National bioeconomy policies and strategies in

Brazil, Colombia, Costa Rica and Peru

Opportunities and challenges for developing the bioeconomy sector in Colombia.

Study conducted by: Latimpacto

With the support of: argidius BY PORTICUS

Credits:

Research and Authorship
Leidy Caterin Riveros

Study Coordination
Manuela Jiménez

Contributors
Catalina Herrera y Juan David Ferreira

Editing
Bernardo González (AZOMA)

Design Lead
Xiomara Ocampo

Design and Layout
Ashlim Brito

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01 Introduction

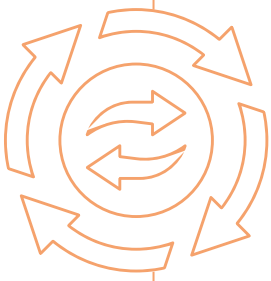
In recent decades, the conventional economic model characterized by a high dependence on fossil resources has demonstrated its environmental, social and economic limitations. The intensification of pressure on ecosystems, the progressive depletion of non-renewable natural resources, the impacts of climate change and the challenge of ensuring food security in the face of sustained global population growth have highlighted the need to move towards more sustainable and resilient development paradigms (Foster & Elzinga, 2015).

The bioeconomy has emerged within this framework as a comprehensive strategy aimed at decoupling economic growth from environmental degradation while simultaneously promoting technological innovation, food security, climate change mitigation and ecosystem restoration.

In 2015, the first World Bioeconomy Summit was held in Berlin, Germany with 700 participants from around 80 countries, including government representatives, scientists, entrepreneurs and members of civil society. This global meeting had the objective of defining how the bioeconomy can contribute to green growth, the Sustainable Development Goals and climate change mitigation. The World Bioeconomy Summit has since been held every two years, becoming the main international forum to discuss emerging opportunities and challenges for the bioeconomy (ECLAC, 2015).

At the global level, several regions have adopted bioeconomy strategies as part of their sustainable development policies. The European Union has been a pioneer in establishing regulatory and institutional frameworks, primarily its Bioeconomy Strategy (European Union, 2018) that seeks to maximize the use of renewable biological resources and promote technological innovation. Countries such as Germany, Finland and France have implemented national roadmaps that prioritize research, sustainability and competitiveness. Agro-industrial powers such as the United States and Canada have promoted investments in bioproducts and bioenergy, while Asia and Africa are making progress with strategies that have been adapted to their productive and socioecological contexts (Rodríguez, 2017).

Latin America is no exception, given that the bioeconomy has gained relevance in the region as a tool for promoting sustainable development, social inclusion and productive diversification. Countries such as Brazil, Argentina, Colombia, Uruguay and Costa Rica have formulated national or sectoral strategies for the bioeconomy that are designed to take advantage of their high levels of biodiversity, agricultural capacity and biomass potential. Regional organizations such as the Economic Commission for Latin America and the Caribbean (ECLAC), the Inter-American Development Bank (IDB) and the United Nations Food and Agriculture Organization (FAO) have promoted cooperation frameworks and conducted diagnostic studies to support the integration of the bioeconomy into public policies. These entities have highlighted the bioeconomy's capacity to generate employment, add value and strengthen environmental resilience in the region (ECLAC, 2020).



Against this backdrop, Latimpacto[1] conducted a comparative study of national bioeconomy policies and strategies in Brazil, Colombia, Costa Rica and Peru with the goal of identifying good practices, opportunities for improvement and transferable elements that can contribute to strengthening the bioeconomy agenda in Colombia.

This report is divided into five chapters, the first of which is this introduction. Chapter 2 provides a contextual review of the national initiatives in the four countries selected for this study while also examining some complementary policies associated with the bioeconomy. Chapter 3 assesses these policies in relation to eight enabling elements in order to identify whether these countries are facilitating or restricting the development of the bioeconomy. Chapter 4 presents challenges and opportunities for the four countries that were identified during this exercise and contains recommendations for developing the bioeconomy in Colombia based on successful experiences and strategies. Finally, Chapter 5 summarizes the current level of progress with the policy framework for the bioeconomy in each country while also including a number of suggestions for strengthening the agenda for this sector in Colombia.

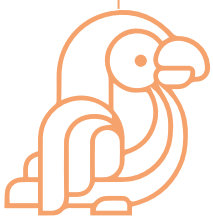
[1] Peer-to-peer network in Latin America and the Caribbean that facilitates collaboration, learning opportunities and connection between actors that deploy resources for impact in the region.

02 National bioeconomy policies and strategies in four Latin American countries

This chapter reviews national bioeconomy policies and strategies in the four countries selected for the study: Brazil, Colombia, Costa Rica and Peru. This analysis involved a documentary review of the most relevant policy frameworks in each country and had the objective of identifying each country's approaches, strategic objectives, areas of action, implementation mechanisms and governance schemes. An evaluation of the stage of development and institutional maturity of each strategy was carried out, as well as identifying both distinct and shared elements in the regional bioeconomy panorama.

2.1. Brazil

Brazil is the most biodiverse country in the world due to its vast size of more than 8.5 million km² and the diversity of its climates that range from humid tropical to semi-arid. The country is home to six main biomes: Amazon, Atlantic Forest, Cerrado, Caatinga, Pantanal and Pampa, each with unique characteristics and endemic species (Ministério das Relações Exteriores, 2022). However, it is the Amazon that dominates Brazil, occupying about 60% of its continental territory and holding a significant climatic and biodiversity role at the global level (Thompson, I., 2021).



With the world's largest tropical rainforest, Brazil also faces severe conservation challenges. Deforestation and climate change threaten biodiversity and natural resources, which between 2001 and 2020 led to the loss of approximately 10.76% of the country's old-growth forests (Weisse, M., Goldman, L., Carter, S., 2023). These phenomena also impact the communities that inhabit these areas, leading to losses of their culture and ancestral knowledge. For this reason, Brazil has implemented a number of projects focused on forest and environmental recovery[2]. In recent years, structural policies like the National Bioeconomy Strategy have been implemented that incorporate a social and economic approach designed to empower local communities through the protection, conservation and sustainable use of the Amazon's biodiverse resources.

[2] *National Biodiversity Strategy and Action Plans (NBSAP) 2017, National Plan for the Recovery of Native Vegetation (Planaveg) 2024, among others.*

2.1.1. National bioeconomy policy or strategy

Although Brazil is one of the countries in the region that has made the most progress with developing its bioeconomy[3], it wasn't until 2024 that this was formalized through Decree No. 12044, which created the National Bioeconomy Strategy. This Decree establishes a legal framework for the coordination and implementation of public policy aimed at developing the bioeconomy. It establishes objectives, cross-cutting components, a governance structure and a formal definition of bioeconomy in articulation with civil society and the private sector. The definition adopted in the Decree describes the bioeconomy as:

> *"A productive and economic development model based on values of justice, ethics and inclusion, capable of efficiently generating products, processes and services that are focused on the sustainable use, regeneration and conservation of biodiversity and guided by scientific and traditional knowledge along with relevant innovations and technologies. The goal of this model is to add value and generate employment, income, sustainability and climate balance."*
>
> *(Presidency of the Republic of Brazil, 2024, Article 2)*

This strategy highlights Brazil's focus on the concept of sociobiodiversity, which describes the interdependence between biological diversity and sociocultural systems. The products generated through this approach include goods and services derived from biodiversity that are integrated into production chains involving indigenous peoples, traditional communities and small-scale farming families. The sociobiodiversity approach values traditional knowledge, promotes territorial rights, generates income and contributes to improving quality of life and environmental sustainability (The Nature Conservancy - TNC Brazil, IDB & Natura, 2021).

The National Bioeconomy Strategy is led by the National Bioeconomy Commission (CNBio), an entity with representatives from the Ministry of Environment and Climate Change, the Ministry of Development, Industry, Trade and Services and the Ministry of Finance. To ensure balanced governance, this body is governed by a presidency that rotates between the three ministries. It also has a parity structure, with the Commission consisting of 17 representatives from the federal government and 17 representatives from civil society. A notable member of the Commission is the Brazilian Banking Federation (FEBRABAN), which plays a strategic role in the design and implementation of financing mechanisms for the development of the bioeconomy (Saab, 2025).

[3] For example, it already has the Bioeconomy Science, Technology and Innovation Action Plan, the National Biotechnology Policy and the Bioeconomy Brazil Sociobiodiversity Program.

This strategy will be delivered through the National Bioeconomy Development Plan (PNDBio). Its implementation is currently being coordinated by the National Bioeconomy Commission. The Commission established three thematic Working Groups (WGs) during its inaugural session, with each focused on a strategic area: Biomass, coordinated by the Ministry of Agriculture and Livestock; Bioindustry and Biomanufacturing, led by the Ministry of Development, Industry, Trade and Services; and Terrestrial and Aquatic Ecosystems and Sociobioeconomy, which is under the supervision of the Ministry of Environment and Climate Change (see Graphic 1). These groups have the responsibility of designing specific policies, validating strategic missions and analyzing recommendations from public consultations as part of an effort to foster the transition to a more sustainable economy (Saab, 2025).

Graphic 1. Thematic Working Groups (WGs) of the National Bioeconomy Commission

Source: Own elaboration based on Saab, 2025.

This plan, which is expected to be launched at the end of 2025, consists of at least five fundamental thematic axes: 1) public and private financial instruments; 2) policy, regulatory and fiscal frameworks; 3) data, information and knowledge management; 4) infrastructure, sustainable production systems, markets and value chains; and 5) professional education, research, science, technology and innovation. The Plan's implementation will be technically and operationally supported by the National Bioeconomy Information and Knowledge System, which is an integrated platform that consolidates relevant data and knowledge in order to promote the development of this emerging sector.

This strategy will be implemented in coordination with Brazil's states, municipalities, the Federal District, civil society organizations and private entities, so that each state has the autonomy to design and implement its own bioeconomy strategy. The National Strategy will function as a guiding document that outlines what the country wants to achieve for the bioeconomy, which will contribute to increased effectiveness and efficiency in related public policies. The state of Pará has been the first to make an early commitment to the bioeconomy, acting as a key player in the production and export of socio-biodiversity products, as evidenced in the following section.

2.1.2. Regional bioeconomy policies and strategies

2.1.2.1. State of Pará

Pará is located in the northern region of Brazil and has a total area of approximately 1.25 million km², making it the second largest Brazilian state. It is home to important ecological systems including the Marajó Archipelago and is part of the Amazon biome with high levels of biodiversity and forest cover (The Nature Conservancy - TNC Brazil, IDB & Natura, 2021).

Pará is also a leader in the production and export of socio-biodiversity products such as açaí, andiroba and bacaba, among others (The Nature Conservancy - TNC Brazil, IDB & Natura, 2021b). These products are fundamental components of the local economy and contribute to the conservation of Amazonian biodiversity.

Recognizing its natural wealth and the strategic role it can play in the fight against climate change, the state of Pará formulated its own State Bioeconomy Strategy through Decree No. 1943 of 2021. The objective of this strategy is to establish the necessary guidelines and elements that will promote an economic transition towards models with low greenhouse gas emissions that are resilient to the impacts of climate change. This strategy also seeks to generate social, environmental and economic benefits that contribute to overcoming poverty through promoting the sociobioeconomy.

The Pará State Bioeconomy Plan (PlanBio Pará) was designed to achieve these goals and is structured into three thematic areas. The first, Research, Development and Innovation, supports the generation of scientific and technological knowledge that will lead to innovative and sustainable solutions for addressing the challenges faced by the bioeconomy. The second thematic area, Genetic Heritage, Associated Traditional Knowledge and Production Chains, aims to recognize and value ancestral cultures and local communities' knowledge, integrating them into sustainable production systems. Finally, the Sustainable Business thematic area is focused on promoting the creation and consolidation of entrepreneurial initiatives that combine economic growth with environmental conservation.

These three thematic areas are reflected in the biggest value chains in the state of Pará. These include cacao, Brazil nuts, heart of palm, rubber, copoazú and açaí, with Pará being the biggest producer of açaí berries in the world (Secretaria de Estado de Meio Ambiente e Sustentabilidade - SEMAS, 2022). These value chains, primarily developed through small-scale and

family-based agroforestry systems, generate income comparable to livestock farming in the region, with local added value estimated at BRL 4.24 billion in 2019 (approximately USD 1.077 billion[4]). In addition to their economic impact, these industries contribute to forest conservation and the provision of ecosystem services, positioning themselves as a sustainable alternative with high employment potential that generate more than 224,000 associated jobs (The Nature Conservancy - TNC Brazil, IDB & Natura, 2021).

The PlanBio also incorporates four crosscutting components for its implementation. The first, Infrastructure and Logistics, seeks to overcome existing limitations in accordance with the state's vision of sustainable development. The second, Financing, proposes economic and financial instruments designed to boost the bioeconomy. The third, Safeguards, establishes mechanisms to manage risks and guarantee responsible implementation that take into account socio-environmental and gender aspects while seeking equitable access to resources. Finally, the Governance crosscutting component functions at both strategic and executive levels, defining the framework for coordination and follow-up while integrating public, private, academic and civil society actors.

It is important to note that by 2024, Pará State's Bioeconomy Strategy has achieved the implementation of more than 50% of the 92 actions in its strategic roadmap, reaching more than 67,000 direct beneficiaries and supporting the growth of 275 sustainable-based enterprises. During this period, 12 Marketplace events have been held to promote Amazonian bioproducts, which has developed more inclusive marketing circuits. Public investment of more than R$34 million has strengthened production chains linked to socio-biodiversity. This strategy is aligned with the Pará State Climate Change Policy and is also part of the Amazon Now Plan, which contains specific climate goals to achieve a reduction in greenhouse gas emissions of 37% by 2030 and 43% by 2035 in accordance with the state's international commitments (SEMAS, 2024).

[4] The average BRL/USD exchange rate was $0.254 per reais on December 31, 2019. Retrieved from https://www.exchange-rates.org/exchange-rate-history/brl-usd-2019-12-31

2.1.2.2. Campinas

Another major initiative in the field of bioeconomy at the subnational level is Agropolo Campinas-Brazil, a collaborative platform between public institutions and private companies based in Campinas municipality. The objective of this platform is to promote technological innovation for the tropical bioeconomy and increase the added value of national products. Inspired by Agropolis International (France), in 2016 this platform conducted a study of strategic sectors that included agriculture, health, food, green chemistry and bioenergy. This research informed the design of a tropical bioeconomy roadmap with support from the São Paulo State Research Support Foundation (FAPESP).

The "Public Policies in Tropical Bioeconomy" (PPPBio) project emerged from this platform with the goal of building a strategic vision for the development of the bioeconomy. Through a series of technical meetings with specialists from different disciplines, the project identified bottlenecks in key production chains and proposed interdisciplinary solutions aimed at generating final products with high levels of added value. This initiative addressed priority issues for the tropical bioeconomy such as waste management, precision agriculture, essential oils, sustainable animal production, efficient water use, new coffee and citrus industries, functional ingredients, sustainable packaging, processing technologies, biofuels and industrial enzymes.

