v.6, n.1, 2024, DOI: 10.52664/rima.v6.n1.2024.e228

RIMA
Revista Interdisciplinar e do Meio Ambiente
Interdisciplinary and Environment Journal

Ecological Footprint Deficit in Brazil: An analysis of reports from The World Wide Fund For Nature

Deficit de la Huella Ecológica en Brasil: Un análisis de informes del Fondo Mundial para la Naturaleza

Michael Douglas Sousa Leite[1] *& Isabel Lausanne Fontgalland* [2]

Abstract: This article aimed to analyze changes in the ecological footprint in Brazil over time, focusing on reports from the World Wide Fund for Nature (WWF) and scientific literature. To do so, the present article is of a documentary, bibliographical, and qualitative nature. Data collection was conducted through systematic searches, employing search terms such as "Ecological Footprint," "Brazil," "World Wide Fund for Nature." The results showed that despite having one of the largest global biocapacities, Brazil faces challenges in effectively translating this advantage into sustainable benefits. The findings highlight the phenomenon of horizontal and vertical scale growth in the Brazilian economic system, pointing to the combination of population growth with increased consumption, especially in urban areas. Regional disparities in per capita Ecological Footprint are evident, indicating distinct consumption patterns in different parts of the country. WWF reports emphasize the importance of strategic interventions to trigger significant transformations. In this point of view, the study highlights the need to rethink consumption models and adopt more sustainable practices. The deficit of the Ecological Footprint in Brazil requires a proactive and collaborative response from policymakers, communities, and economic sectors. Only through strategic interventions and a fundamental shift in the approach to natural resources can one aspire to a future where Brazil's biocapacity is effectively transformed into sustainable benefits, ensuring harmony between economic development and environmental preservation.
Keywords: *Biocapacity. Brazil. Ecological footprint. WWF.*

Resumen: Este artículo tiene como objectivo analizar los cambios en la huella ecológica en Brasil a lo largo del tiempo, centrándose en los informes del Fondo Mundial para la Naturaleza (WWF) y en la literatura científica. Para hacerlo, el presente artículo es de carácter documental, bibliográfico y cualitativo. La recogida de datos se realizó mediante búsquedas sistemáticas, empleando términos de búsqueda como "Huella Ecológica", "Brasil", "Fondo Mundial para la Naturaleza". Los resultados mostraron que, a pesar de tener una de las mayores biocapacidades mundiales, Brasil se enfrenta a retos para traducir efectivamente esta ventaja en beneficios sostenibles. Las conclusiones destacan el fenómeno del crecimiento a escala horizontal y vertical en el sistema económico brasileño, apuntando a la combinación del crecimiento demográfico con el aumento del consumo, especialmente en las zonas urbanas. Las disparidades regionales en la Huella Ecológica per cápita son evidentes, indicando patrones de consumo distintos en diferentes partes del país. Los informes de WWF destacan la importancia de las intervenciones estratégicas para desencadenar transformaciones significativas. En este sentido, el estudio destaca la necesidad de repensar los modelos de consumo y adoptar prácticas más sostenibles. El déficit de la Huella Ecológica en Brasil requiere una respuesta proactiva y colaborativa de los responsables políticos, las comunidades y los sectores económicos. Sólo mediante intervenciones estratégicas y un

*Author for correspondence
Received for publication on 2024/04/04; approved on 2023/10/25.
[1] Bachelor's degree in Business Administration from the Federal University of Campina Grande, Master's degree in Agroindustry Management and Systems - PPGSA/UFCG, PhD candidate in Natural Resources Engineering and Management - PPGEGRN/UFCG, ORCID: https://orcid.org/0000-0002-9356-1872;*
[2] BA in Economics from the Federal University of Ceará; MA in Economics from the Federal University of Paraíba; PhD in Industrial Economics - Université de Sciences Sociales de Toulouse 1- France (LIRHE) and Post-Doctorate in Economics from Ohio University - Athens - Ohio - USA, ORCID: https://orcid.org/0000-0002-0087-2840.

cambio fundamental en el enfoque de los recursos naturales se puede aspirar a un futuro en el que la biocapacidad de Brasil se transforme efectivamente en beneficios sostenibles, garantizando la armonía entre el desarrollo económico y la preservación del medio ambiente.
Palabras clave: *Biocapacidad. Brasil. Huella ecológica. WWF.*

INTRODUCTION

In recent years, growing concern about environmental issues has driven the search for solutions that can mitigate the adverse impacts of human activity on the global ecosystem. In this context, the ecological footprint has emerged as an innovative metric which quantifies human demand on natural resources and compares this consumption with the Earth's capacity for regeneration. The ecological footprint not only offers a tangible assessment of the environmental impact of human activities, but has also proved to be a powerful tool in environmental education, promoting a deeper understanding of the interconnections between society and the environment.

Twenty years ago, Cavalcanti (2003) warned about the need for a paradigm shift, with the rejection of the belief in unlimited growth and the adoption of a new non-economic ethic in the view of the economy and the management of natural resources. The author argues in favor of a deeper integration between development and the environment, going beyond the fragmented vision which sees nature as just another economic sector. The proposal for a new paradigm also implies an education that trains professionals capable of understanding the complex interrelationships between man, society, the economy and nature. The author proposes a more holistic, ethical and sustainable approach to the development, highlighting the urgent need of rethinking the foundations that guide public policies and socio-economic practices.

The *Ecological Footprint* (EF) is an assessment tool proposed by Wackernagel and Rees (1996). It represents the extent of ecological space needed to maintain a specific system or unit. This approach consists of a metric that translates the flows of matter and energy into and out of an economic system, converting these flows into an equivalent area of land or water existing in nature, necessary to sustain the functioning of that system (Van Bellen, 2002).

