Planetary Pressures-Adjusted Human Development Index in the States of Brazil

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1. Introduction

The Covid-19 pandemic experience illustrated an alarming truth long predicted by the scientific community: zoonotic pandemics, in which pathogens transition from animals to humans, are a direct consequence of our intensive exploitation of the environment (Taylor, Latham, and Woolhouse, 2001). This health crisis reflects the proposal of a new geological era, the Anthropocene, defined by human influence over the planet, occurring at an unprecedented scale, speed, and scope (Zalasiewicz et al., 2019). At the same time, the pandemic highlighted and exacerbated pre-existing global inequalities, making it clear that crises, while universal, have disproportionate impacts, affecting those in vulnerable situations more severely. In this context, Covid-19 is not only a public health crisis but also an acute symptom of the ecological and social imbalances fueled by disparities in wealth and power around the world (UNDP, 2020).

In light of the challenges posed by the Anthropocene, there is a clear need to evolve the metrics that define human development. Since its inception in 1990, the Human Development Index (HDI) has proposed a paradigm shift by focusing on basic elements for a minimum quality of life, considering income, education, and health as its pillars. While this measure has significantly influenced public and political discourse and has been expanded to incorporate factors such as inequality, gender, and multidimensional poverty, it is recognized that its components do not reflect the pressures exerted on the planet (UNDP, 2020).

The UNDP (2020) proposes a global methodology to calculate the Planetary Pressures-Adjusted Human Development Index (PHDI). The present study aims to present a proposal for calculating the PHDI adapted to the Brazilian context, applied to the 27 states, using the HDI calculated by the João Pinheiro Foundation in partnership with the UNDP as a basis.

2. Planetary Pressures-Adjusted Human Development Index

The Planetary Pressures-Adjusted Human Development Index (PHDI) emerged as an attempt to harmonize high performance in the index with a lower ecological footprint. The reformulation of the HDI accounts for environmental impact through a corrective factor based on per capita carbon dioxide emissions and per capita material footprint (UNDP, 2020).

The first indicator considers carbon dioxide emissions produced as a consequence of human activities (such as coal, oil, and gas combustion for industrial processes, gas flaring, and cement manufacturing),

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divided by the mid-year population. The values represent territorial emissions, meaning that emissions are attributed to the country or region where they physically occur. The estimates include emissions of all gases provided for in the Inventories, but with a primary focus on carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O), which account for over 99% of emissions in carbon dioxide equivalent (CO2e).

The material footprint refers to the total amount of raw materials extracted to meet the demands of final consumption. It is an indication of the pressures exerted on the environment to support economic growth and meet people's material needs (UNSTATS, 2024). The Material Footprint is a consumption-based resource use indicator. It is calculated as the equivalent of imported raw materials plus domestic extraction minus the equivalent of exported raw materials. Studies on material flow accounting by Eurostat (2018) and the United Nations Environment Programme (2023) treat the national economy as a black box, excluding the flows of materials in and out associated with trade, as well as the flows of recycling or reuse within the economy and the mobilization of materials that do not enter the economic process.

3. Methodology and Database

Brazil developed the Municipal Human Development Index (MHDI), which is based on the global HDI methodology but adjusted to apply to the local context of Brazilian municipalities. The MHDI is an initiative of the United Nations Development Program (UNDP) in partnership with the João Pinheiro Foundation (FJP) and the Institute for Applied Economic Research (IPEA). In census years, it is calculated for all Brazilian municipalities using data from the Demographic Census conducted by the Brazilian Institute of Geography and Statistics (IBGE), and in non-census years, it is calculated using the Continuous National Household Sample Survey (PNADC), also conducted by the IBGE. This produces the index for all states and metropolitan regions included in the survey's sampling plan, referred to as the MHDI Radar.

The PHDI is calculated as the product of the HDI and (1 - planetary pressures index), where (1 - planetary pressures index) can be seen as an adjustment factor (UNDP, 2022). The adjustment factor for planetary pressures is the arithmetic average of the indices that measure per capita carbon dioxide emissions and per capita material footprint, which assumes a perfect substitution between these two indicators.