PPPBio identified systemic limitations that impede progress with the bioeconomy and developed short, medium and long term public policy recommendations. These recommendations cover strategic areas such as science, technology and innovation, education and professional training, technology transfer, financing, regulatory frameworks and international cooperation, constituting a comprehensive foundation for the promotion of the tropical bioeconomy in Brazil (Agropolo Campinas-Brazil, 2021).

It is important to note that Agropolo Campinas is led by an Administrative Council consisting of municipal and university leaders. The Council is chaired by the Mayor of Campinas and the President of the State University of Campinas (UNICAMP) who are responsible for working with all stakeholders, including the Agronomic Institute of Campinas (IAC), UNICAMP, the Institute of Food Technology (ITAL), the Prefecture of Campinas, Technopark Campinas and the French Consulate in São Paulo. The Council is also responsible for obtaining the necessary tools to provide knowledge and technology-based solutions that meet needs and address opportunities for improving bioeconomic projects.

2.1.3. Other policies related to the bioeconomy

Although the National Bioeconomy Strategy is not the only policy focused on issues such as climate change, deforestation, sustainable production chains, biotechnology and Industry 4.0, it is a strategic framework that works across all of these areas. Its main role is to articulate and integrate existing bioeconomy initiatives[5], serving as a platform that links state, economic, academic and civil society actors. The National Bioeconomy Strategy guides coordinated actions towards a common goal: the development of a sustainable, inclusive and innovative national bioeconomy.

One of Brazil's most relevant policies for the bioeconomy is the National Biotechnology Policy, a government strategy designed to promote scientific, technological and economic development in the field of biotechnology. This covers sectors such as health, agriculture, environment and industry. Its greatest achievement has been the creation of the National Biosafety Council (CNBS) and the restructuring of the National Biosafety Technical Commission (CTNBio), which regulates activities involving genetically modified organisms (GMOs), ensuring safety in their development and use. The main objectives of this policy are to encourage biotechnological research and development, promote innovation in key sectors such as health, agriculture and the environment, ensure biosafety in the handling of genetically modified organisms and strengthen infrastructure and human resources in the biotechnology sector (Presidency of the Republic of Brazil, 2007).

Another key policy and precursor of the bioeconomy in Brazil is the Bioeconomy Brazil - Sociobiodiversity Program. This is a government initiative that aims to promote the sustainable use of biodiversity, generate income for rural and traditional communities and conserve the country's ecosystems. It is coordinated by the Ministry of Agriculture, Livestock and Supply (MAPA) and receives support from other government agencies. The program is structured into different thematic areas: sustainable production and extraction; strengthening of industrial processes; access to markets; social and productive organization; and the valorization of traditional knowledge (Ministério de Agricultura, Pecuária e Abastecimento (MAPA), 2019).

[5] Law on Access to Genetic Resources and Traditional Knowledge (Law No. 13.123/2015); National Policy on Genetic Resources for Agriculture (PNRGA) (Decree No. 8.772/2016); National Biotechnology Policy (PNB) (Decree No. 6.041/2007); National Policy on Climate Change (Law No. 12,187/2009), among others.

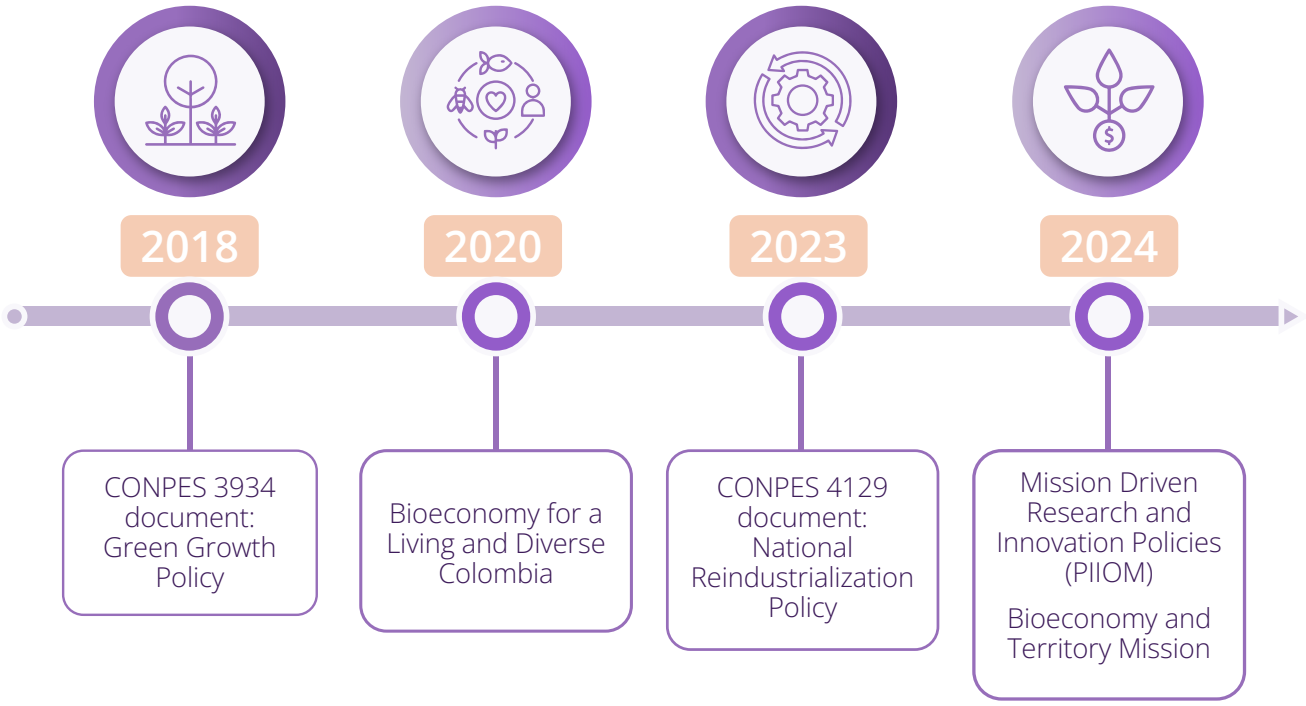
2.2. Colombia

Colombia is the fourth most biodiverse country in the world[6]. It ranks first in biodiversity for birds, orchids and butterflies; second in amphibians, freshwater fish, palms and bats; and third in plants. Its biological richness is particularly concentrated in the Andean and Amazon regions. It also has unique ecosystems like the páramos, with more square kilometers of these biomes than anywhere else in the world. This biodiversity includes more than 80,000 registered species with a high number of endemic species and critical ecosystems that require conservation. This means that Colombia has enormous natural capital for its bioeconomy (SiB Colombia, 2024).

2.2.1. National bioeconomy policy or strategy

Since 2018, Colombia has created a number of policy documents in relation to the bioeconomy. All of these seek to establish this sector as a strategic axis for the country's sustainable development and productive transformation. Below is a timeline for the four national policies that were identified as part of this study, as well as their most important elements.

Graphic 2. Timeline of Colombia's national bioeconomy policies.



Source: Own elaboration

[6] *The three most biodiverse countries in the world are: Brazil, Indonesia and China.*

CONPES Document 3934 - Green Growth Policy.

This was the first policy instrument in Colombia to incorporate the concept of bioeconomy, defining it as an

> *"economy that efficiently and sustainably manages biodiversity and biomass to generate new products, processes and value-added services based on knowledge and innovation"*
>
> *(Biointropic, 2018)*

The inclusion of the concept in this document is relevant, given that the bioeconomy facilitates the transition to green growth and improves interrelationships between natural capital, economic production and population.

In order to generate conditions that promote new economic opportunities based on the use of natural capital by 2030, this CONPES document[7] proposes five strategies for the bioeconomy: 1) Define a governance scheme that coordinates strategies and actions for the bioeconomy[8]; 2) Strengthen Research, Development and Innovation (R&D&I) capacities in the bioeconomy and facilitate collaboration and transfer of knowledge and technologies[9]; 3) leverage economic resources from public and private sectors to promote the bioeconomy in Colombia[10]; 4) grow the bioproducts market and improve competitiveness in sectors related to the bioeconomy[11]; and 5) develop appropriate regulations to promote the bioeconomy[12].

The public institutions and agencies that are responsible for implementing this policy include: the National Planning Department (DNP); Ministry of Science, Technology and Innovation (MinCiencias); the Ministry of Environment and Sustainable Development (MinAmbiente); the Ministry of Commerce, Industry and Tourism (MinComercio); the Ministry of Agriculture and Rural Development (MinAgriculture); and the National Department of Statistics (DANE).

[7] A CONPES document is a public policy instrument prepared and approved by the National Council for Economic and Social Policy (CONPES), a public entity that advises the Colombian government on all aspects related to the country's economic and social development. These documents contain guidelines and specific actions on the economic, social and environmental issues required to achieve the objectives established in a policy (Oficina Asesora Jurídica del Departamento Nacional de Planeación, n.d.).
[8] This area is focused on consolidating the institutional framework that enables coordination and collaboration between relevant actors and ensures effective leadership to promote the development of the bioeconomy.
[9] The objective of this area is to increase scientific and technological knowledge and innovation while promoting the generation of value-added products, processes and services in the bioeconomy.
[10] The main purpose of this area is to mobilize and secure the financing required to support initiatives and projects that contribute to the growth and consolidation of the bioeconomy in the country.
[11] The objective of this area is to promote the supply and demand of products and services produced by the bioeconomy, seeking to improve their positioning and competitive capacity at national and international levels.
[12] The central focus of this area is to create a favorable and efficient regulatory environment that facilitates the implementation of activities related to the bioeconomy, eliminating barriers and promoting legal certainty.

Bioeconomy Mission for a Living and Diverse Colombia: Towards a knowledge-driven society:

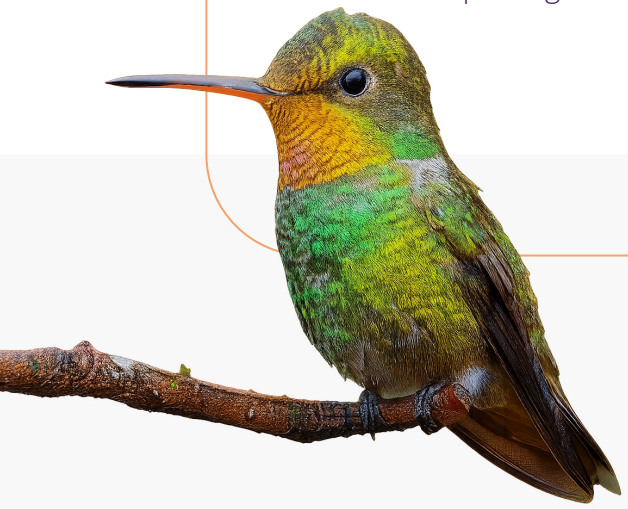
This policy envisions Colombia in 2030 as

> *"an innovative and competitive country that is globally recognized for the intelligent, circular and sustainable use of its megabiodiversity, ecosystem services and biomass"*

To achieve this vision, the country proposes that

> *"the bioeconomy is consolidated as a development engine with a territorial approach, [...] that enables growth, diversification, sophistication and decarbonization of the economy, social equity, environmental protection and mitigation and adaptation to climate change"*
>
> *(Government of Colombia, 2020, p.20).*

In accordance with the definition established in CONPES 3934, this Bioeconomy Mission focuses on five strategic areas and challenges: 1) biodiversity and its ecosystem services, designed to take advantage of continental and oceanic biodiversity; 2) biointelligent Colombia, which understands and builds on the country's biodiversity; 3) productive and sustainable agriculture, which contributes to the construction of social fabric; 4) biomass and green chemistry, with the goal of using 100% biomass in these processes, generating added value and zero waste; and 5) health and well-being, with advanced technologies improving the health and well-being of Colombians.



In the framework of these strategic areas, the document identifies 20 potential products and processes where Colombia can generate added value. Categorizing these potential products using the sectors and subsectors defined by Grilli et al. (2024) shows that the country has comparative advantages in seven sectors: biodiversity and ecosystem services; sustainable and intensive agriculture; food and beverages; biofuels; industrial biotechnology; biomedicine; and biointelligence. This is shown in detail in Table 1.

Table 1. Potential bioeconomy sectors and subsectors in Colombia.

Sector	Biodiversity and ecosystemic services	Ecological engineering	Sustainable and intensive agriculture
Subsectors in Colombia – Bioeconomy Mission 2020	• Bioprospecting • Nature tourism • Payments for environmental services • Use and valorization of biodiversity • Bioactive compounds for cosmetics		• Agricultural inputs • New varieties • Sustainable agriculture and livestock • Clean production, conscious consumption and healthy foods
	Silviculture	**Food and beverages**	**Biofuels**
		• Natural and bioactive ingredients for food	• Sustainable bioenergy (bioenergy and biofuels)
	Industrial biotechnology	**Biomedicine**	**Biointelligence**
	• Biofactories • Biorefineries • Biological catalysts • Green chemistry	• Essential, biotechnological, biosimilar and phytotherapeutic medicines • Personalized medicine • Regenerative medicine • Precise nutrition • Advanced biotechnology for health at productive and commercial scale • Bioactives for the pharmaceutical industry	• Omics studies • Biointelligent data • Data science

Source: Own elaboration based on Government of Colombia (2020) and Grilli et al. (2024).

The document also establishes two key cross-cutting components to achieve the policy's objectives. The first is Governance, in which MinCiencias leads the Technical Committee on Sustainability and coordinates the actors responsible for the different strategic areas (MinAmbiente, MinAgriculture, MinHealth, MinComercio and MinEnergía). Departmental Science Councils, Regional Competitiveness Commissions, Innovation Centers and universities will also participate in this work, helping to promote a sustainable and competitive regional bioeconomy. The second component is Financing and Investment Incentives, which involves designing financial instruments and incentives that stimulate the development of the bioeconomy.

CONPES Document 4129 - National Reindustrialization Policy.

This policy was formulated by the Colombian State with the purpose of promoting the generation of added value in the production of goods and services. It is designed to facilitate the transition to an economy based on knowledge, productivity, sustainability and inclusion while reducing dependence on extractive activities, closing productivity gaps and promoting territorial development.

In the framework of this policy, the bioeconomy is positioned as a strategic area that will contribute to this new productive structure. The document includes specific actions that will build the technological, scientific and financial capacities required to make bioeconomy projects viable. Some examples of these projects include: the design of programs to promote enabling technologies such as gene editing; the creation of financing portfolios for small and medium-sized enterprises to support their modernization in terms of sustainability, circular economy, bioeconomy and/or climate change management; and the implementation of internationalization plans and projects to promote export linkages.

This policy also proposes diversifying the country's productive matrix and strengthening the bioeconomy's institutional framework. Diversification will be achieved through the design and implementation of 32 departmental agendas that are focused on the bioeconomy and Agriculture 4.0 (intelligent agriculture) with an emphasis on regenerative practices and the sustainable use of biomass. Institutional strengthening will also be promoted through the creation of a National Bioeconomy Observatory that will monitor progress and contribute to informed and strategic decision-making.

This CONPES document establishes a structure for institutional governance of the bioeconomy, with each public entity allocated a specific role based on its mission: The DNP is responsible for leading the design and implementation of the National Bioeconomy Observatory; Agrosavia and the Colombian Agricultural Institute (ICA) are in charge of the development and adoption of enabling technologies such as gene editing; the Rural Development Agency will lead the implementation of the departmental agendas; while the Ministries of Commerce, Environment and Culture will coordinate programs aimed at achieving sustainability and productive reindustrialization.