The fundamental essence presented by the authors is that each individual or region, as a participant in different processes, has an impact on the planet through the consumption of resources and the generation of waste. Calculating the Ecological Footprint involves quantifying in hectares the amount of productive land and water used to acquire the resources consumed, as well as to absorb the waste produced. In general, this Ecological Footprint should be smaller than the corresponding share of the planet's ecologically productive surface (Lisboa; Barros, 2010).

The Ecological Footprint (EF) is universally recognized as a sustainability metric, as it has the ability to quantify the consumption of natural resources, offering data that makes it possible to assess the carrying capacity of the Earth's ecosystem. This approach can calculate the extent of production area used to generate the resources needed to sustain the way of life of individuals, cities, regions or nations (Rees, 1992).

EP plays a crucial role in the study of natural resource consumption, playing a key role in planning policies aimed at sustainability, as it is considered an accessible indicator that provides comprehensible understanding. In addition, it serves as a valuable tool for investigating the degree of land use, allowing for the analysis of different scenarios related to the use of natural resources and their potential (Iazdi; Pedroso, 2020; Martins; Fontgalland, 2021).

With this in mind, this article seeks to analyze changes in Brazil's ecological footprint over time, focusing on reports by the *World Wide Fund for Nature (WWF)* and scientific literature.

THEORETICAL BACKGROUND

The World's Ecological Footprint

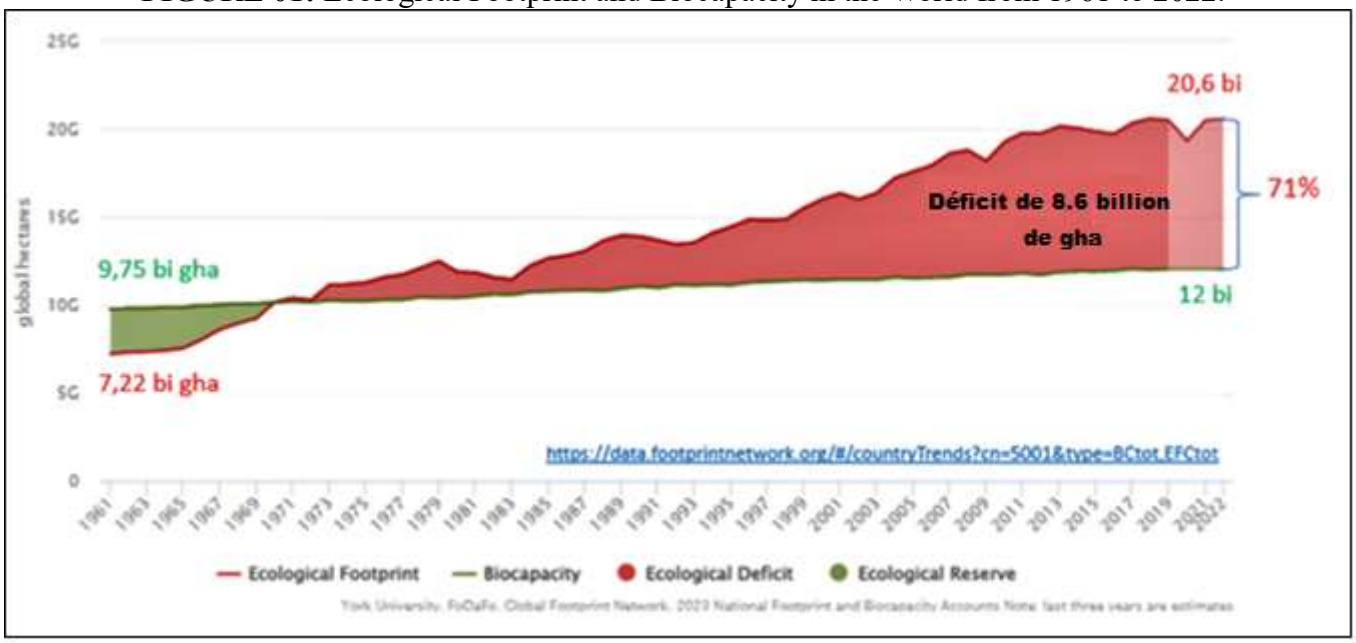
Humanity has exceeded the Earth's sustainable capacity. This term refers to the maximum amount of natural resources that the planet can provide on a long-term basis, taking into consideration the basic needs of the population, consumption patterns and the preservation of ecosystems. Carrying capacity represents the maximum population that the environment can sustain indefinitely, considering food, water, *habitat* and all the other demands of the human species (Lamim-Guedes, 2015).

The total capacity of available productive area in the world, known as biocapacity, is 11.9 billion global hectares, which is equivalent to an average of 1.8 global hectares per inhabitant, considering the world population of 7 billion people in 2011 (UN Brazil, 2011). Furthermore, biocapacity is declining, whether due to population growth or the degradation of soils and seas (Fava; Vialli, 2009; Lamim-Guedes, 2018).

At present, the global average Ecological Footprint amounts to 2.7 global hectares per person, significantly exceeding the available biocapacity, which is only 1.8 global hectares per individual. This disparity results in a serious ecological deficit for the planet's population, calculated at 0.9 gha/cap. Humanity is currently operating on a deficit of 0.9 planets, indicating that we need 1.5 planets to sustain our current consumption pattern. This situation represents a substantial threat to planetary biocapacity (WWF, 2023).

Figure 01 drawn up by the *Global Footprint Network* Institute (2023) shows data on the global ecological footprint and global biocapacity from 1961 to 2022.

FIGURE 01: Ecological Footprint and Biocapacity in the World from 1961 to 2022.



