

## AMAZON BIOECONOMY: Overview of worldwide scientific publications



### In this issue:

Amazon Bioeconomy

Exploratory Mapping  
of initiatives in Amazon  
Bioeconomy

Overview of the Scientific  
Production on the Amazon

Final Considerations

The series of thematic reports occurs in the scope of the Bioeconomy Observatory (Observatorio de Bioeconomia - OBio), whose mission is to support the development of the Brazilian bioeconomy by providing strategic intelligence to support decision-making in public, academic, and business policies. The observatory also creates an integrated, structured, and interactive space to orchestrate the creation, analysis and sharing of knowledge about bioeconomy. In this context, the Center for Strategic Studies and Management (CGEE) has released thematic reports on the bioeconomy, whose third edition has the Amazon Bioeconomy as its theme.

This report considers the following definition of bioeconomy:

“The bioeconomy comprises all economic activity derived from bioprocesses and bioproducts that contributes to efficient solutions in the use of biological resources - facing challenges in food, chemicals, materials, energy production, health, environmental services, and environmental protection - that promote the transition to a new model of sustainable development and societal well-being” (CGEE, 2020).

The first edition of the bioeconomy thematic report presented a global overview of the main themes addressed in scientific publications on the bioeconomy. The second edition focused on the Brazilian bioeconomy and analyzed 8,951 national articles. For this third edition, the Amazon Bioeconomy theme was chosen. This choice responds to a clear demand to

understand the opportunities that this megadiverse biome has to offer and, more specifically, was made by listening to specialists. A poll applied at the launching of the second bioeconomy report, on February 15, 2022 (CGEE, 2022)<sup>1</sup>, questioned the participants about what should be the subject addressed in the next edition. The most voted themes were **Bioeconomy and**

### **Amazon and Brazilian biodiversity.**

The next sections of this report present a brief discussion on the Amazon Bioeconomy; the results of an exploratory mapping of bioeconomy initiatives in the Amazon; an overview of more than 23,000 scientific publications on the Amazon; and the final considerations from the discussions held.

## 1. Amazon Bioeconomy

The bioeconomy presents itself as a path to sustainable development since it is based on the transition from fossil non-sustainable raw materials to renewable biological resources. This paradigm shift requires considerable efforts of technological, regulatory, market, organizational, and social dimensions. The conditions under which this transition is planned can vary significantly in relation to the biomass used and the product that is to be generated. The situations vary, for example, from the use of agro-industrial residues to generate bioenergy to the use of compounds from biodiversity to produce pharmaceuticals.

The diverse configurations possibilities of the use of a renewable biological resource to produce goods and services creates a complicating factor for the

development of a single bioeconomy strategy. The very definitions of the term indicates directions on the type of bioeconomy to be developed. The work of Daniel Bergamo et al. (2022) discussed how different motivations about bioeconomy influence its definition, showing, for example, that it could focus on energy transition or biodiversity preservation. The two objectives, although synergistic, do not necessarily have the same priorities in the bioeconomy development process.

Such differences should be discussed mainly in the Brazilian case, which has opportunities for various forms of bioeconomy configuration.

Brazil is a mega biodiverse country that holds about 20% of the planet's species (INSTITUTO ESCOLHAS,

2021). It is estimated that 15% of all the world's biodiversity is concentrated in the Amazon ecosystem alone (HUBBELL et al., 2008). Biodiversity, besides playing a leading role in the planet's regenerative processes, presents enormous economic potential - if it is exploited in a sustainable way.

There is still no conclusive data on the financial value that a bioeconomy of biodiversity could generate, but some value chains that are already under development point to an enormous potential. Data from the Amazônia 4.0 project indicate that while cattle ranching and soybean demand 240 thousand square kilometers to generate R\$ 604 per hectare per year, three Amazonian foods - açai, cocoa and nut - demand 3,550 square kilometers in agroforestry systems and

<sup>1</sup> Access the recording of the event [here](#)

result in R\$ 12.400 per hectare per year (AMAZÔNIA 4.0, 2022). A study organized by the Brazilian Bioinnovation Association (ABBI) estimated that the bioeconomy could add US\$ 284 billion to the Brazilian industry by 2050 (ABBI, 2022).

In the case of the Amazon, in addition to the biological product itself as the basis for a bioeconomy, it is important to include the value of traditional knowledge. Researcher Ricardo Abramovay discusses how the knowledge of traditional native peoples has contributed to the pharmaceutical industry. In the article Knowledge of forest peoples can revolutionize the pharmaceutical industry, the author compiles information about how the expectation related to technologies of artificial intelligence for the discovery and development of new molecules has not been fully achieved and, for this reason, the pharmaceutical industry has resorted to the knowledge of forest peoples to identify valuable molecules (ABRAMOVAY, 2021).

The case of the Amazon Bioeconomy is unique, as it presents challenges and opportunities specific to the region. The publication An Innovative Bioeconomy for the Amazon: Concepts, Limits and Trends for an Appropriate Definition for the Rainforest Biome (Uma bioeconomia inovadora para a Amazônia: conceitos, limites e tendências para uma definição apropriada ao bioma floresta tropical),

developed by WRI Brazil, discussed the understanding of bioeconomy in Brazil, with its connotations, limitations and trends when applied to the Brazilian Legal Amazon. The text highlighted some specific needs of the Amazon Bioeconomy, such as the conservation of forest assets through the sustainable exploitation of forest products; territorial planning to combat illegalities; and the recognition of the contributions of indigenous, traditional, quilombola and family farmer communities in making this economy viable (NEA, 2022).

Several efforts have been undertaken to guide the sustainable use of Amazonian biodiversity resources. Some examples are the study developed for the Pará Bioeconomy (COSTA et al., 2021); the selection of the 10 business principles for a Sustainable Amazon - 10 princípios empresariais para uma Amazônia Sustentável by the Possible Amazon initiative (AMAZÔNIA POSSÍVEL, 2020); the study Amazon Bioeconomy: a navigation through the scientific frontiers and innovation potentials - Bioeconomia Amazônica: uma navegação pelas fronteiras científicas e potenciais de inovação (COI, 2022); and the proposal of the Amazon Institute of Technology (AmIT) as part of the Amazônia 4.0 program (AmIT, 2022). In addition, the Superintendence for the Development of the Amazon (Sudam) is coordinating a process to prepare the Regional Plan for the Development of the Amazon (PRDA),

in view of the next planning cycle 2024-2027 - which includes, among the axes of action, important aspects for the Amazon Bioeconomy, such as productive development and Science, Technology and Innovation (CT&I).

In this context, during the UN Conference on Biodiversity (COP 15), held in December 2022, it was agreed among the parties to mobilize at least US\$ 200 billion per year in domestic and international financing related to biodiversity by 2030. While COP 15 has the primary objective of halting the accelerating destruction of the world's biodiversity, efforts to preserve and make use of these valuable resources are also essential elements of a bioeconomy (UNEP, 2022). According to the Paulson Institute, maintaining the balance of nature delivers an estimated \$125 trillion to \$140 trillion worth of value that is provided by biodiversity to the planetary economy each year. This value comes in the form of ecosystem services such as agricultural crop pollination, clean water, fresh air, disease control, flood protection, productive soil, and forests and oceans that absorb carbon (ONE PLANET, 2022).

Given the complex scenario of the Amazon Bioeconomy, this report has the ambition to contribute to the knowledge about the region by offering an exploratory mapping of the bioeconomy initiatives and a broad analysis of scientific articles about the subject.

From a vast network of scientific publications, thematic clusters that could indicate issues related to the Amazon Bioeconomy were investigated. Unlike the first two editions of the bioeconomy thematic report, this publication did not take the term **bioeconomy** as a starting point, precisely because

it recognizes that the context of an Amazon Bioeconomy goes far beyond a linear process (i.e., production of the raw material, conversion and commercialization of product). As already mentioned, the issues of deforestation, respect for traditional peoples and conservation of ecosystem services, among

others, will always be related to the development of the biodiversity bioeconomy value chains. For this reason, we chose to analyze an **Amazon Network**, and within it, identify aspects related to the bioeconomy. Picture 1 summarizes the methodological processes used for each of the editions of the reports.



**Picture 1:** Description of the methodological processes for the three bioeconomy report cards

Source : From the author, 2022.

## 2. Exploratory mapping of Amazon Bioeconomy initiatives

Considering the plurality of the Amazonian overview in Brazil, it was pertinent to investigate some of the main initiatives on Amazon Bioeconomy in the country, so as to highlight the dynamic relations between social, financial, scientific and governmental institutions aimed at valorizing the region's potentials. These relations seek not only to face and overcome the complexity mentioned in the previous section, but mainly to make sustainable use of national wealth.