Mission-Oriented Research and Innovation Policies (PIIOM): Bioeconomy and Territory Mission

Giving continuity to what was established in CONPES 3934 of 2018 and the 2020 Bioeconomy Mission, this policy document covers actions until 2033 and aims to

> *"strengthen the development of value chains [innovation routes and pathways] based on the sustainable use of biodiversity and biomass in the Colombian territory."*

It establishes four specific objectives: 1) increase science, technology and innovation capacities at the national level for the development of bio-based products and services; 2) strengthen articulation between actors involved in the different links of the value chains for the generation of bio-based products or services; 3) increase the level of sophistication, positioning and diversification of the national market for bio-based products and services; and 4) increase the country's competitiveness so that products with high added value can be sold to international markets.

Because this policy was collectively designed and the actors who participated in this process emphasized the importance of establishing a conceptualization of bioeconomy that is adjusted to the specific contexts and needs of the country, this document presents a new definition:

> *"Economy that sustainably manages biodiversity and the biomass of continental, coastal and marine ecosystems for the production and fair trade of goods and services with high added value in all economic sectors based on the exchange of traditional and scientific knowledge as well as the implementation of science, technology and innovation activities that contribute to the development of the regions in accordance with local contexts and while responding to their needs."*
>
> *(p. 24).*

This shows that in the framework of this mission, the bioeconomy is a fundamental area for generating value beyond traditional economic models. Its purpose is to overcome the dominant economic vision that is solely focused on production and growth, instead seeking to promote the creation of markets that drive social development and contribute to reducing inequalities. This policy involves the implementation of strategies and programs that guarantee equitable access to opportunities generated by the bioeconomy while comprehensively addressing the causes and consequences of territorial, gender, ethnic and socioeconomic inequalities.

It is important to note that this Mission incorporates the five thematic areas selected for the "Bioeconomy for a Living and Diverse Colombia: towards a knowledge-driven society" program, establishing subsectors for public investment in the bioeconomy: biodiversity and ecosystem services; the use of biomass for chemistry and green energy; efficient and regenerative agriculture-food systems; and advanced health for human, animal and environmental wellbeing. Practical applications for these five subsectors include: science, technology and innovation applied to nature tourism, bioremediation, agricultural bioinputs, functional foods and beverages, biopolymers and biorefineries, cosmetics (natural and cosmeceutical) and phytomedicines. In accordance with the approach proposed by Grilli et al. (2024), the classification of these actions is detailed in Table 2.

Table 2. Prioritized bioeconomy subsectors and practical applications in Colombia

Sector	Biodiversity and ecosystemic services	Ecological engineering	Sustainable and intensive agriculture
Subsectors in Colombia	• Science, technology and innovation applied to nature tourism • Cosmetics (natural cosmetics and cosmeceutics)	Bioremediation	Agricultural bioinputs
	Silviculture	**Food and beverages**	**Biofuels**
		• Functional food and beverages	
	Industrial biotechnology	**Biomedicine**	**Biointelligence**
	• Biopolimers • Biorefineries	• Phytomedicines	

Source: Compiled by author based on Ministry of Science, Technology and Innovation (2024) and Grilli et al. (2024)

Finally, this Mission recognizes the importance of integrating traditional and ancestral knowledge from local communities to achieve the sustainable use of biodiversity. It proposes establishing a bridge between ancestral knowledge and bioeconomy initiatives, a relationship not based on exploitation but true integration. The Mission proposes that this knowledge should be documented with consent and guidance from the communities while respecting their cultural contexts.

2.2.2. Institutional commitment to the bioeconomy

In Colombia, a number of the scientific and technical research entities that form part of the National Environmental System (SINA) have been including bioeconomy actions in their Quadrennial Institutional Environmental Research Plans (PICIA). These include the Alexander von Humboldt Biological Resources Research Institute and the Amazonian Institute for Scientific Research (SINCHI).

In its 2023-2026 PICIA, the Humboldt Institute established "Bioeconomy / Biobased Business" as one of the six research and management missions it will carry out until 2030. This work aims to boost bio-based businesses and foster greater innovation and technological development in this sector. This mission plans to identify the critical factors that affect the performance of biobusinesses as well as the products and technologies that are essential for boosting prioritized value chains, especially when they are being constructed. This mission will also validate technological solutions that improve the competitiveness of biobusinesses while accelerating these entrepreneurial initiatives through innovative business models and technological development. The Humboldt Institute proposes a monitoring system that will track progress and measure the impact of these initiatives (Instituto de Investigación de Recursos Biológicos Alexander von Humboldt, 2023).

In its 2023-2026 PICIA titled *Science and knowledge for the transition of the Colombian Amazon towards sustainability,* the SINCHI Institute also prioritizes the bioeconomy. This plan outlines the implementation of bioeconomy agendas with local actors in the six departments that form the Colombian Amazon region and has the goal of developing goods and services that strengthen the biodiversity economy, particularly in the fields of biotechnology and bioprospecting. Research Line 4 is defined as: "Bioeconomy for productive, innovative and sustainable transformation in the Colombian Amazon", under the "Operations and Sustainability Models" program. Through this Research Line, the Institute aims to contribute to the development of sustainable value chains that draw on the region's biodiversity. The expected results are: generation of knowledge about the composition and potential use of Amazonian species; development of bio-based ingredients and products; design of equipment and energy solutions for the use of biodiversity species; and the implementation of bioeconomy agendas and consolidated value chains (Instituto Amazónico de Investigaciones Científicas - SINCHI, 2023).

These plans show that both the Humboldt Institute and the SINCHI Institute have understood their role within Colombia's vision of the bioeconomy until 2030. They have aligned their future work plans with science, technology and innovation so that they can contribute to the positioning of the bioeconomy as an engine for sustainable development and territorial conservation.

2.3. COSTA RICA

Costa Rica is characterized by diverse topography, a result of its location in the Central American Isthmus, which gives the country a remarkable ecological and geological richness. Costa Rica is crossed by two major mountain ranges that are home to several active volcanoes and a complex network of river basins. The combination of its altitudinal and latitudinal variations generates a broad range of climatic conditions, from humid tropical zones on the coasts to temperate climates in mountainous areas. This heterogeneity contributes to the existence of multiple ecosystems including tropical forests, mangroves and coral reefs, positioning the country among the most megadiverse on the planet (Piedra, L., Bermúdez, T., & Romero, M., 2013).

Costa Rica has excelled in environmental conservation through the implementation of policies and programs aimed at protecting its biodiversity. These initiatives form an extensive network of protected areas, including 32 national parks and biological reserves that cover approximately 20% of the country's land area. This approach has boosted the implementation of bioeconomy activities that contributed 13% of the national added value and were responsible for 17% of the total employment generated in the country in 2021 (Banco Central de Costa Rica -BCCR, 2024).

2.3.1. National bioeconomy policy or strategy

Following its participation in the 2015 and 2018 Global Bioeconomy Summits, Costa Rica launched its "2020-2030 National Bioeconomy Strategy" in 2020. This policy focuses on the production, use and conservation of biological resources to generate new products, services and processes through science, technology and innovation with the goal of moving towards a sustainable economy. The strategy is based on three guiding concepts that represent innovative approaches to productive development. The first is fossil decarbonization, which seeks to gradually replace the use of fossil resources with biological inputs through the development of biorefineries and bioenergy. The second is the circular bioeconomy, which involves the efficient use of resources, reducing the extraction of inputs and reusing materials that would traditionally be considered waste. Finally, the bioeconomy forms part of the country's vision for Industry 4.0, which promotes industrial production based on the integration of advanced digital, physical and biological technologies designed to improve the sustainability and competitiveness of production systems.

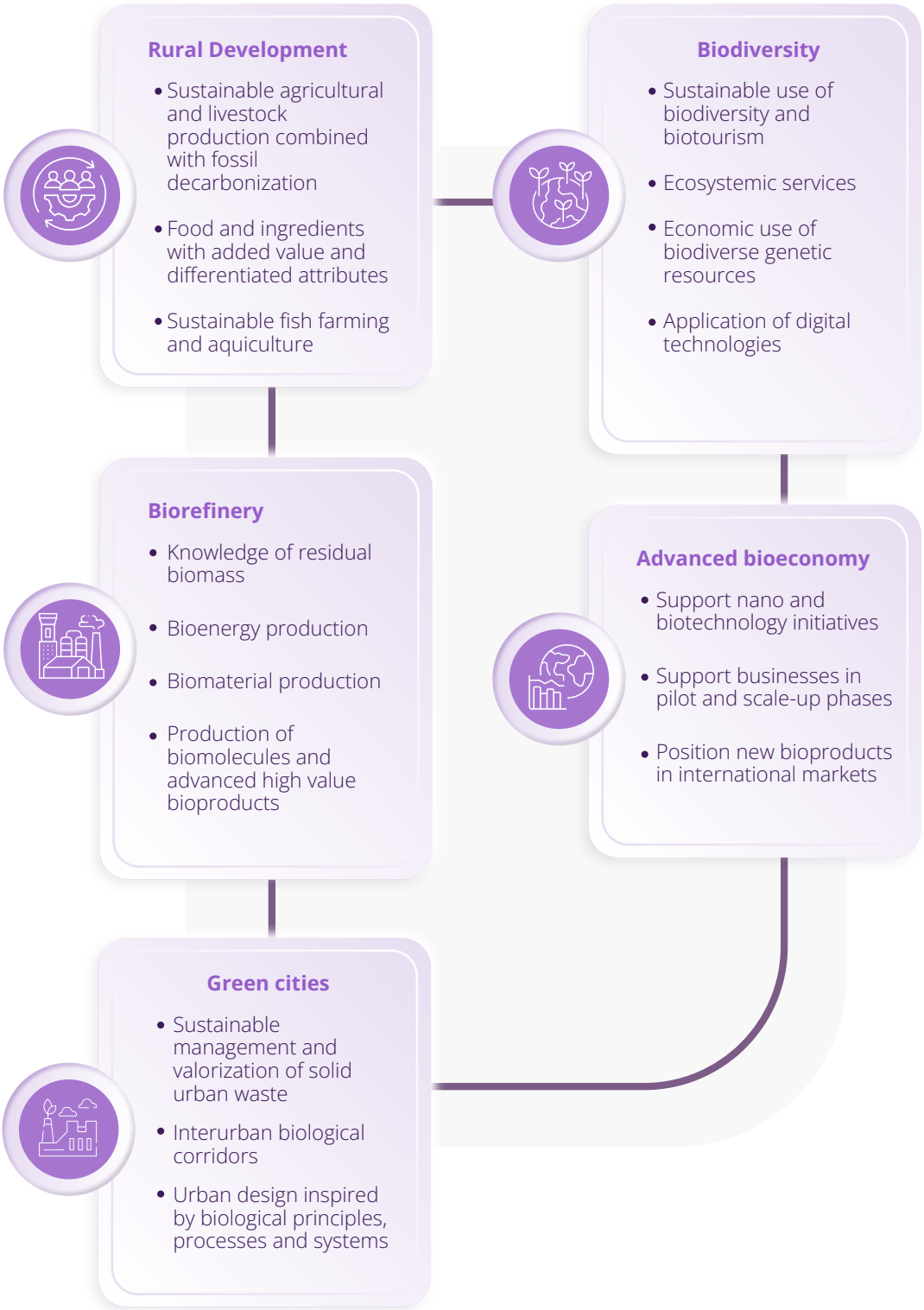
This strategy uses a holistic and long-term approach. Its vision is to consolidate the country as a reference point for sustainable production with high added value that has a presence in all regions and emerging biocities[13]. This vision requires the equitable and responsible use of national biodiversity, promoting the circular use of biomass and biotechnological progress, both of which are key elements in the transition to a knowledge-based society.

There are three strategic objectives in the strategy that seek to transform Costa Rica into a global model of sustainable development, consolidate the bioeconomy as an essential pillar in the country's productive transformation and promote synergies between national biological resources and local scientific capabilities. These actions will increase the adoption and application of the strategy in different productive sectors.

In order to achieve these objectives, the Bioeconomy Strategy is structured into five strategic areas. Bioeconomy for Rural Development promotes sustainability and the generation of added value in the territories. Biodiversity and Development focuses on the sustainable use of ecosystem services. Biorefinery of Residual Biomass involves the efficient use of biomass and bioenergy production. Advanced Bioeconomy promotes the development and application of biotechnologies. Finally, the Urban Bioeconomy and Green Cities strategic area proposes the design of urban environments inspired by biological principles with the goal of achieving sustainable cities that are more integrated with nature (see Graphic 3).

[13] *Emerging biocities are defined as cities that are moving towards a model that incorporates: i) the integration of production, supply, use and recycling systems that promote circular economy processes for materials and energy; ii) the minimization of emissions, waste and losses; iii) the integration of production, housing, leisure and service provision spaces; iv) the application of biological principles and the use of biological resources in the design and construction of buildings; and v) the development of biological corridors (Costa Rica, Ministry of Science, Technology and Telecommunications - MICITT, 2020).*

Graphic 3. Strategic areas and lines of action of the National Bioeconomy Strategy



Source: Own elaboration based on Costa Rica. Ministry of Science, Technology and Telecommunications MICITT (2020)

The strategy uses a sectoral approach with territorial integration and was promoted with support from the Ministry of National Planning and Economic Policy (Mideplan). Draft versions of the strategy were disseminated by the Regional Development Councils (Coredes) with the objective of raising awareness with local stakeholders and gathering information about specific needs and opportunities in each region. This approach has led to the identification of productive subsectors that have a high potential for developing the bioeconomy, as shown in Table 3.

Table 3 - Bioeconomy subsectors with development potential in Costa Rica

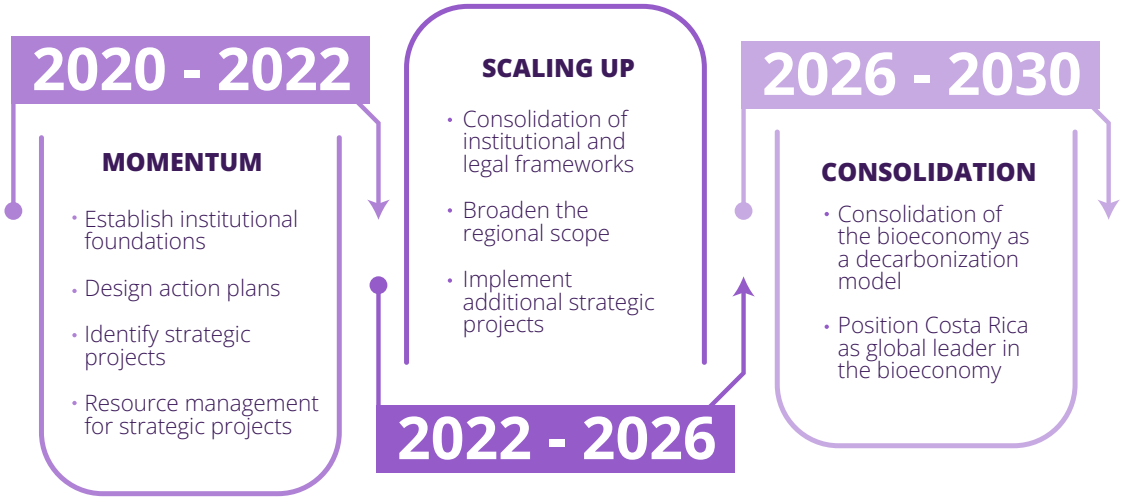
Sector	Biodiversity and ecosystemic services	Ecological engineering	Sustainable and intensive agriculture
Subsectors	• Bioprospecting • Cosmetics	Bioremediation	• Agroforestry • Precise agriculture • Biofertilizers and biopesticides • Sustainable fish farming and aquiculture
	Silviculture	**Food and beverages**	**Biocarburantes**
	• Silviculture with a bioenergy production approach	• Alternative food and protein production	• Biofuels • Bioethanol • Biodiesel • Biogas and biomethane • Second generation
	Industrial biotechnology	**Biomedicine**	**Biointelligence** / **Genetic engineering**
	• Industrial enzyme production • Production of biodegradable bioproducts and materials • Industrial fermentation for chemical production	• Biopharmaceutica	• Big data and AI applied to key sectors including health, agriculture, energy and industry • Genetic engineering to improve coffee crops

Source: Own elaboration based on Costa Rica. Ministry of Science, Technology and Telecommunications - MICITT (2020) and from Grilli et al. (2024).

