Executive Summary

Socio-biodiversity Bioeconomy in the State of Pará

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Inter-American Development Bank - IDB
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Acknowledgment
Climate, Forest and Agriculture Brazil Coalition

Citation: Costa. F. A., Ciasca, B.S., Castro, E.C.C., Barreiros, R.M.M., Folhes, R.T., Bergamini, L.L., Solyno Sobrinho, S.A., Cruz, A., Costa, J. A., Simões, J., Almeida, J.S., Souza, H.M. Socio-biodiversity Bioeconomy in the State of Pará. Brasília, DF: The Nature Conservancy (TNC Brasil), Banco Interamericano de Desenvolvimento (BID), Natura, IDB-TN-2264, 2021.

Brasilia, DF, Brazil
October 2021

Summary

1.Introduction

The coverage of the Amazon rainforest in the state of Pará and the sociocultural diversity of indigenous people, quilombolas, traditional and local communities where they live, make the state one of the largest producers and exporters of socio-biodiversity products in Brazil. With an area of 1.2 million km^2 and a population of 8.7 million people, the state of Pará has 76.6% of its forests conserved and protected. Out of this percentage, 31.8% of the forests are in indigenous lands, while 23.3% and 12.8% are in areas of protected areas for sustainable use and integral protection, respectively. Family producers are responsible for 5.4% of this protected area and 1% is part of quilombola territories.

Products of Socio-biodiversity and Production Chains

The concept of socio-biodiversity represents the relationship between biological diversity and socio-cultural systems diversity. Products of Socio-biodiversity refer to goods and services (final products, raw materials or benefits) that are generated from biodiversity resources. These products are aimed at forming production chains that serve traditional people and communities, as well as family producers, who work to maintain and add value to their own traditions and knowledge, ensuring the respect of rights, generating income and improving the quality of life as well as the environment in which they live.

The production chain of socio-biodiversity products consists of an integrated system with independent actors and a succession of processes for educating, researching, handling, producing, benefiting, distributing, selling and consuming products and services of socio-biodiversity with the local cultural identity, values and knowledge, ensuring the fair and equal distribution of its benefits.

Unlike what we see in agriculture commodities - in which production takes place within monocultures – socio-biodiversity production chains are characterized by a large variety of products, with over 40 types of biome specific products. This is made possible due to the rich biodiversity and social diversity of local communities, an advantage that leads to production diversification. Combining income generation, conservation of native vegetation and ecosystem services, this diversity situates the state of Pará and Brazil in a privileged position. According to results from this study, the income generated from 30 different socio-biodiversity products value chains in Pará in 2019 was around R$ 5.4 billion, generating 224,000 jobs. However, this treasure could be threatened by deforestation and forest degradation, as well as a lack of public policies such as access to financial credit and technical assistance for the sector and for local communities.

Since 2006, Pará is first on the Amazon rainforest states with the highest rates of deforestation, representing 47% of the total deforestation of the biome in 2020. The income generation provided by the socio-biodiversity offers the state an unique opportunity to break the conversion cycle and become a global benchmark in the development and implementation of a bioeconomy policy, adding value to a preserved forest.

The concept of bioeconomy includes three main pillars of development: biotechnological, bioresources and bioecology. Biotechnological focuses on the importance of research to drive innovation of biological base processes that can be used in different economic sectors, as happened with the biorefineries. Bioresources focuses on the development of products from biological raw materials and the new value chains resulting from them. The third pillar of bioecological bioeconomy values ecological processes that are fundamental parts of forest conservation, optimizing the use of energy and nutrients from biodiversity, as opposed to the chemical mechanical technology paradigm that can lead to soil and water supply degradation.

This study is centered around the bioecological bioeconomy that will be named the Socio-biodiversity Bioeconomy of the state of Pará (EcoSocioBio-PA). This focus is due to the characteristics of the production process of socio-biodiversity products, meaning that they origins with the traditional knowledge and cultural practices of local people for collecting and extracting products from the forest in natural ecosystems of high biological and socio-cultural diversity, valuing ecological processes.

Even though the importance of bioeconomy for local development is well-known, there is a significant gap in data and information about the value chain of these products. Official data only encompasses rural production, the first link of the chain (Table 1). The absence of information for the complete chain leads to a lack of recognition for many of the economic sectors that process or sell these products. They are not recognized as part of the bioeconomy of the socio-biodiversity production system, which seriously restricts the reach of public policies.

The results of this study aim to fill this gap, offering information and analysis on adding value throughout the entire chain of 30 socio-biodiversity products, from the main link (the rural production sector) to the final commercial link (local or national wholesale or retail), explaining the financial flow between 14 economic sectors (Table 1).

<table>
<tr><th colspan="4">Table 1: Economic sectors of value chain of socio-biodiversity products</th></tr>
<tr><td rowspan="10">Local economy</td><td rowspan="6">Alpha sectors – Local rural economy</td><td>Rural production</td><td>Visible economy – official statistics</td></tr>
<tr><td>Rural mediator</td><td rowspan="13">Invisible economy
Economy sectors that have been identified by the methodology of Social Alpha Accounts (CSα).</td></tr>
<tr><td>Rural processing industry</td></tr>
<tr><td>Rural transformation industry</td></tr>
<tr><td>Rural wholesale</td></tr>
<tr><td>Rural retail</td></tr>
<tr><td rowspan="4">Beta sectors – local economy of urban centers</td><td>Urban centers processing industry</td></tr>
<tr><td>Urban centers transformation industry</td></tr>
<tr><td>Urban centers wholesale</td></tr>
<tr><td>Urban centers retail</td></tr>
<tr><td rowspan="4">National economy (extra-local)</td><td rowspan="4">Gama Sector – National economy and the rest of the world</td><td>National processing industry</td></tr>
<tr><td>National transformation industry</td></tr>
<tr><td>National wholesale</td></tr>
<tr><td>National retail</td></tr>
</table>

Methodology of Social Alpha Accounts

Local economy representations require the creation of special input-output matrices[1], created to guide three methodology principles. The first is to address the diversity of actors and structures within the local economy. The second is to assess the relationships between these actors in links that are part of local systems and arrangements. The third principle is verifying the growing productivity indices of these economies in the totality of local/extra local configurations on one side and urban/rural on the other. The model of Social Alpha Ascendant Accounts (CSα) is based on these principles, using the description and analytical potential of Leontief's (1983) matrices from a perspective that values structural diversity. This allows us to define actors' situations and relevant structures in the context of system relationships that are established in Local Production Arrangements (APL) and in the constitution of the local economy and its interactions with broader contexts (regional and national). CSα are an ascending calculation of input-output matrices of computable balance. The combination of its algorithms make up the Netz Program, developed by the Agrarian Dynamics and Sustainable Development in the Amazon Group (GPDadesaNAEA) of the Federal University of Pará (Costa, 2002; Costa, 2006; Costa; Inhetvin, 2006; Costa, 2008).

Therefore, aiming to represent the importance of local economy for socio-biodiversity products, the Social Alpha Accounts (CSα) methodology was used, composed of input-output matrices that represent value chains of socio-biodiversity products updated to the year 2019. The analysis of the value chain that permeates from production to benefiting processes, transformation and selling is, therefore, what composes EcoSocioBio-PA

Many indices are extracted from input-output matrices. Among them:

i) Indices of product and gross production value generated by each sector and by the economy (from the perspective of production).

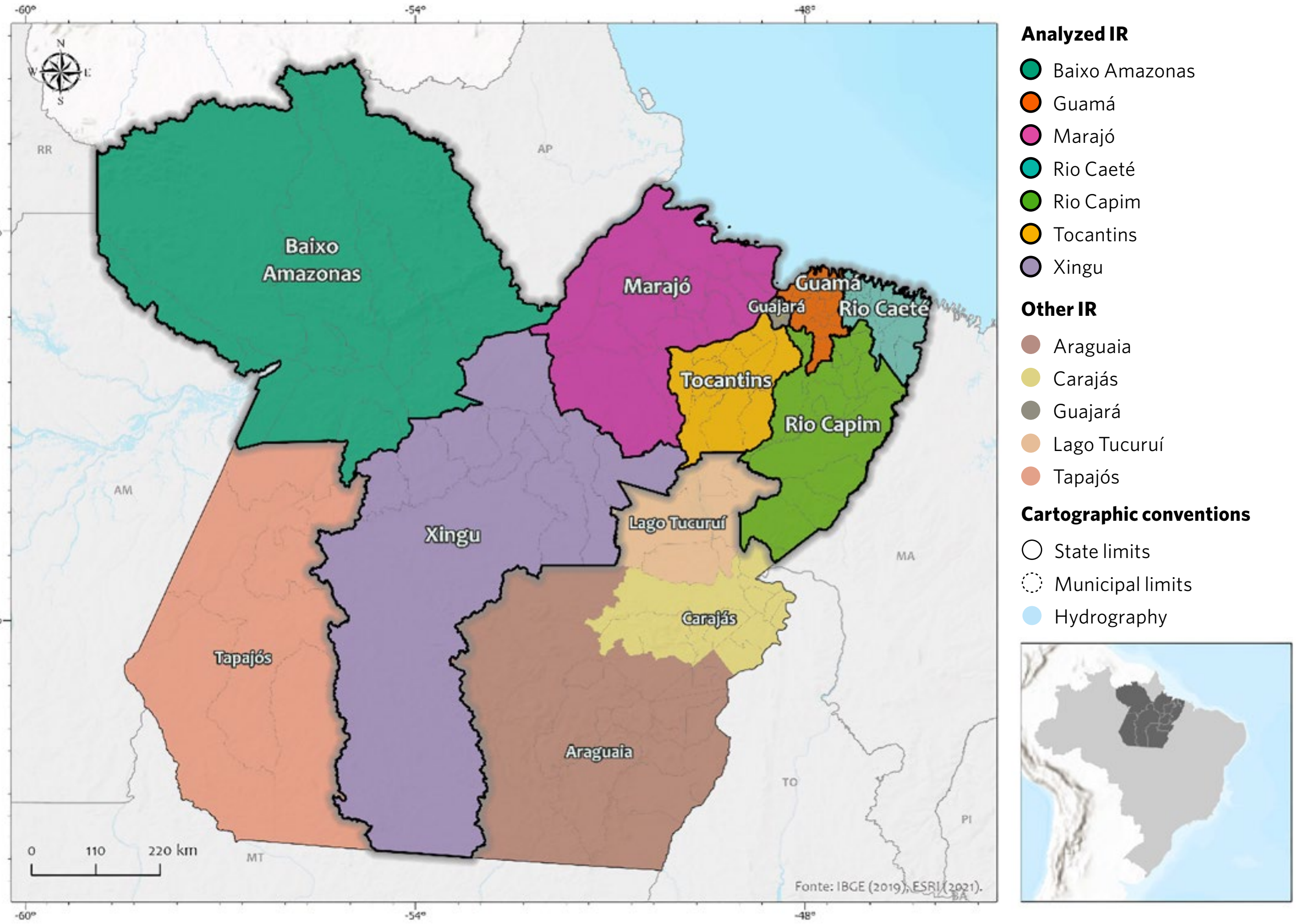
ii) Intermediate consumption (intermediate demands) of each sector and the origin of the final local and national demand (from the perspective of demand).

iii) Value added that represents income generated by the economy (from the perspective of income).

1 The input-output matrix is a matrix description of monetary flows of goods and services between different sectors of an economy, consisting of the balance between the product and the income, supply and demand in the sector and the whole of an economy.

Aiming to direct public policies, the study considered the administrative limits of Integration Regions (IR) of the state of Pará, which are used to manage and plan public policies (Map 1). The analysis of the bioeconomy of socio-biodiversity was undertaken for 7 out of 12 Integration Regions highlighted on the map: Rio Capim, Guamá, Marajó, Tocantins, Baixo Amazonas, Xingu and Caeté. Considering the total Gross Value of Production (GVP) of socio-biodiversity products listed by the Brazilian Institute of Geography and Statistics (IBGE), the analysis of these IRs represents 88.5% of rural production in the state of Pará. The other five IRs were not analyzed due to the absence of primary studies in these regions – the non-application of Social Alpha Accounts made it impossible to obtain data on value chains, which highlights the importance of applying the method in the future for this study.

Map 1: The twelve Integration Regions of Pará



The input-output matrices created by CSα for this study describe the relationships in the local economy (in the state of Pará) and in the extra-local economy (national, representing exports to other states or countries).

The "local economy" is described by two sets of socio-productive relations: i) the one that occurs in the "rural" area is composed of the rural production sector (extractive and agriculture), the rural mediator, the processing and transformation industry and the wholesale or retail commerce that exist around the production process; ii) the one that occurs in "urban centers", encompassing the processing and transformation industries and the commerce (wholesale and retail) that absorbs the local rural production in average or long supply chains and that, at times, sends products to the rest of Brazil and the world.

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Motivated by the commitment to halting the growing deforestation of the Amazon rainforest and strengthening value chains of socio-biodiversity, The Nature Conservancy (TNC), in partnership with the Inter-American Development Bank (IDB) and Natura, present this document, the main results of the study "Bioeconomy of socio-biodiversity in the state of Pará". The study was supervised by Prof. Dr. Francisco de Assis Costa, an economist from the Nucleus of Higher Amazonian Studies (NAEA/UFPA), an organization which aims to clarify the economy of the conserved forest and of traditional peoples and communities, which were underestimated in official data for many years.

Traditional Peoples and Communities

According to Decree N. 6040/2007, Traditional Peoples and Communities are unique cultural groups that recognized themselves as traditional, who have their own ways of socially organizing, who live and use territories and natural resources as an important part of their cultural, social, religious, economic and ancestral reproduction, using knowledge, tools and practices that were created and transmitted by tradition.

Alongside this introduction, this summary is composed of five other sections. Section 2 presents the updated economic value of value chains of socio-biodiversity products. Section 3 highlights regional economic results for four priority Integration Regions in Pará. Section 4 describes production structures of this bioeconomy, discussing, under techno-productive trajectories (TTP), aspects of land ownership distribution, carbon stocks and sequestration in these territories, access to credit and to technical assistance. Section 5 presents results of potential value when considering three possible scenarios: business as usual, implementation of carbon pricing policies as well as cost reduction policies and redistribution of value added. Finally, section 6 presents recommendations for public policies for this bioeconomy.