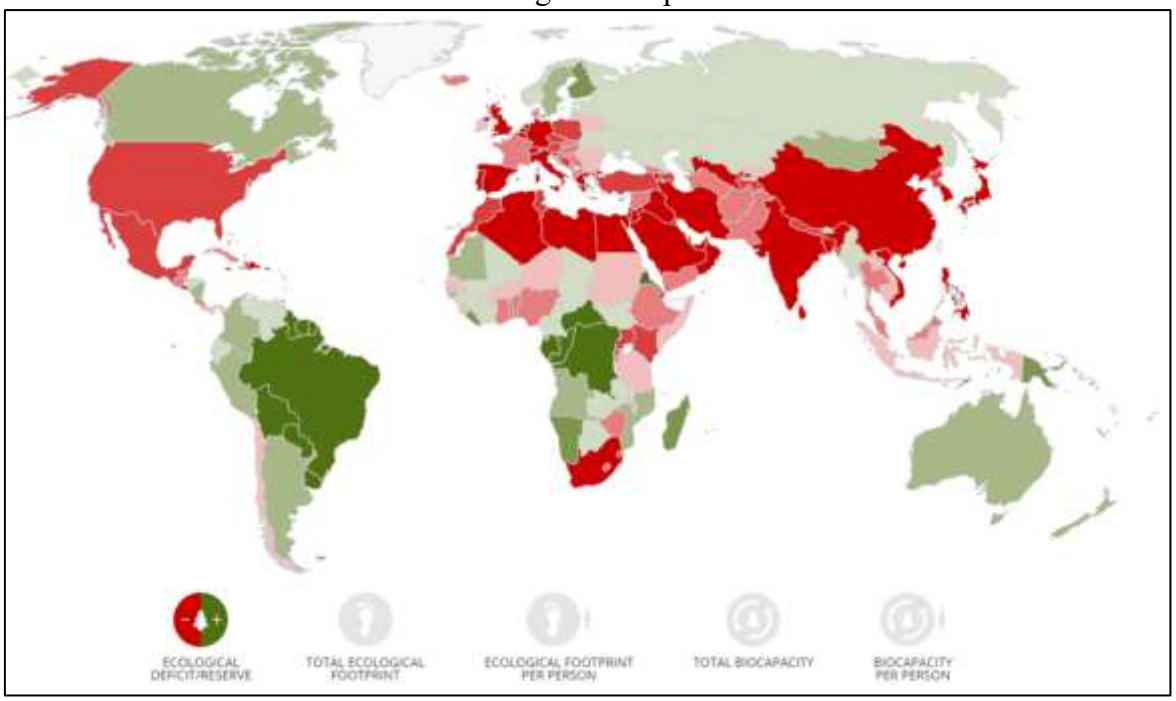
SOURCE: *Global Footprint Network* Institute (2023)

In 1961, the world**'s** population was around 3 billion people, with a biocapacity of 9.75 billion global hectares (gha) and an ecological footprint of 7.22 billion gha. At that time, the planet enjoyed an environmental surplus, represented by the green area in the graph above, a condition that lasted throughout the 1960s. Today, most countries, as a whole, are experiencing ecological deficits. In fact, today more than 85% of the world's population lives in countries with an ecological deficit. The global ecological deficit is referred to as the global ecological surplus (Global Footprint Network Institute, 2023).

It is possible to see a reduction of around 35% in biodiversity in the period from 1970 to 2000 alone, which represents a loss comparable only to mass extinction events that has occurred on only four or five occasions over the billions of years in history (WWF BRAZIL, 2023).

Figure 02 shows the red areas in deficit and the green areas with an environmental surplus.

FIGURE 02: Ecological Footprint in the World.



SOURCE: *Global Footprint Network* Institute *(2023).*

Data from 2022 show a decrease in the global ecological footprint due to the impacts of the covid-19 pandemic, which triggered a global economic recession. However, as economic activities resumed, the ecological footprint increased again, resulting in a growing environmental deficit. In other words, in 2022, humanity was over-consuming resources, reaching 71% more than the planet could sustainably supply (Global Footprint Network Institute, 2023).

Projections for the year 2050 warn that, if we maintain this pattern of consumption, we will need more than two planets to satisfy our needs. A global effort to reverse this trend is imperative in order to ensure that we can live within the limits of the planet's biocapacity (WWF Brasil, 2023). Table 01 shows the countries in deficit and surplus.

TABLE 01: Ranking of Ecological Footprint deficit and surplus countries.

Largest Deficits		**Best Surpluses**	
Nauru	- 46.000%	French Guiana	4.900%
Singapore	- 6.100%	Suriname	2.160%
Reunion Island	- 3.200%	Guyana	1.460%
Israel	- 1.600%	Gabon	811%
United Arab Emirates	- 1.500%	Congo	635%

Bahrain	- 1.400%	Central African Republic	462%
Kiribati	- 1.300%	Bahamas	447%
Saint Kitts and Nevis	- 1.800%	Uruguay	380%
Qatar	- 1.100%	Bolivia	361%
Lebanon	- 950%	Puerto Rico	315%
Kuwait	- 900%	Paraguay	236%
Luxembourg	- 840%	East Timor	232%
South Korea	- 810%	Brazil	219%

SOURCE: Based on data from the *Global* Footprint Network Institute (2023).

Table 01 of the ecological footprint deficit reveals an alarming situation in several countries. Nauru stands out with an extraordinary deficit of 46,000%, indicating an unbridled dependence on resources in relation to the environment's capacity for regeneration. It was once the country with the second highest per capita income on the planet, ahead of any European territory. However, after years of exploitation, the smallest republic on the planet has become a poor place, completely devastated by human greed.

Singapore and Reunion Island also show consumption far beyond sustainable limits. Other countries, such as Israel (1,600%), the United Arab Emirates (1,500%), Bahrain (1,400%), and Saint Kitts and Nevis (1,800%), show considerable deficits, indicating significant pressure on natural resources. These figures suggest an urgent need to re-evaluate consumption practices and adopt more sustainable approaches to mitigate the overexploitation of the planet's resources.

With regard to countries with a surplus, Table 01 highlights a list of countries with notable ecological footprint surpluses, indicating an environmental regeneration capacity that significantly exceeds local consumption. French Guiana leads the way with a surplus of 4,900%, followed by Suriname with 2,160% and Guyana with 1,460%. These significant figures suggest that these countries have the capacity to maintain a balanced relationship between their consumption of natural resources and the environment's ability to regenerate itself (Alves, 2023).

