The SEEA Ecosystem Accounts for Brazil

POLICY BRIEF

IBGE
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MAKING NATURE COUNT

Brazil is renowned for its globally important habitats and biodiversity, including being host to the majority of the largest intact tropical rainforest, the Amazon. Brazil's takes its conservation responsibilities to the global community seriously but must also support the social and economic aspirations of its people so they can benefit from the country's rich natural resources. Brazil is also among the major suppliers of food and raw materials to the world.

Brazil's diverse habitats provide essential ecosystem services, which benefit the people of Brazil, as well as contribute to economic activities, in the form of raw materials and non-timber forest products, clean water, productive soils, flood control, and in the longer term, climate regulation.

The contributions provided by this 'natural capital' are often taken for granted and not sufficiently accounted for when making important economic and policy decisions. They are also missing from key economic and well-being metrics, such as gross domestic product (GDP). Environmental economic accounts have been developed to address this gap.

This policy brief reports on key aspects of how Brazil, through support of the Natural Capital and Valuation of Ecosystem Services (NCAVES) project, has implemented the Brazilian System of Environmental-Economic Accounts.

ECOSYSTEM ACCOUNTING

The System of Environmental Economic Accounting (SEEA) facilitates integrated policy- and decision-making by providing a means of monitoring an economy's impacts and dependencies on the environment. It consist of two complementary frameworks: the SEEA Central Framework (CF) and the SEEA Ecosystem Accounting (EA). The SEEA provides statistics and indicators that are consistent with the system of national accounts and indicators, such as GDP.

The demand for this type of accounting is driven by important global policy drivers, including:

(i) achieving the targets set out in the United Nations (UN) 2030 Sustainable Development Goals (SDGs);

(ii) the UN Decade of Ocean Science for Sustainable Development 2021-2030;

(iii) the UN Decade on Ecosystem Restoration 2021-2030;

(iv) the post-2020 biodiversity agenda (the Convention of Biological Diversity); and

(v) the Paris Agreement of the United Nations Framework Convention on Climate Change (UNFCCC).

The SEEA EA framework starts with a spatial approach.

The SEEA EA is now a global accounting standard following adoption by the UN Statistical Commission at its 52nd session in March 2021.

Across a landscape different ecosystem types, or assets, provide different sets of ecosystem services, dependent on their extent and condition. These are two key accounts in the SEEA EA

> **It is important to note** that the ecosystem condition account and the non-timber forest products and water supply economic valuation accounts are experimental and still under evaluation. They have not yet fully matured in terms of coverage or methodology. Nevertheless, publishing this information is still valuable as it advances discussion on ecosystem accounting.

(see Figure 1). The flows of benefits from these ecosystem assets are then recorded in the SEEA EA's ecosystem service flow accounts. These accounts can be recorded in either physical units or monetary units, depending on the data needs and availability. Monetary estimates of the value of ecosystem services are derived by applying a range of established economic valuation techniques, such as the resource rent or replacement cost approach.

BRAZIL AND THE NCAVES PROJECT

The NCAVES project began engagement with Brazil in May 2017. The Brazilian Institute of Geography and Statistics (IBGE, acronym in Portuguese) was the lead institution, in collaboration with a range of other national partners, including the National Water Agency (ANA), National Forest System (SNF) and the Federal University of Rio de Janeiro (UFRJ). NCAVES was funded by the European Union.

For Brazil, a key reason for taking part in the NCAVES project and its piloting of the Ecosystem Accounting methodology, is the national commitment to monitoring the related global SDG indicators. This national commitment will allow for methodological development, specification of data and metadata, and policy applications for ecosystem accounting, including mapping the supply and use of ecosystem services and ecosystem accounts at national and regional/ municipal levels.

In addition, there are national policies that can be informed through ecosystem accounting, including the 2017 National Policy for Native Vegetation Recovery, which is designed to protect and restore forests in the Forest Code.