2. Value chains of socio-biodiversity products

Thirty products, listed in table 1, are the base of Pará's socio--biodiversity bioeconomy. Its Gross Value of Rural Production (VBPR) grew at an average of 8.2% per year from 2006 to 2019: from R$ 1 billion in 2006, it reached R$ 1.9 billion in 2019, with price fluctuations (all amounts mentioned are at constant prices of 2019). However, this amount represents only one link in the chain: the rural production sector.

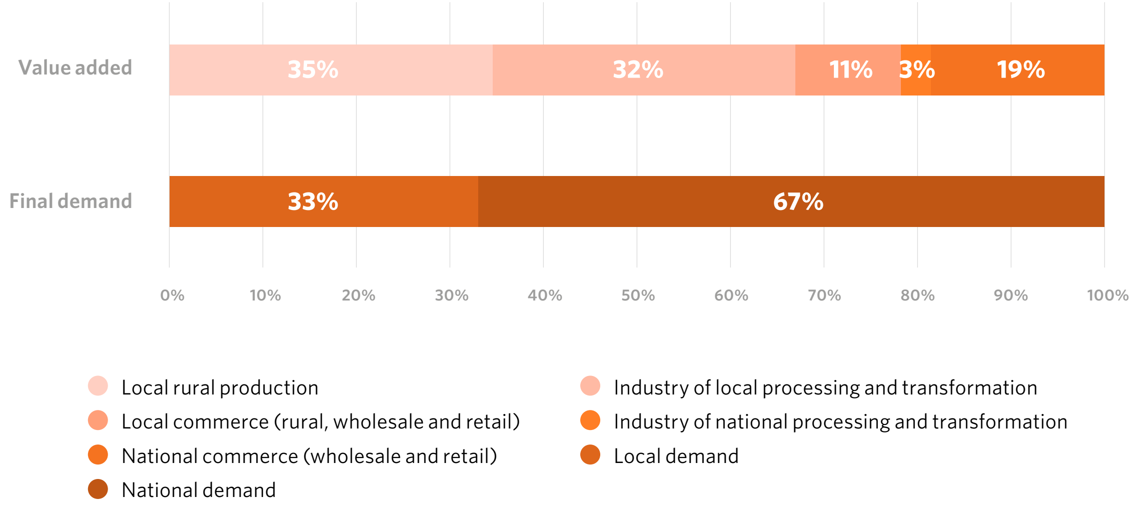
Table 1: Thirty main products of socio-biodiversity of EcoSocioBio-PA

1	Açaí	**11**	Cupuaçu	**21**	Bacaba
2	Cocoa beans	**12**	Achiote	**22**	Açaí seeds
3	Brazil nuts	**13**	Bacuri	**23**	Uxi
4	Hearts of palm	**14**	Honey	**24**	Breu-branco
5	Rubber	**15**	Pupunha hearts of palm	**25**	Pequi
6	Cupuaçu nuts	**16**	Murici	**26**	Pequi oil
7	Cumaru	**17**	Andiroba	**27**	Vegetable milks
8	Tucumã	**18**	Copaíba	**28**	Handmade goods
9	Brazil nut oil	**19**	Buriti	**29**	Medicinal plants
10	Murumuru	**20**	Yellow mombin	**30**	Cocoa fruit

As presented in the Input-Output Matrix of EcoSocioBio-PA (table 2), adding value occurs between the links of the chains - in natura or processed - to the final consumer in Pará itself, in Brazil or all over the world. It is estimated that an aggregated economy with a total value added (VA) – meaning the generated sector income – amounted to R$ 5.4 billion in 2019, 2.9 times the value of rural production at R$ 1.9 billion. This amount represents the GDP index of EcoSocioBio-PA minus taxes on product, free of subsidies. Considering the latest publication of data from IBGE's regional accounts for 2018, the generated VA for EcoSocioBio-PA local economy represented 2.6% of the total VA for the state of Pará. When we analyze only the VA of agricultural activities in 2018, the VA of the rural production sector of EcoSocioBio-PA represented 12.5% of the generated income by agriculture.

From the input-output matrix we can obtain the distribution of value added of EcoSocioBio-PA across the chain, as well as the disposition of final demand. It is noticeable that the income of the sector was distributed between local economy (in the countryside of the state of Pará) with 78% and national economy (outside of the state of Pará) with 22%. In the local economy, different sectors have benefited: the rural production sector acquired 35% of the income (R$ 1.87 billion), followed by the processing and transformation industry (rural and urban centers), which acquired 32% of the income (amounting to R$ 1.75 billion). Rural wholesale and retail represented 11% of the acquired income (amounting to R$ 609 million). The national economy, on the other hand, generated income in the industrial and commercial sectors, acquiring 3% (amounting to R$ 146.7 million) and 19% (amounting to R$ 1 billion) of the total VA respectively (Graph 1). The total employment rate related to this production was 224,600 workers, 90% of them being in Pará and 10% outside the state.

Graph 1: Distribution of Value added generated in the sectors and of final demand of EcoSocioBio-PA (%)



The final demand for EcoSocioBio-PA products has a strong external consumer market, representing 67% of production, while local consumers represent only 33% of production.

Considering the importance of the external consumer market, EcoSocioBio-PA socio-biodiversity products are differentiated between those with a high external sale demand (interstate market and international export) or those produced mainly to supply the internal demand of the state of Pará. These categories aim to identify products of long chains and short chains, guiding specific public policies, such as fiscal policies and instruments of environmental services payment.

It is important to note that due to the gap in the official data regarding the entire production chain of socio-biodiversity products, results were obtained from data gathered by key actors in the seven IRs, which allowed us to apply the Social Alpha Accounts (CSα) methodology. Therefore, aiming to continue to highlight the economic importance of income generation across multiple sectors, we recommend the development of a continuous database system on these chains (See **Axis 2** recommendation).

Table 2 – Input-output matrix of the total of EcoSocioBio-PA in 2019, in R$ 1,000.00

Sectors	Intermediate production															Final Demand				Gross Output
	Local economy										Extra-local economy				Total Intermediate Production	Local		National and other countries demand	Total	
	A-Rural and surroundings						B-Urban Centers				C-National					Rural and surroundings	Urban Centers			
	A0	A1	A2	A3	A4	A5	B1	B2	B3	B4	C1	C2	C3	C4						
A0 Production	-	1,208,985	424,102	1,877	51,284	22,659	7,898	1,182	96,258	2,173	23,178	-	67	26	1,839,689	34209	1752	11	35,972	1,875,662
A1 Primary mediator	-	309	377,995	663	545,758	5,317	351,535	471	95,882	2,448	6,929	324	44,106	4,129	1,435,864	17470	707	-	18,177	1,454,041
A2 Processing industry	-	-	3,974	1,291	695	4,415	8,202	699	5,446	2,607	-	6,555	2,693	279,756	316,334	1175572	459	-	1,176,031	1.492.365
A3 Transformation industry	-	-	-	-	488	1,250	-	506	4	2,475	-	-	-	2,472	7,195	33901	-	-	33,901	41,096
A4 Wholesale	-	349	6,827	32	136	466	61,902	11,618	18,488	380	-	733,467	-	242	833,908	1681	29	-	1,710	835,618
A5 Retail & services	-	-	22,553	1,924	-	69	15,281	-	-	-	-	-	-	56	39,884	25,833	71	-	25,904	65,788
B1 Processing industry	-	-	-	-	-	1,531	-	10	-	51,610	-	-	-	1,250,748	1,303,899	-	397,443	49,871	447,314	1,751,213
B2 Transformation industry	-	-	-	-	-	-	-	78	-	74	-	342	-	6,024	6,517	-	764	11,944	12,708	19,226
B3 Wholesale	-	-	-	-	-	-	251,640	43	563	275	-	34,596	-	33	287,149	6065	1963	-	8,028	295,177
B4 Retail & services	-	-	-	3	-	1	594	83	-	19	-	-	-	-	699	-	80159	-	80,159	80,858
C1 Processing industry	-	-	-	-	-	-	-	-	-	-	-	-	-	220	220	-	-	76,079	76,079	76,299
C2 Transformation industry	-	-	-	-	-	-	-	-	-	-	-	-	-	893,928	893,928	-	-	3,052	3,052	896,979
C3 Wholesale	-	-	-	-	-	-	-	-	-	-	21,149	29	-	50,541	71,719	0	-	-	0	71,719
C4 Retail & services	-	0	-	-	-	-	-	-	-	0	-	-	-	-	0	-	0	3,484,143	3,484,143	3,484,143
Intermediate production	0	1,209,642	835,450	5,789	598,361	35,709	697,053	14,689	216,640	62,061	51,255	775,313	46,866	2,488,163	7,037,004	1,294,731	483,347	3,625,101	5,403,179	12,440,182
Total-VAB	**1,875,662**	**244,399**	**656,915**	**35,306**	**237,257**	**30,079**	**1,054,160**	**4,537**	**78,537**	**18,796**	**25,044**	**121,666**	**24,852**	**995,980**	**5,403,190**	-	-	-	-	-
Total-salaries	156,145	115,695	99,896	2,751	66,488	5,235	117,223	1,287	23,487	6,434	6,242	73,379	9,775	302,287	986,324	-	-	-	-	-
Profits + other ingredients	1,719,516	128,704	557,019	32,556	170,769	24,844	936,937	3,250	55,050	12,363	18,802	48,287	15,077	693,693	4,416,867	-	-	-	-	-
Total gross income	1,875,662	1,454,041	1,492,365	41,096	835,618	65,788	1,751,213	19,226	295,177	80,858	76,299	896,979	71,719	3,484,143	12,440,182	-	-	-	-	-
Total occupied personnel	184,128	6,003	4,818	133	3,452	272	5,653	62	1,219	334	204	2,394	322	15,644	224,640	-	-	-	-	-
Total salary workers	19,088	6,003	4,818	133	3,452	272	5,653	62	1,219	334	204	2,394	322	15,644	59,599	-	-	-	-	-

Source: Data from the IBGE research (PAM and PEVS), Agriculture census of 2017, field research and Netz System processing

A0- Rural and surrounding production; A1- Primary (retail) mediation and surroundings; A2- Rural and surroundings processing industry; A3- Rural and surroundings transformation industry; A4- Rural and surroundings wholesale; A5- Urban rural wholesale and surroundings; B1 – Processing industry urban centers; B2- Transformation industry urban centers; B3- Wholesale urban centers; B4- Retail urban centers; C1- National processing industry; C2- National transformation industry, C3- National wholesale; C4- National urban retail

2.1 Products of high demand for external sales: long chain

Out of the 30 products analyzed, 10 have an external demand that is higher than local demand: açaí, cocoa beans, Brazil nuts, hearts of palm, rubber, tucumã, cupuaçu nuts, cumaru, murumuru and Brazil nuts.

These products, which are part of long chains and go beyond the borders of the state of Pará, amount to an income generation of R$ 5.2 billion or 96% of EcoSocioBio-PA. Among the products with the highest value added is hearts of palm, as a markup[2] of the 965% chain, followed by Brazil nuts and Cupuaçu nuts, with value added of 776% and nearly 296% of production value respectively (Table 3).

Table 3: Gross Production Value (R$ 1,000), Gross Value added (R$ 1,000) and percentage of Aggregated Value (%) per export base product

Products	Gross Production Value (R$ 1,000)	Value added (R$ 1,000)	Value Aggregation (%)
Açaí	1,258,179	3,666,217	191%
Cacao beans	549,585	1,276,933	132%
Brazil nuts	16,008	140,212	776%
Hearts of Palm	8,370	89,129	965%
Rubber	2,120	4,898	131%
Cupuaçu nuts	301	1,190	296%
Cumaru	253	566	124%
Tucumã	1,288	1,900	48%
Brazil nuts oil	4	7	76%
Murumuru	44	96	120%
Total	**1,836,151**	**5,181,148**	**182%**

Under the perspective of Global Value Chains[3] (GVCs), long chains can establish power relationships that result from asymmetries, such as financial and institutional resources. These asymmetries characterize chains as producer-driven or buyer-driven, dividing them based on what leads them and their capacity to retain value.

These polarities are represented by conditions such as: i) domain and subordination (hierarchy); ii) (market) parity or iii) cooperation (related), all prevailing from interactions. This perspective is the basis of research around the meaning of product particularities and the level of specification that they have in determining the cost of transaction. It is important to consider that EcoSocioBio-PA products are, by definition, in larger or smaller scale, biome-specific. Therefore, obtaining these products requires tacit knowledge, from knowledge of species distribution to knowledge of extraction techniques that do not cause damage that could affect productivity. This knowledge, which is diverse and complex, could lead to a variety of governing arrangements that would result in generation and distribution of value among the different links in the chain, based on equative principles of rural producer valorization.

2 Markup is equal to the percentage difference between purchase price of primary product and final selling price following transformations, which indicate added value throughout the chain

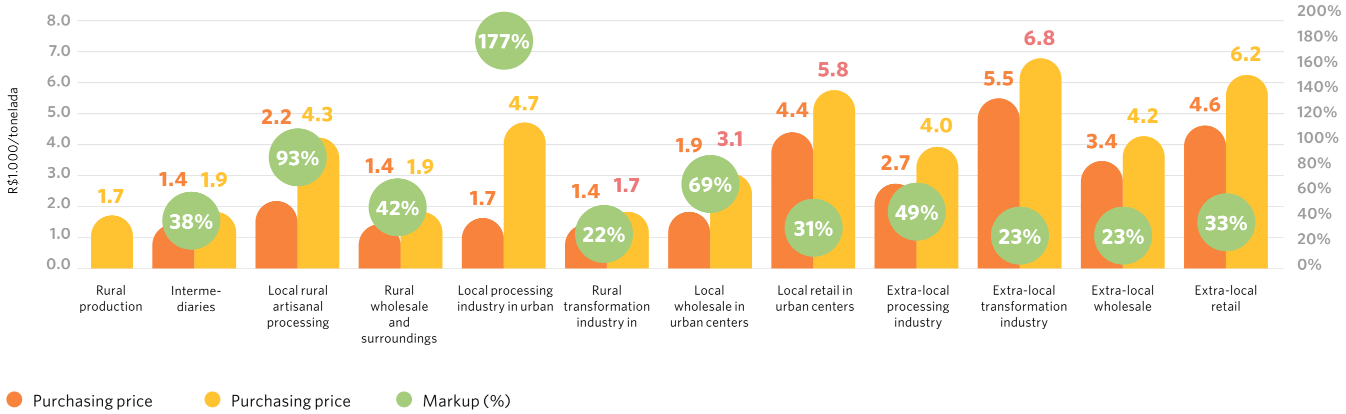
3 The focus of Global Value Chains (GVCs), which was originally aimed at the analysis of relationships between companies operating in certain sectors or production lines, has gradually grown to a national dimension, currently informing the discussion of international participation and development. CGV raises the discussion on the development of policies that contribute to increase the percentage of added value captured by the domestic economy in economies with a more diversified production structure. The discussion on industrial and commercial policies that foster the growing internalization – or capture – by added value generated by value chains growth (IPEA, 2017)..