Countries such as China, India, the United States, Indonesia, Russia, Japan and Germany stand out. These countries together accumulate an ecological footprint corresponding to the entire biocapacity of the planet, which is 12 billion gha (Alves, 2023).

China currently has the largest total ecological footprint and the largest absolute environmental deficit. This contrasts with the situation in 1961, when the Chinese population was 655 million. At that time, the country had a small environmental surplus, with a total biocapacity of 575 million global

hectares (gha) and a total ecological footprint of 548 million gha. Over the following decades, population and economic growth transformed this dynamic.

In 2022, with a population of 1.41 billion, China's total ecological footprint skyrocketed to 5.28 billion gha, while biocapacity reached 1.17 billion gha. As a result, China's absolute ecological deficit reached 4.1 billion gha, representing a relative deficit of 351%. This evolution highlights the growing pressure on the country's natural resources due to its rapid economic development and population growth (WWF China, 2023; Global Footprint Network, 2023).

India had a population of 456 million in 1961, which grew significantly to 1.41 billion in 2022, making it the most populous country in the world by 2023, overtaking China. Initially, India had a small environmental deficit in 1961.

However, demographic and economic growth over time has resulted in a total ecological deficit of 1 billion global hectares (gha), with an ecological footprint of 1.47 billion gha and a biocapacity of 0.485 billion gha in 2022. This relative deficit is significant, reaching 203%. Despite having a per capita ecological footprint below the world average, India ranks third in terms of total ecological footprint due to its large population and the fact that it is currently the country with the highest economic growth rates in the world. This highlights the complex dynamic between economic development, population density and environmental impacts in the Indian context (Nathaniel, 2021; Global Footprint Network, 2023).

The population of the United States consumes twice as many renewable natural resources and regenerative services within its borders. Virginia, Maryland and Delaware are the states with the highest Ecological Footprints per capita, indicating a high environmental impact per inhabitant. In contrast, New York, Idaho and Arkansas have the lowest Ecological Footprints per person, suggesting more sustainable practices in these states (GLOBAL FOOTPRINT NETWORK, 2015).

The population of the United States of America (USA) in 1961 was 180 million inhabitants, registering a total ecological footprint of 1.64 billion global hectares (gha) and a total biocapacity of 1.03 billion gha.

During this period, the US had an environmental deficit of 64%, with the notable fact that its total ecological footprint was greater than the sum of the ecological footprints of China and India. Over the last six decades, the U.S.'s ecological footprint has fluctuated, reaching 2.52 billion gha, while total biocapacity has increased to 1.26 billion gha.

This resulted in an absolute environmental deficit of 1.3 billion gha and a relative deficit of 101%. This evolution highlights the changes in pressure on natural resources in the US over time, reflecting the complex interaction between population growth, consumption patterns and environmental impacts (Nathaniel, 2021; Global Footprint Network Institute, 2023; WWF USA, 2023).

When it comes to biocapacity, a measure of bioproductive land, it is Alaska, Texas and Michigan that stand out as the most resource-abundant states. In contrast, Rhode Island, Delaware and Arizona show the lowest biocapacities, indicating a more limited capacity to support ecological demand.

The states of California, Texas and Florida face the greatest ecological deficits, indicating that their demand for resources significantly exceeds the regenerative capacity of the environment. On the other hand, Alaska, South Dakota and Montana have the largest ecological reserves, suggesting a more balanced relationship between consumption and environmental regeneration capacity in these states (Global Footprint Network, 2015).

In the current scenario, humanity is heading dangerously towards an environmental catastrophe, as the constant increase in the ecological footprint is unbalancing the global climate and accelerating the process of mass extinction of species, known as the 6th extinction (Lamim-Guedes, 2018).

However, it is crucial to understand that this path also represents a route towards self-destruction and civilizational decline. Facing the challenges of survival and sustainability requires intricate approaches, diverse solutions and immediate action. Time is a precious resource, and we cannot afford to lose it in the face of this global urgency.

METHODOLOGY

This is a documentary, bibliographical and qualitative article. The scope of the research is the reports of the *World Wide Fund for Nature* (WWF). WWF is an independent conservation organization active in almost 100 countries, working to sustain the natural world for the benefit of people and wildlife. The organization is a growing coalition calling on world leaders to put nature on the road to recovery by 2030 - a New Deal for Nature and People as comprehensive as the global climate agreement (WWF, 2023).

Concerning **to** the bibliographic survey, a comprehensive search was carried out for articles, dissertations and theses on the ecological footprint in Brazil. The databases used were: *Scielo; Google* Scholar and the CAPES database **(**also known as CAPES Foundation, is a Brazilian federal government agency**)**. There were no time restrictions on the selection of studies, in order to cover the literature on the subject.

Data was collected through systematic searches on the Internet, using search terms such as "Ecological Footprint", "Brazil", " *World Wide Fund for Nature* ". The search was restricted to Portuguese and English to ensure the relevance of the selected literature. Academic articles, dissertations and theses which addressed the use of the Ecological Footprint in Brazil were considered for inclusion in the review.

Articles that had no direct link to the topic were excluded, as were those which were not available for reading. The selected articles were subjected to a detailed analysis, which included identifying the results and using the comparative method. The analysis focused on understanding the changes in Brazil's ecological footprint over time.

Reports from the *World Wide Fund for Nature* (WWF)

WWF, a non-governmental and non-profit organization, is dedicated to transforming the current trajectory of environmental degradation, aiming for a more equitable and healthy future for all, where society and nature coexist harmoniously.

To achieve this, we prioritize dialogue and collaboration with various sectors of society, including traditional communities, local organizations, companies and the government. At the heart of our approach is strengthening the actions of communities and initiatives that are at the forefront of protecting biomes (WWF, 2023).