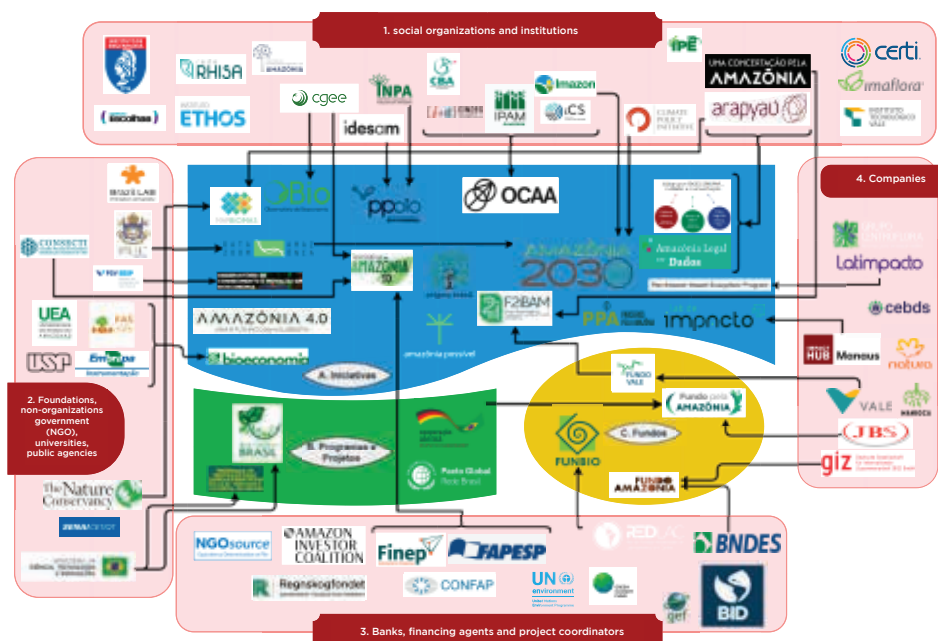
During the elaboration of the scope of this report, the team responsible parti-

cipated in working groups and debates with specialists. Thus, the technical team made contact and integrated the activities of the Working Groups (WG) on bioeconomy promoted by the following organizations: **Brazil Climate, Forests and Agriculture Coalition** and the **Concerts for the Amazon**.

The participation in these discussion groups and subgroups not only enabled a broad network of contact and understanding about the theme but also provided inputs for the mapping. With this, it was possible to further investigate each organization and find

other initiatives, works and projects about Bioeconomy in the Amazon, which revealed the dynamics of intra, and inter-institutional support needed on this issue.

Picture 2 shows the mapping of initiatives performed. As the interactions of the agents take place, several initiatives emerge to facilitate understanding in these connections. The map shows the interactions between social organizations, foundations, non-governmental organizations (NGOs), universities, banks, funding agents, and private companies.



**Picture 2:** Mapping bioeconomy initiatives in the Amazon

Source : From the author, 2022.

At the center of Picture 2 there are the different projects and initiatives that are helping to promote the bioeconomy in the region. Section A (blue box) comprises active initiatives, with multiple objectives and focuses. Section B (green box) presents projects and programs, generally linked to the governmental sphere. Finally, section C (yellow box) highlights the different Brazilian funds usually linked to the Amazon.

It is important to point out that this exercise did not aim to identify all the initiatives or even which ones could be considered the main ones, but rather to present an overview of several joint efforts by various economic, social, academic, and environmental agents to promote the bioeconomy in the Amazon territory.

The use of the term **initiative** in this work is defined in a broad way, in order to cover any and all activities or set of actions that have continuity and aim to promote the Amazon Bioeconomy. The motivation may vary among the various initiatives. The focus can be, for example, economic development, as is the case of the Impact

Hub Manaus (which helps micro and small local entrepreneurs), or even the promotion of knowledge, information and connections, as is the case of the Working Groups of the **Brazil Climate, Forests and Agriculture Coalition** and the **Concerts for the Amazon**.

Some initiatives fit into specific niches. **Legal Amazon in data, Amazon Data Zoom and Biomaps**, Data Zoom Amazônia and MapBiomass - as well as the data analysis subgroup of the GTs mentioned - carry out an effort to survey data on the Amazonian environment. Each of these seeks to quantify different aspects of the Legal Amazon region and monitor data, mainly in the scope of available resources. There are also initiatives such as Amazônia 4.0, concerned with developing technologies to increase the added value of the different local production chains. Other initiatives focus on the local economy.

In this aspect, one can highlight the Observatory of Trade and Environment in the Amazon - Observatório de Comércio e Ambiente na Amazônia (OCAA). The platform gathers information about

the relations between international trade and environment in the region, making available different analysis materials and allowing several agents to follow and participate in debates and cooperation. The Origins Brazil network - rede Origens Brasil, in turn, positions itself as a seal of approval for sustainable production and good relations between the private sector and native peoples in development and commercial production.

It is also worth mentioning actions that support the development of studies and the direct injection of resources - and that are usually characterized by the long-term aspect. This is the case of initiatives such as: Amazônia+10 (AMAZÔNIA+10, 2022); Bioeconomy Brazil Program - Sociobiodiversity (BRASIL, 2019); Brazilian Fund for Biodiversity (Funbio) (FUNBIO, 2022); and Fundo pela Amazônia (JBS, 2021).

In addition, financial support for specific projects is critical for change to occur fairly and efficiently.

### 3. Panorama of scientific production about the Amazon

This report gathered 23,752 scientific articles dealing with the Amazon and sought, within this sample, clusters related to the development of an **Amazon Bioeconomy** in order to understand

how this topic has been discussed in academia. This section presents:

**i)** the methodology for data collection, treatment and analysis.

**ii)** the network analysis, focusing on pre- and post-pandemic observation.  
**iii)** the characterization of the network by thematic clusters; and  
**iv)** a national panorama on the theme.

### 3.1. Methodology of data collection, treatment and analysis

For the survey of articles on the Amazon, the Web of Science database was used<sup>2</sup>. We searched for the term “amazon” in papers published in the last five years - more specifically from May 2017 to May 2022. The use of the general term “amazon” had the purpose of keeping the contents comprehensive, highlighting the thematic complexity of the region.

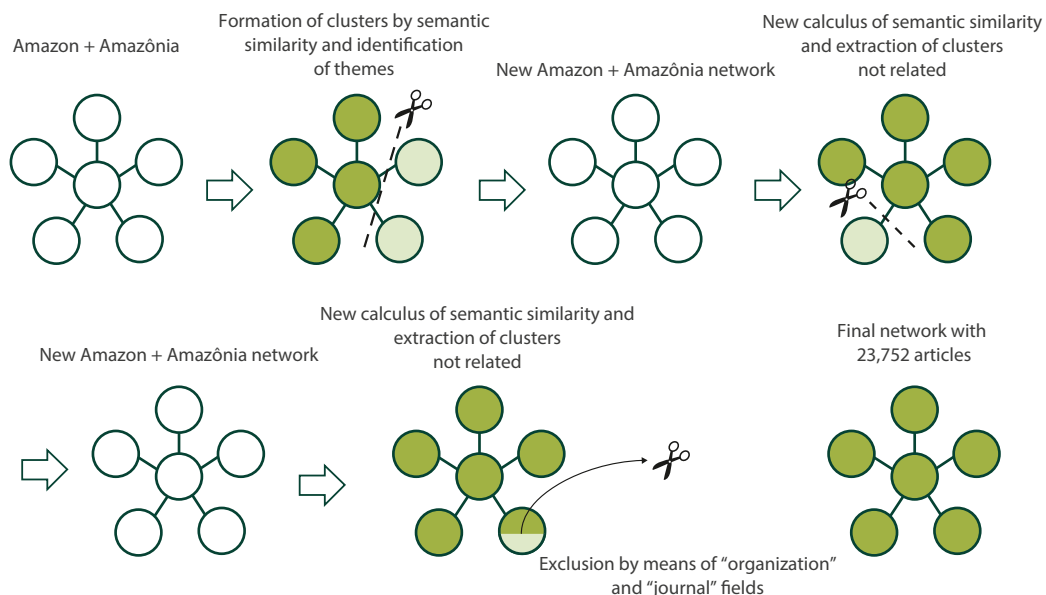
The main challenge of this methodology was to extract articles related to Amazon, an e-commerce company. The extraction was possible by the use of the Insight Net tool, developed by CGEE. With a method that used semantic similarity clusters and keyword

search, it was possible to reduce the articles related to Amazon to less than 2% of the network.

The method was based primarily on sequential extractions of clusters unrelated to the Amazon theme. Initially, data was collected with the search for “amazon” OR “Amazônia” OR “Amazonia” from the last five years, totaling 32,046 articles. This dataset was entered into Insight Net and thus the semantic similarity of the articles in the network was calculated to generate clusters of publications. The aggregation resulting from the clustering made it possible to identify groups of articles unrelated to the

Amazon theme and remove them from the network. After extraction, the semantic similarity analysis process was repeated, generating new clusters.

