environmental crises (climate change, biodiversity loss, and pollution). The common thread is the unsustainable pattern of production and consumption, which leads to international and local socio-environmental injustices. Seeking environmental justice in Brazil, the success of the rubber tapper social movement stands out, culminating in the Chico Mendes Extractive Reserve (RESEX) implementation in the Brazilian Amazon. However, the residents have struggled to generate income to help their families' social reproduction. Conventional payment instruments for environmental services have failed to remunerate the socio-environmental attributes of sustainable products adequately. This paper aims to carry out a socio-environmental economic-ecological valuation of the main extractive products of the RESEX in 2021/2022. To this end, a methodology calculates the cost of social reproduction of rural family production, being a non-market price index reference for monetary valuation. The results indicate the acceptability of the socio-environmental valuation of native rubber and Brazil nuts, as they can guarantee environmental conservation, improve the families' well-being with adequate income for their social reproduction, as well as value attributes outside the market, which helps in the fight against further expropriation or enclosure of rural families in the Amazon.

Keywords

Rural Family Production, Social Reproduction, Socio-Environmental Valuation, Chico Mendes RESEX, Payment for Socio-Environmental Services (PSES)

1. Climate Change and Socio-Environmental Conflicts: The Chico Mendes Extractive Reserve Creation

There is scientific evidence surrounding the current climate crisis, which has been exacerbated by human activities [1]-[3]. The common thread behind these crises is the unsustainable pattern of production and consumption (above ecosystem resilience); the solutions still lack consensus among different areas of knowledge [2].

Environmental crises in rural areas profoundly impact both the environment and its inhabitants. However, understanding the effects of the relationship between the capitalist mode of production and climate change in rural areas has received little attention, especially when connecting land tenure struggles with the climate change crisis [3].

According to [4] (p. 1), “The growth in social metabolism is one main cause of global and local environmental injustices”, which is at the heart of contemporary world capitalism’s global scale. These changes help explain the growing existence of resistance movements referring to conflicts of ecological distribution (CDE) [5].

In the search for environmental justice, those movements called the “Environmentalism of the Poor” [4] stand out. He presents the rubber tapper social movement¹ as an emblematic case of success in the struggle for land ownership in the Brazilian Amazon. Specifically in the state of Acre, Extractive Reserves have been set up, including “Chico Mendes”, named after its most outstanding leader, murdered in 1988, whose struggle has become a symbol for the global environmental justice movement, which is the subject of this study.

Thus, local and global resistance movements for environmental justice can help move society and the economy toward social justice and ecological prudence². Social justice is at the heart of discussions on the “Environmentalism of the poor”, with the basic premise being the inseparability between the struggle for human rights and the environment. Nature is, therefore, the source of families’ livelihoods [4]. In this sense, the thesis of the “environmentalism of the poor” is in line with the inherent capacity of local populations, in particular rural family production, such as extractivists, to manage their forest areas, which can play an essential role in helping to mitigate climate change [6].

¹For more information, please access

<<https://ejatlas.org/conflict/rubber-tappers-against-cattle-ranchers-the-murder-of-chico-mendes>>.

²It is important to note that the thesis of the environmentalism of the poor does not claim that poor people are environmentalists as a rule. The poor are always on the side of preservation to the detriment of capitalist companies, being consistent with their interests and values (Martinez-Alier, 2014).

2. Rural Family Production and Nature

According to [6], rural family production or local communities, such as indigenous peoples, manage most global forests. Almost a quarter (1/4) of the global land area is occupied by indigenous peoples or local communities, and more than a fifth (1/5) of the area of tropical forests is managed by these populations, as is the case with the Chico Mendes RESEX. Thus, more than half a billion people are involved in resource management through community forestry activities.

According to [7], the key to understanding the inherent capacity of local communities to properly manage the use of natural resources, regardless of the location or region of the planet, is how agricultural, extractive (forestry), or agroforestry production is managed, *i.e.*, by farms in which the family participates in production, both in the management and execution of activities. Rural family production, therefore, corresponds to a production unit where ownership and work are closely linked to the family.

According to the author, this way of managing production can also help rural family production adapt to the demands imposed by socio-cultural changes in markets over time, struggles for land ownership, and, in recent times, climate change.

Understanding the family farming production logic is fundamental to understanding the alternative paths to sustainability and its effects on using nature and its resources. The specific motivation behind rural family production is to satisfy the needs of families who depend solely on family labor to guarantee their social reproduction.

At the heart of satisfying the family's needs is the balance between work and consumption, in which the demand for consumption is related to the labor availability in the family production unit through total production (the sum of self-consumption products and those destined for the market) and the consumption of the family's needs [8].

The balance between work and consumption needs to be dynamically combined to regulate the characteristics and operations in the family unit's production process. On the other hand, the workforce needs to generate a fair and sufficient income to meet their needs. The quest to improve income unites the constituent elements of the family production system [8].

An essential balance in rural family production takes place between people and nature. Rural family farming should be better delineated as a co-production between the social and the natural. It can be seen as an interaction in motion, a mutual transformation [8]. In other words, people and nature are combined in the productive practice of rural family units, building a balance of their own that brings together various objectives, allowing families to "live off the land" with sufficient production³, as well as meeting the needs of nature itself, enriching, improving

³According to Abramovay (2022), the concept behind sufficient and adequate production is eco-sufficiency, which means a local (and global) effort to ensure that the production system does not exceed ecosystem boundaries. Ecological economists understand this concept as "Strong Sustainability" (ecological view of the economy).

and diversifying it.