The organization was founded in 1961. WWF describes itself as a network organization. Its composition and structure are dynamic. The organization is made up of around 30 National Offices (NOs) and 27 Programme Offices (POs) (Zwieten; Lamers; Van Der Duim, 2019). The purpose of the reports goes beyond merely determining the Ecological Footprint of a municipality or country; the organization seeks to establish it as an effective tool in urban environmental management.

Although the calculation plays a crucial role in this process, the WWF stresses that it is necessary to mobilize the population to understand its significance in depth. The idea is that, based on discussions about the results released by the organization, mitigation strategies will be developed in collaboration with the public and private sectors (WWF, 2012).

In this way, the calculation is not limited to a mere environmental accounting practice, but **it** becomes a catalyzing tool which will encourage the population to reconsider their consumption habits, favoring the choice of more sustainable products. In addition, this approach will seek to motivate companies to improve their production chains in favor of sustainability (WWF, 2012).

Ecological Footprint Met

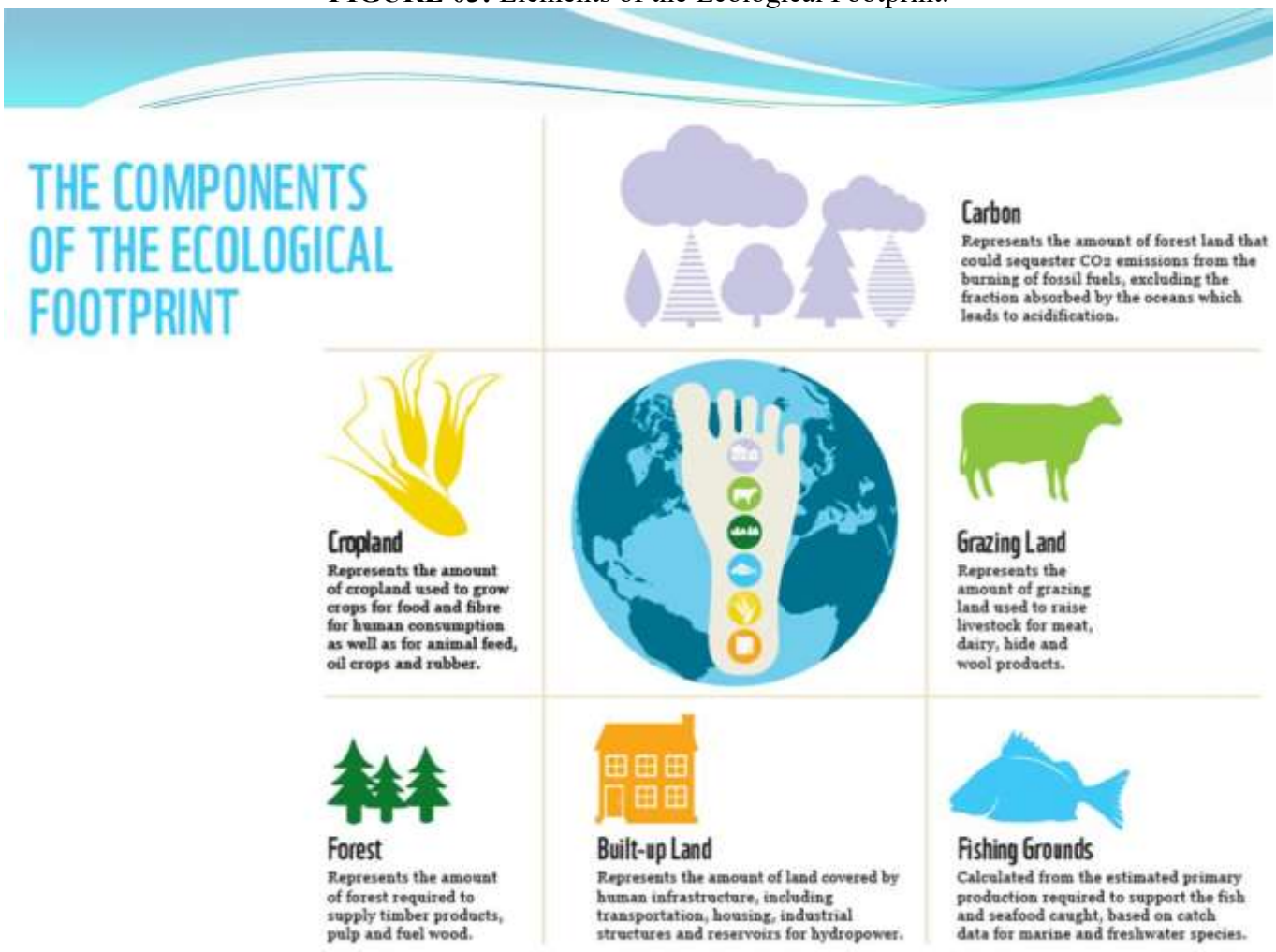
The concept of ecological footprint covers, not only the amount of resources we consume but also the extent to which we produce waste, considering the limits of the planet's capacity to absorb them and transform them into resources over time. This relationship is fundamental to assessing how the use of natural resources and the generation of waste align with the planet's capacity for regeneration. The understanding of this dynamic has led to the development of the concept of a sustainable society, which

advocates the balanced use of natural resources without compromising their availability for future generations as a result of the underlying activities of exploitation (Fontgalland, 2022).

The Ecological Footprint is an accounting method that evaluates humanity's simultaneous demands on the biosphere, comparing human demand with the planet's regenerative capacity. This process involves adding up the areas needed to provide renewable resources used by people, the areas occupied by infrastructure and the areas needed to absorb waste.

In the current national Ecological Footprint balance sheets, the resource inputs monitored include grain, fish, wood and pasture. CO_2 is the only waste currently considered. As human consumption covers global resources, the Ecological Footprint totals these areas regardless of their location on the planet (WWF, 2013).

FIGURE 03: Elements of the Ecological Footprint.



SOURCE: WWF, (2012).