Costa Rica's National Bioeconomy Strategy covers five cross-cutting areas: education and capacity building; research, development and innovation (R&D&I); financing and incentives[14]; access to markets; and communication with society. These enabling elements strengthen the country's bioeconomic ecosystem by promoting training, generating knowledge, contributing to the growth of innovative businesses through incentives, financing and attracting foreign investment, effective insertion in national and international markets and awareness raising about the economic, social and environmental benefits of the bioeconomy.

It is important to note that Costa Rica has different goals for the three phases of its strategy: Momentum (2020-2022), Scaling up (2022-2026) and Consolidation (2026-2030). The first phase seeks to establish a solid institutional base. The second focuses on expanding the adoption and implementation of regional action plans. Finally, the third phase aims to consolidate Costa Rica as a global reference point for the bioeconomy, prioritizing sustainability and decarbonization (see Graphic 4).

Graphic 4. Phases of the Goals of Costa Rica's Bioeconomy Strategy



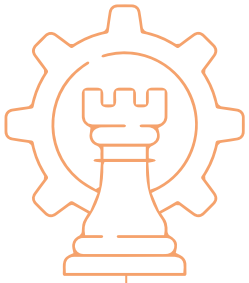
Source: Own elaboration based on Ministry of Science, Technology and Telecommunications MICITT (2020)

Finally, and in order to achieve its ambitious scope and goals, this strategy establishes a governance scheme at the national level that seeks to ensure an effective balance between sustainability and economic development. It proposes that the Ministry of Science, Innovation, Technology and Telecommunications (MICITT), in its role as coordinator and lead agency for the strategy, is responsible for establishing the Interministerial Bioeconomy Commission (CIB). This Commission is a technical space for the coordination of actions by the four ministries charged with implementing the strategy: the Ministry of Agriculture and Livestock (MAG), the Ministry of Economy, Industry and Commerce (MEIC), and the Ministry of Environment and Energy (MINAE). Its formation facilitates coordination with different sectoral directorates, as well as with representatives of academia, the business sector, public institutions, entrepreneurs and civil society at the regional level.

[15] *Examples of these financing sources include the ECLAC-BMZ/GIZ program led by ECLAC, the UNDP BIOFIN program, of which Costa Rica is a pioneer and promoter, the Incentive System for Research and Technological in Companies, the Propyme Fund, and the National Forestry Financing Fund (Fonafifo), among others.*

2.3.2. Other policies related to the bioeconomy

Although the National Bioeconomy Strategy is not the first national program that Costa Rica has developed in relation to decarbonization and biodiversity[15], it is the first to have a strong economic and technological focus. For Costa Rica, the bioeconomy is a strategic opportunity to achieve convergence between productive development policies and environmental policies implemented over the last seven decades. Although the country does not have a specific national bioeconomy law, Costa Rica has adopted an integrated approach for sustainability that is framed in numerous environmental laws such as the Executive Decree for the Regulation of Biodiversity, MINAE (34433 of 2008), biotechnology laws like the Law of Approval for the Cartagena Protocol on Biosafety (8537 of 2006) and energy laws such as the Regulation for Liquid Biofuels and their Mixtures, MINAE and MAG (Executive Decree 40050 of 2016), among others. These laws are aligned with the content of the country's bioeconomy strategy.



2.4. Peru

Peru is recognized as one of the 17 megadiverse countries on the planet that are home to more than 70% of the world's biodiversity. The country has 84 of the planet's 117 life zones and more than 73 million hectares of forests. The Peruvian Amazon represents a fundamental and extensive part of this heritage. Its lowland rainforest, known as the Omagua region, occupies 61% of Peru's continental surface with an enormous ecological importance. The country is also notable for being a global center for the origin and diversification of important genetic resources (Ministry of Environment, 2014).

However, the extraction and use of ecosystem services in Peru has not always been carried out in a sustainable manner. Examples include hydrocarbon exploitation in the Peruvian Amazon, given that this income has not necessarily been used to finance local development, as well as alluvial mining, which is generally illegal and has caused serious environmental impacts such as pollution and deforestation (Scientific Panel for the Amazon, 2021).

2.4.1. National bioeconomy policy / strategy

Peru is one of the countries in Latin America that does not yet have a national bioeconomy policy or strategy. However, since 2023 strategic activities have been carried out to support the bioeconomy in the medium term and in the framework of the National Roadmap for the Circular Economy (HdRNEC) until 2030. This is essential because the roadmap states that "by 2030 the circular

[15] *Programa Nacional de Biocombustibles (2008), Estrategia Nacional de Biodiversidad 2015-2025 (2015), Estrategia Nacional de Cambio Climático (2007), Estrategia Nacional REDD+ Costa Rica (2015), NAMA Café, NAMA ganadería.*

economy [will be] the engine of Peru's sustainable development through the implementation of circular, innovative, competitive and socially inclusive value chains in production and service sectors, as well as in strategic territories [...]" (Ministry of Environment, 2023, p. 13). The bioeconomy will create opportunities so that the country can generate added value for its natural capital while conserving its ecosystems.

Specifically, the HdRNEC indicates that the National Bioeconomy Strategy will cover:

> *"The production, utilization, conservation and regeneration of biological resources through the application of knowledge, science, technology and innovation with the objective of providing sustainable solutions (information, products, processes and services) in and for all economic sectors, facilitating the transformation towards a sustainable economy. The strategy will also cover the different sectors and systems that depend on biological resources, their functions and principles"*
>
> *(Ministry of Environment, 2023, p. 18)*

This text provides guidance for the conceptual construction of the bioeconomy in Peru, even though there is still no official definition. Participatory working groups have been planned to develop this policy (Del Águila, 2025).

The Ministry of Environment (MINAM), as well as the National Center for Strategic Planning (CEPLAN), are leading the formulation of this policy. Other important entities involved are the Ministry of Production (PRODUCE), the Ministry of Agrarian Development and Irrigation (MIDAGRI), the Ministry of Foreign Trade and Tourism (MINCETUR), local and regional governments, Andean and Amazonian communities and international cooperation.

Another of the strategic actions included in the Roadmap, which is related to the bioeconomy, is "strengthening product development plans and programs" (Ministry of Environment, 2023, p. 25). It is expected that the regional governments prioritized for the bioeconomy will design development plans that incorporate economic and social development through the commercialization of biodiversity products.

It is important to note that, in accordance with the above, Peru has been making efforts to promote the bioeconomy, especially in the Amazon region. An example of this is the creation of the Bioeconomy Working Group in 2024, which was formed by MINAM and the British Embassy. The purpose of this

initiative is to design and implement development strategies for eco-businesses[16] and biobusinesses[17] in the Peruvian Amazon, promoting the conservation of forests and sustainable economic growth (Inforegión Redacción, 2024). Thanks to this support, Peru has been able to exchange lessons learned with Brazil in order to understand this country's bioeconomy ecosystem with the goal of adapting good practices to its own context (Del Águila, 2025).

IDB has provided funding to strengthen biobusinesses in the country. Since 2020, Peru has been implementing three initiatives financed with resources from this multilateral bank:

Technical Assistance Fund - Program to Boost Private Investment Financing in the Peruvian Amazon - Opportunity to Leverage Biobusinesses (PE-T1456)[18]: This technical cooperation seeks to strengthen the biobusiness portfolio of Corporación Financiera de Desarrollo S.A. (COFIDE) in the Peruvian Amazon, working with business and technical advisory entities as well as accelerators, incubators and innovation centers.

Program to Boost Sustainable Financing in the Peruvian Amazon - Opportunity to Leverage Biobusinesses (Biobusiness Program) (PE-L1258) (PE-G1007)[19]: The purpose of this program is to "increase investment in biobusinesses in the region" (Inter-American Development Bank, 2022a) by offering a portfolio of innovative financial products that include associative credit mechanisms for anchor companies, medium-term credit for the expansion of product processing/procurement/distribution capacities, loan guarantees and factoring. Non-reimbursable resources are also provided to support smaller-scale and/or higher risk credit operations[20]. One of the most important technical results of this program has been the analysis of six value chains: permanent agriculture, aquaculture, agroforestry, non-timber forest products (NTFP), nature tourism and the provision of ecosystem services.

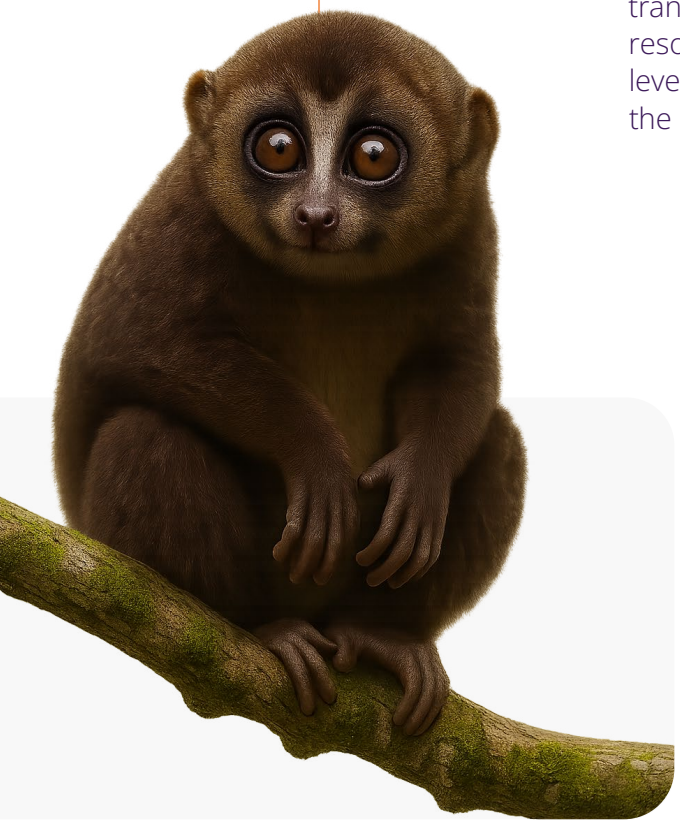
[16] Eco-businesses are defined as "businesses providing goods or services that contribute to the care of the environment [...] not just economic sustainability but also social and environmental sustainability with a fair distribution of benefits" (Ministry of Environment, 2020, p.12).
[17] Biobusinesses "are businesses based on the sustainable use of biodiversity products, taking into account environmental, social and economic sustainability criteria. Biobusinesses assume costs for the conservation of natural resources, the inclusion of communities and traditional knowledge in the generation of value and the dynamization of local economies. Biobusinesses can be grouped into three subcategories: ecotourism services, direct consumption products and products derived from flora and fauna" (Ministry of Environment, 2020, p.14).
[18] This non-reimbursable technical cooperation was approved in 2020 and is currently being implemented. It has a total cost of USD 3,000,000 (Inter-American Development Bank, n.d.).
[19] The Ministry of Economy and Finance (MEF) is the borrower for the program with Peru's sovereign guarantee. The executing agency is the Ministry of Environment (MINAM) and receives technical support of the Corporación Financiera de Desarrollo S.A. (COFIDE), which acts as the implementing agency (Inter-American Development Bank, n.d.). The program involves the provision of an investment loan in the global credit modality, given that the actions involve financial intermediation. It is financed with USD 20,000,000 in ordinary capital from the IDB (PE-L1258) and a non-reimbursable contribution of USD 2,000,000 from the Natural Capital Laboratory Trust Fund of France and the IDB (PE-G1007) (Inter-American Development Bank, n.d.).
[20] Support mechanisms include: i) compensated interest rates, blending or incentives for compliance; and ii) hedging instruments/guarantees for risk transfer or indemnification in the case of claims (Inter-American Development Bank, 2022a).

Strengthening Sustainable Value Chains of Native Communities in the Peruvian Amazon (PE-T1514)[21]: This initiative seeks to improve territorial governance, associativity and productive capacity for the indigenous border community of Bélgica in order to achieve this community's insertion into regional sustainable development dynamics (Inter-American Development Bank, 2022b).

2.4.2. Other policies related to the bioeconomy

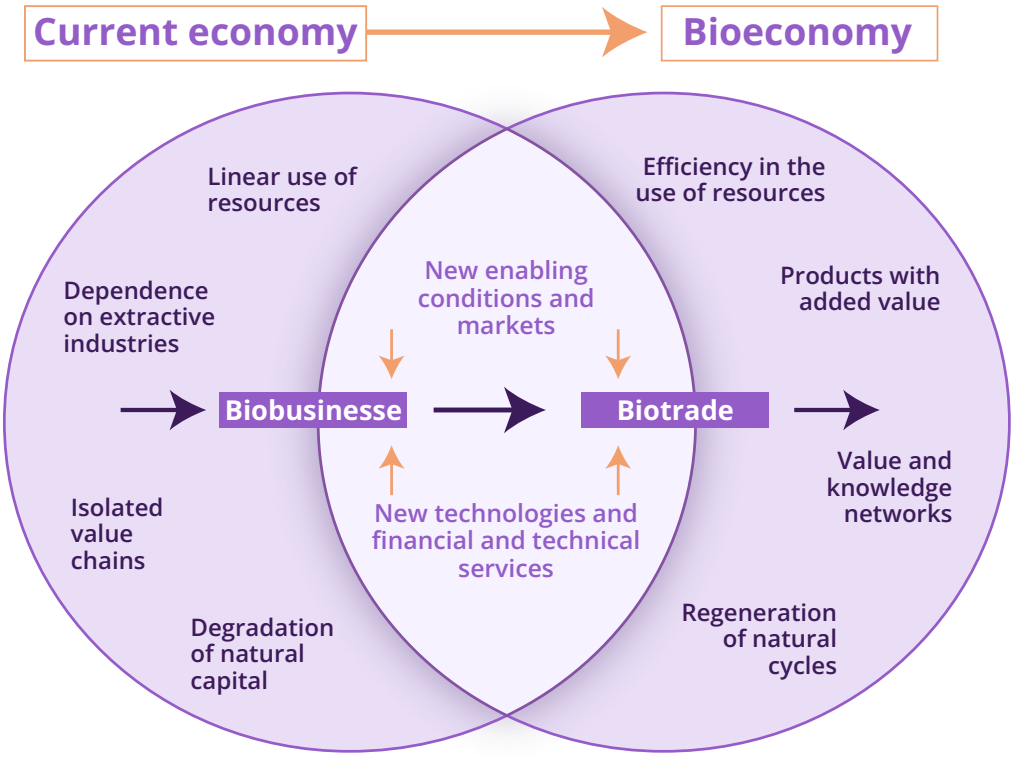
Although Peru has not yet formulated a specific policy and/or strategy associated with the bioeconomy, the country has been focused on eco-businesses, biobusinesses and biotrade since 2001. Ministerial Resolution 046-2020-MINAM established general guidelines for identifying and supporting these types of businesses, providing clarity and a framework for promoting them. One of the first steps for making progress in this area will be updating these guidelines in order to align them with the bioeconomy approach (Del Águila, 2025).

