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Editorial

Bioeconomy and Innovative and Sustainable Business in the Context of Natural Resource Management and Confrontation of Climate Change in the Amazon

Bioeconomia e Negócios Inovadores e Sustentáveis no Contexto da Gestão de Recursos Naturais e Enfrentamento às Mudanças Climáticas na Amazônia

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INTRODUCTION

For more than 50 years the debate on sustainable development has been present in the academic world and has been approached from a political perspective, given the need to reconcile the productive system with the conservation of natural resources. The deleterious effects of the economic development model based on a production system that is highly exploitative of natural resources and an energy matrix based on fossil fuels were two of the many reasons that raised the debate on sustainable development worldwide.

The scientific projections that the planet would suffer from climate change, particularly temperature increases caused by the emission of greenhouse gases by all economic and human activities within the existing production and consumption model, have been confirmed. Data from the United Nations Environment Program (United Nations Environment Programme [UNEP], 2024) indicate that in 2023 the earth's temperature was 1.45 degrees Celsius above pre-industrial levels, given that the volume of carbon dioxide put into the atmosphere has increased by 35% since the Industrial Revolution. The greatest responsibility for this volume of emissions lies with the industrialized countries that make up the G10 and the emerging economy countries that expand the list to G20.

In view of the projected increase in temperature, the UN created the COP (Conference of the Parties) in 1994, which is a forum for discussions and agreements to regulate and reduce the emission of polluting gases that have a direct influence on the global climate system. This forum covers more than 190 countries and in 2024 it reached its 29th edition. Throughout its history, many treaties and agreements have been reached to reduce greenhouse gas emissions, but with few effective results in controlling the rise in the planet's temperature.

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In this context, Brazil, as an emerging economy, has made several commitments to reduce carbon emissions into the atmosphere since it first took part. At COP-29, Brazil pledged to reduce net greenhouse gas emissions by 59% to 67% by 2035, a proposal that uses 2005 as a benchmark. During the event, Brazil announced a reorganization of its development model through two plans and one initiative: Climate Plan, Ecological Transformation Plan and Pact between the three powers for Ecological Transformation. Within the Ecological Transformation Plan, actions will take place along 6 lines: (a) New Green Infrastructure and Adaptation; (b) Sustainable Finance; (c) Bioeconomy and Agrifood Systems; (d) Energy Transition; (e) Technological Densification and the Productive Sector; and (f) Circular Economy.

Although all the dimensions presented are intrinsically related in the Amazon context, the most prominent discussion in the region for at least five years has been Bioeconomy and Agrifood Systems. In effect, this involves implementing a production model that places greater weight on small-family farming within agroforestry systems, managed extractivism, and forest preservation, in conjunction with regional culture and technological development to support new business arrangements. The model is based on the understanding that the Amazon has a rich and unique sociobiological and cultural diversity that enables it to implement innovative business arrangements that reconcile nature conservation and regional culture with technological development. Bioeconomy is understood as a proposition that uses nature, culture and science, technology, and innovation to support new businesses (Bioökonomierat, 2018; Lopes & Chiavari, 2022; Nobre & Nobre, 2019).

Given the broad spectrum of the existing discussion on the bioeconomy due to the enormous diversity of businesses that already exist and/or may come into existence, it is important to debate its meanings in greater depth, as well as to discuss innovative and sustainable business experiences and proposals in the Amazon that are in line with this concept.

BIOECONOMY

The term Bioeconomy is not new and can be said to date back to the beginning of the 20th century when Hermann Reinheimer published the work E*volution by Co-operation - A Study in Bio-economics* in 1913 (Barañano et al., 2021), although the discussion was correlated with the debate on population growth and not with the economic use of natural resources in production processes (Wam, 2010). In any case, this has been identified as the first moment in which the term appeared.

In keeping with discussions of evolution and population centered on mathematical models, other studies have also used the term. A notable example is Fedor Ilyich Baranov's writings on fish catches and population dynamics (Giampietro, 2019). Although Baranov's work focused on understanding the limits of the natural ecosystem in the economic exploitation of fish, the correlation between economics and nature was already present (Giampietro, 2019).

However, discussions of direct correlations between economics and biology only took place in the 1960s when Jiri Zeman used the term Bioeconomy to talk about the possibility of a new economy, whose biological bases should be present in the main economic activities (Barañano et al., 202; Pietzsch, 2020).