Another important balance regarding the family production unit is autonomy and dependence on the market. According to [8] (p. 61), “It is possible to define the peasant condition⁴ as a struggle for autonomy and improved income within a context that imposes dependence and deprivation”.

In addition, some socio-cultural practices of rural families are non-capitalist social relations since they are not mediated by money, such as solidarity, reciprocity, and redistribution of a network of relatives or community. These practices guarantee producers some level of autonomy from the market. According to the author, family producers have sought different ways of negotiating with the market to improve their income. In this process, various experiences of producer associations and cooperatives are crucial in providing economies of scale, increasing the purchasing power of production factors, and setting prices for a given product [9].

In this way, rural family production can achieve high gains in added value through productive intensification driven by family labor and access to niche markets, particularly those related to the environmental attributes embedded in the products marketed, helping the families’ social reproduction. Therefore, understanding the concept of social reproduction is essential for understanding production (and its value) and its relationship with the environment.

3. Social Reproduction as a Reference for Socio-Environmental Valuation

According to [10] (p. 1), “social reproduction is a lens through which to analyze the persistence of society over time”, underlying the dynamics of the process of change in material and human components. It continues, “Its main value is in identifying and explaining tensions that emerge between the logic that reproduces society, and the continued survival (biological reproduction) and well-being of the population” [10] (p. 1).

The origins of discussions around social reproduction can be traced back to the work of Karl Marx in his critique of political economy, the process of accumulation, and the reproduction of capital. However, modern social reproduction theory seeks to analyze some of the blind spots in Marxist analysis, particularly gender issues in the reproductive process, such as a feminized sphere of “domestic production” in the support of workers and non-workers [10].

Still, from the modern perspective of social reproduction, people are increasingly dependent on the market for their reproduction [11]. Flexible combinations of economic and non-economic activities (considered unproductive) can help guarantee the stability of social metabolism, even if only temporary and in specific economic contexts and spaces, as is the case with rural family production.

Combining social metabolism and social practices (those related to basic social reproduction such as eating, cooking, living, heating, cleaning, moving around,

⁴Or rural family production.

and caring) reveals the predominant way of life. This connection is driven by biophysical issues and symbolic and cultural horizons, although the material significance of consumption is still preponderant, given the need for collective social reproduction [11].

Social reproduction encompasses the activities, customs, needs, ambitions, identity, culture, and social norms of people who individually or collectively work to achieve an adequate and meaningful life within and across generations [12] [13]. Given the dynamism of social reproduction, as possibilities and ambitions change, so do livelihood patterns. According to [13], the interconnectedness between social reproduction and nature makes it almost impossible for an ecological crisis without a social reproductive crisis. Also, the price of reproduction has not changed over time and space: “Even though reproduction has a cost to each woman and man, it is not remunerated. Although reproduction constitutes the substance of the current production, it continues to be seen and considered as non-labor and subjected to a non-salary” [14] (p. 91).

Given this complex dynamic, which involves the social, cultural, economic, and environmental dimensions, measuring the value of social reproduction is necessary to remunerate rural family production adequately. Conventional valuation methods (mainstream economics) are incapable of valuing the socio-cultural and ecological dimensions, so it is recommended to use a multidimensional economic-ecological valuation instrument known here as Payment for Socio-Environmental Services (PSES).

4. Socio-Environmental Valuation and Payment for Socio-Environmental Services (PSES)

As in Extractive Reserves, command-and-control policies have struggled to guarantee forest conservation and social well-being, mainly because of the economic results. Complementary economic instruments have been adopted to ensure environmental conservation through incentives via financial payments [15] [16].

Over the last 35 years, several approaches have been put forward to guarantee environmental conservation, with market-based approaches becoming dominant, such as Payments for Environmental Services (PES), notably those economic instruments associated with the carbon market, such as REDD+ (Reducing Emissions from Deforestation and Forest Degradation in Developing Countries), which was adopted on an expanded scale at the 16th Conference of the Parties (COP16) in 2010⁵ [16]-[19]. The PES has gained popularity because it promises to conserve forests and simultaneously compensate local populations for losses resulting from protection with improved social welfare [20].

However, several researchers have criticized environmental valuation based on conventional market instruments for environmental governance embedded in PES. According to [20], one of the critical points for REDD+ is the balance between forest protection and social welfare, as several studies demonstrate the

⁵According to <<https://www.un-redd.org/glossary/cancun-safeguards>>.

trade-off between forest-based livelihoods and the ecological outcomes of the forest system. [21] showed “modest forest and welfare impacts from current REDD+ initiatives” with practically neutral socio-economic welfare impacts, notably improved income. In addition, [18] stated that, due to PES, environmental degradation has been documented on several continents and the marginalization of local and traditional users, with elites receiving the benefits.

According to [22], based on ten years of practical experience with this mechanism, the strategy of “selling nature to save it” associated with PES involves the criteria of market efficiency in direct conflict with poverty reduction priorities. This contradiction is inevitable given the non-social logic of neoclassical economics framed in the projects.

A vast amount of literature presents the causes of PES project failure. Among the main ones are lack of knowledge of local conditions and contexts, low availability of labor, problems with forest governance and management, economic risk not assessed in project design, and issues related to project financing, such as delays and suspension of payments [17] [19] [20] [23] [24].

