

Executive Summary

PATHWAYS TO A SUSTAINABLE BIOECONOMY

Society's contributions in the context of the G20

Brasília

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Disclaimer: *This publication synthesizes and analyses the results of the national stakeholder consultations held in preparation for the official meetings of the G20 Global Bioeconomy Initiative. The author (s) carefully compiled and reviewed the results, interpretations, and recommendations expressed in this study.*

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PREFACE

Debates about the direction of the world's economy can no longer ignore central aspects such as the climate crisis, the global decline of biodiversity, disputes over scarce resources, the need for energy transition, and all the other inevitable socio-environmental impacts resulting from the inadequate exploitation of natural resources.

In the last decade, the bioeconomy has emerged as a strategic path to provide effective responses to these contemporary challenges. This field has gained prominence for its ability to promote economic growth and prosperity based on the sustainable use of biodiversity and biological resources. More than 60 countries are already implementing sector-related policies related to the bioeconomy, recognizing its potential to mitigate the climate crisis, preserve biodiversity, and ensure an efficient energy transition (IACGB, 2020).

Despite being widely discussed internationally and by countries, there is neither consensus on a bioeconomy concept nor alignment on the desired principles for a global bioeconomy. So far, each country interprets it in its own way. For some countries, it is often associated with the ecological sustainability of industries, decarbonization through substituting fossil resources with biological resources, or biotechnology. For others, particularly those megadiverse, the bioeconomy presents an opportunity to use resources and knowledge associated with biodiversity sustainably, respecting ecological limits, stimulating local and regional economies, and promoting employment and income for populations whose livelihoods depend on ecosystems.

Although countries adopt unique views of bioeconomy based on their national context, decisions made in one place may affect another. Strict environmental certifications imposed by some countries may restrict market access for products from developing countries, for example, that lack the capacity to quickly meet these demands. Meanwhile, megadiverse countries, aiming to protect their biodiversity and its associated traditional knowledge, adopt stringent regulations against biopiracy that often restrict research and the development of new products without necessarily achieving the expected effectiveness in protecting genetic heritage or benefiting populations holding traditional knowledge.

For Brazil, the bioeconomy represents a national priority for increasing productivity and competitiveness while promoting environmental sustainability with social justice and

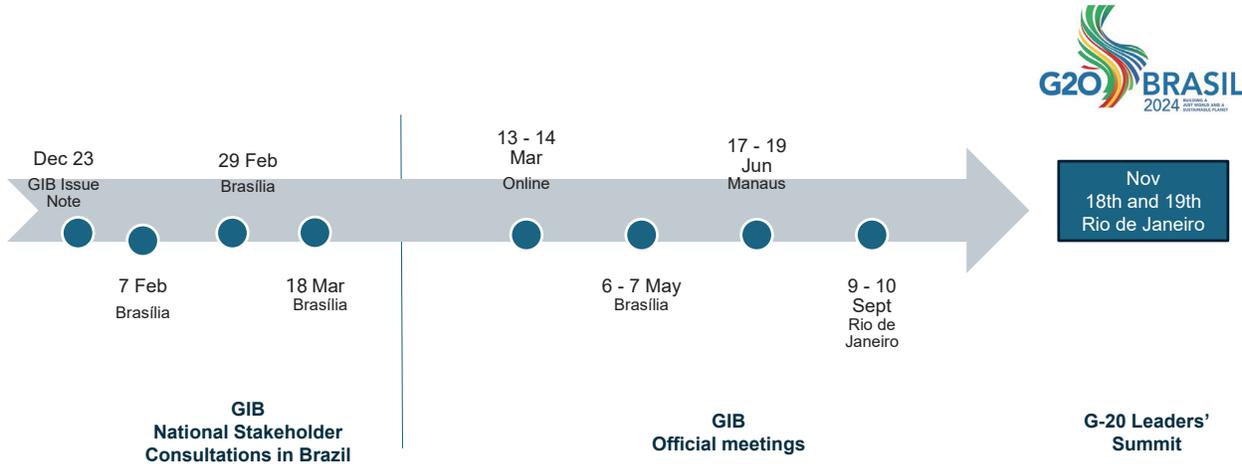
equity. In this context, the bioeconomy constitutes a pillar of the Growth Acceleration Plan (PAC) and of the Ecological Transformation Plan. In 2024, Brazil also launched the National Bioeconomy Strategy to promote the coordination of more than 30 sectoral-related policies, plans, and instruments in the country.

As a forum for debates between industrialized and emerging countries responsible for about 85% of the global Gross Domestic Product, 75% of the world’s trade, and 2/3 of the worldwide population, the G20 is a privileged space for reflections and discussions on pathways for bioeconomy.

Thus, in the context of the Brazilian presidency of the G-20, Brazil innovated by creating the Global Bioeconomy Initiative (GIB) to debate and build a shared vision of the bioeconomy and the desired high-level principles for a sustainable bioeconomy. Discussions of bioeconomy concepts, principles, and guiding criteria in the G-20 is a crucial step to ensure the deployment of bioeconomy policies and strategies at the international, national, and subnational levels promote economic development, social inclusion, and environmental sustainability, aligning G20 member countries efforts to global priorities.

To access society’s perceptions and build Brazil’s inputs for the G-20 Initiative on Bioeconomy, the G-20 Presidency promoted three stakeholder consultations in partnership with the United Nations Environmental Programme. They took place in February and March 2024 before the official GIB meetings.

Following, the GIB meetings promoted a space for knowledge exchange and negotiation among the G20 member countries, resulting in the approval of the High-Level Principles for Bioeconomy. These results are expected to guide future international and national discussions.



1. INTRODUCTION

The bioeconomy in Brazil

Brazil is home to the world's largest extension of tropical forests, covering nearly 5 million km². Among the 17 megadiverse countries, Brazil likely is the most biodiverse nation on the planet, spread across six terrestrial biomes and three major marine ecosystems. Some figures highlight the extent of biodiversity with a high degree of endemism. It is estimated that there are 42,000 species of plants, 9,000 species of vertebrates, and 129,840 species of invertebrates (Bustamante, 2024). Additionally, it is estimated that the country houses around 20% of the total species in the world, both terrestrial and aquatic.

The megadiversity and spatial heterogeneity in the country provide various resources from ecosystems. Beyond native biodiversity, Brazil is one of the leaders in producing agricultural products, renewable energy, and biofuels. Furthermore, the biodiversity and associated knowledge place Brazil in a strategically prominent position due to its high potential for developing highly technological products while contributing to the generation of ecosystem and environmental services.

This rich biodiversity, combined with Brazil's productive capacity, holds enormous potential for developing innovative and highly technological products, processes, and services, primarily through native biodiversity. Beyond native biodiversity, Brazil is also a leader in producing renewable energy and food resources.

To translate the strategic vision of bioeconomy into public policy, the Brazilian Government has made it one of the pillars of the Ecological Transformation Plan and the Multiannual Plan for 2024 to 2027. In 2024, Brazil launched its National Bioeconomy Strategy, is drafting an Action Plan for the sector, and is developing a National Sociobioeconomy Program.