Another important discussion that dealt with the relationship between economics and biology was Georgescu-Roegen´s (1971), ntropy law. Indeed, the author argues that the development model based on unlimited growth in production and consumption as the fundamental objective of economic activity cannot be reconciled with the finiteness of nature (Cechin & Veiga, 2010). This, the authors argue, is because nature is a closed and finite system and the economic system is an open and infinite system; thus, it is not nature that is part of the economic system, but on the contrary, it is the economic system that is part of nature and is limited by it (Cavalcanti, 2010; Queiroz, 2024). Georgescu-Roegen's (1971) discussion provides further foundations for the emergence and unfolding of the Bioeconomy debate, although this is not always the term used.

The first development in the discussion of bioeconomy involves authors from the more socio-critical strand of classical economics, including Georgescu-Roegen (1971). In light of the understanding that the economic system is a subset of larger processes that occur in the natural environment, there is a need to create an economic model that is more centered on nature and based on a holistic view of the relationship with society. This gave rise to the first interpretations of ecological bioeconomics, which is one of the current trends in bioeconomics.

The second development takes place within classical economics with the argument that the natural world can be viewed through the lens of economic thinking. Science, technology, and innovation would be the bases for mitigating the impacts of economic production processes by replacing inputs and creating new processes and products. Glick (1982) describes the 'biological industrial revolution', which proposes replacing traditional production processes with the support of molecular biology and genetic engineering to increase productivity, especially in the agricultural, chemical, and pharmaceutical fields. Biotechnology, then, is given as one of the foundations in the bioeconomy, which unfolds

in new debates on the use of waste to generate energy, the development of biodegradable products, and the creation of bioproducts derived from living organisms such as plants, animals, insects, viruses, fungi, and bacteria.

The discussion on the use of living organisms to create new products or even to replace non-renewable or endangered inputs from the forest has brought bioeconomics closer to the forestry sector and the resources and bioactive substances that nature offers.

Given this context, Bugge et al. (2016) provided the most prominent literature review on the bioeconomy and classified it into three visions: bioecological bioeconomy, biotechnological bioeconomy, and bioeconomy based on bio-resources. In the bioecological vision, the focus lies in the proposition of the circular model of the economy, which optimizes the use of nutrients and energy in order to minimize the demand for new external inputs as possible into the production process. It emphasizes the integrity of the ecosystem in order to prevent soil degradation and discourage monoculture. From a biotechnological perspective, the emphasis is on developing research and technologies applied to the use of biomass to increase environmental efficiency and create new products to address problems of scarcity and supply. It should be noted that this aspect is inextricably linked to high-tech research centers. And the vision of the bioeconomy based on bio-resources focuses on the processing and conversion of biomass into new products and the establishment of unique value chains. This vision on the one hand involves economic growth and sustainability by replacing non-renewable production inputs with those derived from renewable biological resources; and, on the other hand, the use of bioactive substances from the forest and its resources to create new value chains. The relevance of research and innovation as a driving force for the development of the bioeconomy based on bio-resources is emphasized, despite the fact that, in principle, it requires less complex and/or more territorially established technologies than in the biotechnological vision, since spatially it is concentrated in rural areas (Costa et al., 2021; Lopes & Chiavari, 2022). What stands out in the context of a bioeconomy based on bio-resources is the approach to correlated knowledge with which science seeks certain explanatory bases, particularly when with reference to resources from the forest in areas that are still little explored, as in the case of the Amazon. Much of the knowledge mastered by the peoples of the forest has not yet been properly systematized by science in order to give rise to new value chains.

The aspects of the term 'bioeconomy' that have been put forward here ultimately stress the dynamics of economic and social relations with living organisms, particularly with regard to the use, exploitation, and management of natural resources, technologies, and associated knowledge, given the need to find alternative ways of implementing the concept of sustainable development. In a formal and normative view, bioeconomy is the "production, utilization, and conservation of biological resources, including related knowledge, science, technology, and innovation, to provide information, products, processes, and services in all economic sectors aimed at a sustainable economy" (Global Bioeconomy Summit, 2015, p. 2).

INNOVATIVE AND SUSTAINABLE BUSINESS IN THE CONTEXT OF NATURAL RESOURCE MANAGEMENT IN THE AMAZON

Since the 1990s, the debate on the need to manage natural resources for sustainable regional development in and of the Amazon has been prominent. In the context of this debate, at least five major theoretical components have been put forward as economic alternatives to underpin regional development (Vasconcellos, 2013).