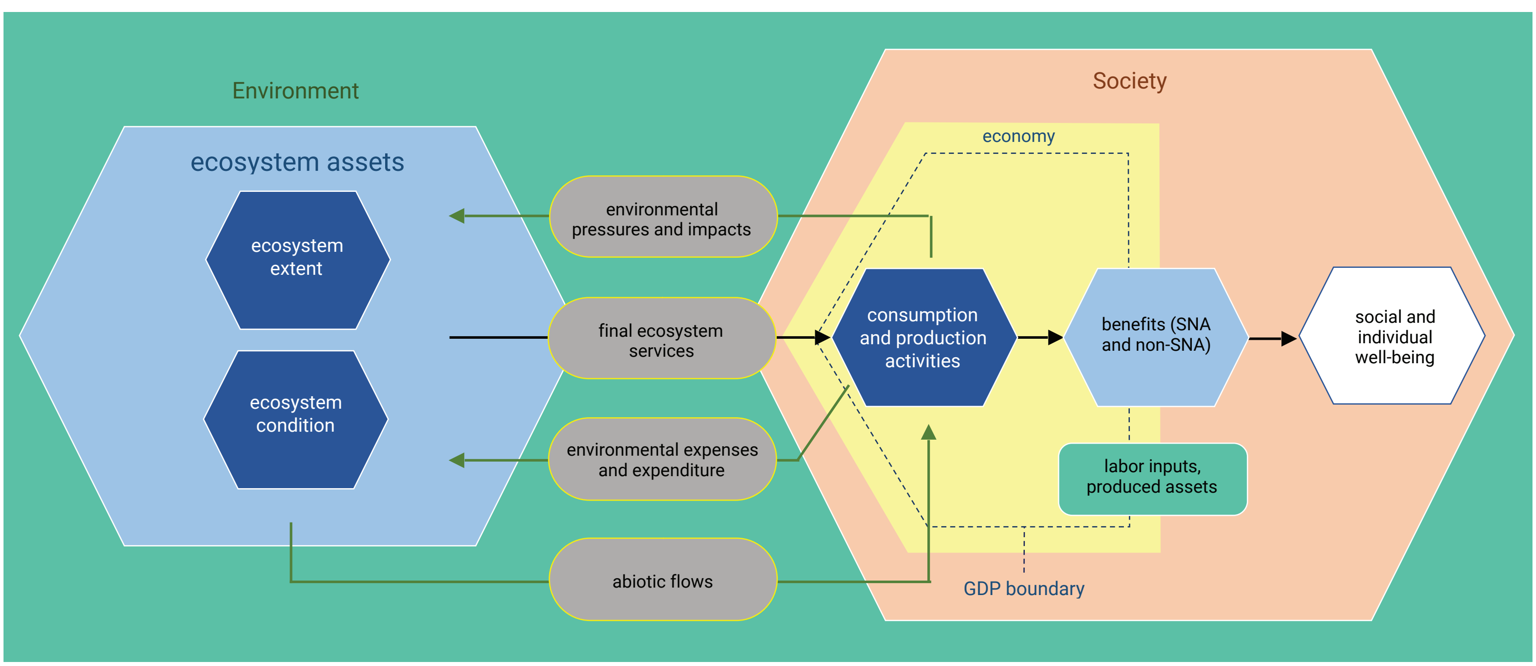
The NCAVES project pilot testing of accounts had the following objectives:

1. improve the measurement of ecosystems and their services, in physical and monetary terms, at national and sub-national levels;
2. integrate accounting indicators of natural capital related to the protection of biodiversity and ecosystems into the planning and implementation of policies; and
3. contribute to the development of an internationally agreed methodology and its use in partner countries.

The specific choice of which ecosystem accounts to pilot was driven by:

- existing environmental pressures, such as deforestation, water scarcity, and risks to biodiversity;
- the availability of mapping data, for land cover/use, vegetation, ecosystem types, soil and geology, hydrology, elevation, and urban infrastructure; and
- the ability to link maps and data on ecosystems and the economy, either to the economic activities of companies or to household consumption.

Figure 1: *The SEEA EA framework showing the relationship between extent and condition accounts and supply and use accounts*



ACCOUNTS PRODUCED

ECOSYSTEM EXTENT ACCOUNT: LAND USE BY BIOME

The ecosystem extent account is the foundational account for SEEA EA. This account compiles data on what ecosystem types are present and the physical boundaries of contiguous ecosystem assets to ascertain their size.

Creating common classifications for ecosystem assets so that national statistics can be compared across countries is a very complex and evolving discipline. It is designed to provide a common basis for determining indicators for land use processes, including deforestation, agricultural conversion, urban expansion, landscape fragmentation, and other forms of ecosystem change. Such accounts enable land use trade-offs to become visible.

Brazil's ecosystem extent account analysed land cover change in six terrestrial biomes: the Amazon, Cerrado, Caatinga, Atlantic Forest, Pantanal and Pampa and the Coastal-Marine System. The account used data from the biennial Monitoring of Land Cover and Use, prepared by the IBGE, with a spatial overlay of the Map of Brazilian Biomes, which was updated in 2019. For indicator purposes, the 12 land cover classes were aggregated into natural areas and human modified, or anthropic, areas.