2.1.1 Distribution of value added and product demand

Out of the products with high external sales, **açaí** is the product with the highest value added, amounting to R$ 3.7 billion. As seen in Graph 3, this income is distributed as follows: 34% to the rural production sector, 43% to the local processing and transformation industry, 10% to local commerce and 12% to national commerce. The final demand for the product is divided 46%-54% between local and national.

Value aggregation takes place along different links in the chain. However, pulp processing companies play an important role as they supply to extra-local markets, registering a 177% markup. These industries buy from intermediaries who buy from producers at an reduced price (R$ 1,400/per ton) compared to what is paid by açaí beaters (R$ 2,200/per ton). Açaí beaters, who buy directly from producers and process the product by hand to supply local markets with fresh pulp, buy it at a price 57% higher than intermediaries and resell it at an inferior price by 8.5% in comparison to the processing industry, which explains the 93% markup (84 percentage points below the processing industry) (Graph 2).

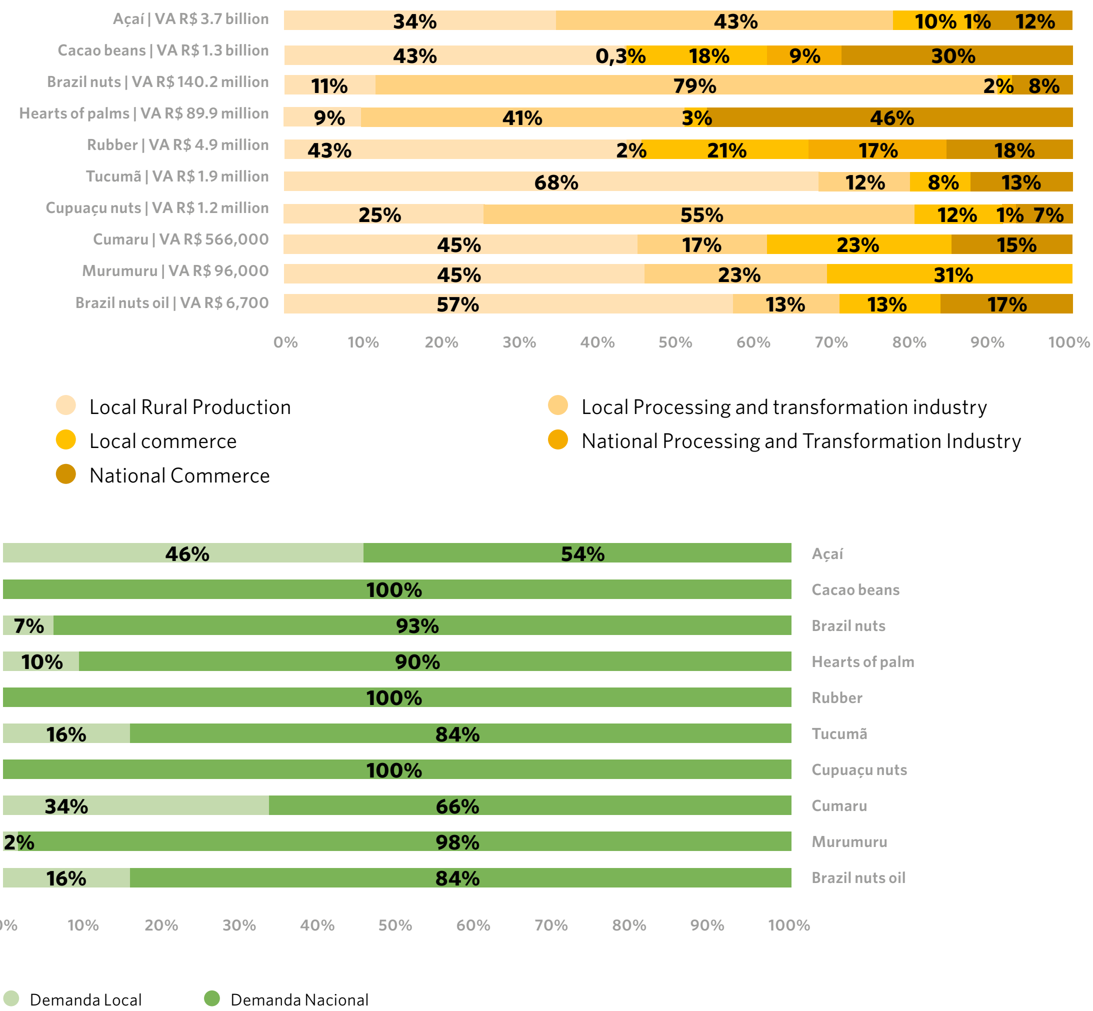
Graph 2 - Price formation and markup throughout the value chain of the Açaí fruit (R$ 1,000.00 and % of purchasing price)



Due to the importance of these agents in the purchase of açaí directly from producers (44% by açaí beaters and 65% by intermediaries), investments that contribute to adding value in artisanal and industrial processing are key to strengthening local agents. Furthermore, each actor sells the products at different prices, indicating a power difference between intermediaries - who buy and resell açaí to the processing industry to meet the extra-local demand – and açaí beaters – who buy to meet local demand. This suggests that cooperation systems must be put into place among different actors in the local rural situation (See recommendation in **Axis 1**).

Cocoa beans - the second most economically important product - generated a R$1.3 billion income in 2019, 61% in the local market and 39% in the national market. In this case, cocoa had limited participation in the local processing and transformation industry, with only 0.3% participation. Nationally, this industry represents 9% of the value added. Out of the total sales in the local rural wholesale market, 99% is destined to go to the national transformation industry, leading the rural wholesale sector to represent 18% of the value added (Graph 3). Although the markup of the transformation industry for cocoa is 40%, the local industry buys only 0.7% of rural production, which explains the importance of investing in the transformation sector to add value to the local economy. National commerce represents 30% of the total generated income, which explains the high markup in retail of 43% (graph 4). The demand for cocoa beans is completely external, which highlights the importance of investing in Science, Technology & Innovation and adopting appropriate fiscal policies (see Recommendation in **Axis 1** and Recommendation in **Axis 6**)

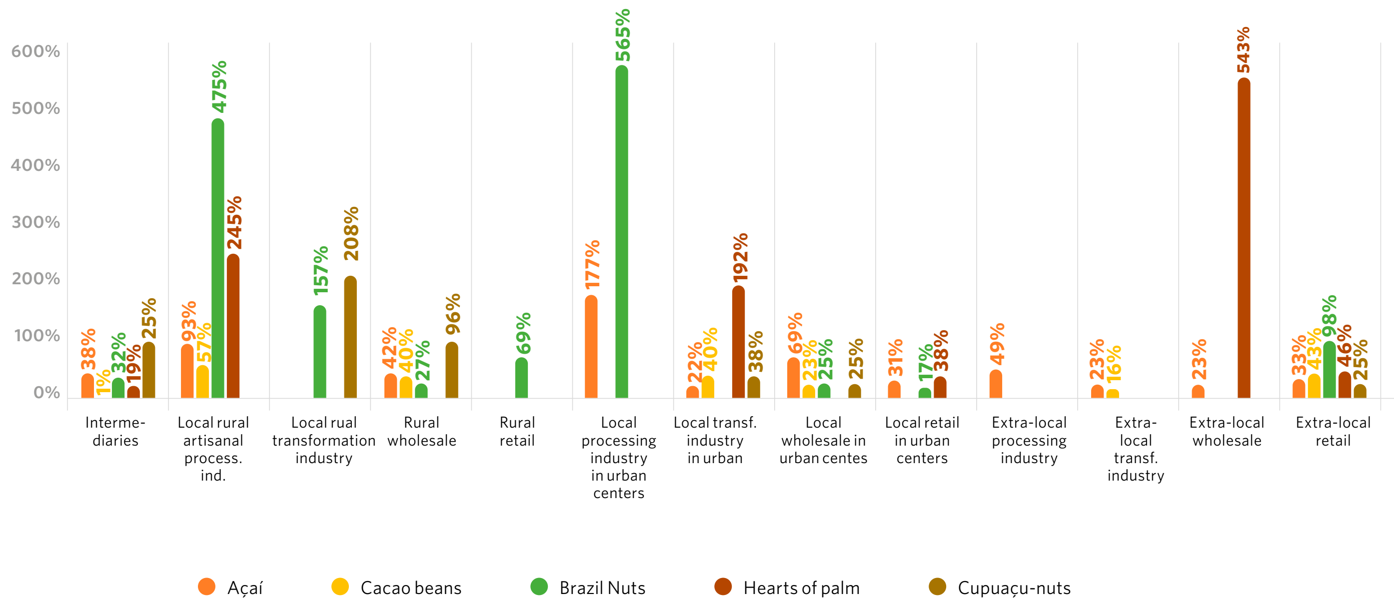
Graph 3: Generated income (VA) distribution by sector of the chain of base products of export and distribution of local and national demand (%) in 2019



Brazil nuts are the third most economically relevant product, generating R$ 140.2 million. It has a final demand in which external consumers represent 93% of consumption and internal demand only 7%. The local rural production sector represents only 11% of generated income, while the processing and transformation sector represents 79% of the income and national commerce represents 8%. The largest markups occur in the local processing industry and in urban centers: 475% and 565% respectively. The national commerce sector has a 98% markup (Graph 4). Just like with açaí and cocoa beans, investments in technology, innovation and technical assistance to improve the quality of Brazil nut processing are greatly important to foster income generation in this link of the chain. Furthermore, rural producers represent a small percentage of the income from Brazil nuts (11%), which indicates that the sector has low remuneration in comparison to others. This also indicates the importance of a fiscal policy for income distribution (see recommendation **Axis 1** and Recommendation **Axis 6**).

The **hearts of palm** chain has the most important value aggregation rate (965%) among the products analyzed (Table 2). It amounted to a total income of R$ 89.1 million, with most of the income concentrated in national commerce (46%). This can be explained by the markup of 543% in national wholesale commerce (Graph 4). Value aggregation in this sector leaves the rural producer with a low participation in the total generated income (9%). The chain of **cupuaçu nuts**, on the other hand, has a relevant value aggregation in the local transformation industry sector, representing 55% of the total value added due to a 208% markup (graph 4).

Graph 4: Markup by chain link (%)



The knowledge on adding value, which occurs at every link of the chain, and the respective income distribution are key aspects for creating specific public policies. Based on the results analyzed here, these policies must be directed at structuring cooperation markets, investing in science, technology and information, in order to develop the local processing and transformation industry, as well as creating a specific fiscal policy applied to products with high extra-local demand (see recommendation **Axis 1** Recommendation **Axis 2** and Recommendation **Axis 6**).

2.2 Products of high local demand: short chains

Out of the 30 products we analyzed, 20 are mainly consumed in the state of Pará. Amounting to a total value added of R$ 81.9 million (Table 4). Unlike products that have an important export participation in their final demand, the product chains with a larger percentage of internal consumption generate value mainly inside Pará. It is important to note that, combined, these products have a markup that is less than each of the four long chain products.

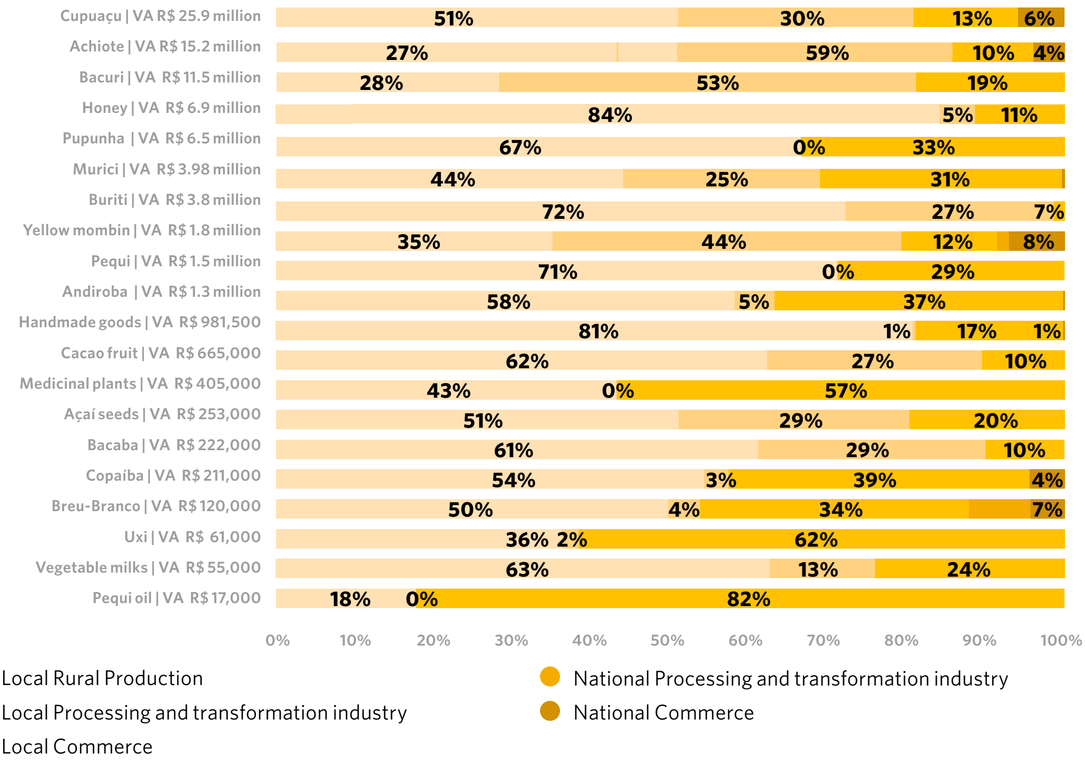
Income generation in value chains of this group of products, being short chains, is led by **cupuaçu**, followed by **achiote** and **bacuri**, which generated R$25.9 million, R$ 15.2 million and R$ 11.5 million of value added, respectively, in 2019.