It is, therefore, essential to evaluate the nature of PES projects. Ecological economists have criticized the fundamental limitations of the monetary valuation of environmental resources and services, focusing on a few points [25] (p. 98):

- 1) Because ecosystems are highly complex and interconnected, their value cannot be compressed in a simple metric;
- 2) There are multiple values and relevant languages of valuation other than those expressed in monetary terms;
- 3) There is no unique value for environmental goods and services independent of the distributional and institutional settings within which such values are expressed;
- 4) Social valuation processes, including monetary valuation, are value-articulating institutions (VAIs).

According to [26] (p. 30), the main limitations of the monetary valuation of nature are based on the need to consider the “ecological values of ecosystems determined by the integrity of their functions, as well as ecosystem parameters of complexity, diversity and rarity”. [27] mentions that for Ecological Economics, the monetary pricing of natural resources would not be a necessary and sufficient condition for tackling environmental challenges since ecosystems have other value dimensions besides monetary metrics, such as sociocultural and ecological dimensions.

Thus, [28] indicates that an effort must be made to learn how to think about conflicts of incommensurable socio-environmental values⁶, rejecting a reductionist measure of monetary values. For the authors, both nature and human and non-human species have other values that are not measurable in monetary terms.

⁶“The absence of a common unit of measurement between plural values implies the rejection not only of monetary reductionism, but also of any physical reductionism (e.g. eco-energy evaluation)” [28] (p. 283).

Therefore, instead of correcting “market failures”, we should focus on the creative power that this problem of resource allocation has to provide new valuation methods, such as multi-criteria analysis of the realities under study, given that this type of valuation is multidimensional by definition and considers the interactions between society, the economy, and nature [29] [30].

According to [25], the criticisms made by Ecological Economics about monetary valuation can be enriched by the framework of Political Ecology within a broad historical process of commodification and accumulation through dispossession, which is at the root of ecological distribution conflicts. According to the authors, even considering the limitations and objections to commodifying ecosystem resources and services, monetary valuation is not always undesirable, presenting a pragmatic yet radical approach.

Radicalism lies in understanding the issue of monetary valuation, primarily concerning the objectives of environmental protection and egalitarianism, including elements of social and distributive justice. On the other hand, “particular action within contemporary political-economic dynamics and the rooted positions of social and environmental movements” must be considered. Pragmatism is about considering “a theory or practice that places primary emphasis on practical circumstances and goals” [25] (p. 103), distrusting abstract ideas that are distant from the reality of human and non-human agents. However, being pragmatic does not mean that, even in a market society, one must accept its rules.

Therefore, the environmental and monetary valuation of ecosystem resources and services is acceptable if it is part of processes that improve the environment (principle of additionality) and simultaneously bring about more equality. This includes maintaining the relevance of plural valuation methods and not causing “new enclosures” accumulation by expropriation [25] [31].

According to this approach, the results of evaluations of the PES implemented in various regions of the global South, particularly REDD+ projects, indicate that many of these projects should not have a monetary valuation of the resources and ecosystems involved and that they need to be reviewed [16] [17] [19]-[22]. For PES projects, when there is no trade-off between improving the environment and social well-being, there is no improvement in either. Furthermore, economic valuation often focuses on a single ecosystem service, such as carbon stock maintenance, disregarding the other values of both services and resources, and they are inducing new private enclosures in the areas.

This paper will use the approach proposed by [25] for the socio-environmental valuation of the leading products of the Chico Mendes RESEX, the fruit of the rubber tapper social movement against the expansion of the capitalist accumulation frontier in the Amazon.

From a pragmatic point of view, the study is based on a demand from the extractivist community regarding the basic social reproduction of RESEX families. In the ASPF Project’s research over more than two and a half decades, one of the extractivists’ questions was and still is: “What can we produce to make money?” This question is pertinent given the difficulties of buying goods and services on

the market to satisfy their needs.

In this sense, from a radical point of view, the aim is to carry out a socio-environmental valuation based on the essential social reproduction of the extractivists in their process of co-production and interaction with the forest environment, whose reasons for reproduction go beyond economic efficiency and the logic of the market, strengthening another valuation language, not based on the market, for forest conservation.

Thus, based on the precepts of Ecological Economics, this work is part of a strategy to develop tools for evaluating sustainability in the Chico Mendes RESEX, combining the socio-environmental monetary valuation of products, which is carried out in this work, with the multi-criteria analysis carried out by [30], in an attempt to estimate and compare, albeit weakly, the fundamental values linked to the multiple dimensions of sustainability, which are incommensurable.

5. Methodology

This paper presents some results of the “Socioeconomic Analysis of Rural Family Production Systems in Acre” research project known as the ASPF Project. This project has been underway since 1996 and is led by the Center for Applied Legal and Social Sciences at the Federal University of Acre (UFAC). The aim is to carry out a socio-economic diagnosis of rural family production units (UPF) in Acre, Brazil.

The object of study is the extractivist families who live in the Chico Mendes Extractive Reserve (RESEX), which is part of an extractivist rural family production system in the region of Acre. The RESEX (Creation Decree No. 99.144, of March 12, 1990) has an area of approximately 970570 hectares (ha) and is a federal conservation unit for sustainable use, managed by the Chico Mendes Institute for Biodiversity Conservation (ICMBio) and granted for sustainable use by extractivists. There are currently around 2000 family production units, known as “colocações”. **Figure 1** shows the location of the Chico Mendes RESEX.

This research analyzes the social reproduction of extractivist families based on basic social reproduction such as eating, cooking, living, heating, cleaning, moving around, and taking care of themselves [11].