Key Findings

Between 2000 and 2018:

- All Brazilian biomes lost natural habitat, but the rate of loss decreased gradually over time, except for the Pampa and the Pantanal biomes.
- Brazil's terrestrial biomes lost approximately 500,000km^2 of natural cover, or 8.3%. Correspondingly, human modified areas increased by the same area, or by 19.5% in relative terms.
- In absolute terms, the greatest losses of natural areas occurred in the Amazon (269,800km^2) and the Cerrado (152,700km^2) biomes. In proportional terms, the Pampa biome lost the most natural area (-16.8%).
- Forest cover represented 81.9% of the total area of the Amazon in 2000 but this was reduced to 75.7% in 2018, replaced mainly by managed pastures, which increased in area from 248,800km^2 to 426,400km^2.
- Between 2000 and 2018, the Pantanal biome experienced the lowest losses, both in area (-2,100km^2) and in percentage terms (-1.6%). Since 2010, approximately 60% of the changes here were from natural grassland areas to managed pastures.
- The Atlantic Forest, which has been most affected by intense settlement the longest, retained only 16.6% of its natural area in 2018, the lowest percentage among biomes.

Whilst the transformation of these habitats to human modified environments represents a loss of biodiversity, it needs to be understood that this transformation has also provided economic benefits to the people of Brazil. The role of the SEEA EA framework is not to judge this change, but to make trade-offs more transparent to policy makers.

Results

Table 1 reports the results of Brazil's ecosystem extent account.

Table 1: *Changes in Brazil's ecosystem extent between 2000 and 2018.*

Variables	Total		Biome												
			Amazon		Cerrado		Atlantic Forest		Caatinga		Pantanal		Pampa		
	Natural areas	Anthropized areas	Natural areas	Anthropized areas	Natural areas	Anthropized areas	Natural areas	Anthropized areas	Natural areas	Anthropized areas	Natural areas	Anthropized areas	Natural areas	Anthropized areas	
2000															
Opening extent (km^2)	**5,877,298**	**2,510,306**	**3,684,512**	**450,865**	**1,185,192**	**790,693**	**195,614**	**896,686**	**581,581**	**274,213**	**134,205**	**15,358**	**96,194**	**82,491**	
2018															
Closing extent	**5,387,421**	**5,387,421**	**3,414,711**	**720,599**	**1,032,486**	**943,329**	**181,781**	**910,518**	**546,314**	**309,469**	**132,096**	**17,463**	**80,033**	**98,652**	
Net changes															
Absolute (km^2)	(-) 489,877	(-) 489,877	(-) 269,801	269,734	(-) 152,706	152,636	(-) 13,833	13,832	(-) 35,267	35,256	(-) 2,109	2,105	(-) 16,161	16,161	
Percentage (%)	(-) 8.34	(-) 8.34	(-) 7.32	59.83	(-) 12.88	19.30	(-) 7.07	1.54	(-) 6.06	12.86	(-) 1.57	13.71	(-) 16,80	19.59	
Turnover															
Absolute (km^2)	536,013	536,013	294,879	534,514	160,972	350,234	15,561	132,784	43,277	61,338	4,449	4,263	16,875	21,029	
Percentage (%)	9.12	9.12	8.00	118.55	13.58	44.29	7.95	14.81	7.44	22.37	3.32	27.76	17.54	25.49	

Figure 2 summarises land use conversion dynamics in the six terrestrial biomes between 2000-2018. It shows the greater absolute scale of land use change in the larger of the biomes (Amazon and Cerrado), especially due to an increase in grazing (managed pasture) and cropping.

Figure 3 shows the status of the Amazon biome in 2018 as an example of the spatial data underlying Brazil's ecosystem extent account. In the Amazon biome, the major land use change, particularly to grazing, has occurred on the southern fringes and along major access routes.

CONDITION ACCOUNT: WATER BODIES

The ecosystem condition account reports on the quality of an ecosystem in terms of its living and non-living characteristics. This data can support environmental policy and decision making that focusses on protection and restoration of ecosystems. Condition is assessed against the composition, structure, and function of an ecosystem that sustains ecological integrity and supports its ability to provide services on an ongoing basis.

The ecosystem condition typology (ECT) is a hierarchical organisation of data on ecosystem condition characteristics aiming to establish a common terminology to support comparability between different ecosystem condition studies. A summary of the typology used in Brazil's ecosystem condition account is shown in Table 2.

The analysis of condition of Brazil's water bodies presents indicators on the direct abstraction of water from the environment, the chemical and physical state of that water, and the proportion of endangered aquatic species present for the six biomes between 2010 and 2017.