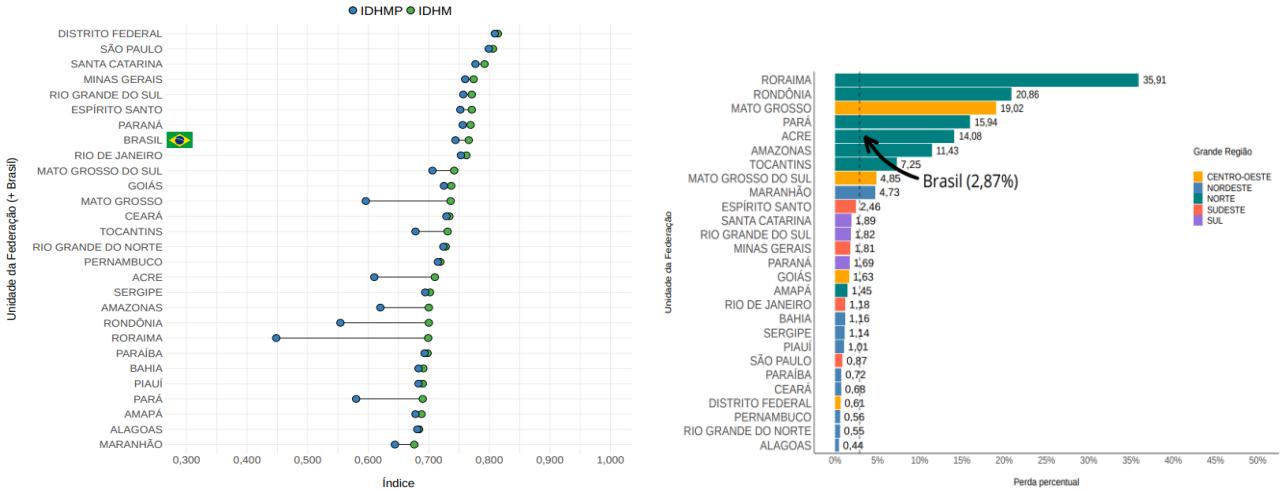
Regarding data sources in Brazil, the SEEG (Greenhouse Gas Emissions and Removals Estimation System) provides estimates of greenhouse gas (GHG) emissions and removals from economic activities occurring within Brazilian territory. SEEG is overseen by the Climate Observatory, a network formed by non-governmental organizations and social movements. The platform provides the public with dynamic tables, maps, graphs, and infographics, enabling queries based on territorial divisions or economic sectors, divided into five major groups representing the sources of these gas emissions: Agriculture, Energy, Industrial Processes and Product Use (IPPU), Waste, and Land Use and Forests (LUCF).

As for the material footprint, there is no single data-producing source in Brazil, so its compilation involves different sources. However, a significant obstacle in the data collection for the material footprint in this study is the lack of inter-state trade data measured in tons. Therefore, in the current version of this article, this indicator was not used, but future studies are encouraged to include it or explore a proxy for this indicator.

4. Analysis of Results

In 2021, the Federal District, São Paulo, Santa Catarina, and Minas Gerais occupied the top positions in the MHDI ranking, revealing them as the states with the highest human development in the country. In contrast, Piauí, Amapá, Alagoas, and Maranhão were the states with the lowest MHDI in Brazil in 2021. However, when calculating the Planetary Pressures-Adjusted MHDI (PHDMI), the top-ranking states remained in the leading positions, while the lower-ranked states showed improvement: Piauí, Amapá, Alagoas, and Maranhão moved up to the 16th, 19th, 18th, and 21st positions, respectively. The lowest-ranking states in the PHDMI were Roraima, Rondônia, Pará, and Mato Grosso, revealing a different panorama in Brazil when greenhouse gas emissions are considered in the MHDI. Graph 1 presents the MHDI and the PHDMI for the states and Brazil.

Graph 1: MHDI, PHDMI and Percentage losses in PHDMI compared to MHDI – Brazilian States and Brazil - 2021



Source: UNDP/FJP/Ipea and Own Work.

The results of the Northern region stood out, showing that it is a region exerting significant planetary pressures within its territory, and when the MHDI calculation is adjusted, these states suffer the most losses. Roraima dropped by 35.91%, and Rondônia by 20.86%. Additionally, Mato Grosso fell 13 positions in the ranking, with a decline of 19.02% in its MHDI. Graph 1 presents the percentage losses for all states and shows that Brazil as a whole experienced a 2.87% decline in 2021.

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