The field research was carried out using open and closed questionnaires. The items raised in the questionnaires about family maintenance are related to food, clothing, hygiene and cleaning, education, health, transportation, and communication. The items related to maintaining the means of production are improvements, machinery, equipment, and tools. The methodology also takes into account maintenance and depreciation costs. The field survey was conducted by sampling, following the criterion that the extractivist has lived in the area for at least two years. The sample was defined in three stages:

- 1) Area Stratification according to the level of development (high, medium, or low) concerning criteria relating to production volumes, ease and quality of access, availability of infrastructure, technical assistance, and the degree of community organization.

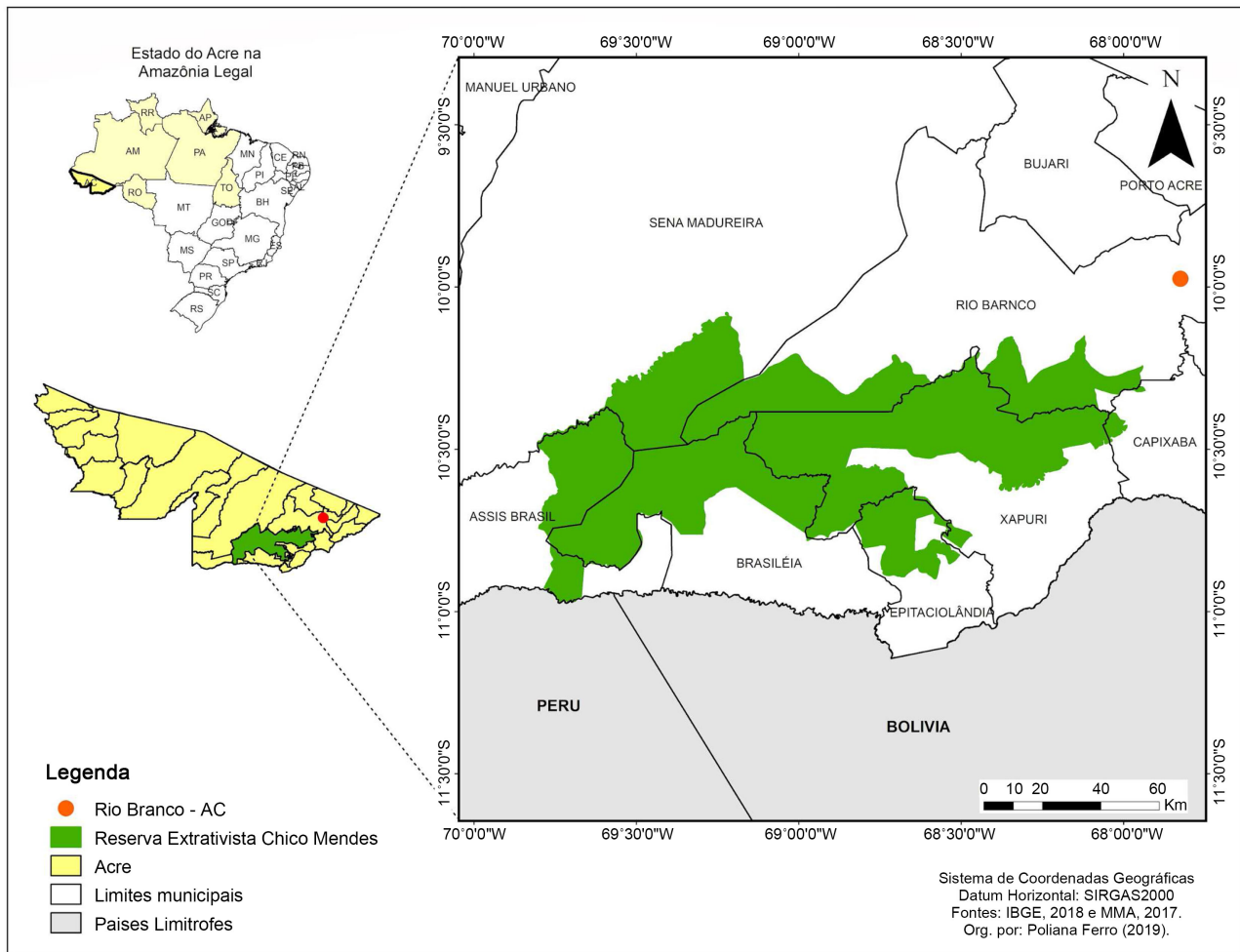


Figure 1. Location of Chico Mendes RESEX, Acre, Brazil. Note: The Chico Mendes Extractive Reserve (RESEX) is located in the southwestern region of the Brazilian Amazon and, more specifically, in the southeastern region of the state of Acre, with an area of approximately 970570 hectares (ha), between the following geographical coordinates: $10^{\circ}06'11''$ to $10^{\circ}58'39''$ South latitude and $67^{\circ}56'13''$ to $69^{\circ}48'00''$ West longitude. This area covers the municipalities of Rio Branco, Xapuri, Epiaciolândia, Brasiléia, Assis Brasil, Sena Madureira, and Capixaba. Source: [32].

2) Drawing half of the conglomerates in the study areas, the Seringal (designation of rubber tree forests), in the case of the Chico Mendes RESEX, representativeness within each defined stratum.

3) Within each conglomerate drawn, a simple random sample is carried out, drawing 10% of the production units that are part of the object of study.