Figure 2: *Dynamics of conversion of land use and coverage in Brazilian biomes, 2018-2000*

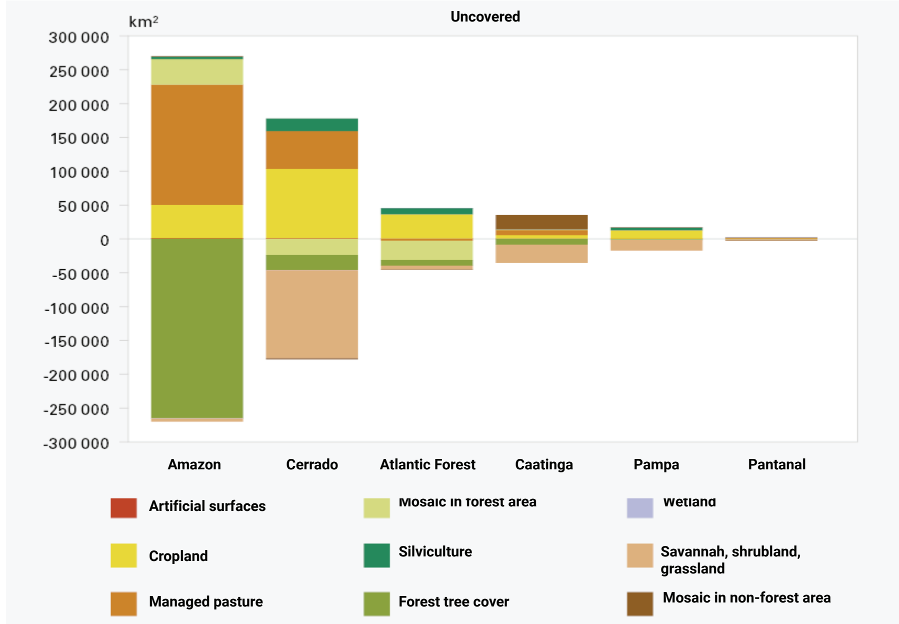


Figure 3: *Land cover and land use change in the Amazon biome in 2018*

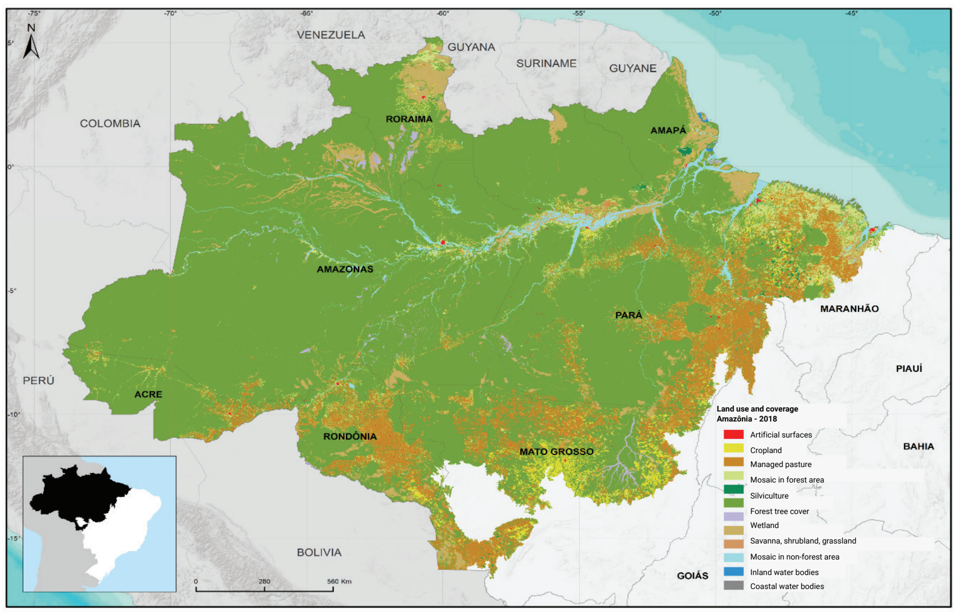


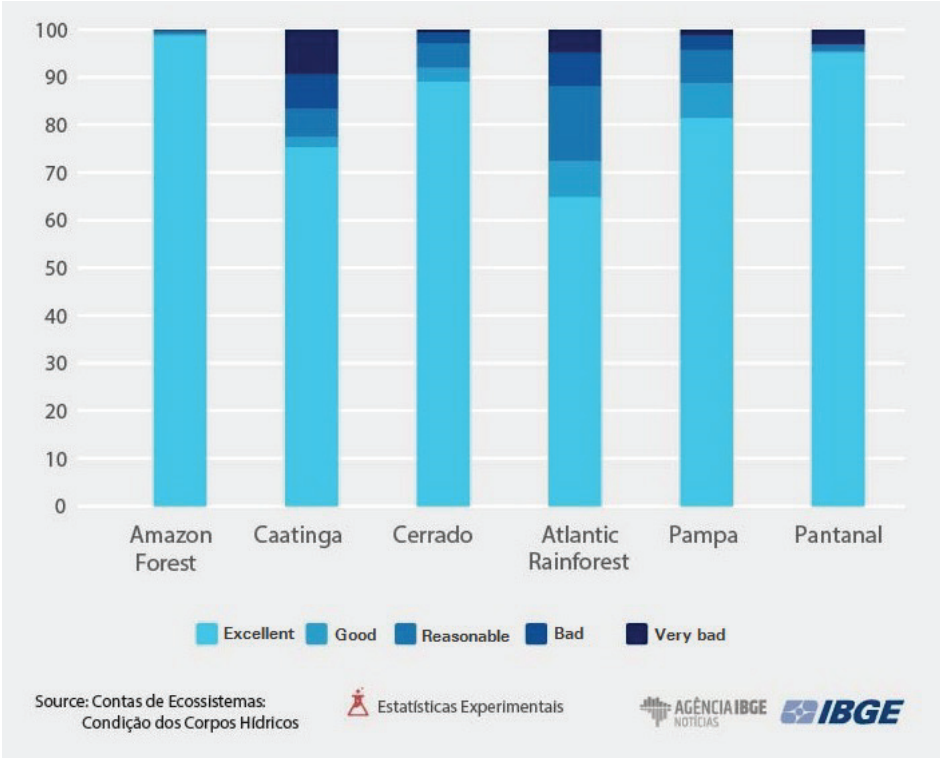
Table 2: *Ecosystem condition typology and variables used for assessing Brazil's water bodies.*

ECT groups	ECT categories	Description	Variables
Abiotic characteristics	Physical state	1. Characteristics such as soil structure and water availability	Quantitative water balance, Qualitative water balance
	Chemical state	2. Characteristics such as soil nutrient levels, water quality and air pollutant	Biochemical oxygen demand; E coli, total phosphorous, turbidity
Biotic characteristics	Compositional state	3. Species-based indicators	Number of threatened aquatic, fauna and flora species
	Structural state	4. Status characteristics, including vegetation, biomass, and food chains	Not compiled
	Functional state	5. Status characteristics, including ecosystem processes and disturbances	Not compiled

Key Findings

- Brazil's Atlantic Forest was the biome that saw the highest levels of water abstraction, which accounted for 42% of all water abstraction in 2010 and for 39% in 2017. This was mainly due to supply to urban areas.
- The proportion of testing sites with acceptable levels of E. coli in the Amazon increased from 79% to 87% between 2010 and 2017; that is, water safety improved. In the Cerrado there was an increase from 72% to 60% in rivers and creeks. In Pantanal, the change was from 63% to 100%.
- The Biochemical Oxygen Demand (BOD) recorded a significant decrease in seven years (from 99% to 47%) in lagoons and dams of the Caatinga. This indicator assesses water pollution from sewer systems and shows improvement in water quality.