To assess whether human demand for renewable resources and the absorption of CO_2 can be sustained, the Ecological Footprint is compared with the planet's regenerative capacity, i.e. its biocapacity. Both are expressed in global hectares (gha), representing the productive capacity of a hectare of land with average world productivity.

For Fontgalland (2022), the Ecological Footprint is a quantitative measure that assesses the natural resources needed to maintain society's standard of living. When an individual's level of consumption exceeds nature's capacity to replenish itself, they are contributing to unsustainable spending that poses a threat to future sustainability and the preservation of life on the planet. The Ecological Footprint uses flows of materials and energy to calculate the biophysical load that human populations or industrial processes impose on global ecosystems.

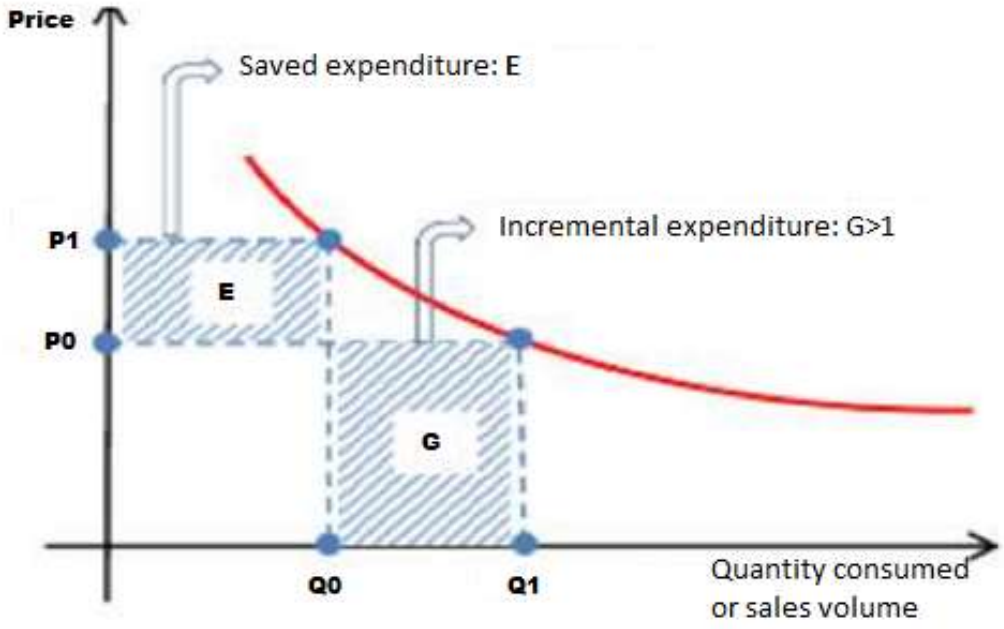
The assessment of the ecological footprint of the population of a given area, which represents the demand for services from natural capital, is carried out considering consumption within its geographical boundaries (Gonzalez; Andrade, 2015). This process is expressed according to Ewing *et al*. (2010) in Equation 1.

$$PE_c = PE_p + PE_i - PE_e \quad [1]$$

In the equation, PEc denotes the ecological footprint of consumption, while PEp reflects the demand for goods from the region, including food, forest products and the biocapacity used in urban areas, as well as the biocapacity needed to absorb the carbon emitted by the local population. PEi represents the same demand, but associated with the production of goods originating outside the region (imports), and PEe is the portion of PEp that corresponds to regional production destined for other areas (exports) (Ewing et al., 2010). This equation is used when the population's consumption data is not available, thus resorting to production and trade data (Ewing *et al*., 2010; Gonzalez; Andrade, 2015).

The ecological footprint methodology uses the key concept of *Overshoot*. Just as expenditure is compared to income in finance, the National Footprint Accounts compare Gross Domestic Product (GDP) values to assess the state of natural capital. A biocapacity deficit is identified when the Ecological Footprint value exceeds the biocapacity value. On the other hand, when the biocapacity exceeds the Ecological Footprint, the National Footprint Accounts indicate a situation of biocapacity reserves (Fontgalland, 2022).

FIGURE 04: Relationship between price and quantity consumed.



SOURCE: Wacknagel & Rees (1992); Fontgalland, (2022, p. 91).

The underlying premise is that different human activities, such as energy consumption, resources and waste emissions, require a certain amount of production, land or water to absorb. In a context of globalization, the Ecological Footprint provides *insights* into the elements needed to understand and sustain the existence of a specific human population, often situated far beyond the physical area in which that population resides (Fontgalland, 2022).