The region's agricultural calendar was used as a reference to gather information. The calendar refers to the period from May one year to April the following year, encompassing all of the families' productive economic activities. The current study used information on the evolution of household performance for the periods 1996/1997, 2005/2006, 2014/2015, 2018/2019, and 2021/2022.

To process and analyze the data, software developed for the ASPF Project was used, which stores the information in a database and carries out specific processing for tabulation and analysis, with the data being exported to the Microsoft Excel® program to generate graphs, figures, and tables. To ensure the representativeness

of the family production units, the median was used to measure central tendency precisely because the population is heterogeneous and has extreme values. The leading indicators used as parameters for basic social reproduction in the research are briefly described below:

1) **Self-consumption:** production for family consumption.

2) **Gross Income:** an indicator of the scale of production.

3) **Market Dependency:** these are the median amounts spent on the consumption of goods and services on the market, plus purchases related to the replacement of fixed capital (machinery, equipment, tools, improvements) available to maintain the existing means of production.

The social reproduction indicators of the extractivist families were used as parameters for the socio-environmental valuation of the leading products of the RESEX, considering the co-production process and interaction between people and nature. However, according to [25] (p. 100), before accepting and validating the calculated socio-environmental monetary value, it is necessary to answer:

1) Will it improve the environmental conditions at stake? (additionality)

2) Will it reduce inequalities and redistributive power? (equality)

3) Is it likely to suppress other languages of evaluation and value-articulating institutions? (complexity blindness)

4) Will it serve processes of enclosure of the commons? (accumulation by expropriation)

As an indicative guideline, if the answer is 1 (no), 2 (no), 3 (yes), or 4 (yes), you should consider moving away from the monetary valuation and, if necessary, opposing it.

6. Results and Discussion

The Chico Mendes RESEX was created 34 years ago by the rubber tapper social movement. It significantly changed the Amazon region's environmental and land policies, guaranteeing land tenure for traditional populations and conserving ecosystem resources and services. This process was intended to strengthen traditional extractive activities and generate adequate income for the social reproduction of families in the forest.

Over the last 27 years, the ASPF project's research has highlighted the difficulties faced by the families surveyed in generating income for basic social reproduction despite the need to buy goods and services on the market [33] [35].

According to **Table 1**, on the one hand, the difficulties in generating income are leading RESEX producers to change the type of activities carried out in family production units, such as increasing cattle breeding (which is unsustainable from an environmental point of view). However, it can be seen that in the 2021/2022 period, extractivism regained its prominence, to the detriment of the 2018/2019 period, as the main generator of income for families, notably with the recovery of the sale of Brazil nuts and the strengthening of the sale of native rubber in the region, the main extractive products.

Table 1. Evolution of Gross Income generation among family production units in the Chico Mendes RESEX - Acre - 1996/1997, 2005/2006, 2014/2015, 2018/2019 e 2021/2022.

Period/ Evolution	Gross Income (%)					
	Agriculture	Livestock/ Cattle	Extractivism	Brazilian Nut	Rubber/ Latex	Others
1996/1997	34%	11%	29%	15%	13%	26%
2005/2006	25%	17%	45%	27%	10%	13%
2014/2015	30%	16%	41%	27%	12%	13%
2018/2019	11%	42%	32%	7%	24%	15%
2021/2022	14%	37%	43%	27%	16%	5%

Source: [34].

On the other hand, according to **Figure 2**, the gross income from the productive activities carried out in family production units falls well short of the market dependency line. Over the last two decades, income has only met around 46% of the market's need to purchase goods and services. This result has dramatically hindered the basic social reproduction of families, who are looking for various strategies to “make money”, *i.e.*, other income, such as access to government transfers like pensions and the “Bolsa Família”, temporary employment of family members and, as a last resort, indebtedness to local traders.

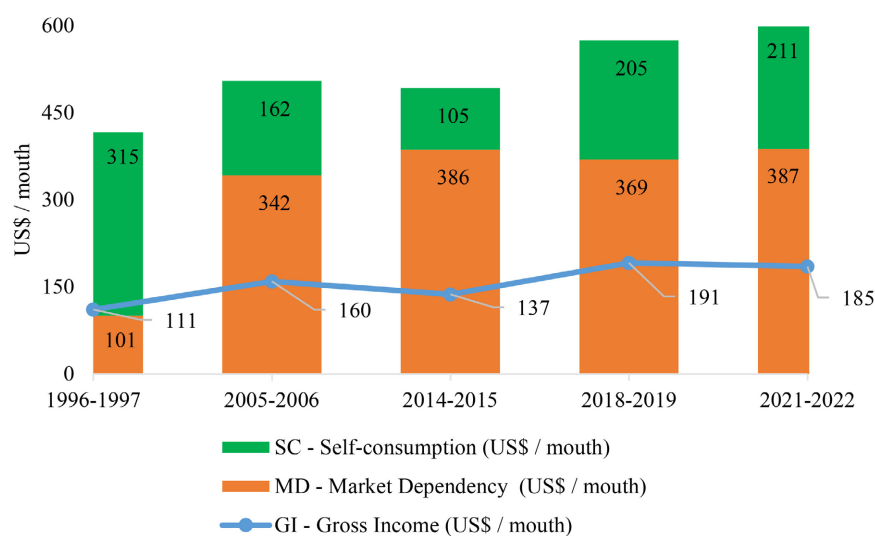


Figure 2. Changes in Self-consumption, Gross Income, and Market Dependency among family production units in the Chico Mendes RESEX - Acre - 1996/1997, 2005/2006, 2014/2015, 2018/2019, and 2021/2022. Note 1: Through the 27-year research project (ASPF), it is possible to observe the Self-consumption changes (green column), Market Dependency (orange column), and Gross Income (blue row) among family production units in the Chico Mendes RESEX between the harvest years 1996/1997, 2005/2006, 2014/2015, 2018/2019, and 2021/2022. Note 2: Median values. Note 3: The values were updated to March 2024 by INPC/IBGE. Note 4: The amount is in US\$ (1 US\$ = 5.59 R\$ - exchange rate as of July 1st, 2024) by Brazil's Central Bank. Source: [34].