- Most catchments had excellent water availability for abstraction (known as water balance). However, in the Caatinga and Pampa biomes, analyses showed critical water balance conditions.
- The account for qualitative water balance, which describes the capacity of a water body to dissolve pollutants, showed that most river basins were in excellent conditions in all the biomes. However, in the Atlantic Forest biome, where there is greater pressure from urban development, 28% of the river basins had *reasonable*, *bad* or *very bad* water balance conditions.

Figure 4: *Capacity of water bodies to dissolve pollutants (2016) by biome.*



ECOSYSTEM SERVICE ACCOUNTS

Ecosystem service supply and use accounts define the contributions of nature to the people and the economy. These contributions extend far beyond marketed goods and services, such as timber and food, as they also ensure the delivery of services, such as clean air and water, and nature-based recreation are assessed.

WATER SUPPLY

Biophysical accounts

The NCAVES project assisted Brazil in establing supply and use accounts for water supply services from surface and ground water resources ('blue water'). Blue water services are inputs into many economic sectors, such as agriculture, mining, electricity generation, and domestic drinking water supply.

Findings

Between 2010 and 2017 blue water abstraction increased by 13% from 1843m^3/s to 2,043m^3/s, or 1.9% per year. Sectors that saw the biggest proportional rises were mining (32%, though off a small base) and irrigated agriculture (19.9%), or 180m^3/s. Urban demand also increased significantly, by 48m^3/s or 10.7%.