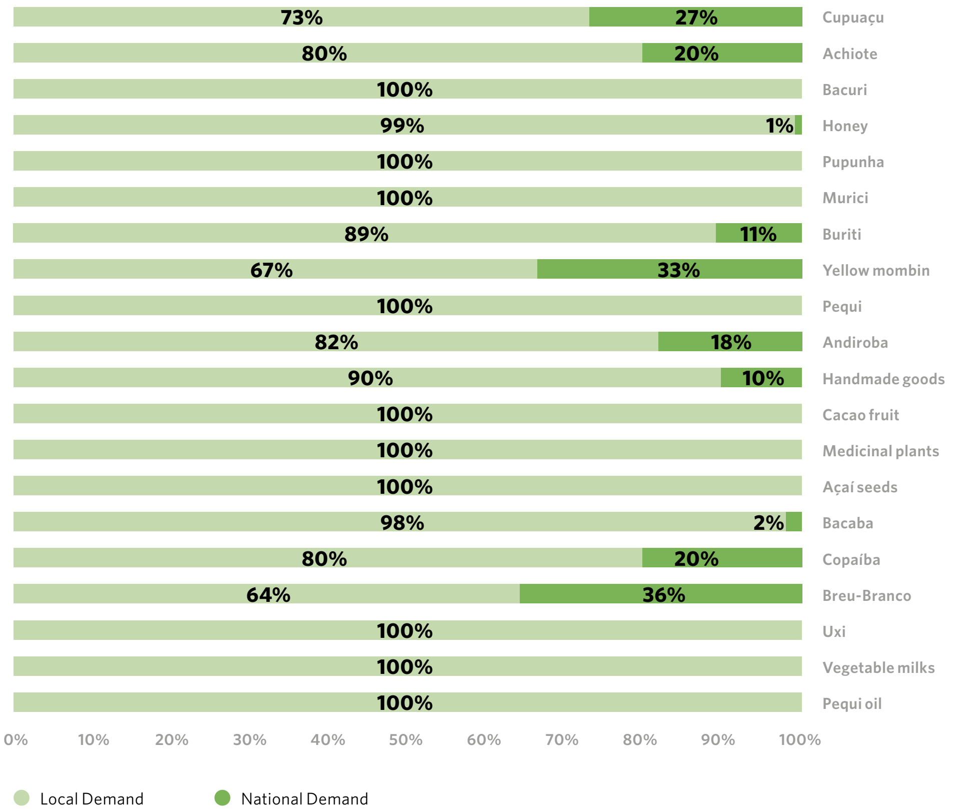
The products that retain the largest portion of income from the rural production sector are honey (84%), followed by handmade goods (81%), buriti (72%), pequi (71%), pupunha hearts of palm (67%), vegetable milks (63%), cocoa fruit (62%) and bacaba (61%). Only a handful of products have a chain with a high rate of participation from the processing industry sector. Among them are achiote (59%), bacuri (53%) and yellow mombin (44%) (Graph 5).

Table 4: Gross Value of Production (R$ 1,000), value added (R$ 1,000) and percentage of aggregation value (%) per product

Products	Gross Value of Production (R$ 1,000)	Value Added (R$ 1,000)	Aggregation value (%)
Cupuaçu	13,233	25,930	96%
Achiote	4,073	15,230	274%
Bacuri	3,255	11,544	255%
Honey	5,798	6,895	19%
Pupunha Hearts of Palm	4,359	6,538	50%
Murici	1,755	3,976	127%
Andiroba	780	1,342	72%
Copaíba	115	211	84%
Buriti	2,720	3,777	39%
Yellow Mombin	644	1,842	186%
Bacaba	137	223	63%
Açai Seeds	129	253	95%
Uxi	22	61	175%
Breu-branco	59	120	101%
Pequi	1,049	1,471	40%
Pequi Oil	3	17	452%
Vegetable Milk	35	55	59%
Handmade Goods	793	982	24%
Medicinal Plants	175	405	131%
Cacao fruit	415	665	60%
Total	**39,548**	**81,537**	**106%**

Graph 5: Distribution of generated income (VA) by sector in the product chain of local demand and local and national demand distribution (%) in 2019





It is worth noting that some of these products, which are typically consumed locally, are characterized by a high value added in commerce. That is the case for pequi oil, medicinal plants and uxi, which have 82%, 57% and 43% of their total income, respectively, internalized.

Other products have a small portion of exports related to the high participation of income aggregation in the national commerce sector: breu-branco, cupuaçu, yellow mombin, copaíba and achiote, which contribute to adding value in national commerce by 36%, 27%, 33%, 20% and 20% respectively.

Taking into consideration the large variety of products in short chains, their specificity and their importance to local economy, we suggest the creation of continuous data bases, policies for science, technology and innovation and access to credit and technical assistance (Recommendation **Axis 1** and Recommendation **Axis 2**).

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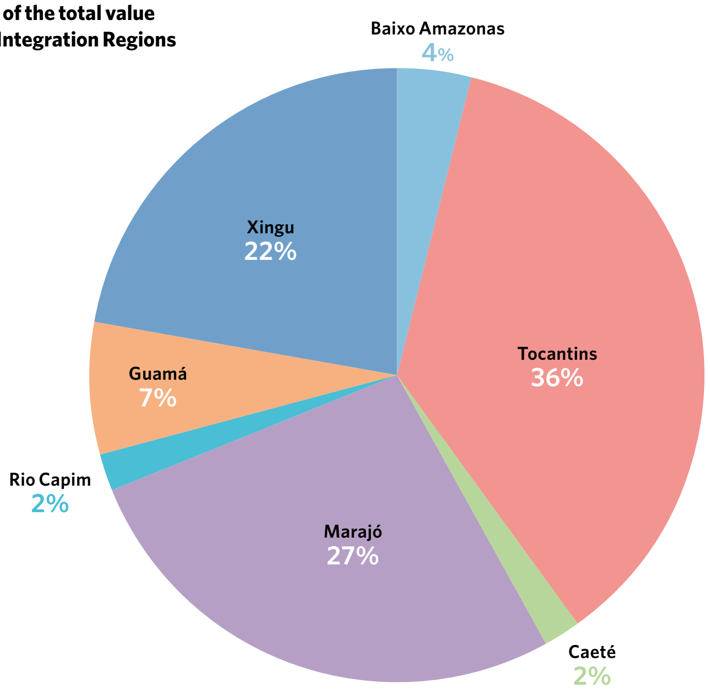
3. Regionalization of the socio-biodiversity bioeconomy of Pará: the four priority Integration Regions

Three out of the seven Integration Regions that were analyzed in this study represented 85% of the total VA of EcoSocioBio-PA in 2019: Tocantins with 36%, Marajó with 27% and Xingu with 22% (Graph 6). In order to analyze productive foundations of EcoSocioBio-PA, three IRs with the highest proportion of value added to EcoSocioBio-PA were chosen. A fourth region, Baixo Amazonas, was also chosen due to it boasting 30% of the remaining forest in Pará (the largest portion among the seven IRs of EcoBio). The region also has indigenous land, protected areas that protect 80% of that area and, at the same time, is witnessing the expansion of soy farming in the Amazon, which puts the region in the middle of decisive disputes over the future of EcoSocioBio-PA in the area.

Graph 6 – Territory distribution of the total value added of EcoSocioBio-PA – per Integration Regions



Source: Table 2-1.

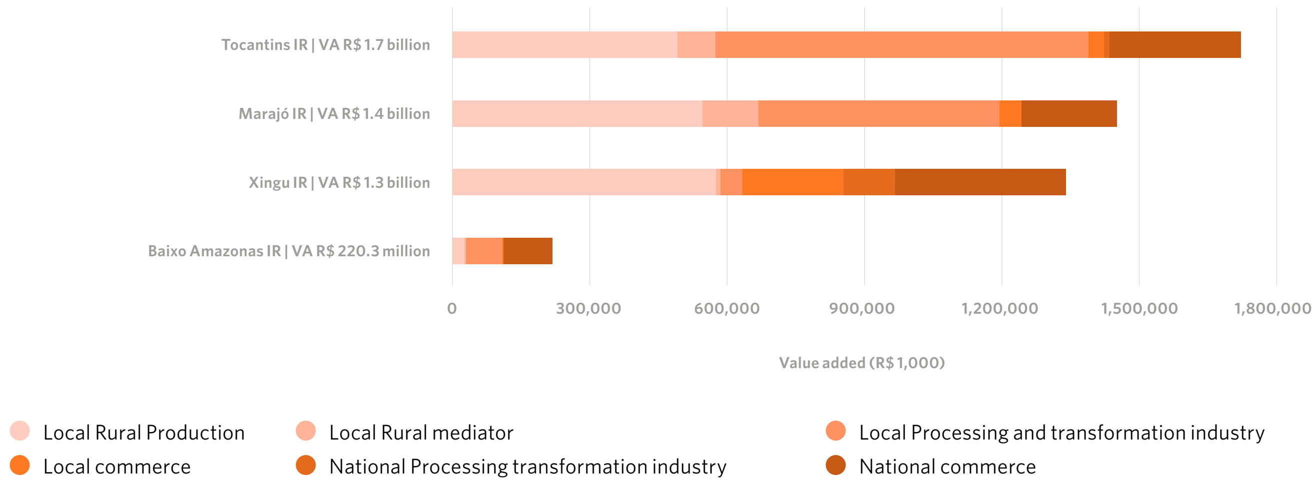
Among the four IRs we analyzed, the one with the largest supply and value added is the Tocantins IR, with a total of R$ 1.7 billion and 82,100 jobs (Graph 7). In the region, the production of açaí is the most important, representing 95% of the total VA, followed by Brazil nuts (3%) and cocoa (1%). However, other products are also part of the bioeconomy of the region, such as: cupuaçu, andiroba and yellow mombin. Out of the total VA generated, 83% remains in the local economy and 17% are generated from the national economy. Out of the final demand, consumption is mostly generated outside of the state of Pará, representing 69% of consumption. Only 31% is consumed in the state.

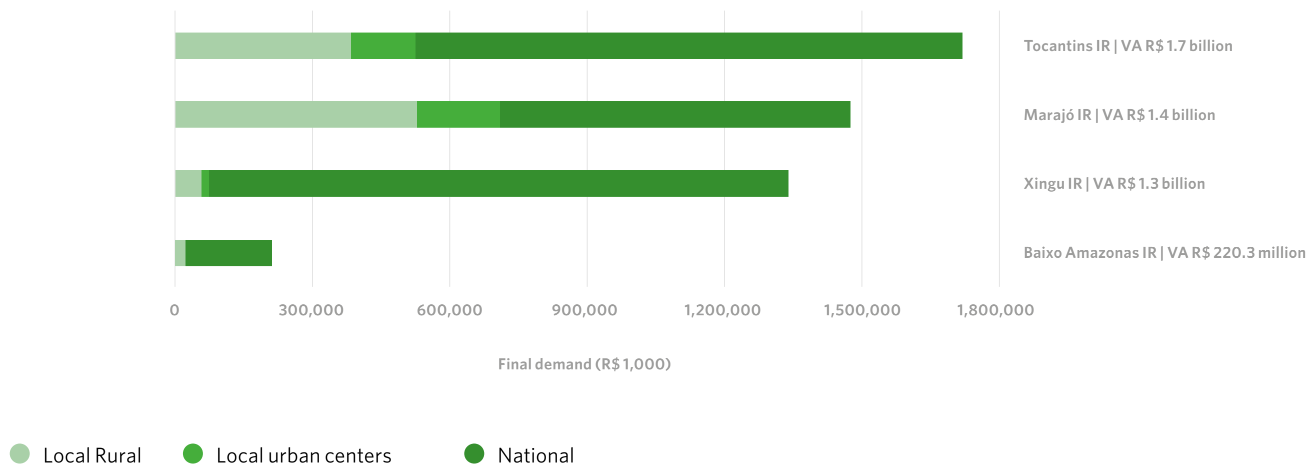
The Marajó IR generated a total income of R$ 1.5 billion and 80,000 jobs. In this region, 85% of the income is retained in the local economy. The main product of the region is açaí, which represents 86% of the total VA, followed by hearts of palm (13%) and Brazil nuts (1%). Local demand represents 49% of the final demand.

The Xingu IR represents 22% of EcoSocioBio-PA, with a VA of around R$ 1.3 billion and 39,700 jobs. The main socio-biodiversity chain in this region is cocoa beans, which represents 93% of the total VA for the region, followed by açaí (5%), Brazil nuts (1%) and achiote (1%). In this region, 64% of the income generated by supply is local. The national economy represents 36% of the generated income, which is retained in commerce (28%) and in the transformation sector (8%), primarily from cocoa trade, which is processed outside of the state of Pará.

The EcoSocioBio of the Baixo Amazonas IR contributes to an income generation of R$ 220 million and 82,000 jobs. The region produces mainly Brazil nuts - representing 82% of the total VA of the region - followed by açaí (14%) and cupuaçu (1%). In this region, 52% of the income generated by the supply is local. The national economy represents 48% of the income, which is fully retained in the commerce sector, primarily due to the consumption of Brazil nuts outside of the state of Pará. External demand represents 84% of the total final demand, also due to Brazil nut consumption.

Graph 7: Local and national value added generated in chain of socio-biodiversity products and local and national demand





4. Characteristics of the production structure of socio-biodiversity bioeconomy

In order to analyze the value chain of socio-biodiversity products in depth, we need to characterize the production structures of agents who are responsible for the rural production linked to territories. Based on Costa's analysis (2009; 2012b; 2021), this study described the different rural production structures that are linked to rural establishments included in the agriculture census.

However, it is important to note that agriculture census data does not include indigenous peoples living in indigenous lands, which creates a gap in information about the production of socio-biodiversity products. Social groups, such as local and traditional communities in agro-extractivist land or quilombola territories are included in the census, but it is not possible to identify their specific conditions or their common territories where they are located. Data from agriculture census and land demarcation allowed us to overcome these limitations.

Production structures that includes different social agents are analyzed based on **six techno-productive trajectories (TTP), denominated T1, T2, T3, T4, T5 and T7**. These trajectories consist of rural establishment groups with similar production characteristics, social relations and techniques, which occur in cooperation or competition with access to products and intermediaries markets:

i) T1: Family establishments[4] with a relatively specialized agriculture;
ii) T2: Family establishments based on Agroforestry Systems (SAF);
iii) T3: Family establishments with relatively specialized livestock raising;
iv) T4: Employer-based establishments led by livestock raising;
v) T5: Employer-based establishments led by permanent crop;
vi) T7: Employer-based establishments led by temporary crop.