The tendency of this process was to leave the articles unrelated to the Amazon more concentrated and away from the central part of the network. After three exclusion processes, a more detailed analysis was performed, removing the articles selected through the “organization” and “journal” fields. This process resulted in a network of 23,752 articles about the Amazon, without the need to point to specific areas of knowledge. Picture 3 presents the methodology in summarized form.



Picture 3: Methodology for developing the Amazon Network

Source : From the author, 2022.

2 Internationally recognized as a broad and rich base of representative, quality journals.

## 3.2. Amazon Network Analysis

### 3.2.1. Overview of the Amazon Network

One way to get an overview of the content covered in a network of thousands of articles is to look at its keyword

cloud<sup>3</sup>. Picture 4 shows the keyword cloud of the complete network, highlighting the 20 most frequent words.

The word **amazon** is the most frequent since it was the search term used.



key-word	Frequency	key-word	Frequency
amazon	1205	amazonia	300
brazil	893	conservation	278
biodiversity	789	taxonomy	265
forest	568	biomass	265
patterns	478	morphology	226
land-use	461	biogeography	201
amazon basin	422	rainfall	199
rain-forest	387	dynamics	198
diversity	331	models	191
impact	315	performance	190

**Picture 4:** Complete Amazon Network word cloud

Source : From the author, 2022.

<sup>3</sup> Here the keywords placed by authors and journals are considered.

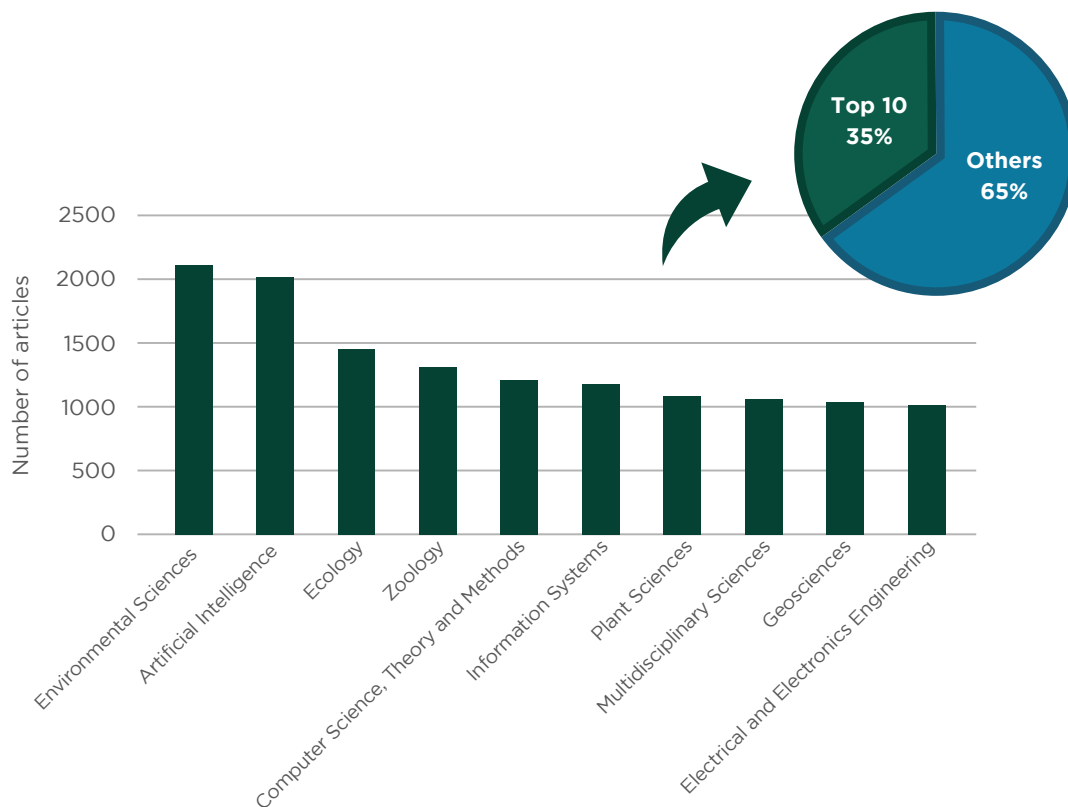


The word **brazil**, in turn, was the second most frequent indicating that the territorial predominance of the Amazon in Brazil translates into the number of publications. Other words that appear among the most frequent ones reflect ecological aspects, such as **biodiversity**, **forest**, **rainforest**, **diversity**, **morphology**, and **biogeography**. Some also seem to indicate studies on human action in the biome (**patterns**, **land use**, **impact**, **conservation**, and **biomass**), or are even related to the water complexity of the region (**amazon basin** and **rainfall**).

In a complementary manner, it is possible to analyze the themes addressed in the articles by their areas of knowledge. Graph 1 shows the ten areas of knowledge that, according to the Web of Science, are the most frequent. It can be observed that in this group are found mainly areas related to the environment and its biological and geophysical constitution; and transversal disciplines such as artificial intelligence and computer science.

It is important to note that the ten most frequent areas correspond to only 35%

of the network, indicating the plurality of areas on the theme. Observing the 50 most frequent ones, for example, the themes become even more varied and encompass, among others: linguistics; biochemistry and molecular biology; meteorology; telecommunications; anthropology; remote sensing; and public health. This variety of words and areas of knowledge reflects the tip of the iceberg that is the complexity of themes related to the Amazon.



**Graph 1:** Knowledge areas (Web of Science)

Source : From the author, 2022.

# BRAZILIAN BIOECONOMY:

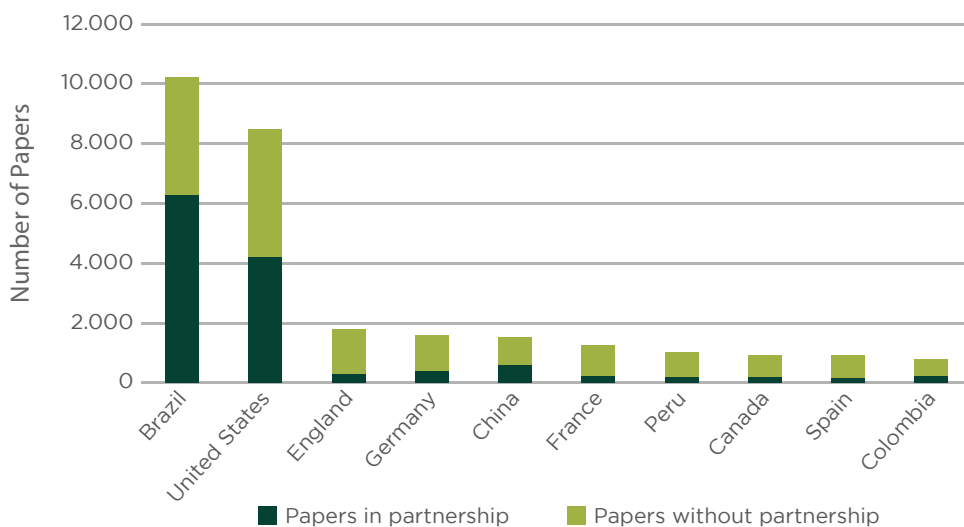
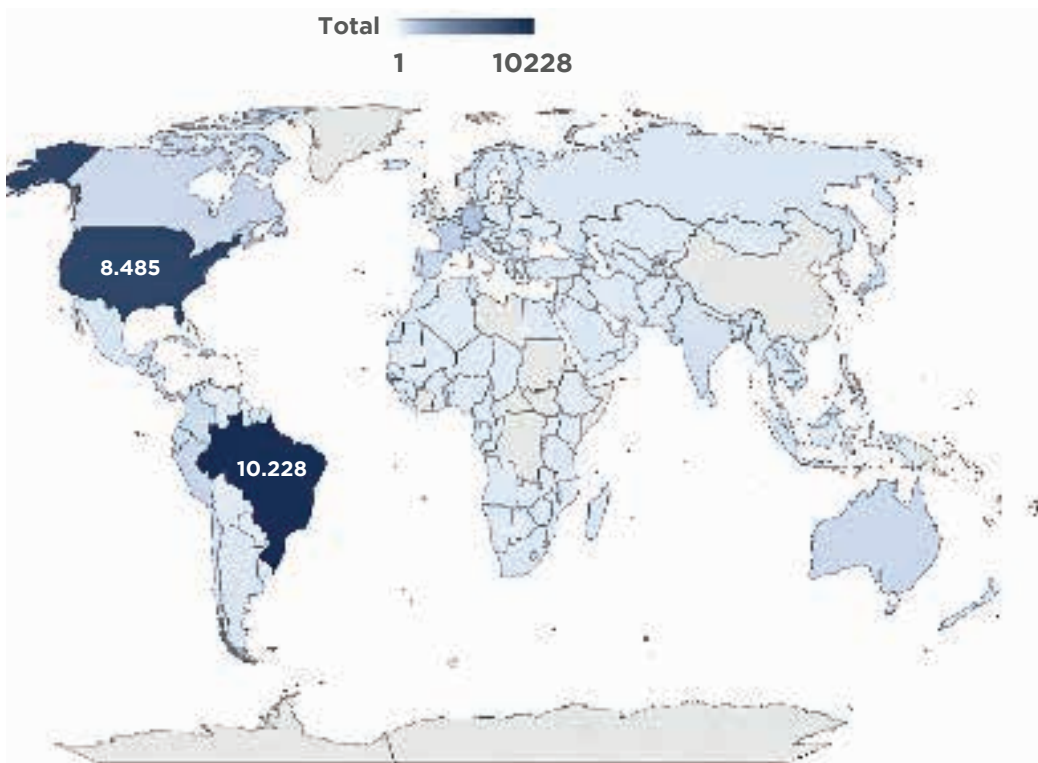
Amazon Bioeconomy