Blue water demand by sector differed across Brazil's biomes. This is related to climate, geography, and intensity of urban, agricultural, and industrial development. For example, in the Pampa, the Caatinga, and the Cerrado biomes, irrigated agriculture was the dominant source of demand, accounting for 91%, 75%, and 61% of total water abstracted in these biomes respectively; whilst in the Atlantic Forest biome, urban demand took the greater proportion (39%).

Monetary valuation

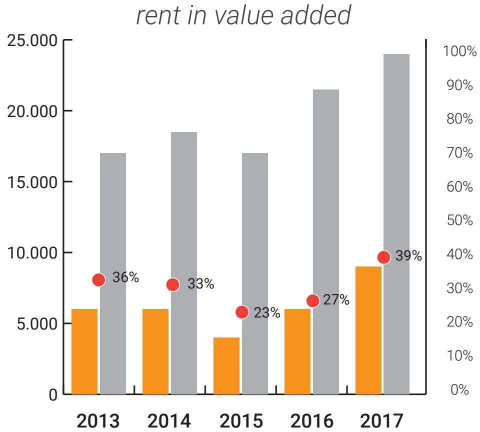
Brazil has played a key role in the development of environmental economic accounts for water. This has informed debate over future water charges for the direct abstraction of blue water.

To estimate the economic value of blue water *(a provisioning ecosystem service)* the Brazil team looked for relevant empirical studies to apply; however, few examples from Brazil could be found. For valuation purposes, a study that used the 'resource rent method' was used. This method uses net revenue from extraction, by the water supply sector, less all costs incurred in the extraction process, such as capital and labour costs – the residual being the value attributable to ecosystem services.

Findings

The economic value of the provisioning service rose steadily between the period 2013 to 2017 from R$ 6,412 million to R$ 9,319 million. The share of the resource rent was approximately 31% of the value added of the water supply sector, on average, between 2013 and 2017 (see Figure 5).

Figure 5: *Share of resource rent in value added*



Non-Timber Forest Products

Brazil's non-timber forest products

Brazil's biodiversity provides a wide variety of non-timber forest products (NTFP). Traditional knowledge from Brazil's Indigenous Peoples has been important in bringing the value of more than 50 NTFPs to domestic and international markets.

When NTFP are extracted or harvested, they provide environmental and socio-economic benefits, including a vital source of income for local communities. In some instances, due to their high demand, certain NTFPs are cultivated in permanent plantations, including rubber, açaí, and palm hearts. Therefore, when determining the economic value of ecosystem contributions to NTFPs, two different methods are required.

Figure 6: *Value of wild NTFP provisioning service (per thousand R$) – 2006 to 2016 (note different vertical scale to Figure 5)*

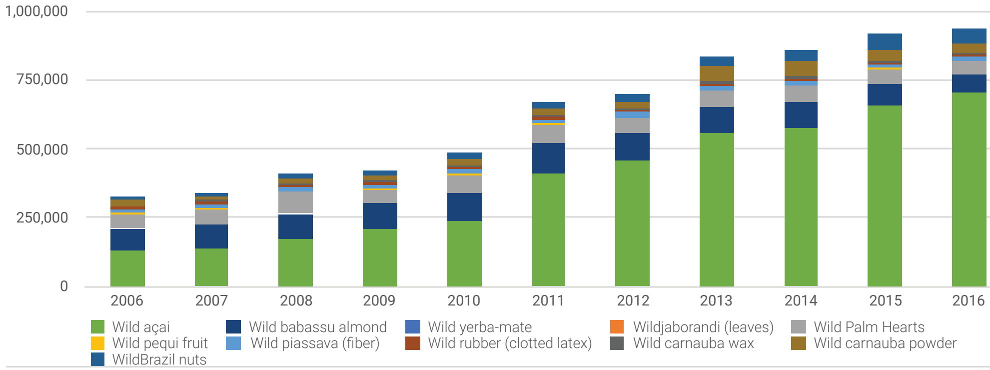
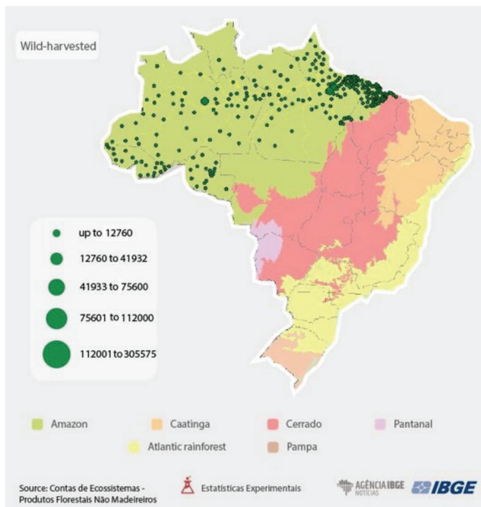


Figure 7: *Location of main sources of Açaí berries*



Findings

The NCAVES project assessed 12 selected NTFP between 2006 and 2016. Over this period there was a drop in physical production of several products in most biomes. However, due to changes in prices, driven by export demand, the economic value of NTFP actually increased. This demonstrates the role of environmental economic accounting in helping understand the drivers of economic development.