Five of these TTPs aim for efficiency and specialization and use of chemical-mechanical techniques: T1, T3, T4, T5 and T7. One of them, T2, is based on the diversity of agroforestry systems (SAF)[5] in production systems that comprise forest, agriculture and livestock raising.

In the T2 trajectory there are more relevant actors for the constitution of EcoSocioBio-PA's rural base: farmer groups treated like local and traditional people in the Amazon – once known as *ribeirinhos* or *caboclos*, or as *seringueiros* - as well as people of the forest or as family farmers who practice agroforestry systems. These historical groups of the region (Costa, 2019; Castro, 2013; Harris, 1998; Nugent, 1993), have the family or domestic condition of work in common as well as the common use of techniques developed in the Amazon biome.

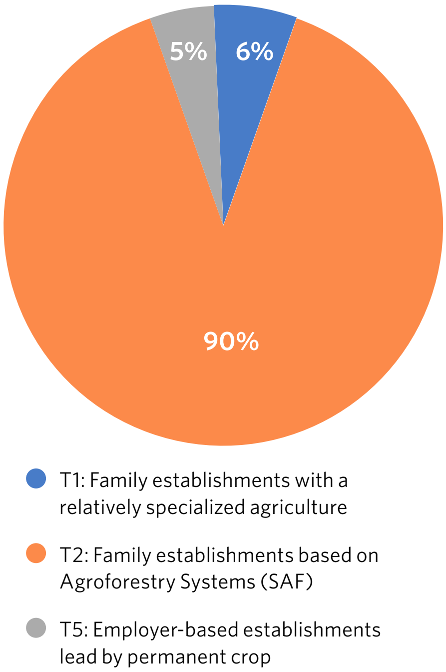
The distribution of different techno-productive trajectories of socio-biodiversity products in each IR makes T2 (Family establishments based on Agroforestry Systems) key to EcoSocio-Bio-PA. In the Tocantins and Marajó IRs, T2 represents 90 and 99%, respectively, of the production value of socio-biodiversity products. In the Baixo Amazonas IR, T1 – Family establishments relatively specialized – predominate, with 62% of production, while T2 represents only 36%. In the Xingu IR, trajectory T3 – family establishments with relatively specialized livestock raising – is more noticeable, with 65% of production, while T2 – family establishments based on Agroforestry Systems - represent 16% (Graph 8).

4 Aiming to use a term that is common to public policies, we have used the concept of "family agriculture" replacing the concept used by Costa (2009, 2012b; 2021) of "peasant agriculture." In family-based methods of rural production, farmers are radically different than employer-based methods, as the production decisions take into consideration the reproductive conditions of the family – meaning that the consumption needs of family members are covered by the results of their efforts and means of production (Chayanov, 1923).

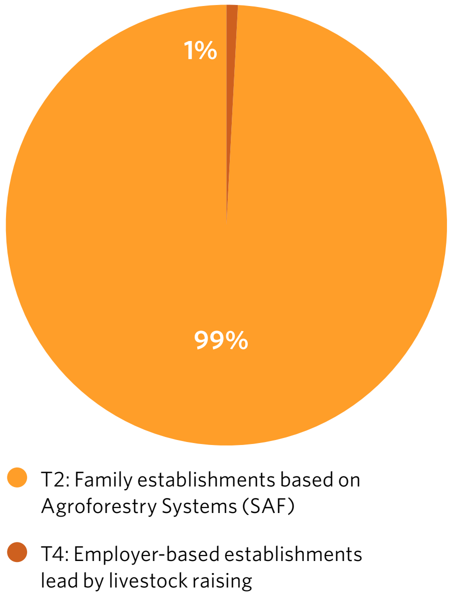
5 Agroforestry systems are described as the productive technical solutions for managing resources that originate from the Amazon biome, such as resources from the forest, the water and the soil, in a sort of "dynamic extractivism" that maintains the diversity and the complexity of "silviagriculture systems."

Graph 8: Productive structure trajectory of socio-biodiversity product groups in each Integration Region

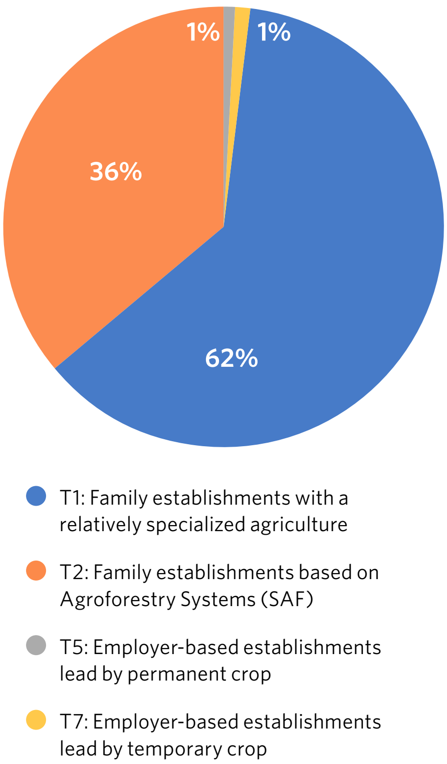
Tocantins IR (%)



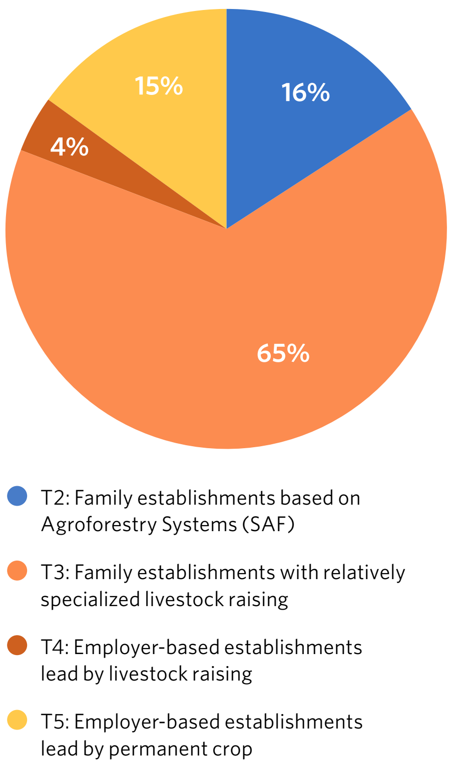
Marajó IR (%)



Baixo Amazonas IR (%)



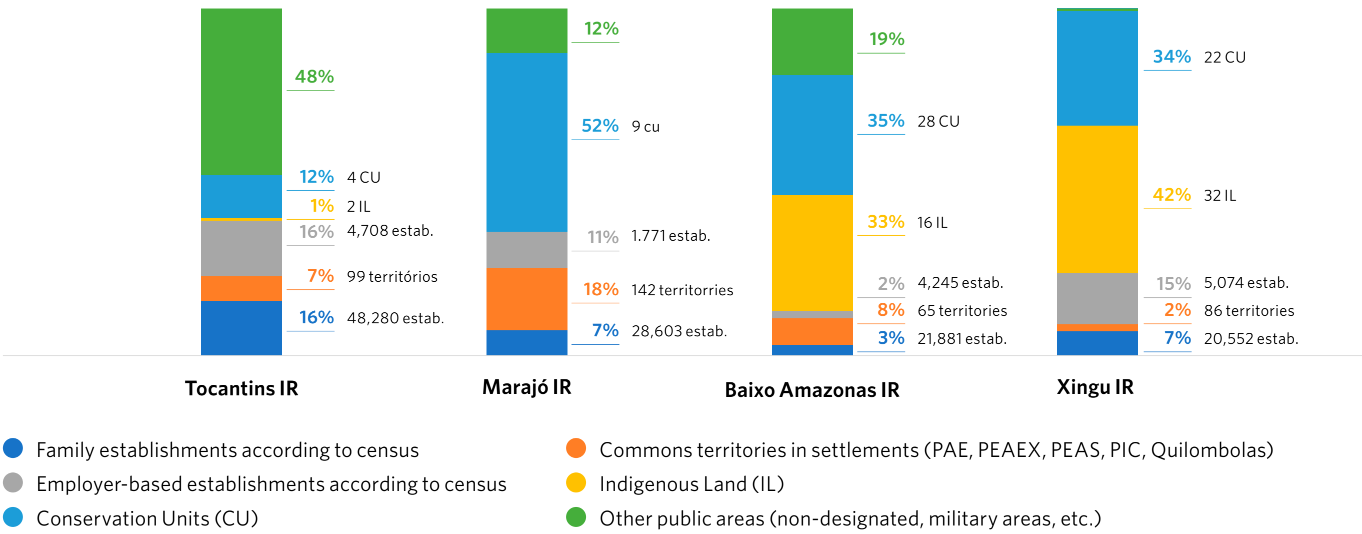
Xingu IR (%)



4.1 Land distribution condition and carbon stock per type of public and private territory

Aiming to understand land distribution in high-priority IRs, we have cross analyzed land information, identifying private land (small rural properties and large employer-based proprieties) and designated public land of common use and differentiating them from protected areas. Among the territories that were designated as common use there are settlements, such as State Projects of Sustainable Settlement (PEAS) and Agro-extractivist (PEAEX), Integrated Colonization Project (PIC), *quilombolas* territories and indigenous lands (IL). From the analysis on land distribution (Graph 9) we estimated the stock of carbon per territory (Graph 10). We have also calculated the average density of carbon stock per hectare of private lands, common use territories, indigenous lands and protected areas (Graph 11).

Graph 9: Distribution of land ownership condition in total of land by IR (%)



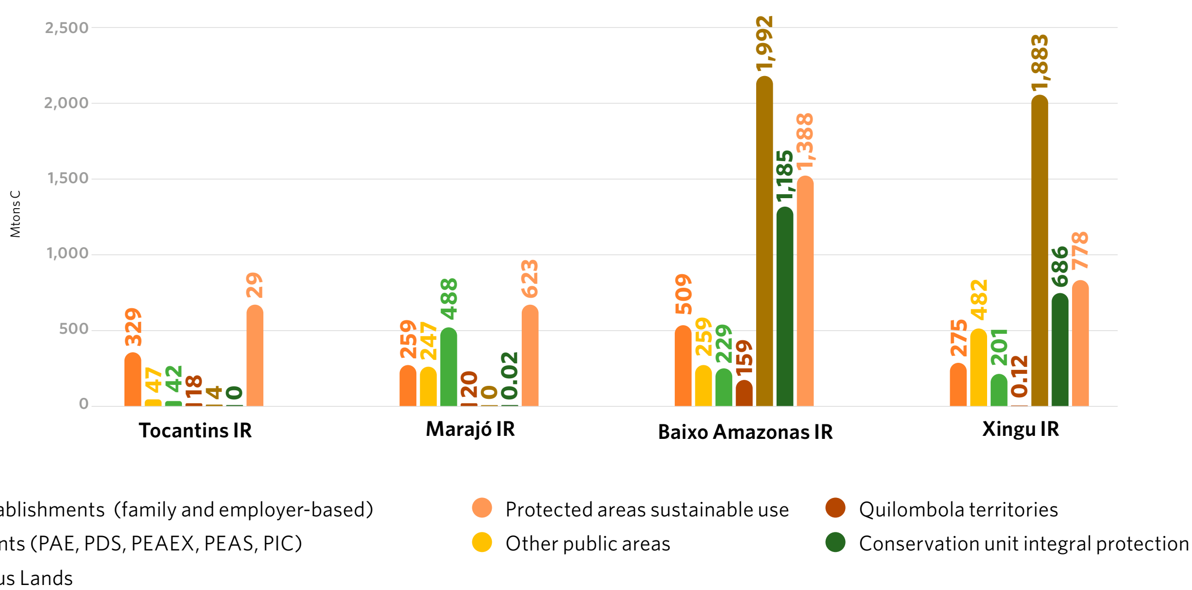
The Tocantins IR, which has an area of 35,800 km², is divided between 48,280 family establishments and 4,708 employer--based establishments, which occupy equal portions of land: 16%. Due to the large number of rural family establishments, there is a difference in area, with family establishments having an area of around 12 hectares and employer-based establishments occupying around 122 hectares. Common use lands for family farmers in settlements (PAE, PDS, PEAEX, PEAS and PIC), amount to ninety-nine territories that represent 7% of the region. Protected areas represent 13% of the territory and indigenous land represents 0.6%. 49% of the region is covered by original forest. The IR's carbon stock is mainly in rural establishments (family and employer-based) at an estimate of 329 million tons of Carbon (Mtons C). However, this class of territory, when compared to others, has a smaller average density of 119 tons of carbon per hectare (tons C/ha). Settlements and quilombola territories stock around 42 Mtons C and 18 Mtons C, concentrating an average of 189 tons C/ha and 161 tons C/ha respectively, which is 59% and 35% higher than rural establishments. This shows that even though they occupy smaller areas and have a common use of production, settlements and quilombola territories have a larger carbon density, which means a larger conservation rate. Indigenous lands in the Tocantins IR, on the other hand, have a larger average density of carbon, with 208 tons C/ha.

Land distribution in the Marajó IR, which has an area of 102,800 km², has 52% of its total area divided into 9 protected areas, 18% designated as common use territories – a total of 142 settlements – 11% as employer-based rural establishments – a total of 1,771 rural properties (an average of 628 hectares per establishment) – and only 7% as rural family properties, a total 28,603 establishments (with an average of 25 hectares per establishment). Protected areas of Sustainable Use provide the largest carbon stock of the region with 623 Mtons C. However, these areas have an average concentration of 15 tons C/ha, which is lower than the average carbon concentration of common use territories, which stock 488 Mtons C and have an average density of 199 tons C/ha. In the Marajó IR, rural properties – which amount to 18% of the total area of the region – have an average carbon density of only 110 tons C/ha, which is 45% lower than the density of settlements.