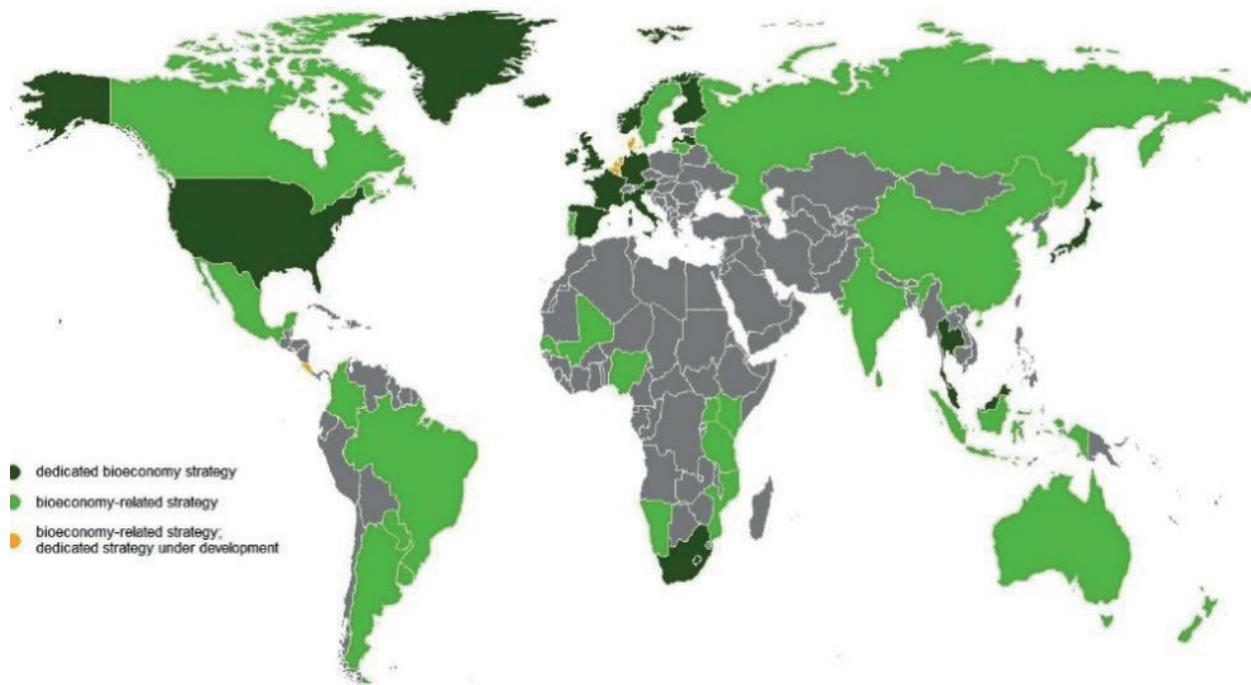
In the Brazilian context, the National Strategy defines bioeconomy

as a model of productive and economic development that is fair, ethical, and inclusive, generating products, processes, and services efficiently, based on sustainable use, regeneration, and conservation of biological diversity, guided by scientific and traditional knowledge, its innovations, and technologies, aiming for value addition, job and income generation, sustainability, and climate balance (Decree 12,044 of June 12, 2024).

The Brazilian bioeconomy is composed of several economic sectors such as socio-biodiversity production chains, tourism, regenerative practices, sustainable agri-food systems, biofuels, biotechnology, bioinputs, fibers, parts of the industrial sector that develop innovations such as bioplastics or bioproducts based on native biodiversity. Currently, Brazil counts with more than 30 sectoral-related policies and strategies related to the theme (MMA, in press).

The bioeconomy in the world

Until 2020, more than 60 countries had policies or sectoral strategies related to bioeconomy in areas such as research and innovation, bioenergy, forestry, and agri-food systems, among others. Furthermore, 17 countries and three macroregions had a dedicated strategy at the national or macro-regional level (IACGB, 2020)¹.



Fonte: IACGB, 2024

¹ There were three macro-regions (European Union, East Africa, Nordic Countries), 10 countries from the European Union (Germany, Austria, Spain, Latvia, Finland, France, Ireland, Italy, Norway and the United Kingdom), three from Asia (Japan, Thailand and Malaysia) and one from North America, Africa and Latin America (United States, South Africa and Costa Rica, respectively) (IACGB, 2020).

Despite receiving increasing visibility and being the subject of various international debates, each country interprets bioeconomy differently. Bioeconomy is closely tied to the productive and economic structures of the nations (considering its higher or lower dependence on raw materials or industrial sectors). The term bioeconomy is applied broadly, depending on the various countries' environmental, geographical, cultural, and geopolitical dimensions.

Generally, countries in the Global North have a narrative centered on using cutting-edge technologies to develop solutions and replace non-renewable raw materials with renewable ones, with a solid agricultural and technological bias to address current environmental problems.

Countries with high biodiversity, particularly those in the Global South, such as Latin American, Southeast Asian, and African nations, not only seek to invest in science and technology to create innovations and add value to biological resources (such as in biopharmaceuticals) or to increase the efficiency of renewable input production (like in biofuel production) aimed at decarbonization. They go further. Megadiverse countries seek to leverage their significant potential related to the sustainable use of biodiversity and environmental services to promote regional development and generate income and well-being for local populations.

Thus, bioeconomy encompasses a broad spectrum of economic sectors. On the one hand, it includes the agribusiness, biofuel, and biotechnology sectors, sectors with substantial economic capacity, highly productive, integrated into national and international markets, and access to specific and established sectoral policies and incentives. On the other, it encompasses productive value chains based on the sustainable use of biodiversity, mainly practiced by Indigenous People and Local Communities (IPLC), small rural producers, and entrepreneurs with low access to infrastructure, information, markets, and finance.

Stakeholder consultations on the pathways for bioeconomy in the context of the G20