In 2016, the value of provisioning services of wild-harvested products was estimated at R$ 703.1 million for acai berry, R$ 65.1 million for babassu nut, and R$ 55 million for Brazil nut, see Figure 6.

Between 2006 and 2016, wild harvested products with biggest increase in value of provisioning services were acai (436%), and Brazil nut (345%).

For cultivated products, the value of provisioning services in 2016 was R$ 2 billion for acai, R$ 288 million for yerba mate, R$ 76.1 million for palm hearts.

THEMATIC ACCOUNTS: ENDANGERED SPECIES

Through the NCAVES project, Brazil generated thematic accounts for endangered species. This account aimed to build national and subnational, spatially-defined indicators on the status of conservation of biodiversity. This can help Brazil monitor its commitments to the Convention on Biological Biodiversity.

Two types of analyses were undertaken. Firstly, accounts were generated for years 2010, 2014 and 2018, based on global data from

IUCN's Red List. This time series approach resulted in an account that reports opening and closing 'stocks' for the number of species in each conservation category (from 'Extinct' to 'Least Concern' and 'Data deficient') for terrestrial, freshwater and marine 'realms' for each of Brazil's biomes. To be able to compare highly biodiverse biomes with less biodiverse biomes, this account was normalised to report a 'Red List Index' (RLI), as a measure of risk of extinction.

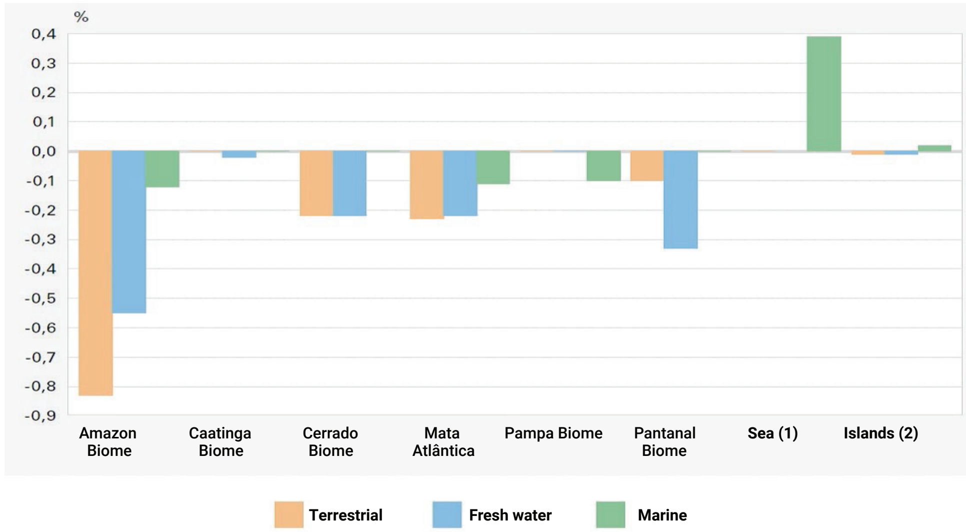
In the second analysis, national data from species lists from the Ministry of the Environment, developed by the Chico Mendes Institute for Biodiversity Conservation and the National Center for Plant Conservation of the Botanic Garden of Rio de Janeiro were assessed. The lists register 4,617 flora species and 12,262 fauna species from more than 49,000 flora and 117,00 fauna species recognized in Brazil.

Findings: global data

Figure 8 reports changes in RLI values for Brazil's biomes. It shows values falling in most biomes, linked to an increase in pressures from land use change and degradation. However, through the NCAVES project, the generation of RLI data in a consistent reporting framework can enable policy makers to prioritise conservation actions.

Brazil had 3,299 species of animals and plants threatened with extinction in 2014. This number represents 19.8% of the total of 16,645 species surveyed. The study also analysed threatened species by biomes and by different types of ecosystem realm (terrestrial, freshwater, and marine).