Figure 2 shows the possible causes for the 2.4-fold increase in households' dependence on the market in the first decade of the survey, rising to around 17% in the last decade. One plausible explanation is a greater penetration of consumption among family units. On the one hand, there is the rural electrification program called "Luz para Todos" (Light for All, free translation)⁷, implemented by the Federal Government in 2003, which makes it possible to buy a range of goods and services, particularly durable goods such as television, which makes people want things from the city. On the other hand, branch lines are open throughout the RESEX, making it easier to connect to various markets, both for the sale of production and the acquisition of goods and services [33].

Another critical aspect of **Figure 2** is the role of self-consumption in the basic social reproduction of extractivist families. In the first period analyzed, it was around three times greater than the value of the market dependency line, which was supplied by the income earned by the extractivists. In the last two surveys, the relationship between improved income and an increase in the level of self-consumption, which helps with the basic social reproduction of families, can be seen.

The search for improved income to meet the reproduction needs of extractivist families has been unsuccessful throughout the existence of the Chico Mendes RESEX, particularly in strengthening traditional activities such as rubber and Brazil nuts, which are at the heart of co-production with the forest. What has been decisive for the failure of these initiatives is precisely that the markets do not adequately value the products of these activities via conventional price mechanisms.

Nevertheless, since 2006, an initiative by the sustainable footwear company Veja Fair Trade© has made progress in recognizing the socio-environmental values linked to the production of native rubber, notably Virgin Pressed Cernambi (CVP). This initiative makes a Payment for Socio-Environmental Services (PSES), via prices, directly to the RESEX extractivists, whose products have reached a global scale since 2018.

The impact of this initiative can already be seen in the national statistics for this product. **Figure 3** shows the production behavior and coagulated latex prices (CVP). The first detail that stands out is the vertiginous decline in CVP production, even with the implementation of the Chico Mendes RESEX in 1990, which shows a secular downward trend in native rubber prices. However, the subsidy provided by the Chico Mendes Law from 1999 onwards and the federal minimum price subsidy since 2009, which increased CVP prices by 90% between 1999 and 2015, the year in which production reached its lowest level, with 80 tons sold, were not enough to halt the fall in CVP production.

Figure 3 also shows that the minimum price set by the Federal Government, which in 2023 was US\$1.29 (R\$7.18), made up of the market price of US\$0.54 (R\$3.00) plus the difference paid by the Brazilian Food Supply Company (CONAB) US\$0.75 (R\$4.18), was the leading benchmark for CVP prices until 2019, with an

⁷For more information, please access

<<https://www.gov.br/mme/pt-br/destaques/Programa%20Luz%20para%20Todos/sobre-o-programa>>.

appreciation of around 25% over the last 14 years. However, this is still insufficient to boost production and income for extractivists.

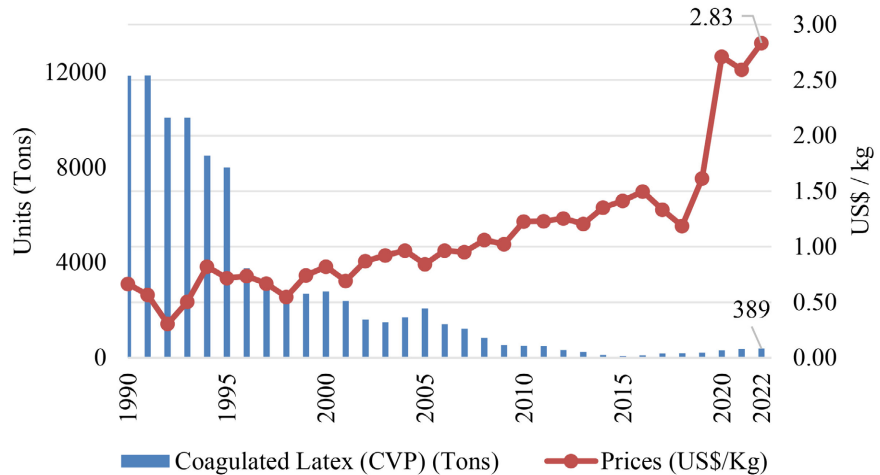


Figure 3. Coagulated Latex (CVP) production trends and prices, Acre - Brazil, 1990-2022. Note 1: This figure represents the Coagulated Latex (CVP) production (measured in Tons) and the prices (in Acre - Brazil) between 1990 and 2022. The vertiginous production decline (blue column) and the significant price rise (red row) can be observed. Note 2: Updated values by the INPC (IBGE) for January 2024. Note 3: The amount is in US\$ (1 US\$ = 5.59 R\$\$ - exchange rate as of July 1st, 2024) by Brazil's Central Bank. Source: [36].

Also, **Figure 3** shows the resumption of CVP production, which had already been underway since 2016, with a significant 378% increase in the quantity produced (2016-2022), clearly led by the express appreciation of prices, close to 239% in the 2018-2022 period.