Peru also has a "National BioTrade Strategy and Action Plan to 2025" (National Commission for the Promotion of BioTrade, 2015). This plan is relevant, given that it establishes both biobusinesses and biotrade as tools that will make the bioeconomy a reality in Peru (Nature Services Peru, 2020). Biobusinesses and biotrade are essential for achieving the transition from the current economy based on the linear use of resources, extractive industries, degradation of natural capital and isolated value chains to a more sustainable bioeconomy. They need to be supported by improved enabling conditions, markets, technologies and financial services. This transformation will make it possible to achieve a more resource-efficient economy that consists of products with higher levels of added value, integration into knowledge networks and the regeneration of natural cycles (see graphic 5).



[21] This technical cooperation was approved in 2022 and is currently being implemented. It has a total cost of USD 376,400, of which 93% is financed by the IDB (USD 350,000) and the rest of the funding is provided by the Peruvian state (USD 26,400) (Inter-American Development Bank, 2022b).
[22] The strategy adopts the definition of biotrade from Article 87 of the Regulations of Law 26839, Law on the Conservation and Sustainable Use of Biological Diversity, which defines it as: "An activity that, through the sustainable use of native biodiversity resources, promotes investment and trade in accordance with the objectives of the Convention on Biological Diversity, supporting the development of economic activities at the local level, through strategic alliances and the generation of added value for competitive biodiversity products in the national and international market using the criteria of social equity and economic profitability".

Graphic 5. Importance of biobusiness and biotrade in moving towards the bioeconomy



Source: Nature Services Perú (2020)

In order to achieve this goal, the strategy proposes seven thematic areas through which the country's institutional framework, legal framework and mechanisms required to promote and implement biotrade in Peru will be consolidated. These thematic areas are: 1) policies and regulatory framework for the promotion and implementation of biotrade[23]; 2) institutional framework related to biotrade[24]; 3) development of supply[25]; 4) research, development and innovation[26]; 5) market development[27]; 6) knowledge management[28]; and 7) monitoring and evaluation[29] (Comisión Nacional de Promoción del Biocomercio, 2015).

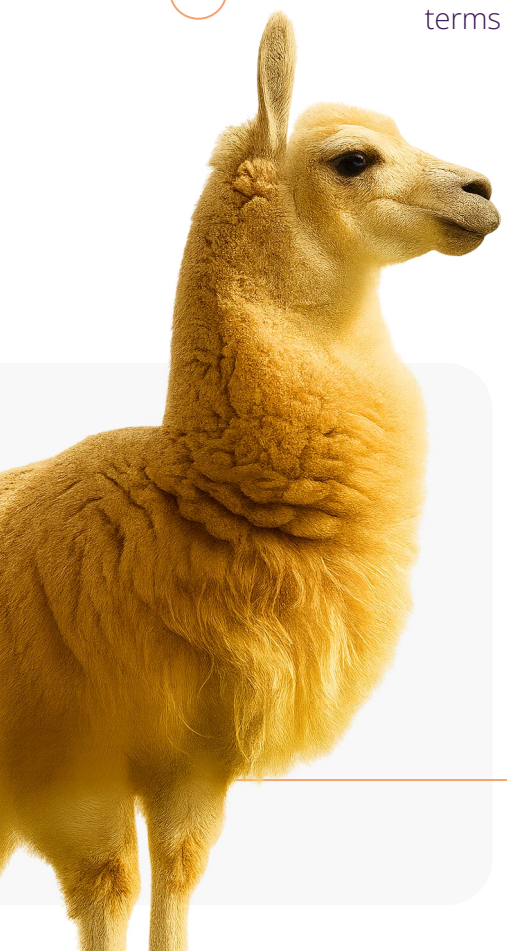
[23] This axis plans to integrate biotrade into Peru's policy agenda, ensuring that it is mainstreamed across all sectors. This involves strengthening the regulatory framework and ensuring its inclusion in regional planning and budget allocation strategies and tools.
[24] This axis seeks to strengthen the National Biotrade Promotion Program and the National Biotrade Promotion Commission, as well as promoting biotrade financing. In order to achieve this, Peru plans on developing and implementing biotrade management instruments, building capacity in this area for financial institutions and leveraging international cooperation resources.
[25] This axis is aimed at promoting the potential of the supply of products derived from native biodiversity through supporting biotrade initiatives to develop technical, environmental, productive management and organizational capacities. This also involves achieving compliance with health, quality and sustainability standards that meet the current needs of consumers.
[26] This thematic area seeks to promote applied research, innovation and development for biotrade goods and services, as well as systematizing and disseminating scientific information about biotrade goods and services.
[27] This area is focused on understanding and promoting biotrade goods and services in national and international markets. This involves commercial prospecting activities to identify new markets, promote the commercialization of products derived from biodiversity and the positioning of these products in markets.
[28] This area focuses on knowledge management through exchanges of experiences, systematization and dissemination actions with different biotrade topics/actors. Specifically, its goal is to create a biotrade knowledge management system that includes scientific, agricultural and forestry databases as well as publications and ongoing projects. It also promotes training for professionals in public and private sectors, universities and research centers.
[29] The purpose of this area is to generate an integrated system for monitoring biotrade in the country. This will make it possible to monitor and evaluate the implementation of this strategy and other biotrade initiatives in accordance with established principles and criteria.

In terms of governance, the strategy mentions the importance of strengthening the National Biotrade Promotion Program (PNPB) created in 2004, and the National Biotrade Promotion Commission (CNPB) created in 2010. This Commission is led by MINCETUR and supported by the Commission for the Promotion of Peru for Exports and Tourism (PROMPERU) and the Peruvian Amazon Research Institute (IIAP), which share the role of Technical Secretariat. The Commission works in coordination with ministries such as MINAM, MIDAGRI, PRODUCE and the Ministry of Foreign Affairs, as well as research institutions, business associations and universities. It also collaborates with other actors to promote and develop biotrade in the country including regional and local governments, NGOs, universities and business service centers.

03 Analysis of bioeconomy policies and/or strategies

This chapter analyzes each of the strategies in the countries selected for this study that guide their medium and long term actions for the bioeconomy. This analysis incorporates an understanding of the role that governments play in a country's development. It was complemented by some of the findings obtained during the review of relevant policies.

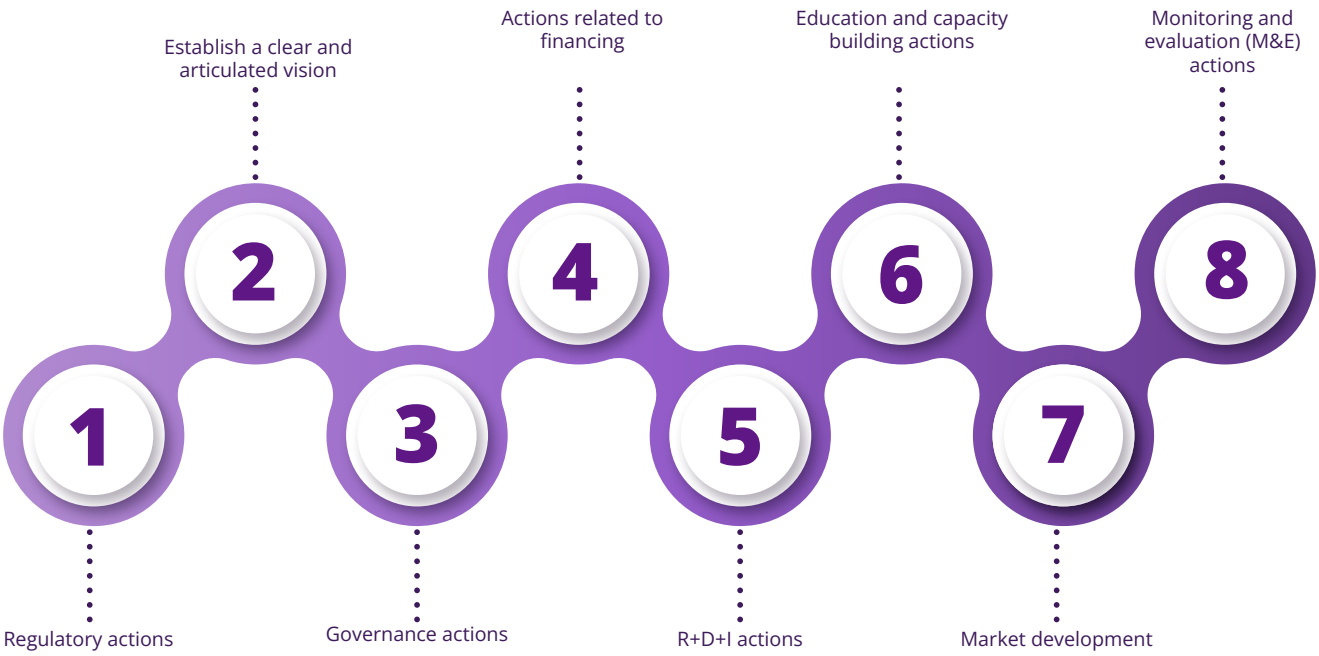
According to Lahera (1997), there are several areas in which a government has responsibility. First, it must ensure the rule of law and establish a clear regulatory framework to govern the production, exchange and distribution of goods and services (regulation). It must define mechanisms for articulation between actors and for problem solving (governance), as well as promoting financial instruments that take into account externalities, information problems, imperfections and gaps in credit and capital markets (financing). The public sector must guide educational activities (capacity building) and scientific and technological research (R&D&I) that lead to the modernization of companies and increase their productivity. Finally, the government has a role in inserting organizations into both national and international markets and strengthening evaluations of investments to measure their impact and guarantee their effectiveness (monitoring progress in terms of execution and impact).



In relation to the second point, it was identified that it is important to have a policy framework with a clear vision. This provides direction and focus while mobilizing the actors involved, aligning their efforts in terms of common objectives, optimizing resources and increasing effectiveness.

Based on the above, eight enabling elements were defined for evaluating the extent to which countries, through their policy documents, are facilitating or limiting development of the bioeconomy. These are presented in Graphic 6 and explained below.

Graphic 6. Enabling elements assessed in bioeconomy policies and/or strategies



Source: Own elaboration

Establish a clear and articulated vision. Ensures that policy frameworks have a clear vision that strategically guides a country's actions for the bioeconomy. This shared vision facilitates decision-making, avoids fragmented or contradictory efforts and improves communication and legitimacy of the policy.

Regulatory actions. Reviews if the strategies include the creation and/or modification of regulations with the objective of providing legal certainty to the actors involved in the bioeconomy ecosystem and reducing entry barriers.

Governance actions. Analyzes if the strategies define mechanisms or schemes for coordination, articulation and decision making between the different actors involved (i.e. government, private sector, academia, civil society and regional populations). This is essential because strong governance facilitates the alignment of efforts, avoids duplication and strengthens policy implementation.

Actions related to financing. Examines whether the strategies include mechanisms or incentives that mobilize resources to companies and compensates them for market failures in this area. Specifically, it reviews whether government intervention is considering subsidies, credits, tax incentives or other tools that facilitate investments, reduce risks and encourage participation from the private sector.

Research, Development and Innovation (R&D&I). Analyzes whether the proposed policy frameworks promote the generation and application of scientific and technological knowledge to promote sustainable solutions and improve competitiveness. This aspect is essential since R&D&I makes it possible to develop new products, processes and services, as well as adding value to the strategic sectors prioritized in the country's bioeconomy approach.

Education and capacity building. Verifies whether the strategies incorporate initiatives to develop the skills, knowledge and competencies required by the bioeconomy. This is particularly relevant in this innovative sector that requires well-trained people at all stages from research to the production of goods and services.

Development of markets. Checks whether the strategies are considering measures that facilitate access to local and international markets and seek to improve the competitiveness of biobased products and services. This is important because without a dynamic and accessible market, technological and productive developments in the bioeconomy cannot be scaled up or generate a sustainable economic impact.

Monitoring and evaluation. Analyzes whether the strategies incorporate monitoring systems, indicators and evaluation mechanisms that enable measurement of the real progress of actions. This guarantees transparency, identifies opportunities for improvement, contributes to informed decision making and ensures that the established objectives are translated into concrete and sustainable results.

Sections 3.1 to 3.5 contain the main results obtained after reviewing the eight criteria mentioned above, as well as notable aspects of policies in the countries selected for this study.

3.1 Brazil

Decree 12044 establishes the legal, institutional and operational basis for the continued development of the bioeconomy in Brazil. This Decree:

Determines a clear strategic framework for the bioeconomy. The Decree formally constitutes the National Bioeconomy Strategy, uniting what was previously a number of separate policies to create a more favorable environment for investment and long-term planning.

Incorporates a sociocultural approach that values the role of traditional knowledge in the bioeconomy. Brazil conceives the bioeconomy not just as a productive alternative, but as a comprehensive development model that connects scientific and traditional knowledge and generates biodiversity regeneration, social inclusion and justice. This approach emphasizes the active participation of indigenous peoples and traditional communities and the valorization of their ancestral knowledge, integrating this into production chains and creating green assets that generate added value within the bioeconomy.

Includes clear implementation mechanisms. The Decree states that this strategy will be implemented through the National Bioeconomy Development Plan that is supported by a National Bioeconomy Information and Knowledge System. It also identifies the need to create a National Bioeconomy Commission as a governance body. This demonstrates a structured approach to the implementation of the strategy.

Despite the above, and with the National Bioeconomy Development Plan soon to be published, Brazil still requires:

Specific thematic areas and goals. Although Article 9 of the Decree lists thematic areas, it does not define concrete Brazil's planned actions and goals in terms of: regulations that promote the bioeconomy; economic incentives and financing; the role of public institutions and governance; research, development and innovation; market promotion; education and capacity building; and monitoring and follow up mechanisms to measure progress with these goals. These will be defined in the National Bioeconomy Development Plan, the final version of which will be published at the end of 2025.

Detailed articulation with subregional strategies. Article 5 of the Decree states that the national level of government will implement this strategy in cooperation with the states and municipalities. Although there is already some dialogue with states such as Pará, which have advanced bioeconomy plans, and there are plans to strengthen coordination with regional and state levels, the Decree does not establish concrete mechanisms for this articulation nor does it outline how sub-regional strategies will form part of the national strategy.