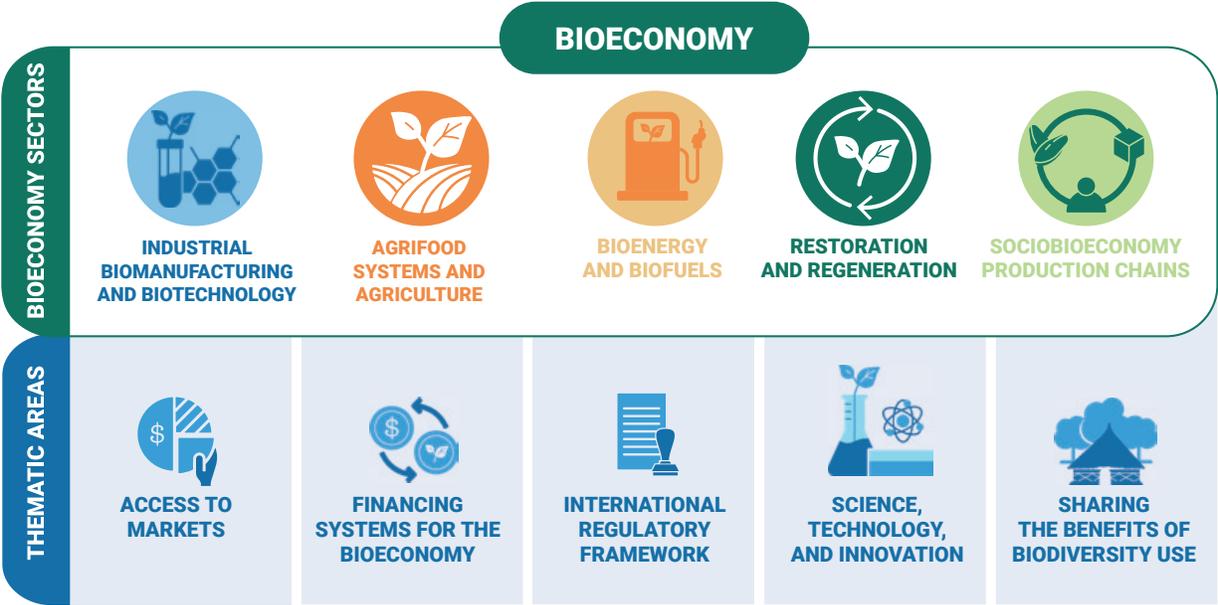
To dialogue with productive sectors, experts, and the society about the bioeconomy in Brazil, its limitations, and needs, as well as to raise inputs on paths to the bioeconomy in the context of the G-20, the federal government organized three stakeholder consultations. Coordinated by the Ministries of Foreign Affairs (MRE), Environment and Climate Change

(MMA), and Science, Technology, and Innovation (MCTI), they took place on February 7th and 29th, and March 18th at the Itamaraty Palace in Brasília.

More than 200 experts from productive sectors, the federal and subnational governments, civil society, and academia participated in the dialogues, marked by the plurality of perspectives that comprise the bioeconomy. The events included technical-scientific presentations, debate of ideas, and work in discussion groups. Each meeting had a guiding theme, as follows:

- the importance of the sustainable use of biodiversity for the bioeconomy;
- the role of science, technology, innovation, and traditional knowledge for a sustainable bioeconomy;
- bioeconomy as a driver of sustainable development.

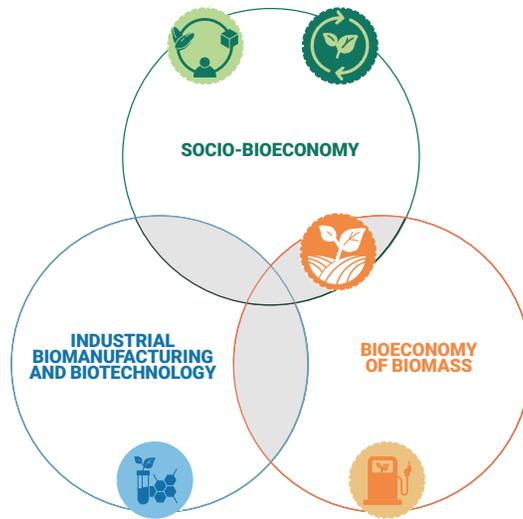
As a result, two main sets of contents stood out from the dialogues. They were systematized and classified as i. Brazil’s bioeconomy sectors, and ii. Pathways to the bioeconomy, consolidating challenges and needs and generating inputs for the development of bioeconomy principles within the context of the G20 (Figure 1).



Following the dialogues, four official GIB meetings occurred in March, May, June, and September 2024. These meetings resulted in negotiating and approving the High-Level Principles of Bioeconomy. The figure below summarizes the key GIB process.

2. BIOECONOMY SECTORS IN BRAZIL

The following sectors with potential for the bioeconomy in Brazil were addressed: i. The sociobioeconomy production chains; ii. Ecosystem regeneration and restoration; iii. Industrial biomanufacturing and biotechnology; iv. Agri-food systems and agriculture; and v. Bioenergy and biofuels.



SOCIOBIOECONOMY PRODUCTION CHAINS



The **socio-bioeconomy** is composed of several production chains based on the interrelationship between biological diversity and socio-cultural systems, which enable income generation, biodiversity conservation and ensure the integrity of territories and social development.

BIOENERGY AND BIOFUELS



Bioenergy and biofuels are characterized as renewable alternatives to fossil fuels, which, with successive technological developments, have the potential to reduce greenhouse gas emissions.

RESTORATION AND REGENERATION



Encompasses **ecological restoration**, agroforestry systems (AFS), as well as production systems that integrate crop-livestock-forestry with the purpose of recovering degraded areas.

BIOMANUFACTURING AND BIOTECHNOLOGY



Biotechnology and **industrial biomanufacturing** are already present in the field of health, cosmetics and the generation of new materials, and have the tendency to become increasingly central with frontier research.

AGRI-FOOD SYSTEMS AND AGRICULTURE



Agri-food systems produce food, energy, and other products and have a great potential for diversification and regeneration actions.

Socio-bioeconomy Production Chains

Brazil stands out for its enormous biodiversity potential. Therefore, sociobioeconomy production chains based on the sustainable use of biodiversity practiced by Indigenous People and Local Communities (IPLC), small rural producers, and entrepreneurs are vital to promoting the sustainable development of biodiversity-rich regions, generating jobs, social inclusion, and prosperity.

Sociobioeconomy relates to the economic and sustainable use of biodiversity and ecosystem services, ensuring social development and environmental conservation. It aims to explore biodiversity's economic potential, creating products, services, and innovations that aggregate value to species from conserved, managed, or regenerated ecosystems. It valorizes the traditional knowledge from IPLC. Sociobioeconomy production chains are essential for creating jobs, promoting income, economic development, and social justice in forest, marine, and coastal regions.

Access to international markets for sociobioeconomy products remains low. The lack of incentives and adequate financing instruments, the gap in processing and transport infrastructure, and the limited training opportunities restrict the deployment of these value chains. Logistical challenges result in high production costs and low value-added to products. The marginalization of IPLC is the root of the invisibility of these actors' roles in the bioeconomy.

Socio-bioeconomy is defined as “an integrated system, made up of interdependent actors and a succession of processes of education, research, management, production, processing, distribution, commercialization and consumption of socio-biodiversity products and services, with cultural identity and incorporation of local values and knowledge of traditional peoples and communities and family farmers and that ensure the fair and equitable distribution of their benefits” (Brasil, 2009).



In the Brazilian Amazon, there are around 2,250 non-timber forest products (NTFPs), of which 1,037 are food products, 1,001 are medicinal, and many are used in cosmetics, crafts, and other applications. However, Brazilian forest products' share in the international market accounts for only 0.17% of global forest product exports” (Ministry of Finance, 2024).

In the G20 context, it is essential that bioeconomy ensures rights and recognizes and values the role of IPLC in the bioeconomy. Market access needs to be enhanced for sociobiodiversity products. In this context, a proposal to develop certification systems at the international level has been raised. Advancing with local and regional processing infrastructures to add value to sociobioeconomy products is necessary. To strengthen these chains, international cooperation and financing mechanisms are crucial to promote capacity building, knowledge exchange, and technology transfer.