Adequately valuing the prices of forest products such as rubber (CVP) is vital to maintaining the extractivists and forest ecosystem. This is at the heart of the Payment for Socio-Environmental Services (PSES) to the extractivists of the RESEX and has been carried out in recent years by the sustainable footwear company Veja Fair Trade©. Taking as a reference the minimum prices practiced over the last decade, an average of US\$1.32 (R\$7.38) per kilo of CVP, and the prices paid in 2022 were US\$2,83 (R\$15.84), the PSES for the extractivists was around US\$1.51 (about R\$8.50) in 2022 (**Figure 3**).

The prices paid for native rubber in 2021/2022 include values that have been added to the market prices of rubber over time, seeking a fairer price given the tangible and intangible socio-environmental attributes (social equity, maintenance of ecosystem services, etc.) associated with extractive production.

It is worth noting that, since 2019, Veja Fair Trade© and the ASPF project have partnered to prepare a socio-economic diagnosis of RESEX and the formation of prices in the rubber production chain in Acre. The aim is to identify the impacts of PSES among families and improve the values paid in PSES⁸.

⁸The research results are presented in [15] [33]-[35]. The amount is calculated in US\$ (1 US\$ = 5.59 R\$\$ - exchange rate as of July 1st, 2024) by the Central Bank of Brazil.

Thus, according to **Table 2**, the prices paid per kilo of rubber (CVP) could reach US\$4.29/kg (R\$23.98/kg) if all the amounts are paid. When buying the product, rubber tappers receive US\$2.50/kg (R\$14.00/kg), equivalent to the market prices, the quality premium, and the Payment for Socio-Environmental Services (PSES) paid by Veja Fair Trade©. The municipal subsidies in Assis Brasil and Xapuri, as well as the state and federal subsidies, are paid through the bureaucratic processes of proof of sale by the associations and cooperatives and the budgetary availability of the government institutions.

Table 2. Rubber prices formation (CVP) according to their origin, Acre, 2022/2023.

Origin	Price (US\$)
Market	0.54
Cooperative Incentive (quality premium)	0.09
Payment for Social and Environmental Services (PSES/Veja Fair Trade©)	1.88
Bonus	0.36
Municipal subsidy	0.27
State subsidy	0.41
Federal subsidy	0.75
Total	4.29

Source: [35].

It should be noted that, based on the Payments for Socio-Environmental Services (PSES), all the agents in the rubber production chain in the region, such as the individual and central cooperatives, receive the value of these services, especially the extractivists, who are the ones who can effectively guarantee the maintenance of ecosystem services and who directly receive most of the amounts paid in the chain, adding to the amounts paid by the shoe company, the amounts received through government subsidies [35].

So, looking inside the family production units (colocações), a question arises: Can US\$4.29/kg of CVP rubber be considered a fairer price for the extractivists? This question can be answered from two points of view: production and the maintenance of socio-environmental services.

From the point of view of the economic viability of CVP production, according to Maciel (2023), the median cost per kilo of rubber sold in the 2021/2022 period was US\$3.47 (about R\$19.41)⁹. In other words, to make production profitable, with current practices, the price should be at least US\$3.49 (R\$19.50), and revenue almost equal to the cost of production can bring economic efficiency to a situation of equilibrium.

Furthermore, taking the natural rubber market as a proxy and the viability of rubber tree cultivation, the return on revenue concerning cost should be around 16%. This means that the price of rubber for the RESEX extractivists should be

⁹Updated by the INPC (National Consumer Price Index of Brazil) to December 2023.

around US\$4.04 (R\$22.62) to be considered viable and fair productively. Moreover, according to **Table 2**, this price level became a reality in 2023, with the production chain indicating a total price of US\$4.29/kg (R\$23.98) paid for the kilo of CVP commercialized.

From the PSES's point of view, the remuneration paid to extractivists is even further from what would be fair. The maintenance of these services depends on the social reproduction and maintenance of the families in their traditional activities. This maintenance involves the constant search to "make money" in the face of their need to purchase goods and replace and maintain their assets on the market.

According to **Figure 2**, the median Market Dependency (MD) among the Chico Mendes RESEX extractivists is US\$4647.00 (R\$25977.00) per year or US\$387 (R\$2165.00) per month. Based on the 2023 price, this means that to generate this income from native rubber alone, the producer would have to produce approximately 1131 kg, which is unfeasible under current management.

The region's median annual rubber production is around 365 kg, which makes it economically viable. Given this production and the need to "make money" US\$4647.00 (R\$25977.00) per year from rubber alone, the "fair" remuneration for socio-environmental services embedded in basic social reproduction would be US\$12.73 (R\$71.17) per kilo.

Nevertheless, according to **Table 1**, rubber and Brazil nuts are the traditional extractive products that are part of the co-production between people and the forest and generate the majority of the family's income, given their characteristics as commodities on a commercial scale. In this way, the ideal would be to place a socio-environmental value on both products to improve income and maintain family social reproduction.

As previously seen, native rubber, in the form of pressed virgin Cernambi (CVP), has been effectively monetarily valued since 2018 through the Payment for Socio-Environmental Services (PSES), whose price paid per kilogram (kg) of CVP reached US\$4.29 (R\$23.98) in 2023, generating an income of US\$1565.78 (R\$8752.70) per year. The PSES paid to extractivists represents over seven times the market price of US\$0.54/kg (R\$3.00/kg). These figures show how much the conventional market "fails" to adequately price socio-biodiversity products in the region, jeopardizing social reproduction and environmental conservation.