OBSERVATORY OF BIOECONOMY • YEAR 3 • N° 3 • APRIL - 2023

Still within this context of general analysis, we sought to identify the countries with the most publications on the Amazon theme - it is important to remember that there was no territorial limitation in the search for articles. Gra-

ph 2 presents the results of the analysis by country. It is worth noting the strong presence of the United States, even though almost half of its publications were made with other countries - 840 only between Brazil and USA and

1,402 with Brazil and other countries. One can also observe, besides the clear Brazilian predominance in the network, the relevant participation of non-Amazonian countries.



**Graph 2:** Analysis of the countries that most publish on the Amazon Network

Source : From the author, 2022.

From the point of view of partnership productions, the predominance of non-Amazonian countries can be justified in several ways, such as sharing expertise and equipment; and exchange of researchers. Even so, the quantity

of articles spread around the world on the Amazon evidences the international attention that the theme has received.

In order to deepen the analysis on the complete network, the next sections

focus on pre- and post-pandemic analysis - since publications from the last five years were considered - and on characterizing the network by means of thematic clusters.

### 3.2.2. Pre- and post-pandemic analysis

The Covid-19 pandemic has had an impact in virtually every area and sector around the world. Academic production was no different. Seeking to identify the impact of the pandemic on scientific publications about

the Amazon, we analyzed the set of keywords of articles published before and after Covid-19 reached Brazil<sup>4</sup>. Picture 5 shows the difference in the keyword clouds of the pre- and post-pandemic networks. Starting in

2020, the Covid-19 keyword starts appearing in the network, ranking 36th. In 2022, Covid-19 becomes the 10th most frequent keyword in the network, showing that the theme has been strongly addressed by researchers.



**Picture 5:** Pre- and post-pandemic keyword clouds

Source : From the author, 2022.

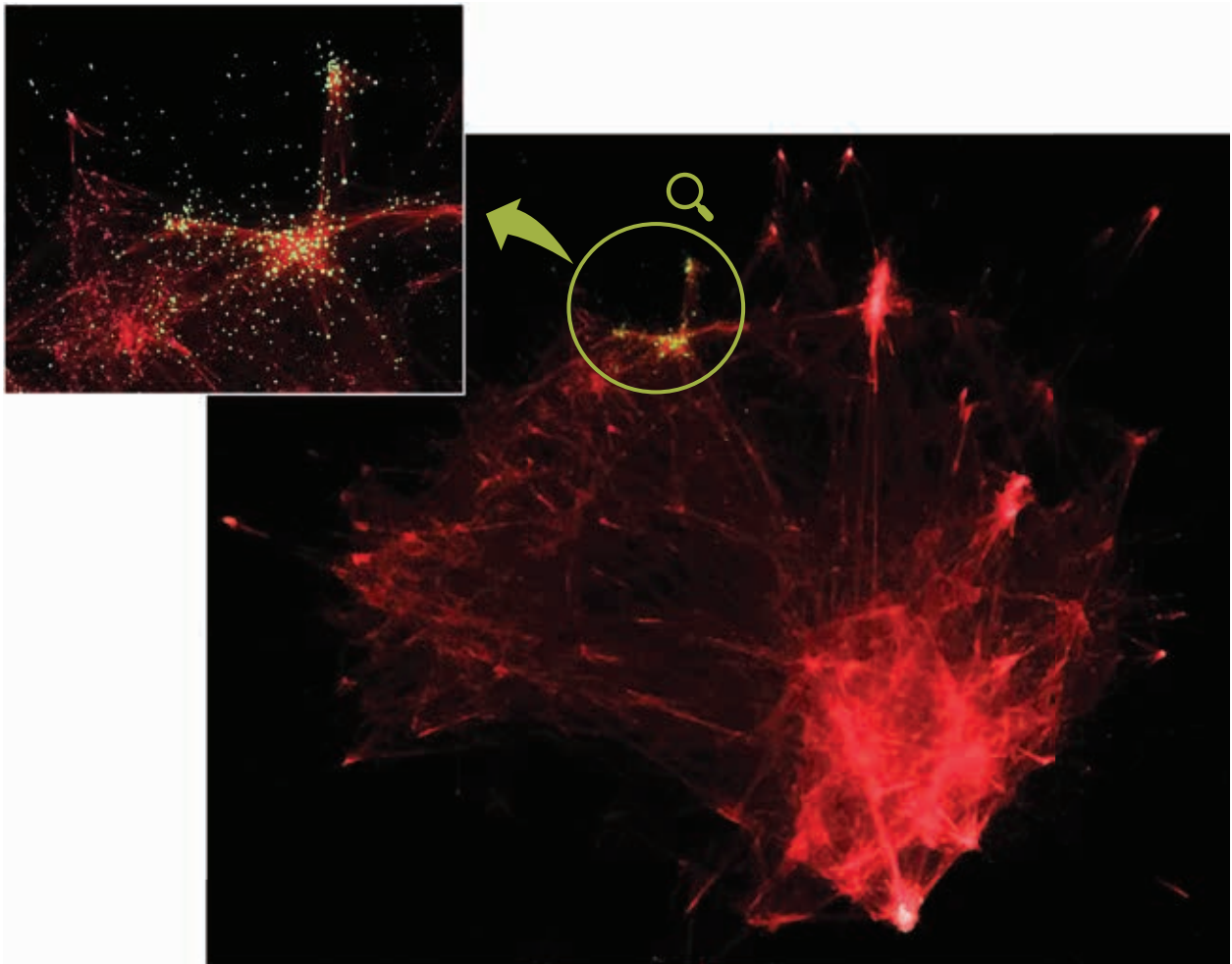
4 The pre-pandemic separation considered articles from 2017, 2018, and 2019 and the post-pandemic, from 2020, 2021, and 2022.

It was also possible to identify the formation of a thematic cluster at the top of the network on the Covid-19 theme (Picture 6). This cluster gathered 502 articles and presented the keyword profile shown in Picture 7. In the central part, the themes focused on the impacts that the pandemic caused from different perspectives: post-traumatic stress, change in family routine, misinformation, the role of the media, and the impact on the

health system, among others. The top part of the cluster, on the other hand, featured articles mainly about the gamma variant and the impact of Covid-19 on traditional communities.

In the context of the overall network, it is noticeable that the region that clustered articles on health issues had considerable growth. Around the Covid-19 cluster, other health topics can be identified, such as public health

system; mental health; other respiratory diseases, such as tuberculosis; and impacts of different drugs on youth and adult health. In other words, the area of health, which was already a large part of the network on Amazon, had an important impact in the pandemic period. The next section will present more details about this process of characterization of the network, through thematic clusters.