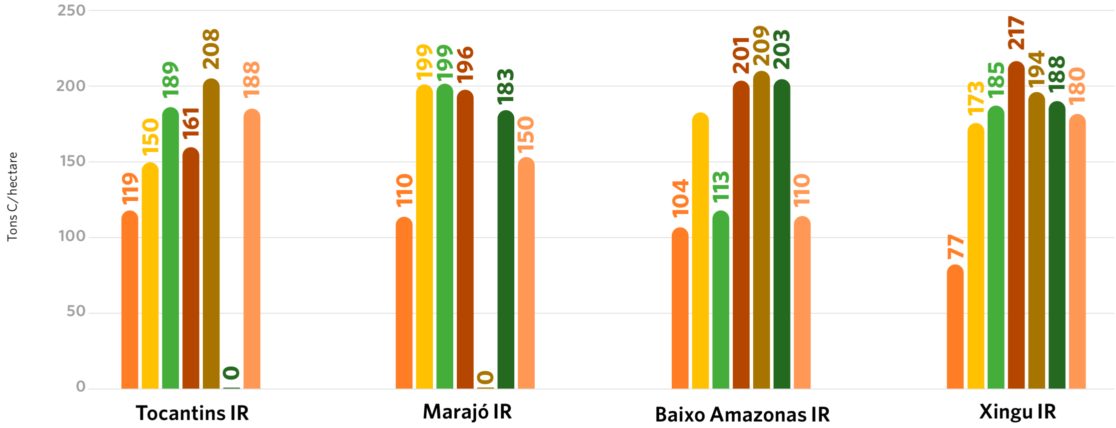
The Baixo Amazonas IR is the largest region of the state, with an area of 315,800 km². The region has 88% of its territory covered in original forest, 35% into Protected areas, 33% indigenous land with 16 ILs, 8% land of common use with 65 settlements and quilombola territories, 3% rural family establishments – divided between 21,881 properties (an average of 43.3 ha per establishment) – and 2% employer-based establishments, divided between 4,245 properties (148.8 ha per establishment). Since they occupy vast swathes of land and have a way of life that combines the use of land with vegetation conservation, indigenous lands have the largest volume of carbon stock, with 1,992 Mtons C, as well as the largest average density of 209 tons C/ha, followed by Protected areas of Sustainable Use and Integral Protection, with a 1,388 and 1,185 Mtons C, respectively. Unlike the Conservation Unit for Integral Protection, which has a high average density of 203 tons C/ha, the Conservation Unit for Sustainable Use has a density of only 110 tons C/ha. Quilombola territories have an average density of 201 tons C/ha, an amount that is close to that seen in indigenous lands and Protected areas for Integral Protection. The way the land is occupied and used in rural establishments (family or employer-based) in this region leads to a smaller average carbon density, with an average concentration of 104 tons C/ha - 48% lower than the carbon density of quilombola land.

The Xingu IR - the second largest region of the state - has an area of 250,800 km², of which 86% is forest and 42% is indigenous land. As with the Baixo Amazonas IR, indigenous lands represent the largest carbon stock of the region, with 1,883 Mtons C. The other 34% of the region is occupied by Protected areas, which also stock significant amounts of carbon, amounting to 1,464 Mtons C. In this region, where rural employer-based and family establishments represent 15% and 7% of the area, respectively, there is a high rate of livestock raising activity, therefore there is a low average concentration of carbon, at around 77 tons C/ha. In traditional community settlements and quilombolas areas, even though they register a smaller total carbon stock – 201 Mtons C and 0.12 Mtons C, respectively – there is a high concentration of carbon per area, with 185 tons C/ha in settlements and 217 tons C/ha in quilombola territories, which indicate a high level of forest conservation. Indigenous lands, on the other hand, have an average density of 194 tons C/ha.

Graph 10: Carbon stock (Mtons C)



Graph 11: Carbon density per hectare (tons C/ha)



- Rural establishments (family and employer-based)
- Settlements (PAE, PDS, PEAEX, PEAS, PIC)
- Indigenous Lands
- Protected areas sustainable use
- Other public areas
- Quilombola territories
- Conservation unit integral protection

In the regions analyzed, rural properties are those with lower carbon density rates per area. Due to the importance of traditional communities and indigenous and quilombola peoples for the conservation of native vegetation and carbon stocks, the administration needs to recognize the role of indigenous land and traditional communities in climate regulation. Aiming to implement a socio-biodiversity bioeconomy policy that is based on forest conservation, it is key to implement land ownership policies that offer judicial safety to indigenous and quilombola peoples, as well as traditional peoples. Their land must be defined and legally owned. It is also necessary to develop carbon pricing, so social benefits related to climate regulation services are applied to these territories (See Recommendation **Axis 3**, Recommendation **Axis 4** and Recommendation **Axis 5**).

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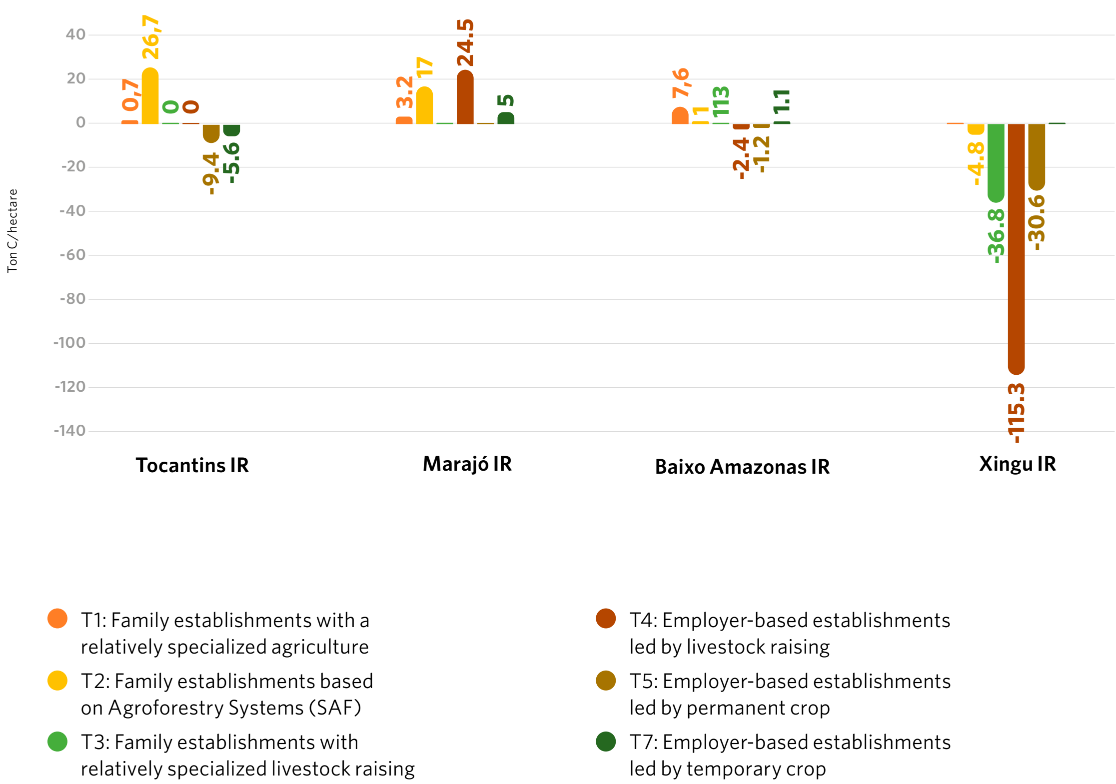
4.2 Net carbon sequestration per production trajectory

Rural production processes affect the natural environment in different ways, which can be represented by the balance between deforestation/biome restoration, emission/sequestration of greenhouse gases, destruction/recovery of biodiversity, soil compaction-leaching/aeration-restoration, water pollution/cleanliness. These balances are usually very different, depending on the technological paradigm in which solutions are used for production.

We aimed to indicate how EcoSocioBio-PA structures behave in relation to the environment based on two aspects that are linked to carbon issues: stocks and net balances of CO2 associated to EcoSocioBio productive structures. Graph 12 shows the average net sequestration of carbon per year, per trajectory and per IR. When negative, these rates represent net emission of CO2. We can see that trajectory T2 – Family agriculture based on Agroforestry Systems – in the Tocantins and Marajó IRs have a positive net sequestration of 26.7 Mt/year and 17 Mt/year, respectively. Trajectory T4 – Employer--based agriculture led by livestock raising - in IR Xingu has the largest net emission at around 115.3 Mt/year.

Graph 12: Net CO2 sequestration per trajectory and Integration Region (Mt/year)



4.3 Access to credit and technical assistance

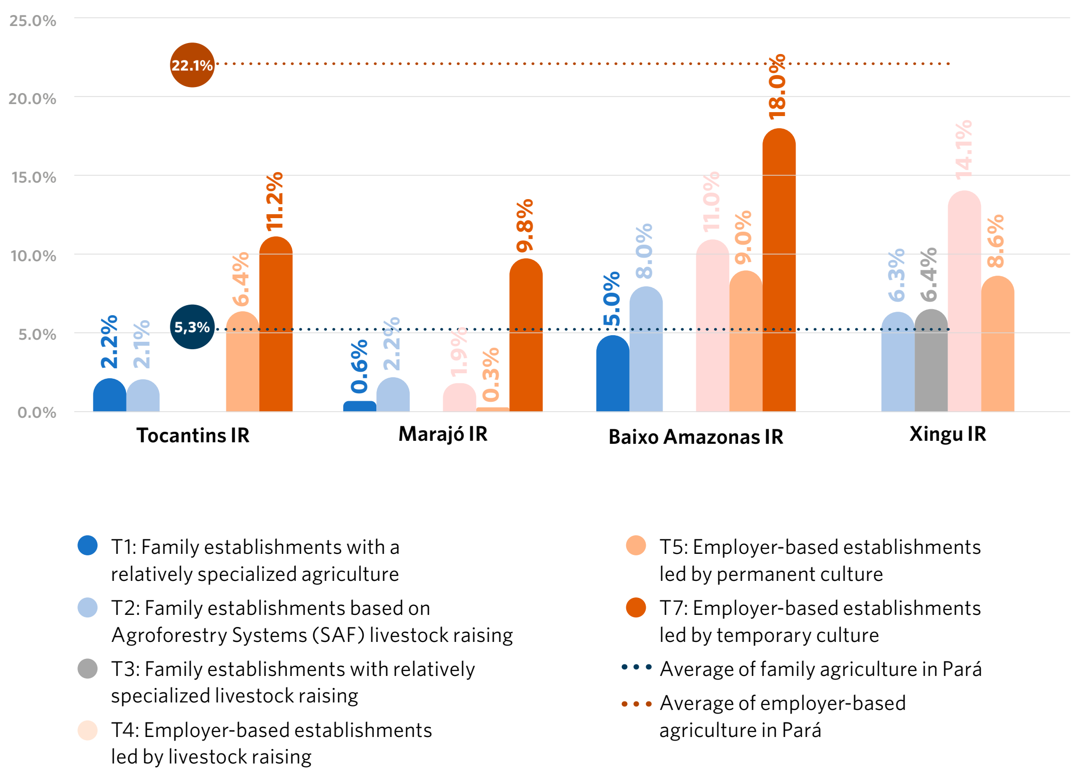
Formal and informal institutions for capital access and technological knowledge are key to the dynamics of the trajectories and their capacity for competition (Costa, 2013; Costa; Fernandes, 2016). In order to analyze the level of access to capital, we have considered participation in the volume of credit in relation to the Gross Production Value (GPV) in each trajectory in high-priority IRs in the year 2017 (Graph 13).

First, we note there is a huge difference between average participation in credit access for employer-based agriculture in comparison to family agriculture in the state of Pará. Employer-based establishments receive 22.1% of credit, while family establishments receive only 5.3% of GPV. This difference of nearly 17 percentage points reveals that family agricultural establishments are at a disadvantage when it comes to capital access and investment capacity. This shows the differences between trajectories.

When we analyze indices by trajectories, we see that T2 – Family establishments based on Forestry Systems – in the Tocantins and Marajó IRs has a credit participation that is lower than the average for the state: 2.1% and 2.2% of GPV, respectively. In these IRs, the difference in credit participation when compared to T7 – Employer-based establishments lead by temporary culture – is 9.1 percentage points for the Tocantins IR and 7.6 percentage points for the Marajó IR.

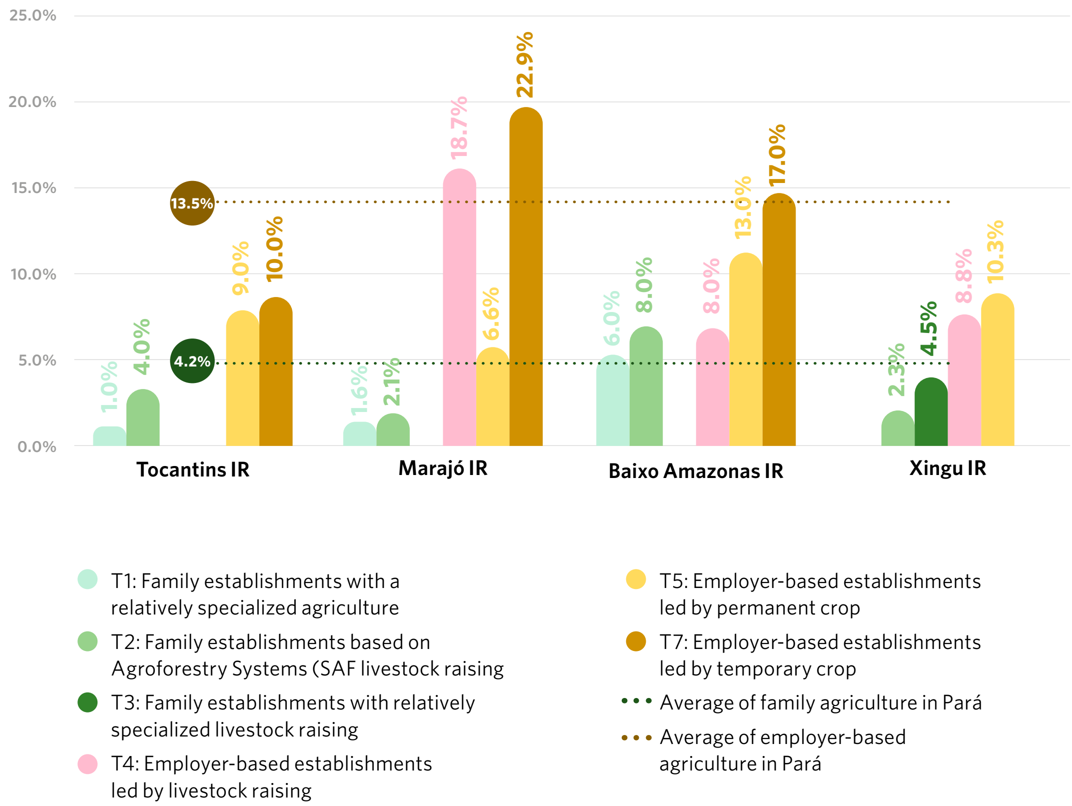
The Baixo Amazonas IR has the largest percentage of GPV credit. However, there is a significant difference between trajectories. T2 has 8% of GPV - above the average for the state. T7 has 18% of the GPV, a 10 percentage point difference in comparison with T2. In the Xingu IR this difference is more significant between T2 – with 6.3% of GPV – and T4 (employer-based establishments led by livestock raising) - with 14.1% of the GPV - which means an 8 percentage point difference exists between these trajectories.