The first advocates the verticalization of the production of resources (prominent exports up till now), such as iron, manganese, timber, and products linked to agribusiness. The production of commodities is at the heart of this proposal. The basic assumption behind the verticalization of production is that the Amazon is a major holder of natural resources, but that it exports them *in natura* or with low added value. Verticalizing production would add more value to the products and generate more work and income. Among the main problems with this logic are the low technological and financial capacity to set up industries, as well as logistical problems and a shortage of labor. Critically, in addition to these problems, the industrial model is highly concentrated in wealth and seeks to reduce the use of human labor with low formal qualifications, which is the general profile of workers in the Amazon.

The second component is based on small family farming, since most of the rural and regional businesses and population are linked to it, and family farming would therefore be the way to generate work and income for regional development. The inclusion of small Amazonian farms in public policies involves guaranteeing minimum prices for biodiversity products. In the same vein, the implementation of agri-food systems is being discussed in order to reduce monoculture and provide greater possibilities for food security. In terms of respect for local culture and social and environmental sustainability, this component is closely related to the regional reality. In economic terms, it is basically concerned with the market and local society, which does not allow it to be involved on a larger scale. It is closer to the social, solidarity, and cooperative economy.

The third component proposes development based on managed extractivism and/or forest maintenance for the purposes of carbon sequestration and environmental compensation. Consequently, industrialized societies should pay for this environmental service. This proposal is based on valuing the culture of local and indigenous communities, as they are the ones who know the forest best. This component is closely linked to the need to tackle climate change, which is increasingly being felt in all areas of the planet. This component includes discussions on green bonds, reducing greenhouse gas emissions (REDD+), ecosystem services, and payments for environmental services.

The fourth component can be characterized as local development. Indeed, it is a component that brings assumptions of territorial delineations in which each territory must exploit its singularities and peculiarities to endogenously produce products that have domains of knowledge and technology and are strictly linked to the environment, culture, and identities of the territories. According to Dallabrida et al. (2020), territories must activate existing environmental resources. This is an approach that is economically concerned with both the local and global markets, while socially absorbing the local workforce within its current formation.

The fifth component can be called selective internationalization (Vasconcellos, 2013). This is based on the exploitation of natural resources specific to the Amazon and on having a command of knowledge, science, and technology at a regional level. The areas of pharmaceuticals and fine chemicals, whether in terms of products that have already been developed through scientific research, or in terms of inputs with added value, represent this aspect well. This approach is concerned with exports and generating foreign currency for economic growth, based on bioindustry and the creation of new value chains. The biggest criticism of this model is that it requires extensive and long-lasting investments in science, technology, and innovation, which will require significant financial resources, a highly qualified workforce, and time for implementation, either because of the time needed to train researchers and workers for the new industry or because of the need for maturing of the products created.

Notably, in the last five years a debate has emerged in the Amazon that partly reconciles the last four components through the bioeconomy as a new proposal for sustainable development (Costa et al., 2021; Nobre & Nobre, 2019).The Amazon bioeconomy is based on the understanding that the region needs to use its sociobiological and cultural diversity to implement new and innovative business arrangements that reconcile nature conservation, local knowledge, identity, and regional culture with scientific and technological development. This is a proposition in which science, technology, innovation, local knowledge, and territories (Costa et al., 2021; Lopes & Chiavari, 2022) provide support for new businesses.

Despite the new elements that the initial theoretical proposition for the Amazon bioeconomy brings, including presenting itself as a 'new alternative' for sustainable regional development, there are many criticisms of this interpretation (Homma et al., 2020; Vivien et al., 2019). The most substantiated argument against the Amazon bioeconomy is that the central lines of the proposal (bio-resources for the economy and development) have always been present in all the development models implemented in the region.

In any case, the emerging bioeconomic proposal for the Amazon has also been put forward as one that can reconcile regional sociobiological and cultural diversity, small family producers (agriculture or neo-extractivism), and the provision of environmental services through forest conservation and/or restoration, precisely through an ecological bioeconomy (Costa et al., 2021; Nobre & Nobre, 2019). But in order for this to happen, new business models need to be implemented, which obviously imply an innovative and sustainable perspective.