**Picture 6:** Identification of the Covid-19 cluster

**Source :** From the author, 2022.



keyword	Frequency	keyword	Frequency
covid-19	88	impact	12
coronavirus	21	mental health	10
anxiety	21	psychometric properties	9
health	15	sars-cov-2	8
attitudes	15	adolescents	8
suicide	14	symptoms	8
stress	14	metaanalysis	8
associations	13	gender	8
amazon	12	questionnaire	8
metal-health	12	wikipedia	8

Picture 7: Cluster keywords about Covid-19

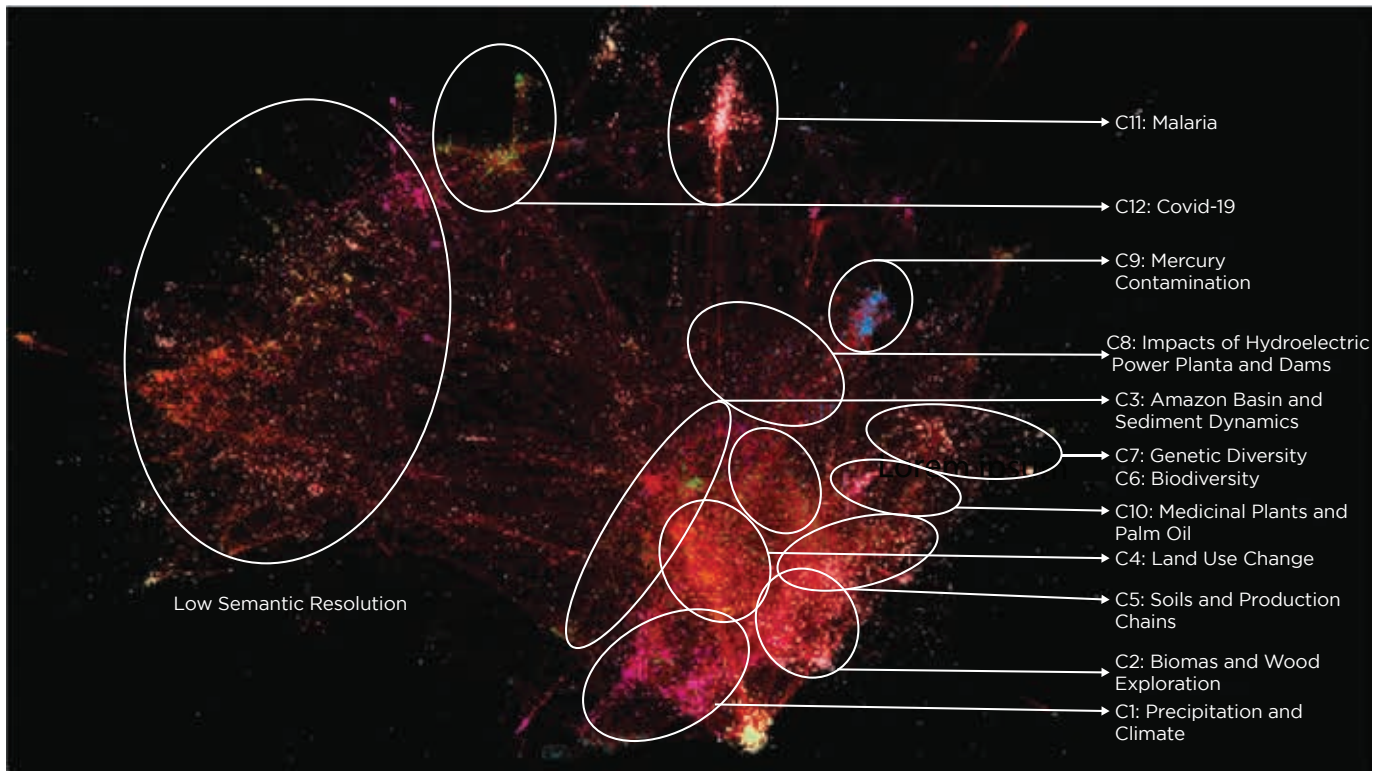
Source : From the author, 2022.

### 3.2.3. Network characterization - thematic clusters

This subsection presents the result of the process of characterizing the network by thematic clusters. In total, 12 clusters were analyzed, one of them being Covid-19, already discussed in the previous subsection. Picture 8 presents the mapped clusters. It is

possible to observe that there is an area with low semantic resolution, that is: even though the program managed to cluster the articles in a modularity class, the themes still varied considerably. This is expected in networks with a very large plurality of themes.

The 12 largest clusters with high semantic resolution were chosen and analyzed for the characterization of the network. For each cluster exposed below (Picture 8), the keyword clouds and the five countries that published the most articles will be presented.



**Picture 8:** Clusters analyzed in the network characterization process

Source : From the author, 2022.

## Cluster 1 - Precipitation and climate

The first cluster deals mainly with precipitation patterns in the Amazon region. In the most central and leftmost part of the cluster, topics range from: identification of precipitation patterns; studies of causes and consequences of changes in patterns; its relation to climate change; impacts on fauna, flora, and ecosystem dynamics; and prediction models, impacts, and probability.

There are also many studies on the assessment, impacts and changes in the El Niño-Southern Oscillation (ENSO). Further to the right of the network, the theme shifts to droughts in the region. Again, studies deal with the causes and consequences of droughts; evaluate impacts; propose explanations and solutions; and discuss models and scenarios for the future.

Picture 9 and Graph 3 present the cluster's cloud of keywords and the five countries that most published on the theme, respectively. It can be observed that, among the top 5, only Brazil is an Amazonian country, having published 417 articles.











### Cluster 5 – Soil and amazon products

The fifth cluster deals largely with soil quality characteristics in the Amazon region. Several studies show how

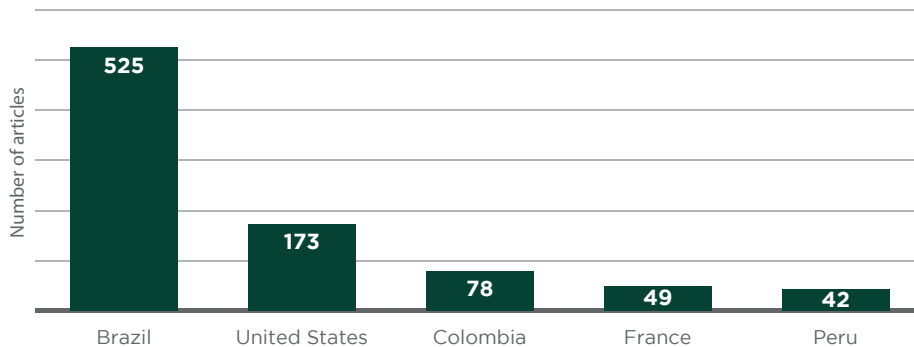
different agroforestry systems can impact on the improvement or worsening of soil quality. The types of

evaluation take into account different characteristics: physical, chemical, microbiome, level of degradation, etc.



Picture 13: Cloud of keywords of the **Soil and Amazon products** cluster

Source : From the author, 2022.



Graph 7: Countries that publish the most in the **Soil and Amazon products** cluster

Source : From the author, 2022.

Although the main attractive factor is the soil theme, on the periphery of the cluster it is possible to identify themes related to several Amazonian products. The right edge, for example, aggregates several studies on the cocoa-based agroforestry system, with indications

that this would bring benefits to soil quality. In more peripheral areas, it is also possible to identify studies on guaraná, açaí, cupuaçu, and papaya.

Picture 13 and Graph 7 present the cluster's cloud of keywords and the five

countries that most published on the theme, respectively. It is interesting to note that, in this cluster, the presence of Amazonian countries is much stronger, Brazil having the largest number of publications.





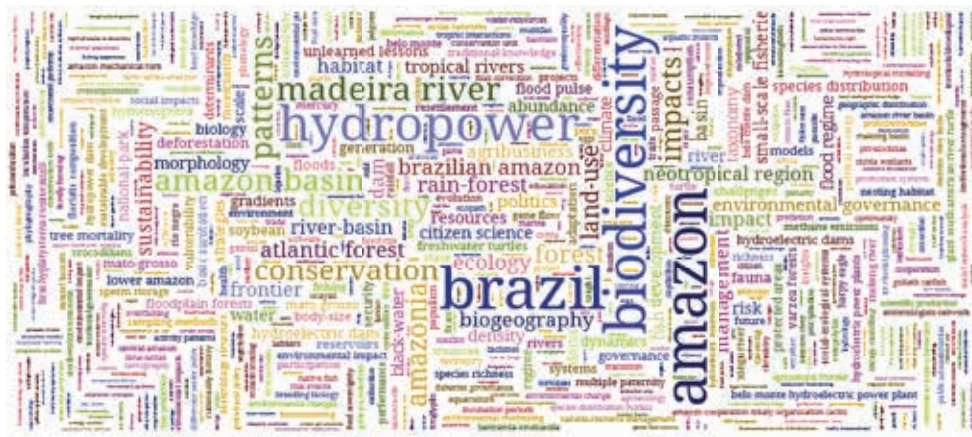
**Cluster 8 – Impacts from hydroelectric and dams**

The eighth cluster is in a very central part of the network and is relatively concentrated. Its articles deal mainly with the construction of hydropower plants and dams for different purposes, with a focus mainly on the types of impact these systems can cause - in particular the animal species affected, hydrological change, and social consequences.