The perspective of Indigenous, traditional, and extractivist populations is rooted in biodiversity. Life is based on biodiversity.”

— **Joaquim Belo**

National Council of Extractive Populations



The native species of Brazilian biodiversity are used by 11 industrial sectors: food, beverages, textiles, clothing, leather, wood, pulp and paper, biofuels, pharmaceuticals, rubber, and furniture. Given the wide range of economic activities that use native species, these activities could potentially contribute approximately US\$50 billion in annual exports. However, only 1% of this market is consolidated, currently contributing just US\$500 million annually in exports.”

— **Sonia Ribeiro**

Federal University of Minas Gerais

Restoration and Regeneration

Ecosystem restoration and regeneration are means of reestablishing ecosystems and their ecological functions, restoring productivity to the land, mitigating the effects of climate change, recovering biodiversity and environmental services, and generating employment and income in sectors that produce inputs and services. Thus, restoring nature is a global imperative in the context of the sharp decline in biodiversity and the pressure on ecosystems. Brazil has committed to restoring at least 12.5 million hectares by 2030 as part of the National Plan for the Recovery of Native Vegetation (PLANAVEG) and reducing its carbon emissions by 37% by 2025 and 43% by 2030. To achieve these goals, PLANAVEG proposes the restoration and

recovery of 10.3 million hectares in permanent preservation areas (APP) and legal reserves (RL), as well as 2.2 million hectares in degraded, low-productivity areas.

The Restoration Arch Project launched by Brazil aims to restore 24 million hectares, with planned investments of US\$ 24 billion, mainly through agroforestry systems.

Articles have addressed that restoring at least 5% of the degraded areas of the Amazon biome can prevent the collapse of ecosystems and increase the resilience of the Biome. (Source: FLORES apud COUTO, 2024)

There is great potential for these activities. Across the country, about 98 million hectares of degraded land can be restored, regenerated, or cultivated. However, the sector faces a scarcity of restoration and regeneration models for cultivating native forest species and lacks investments and adequate funding for these costly activities. Moreover, the limited capacities and lack of structure restrict the entire regeneration chain. Also, the lack of economies of scale in existing regenerative agriculture and livestock initiatives results in low competitiveness of the activities.

Some pathways were suggested to strengthen restoration and regeneration initiatives in the international context, such as creating a global fund for the recovery and regeneration of native ecosystems, expanding research and generating new technologies and restoration models, and leveraging funding for converting degraded pastures into sustainable agricultural and forestry systems. Finally, international cooperation plays a crucial role in developing capacities and methods and promoting research for the collaborative development of technologies for new restoration models.

Agri-Food Systems and Agriculture

Currently, agri-food systems in Brazil are strongly dependent on monocultures and intensive agricultural practices. For example, soybean cultivation represents 65% of the cultivated agricultural area in the country, and commodities like corn and soybeans account for 75% of rural credit allocated to agricultural producers. This reality contrasts with the country's enormous potential for biodiversity.

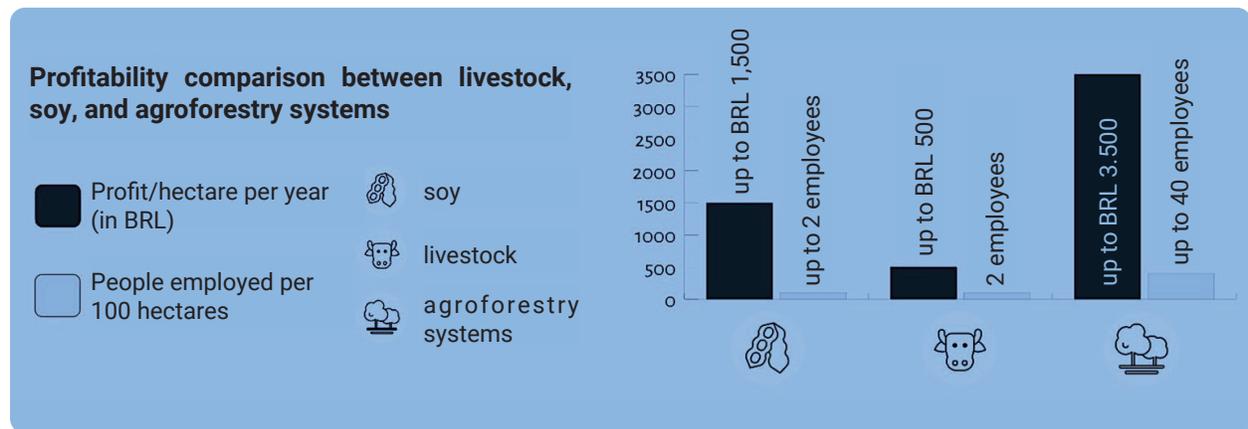
Diversifying agri-food systems through the bioeconomy can bring social, environmental, and economic gains. Agroforestry systems, for instance, can generate an income of around R\$1,500 to R\$3,500 per hectare and year and generate up to 40 jobs, while soybeans generate R\$1,500 and extensive cattle ranching R\$500.



Historically, the Americas ignored its diversity and invested have invested in the production of few products. (...) Brazil has the potential to develop a new socio-bioeconomy based on this diversity.”

– **Carlos Nobre**

Brazilian Academy of Science and Institute for Advanced Studies, University of São Paulo



Climate change is altering rainfall regimes and causing extreme droughts, so these low-biodiversity systems face significant risks and challenges. In this context, boosting the bioeconomy by diversifying agrifood systems and combining knowledge about biodiversity with technological advances is an excellent opportunity to increase resilience and generate co-benefits such as environmental services.



Little diversification and limited biodiversity knowledge. While **cattle farming accounts for 7% of Brazil's GDP**, biodiversity products contribute **only 0.3%**.



65% of the area occupied by Brazilian agriculture is made up of soya

Several actions are necessary to influence this scenario positively. Capacity building for stakeholders in the socio-biodiversity and agroforestry chains is essential, as is the formulation and definition of principles for healthy agri-food systems at a global level. This includes establishing incentives for using bioinputs and creating regulations for pesticide use, especially within the G20 context. It is also crucial to increase the presence of biodiversity assets in international food trade, strengthening their conservation and promoting more sustainable agricultural practices globally.

The creation of global and national funds stands out among the needs identified to facilitate the implementation of diverse, healthy agri-food systems and regenerative agriculture. These funds can encourage investments in converting degraded pastures into agroforestry systems and promote a more sustainable agriculture resilient to climate change. They can also contribute to biodiversity conservation and generate economic and social benefits for local communities.

Biotechnology and Biomanufacturing

Biotechnology and industrial biomanufacturing have attracted significant investments from international powers as frontier areas in countries' technological development. In Brazil, the newly launched Neo Industrialization Plan includes actions for decarbonizing industrial activities, promoting a circular economy, and utilizing bioinputs.