In terms of Brazil's Nut production, the extractivists currently produce, on average, 90 cans of nuts a year, which are sold at US\$8.94 (R\$50.00) per can, giving them a gross annual income of US\$805 (R\$4500.00) at market prices.

Given that the market fails to capture socio-environmental attributes, the appropriate price for the Brazil nut can be calculated from the basic social reproduction values not satisfied by the rubber income, which already has the PSES incorporated into the price. Thus, discounting the rubber income from the value of the market dependency line, the value of US\$3081.21 (R\$17223.95) per year would be missing to guarantee social reproduction. To reach this value, the price of the nut

with PSES would have to be around US\$34.24 (R\$191.38) per can, meaning that the PSES would be US\$25.29 (R\$141.38), around 2.8 times the market value.

Someone might point out that the PSES is being calculated based on gross income, and it is necessary to adjust this to what the families will pocket from their income, which in the ASPF project's research is called the Gross Family Margin (GFM). However, what lies at the heart of this work is precisely the ecological awareness of using the basic social reproduction values of extractivist families as a kind of price index based outside the market, which can be used as a parameter to guide the socio-environmental valuation of a product or mix of products, on a commercial scale, from rural family production, as is the case with the Chico Mendes RESEX. New surveys could periodically adjust these prices to update the price index.

With the appropriate valuation of the PSES for rubber and chestnuts in the RESEX, it can be seen that the current difficulties in generating income and making extractive products economically viable have been resolved. According to **Table 3**, rubber has become economically viable, and Brazil nuts can significantly improve their economic efficiency through the PSES. Moreover, both activities will be more efficient and competitive than the production of calves, the main product of cattle breeding in the region, meeting the economic-ecological tripod of sustainable development: ecological prudence, social justice, and economic efficiency [27].

Table 3. Comparison between the economic performance indicators of the main extractive products (with PSES) and cattle ranching in the Chico Mendes RESEX, Acre, Brazil, 2024.

Product	GI	TC	EEI	UPC	Price	Qtd	Unit	Area (ha)	UPC (ha)
Brazil Nuts*	3081.25	522.64	5.90	5.88	34.24	90	cans	300	0.02
Latex (CVP)**	1565.78	1098.49	1.43	3.49	4.29	365	Kg	300	0.01
Cattle	1395.35	1059.79	1.32	153.97	232.56	6	units	15	10.26

Notes: * Updated values for Payment for Socio-environmental Services (PSES) forecast; ** Actual values with Payment for Socio-environmental Services (PSES); Note 1: Performance indicators description: GI, Gross Income; TC, Total Cost; EEI, Economic Efficiency Index; UPC, Unit Production Cost; Qtd, Quantity Produced; ha, hectare. Note 2: Median values; Amount in Dollars (US\$); Source: Adapted from [34] and [35].

With the socio-environmental valuation carried out in this study, the questions proposed by [25] can be answered, demonstrating the acceptability of this monetary valuation. With the strengthening of traditional extractive activities, environmental conservation continues to be guaranteed in the RESEX. Improving income through PSES via prices directly to the extractivist will effectively improve income distribution within the forest, ending poverty and improving the well-being of families. This methodological proposal aligns with the valuation of multiple approaches based on the social reproduction of families and can be enhanced with

other economic-ecological valuation methods.

In this way, progress has been made in effectively connecting producers to companies with socio-environmental responsibilities, such as Veja Fair Trade®, seeking to develop mechanisms for strengthening the production chains involved with carbon in setting strategies, monitoring deforestation, organizing and managing production, evaluating socio-economic results, and appropriate and ongoing planning for fair remuneration for the region's socio-environmental services. Therefore, Chico Mendes RESEX continues to symbolize the struggle against enclosure in the area.

7. Conclusions

The environmental crises that have plunged the planet highlight the lack of practical solutions to how goods and services are produced in the capitalist system, which is flexible and innovative (as always) and centralizing and concentrating (as before), exploiting the planet's borders, seeking new forms of capital accumulation and spreading socio-environmental injustices and the resulting distributive conflicts.

The resistance movements in search of environmental justice, with emblematic cases of success against the system, such as the Chico Mendes RESEX, demonstrate that an alternative mode of production, such as rural family production, which works in co-production and interaction with nature, in other words, more sustainable, can help to solve socio-environmental problems, especially in the rural world.

A vital issue in the coexistence of this alternative mode of production with capitalism is its interference in rural communities, whose logic of reproduction is based on non-market values but with partial dependence on them. However, markets "fail" to allocate resources efficiently in sustainable practices because they tie product prices to production costs and the logic of profit. In the rural family production model, the logic that drives family production units is not the pursuit of profit but the social cost associated with the collective reproduction of the family, which is not remunerated by the market.

This study sought to develop a new mechanism for adequate economic-ecological valuation through Payment for Socio-Environmental Services (PSES), particularly in areas of sustainable rural family production, taking the extractive production of the Chico Mendes RESEX as a reference. This valuation takes as its parameter values pertinent to the basic social reproduction costs of the families studied, such as food, clothing, hygiene and cleaning, education, health, transportation, and communication, as well as the costs of maintaining the production units.

The results indicate the acceptability of the socio-environmental valuation of native rubber and Brazil nuts, as they can guarantee environmental conservation, improve the well-being of families with adequate income for their social reproduction, as value attributes outside the market, help in the fight against new

expropriations or enclosures of rural families in the Amazon region and contributing to the effectiveness of the sustainable development tripod.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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