Among the animal species, fish are clearly the most studied, but several articles also deal, for example, with turtles and crocodiles. In the central part of the cluster, there is a strong concentration of studies on the Madeira River Hydroelectric Complex, focusing on the impacts of the project. On the left, several studies talk about the role

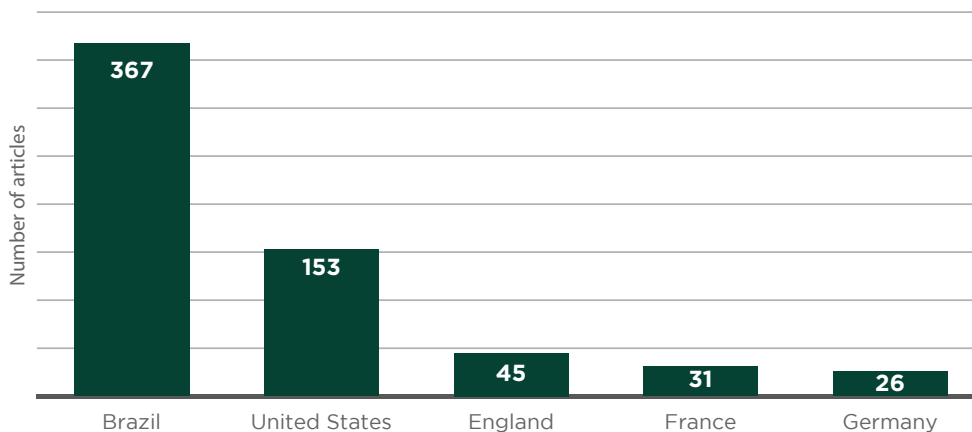
of government in the use of natural resources, addressing the development of regional strategies and legal protection.

Picture 16 and Graph 10 present the cluster’s keyword cloud and the five countries that have published the most on the topic, respectively.



**Picture 16:** Keyword cloud for the cluster **Impacts from hydroelectric power plants and dams**

Source : From the author, 2022.



**Graph 10:** Countries that publish the most in the cluster **Impacts of Hydropower and Dams**

Source : From the author, 2022.









tamination of the ecosystem, and the spread of malaria.

On the other hand, it was also possible to identify the potential of the region. Clusters **5 - Soil and Amazon products**, **6 - Biodiversity**, **7 - Genetic diversity**, and **10 - Medicinal plants and palm oil** are some examples within the network of studies that seek to develop a bioeconomy in the region.

### 3.2.4. National overview

As mentioned earlier, 43% of the publications of the entire Amazon Network - that is, 10,228 articles - are Brazilian. However, not all were produced exclusively by national institutions, and many are the re-

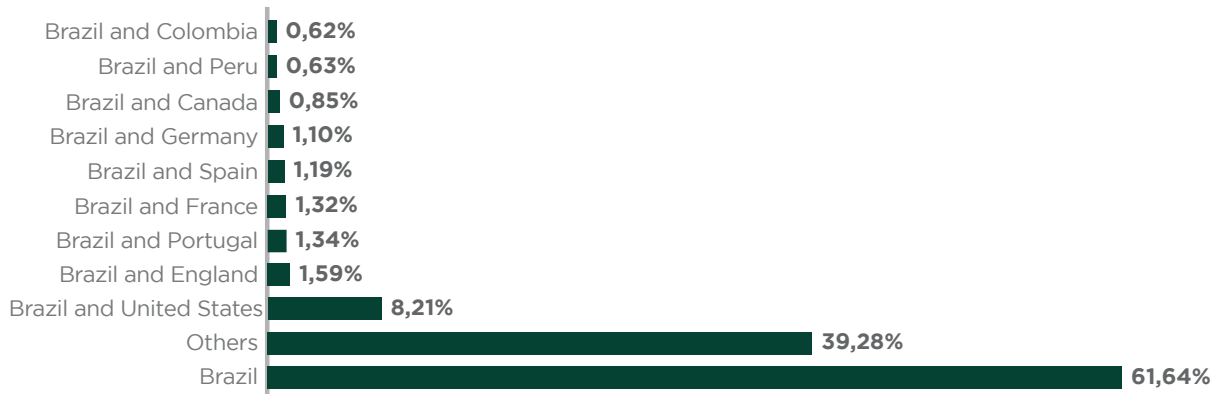
Another aspect to be highlighted is the presence of Brazil as the leading producer of articles in 10 of the 12 clusters analyzed. Clusters **1 - Precipitation and climate** and **12 - Covid-19** were the only ones that had the United States as the leader in number of publications. Even in these cases, Brazil occupied a prominent position, in second place. The strong presence of Brazil in

the clusters was already expected, given the predominance of Brazilian publications in the complete network. The country is present in 43% of the total network of articles, which is understandable since 60% of the Amazon biome is located in the national territory. The next subsection is dedicated to the analysis of national publications.

sult of partnership with one or more countries.

Graph 14 shows the proportion of national publications in relation to partnerships. It is possible to verify

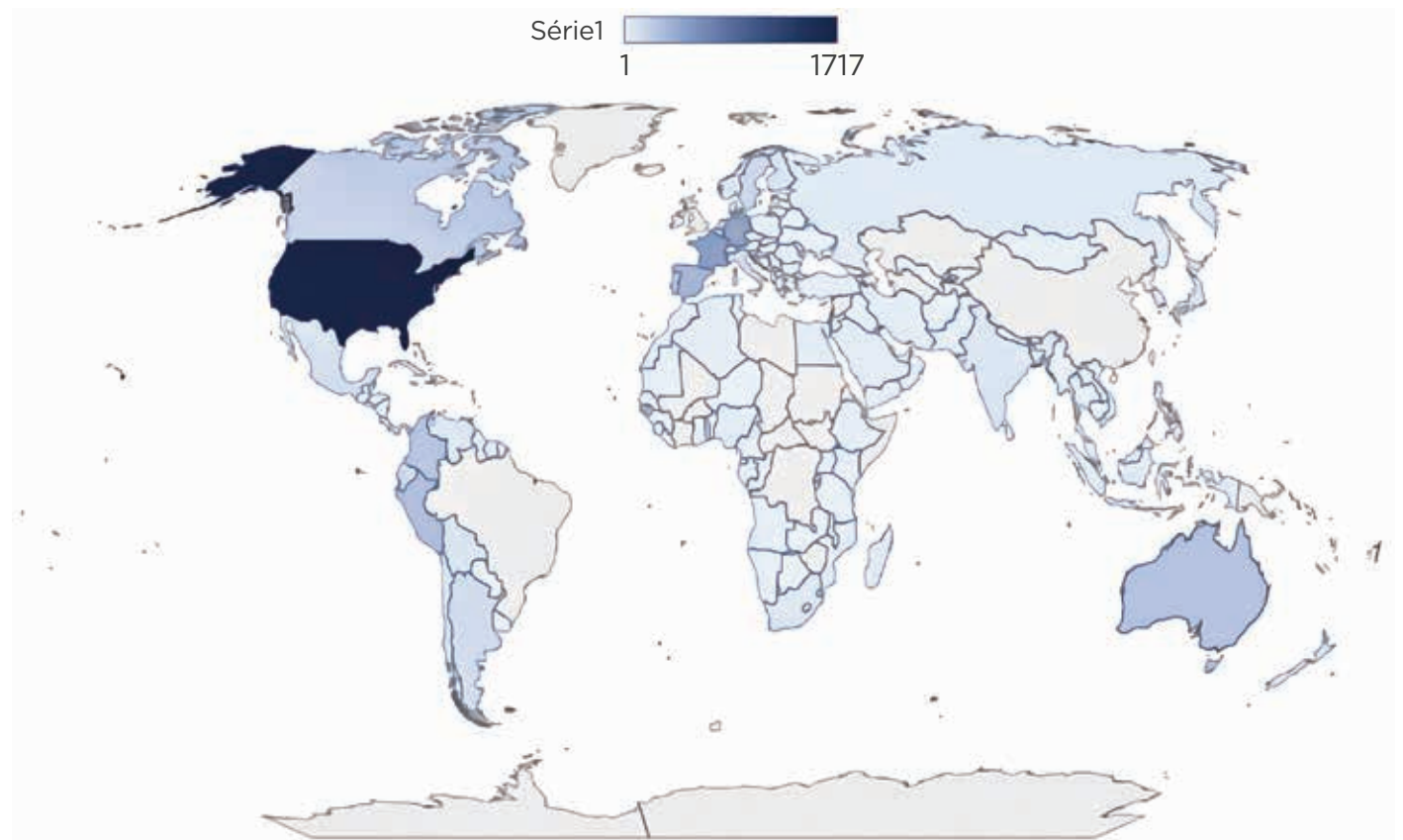
that 61.64% of the Brazilian papers are exclusively national. A considerable part of the articles (8.21%) is the result of an exclusive Brazil-United States partnership.



**Graph 14:** Distribution of partnership among countries in national publications

Source : From the author, 2022.

Picture 20 shows a heat map with the publications Brazil has made in partnership with other countries.