Mechanisms for the valorization of ancestral knowledge and the inclusion of communities. Article 2 of the Decree defines the bioeconomy as including traditional knowledge, while Article 3 establishes respect for the rights of indigenous peoples and traditional communities and the fair sharing of benefits as structural components of the bioeconomy. However, while the Decree establishes these principles, it does not contain specific operational mechanisms to effectively achieve the valorization of ancestral knowledge and inclusion of communities in Brazil, nor does it state that this should be included in the National Bioeconomy Development Plan.

Detailed information about the enabling elements analyzed for Brazil is contained in Annex 1 of this document.

3.2 Colombia

Colombia is another Latin American country that has been working to generate a robust enabling environment that contributes to the development of the bioeconomy in its territory. The country's regulatory framework contains the following elements:

Definition of a long-term vision and strategic approach on how to make progress with the bioeconomy. There are two documents that guide the country's objectives and action areas in the bioeconomy. The Bioeconomy Mission for a Living and Diverse Colombia establishes the country's mission and vision until 2030, highlighting the role of the bioeconomy as a driver of sustainable development and international competitiveness based on the circular use of biodiversity and its ecosystem services. The Bioeconomy and Territory Mission establishes a roadmap focused on strengthening value chains based on the sustainable use of biodiversity. This document clearly defines "pathways" and prioritized strategic sectors for public investment. These are similar to the "areas with potential" identified in the first mission.

Detailed descriptions of actions to promote the bioeconomy. Colombia has designed a broad and detailed set of actions to develop its bioeconomy. This is evidenced by the existence of at least four policy documents, all describing different actions to be implemented that are categorized into six of the enabling elements identified in this document: regulation, financing, R&D&I, market development, education, capacity building and monitoring of the impact of the bioeconomy.

Incorporation of follow-up and/or monitoring mechanisms to measure the impact of the bioeconomy in the country. All of the Colombian bioeconomy policies analyzed for this study include mechanisms and instruments for the monitoring and/or evaluation of their implementation. Specific indicators are included that measure different areas of progress, both in the implementation of actions and expected impacts, as well as biannual reporting schemes that ensure the periodic monitoring of progress. There are a number of notable proposals from different public institutions. The National Department of Statistics (DANE) plans to establish a satellite account that would measure the contribution made by the bioeconomy to the GDP. The DNP has proposed the creation of the National Bioeconomy Observatory, which aims to centralize and analyze strategic information from the sector. These initiatives reflect an effort to strengthen traceability and evidence-based decision making.

However, and following a review of the country's bioeconomy policies, there are several areas in which Colombia has opportunities to improve:

There is no evidence of articulation between the policy documents that guide the bioeconomy. Even though each policy addresses different dimensions for developing the bioeconomy, there is no clear articulation and coordination between them. This lack of integration can generate confusion among the actors involved and affect information management, limiting the possibility of clear and coherent monitoring of the real progress made by the bioeconomy in Colombia.

There are divergences in institutional and governance proposals. A review of bioeconomy policies in Colombia shows that institutional proposals are diverse and do not form part of a common structure. For example, CONPES 3934 proposes an inter-institutional commission to lead the development of the sector. The Bioeconomy Mission for a Living and Diverse Colombia proposes a Technical Committee for Sustainability with elected ministerial leadership and regional participation. The Bioeconomy and Territory Mission proposes a broader inter-ministerial committee with the participation of unions, universities and companies. These differences reflect the different governance approaches that hindered the effective articulation of ecosystem actors before the Intersectoral Bioeconomy Mechanism was established in 2024.

Not all policy documents have specific follow-up actions to monitor progress with their implementation. The Bioeconomy Mission for a Living and Diverse Colombia and the Bioeconomy and Territory Mission have not proposed monitoring systems for the implementation of planned actions. This makes it difficult to evaluate the real and general progress with all of the policies, also limiting the capacity to make timely adjustments during the implementation period.

Detailed information about the enabling elements analyzed for Colombia is contained in Annex 1 of this document.

3.3 Costa Rica

Based on the information contained in Costa Rica's National Bioeconomy Strategy, it is clear that this policy enables and contributes to the implementation of this development model. This is because the strategy:

Establishes a strategic approach based on fossil decarbonization, circular economy and Industry 4.0 as guiding concepts. The strategy establishes the bioeconomy as an alternative to progressively reduce dependence on fossil fuels, supporting the goals contained in the 2019-2050 National Decarbonization Plan. It also promotes a circular bioeconomy that optimizes the use of resources through the reuse, recycling and recovery of materials, minimizing environmental impact and the extraction of inputs. Finally, it recognizes Industry 4.0 as a key ally in transforming production processes through digital, physical and biological technologies that facilitate an efficient transition to more sustainable and circular models.

Is structured using a clear sectoral approach. Costa Rica doesn't just define its long-term vision, it has also structured its strategy based on strategic dimensions and action areas aimed at promoting sectors with high potential such as sustainable rural development, use of biodiversity, waste biorefineries, advanced bioeconomy and urban bioeconomy. The strategy also contains a governance proposal that facilitates articulation between different ecosystem actors, aligning their efforts with the defined priorities.

Proposes specific enabling actions for each of the strategy's action areas. Instead of defining activities for its cross-cutting themes, Costa Rica chose to establish specific actions for each strategic area in key fields including regulation, financing, R&D&I, market development and education and capacity building. All of these actions directly contribute to the objectives of each action area. This focus on enabling actions achieves a more precise implementation that meets the needs of each sector of the bioeconomy supported by the government.

Despite the above, there are areas where additional actions could be implemented or existing ones could be strengthened to achieve even greater momentum. One component that could be strengthened is identified below:

Proposal for monitoring progress with the implementation and impact of the strategy. Although the roadmap defines an implementation framework, it does not establish key performance indicators (KPIs) for each action area. There is also no clear allocation of responsibilities for ongoing monitoring, the definition of reporting frequency or formal mechanisms for feedback and decision making based on monitoring results. This situation makes it difficult to objectively evaluate progress and make timely adjustments to ensure that the objectives in Costa Rica's National Bioeconomy Strategy are achieved.

Detailed information about the enabling elements analyzed for Costa Rica is contained in Annex 1 of this document.

3.4 Peru

Peru is at an early stage of strategic planning for the bioeconomy. This is evidenced by the 2030 National Circular Economy Roadmap published in 2023, which recognizes the need to design and implement a National Bioeconomy Strategy. The Roadmap positions the bioeconomy as a key component of the transition towards more sustainable production models while also evidencing the emerging political will to consolidate the bioeconomy within the country's environmental, economic and social agenda. Because the Roadmap is a priority action within a national policy instrument, this highlights the bioeconomy's strategic relevance and creates the possibility of building a long-term vision articulated with other efforts in the areas of circular economy, climate change, biodiversity and technological innovation.

Although there is still a long way to go, Peru has several positive elements that will contribute to the design of its bioeconomy policy. These include:

- **Existence of previous initiatives and experiences.** Peru had a National Biotrade Strategy until 2025 and has implemented programs to support biobusinesses, representing a foundation of knowledge and lessons learned for the creation of a broader bioeconomy strategy.

- **Support from international cooperation.** The involvement of the British Embassy and the IDB's financing and technical assistance are key factors that facilitate progress with the design of the strategy and the strengthening of biobusinesses.

- **Recognition of the need for a single definition and understanding of the bioeconomy.** The Ministry of Environment is taking steps to build a solid conceptual basis for the bioeconomy with the participation of different stakeholders. This is a fundamental step for the effective planning and implementation of the strategy.

Detailed information about the enabling elements analyzed for Peru is contained in Annex 1 of this document.

3.5 Comparison of policies and/or strategies

As a final exercise in this analysis, the selected countries were compared in three aspects: i) the concept of bioeconomy; ii) sectors where they have a comparative advantage based on their policies; and iii) the role of actors that are part of the bioeconomy ecosystem.

It should be noted that the bioeconomy concepts developed by the four countries share the idea of taking advantage of biological resources through the use of knowledge, science, technology and innovation to generate economic value and move towards sustainability. However, there are differences in their focus and emphasis. Costa Rica's strategy prioritizes the production, use and conservation of biological resources with a strong link to fossil decarbonization, circular economy and Industry 4.0. Brazil's concept of the bioeconomy incorporates values such as justice, ethics and inclusion, as well as the role of traditional knowledge alongside scientific knowledge. Colombia presents multiple definitions in its different policy documents. One of them uses Costa Rica's definition while another uses Brazil's but omits the values of justice, ethics and inclusion. Peru has a concept of bioeconomy that is very similar to Costa Rica's National Circular Economy Roadmap, but this is a preliminary text that is being used while they work towards their own definition.

In terms of comparative advantages, Colombia and Costa Rica have identified which sectors and subsectors they want to promote through the bioeconomy in their policy documents. Although a rigorous identification of these advantages has not been carried out in the framework of Brazil's strategy, the working groups formed for the CNBio have recognized at least three potential sectors that could be promoted. Each of these three countries prioritize the "sectors" of biodiversity and ecosystem services and industrial biotechnology (see Table 4). Sustainable and intensive agriculture, food and beverages and biomedicine also appear with high frequency in the three countries' policy documents, evidencing a common interest

in modernizing production systems and adding value through biological knowledge. Biointelligence and genetic engineering have a lower level of importance and are present in only a few strategies, highlighting the importance of technological maturity, national capabilities and specialization.

Table 4. Comparison of prioritized sectors and subsectors of interest for Colombia[30], Costa Rica and Brazil

Sector	Biodiversity and ecosystemic services	Ecological engineering	Sustainable and intensive agriculture
Subsectors in Colombia	• Bioprospecting • Nature tourism • Payments for environmental services • Use and valorization of biodiversity • Bioactive compounds for cosmetics		• Agricultural inputs • New varieties • Sustainable agriculture and livestock • Clean production, conscious consumption and healthy foods
	Silviculture	**Food and beverages**	**Biofuels**
		• Natural and bioactive ingredients for food	Sustainable bioenergy (bioenergy and biofuels)
	Industrial biotechnology	**Biointelligence**	**Genetic engineering**
	• Biofactories • Biorefineries • Biological catalysts • Green chemistry	• Omic studies • Biointelligent data • Data science	
	Biomedicine		
	• Essential, biotechnological, biosimilar and phytotherapeutic medicines	• Personalized medicine • Regenerative medicine • Precise nutrition	• Advanced biotechnology for health at productive and commercial scale • Bioactives for the pharmaceutical industry

Sector	Biodiversity and ecosystemic services	Ecological engineering	Sustainable and intensive agriculture
Subsectors in Brazil	Land-based and aquatic ecosystems		
	Silviculture	**Food and beverages**	**Biofuels**
			Biomass
	Industrial biotechnology	**Biomedicine**	**Biointelligence**	**Genetic engineering**
	• Bioindustries • Biomanufacturing			

[30] *The subsectors were taken from Government of Colombia (2020).*

Sector	Biodiversity and ecosystemic services	Ecological engineering	Sustainable and intensive agriculture
Subsectors in Costa Rica	• Bioprospecting • Cosmetics		• Agroforestry • Precise agriculture • Biofertilizers and biopesticides • Sustainable fish farming and aquiculture
	Silviculture	**Food and beverages**	**Biofuels**
	Silviculture with a bioenergy production approach	Alternative food and protein production	• Bioethanol • Biodiesel • Biogas and biomethane • Second generation biofuels from lignocellulosics
	Industrial biotechnology	**Biomedicine**	**Biointelligence**	**Genetic engineering**
	• Industrial enzyme production • Production of biodegradable bioproducts and materials • Industrial fermentation for chemical production	Biopharmaceutical	Big data and AI applied to key sectors including health, agriculture, energy and industry	Genetic engineering to improve coffee crops

Source: Own elaboration based on Government of Colombia (2020); Ministry of Science, Technology and Innovation (2024); Costa Rica. Ministry of Science, Technology and Telecommunications - MICITT (2020), Saab (2025), de Grilli et al. (2024).

In terms of the actors participating in the bioeconomy ecosystem and their roles[31], several common elements were identified among the analyzed countries (see Annex 2). An initial factor is the constant presence of multilateral organizations as strategic mobilizers in all of the countries, reflecting the facilitating role of international cooperation. As for the architects of these policies, the active participation of environmental, agricultural and science and technology ministries is evident, highlighting the intersectoral nature of the bioeconomy. Companies play a role as implementing partners in Brazil, Colombia and Costa Rica while Peru focuses on biobusinesses. There is also a broad range of partners in the bioeconomy across the four countries: development banks and universities in Brazil and research centers and chambers of commerce in the other countries. This heterogeneity reflects different levels of institutionalization, technical capacities and governance approaches, a situation that represents both challenges and opportunities for strengthening national bioeconomy ecosystems.

[31] For this analysis, four roles were reviewed: 1) Strategic mobilizers, who are actors with the capacity to generate regulatory changes but do not operate them directly; 2) Regulatory architects, who have the technical knowledge and convening power to influence regulatory and strategic frameworks; 3) Implementers/users, who are the actors in charge of applying regulations in operations; and 4) Intermediaries and articulators, who do not design regulations directly but contribute to the articulation between regulators, market and society (Latimpacto & Amplo Kaya, 2025).

04 Strengthening the bioeconomy agenda in Colombia

This chapter presents the main challenges and opportunities for Colombia in terms of consolidating and strengthening the country's bioeconomy agenda. This text is structured around the main enabling elements discussed in the previous chapter: regulatory framework, governance, financing, R&D&I, education and capacity building, market development and monitoring and evaluation. The country's challenges with each of the enabling elements are initially identified, followed by a summary of some of the actions proposed in the four policy documents related to the bioeconomy. Recommendations based on the experiences of other countries are proposed as opportunities for Colombia.

It is important to note that because Brazil and Peru do not yet have a bioeconomy action plan, alternative but relevant information was used for this exercise. With Brazil, analysis focused on actions included in the Pará State Bioeconomy Plan, as well as some of the elements mentioned by Saab (2025). For Peru, the policy documents analyzed include its National Biotrade Plan and its 2025 Action Plan, which is similar to a bioeconomy roadmap. These policies serve as reference points, enriching comparative analysis and the design of proposals to strengthen the implementation of the bioeconomy in Colombia.

4.1. Regulatory framework

Several regulatory challenges that could limit the progress of this development model were identified in the review of the different bioeconomy policies in Colombia, as well as other research conducted on this topic. The country's dispersed and complex regulatory structure is a notable difficulty due to regulatory gaps (DNP, 2018) and long and demanding procedures (Latimpacto, 2025). Regulations are outdated, non-existent or very restrictive in key areas such as bioplastics, bioinputs, bioremediation, phytomedicines, biopolymers and forest harvesting (MinCiencias, 2024). There is also a limited understanding of emerging technologies among public entities working in the regulatory framework (Latimpacto, 2025), a lack of knowledge of regulations among the actors involved and an absence of frameworks that promote innovation and scaling up (MinCiencias, 2024). Colombia faces challenges with international standards and certifications, weaknesses in monitoring and oversight and regulations that are not adapted to territorial contexts like the Amazon (Latimpacto, 2025).