RESULTS AND DISCUSSION

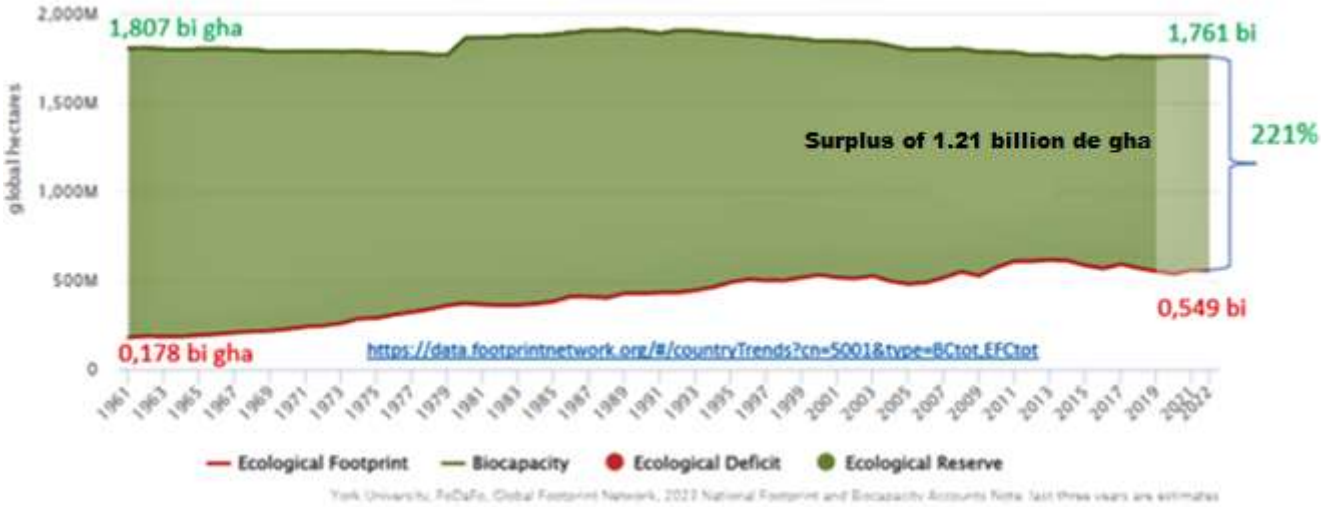
The Ecological Footprint in Brazil

Mathis Wackernagel reports that "Brazil is one of the richest countries in terms of biocapacity. But it hasn't taken advantage of this" (Neofeed, 2022). Mathis Wackernagel's statement highlights a perceived contradiction regarding Brazil and its position in terms of biocapacity. He notes that Brazil is considered one of the richest countries in terms of biocapacity, as shown in Table 01, which means that it has a significant capacity to produce natural resources and ecosystem services. However, he points out that this advantage has not been fully exploited or used effectively.

Despite the country's abundant natural resource potential and ability to provide ecosystem services, there is a gap or failure to transform this advantage into sustainable benefits. This gap can be attributed to various factors, such as unsustainable practices, inadequate policies, unbridled exploitation

of resources or a lack of effective environmental awareness. Figure 05 highlights the Ecological Footprint and Biocapacity in Brazil, from 1961 to 2022:

FIGURE 05: Ecological Footprint and Biocapacity in Brazil from 1961 to 2022.



SOURCE: Global Footprint Network Institute (2023).

Despite having the fifth globally largest ecological footprint, Brazil stands out notably for boasting the largest biocapacity on the planet and, consequently, the largest absolute environmental surplus worldwide. While Brazil's total footprint has doubled since 1961, the country's total biocapacity has seen a slight increase, driven by more intensive agricultural practices (Lamim-Guedes, 2018).

In 1961, with a population of approximately 75 million, Brazil had an ecological footprint of 0.178 billion gha and a biocapacity of 1.807 billion gha, resulting in an absolute environmental surplus of 1.62 billion gha. Over the last six decades, despite population and economic growth, the ecological footprint has increased, while total biocapacity has decreased. Even so, Brazil maintains the highest environmental surplus compared to all countries on the international stage.

According to Moran *et al*. (2008), in 1961, the reduction in this capacity over time in Brazil is mainly attributed to population growth, since an increase in the number of people results in a smaller bioproductive area available. The authors point out that this phenomenon represents horizontal growth in scale, which is more prominent in less developed countries, where there are more people with a more or less constant level of individual consumption. At the same time, there is vertical growth in scale, characteristic of developed countries, in which the population remains more or less constant, but individual consumption levels increase.

Currently, the greatest threat to the intensification of ecological footprint growth is the combination of horizontal and vertical scale growth in the economic system. This phenomenon is particularly observed in developing/emerging countries such as Brazil, Russia, India, Indonesia, China and South Africa (BRIICS group), where population growth persists, coupled with increased consumption made possible by the population's rising income levels (Gonzalez; Andrade, 2015). These concerns, highlighted in the WWF report International (2012), point to the potential for higher ecological footprint estimates for these countries in the near future.

Wackernagel highlights the importance of not only having biocapacity, but also managing and using it in a responsible and sustainable way. The mere presence of natural resources does not automatically guarantee sustainable use, and the effective management of these resources is essential to ensure the continuity of environmental benefits in the long term (Neofeed, 2022).

In 2022, with a population of 203,062,512 (IBGE, 2022 – Brazilian Institute of statistics and geographic issues), Brazil had an ecological footprint of 0.549 billion gha and a biocapacity of 1.76 billion gha. As a result, the absolute environmental surplus was 1.21 billion gha, corresponding to a relative surplus of 221%.

There are notable disparities in the per capita ecological footprint between different segments of the population. For example, many residents from Rio de Janeiro or São Paulo have footprints higher than the average US citizen, while in other regions of the country, such as in the countryside cities of the northeast and the Amazon, the ecological footprint is significantly lower.

The average Ecological Footprint in the state of São Paulo in 2012 was 3.52, indicating that if everyone on the planet adopted a lifestyle similar to that of São Paulo residents, it would take almost two planets to sustain such consumption. In comparison, the Ecological Footprint of the city of São Paulo is 49% higher than the national average and 25% higher than that of the state of São Paulo. In turn, the state of São Paulo has an Ecological Footprint 20% higher than the Brazilian average, which is 2.93 global hectares per person. It can be seen that although there are differences in the scale of consumption of ecological resources between the city, the state and Brazil as a whole, the distribution patterns are similar. There is a distinctive Brazilian pattern, highlighting the demand for areas of pasture, agriculture and CO_2 absorption, compared to the global average, influenced by the low intensity of emissions in the electricity matrix and the efficient use of resources (WWF Sâo Paulo, 2012).

A study carried out in Campo Grande - MS, shows that the average Ecological Footprint of the city's inhabitants is equivalent to 3.14 global hectares, indicating that the population uses an area of 2,471,821 global hectares. This figure represents 35% of the state's Ecological Footprint and 0.46% of the country's Ecological Footprint. In comparison, Campo Grande's Ecological Footprint is 8% higher than

the Brazilian Ecological Footprint, 10% higher than that of the State of Mato Grosso do Sul and 14% higher than the global average (as shown in Figures 01 and 05). The state of Mato Grosso do Sul, on the other hand, has an Ecological Footprint 3% lower than the Brazilian average (WWF Campo Grande, 2012).