Figure 8: *Percent change in Red List Index (RLI) between 2010 and 2018 by realms and biomes. Note that a negative value – a fall in RLI – represents a worsening in the conservation prospects of a species.*

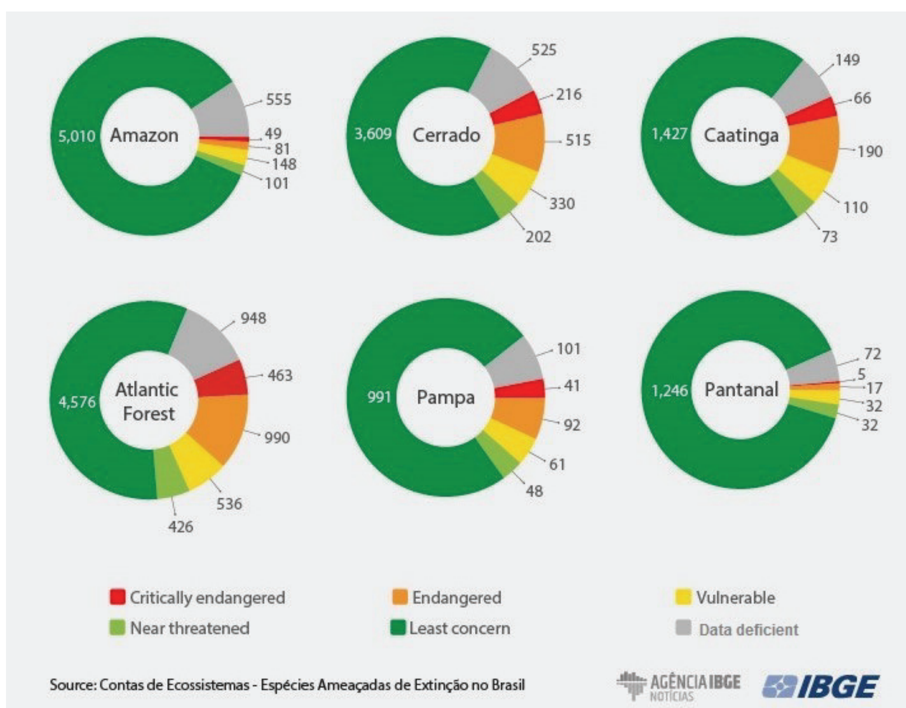


Findings: national data

The Atlantic Forest biome had the highest number threatened species: 1,989, or 25% of all species listed. The Cerrado had 1,061 species threatened, or 19.7%. The Pantanal biome had the least number and the lowest proportion of threatened species: 158, or 3.8%. The globally-important Amazon biome had less than 5% of species listed as threatened. The status for all biomes in shown in Figure 9.

The Brazil team also mapped the spatial distribution of threatened species (Figure 10). As reported in Figure 9, most threatened species are located in the Atlantic Forest biomes, where urban and agricultural development is most intensified.

Figure 9: *Conservation status of fauna and flora by biome (2014)*



THE FUTURE OF ECOSYSTEM ACCOUNTING IN BRAZIL

Through the support of NCAVES, between 2017 and 2020, IBGE, the lead institution for ecosystem accounting, has built a management structure, trained its economic and environmental statistics experts, published important accounts, and launched several studies of experimental statistics related to natural capital accounting. IBGE also solidified partnerships with other specialized institutions in Brazil to improve data availability to provide policy insights.

Brazil can now move into a phase of consolidation and use natural capital- and ecosystem-accounting in a strategic and systemised way across government as the Brazilian System of Environmental Economic Accounts (BRASEEA) to build on its vision that:

Brazilian governments at all levels and communities understand the environment's contribution to the economy and quality of life and ensure that the environment is properly accounted for in decision-making for a prosperous, healthy, and sustainable society.

It is hoped that BRASEEA will:

- fully integrate ecosystem contributions to prosperity and well-being with measures of social and economic activity;
- enable public policy and strategic planning to take account of the benefits of a healthy environment and its contribution to societal well-being;
- help decision-making optimise between sustainable economic, social and environmental outcomes; and
- help the environmental, economic and social returns from investments in the environment be more clearly demonstrated.

To realise this potential road map is proposed, supported by external funding. The road map will involve:

- strengthening the institutional framework (implementation of Technical Cooperation Agreements);
- conceptual development (participation in the development of international methodologies);
- data development (updates, framework for data sharing, etc.);
- accounts development (energy, forests, biodiversity, among others); and
- communication and engagement (workshops with environmental policy and decision makers, conference on application of EEA for environmental policy and decision making, etc.).

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For more information please visit:

https://www.ibge.gov.br/en/statistics/multi-domain/environment/20510-environmental-economic-accounting-for-water-brazil.html?=&t=o-que-e

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