**Picture 20:** International partners for Amazon publications

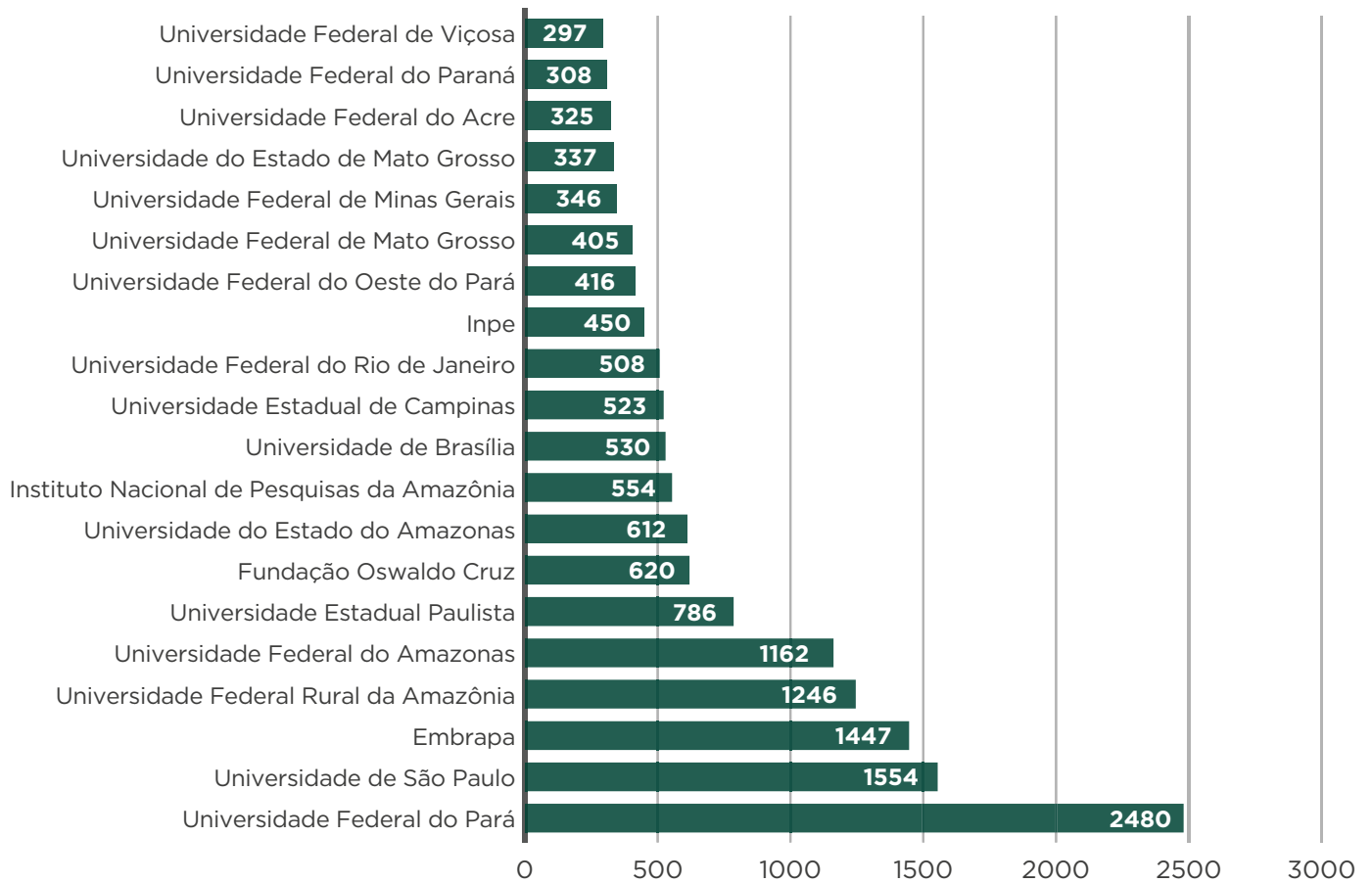
Source : From the author, 2022.

Picture 21 shows the keyword cloud of the Brazilian publications. This analysis is intended to identify possible characteristics of the national articles. When compared to [Picture 4 - Word cloud of the complete Amazon Network](#) [Picture 21](#) shows few differences. Regarding the 20 most cited keywords,

the main difference that Brazilian articles show in relation to the full Amazon Network is verified in the occurrence of the terms **infection** and **brazilian amazon**. The latter is clearly an expected orientation on the national territory; the former, however, indicates a theme that may be a particularity of Brazil.

When searched in the entire network, the word **infection** appears 184 times, of which 150 are in Brazilian publications. The articles are quite varied about the various types of infectious diseases. It is possible to notice the presence of some of them in cluster **11 - Malaria**.





**Graph 15:** Brazilian institutions that most published in the Amazon Network

Source : From the author, 2022.

### 3.2.5. Contributions to the Amazon Bioeconomy

Subsection 4.2.3 presented a set of thematic clusters of the Amazon Network. However, in order to identify more deeply the potential of the Amazon Bioeconomy in the network, the preparation of this report opted for the search for some raw materials of great potential of this biome. The reference for the selection of raw materials were three sources that investigated some of these products: COI (2022), the

Amazon 4.0 project (AMAZÔNIA 4.0., 2022) and the study Bioeconomy of Sociobiodiversity in the state of Pará (COSTA et al., 2021). We also took into account the discussions in the working groups of the network *A Concertação pela Amazônia* and the *Coalizão Brasil Clima, Florestas e Agricultura*.

Initially, we searched for mentions of 14 raw materials in the network's

articles. Then, for a thematic analysis, the six that appeared in larger quantities were selected. These were: açai (139 occurrences), Brazil nut (80), cacao (63), piper (45), guaraná (37) and buriti (32). Picture 22 shows the result of the identification of the articles on the network, as well as their keywords.



Similarly, several studies on Brazil nuts and cacao have addressed the impacts of deforestation. A large number of articles also discussed the genetic diversity of the Brazil nut, as well as its nutritional and antioxidant properties. Another frequent focus was the nut oil and analyses on extraction methods, benefits, and chemical and functional properties. In the case of cocoa, many articles dealt with the cocoa-based agroforestry system, as was seen in the description of cluster **5 - Soil and Amazonian products**. Other studies also discussed techniques of valorization, transformation and use of cocoa seeds, as well as the

relationship between the growth of the sector and the relationship with those who work in it.

Piper, guaraná, and buriti have also been the object of many studies related to the mapping of their genetic diversity and their properties, especially their medicinal properties. In the case of piper, several studies have evaluated its antioxidant, insecticidal, acaricidal, and antiparasitic potential. For guaraná, there has been research, for example, on its antioxidant and anti-inflammatory potential.

In general, it can be seen that discussions about the various potential

products of the Amazon Bioeconomy revolve around three major points:

- i) Balance with nature - that is, both the impacts of deforestation and climate change and the ecosystem balance of the forest's own wealth production.
- ii) Understanding the real value of this bioeconomy - seeking to identify, understand, and transform biological resources from biodiversity into high-value products.
- iii) Social aspect - involves this dynamic of valorization of forest products, which includes, but is not limited to, the communities and traditional knowledge.

## 4. Final remarks

This report sought to contribute to a greater knowledge of the Amazonian Bioeconomy, through the survey, treatment and analysis of information on the subject. The goal was to generate inputs for decision making by stakeholders - whether governmental, academic or business - in the development of a national bioeconomy based on biodiversity.

The information brought here, through the exploratory mapping of initiatives and the analysis of scientific articles, aims to contribute to a better understanding of the complexity of the Amazon

region, but also of its importance and potential. Most of what was analyzed in this publication makes clear the strong relation of balance that needs to exist in the region, which does not only concern the precious physical, chemical, and biological balance, but also the social one.

It is worth noting that this report brought data from the last five years, which undoubtedly limits the broad awareness of what knowledge has been generated on the subject. Even so, the methodology developed was able to raise data about the Amazon

without any predetermined filter that could contain bias on the part of the analysts. A relevant effort was applied in the methodological development for this objective to be achieved.

Like the first two editions of the Bioeconomy Report, this third edition sought to bring one more piece of the complex puzzle that is the exercise of understanding - and seeking to develop - the Brazilian bioeconomy.