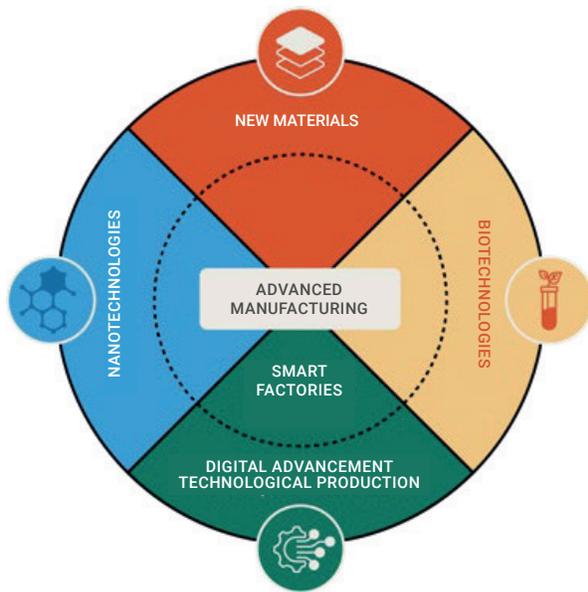
Still, there are marked gaps for these areas in Brazil, such as technological dependence due to low investment in critical technologies, such as enzymes suitable for bioindustrial uses. Also noted are areas for improvement in training and infrastructure such as biotechnology, process intensification, and nanotechnology.

In view of the context, there are ways to develop the respective sectors, such as mobilizing the installed capacity in the academic environment through incentives for research and innovation collaboratively, encouraging initiatives that work at the frontiers of biotechnology and industrial biomanufacturing, and optimizing access to inputs and new technologies.

Bioenergy and Biofuels

Brazil is a world reference in producing clean energy, with 44.7% of its energy matrix composed of renewables. Despite this, it still depends heavily on oil (34.4%). It also

has relevant technological innovation associated with the production processes of bioenergy and biofuels, a competitive differential with the potential to reposition the country in the global energy transition. The kinds of agro energy are diverse: biodiesel, first and second-generation ethanol, biokerosene, biogas, charcoal, firewood, chips, and grasses.



“
Among the 50 most innovative countries in the world, only six are megadiverse. Among the 10 most innovative, only one.”
– **Thiago Falda**
Brazilian Bioinnovation Association (ABBI)

“
Biodiversity and biomass offer possibilities for industrial activities that could make Brazil an industrial leader.”
– **Ricardo Abromovay**
University of São Paulo (USP)

“
... the minimum requirement for competencies and skills to remain competitive in manufacturing will be so high that it will exclude a large proportion of countries from the next phase of manufacturing.”
– **Ly Yong**
UNIDO (2021)

Brazilian biodiesel production went from 5.3 to more than 10 billion liters annually between 2018 and 2023.

Social differential:
The biofuel value chains generate 30 times more jobs than the fossil fuel chains.

In 2021, biodiesel production's GDP was R\$10.5 billion, directly employing more than 19 thousand people.

Several factors pose limitations for developing Brazil's biofuels and bioenergy sectors, mainly: i. the high technological risk associated with adopting new biofuels; ii. non-tariff

barriers related to land use and emissions that restrict market access; and iii. the lack of incentives for developing routes with low levels of technological maturity (low Technology Readiness Level).



Brazil is an extensive country with 7.6% of its areas for agriculture producing biomass. It has the potential to replace fossils with renewable raw materials contributing to decarbonization. If produced sustainably, 1st and 2nd generation ethanol and aviation biofuels contribute to the energy transition and lead to carbon capture and storage during biomass growth. 2nd generation ethanol generates enzymes that reduce external technological dependence - There is a necessary transition for the future: in addition to moving from fossil to renewable, we need to move from renewable to sustainable."

— Eduardo do Couto e Silva

National Center for Research in Energy and Materials (CNPEM)

3. PATHWAYS TO A SUSTAINABLE BIOECONOMY IN THE CONTEXT OF THE G20

During the consultations, stakeholders raised insights on pathways for a sustainable bioeconomy in the context of the G20, as synthesized in the figure below. This chapter elaborates on each of the key thematic areas discussed.



INTERNATIONAL GOVERNANCE

- Advancing the international regulatory and institutional framework and promoting the definition and high-level principles of the bioeconomy.



SCIENCE, TECHNOLOGY, AND INNOVATION

- Promote science, technology, and innovation to create new products and processes and add value to bioeconomy products.



RIGHTS OF INDIGENOUS PEOPLES AND LOCAL COMMUNITIES, AND BENEFIT SHARING

- Strengthen and guarantee the rights of Indigenous Peoples, Traditional Peoples, and Communities to their territories and livelihoods.
- Share the benefits derived from the sustainable use of biodiversity and associated traditional knowledge fairly and equitably within and between countries.



ENVIRONMENTAL SERVICES

- Incorporate ecosystem services into decision-making processes and bioeconomy strategies.



MARKET ACCESS

- Ensure market access for bioeconomy products and reduce non-tariff barriers that create imbalances in global trade.



ENVIRONMENTAL AND SOCIAL SUSTAINABILITY

- Generate employment and income opportunities.
- Ensure bioeconomy is environmentally sustainable, respecting ecosystem limits, maintaining biodiversity, and achieving climate goals.



FINANCE

- Implement innovative financing mechanisms to foster technological development, create new products and businesses, and enhance the value of environmental services generated by bioeconomy.

International governance

Despite the growing interest, the bioeconomy still needs a common concept or an official discussion forum among countries at the international level. Its conceptual understanding depends on each nation's productive and economic structures, particularly their dependence on primary and secondary sectors. While for some countries, it is often associated with the ecological sustainability of industries, decarbonization through the substitution of fossil resources with biological resources, or biotechnology, for others—particularly those that are mega-diverse—the bioeconomy represents an opportunity to promote employment and income for populations who sustainably use natural resources stimulating local and regional economies.

The G20 is pioneering the introduction of this topic into the debate in an official international forum, with the potential to promote relevant alignments and broaden global consensus on the bioeconomy. Establishing a mechanism for international governance presents an opportunity to advance the bioeconomy.

Principles for the bioeconomy

Considering the difficulty of reaching a consensual definition of the bioeconomy and acknowledging its plurality, participants have agreed that the G-20 presidency's proposal to develop and agree upon high-level principles for the bioeconomy is a crucial path.

The principles should delineate common characteristics, boundaries between concepts, and a set of guidelines to ensure that the bioeconomy contributes to sustainability in its economic, environmental, and social dimensions; socio-environmental justice; equity; biodiversity conservation; ecosystem regeneration; decent work; circularity; and profitability.

Regulatory harmonization

The need for harmonization regarding the regulatory framework challenges bioeconomy's advancement, impacting the countries' competitiveness and market access. Thus, to prioritize biodiversity conservation and integrate the associated assets into the global economic matrix, it is necessary to advance with regulatory harmonization that can guide the integrated actions of G20 countries across different sectors and ensure an international governance structure for this process.