The average Ecological Footprint per inhabitant in the municipality of Natal is 3.44 global hectares, exceeding the world's biocapacity (1.8 gha/cap) by 1.63 global hectares per person. This implies that if all the planet's inhabitants adopted a consumption pattern similar to the people from Natal, 1.9 planets would be needed to sustain this lifestyle. In addition, to exceeding the planet's regeneration capacity, the Ecological Footprint of Natal's citizens is 15% higher than the Brazilian national average and 21% higher than the global average.

In the state of Minas Gerais, Gonzalez and Andrade (2015) report that its ecological footprint in 2008 was approximately 4.75 gha per capita, while the global biocapacity in 2007 was 1.8 gha per capita.

The creators of the ecological footprint calculation emphasize that the results of each region's ecological footprint should be compared with global biocapacity. According to this perspective, the footprint should not be interpreted as an exclusive indicator of local sustainability, but rather as a measure of the region's contribution to global unsustainability. This can limit the indicator's usefulness for environmental management at a local level (Costanza, 2000; Veiga, 2010; Gonzalez; Andrade, 2015).

By comparing the local per capita footprint with the global per capita biocapacity, it is possible to determine the minimum number of planets Earth needed to maintain the region's consumption pattern, if this pattern were universalized on a global scale (MORAN et al., 2008).

For WWF (2022), in its Living Planet report, significant transformations can be triggered by strategic interventions, carefully planned to impact crucial points at various scales of action. These interventions aim to alter the architecture of choice which underpins everyday decisions. The creation of these interventions and the conditions necessary for their realization must balance competing objectives, considering different localities and groups within the socio-ecological system (WWF Planeta Vivo, 2022).

In addition, it is vital to consider the role of incentives and political barriers in the implementation of these policies, as shown in Figure 06.

FIGURE 06: Creating possible conditions.

SOURCE: WWF Living Planet (2022).

Transformative change requires a comprehensive approach, combining regulations, public engagement and behavioral and market-based instruments. At the same time, it is crucial to stop harmful subsidies and disincentives that could hinder such changes. This multi-faceted approach is key to fostering real and lasting transformation in the way we make decisions and operate in our socio-ecological system.

Research conducted by scientists at *Oxford* University has established an unprecedented link between meat consumption, health, the environment and the economy. The researchers point out that the rearing of ruminant animals has significant impacts on the planet, since these animals release considerable amounts of methane gas into the atmosphere, methane being 21 times more potent in terms of the greenhouse effect than carbon dioxide (CO_2). In addition, the practice of livestock farming and agriculture leads to the deforestation of forest areas, resulting in the loss of trees' ability to absorb CO_2 and a significant reduction in local biodiversity (Springmann *et al*., 2016).

Scientists have also identified that reducing meat consumption is associated with a reduction in chronic non-communicable diseases related to excess weight and unhealthy diets. In the economic context, they predict that healthier habits can result in lower spending on disease treatment, implying significant annual savings, estimated at between US$700 billion and US$1 trillion (Springmann *et al*., 2016).

The Ecological Footprint faces a major barrier, as its objectives often conflict with economic interests. These economic interests often take priority, as they offer quicker solutions to financial

problems. However, the Ecological Footprint clearly highlights, through data, the social and environmental risks facing humanity (SOUZA *et al.,* 2017).

It is important to emphasize that the intention is not to diminish people's quality of life, but to learn how to use natural resources consciously. However, this reality still seems distant due to unbridled consumerism, which generates significant profit and prioritizes the interests of the majority, ignoring the drastic consequences of the unbridled exploitation of natural resources and the finiteness of the planet.

CONCLUSIONS

The current situation in which human beings are putting the planet is alarming due to their lifestyle patterns and habits, especially in richer and more developed countries, endangering not only the human species, but also all other species.

The analysis of the Ecological Footprint deficit in Brazil, in the light of reports by the *World Wide Fund for Nature* (WWF) and in the literature, showed the complexity of the environmental challenges and the opportunities for more sustainable management of natural resources. The analysis reveals marked disparities between the country's biocapacity and its Ecological Footprint, pointing to a significant gap in transforming the abundance of resources into sustainable benefits.

Brazil, possessing one of the greatest biocapacities on the planet, nevertheless faces crucial challenges in transforming this advantage into sustainable benefits. The increase in the Ecological Footprint over the decades, in contrast to the discreet growth in biocapacity, signals the need to address unsustainable practices, inadequate policies and the unbridled exploitation of resources.

The continued growth of the Ecological Footprint, even in the face of population and economic growth, presents critical challenges. The combination of horizontal and vertical scale growth in Brazil's economic system poses a threat to environmental sustainability. It is imperative to develop strategies that balance economic growth with the preservation of natural resources.

Responsible management of biocapacity is emerging as an essential requirement for guaranteeing long-term environmental benefits. The presence of natural resources does not automatically guarantee sustainable use; it is the effective management of these resources that determines sustainability. Mathis Wackernagel's recommendations on the importance of managing and using biocapacity responsibly highlight the need for a holistic approach to natural resource management.

WWF reports highlight the importance of strategic interventions to trigger significant transformations. These interventions must impact crucial points at various scales of action, altering the architecture of choice that underpins everyday decisions. A multi-faceted approach combining

regulations, public engagement and behavioral and market-based instruments is essential for real and lasting transformation.

It is worth noting that the Ecological Footprint faces challenges due to conflicts with economic interests. Prioritizing quick solutions to financial problems often takes precedence over the objectives of the Ecological Footprint. However, raising awareness of social and environmental risks is fundamental. The challenge lies in balancing immediate economic interests with the need to preserve the environment for future generations.

Finally, the study highlights the need to rethink consumption models and adopt more sustainable practices. The Ecological Footprint deficit in Brazil requires a proactive and collaborative response from policymakers, communities and economic sectors. Only through strategic interventions and a fundamental change in approach to natural resources can we aspire to a future where Brazil's biocapacity is effectively transformed into sustainable benefits, ensuring harmony between economic development and environmental preservation.

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