Colombia plans to strengthen and modernize its regulatory framework for the bioeconomy. It has proposed a package of actions that include:

1. Review and updating of legal and regulatory frameworks to eliminate barriers that hinder technology transfer, the development of biotechnology products and the appropriation of tools such as gene editing.
2. The creation of a specific legal framework for bioproducts, bioenergy, biofactories, biorefineries and green chemistry derivatives, among others.
3. Establish regulatory mechanisms for sensitive areas such as intellectual property, clinical trials and the use of traditional and ancestral knowledge associated with biodiversity.
4. Provide tax benefits and green incentives for micro, small and medium-sized businesses as well as promoting R&D&I in the bioeconomy.
5. Design policies and incentives that facilitate the territorial implementation of the bioeconomy.

These efforts can be complemented with good practices observed in the other countries included in this study. Colombia could:

- **Formulate a specific health regulation agenda for products derived from biodiversity[32].** Although the country plans to update its regulations, and the sanitary component could be implicitly included in this exercise, it is suggested that this dimension should be explicit in the bioeconomy agenda. Differentiated guidelines could be included for products of animal and plant origin that incorporate criteria of safety, traceability, quality and compliance with national and international sanitary requirements.

[32] *Proposal based on Costa Rica. Ministry of Science, Innovation, Technology and Telecommunications - MICITT (2020).*

- **Adopt uniform regulations for the classification of new biotechnology-based products that are similar to those used by main trading partners[33].** Colombia could conduct a comparative analysis of existing regulations in the country's key markets[34], identify critical divergences and design gradual regulatory adjustments to facilitate foreign trade in bio-based products.

- **Provide technical support to subnational governments so that they include the bioeconomy in their development agendas[35].** Although Colombia already has policies and incentives to facilitate this action, there is a need to strengthen local capacities and ensure that this process is accompanied by specific allocations of resources at the territorial level. This will allow regions to take advantage of their comparative advantages in biodiversity, promote sustainable production chains and generate economic opportunities based on the responsible use of their biological resources.

- **Design communication strategies that are adapted to the needs of different actors in the bioeconomy's value chains so that they comply with updated regulations for native biodiversity products[36].** This will improve regulatory compliance, reduce errors in trade and strengthen the confidence of consumers and entities that are part of the bioeconomy ecosystem in the country.

4.2. Governance

In the area of governance, Colombia has a clear lack of institutional leadership to guide and articulate actions for the bioeconomy (DNP, 2018). Due to their highly specialized and cross-cutting nature, these types of activities require multi-stakeholder institutional coordination that brings together a number of public policy perspectives. However, if there is insufficient articulation between the entities involved, then this can lead to fragmented and limited actions, which in turn can affect the participation of the private sector and the implementation of comprehensive actions, particularly at a regional level (Departamento Nacional de Planeación, 2018; MinCiencias, 2024). Added to this is an overlap of responsibilities between entities that impedes the systemic and efficient development of the bioeconomy (Latimpacto, 2025).

This is why Colombia has established the goal of strengthening articulation between different actors in the ecosystem including public, private, academic and community institutions. These proposed actions have the goal of:

[33] *Proposal based on Costa Rica. Ministry of Science, Innovation, Technology and Telecommunications - MICITT (2020).*
[34] *Such as the European Union and the United States.*
[35] *Proposal based on Comisión Nacional de Promoción del Biocomercio (2015).*
[36] *Proposal based on Comisión Nacional de Promoción del Biocomercio (2015).*

Facilitating institutional arrangements that promote inter-institutional coordination and enable the design of policies for bioprospecting, biotechnology, bio-based products, etc. (i.e. Inter-institutional Bioeconomy Commission).

Promoting strategic alliances between universities, research centers, companies and international organizations to share knowledge, advanced technologies and successful experiences for the implementation of bio-based technologies.

Establishing consultation and cooperation spaces with indigenous communities and traditional knowledge holders, ensuring respect for their rights while promoting their participation in the bioeconomy.

hese approaches can be strengthened by adopting recommendations inspired by actions implemented in the countries selected for this study. Taking this into account, Colombia could:

- **Make progress with the creation of an Interinstitutional Bioeconomy Commission as the articulating axis for bioeconomy governance in the framework of the Intersectoral Bioeconomy Mechanism[37].** This entity could be led by a rotating presidency among key government agencies to ensure institutional balance and strategic continuity of the policy. At an operational level, the Commission could be organized into permanent technical chambers (e.g., financing and market intelligence) and thematic working groups, facilitating agile, multisectoral and representative governance that ensures informed decision-making and effective implementation of actions. In addition, the Commission's actions could be complemented with the creation of regional technical roundtables that involve the participation of researchers, entrepreneurs and territorial decision-makers. This would align the bioeconomy agenda with the capacities, needs and opportunities of the different territories in Colombia.

[37] *Proposal based on Saab (2025) and Comisión Nacional de Promoción del Biocomercio (2015).*

- **Promote the participation of cooperatives in territorial governance schemes[38].** Given their potential to carry out actions and consolidate sustainable value chains, cooperatives could become strategic actors for achieving the implementation of the bioeconomy at the territorial level. It is essential that their participation in local and regional governance mechanisms is encouraged, as well as facilitating their coordination with public, private and academic entities. This integration will strengthen their advocacy capacities, improve access to resources and enhance their contribution to economic development through the sustainable use of biodiversity.

- **Design and implement digital tools and collaborative methodologies that facilitate interaction between suppliers, academia, companies, public institutions, commercial agents and financiers[39].** This will ensure coordination and the flow of information at all stages of the production chain derived from biodiversity, ranging from the research phase to commercialization, while also including all of the actors that form part of this ecosystem.

4.3. Financing

Another issue where Colombia faces a significant challenge with the development of the bioeconomy is financing. Despite the fact that publicly financed initiatives have been promoted, significant barriers persist with the private sector, specifically due to the perception of high risks associated with this type of business (DNP, 2018). This situation is partially due to the fact that many of these projects, particularly those in their initial stages, face technical and regulatory obstacles that hinder their progress (MinCiencias, 2024). The lack of structured information and indicators to measure the real impact of the bioeconomy also limit the visibility of this model, making it difficult to attract investment (DNP, 2018). This problem is aggravated by the low level of knowledge in the financial sector about the characteristics and potential of these business models, restricting access to more favorable financing conditions while also limiting the development of specialized products aligned with local needs and realities (DNP, 2018; Latimpacto, 2025).

In order to meet these challenges, Colombia has decided to focus its efforts on mobilizing resources for research, technological development and innovation, as well as facilitating access to financial resources for early-stage ventures and companies. Specifically, the country seeks to:

[38] *Proposal based on Secretaria de Estado de Meio Ambiente e Sustentabilidade - SEMAS (2022).*
[39] *Proposal based on Costa Rica. Ministry of Science, Technology and Telecommunications - MICITT (2020).*

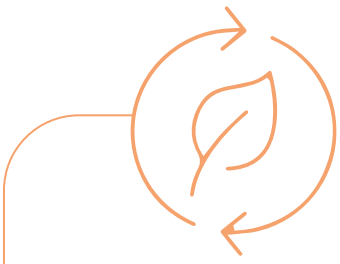
Financially support bioscientific expeditions, biorefineries and public-private innovation challenges focused on bioproducts.

Create financing and support instruments and mechanisms that promote innovation and entrepreneurship for any of the activities in the bioeconomy. These include lines of credit, early stage investment and proof of concept funding, as well as the creation of specific sub-accounts for funding.

Encourage public-private partnerships that promote high value-added projects based on the sustainable use of biodiversity.

Strengthen understanding of the bioeconomy and capacities to work with this sector in financial institutions.

There is an opportunity to enrich what has been proposed above based on the review of actions included by Costa Rica and Peru in their bioeconomy and biotrade strategies, respectively. This opportunity is also informed by the dialogue that Brazil engaged in during the design of its Bioeconomy Development Plan. Based on this research, Colombia could adopt the following recommendations:



- **Update Colombia's Green Taxonomy[40] to incorporate all productive, scientific and technological activities that form part of the bioeconomy[41].** Colombia is currently making progress with the construction of a Biodiversity Taxonomy, which represents an opportunity to evaluate the inclusion of activities in this system. This update would make it possible to align sustainable financial instruments with the opportunities generated by the sector. This in turn will facilitate channeling public and private resources to projects that take advantage of biodiversity while also improving the traceability of financing for this type of initiative.
- **Promote innovative financing mechanisms that combine public and private capital[42].** The use of blended finance schemes, which articulate reimbursable and non-reimbursable resources from multiple actors, represents a strategic opportunity to reduce the perception of risk and improve access to financing for bioeconomy projects. Although Colombia has already considered the creation of different financial instruments to achieve this result, this alternative could help manage the high levels of risk for bioeconomy projects perceived by the financial sector and other investors.

[40] Colombia's Green Taxonomy is a classification system that identifies and defines economic activities and assets that substantially contribute to achieving the country's environmental objectives. Its purpose is to establish a common language that facilitates the identification, evaluation and promotion of green or environmentally sustainable investments for both public and private actors. This helps mobilize resources towards projects that support climate change mitigation and adaptation, ecosystem conservation, sustainable water and soil management, circular economy and prevention of pollution (Government of Colombia, 2022).

[41] Proposal based on Saab (2025).

[42] Proposal based on Saab (2025).

- **Encourage direct foreign investment in bioeconomy activities[43].** Colombia could design financial and non-financial mechanisms and incentives that promote international investment in the prioritized areas: science, technology and innovation applied to nature tourism, bioremediation, agricultural bioinputs, functional foods and beverages, biopolymers and biorefineries, cosmetics (natural and cosmeceutical) and phytomedicines.

- **Organize spaces to facilitate connections between bioeconomy companies and financial entities[44].** Holding financial roundtables and sectoral meetings will help make bioeconomy projects more visible and help entrepreneurs obtain resources from different sources, including the financial sector.

- **Design projects aimed at mobilizing resources from international cooperation and multilateral banks[45].** Although Colombia has proposed promoting science, technology and innovation initiatives to strengthen prioritized value chains, the objective of this recommendation is to ensure that a significant number of these projects are presented to financing sources and gain access to resources.

4.4. Research, Development and Innovation (R&D&I)

Colombia has historically been characterized by its low investment in R&D&I. In 2015, for example, investment in research represented just 0.24% of GDP (DNP, 2018). As of 2020, it had only reached 0.29% of GDP (World Bank Group, 2025), a figure that is considerably lower than regional and global standards (DNP, 2018). Added to this is the low participation of the private sector in research and development activities, given that this responsibility largely falls on the public sector. This is a very different situation compared to other OECD countries where companies finance 70% of R&D (Alarcón, 2016).

Colombia also faces difficulties with incorporating professionals with advanced training into its productive system and the use of advanced technologies. This means that less than 2% of scientists work in the business sector (Alarcón, 2016) where there is a lack of applied research, technology transfer and adequate infrastructure. This is particularly the case in strategic regions such as the Amazon and the Pacific where there is a high level of potential in terms of biodiversity (DNP, 2018). Finally, knowledge management is deficient and there are barriers with disseminating research results (MinCiencias, 2024).

As a result of this situation, supporting R&D&I efforts that strengthen the development of biobased products and processes has been a priority for Colombia's bioeconomy policies. Some of the activities that the country has proposed include:

- Promote R&D&I projects that strengthen prioritized value chains by generating knowledge and technological developments derived from biodiversity.

- Implement dynamic projects such as bioincubators and an omics network that ensure the valorization of biomass and biodiversity.

[43] *Proposal based on Costa Rica. Ministry of Science, Technology and Telecommunications - MICITT (2020).*
[44] *Proposal based on Comisión Nacional de Promoción del Biocomercio (2015).*
[45] *Proposal based on Comisión Nacional de Promoción del Biocomercio (2015).*

- Promote the protection and transfer of inventions through specialized instruments and intellectual property frameworks that recognize both technological innovation and traditional knowledge.
- Strengthen the registration, systematization and management of biological specimens in national and international platforms.
- Create integrated and open information systems that facilitate access, analysis and use of data for patents, biodiversity and scientific records. This will promote open science and national and international collaboration.

There is also an opportunity to strengthen the actions that have already been proposed by Colombia in this area, taking as a reference point the experiences of Costa Rica and Pará state in Brazil. Specifically, some of the initiatives that should be considered include:

Promote regional spaces for demonstration, research and the valorization of the bioeconomy[46]. This activity is aimed at developing physical infrastructures such as bioeconomic parks and specialized centers that are home to technological showcases, innovation nodes and collaboration spaces, bringing together academia, the productive sector and communities. This approach can help stimulate the development of biobased products and services in the territories.

Design and implement digital platforms that simplify the process of granting permits for access to genetic and biochemical resources while also systematizing and disseminating success stories in this field[47]. These platforms could integrate both tools that facilitate procedural management and access to regulatory, technical and follow-up information, as well as case studies and model initiatives that involve access to genetic and biochemical resources and the sharing of benefits.

4.5. Education and capacity building

Con el fin de desbloquear el potencial que tiene Colombia en bioeconomía, es necesario que el país supere varios desafíos que existen en relación con la educación y la formación de capacidades. In order to unlock Colombia's potential for the bioeconomy, it is important that the country overcomes a number of existing challenges in relation to education and capacity building. These include weak continuity for training processes, the shortage of qualified human resources required to drive and lead the bioeconomy (MinCiencias, 2024), the absence of sufficient alignment between the skills sought by companies and those taught by the education and training system (DNP, 2023), the disconnection between scientific and traditional/ancestral knowledge that hinders the sustainable use of biodiversity and the lack of applied research that impedes the development and adoption of innovations to meet territorial needs (MinCiencias, 2024).

Taking into account what was described above, Colombia has established an agenda that focuses on the training of highly qualified human resources while strengthening technical, scientific and management skills. Priorities include:

[46] *Proposal based on SEMAS (2022).*
[47] *Proposal based on Costa Rica. Ministry of Science, Technology and Telecommunications - MICITT (2020).*

- Promote training programs for researchers, entrepreneurs and public officials, particularly on topics such as technology transfer, sustainability and use of biodiversity.
- Promote the social appropriation of knowledge and the development of capacities at the territorial level, linking these processes with local productive dynamics.
- Create and strengthen specialist academic programs in the fields of biotechnology and bioeconomy.
- Increase the number of scholarships for advanced training that prioritize the design of solutions to meet regional challenges.

These efforts can be complemented by three actions inspired by the bioeconomy and biotrade policies in Costa Rica, Pará state and Peru. Specifically, Colombia could:

Strengthen the technical and entrepreneurial capacities of biobusinesses[48]. In order to achieve this, efforts must focus on designing training, technical assistance and business support programs that target bioeconomy producers and entrepreneurs. These educational sessions should cover compliance with health standards, sustainability, good practices and trade and financing processes. These actions could include knowledge-sharing events and certification programs designed to boost the growth of bioeconomy initiatives.

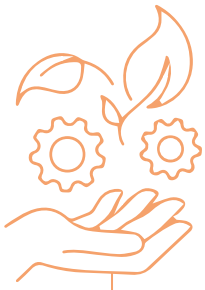
Design differential strengthening programs for indigenous communities and productive cooperatives.[49]. Specific training and advisory processes should be adapted to the cultural and productive contexts of each community and the type of actors involved. This will enhance their participation in sustainable value chains, improve organizational management and promote bioeconomy models.