Graph 13: Participation of credit in Gross Production Value per Trajectory and Integration Region (%)



The situation of technical assistance is also full of differences between trajectories. While the average access rate is at around 4.2% in family agriculture, 13.5% of employer-based agriculture has access to technical assistance. Among the establishments of T2 (family agriculture based on Agroforestry Systems) only 4% and 2.1% have had technical assistance in the Tocantins and Marajó IRs, respectively. However, in these two IRs, 10% and 22.9% of the total number of T7 (employer-based agriculture lead by temporary culture) establishments have received technical assistance in Tocantins and Marajó, respectively (Graph 14).

Graph 14: Proportion of establishments with access to technical assistance per Trajectory and IR (%)



The significant difference in access to credit and access to technical assistance that exists in trajectories involving family agriculture in comparison to employer-based trajectories indicates that the first group has worse financial and technical conditions for production development. Taking into consideration the fact that socio-biodiversity economy depends on T2 (family establishments based on Agroforestry Systems), it is key to implement credit policies as well as technical assistance and rural extension (ATER) policies focused on these specific situations in each region, targeting actors that work in the different links of socio-biodiversity products chains (See Recommendation **Axis 1**).

5. Projections for the future

The evolution of socio-biodiversity bioeconomy in the state of Pará has had an average growth rate of around 8.2% per year from 2006 to 2019. However, the growth of production is marked both by price evolution and also by the ecological limits associated with products extraction. Each product has distinctive production and price growth curves, which must be analyzed individually.

With the aim of estimating future potential economic revenue in socio-biodiversity products chains until 2040, we have made projections for the economic values of ten strategic products that have been selected: i) açaí, ii) Brazil nuts, iii) hearts of palm, iv) honey, v) cupuaçu, vi) buriti, vii) cocoa bean, viii) copaíba, ix) andiroba, x) cumaru, based on three scenarios:

> i) Scenario 1 – Business as usual trend, considering the production and the average price curve evolution from 2006 to 2019.
>
> ii) Scenario 2 – Trend with cost reduction policy and redistribution of value added, considering the implementation of cost reduction policies in the local rural and urban centers processing and transformation sector by 50% and 20% respectively, as well as applying a specific aliquot on sales for extra-local destination at 8%.
>
> iii) Scenario 3 – Trend with a carbon pricing policy, considering the implementation of payment through social benefit of stocked carbon in areas of socio-biodiversity products production, calculated through Social Cost of Carbon, estimated by Ricke et al. (2018).

The analysis of the projection performed for the 10 products indicates a projected revenue of around R$ 170 billion by 2040. Depending on the behavior of the price and quantity of each product, a continuous growth in the revenue generated was projected by chains of açaí, cocoa-almond, cumaru, honey, buriti, hearts of palm and andiroba, and a drop in income generated in the chain of Brazil nuts and copaiba. The results highlighted below presents the projection for the açaí and cocoa bean chain.

5.1 Scenarios for the açaí chain

The projection for the açaí chain under Scenario 1 estimates that, if the total value added was R$ 3.7 billion in 2019, in 2040 the value added is predicted to be R$ 109.3 billion (Graph 15). In 2040, out of the total projected income, the production sector is also responsible for the largest amount: R$ 37.2 billion (34%), followed by rural and urban centers processing industries, which amount to R$ 16.3 billion (15%) and R$ 29.6 billion, respectively. The national retail sector is next, with R$ 13.7 billion (13%), and then rural intermediaries with around R$ 7 billion (6%). In relation to the amount projected for 2040, we predict production will reach 1.2 million tons, with an average annual growth of 3%. With the policies of intermediate cost reduction (Scenario 2), value added participation in the national retail sector drops from 13% to 9.5% as rural processing sectors will be responsible for 19.7% - instead of the current 13.5% - and the industrial sector in urban centers goes from 15.3% to 28.1%. By including the social benefit of stocked carbon in producers' income, we guarantee remuneration associated with forest conservation, which contributes to mitigate climate change.

Under Scenario 3, the participation of generated value added in the production sector goes from 30.8% to 43.5%. The rural mediator sector's participation goes from 20% to 5.5%, while the participation of the processing industry in urban centers goes from 15.3% to 23.2% and drops from 13% to 10.8% for the national retail sector. The value added for producers under Scenario 3 is estimated at R$ 55.5 billion in 2040. However, without the pricing policy, it would reach an value added estimated of R$ 37.2 billion in 2040.

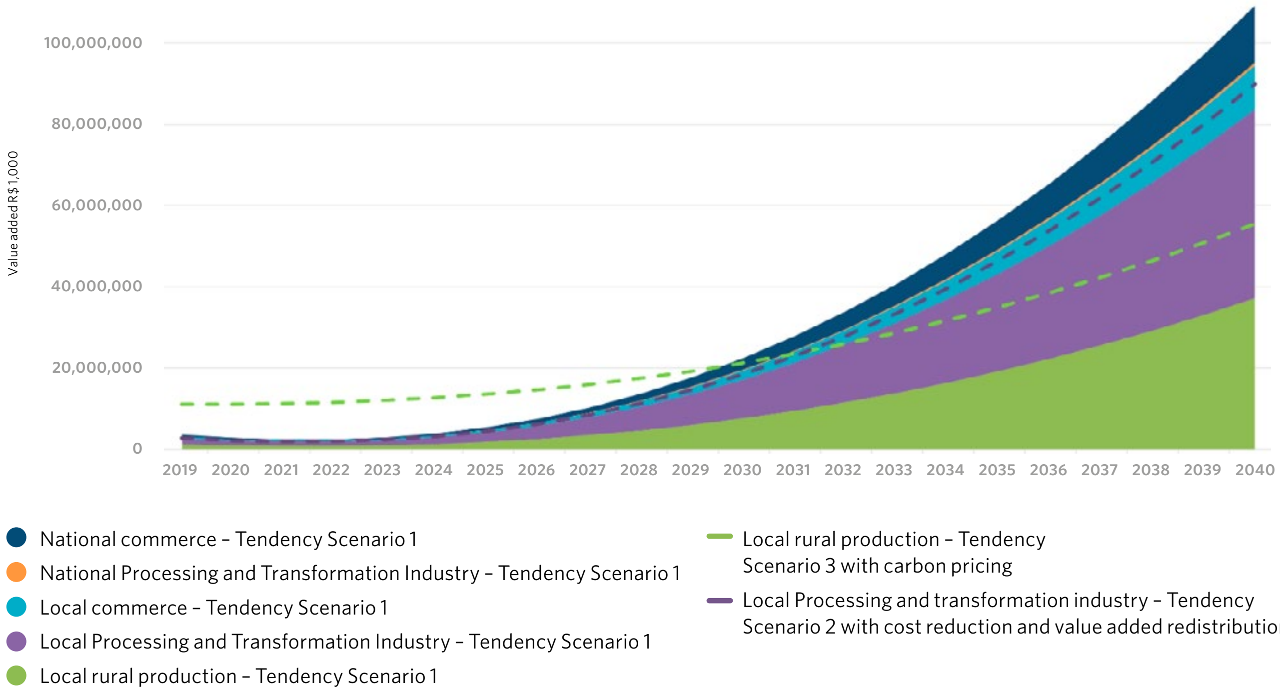
5.2 Scenarios for cocoa bean chain

Projections for the cocoa bean chain under Scenario 1 estimate that, if the total value added of the chain was at around R$ 1.3 billion in 2019, it could be at R$ 59.8 billion in 2040, meaning an average growth in generated income of 20% a year (Graph 16). Out of the total projected income, it is expected that the production sector will be responsible for R$ 25.7%

billion (43%), the local rural wholesale sector for R$ 10 billion (16.8%), the national transformation industry for R$ 5.6 billion (9.4%) and the national retail sector for an amount of around R$ 17.7 billion (29.6%). In relation to the levels projected for 2040, we predict production will reach 524,381 tons, representing an average growth of 10% per year in the period.

Under Scenario 2, the participation of the national retail sector in the total value added drops from 29.6% to 24.3%, while the participation of processing sectors grows somewhat, at around 0.4%. Scenario 2 - with redistribution percentages applied - reveals a low magnitude for value added redistribution, with the need for higher percentages that lead to minimizing costs and taxes for the national economy. Under Scenario 3, with carbon pricing policies, the production sector becomes responsible for 48.2% of the generated value added, against the current 43%. The value added from rural producers projected with carbon pricing reaches R$ 32 billion in 2040.

Graph 15: Value added projection in the açaí chain by scenario until 2040 (R$ 1,000)

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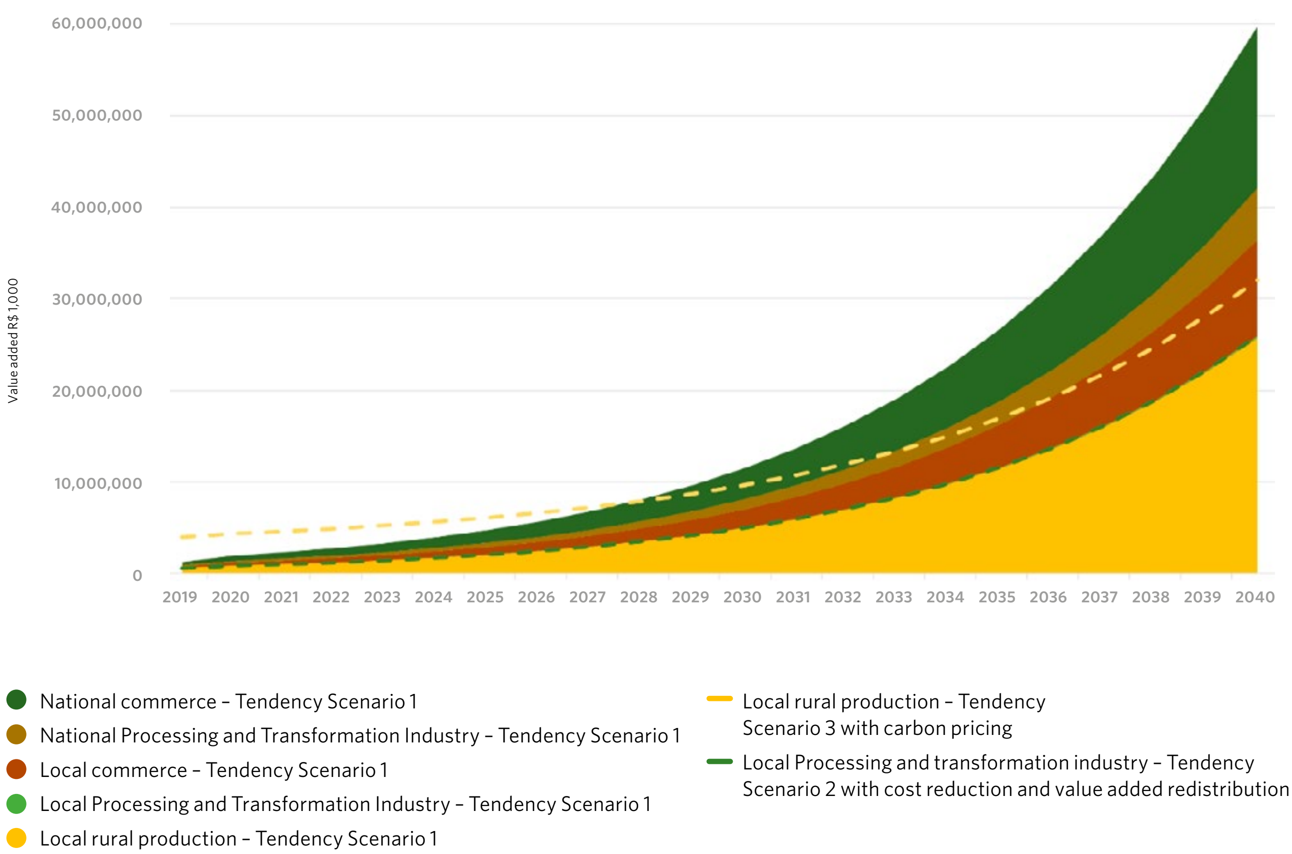
Graph 16: Projection of value added for the Cocoa Bean chain by scenario until 2040 (R$ 1,000)



5.3 Aspects of production trends and limitations of projections

The projection of economic scenarios faces uncertainties related to endogenous and exogenous variables that are not considered in the the model. It is possible to identify some of these interferences with positive and negative socio-environmental and economic implications, which may occur in socio-biodiversity product production. Examples include:

increased knowledge about distribution of species and investments in logistics to access new areas, could contribute to an increase in productivity in product extraction.

technical-economic viability for cultivating certain species could lead to economies of scale and a drop in the price of products, which would then discourage traditional and indigenous people from extracting products to sell. An example is the economic cycle of rubber, which was affected by extensive cultivation of *Hevea Brasiliensis,* leading to a relevant drop in rubber prices on the international market.

Deforestation due to land conversion for raising livestock could lead to a loss in area in which fruit trees thrive. An example of this is *Bertholletia Excelsa*, which produces Brazil nuts and is in a vulnerable extinction threat due to deforestation and wood commercialization.

Some products trend towards growth while others have a tendency to decline, as their progression is related to different socio-environmental and economic factors that must be analyzed case by case.

5.4 Risks of economies of scale for cultivated products

Although many Amazon species that provide socio-biodiversity products are still not cultivated, there are others that can be cultivated in many different soils with technical-economic viability. This last production system, characterized by economies of scale, is implemented in cultures such as rubber trees, cocoa trees and, recently, *Euterpe Oleracea* - the species that provides açaí.

Unlike in culture crops, socio-biodiversity products that are managed by local communities and indigenous peoples have a production frontier with a scale defined by different factors, such as accessibility to the forest, technical knowledge of sustainable management and period of species fruiting. Therefore, the production of socio-biodiversity products in agroforestry systems, for example, is characterized by a productivity aligned and determined by ecological balance and sustainability criteria of species in its surroundings.