## References

- ASSOCIAÇÃO BRASILEIRA DE BIOINOVAÇÃO - ABBI. *Identificação das oportunidades e o potencial do impacto da bioeconomia para a descarbonização do Brasil*. 2022. Disponível em: [https://abbi.org.br/wp-content/uploads/2022/06/Bioeconomia\\_Descarbonizacao\\_Nov2022\\_Final2.pdf](https://abbi.org.br/wp-content/uploads/2022/06/Bioeconomia_Descarbonizacao_Nov2022_Final2.pdf) Acesso em: jan. 2023.
- ABRAMOVAY, Ricardo. *Conhecimento de povos da floresta pode revolucionar indústria farmacêutica*. 2021. Disponível em: <https://ricardoabramovay.com/2021/01/conhecimento-de-povos-da-floresta-pode-revolucionar-industria-farmaceutica/>. Acesso em: dez. 2022.
- AMAZÔNIA 4.0. *Homepage*. Disponível em: <https://amazonia4.org/>. Acesso em: dez. 2022.
- AMAZÔNIA+10. *Homepage*. 2022. Disponível em: <https://www.amazoniamaisdez.org.br/>.
- AMAZÔNIA POSSÍVEL. *10 Princípios Empresariais para uma Amazônia Sustentável*. 2020. Disponível em: [https://d15k2d11r6t6rl.cloudfront.net/public/users/Integrators/7ba73aaa-3da9-4cf1-abf2-ccc85dea5875/uid\\_3084837/AMP\\_10P\\_Empresariais\\_30.07.20.pdf](https://d15k2d11r6t6rl.cloudfront.net/public/users/Integrators/7ba73aaa-3da9-4cf1-abf2-ccc85dea5875/uid_3084837/AMP_10P_Empresariais_30.07.20.pdf). Acesso em: dez. 2022.
- BERGAMO, Daniel; ZERBINI, Olivia; PINHO, Patricia; MOUTINHO, Paulo. The Amazon bioeconomy: Beyond the use of forest products. *Ecological Economics*, v. 199, sept. 2022. Disponível em: <https://www.sciencedirect.com/science/article/abs/pii/S0921800922001100>
- BRASIL. Ministério da Agricultura, Pecuária e Abastecimento - MAPA. *Programa Bioeconomia Brasil - Sociobiodiversidade*. 2019. Disponível em: <https://www.gov.br/agricultura/pt-br/assuntos/agricultura-familiar/bioeconomia-brasil-sociobiodiversidade>.
- CENTRO DE GESTÃO E ESTUDOS ESTRATÉGICOS - CGEE. *Espaço conceitual da Bioeconomia*. Brasília: 2020.
- CENTRO DE GESTÃO E ESTUDOS ESTRATÉGICOS - CGEE. *Webinar sobre bioeconomia brasileira: panorama da produção científica nacional*. 2022. Disponível em: <https://www.youtube.com/watch?v=FxtAUHvuGbw&t=3846s>
- CENTRO DE ORQUESTRAÇÃO DE INOVAÇÕES - COI. *Bioeconomia Amazônica: uma navegação pelas fronteiras científicas e potenciais de inovação*. World-Transforming Technologies – WTT, jul. 2022. Disponível em: <https://wttventures.net/bioeconomia-amazonica-uma-navegacao-pelas-fronteiras-cientificas-e-potenciais-de-inovacao/>.
- 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. *Bioeconomia da sociobiodiversidade no estado do Pará*. Brasília: Sumário Executivo, DF: The Nature Conservancy (TNC Brasil), Banco Interamericano de Desenvolvimento (BID), Natura, 2021. 38 p. Disponível em: [https://www.tnc.org.br/content/dam/tnc/nature/en/documents/brasil/sumario\\_executivo\\_bioeconomia.pdf](https://www.tnc.org.br/content/dam/tnc/nature/en/documents/brasil/sumario_executivo_bioeconomia.pdf).
- DROUVOT, C.M.; DROUVOT, H. O Programa de Produção Sustentável do Dendê na Amazônia: a mobilização dos grupos de interesse no reflorestamento das áreas degradadas. In: Congresso do Instituto Franco-Brasileiro de Administração de Empresas. Inovação, Cooperação Internacional e Desenvolvimento Regional, 6., IFBAE, Franca, 2011. *Anais...* Franca, 2011
- FUNDO BRASILEIRO PARA A BIODIVERSIDADE - FUNBIO. *Homepage*. 2022. Disponível em: <https://www.funbio.org.br/>
- HUBBELL, S.P. et al. How many tree species are there in the Amazon and how many of them will go extinct? *Proc. Natl. Acad. Sci.*, v. 105, p. 11498-11504, 2008. Disponível em: [https://www.researchgate.net/profile/Hans-Ter-Steege/publication/23163844\\_How\\_many\\_tree\\_species\\_are\\_there\\_in\\_the\\_Amazon\\_and\\_how\\_many\\_of\\_them\\_will\\_go\\_extinct/links/09e4150ae024c579aa000000/How-many-tree-species-are-there-in-the-Amazon-and-howmany-of-them-will-go-extinct.pdf](https://www.researchgate.net/profile/Hans-Ter-Steege/publication/23163844_How_many_tree_species_are_there_in_the_Amazon_and_how_many_of_them_will_go_extinct/links/09e4150ae024c579aa000000/How-many-tree-species-are-there-in-the-Amazon-and-howmany-of-them-will-go-extinct.pdf). Acesso em: dezembro de 2022.
- INSTITUTO ESCOLHAS. *Destravando a agenda da bioeconomia: soluções para impulsionar o uso sustentável dos recursos genéticos e conhecimento tradicional no Brasil*, 2021. 17 p. Disponível em: <https://www.escolhas.org/wp-content/uploads/Destravando-a-agenda-da-Bioeconomia-recursos-gen%C3%A9ticos-e-conhecimentotradicional-no-Brasil-Sum%C3%A1rio-Executivo-.pdf>. Acesso em: dezembro de 2022.
- JBS S.A. *Fundo pela Amazônia*. 2021. Disponível em: <https://jbs.com.br/tag/fundo-pela-amazonia/>



NOVA ECONOMIA DA AMAZÔNIA - NEA. Uma bioeconomia inovadora para a Amazônia: conceitos, limites e tendências para uma definição apropriada ao bioma floresta tropical. **WRI BRASIL**. Textos para discussão, jun., 2022. 20 p. Disponível em: [https://www.wribrasil.org.br/sites/default/files/2022-07/NEA-BR\\_Bioeconomia\\_PT.pdf](https://www.wribrasil.org.br/sites/default/files/2022-07/NEA-BR_Bioeconomia_PT.pdf).

PAMPLONA, Leonardo; SALARINI, Julio; KADRI, Nabil. Potencial da bioeconomia para o desenvolvimento sustentável da Amazônia e possibilidades para a atuação do BNDES. **Revista BNDES**, v.28, n. 56, p. 55-86, dez. 2021. Disponível em: <https://web.bndes.gov.br/bib/jspui/bitstream/1408/22024/1/02-BNDES-Revista56-PotencialBioeconomia.pdf>.

PROGRAMA DAS NAÇÕES UNIDAS PARA O MEIO AMBIENTE - PNUMA. **Conferência da biodiversidade da ONU (COP 15)**.

Montreal, Canadá, 7-19 Dec. 2022. Disponível em: <https://www.unep.org/pt-br/events/conference/conferencia-de-biodiversidade-da-onu-cop-15>.

UM SÓ PLANETA. **COP15**: mundo ganha acordo global de proteção da biodiversidade. 2022. Disponível em: <https://umsoplaneta.globo.com/biodiversidade/noticia/2022/12/19/cop15-mundo-ganha-acordo-global-de-protecao-da-biodiversidade-veja-os-destaques.ghtml>. Acesso em dezembro de 2022.

## Working group

<b>CEO</b> Fernando Cosme Rizzo Assunção	<b>Supervision</b> Fernando Rizzo Assunção	<b>CGEE's technical team</b> Barbara Bressan Daniella Fartes Emilly Silva Jackson Maia Alina Cordeiro (Intern) Gabriela Britto (Intern)
<b>Directors</b> Ary Mergulhão Filho Carlos Roberto Fortner	<b>Leader</b> Marcelo Khaled Poppe	
	<b>Administrative Assistant</b> Rafael Metzner	

## Acknowledgements

Uma Concertação pela Amazônia  
Coalizão Brasil, Clima, Florestas e Agricultura

**Edition:** Marianna Nascimento/Graphical Context  
**Cover, layout and infographics:** Graphical Context  
**Layout in English:** Rayellen Mesquita de Souza  
**Graphic Design:** CGEE's graphic design center

Center for Strategic Studies and Management (CGEE), SCS Qd 9, Torre C, 4º andar, Ed. Parque Cidade Corporate, CEP: 70308-200 - Brasília, DF, Phone: (61) 3424 9600

 @CGEE\_oficial |  <http://www.cgее.org.br> |  @CGEE |  @CGEE\_oficial |  @Centro de Gestão e Estudos Estratégicos

All rights reserved by the Center for Strategic Studies and Management (CGEE). The texts contained in this publication may be reproduced, stored, or transmitted, provided the source is cited.

**Bibliographic reference:**

CENTER FOR STRATEGIC STUDIES AND MANAGEMENT - CGEE. Third bioeconomy report - Amazon Bioeconomy. Positive Agenda on Climate Change and Sustainable Development Project. Brasília, DF: 2022. 39 p