The absence of international legal frameworks in key sectors directly affects and limits initiatives in the bioeconomy. This scenario impacts six main areas: i. phytosanitary regulations; ii. metrics for biofuels; iii. regulation of pesticides; iv. granting of patents; v. commercial rules of bioeconomy; and vi. benefit sharing, which has an in-depth section ahead.

Respect for the limits of ecosystems and the protection of biodiversity and climate

Given the different sectoral characteristics of the bioeconomy, it is essential to ensure that the bioeconomy is environmentally sustainable, respecting the limits of ecosystems, maintaining biodiversity, and achieving climate goals.

Bioeconomic productive systems, whether related to land use to produce forest and agricultural products or those associated with the biotechnology industry, must be guided by the principle of respect to the ecological limits of ecosystems, be structured to help ensure biodiversity's conservation, regeneration, and sustainable use, as well as mitigating climate risks. Defining production boundaries based on the regenerative capacity of ecosystems is an important condition for developing truly sustainable bioeconomy models.

Recognition, valorization, and safeguarding of the rights of Indigenous Peoples and Local Communities

An essential foundation of bioeconomy is driven by sociobioeconomy practiced by IPLC in highly biodiverse territories. Sociobioeconomy is a sociocultural productive system that respects the ecological limits of biodiversity's use. IPLC and small rural producers are the key actors in these production systems, playing a crucial role in ecosystem management, biodiversity maintenance, and providing knowledge about the use of biodiversity.

However, these groups feel disregarded or marginalized in policies and initiatives related to the bioeconomy, as they are not properly integrated as critical stakeholders and knowledge holders. Additionally, they face several risks to their rights to their territories and livelihoods. IPLC and small rural producers lack access to technical training, infrastructure, and funding, limiting the success of sociobioeconomy productive chains.

As pathways forward, IPLC's rights to their territories and livelihoods need to be ensured, and their role in maintaining all Brazilian biomes must be valued. IPLC need to be adequately involved in the formulation of bioeconomy policies, as the protagonists of the agenda. Thus, they need to be integrated into technical training, academic research, and the bioeconomy supply chains.

Strengthening science, technology, and innovation

There is a genuine race for science, technology, and innovation development. To achieve cutting-edge advancements in bioeconomy, frontier research is necessary, which requires a consolidated scientific structure, robust foundational research, qualified professional training, and institutions working in bioeconomy across different biomes.

Research, development, and innovation

The development of R&D depends on a robust scientific structure. In the Brazilian context, the scientific environment is limited, with a lack of investment and infrastructure and the absence of coordination between the research area and other sectors, such as the private sector and communities with traditional knowledge.

To transform this context and develop the field of R&D, contributions point to structural actions, including easing research burdens, expanding economic incentives for high-risk technological pathways, strengthening research institutes and innovation programs, and seeking international collaboration, knowledge exchange, and international technology transfer agreements. Changes in knowledge structures are also proposed, with a review of innovation indicators and metrics to incorporate the integration with traditional and ancestral knowledge.

Technical and academic background

There is a significant shortage of skilled labor to develop bioeconomic production modules, as there are no specific courses focused on bioeconomy across the different Brazilian biomes and financial resources for technical and academic training in bioeconomy need to be improved.



Legal Amazon has 330 campuses and 34 R&D institutes and universities in 166 municipalities. However, there are only two Graduate Programs of excellence in Botany. Only about 20 botanists can collect and describe species in the entire region. The number of botanical para-taxonomists is even smaller."

— Mercedes Bustamante

University of Brasília

In this sense, the need to invest in reference institutions in the bioeconomy and promote coordination among networks of institutions, researchers, and trainers at the international level was emphasized. In the global context, it is crucial to encourage knowledge exchanges to strengthen technical and academic training.

International and scientific cooperation and technology transfers

Knowledge asymmetries exist between countries with high technological development and countries rich in biodiversity. In this context, collaboration between countries and international cooperation in science, technology, and innovation becomes a priority.

It is recommended that G-20 countries deepen collaboration and international cooperation to promote capacity development in science, technology, and innovation for bioeconomy, scientific and technological knowledge exchange, and technology transfer for developing bioeconomy supply chains in global south countries.

Databases and genetic resources

There is a significant asymmetry between the quantity and scale of genetic resource banks in developed countries, Brazil, and other megadiverse countries. The limited diversity of genetic resources conserved in germplasm banks restricts potential investments in biotechnology innovation. Expanding and diversifying these collections, especially in Brazil and biodiversity-rich countries, is necessary in the context of global biodiversity decline.

In Brazil alone, there are approximately:

42,000 plant species
9,000 vertebrates
+ 129,000 invertebrates

Threatened Species

+ 1,000 fauna
+ 2,000 flora

To achieve this, coordinated and systematic mapping of genetic heritage should occur, along with the promotion of mechanisms to encourage the development of products from national genetic heritage, aiming for the valorization and sustainability of biological resources.

Positive Experience of NuBBEDB

The Nucleus of Bioassays, Ecophysiology, and Database of Natural Products Biosynthesis (NuBBEDB) was established as the first library of natural products from Brazilian biodiversity. Since its launch in 2013, it has proven to be an essential resource for creating new medicines and dereplicating studies.

Products

Over **245 species** of the **Brazilian flora** serve as the basis for cosmetic and pharmaceutical products, and at least **36 native botanical species** are registered as phytotherapeutic components.



Scaling up bioeconomy financing

To strengthen and position bioeconomy within the global context, investments are needed across the various sectors that comprise bioeconomy development models. The critical question is how to mobilize financial resources.

Creation and implementation of funds

There is a lack of resources for the bioeconomy in almost all sectors. A significant discrepancy is observed when comparing the resources allocated to Amazon with those reaching other biomes, and funding lines that could benefit bioeconomy activities often fail to effectively reach their intended audiences.

To change this scenario, it is proposed to open specific international financing and credit lines for bioeconomy and create a permanent funding mechanism for payments for ecosystem services that support bioeconomy activities preserving these services. The need to establish and implement international funds for (1) biodiversity; (2) diversification of agri-food systems; (3) recovery and regeneration of native vegetation; (4) conversion of degraded lands for sustainable production systems (agricultural and forestry); and (5) science, technology, and innovation.

Access to financing by socio-biodiversity production chains

Special attention has been given to financing sociobioeconomy production chains. Structural bottlenecks include the lack of land tenure and environmental licensing and limited access to resources for small producers, cooperatives, and small production chains. There is a significant shortage of resources for investments in improving product processing stages, primary research, and the development of innovation pathways essential for adding value to these chains. Additionally, there is a lack of integration and visibility of data related to the bioeconomy sector, resulting in opportunities remaining invisible to potential investors.

It is necessary to implement innovative financing mechanisms to foster technological development, create new products and businesses, and value the environmental services generated by bioeconomy.