It should be noted that the concepts of technology and innovation in the context of the bioeconomy in the Amazon are not only constituted from a classical perspective but also from the relationship between scientific knowledge and local and traditional knowledge. This means that innovative and sustainable Amazon-based businesses come from both classic technological innovations and social and socio-technical innovations. The centrality of the businesses is the appropriate use of regional sociobiological and cultural diversity. Innovative sustainable businesses involving Amazonian socio-agrobiodiversity derive from a perspective of valuing and recognizing local knowledge and traditional knowledge about the use and exploitation of natural resources. These can be understood as territorial assets and attributes. Thus, these businesses require the fair appropriation of the value of work and knowledge in the context of the appropriation of benefits.

Based on the assumption that the Amazon is an internally very diverse region, whether in terms of culture, identity, or even infrastructure, and that it has more and less sustainably developed areas and territories with distinct urban, rural, or peri-urban lifestyles, it can be understood that all the bioeconomy proposals that have existed so far are applicable to the region, depending on which Amazonian territory we are talking about. It is believed that it is not wise to generalize the bioeconomy proposition for the entire Amazon region, including respecting the territories that have entered the classic economic model of development.

Thus, in conserved areas, the emphasis can be on the bioecological and biotechnological bioeconomy, valuing

the forest and the knowledge of local communities. In areas where forests have been cut down or deforested, the bioeconomy of bio-resources can help restore degraded areas. In areas under pressure, a bioecological bioeconomy and the sustainable production of biomass through agroforestry systems are alternatives for curbing deforestation. In addition, urban areas can give rise to research, development, and innovation centers, as well as industrial hubs in high-tech sectors. If we could pluralize it, we would say that "sustainable developments in the Amazons" should be pursued.

CONCLUSION: BIOECONOMY AND CLIMATE CHANGE

There is already a consensus in the scientific literature, which to a certain extent is already politically recognized, that the main cause of climate change is the economic model and the current production system sustained by human consumption. While recognizing the need to change the pattern of production and consumption in pursuit of the idea of sustainable development, there is still a search for alternatives on how to implement it. Over the last 50 years, various proposals have emerged, all of which, notwithstanding their merits, are still limited. In any case, there is a recognition of the fact that alternatives must be found in order to curb what is predicted in terms of a permanent rise in temperature and a substantial reduction in the rainfall system, which will result in water and food insecurity, making human life on earth more difficult.

Among the various alternatives, the bioeconomy has been discussed as a model that can contribute to mitigating climate change based on the three aspects identified so far (bioecological, biotechnological, and bioresources), depending on the social time and territory we are talking about.

In the specific case of the Amazon, it is understood that the bioeconomy in the region can not only contribute to mitigating climate change but can also be an alternative for the emergence of new businesses and value chains to combat the region's high level of poverty, which is multidimensional in nature and encompasses the economy and social issues such as education, health, housing, security, access to public services and other dimensions.

The idea of "Amazons", "developments" and "bioeconomies" is being defended, in other words, the implementation of the different components of the bioeconomy based on intraregional diversity itself. In environmental preservation areas, the bioeconomy can be bioecological, with the preservation of the standing forest and its rivers. The concern in these areas should be the Amazon biome and the populations that reproduce there. In practice, economic activities should be developed that do not "disrupt the complex ecological balances that guarantee the health of forests and rivers" (Costa et al., 2021, p. 24), such as ecotourism, agroforestry systems and the extraction of non-timber forest products.

In areas that have already undergone substantial human impacts and where production activities have already been consolidated, biotechnological bioeconomics should be considered to minimize the perverse effects of the production process. In practice, this could involve installations of circular economic models, the achievement of forest management, an increase in integrated crop-livestock-forest installations, and agro-bioeconomy (Veríssimo et al., 2022), the latter based on the intensive production model and restriction to extensive and land-intensive production processes. The agro-bioeconomy should be restricted to areas that have already been deforested and converted. However, support for the biotechnological bioeconomy to recover degraded areas is not ruled out.

Finally, in areas with dense forests, it is essential to domesticate biodiversity resources through scientific research. And to achieve this, a good relationship with urban areas where the necessary infrastructure for bioactive research is located is fundamental. It is even possible to prioritize certain plant and animal species for further studies, as long as they have the capacity for large-scale production (Homma et al., 2020).

In all the ways that can be carried out at a regional level, a bioeconomy in the Amazon contributes to mitigating climate change. This is why all the texts presented in this special edition of the *Journal of Contemporary Administration* are of interest for stimulating reflections on the role of the bioeconomy in managing natural resources in the context of tackling climate change.

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