Support bioeconomy internships in universities and technical and technological institutes[50]. Bioeconomy-focused internships should be included in the curricula of higher and technical education institutions. This will act as a mechanism to bring students closer to practical experiences in companies, research centers and organizations in the bioeconomy at national and international levels.

[48] *Proposal based on Comisión Nacional de Promoción del Biocomercio (2015) and SEMAS (2022).*
[49] *Proposal based on SEMAS (2022).*
[50] *Proposal based on Costa Rica. Ministry of Science, Technology and Telecommunications - MICITT (2020).*

4.6. Development of markets

Colombia must overcome several obstacles if it wants to develop a solid domestic market for its bio-based products. The relative immaturity of the domestic market and low consumption of these products in local markets has prevented production from becoming more dynamic (MinCiencias, 2024). This is compounded by the weakness of value chains, a lack of organizations that exclusively provide technical support to biobusinesses (incubators and accelerators), high logistical costs and a lack of technology to meet required quality standards, which subsequently reduces profitability for local producers (Latimpacto, 2025). Weak articulation between market actors limits coordination between supply and demand (Latimpacto, 2025) while fragmenting commercial efforts and reducing the efficiency of value chains. All of these factors have a negative impact on the development of a robust ecosystem for the bioeconomy.



In terms of participation in international markets, Colombia faces challenges associated with its limited capacity to access and compete in high value-added bio segments at the global level (MinCiencias, 2024). The country's dependence on primary exports with low levels of added-value and high environmental impacts restricts its competitive positioning (DNP, 2018). The country also faces deficits in terms of infrastructure, technology and productive capacity for meeting the quality and quantity requirements of global markets (Latimpacto, 2025). Finally, the lack of strategic information on commercial opportunities further impedes the scaling-up and international insertion of products derived from biodiversity (Latimpacto, 2025).

Taking the above situation into account, Colombia seeks to position its bioeconomy sector in both domestic and international markets through strengthening supply and demand for bio-based products and services. Its efforts in this area are designed to:

- Promote the development of biobusinesses through acceleration and validation instruments.
- Integrate the bioeconomy into business development programs and entrepreneurial support instruments.
- Build a national investment portfolio of organic products with high added value.
- Promote regional clusters and sustainable production chains.
- Stimulate demand through market incentives, sustainable public procurement and mechanisms to replace imports with bio-based domestic products.
- Promote exports of bioproducts.

The Roadmap that the country has designed for its different market policies can be strengthened with a number of actions inspired by the other countries analyzed in this document. In order to develop its domestic market, Colombia could:

[51] *Proposal based on SEMAS (2022).*
[52] *Proposal based on Costa Rica. Ministry of Science, Innovation, Technology and Telecommunications - MICITT (2020).*
[53] *Proposal based on Costa Rica. Ministry of Science, Innovation, Technology and Telecommunications - MICITT (2020); the National Commission for the Promotion of Biotrade (2015) and SEMAS (2022).*

- Generate specialized incubation and acceleration spaces for bioeconomy businesses[51]. This involves establishing programs dedicated to incubating and accelerating biobusinesses that offer specialist technical support, develop capabilities and facilitate access to strategic networks. This will provide these types of businesses with differentiated support for consolidation and scaling up while responding to the specific challenges they face.

- Encourage productive linkages with high added value[52]. This requires promoting alliances between companies, cooperatives and anchor companies that are part of the prioritized value chains. These cooperation schemes would provide knowledge transfers, access to shared infrastructure and the strengthening of local capacities, thus generating more resilient and competitive business models.

- Evaluate the creation of differentiating elements for markets as a strategy for the valorization of products derived from biodiversity[53]. This recommendation involves conducting research on the relevance and feasibility of creating distinctive elements, such as country brands, seals of origin and certifications that highlight attributes such as biocultural origin, productive sustainability and innovation based on traditional knowledge or biotechnology. These elements can contribute to increasing brand recognition, traceability and added value for biobased products, facilitating their differentiation from conventional alternatives and providing them with a commercial advantage in the market.

- Hold territorial innovation fairs and events to increase the public profile of bioproducts[54]. Colombia could hold fairs, business funding rounds, contests and other regional events to identify innovative ideas, increase the public profile of bioeconomy initiatives, attract investment and facilitate connections between entrepreneurs, companies and ecosystem actors. This will contribute to the construction and management of investment portfolios for new bioeconomy businesses, something that Colombia has proposed as one of its activities.

- Consolidate digital platforms for the commercialization of products derived from biodiversity[55]. These platforms should enable the promotion and sale of products at national and international levels while also integrating functions that improve traceability, directly connect producers with buyers and provide information about quality standards, regulatory requirements and business opportunities. The platforms could also include data analysis tools designed to guide commercial decisions and strengthen the competitiveness of bio-based value chains.

[51] Proposal based on SEMAS (2022).
[52] Proposal based on Costa Rica. Ministry of Science, Innovation, Technology and Telecommunications - MICITT (2020).
[53] Proposal based on Costa Rica. Ministry of Science, Innovation, Technology and Telecommunications - MICITT (2020); the National Commission for the Promotion of Biotrade (2015) and SEMAS (2022).
[54] Proposal based on Costa Rica. Ministry of Science, Innovation, Technology and Telecommunications - MICITT (2020) and SEMAS (2022).
[55] Proposal based on Comisión Nacional de Promoción del Biocomercio (2015) and SEMAS (2022).

To boost exports of bioproducts, the country could:

Monitor trends in global value chains[56]. Colombia could establish a permanent system for analyzing global chains related to the bioeconomy in order to identify international trade opportunities and adapt national supply to external requirements. This could be accompanied by tariff codes, as well as compliance with the sanitary and regulatory requirements of the primary destination markets for these products.

Characterize the exportable supply of products derived from biodiversity[57]. Identify and document the export potential of regional value chains in order to align productive capacities with international demand and achieve insertion into these markets.

Promote the internationalization of innovative companies[58]. Provide technical, financial and strategic support for the internationalization of national companies that are part of the bioeconomy so that they can access other markets while meeting global standards.

Facilitate certification that enables access to international markets[59]. Support bioeconomy companies to obtain the certification and accreditation required for exporting bioproducts that includes laboratory tests, manufacturing processes and traceability.

Strengthen the international participation of companies producing bio-based goods[60]. Promote the participation of biotechnology companies in overseas fairs, business funding rounds and trade missions. This will contribute to their positioning in global markets.

Design and implement a communication and marketing campaign that raises awareness about the potential of products derived from national biodiversity, associating them with a narrative focused on sustainability, innovation and cultural wealth[61]. This strategy should contribute to the positioning of Colombia in international markets, highlighting the country's territorial identity and differentiating its bioproducts based on their origin, quality and innovation.

4.7. Monitoring and evaluation

As in any process of continuous improvement, it is important that Colombia obtains information from monitoring the actions established in its bioeconomy policies to measure its level of progress and adjust strategies in a timely manner. As mentioned previously, there is an absence of specific indicators for this purpose in Colombia, which makes it difficult to measure the impact of the bioeconomy in social, environmental and economic terms. This also evidences the need for clear metrics co-created with local communities (Latimpacto, 2025). There is weak articulation in Colombia in relation to the generation, validation, analysis and dissemination of data. This limits informed decision-making and makes it difficult to identify key activities in the territories (DNP, 2018).

[56, 57] *Proposal based on Comisión Nacional de Promoción del Biocomercio (2015).*
[58, 59, 60] *Proposal based on Costa Rica. Ministry of Science, Innovation, Technology and Telecommunications - MICITT (2020).*
[61] *Proposal based on Comisión Nacional de Promoción del Biocomercio (2015) and SEMAS (2022).*

This is why the country has recognized the importance of establishing monitoring and evaluation tools for a number of its policies. This will generate analysis and support decision-making processes related to the bioeconomy. The country has proposed the following actions in this area:

- Develop a bioeconomy satellite account to measure this sector's contribution to national GDP.
- Design science, technology and innovation indicators linked to the bioeconomy.
- Create the National Bioeconomy Observatory.

An additional action that could be taken is described below:

Design and implement a National Bioeconomy Information System[62]. This system should be based on robust big data that consolidates information about different actors in the ecosystem, primarily in strategic territories such as the Amazon. Specifically, a National Bioeconomy Information System could include data about the companies that are part of value chains associated with the bioeconomy and the technical and financial support they receive, among other relevant aspects. By centralizing and systematizing data generated by different public entities, this tool would facilitate the design of evidence-based public policies, as well as the efficient and focused prioritization of investments and institutional efforts.

[62] *Proposal based on Presidency of the Republic of Brazil (2024) and SEMAS (2022).*

05 Conclusions

This section contains the main conclusions from this research study. After a comparative analysis of the approaches and advances in bioeconomy policies and/or strategies in the four selected countries (Costa Rica, Brazil, Colombia and Peru), the level of development achieved by each of them is summarized below. Based on different practices included in their policies and strategies, this section also contains a number of recommendations for actions that can strengthen Colombia's bioeconomy agenda.

Peru was identified as being at an initial stage of development in terms of its bioeconomy. Although it does not yet have a specific national strategy or policy, the country has expressed its commitment to this sector by linking the future National Bioeconomy Strategy to relevant actions contained in the National Roadmap for the Circular Economy to 2030. The country is making progress through complementary actions such as updating eco-business and biobusiness guidelines, aligning them with this approach. Peru has also been analyzing Brazil's experience with building a bioeconomy ecosystem in order to adapt good practices to its own context. Peru has had a National Biotrade Strategy since 2015, which is a key precedent for developing a national bioeconomy policy as it contains components that can be incorporated into a broader and more integrated vision of the bioeconomy.

Costa Rica has made progress with consolidating an enabling environment that is conducive to the bioeconomy, which is reflected in the design of its strategy. This policy framework defines a clear long-term vision and is structured around thematic areas and action lines that are aligned with the sectors and subsectors the country wants to promote (sustainable rural development, use of biodiversity, waste biorefineries, advanced bioeconomy and urban bioeconomy). Each of these thematic areas is accompanied by specific enabling actions in areas such as research, regulation, financing, markets, education and capacity building. This means that the implementation of the strategy is adapted to the particularities of each sector. Despite the above, the strategy does not include specific indicators for each action line, which is a limitation that impedes monitoring and doesn't allow for objective evaluations of progress and effectiveness.

Brazil has extensive experience with developing policies for the bioeconomy. These include the Action Plan for Science, Technology and Innovation in the Bioeconomy, the National Biotechnology Policy and the Bioeconomy Brazil Sociobiodiversity Program. However, it wasn't until 2024 that Brazil established a unified policy framework through the issuance of Decree No. 12044, which created the National Bioeconomy Strategy. This strategy is characterized by its focus on socio-biodiversity and the valorization of traditional knowledge. The strategy will be implemented through the National Bioeconomy Development Plan (PNDBio), which is currently being designed. One of the challenges with this plan will be articulating national level actions with the work being carried out by states like Pará.

Finally, Colombia's approach to the bioeconomy has been established through different policy documents in recent years. The country has created at least four key policy documents since 2018, including CONPES 3934 and 4129, as well as bioeconomy missions. These have defined a long-term vision and outlined enabling actions designed to take sustainable advantage of biodiversity. More recently, Colombia has identified strategic sectors and defined "priority pathways" that are key areas designed to inform public investment in the framework of its bioeconomy strategy. These pathways make it possible to guide institutional efforts towards specific objectives that have a high potential impact. However, significant challenges remain in relation to the seven enabling elements analyzed in this report (regulatory framework, governance, financing, R&D&I, education and capacity building, market development, and monitoring and evaluation) as they require further action.

This study identified 29 additional opportunities for action, in addition to those already contemplated in existing policies. Of these, three are notable, either because of their importance for decision-making, their relevance for the country or because they are not being implemented within the policy framework. These include: i) creating an Interinstitutional Bioeconomy Commission with a rotating presidency, technical chambers and regional roundtables as the entity responsible for national and territorial articulation of the bioeconomy; ii) incorporating all bioeconomy-related activities into Colombia's Green Taxonomy, taking advantage of the current process of drafting the Biodiversity Taxonomy; and iii) strengthening the internationalization of bioproducts through an understanding of global trends, characterization of the exportable supply of bio-based products and their positioning in international markets.

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07 Annexes

Annex 1. Comparative analysis of bioeconomy policies.

View here.

Annex 2. Actors and roles in bioeconomy ecosystems.

Role	Brazil	Colombia	Costa Rica	Peru
Strategic mobilizers: Actors that promote dialogue and regulatory changes without directly being	* Inter-American Development Bank (IDB) * World Bank * Green Climate Fund (GCF) *United Nations Development Program (UNDP) * KFW	* Global Green Growth Institute (GGGI)	* Economic Commission for Latin America and the Caribbean (ECLAC) * Organization for Economic Co-operation and Development (OECD) * German Council for the Bioeconomy	* Inter-American Development Bank (IDB) * British Embassy * German Development Bank (KfW)/German Cooperation Agency (GIZ)
Regulatory architects: Technical knowledge and convening power to influence and define regulatory or strategic frameworks.	* Ministry of Environment and Climate Change * Ministry of Finance * Ministry of Integration and Regional Development * Ministry of Agriculture, Livestock and Supply * Ministry of Development, Industry, Commerce and Services *Ministry of Planning and Budget	* Ministry of Environment and Sustainable Development * Ministry of Science, Technology and Innovation * Ministry of Commerce, Industry and Tourism	* Ministry of Science, Innovation, Technology and Telecommunications (MICITT) * Ministry of Agriculture and Livestock (MAG) * Ministry of Environment and Energy (MINAE) * Ministry of Economy, Industry and Commerce (MEIC) * Ministry of National Planning and Economic Policy (MIDEPLAN	* Ministry of Environment (MINAM) * Ministry of Economy and Finance (MEF) * Ministry of Foreign Trade and Tourism (MINCETUR)

Role	Brazil	Colombia	Costa Rica	Peru
Implementers/users: Actors who must comply with regulations for their operations and can provide feedback for their improvement.	* Companies	* Companies	* Companies	* Biobusinesses
Intermediaries and articulators: Actors that do not directly design regulations but play a key role as intermediaries between articulators, market and society.	* Banco de la Amazonía (BASA) * Banco do Nordeste * Banco do Brasil *Brazilian Federation of Banks (FEBRABAN) *Fundação Getúlio Vargas * University of São Paulo (USP)	* National Planning Department (DNP) * Colombian Corporation for Agricultural Research (Agrosavia) * Alexander von Humboldt Institute *Amazonian Scientific Research Institute (SINCHI) * Pacific Environmental Research Institute Instituto de (IIAP) * National Association of Business Owners (ANDI) * Chambers of Commerce * Regional competitiveness clusters	*Inter-American Institute for Cooperation on Agriculture * National Chamber of Agriculture and Agribusiness (CNAA) *Chamber of Industries of Costa Rica * CR-Biomed Cluster * Costa Rican Investment Promotion Agency * Fundecooperación * University of Costa Rica (UCR) * Technological Institute of Costa Rica (ITCR) * National High-level Technology Center (Cenat) * National University	* Academia * Productive Sectors

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