As pathways in the international context, the development of innovative financing solutions that combine public and private resources, both national and international (blended finance), is highlighted. Existing funds should be improved in their design and execution to reach the target audience effectively. There is a need to advance dialogue with investors to identify barriers that hinder the allocation of resources to initiatives in the sector, ensuring that international financing mechanisms are enhanced in their implementation, particularly in the context of the Global South, to strengthen access to financing for small producers, businesses, and cooperatives. The establishment of international repositories on the types of existing initiatives in the field of bioeconomy was also mentioned, with a focus on projects and proposals originating from PIPCTs.

Valorizing ecosystem services

Bioeconomy activities generate co-benefits that significantly contribute to human well-being by ensuring the provision of ecosystem services. However, these services are often undervalued, and bioeconomy activities frequently struggle to compete with predatory practices related to natural resource use. Valuing and incorporating the environmental services provided by bioeconomy activities has been identified as a critical pathway to enhance value addition and improve bioeconomic activities' financial viability and competitiveness.

Within the G-20 context, there is a need to engage in dialogue with countries about the unique benefits of bioeconomy products, particularly their role in providing ecosystem services. Collaboration between countries and international cooperation is crucial for advancing knowledge exchange and capacity development regarding mechanisms for measuring, valuing, and commercializing these services.

Additionally, it is essential to progress in estimating the economic benefits of bioeconomy on a global scale and promote innovative economic mechanisms to incorporate the values of the environmental services generated. This could include payments for ecosystem services, biodiversity credits, and other financial instruments.

Benefit-sharing from the use of biodiversity and associated traditional knowledge

Historically, the traditional knowledge of local populations and Indigenous peoples in Brazil and other biodiversity-rich countries has been a foundation for developing new products and processes. However, the patenting of these assets often occurs without appropriate benefit-sharing. With its extensive experience in this area, Brazil has much to contribute to the international discussion on benefit-sharing.

There is a significant implementation gap regarding the Nagoya Protocol in many countries, leading to regulatory dissonance concerning the benefit-sharing arising from using biodiversity, genetic heritage, and associated traditional knowledge. The differing regulatory environments among countries create a competitive inequality in benefit-sharing. This scenario is compounded by the low representation of Indigenous peoples and traditional communities in decision-making spaces regarding benefit-sharing at the international level. This entire context limits benefit-sharing and deepens the undervaluation of ancestral and traditional knowledge.

Brazilian experience



Brazil has over **30 years of experience in implementing access and benefit-sharing policies**. The accumulated experience has allowed Brazil to jump from 3,000 access requests (R&D) in 15 years to more than 70,000 requests and 17,000 registered products on the National System for the Management of Genetic Heritage and Associated Traditional Knowledge platform (Sisgen).

Genetic Heritage and Traditional Populations



Example of 'Jenipapo' (genipap)

- Chemical compounds related to the dye obtained from genipap - traditionally used by indigenous peoples - are patented in the USA. There are no patents in Brazil



“Traditional populations are the ones who have knowledge about genetic heritage. It always passes through traditional knowledge. IPLC needs to be involved in the bioeconomy debate because the vision of territories and ethnological development need to be integrated into the discussion.”

Guilherme Faria

Rede PCT - Traditional Peoples and Communities Network

The first step towards transforming this scenario is to advocate for platforms like the G20 and the implementation of already agreed-upon international mechanisms and agreements, such as the Nagoya Protocol, to ensure fair benefit-sharing and combat biopiracy. It is essential to achieve international regulatory alignment on benefit-sharing between industry, Indigenous peoples, and traditional communities. Additionally, it is necessary to increase the presence of PIPCTs in international governance spaces related to benefit-sharing, ensuring intellectual property rights for holders of traditional and ancestral knowledge.

Fair access to markets

Bioeconomy products still face challenges in entering and growing in international markets. There is limited awareness of the socio-environmental benefits of sociobioeconomy chains, and international standards often do not align with national contexts.

Expanding access to international markets for bioeconomy products

Scaling up the bioeconomy requires the presence of its products in international trade. However, differences in phytosanitary regulations between countries and the need for more commercial structures for significant trade agreements involving bioeconomy products hinder the sector's development at scale. Additionally, the higher costs associated with operating within Brazilian biodiversity have also been identified as a limitation to the competitiveness of sociobiodiversity products in accessing markets.

To overcome these limitations, international agreements that create diversified markets for bioeconomy products, ensuring competitive equality compared to other chains, including certification and public procurement, are necessary. Strengthening the bioeconomy through the development of value chains, particularly within the Amazon Cooperation Treaty Organization (OTCA) framework, is also a viable path that can be pursued through international actions.

Reduction of non-tariff barriers

Non-tariff barriers, especially in the case of biofuels, limit the bioeconomy's advancement in relevant markets, such as energy matrices. These barriers stem from narratives regarding land use, emissions, and other issues. Moreover, the low awareness of the socio-environmental benefits of biofuels results in their limited presence in the energy matrix of G20 countries. For instance, in 2022, Brazil's biodiesel industrial capacity was 52% underutilized. Despite the potential to produce 12.8 billion liters, only 6.2 billion liters were generated due to restrictions on international adoption.

The discussion around these barriers should occur internationally, addressing the challenges and opportunities for bioeconomy within the G20 framework. It is recommended that the assessment, proposal of actions, and fostering of international agreements to tackle technical and commercial barriers be assessed, and certification protocols to strengthen the competitiveness of the Brazilian bioeconomy be reviewed. Another avenue for enhancing bioeconomy participation in markets is to seek standard metrics for the life cycle of products and propose regulatory harmonization, ensuring legal certainty and access to international markets.

4. BRAZILIAN CONTRIBUTION TO THE DISCUSSIONS ABOUT THE BIOECONOMY WITHIN THE G20

Bioeconomy can be characterized as a plural field encompassing diverse sectors, chains, and actors. It offers a space for convergence in the search for solutions to global challenges, such as climate emergency, biodiversity loss, pollution, and rising social inequality. Given these issues, how can we respond effectively, generating real contributions to the environmental, social, and economic spheres?

Exploring specific themes reveals various responses to this question. For instance, sociobiodiversity and restoration value chains focus on conservation, sustainable use, and ecosystem restoration, promoting biodiversity maintenance and the resilience of biomes. In contrast, the bioenergy and biofuels sectors present alternatives for energy transition, significantly contributing to the replacement of fossil fuels— a priority for mitigating climate crisis —while generating positive social impacts in job and income development.

For Brazil and other biodiversity-rich countries, bioeconomy holds particular relevance by creating opportunities to add value to biodiversity conservation and sustainable use and the derived environmental services. Special attention has been given to the importance of “sociobiodiversity of standing healthy forests,” incorporating the perspectives of IPLC and their roles in protecting, regenerating, and sustainably using biodiversity. There is also significant potential related to the technological development of innovative products, processes, and services, as well as to regenerative and low-carbon agriculture and livestock, biofuel generation, and biomass utilization for gas and electricity production.

However, advancing the bioeconomy presents challenges at both national and international levels. In order to contribute to sustainability, bioeconomy in the countries should:

1. Contribute to prosperity by generating jobs and income while considering social equity and gender issues.
2. Be environmentally sustainable, respect ecosystem limits, maintain biodiversity, and achieve climate goals.