The production frontier of a cultivation system with increased land use and density of a single species, is determined by aspects such as increased productivity per area and capacity of cultivation development. According to the National Center for the Conservation of Flora (CNCFlora)[6], the cultivation of *Hevea Brasiliensis*, for example, in which significant stretches of forest are destroyed, has led to the extinction threat of other species such as *Dichorisandra leucophthalmos Hook* (vulnerable) and *Picramnia coccinea W.W.Thomas* (endangered).

Therefore, due to the risk of ecological impact from large scale cultivation, we must differentiate cultivated species, such as cultivated açaí cultivated, and the fruit collected and managed in areas with a high diversity of species. This differentiation by the market requires information, such as traceability systems and sociocultural origin certificates, as well as environmental services embodied in products (see Recommendation **Axis 5**).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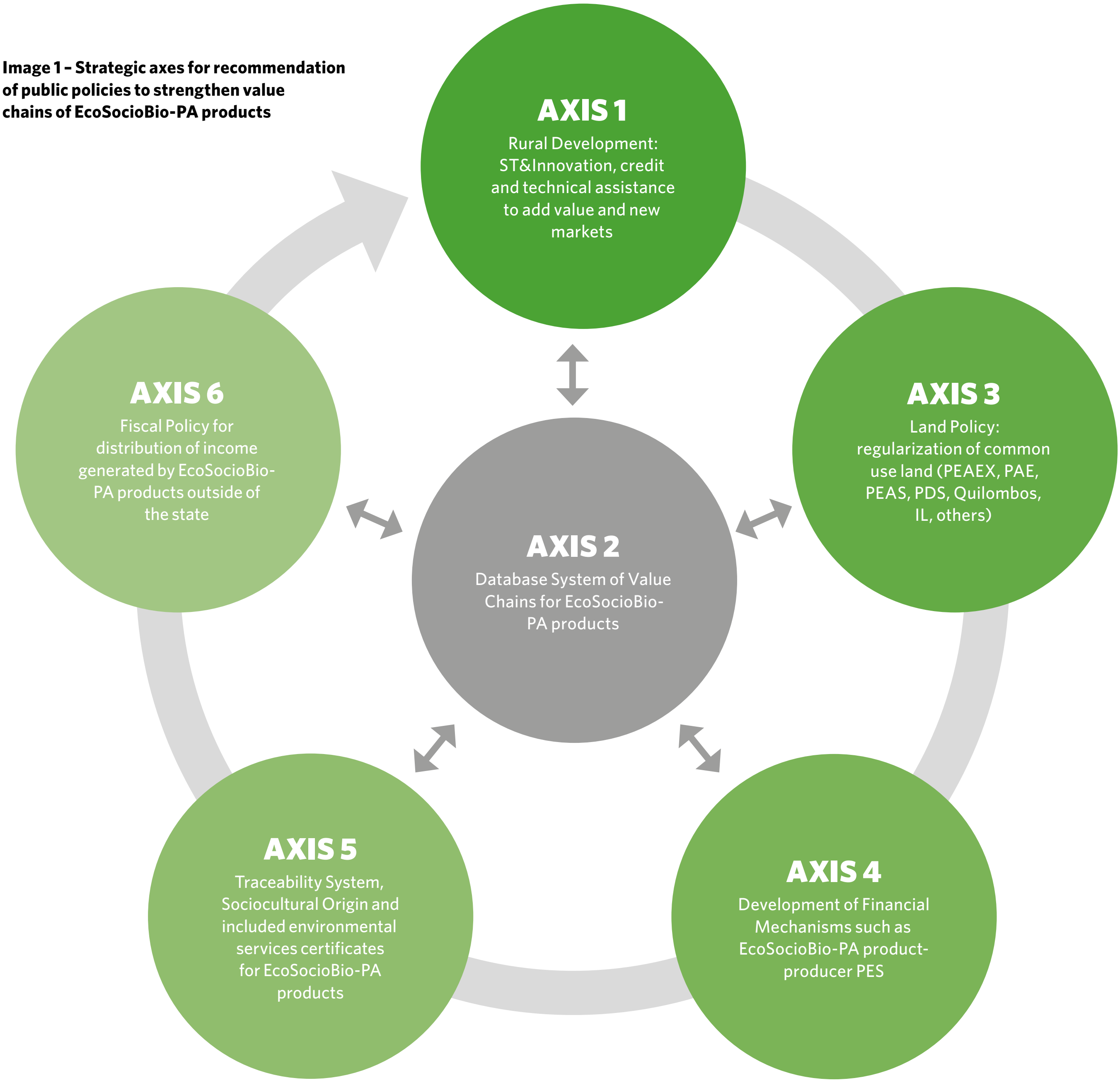
6 http://cncflora.jbrj.gov.br/

6. Recommendation of public policies

The proposed recommendations to strengthen the socio-biodiversity bioeconomy were developed to fill gaps and correct institutional asymmetries that weaken the organization, strengthening agents in value chains for EcoSocioBio-PA products. Analyzing the economic importance of income generation of value chains (part 1 of this document) along with the productive fundaments and institutional and financial support for these chains (part 2) indicates the need for six axes of public policies (image 1).

Initially, actions aiming to strengthen EcoSocioBio-PA must consider increased land coverage compared to that suggested by State Plan of Amazônia Agora – PEAA (Pará, 2020). Beyond the Sustainable Territories (ST) proposed by PEAA as priority areas (Xingu, Tapajós and Araguaia Integration Regions) three other Integration Regions must be included in the bioeconomy plan: Tocantins, Marajó and Baixo Amazonas.

Image 1 – Strategic axes for recommendation of public policies to strengthen value chains of EcoSocioBio-PA products



Below, we describe the main strategies for each recommendation.

Axis 1
Rural Development Policies: ST&I, credit and technical assistance

Science, Technology and Innovation policies (ST&I) must be aimed at stimulating and addressing the demands of T2 – Family Agriculture based in Agroforestry Systems. The aim must be broader ecological processes, not isolated ones, even if this requires more time for better results. These initiatives must be focused on processes of soil and forest ecosystems of the biome, replacing the dominant focus in agricultural research guided by the mechanical-chemical paradigm that is interested in making production systems more uniform to better control them (Costa, 2015).

Policies to foster gains and efficiency in the use of natural capital are usually focused on high-tech technological development, disconnected from day-to-day practices and needs for production in the value chain of socio-biodiversity products. ST&I policies must ensure that technological innovations in products and processes can be accessed and used by agents of these value chains in their urban and rural contexts. These are our recommended actions:

1. ST&I policies guided by the agroecological paradigm to ensure that technological, market and industrial needs of T2 (Family Agriculture based in Agroforestry Systems) are accessible to different links in the EcoSocioBio-PA chain.

2. Credit policies and technical assistance and rural extension (ATER) policies must take place together, in each Integration Region, focused on the regional specificities of T2 (Family Agriculture based in Agroforestry Systems). These policies must include productive projects - both agro-extractivist and production processing activities (açaí beaters, for example) - in rural areas and in urban centers. They must consider profitability, food sovereignty, and both experience as well as the technical needs of families.

3. ATER must be undertaken by gender equity and knowledge exchange, multidisciplinary teams which include technicians from the regions to enable an exchange of local knowledge and experiences about maintaining forest ecosystems or agroforestry systems.

4. Planning the actions of the East Amazon Fund to gather specific resources to develop the socio-biodiversity products chains by training the young.

5. Restart the Forestry Grant Plans to provide support to extractivism, organizing production and valuing non timber forest products, and allowing concession and financing processes for community forestry.

Axis 2
Creation of a continuous database system for value chains of EcoSocioBio-PA products

Due to the gap in official statistics about the different links of the value chain of EcoSocioBio-PA products and the importance of these sectors in generating jobs and income in local economies (rural and urban centers), we suggest the development of a continuous database system for value chains of EcoSocioBio-PA products.

Taking into consideration that collecting data is key to the development of public policies, this recommendation aims to list and register flows of purchase and sale by inducer agents of socio-biodiversity bioeconomy in the state of Pará, promoting recognition of these actors from indigenous peoples and local communities . The development of this system could be linked to the predicted PEAA action to create an “Information Ecosystem”.

We recommend the following actions:

1. Developing a Continuous Database System for EcoSocioBio-PA products connected to the “Information Ecosystem”.

2. Listing and registering inducer agents of EcoSocio-Bio-PA, contemplating the location of production in socioenvironmental areas, such as agro-extractivist areas, quilombola territories, indigenous land and conservation protected areas.

3. Building a continuous database system for value chains of EcoSocioBio-PA products, with data collection and updates fed by local agents who induce product supplies (main chain), contemplating: local

rural production, rural and urban center processing and transformation sectors, rural and urban center commerce sectors.

4. Creating a registration and accounting system for products exported through interstate and international transactions that do not have a code in the Mercosur Common Nomenclature (NCM) system or that are not internally computed. Making the development of data from compatible information viable, adopting specific codes for local products and not for generic products.

Axis 3
Land policy for regulating common use territories (PEAEX, PAE, PEAS, PDS, Quilombos, IL, others)

Ethnic groups, as well as the development of social-environmentalism in countries of the southern hemisphere, have contributed to the recognition, protection and legalization of lands of common use (Colin; Le Meur; Léonard, 2009). The Amazon rainforest version of this world movement led to policies for the recognition and appreciation of indigenous peoples and historical field workers - or caboclos - (Costa, 2019), as well as traditional peoples and local communities, which then led to policies that recognized land rights and delineated Indigenous Lands (IL), quilombolas territories, extractive reserves (RESEX), national forests and special categories for settlements with agro-extractivist projects (PAE), as well as their state equivalents.

However, as of 2009, this situation changed and public policies have been aimed at regulating land ownership of individual properties, like the Legal Land Program, following land disputes and environmental conflicts. It is important to note that there is still another issue regarding land rights related to agents responsible for the economy of T2 – Family Agriculture based in Agroforestry Systems.

This issue presents itself in two different ways. The first is the urgent demand for land regularization in state and federal lands that have already been delineated but not yet legalized, officializing indigenous land. The second is the concession of real right of use (CDRU) when it comes to RESEX, National Forest (FLONA), State Forest (FLOTA), PAE and PEAEX and issuing definitive documents for quilombola territories. The lack of CDRU issuing for PAE in Marajó, Tocantins and Baixo Amazonas IR is an example of this problem, which limits public policies for these territories. We recommend the following:

1. Based on the new selection of priority areas for land development, traditional peoples and local communities must be favored, as well as areas with potential for the development of products and processes of socio-biodiversity value chains. In order to do so, regulation of land distribution plans must be the priority, by recognizing land rights of common use areas, which are key to EcoSocioBio-PA.

2. Developing a geographic system of land ownership information in order to regulate public and private land. One example is the SIG Fundiário developed by the Federal University of Pará in partnership with the State Prosecutors Office, which connects propriety registration information from notaries with cartographic data from land ownership organizations. This allowed for properties to be located and the domain chain to be noted. This system could make it easier to validate Rural Environmental Registry (CAR) and facilitate land ownership regulation processes and judicial analysis to resolve land conflicts.

Axis 4
Development of financial mechanisms, such as Payment for Environmental Service (PES) product-producer of EcoSocioBio-PA

The ecosystem services in territories where socio-biodiversity products are produced are wide-ranging. They include the provision of food, climate and water regulation, conservation of water supply and ecosystem functions, regulation of soil and cultural services related to way of life and production practices.

Developing mechanisms to compensate ecosystem services – such as implementing a payment for environmental services (PES) related to socio-biodiversity products – requires providing-receiving agents and user-payer agents. In the market of socio-biodiversity products we consider providing agents to be indigenous people and local communities, who ensure the conservation of the forest and its multiple services. User agents are the links in the chain who buy products such as raw materials or as final consumers.

Facing the ecosystem service linked to carbon stock in territories in which collection and production for EcoSocioBio-PA take place and considering one of PEAA's goals for implementing PES, we suggest the following:

1. Officializing the implementation of environmental services pricing through product-producer PSA, linked to the environmental service provided by forest conservation to the product and to the producer in the EcoSocioBio-PA value chain.

2. Quantifying environmental services, such as stock and sequestration of carbon that is embodied in the product and that is linked to the territory of producing agents of EcoSocioBio-PA.

3. Aligning the mechanisms for benefit sharing of REDD+ programs to the structure of Sustainable Territories subprograms, with a monitoring, reporting and verification system (MRV) and indices of progression of State Plan of Amazônia Agora's safeguards.

Axis 5
Traceability and sociocultural origin certification, as well as included environmental services certification in EcoSocioBio-PA products

In order to complement the economic instrument of PES, through commercialization of products by EcoSocioBio-PA producers, we also recommend an ecosystem services certification schemes. This could be an important step in adding value to EcoSocioBio-PA products, incorporating prices for ecosystem services. With the certification, consumers are informed of the socio-cultural origins and the socio-environmental benefits of the product.

Considering that PEAA plans for a "We Are Sustainable" certificate, aiming to attest to the environmental legality of the entire production cycle and best social-environmental practices, we suggest:

1. Creating a traceability and sociocultural origin certification, as well as an included environmental services certification for producers in the value chain of EcoSocioBio-PA. Developing traceability systems for the production of socio-biodiversity products based on existing integrated state data, such as SISFLORA-PA linked with the continuous database system for value chains of EcoSocioBio-PA products recommended in Axis 2.

2. Developing a certification system for embodied environmental services in EcoSocioBio-PA products associated with the Amazon biome with value chain agents in partnership with certifying organizations.

Axis 6
Fiscal policy for the redistribution of income generated by EcoSocioBio-PA products outside of the state to the local economy

The fiscal regulation for the state of Pará, determined by Decree N. 4.676 of June 18th, 2001, defines specific rules for socio-biodiversity products, such as brazil nuts, açaí pulp, cupuaçu pulp, cocoa, honey and hearts of palm. The fiscal benefits of regulating these products are divided across three stages of commerce: internal in the state of Pará (local), interstate and exterior.

Due to the regional specificity of socio-biodiversity products, since they are biome-specific and are associated with forest conservation and ecosystem services, we recommend the development of a tax incentive policy and the redistribution of income that is generated by the links in the chain that are located outside of the state of Pará. We suggest:

1. Creating tax incentives for socio-biodiversity products sold inside the state of Pará and applying a different aliquot to interstate commercial operations and exports to other countries, as they are biome-specific products.

2. Applying tax exemptions for processing and transformation operations for cocoa beans, hearts of palm and Brazil nuts.

3. Using the revenue from this aliquot on biome-specific socio-biodiversity products that are sold outside of the state and internationally to develop a fund for investments in the development and strengthening of value chains for EcoSocioBio-PA products.

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