3. Avoid negative impacts on international trade. Harmonizing legislation and eliminating non-tariff barriers that create imbalances in global trade is essential.
4. Implement innovative financing mechanisms to foster technological development, create new products and businesses, and enhance the value of environmental services generated by bioeconomy.
5. Support technology transfer, adequate financing, and investments in innovation, research, and capacity building.
6. Strengthen and guarantee the rights of Indigenous Peoples, Traditional Peoples, and Communities to their territories and livelihoods.
7. Share the benefits derived from the sustainable use of biodiversity and associated traditional knowledge fairly and equitably.
8. Incorporate ecosystem services into decision-making processes and bioeconomy strategies, enhancing bioeconomic activities' economic viability and competitiveness.

In the development process of bioeconomy, the contributions presented in this consultation with Brazilian society are expected to complement the efforts of the G20 Bioeconomy Initiative. In addressing the challenge of developing internationally recognized principles for bioeconomy, Brazil's contributions point to cross-cutting pathways that can positively impact various sectors of the country.

5. FINAL RESULTS OF THE G20 INITIATIVE ON BIOECONOMY

Along 2024 the Presidency of the G20, led by the Ministry of Foreign Affairs supported by the Ministries of the Environment, Finance, Science and Technology and Industry, coordinated a series of four meetings and negotiations of the G20 Initiative on Bioeconomy which resulted in the successful approval by the G20 member countries of a set of High-Level Principles for Bioeconomy. The approved text reads as follows:

“Recognizing the remarkable potential of bioeconomy to contribute to building a sustainable future and fostering economic growth for all, the G20 Initiative on Bioeconomy (GIB) has initiated the international debate on this innovative, complementary productive paradigm. Its members have decided on ten voluntary, non-binding High-Level Principles on Bioeconomy, according to which bioeconomy activities are expected to:

- 1. Integrate and promote **sustainable development** across its economic, social and environmental dimensions, contribute to eradicating **hunger and poverty** and improving health and well-being, whilst ensuring global **food security and nutrition**.*
- 2. Be **inclusive and equitable**, uphold the rights of all persons, including Indigenous Peoples and members of local communities, promote gender equality and the participation of all stakeholders.*
- 3. Advance **mitigation and adaptation efforts against global climate change**, in line with applicable multilateral climate agreements.*
- 4. Contribute to the conservation of **biodiversity**, the sustainable use of its components and the fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge, subject to national laws and in line with applicable international agreements and instruments.*
- 5. Advance **sustainable consumption and production** patterns and the efficient and circular use of biological resources, whilst promoting the **restoration and regeneration of degraded areas and ecosystems**.*

6. Be developed through safe, secure and responsible use of **science, technology, innovation and traditional knowledge**, with potential benefits, risks and impacts assessed scientifically.
7. Benefit from **robust and coherent policy frameworks** that foster trade for bioeconomy products and services, market conditions, sustainable business models, decent jobs, local value creation and private sector and civil society participation.
8. Utilize transparent, comparable, measurable, inclusive, science-based and context-specific **criteria and methodologies** to assess their sustainability throughout the value chains.
9. Be fostered by **international collaboration and cooperation** that addresses global challenges, leverages complementary strengths, innovation and entrepreneurship and promotes financing, capacity building and sharing of best practices.
10. Be based on **country-specific** approaches and implemented in line with national priorities and regional and local circumstances.

* The applicable multilateral climate agreements referred to in Principle 3 include, but are not limited to, the Paris Agreement. The applicable international agreements and instruments referred to in Principle 4 include, but are not limited to, the Kunming-Montreal Global Biodiversity Framework (KMGBF).”

6. REFERENCES

IACGB, 2020a. Expanding the Sustainable Bioeconomy – *Vision and Way Forward. Communiqué of the Global Bioeconomy Summit 2020*, Berlin: International Advisory Council on Global Bioeconomy.

IACGB (2020b). *Global Bioeconomy Policy Report (IV). A decade of bioeconomy policy development around the world*. International Advisory Council on Global Bioeconomy.

IACGB (2024). **Bioeconomy globalization. Recent trends and drivers of national programs and policies**. Berlin: International Advisory Council on Global Bioeconomy.

ABDELNUR, Patrícia Verardi. **O papel da bioeconomia na transição energética**. 2024. Apresentação de slides. Realizada no segundo seminário preparatório Pesquisa, Desenvolvimento e Inovação para a Bioeconomia, em Brasília, dia 29 de fevereiro de 2024.

BARBOSA, Márcia Cristina B. **Iniciativa do G20 em bioeconomia: bioeconomia como propulsora do desenvolvimento sustentável**. 2024. Apresentação de slides. Realizada no 3º seminário preparatório. Brasília, 18 de março de 2024.

BOLZANI, Vanderlan S. **Pesquisa, desenvolvimento e inovação para a bioeconomia**. 2024. Apresentação de slides. Realizada no segundo seminário preparatório: Pesquisa, Desenvolvimento e Inovação para a Bioeconomia. Brasília, 29 de fevereiro de 2024.

BRASIL. Ministério do Desenvolvimento Agrário, Ministério do Meio Ambiente e Ministério do Desenvolvimento Social e Combate a Fome (2009). Plano Nacional de Promoção das Cadeias de Produtos da Sociobiodiversidade. Brasília.

BRASIL. Ministério da Fazenda. **Plano de Transformação Ecológica e a bioeconomia: desenvolvimento inclusivo e sustentável frente à crise climática**. 2024. Apresentação de slides. Realizada no terceiro seminário preparatório: Bioeconomia como propulsora do desenvolvimento sustentável. Brasília, 18 de março de 2024.

BUSTAMANTE, M. (2024). **Interfaces entre a bioeconomia e serviços ecossistêmicos**. 2024. Apresentação de slides. Realizada no segundo seminário preparatório Pesquisa, Desenvolvimento e Inovação para a Bioeconomia. Brasília, 29 de fevereiro de 2024.

COUTO E SILVA, E. (2024). **Perspectivas da bioeconomia no G20 e no Brasil**. 2024. Apresentação de slides. Realizada no segundo seminário preparatório Pesquisa, Desenvolvimento e Inovação para a Bioeconomia. Brasília, 29 de fevereiro de 2024.

MINISTÉRIO DO MEIO AMBIENTE (no prelo). O Estado da Bioeconomia no Brasil. Ministério do Meio Ambiente, Brasília.

NATURE FINANCE. FGV/EAS. **Global bioeconomy: preliminary stocktake of G20 strategies and practices – white paper**. 2024. Apresentação de slides. Realizada no terceiro seminário preparatório: Bioeconomia como propulsora do desenvolvimento sustentável. Brasília, 18 de março de 2024.

SEEHUSEN, Susan Edda. **Sistematização de Resultados - Seminários Preparatórios para a Iniciativa do G20 em Bioeconomia**, 2024. Apresentação de slides. Realizada no terceiro seminário preparatório: Bioeconomia como propulsora do desenvolvimento sustentável. Brasília, 18 de março de 2024.

