Brief notes on Sustainable Development

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Abstract. This analysis compares five recent papers on measuring sustainable development, published between 2021 and 2023. The papers discuss various aspects of sustainable development, including resource security, ecological breakdown, and carbon emissions. The objective of this paper is to briefly describe each one of them and them to explore the similarities between them. The papers by Aleissa and Bakshi (2023), Hickel (2020), and Hickel et al. (2022) all base their arguments on social justice, with Hickel (2020) and Hickel et al. (2022) addressing carbon emissions and resource use, respectively. Wackernagel et al. (2021) examines resource security and its impact on poverty eradication, revealing unequal resource distribution among countries. The results of these papers emphasize the disproportionate responsibility of high-income countries in terms of resource consumption and climate change, highlighting the need for more equitable policies and resource distribution.

Keywords. Sustainable development; Measurement; Responsibility; Fair and Just transition.

1. Introduction

This analysis looks at five papers contributing to the discussion on measuring sustainable development. The publications are all recent, dating from 2021 to 2023. This comparative exploration aims to clarify each paper's premises, results, and implications.

This work will review the following papers: *Quantifying national responsibility for climate breakdown: an equality-based attribution approach for carbon dioxide emissions in excess of the planetary boundary*, by Hickel, 2020 [1]; *The importance of resource security for poverty eradication*, by Wackernagel et al., 2021 [2]; *National responsibility for ecological breakdown: a fair-shares assessment of resource use, 1970-2017*, by Hickel et al., 2022 [3]; *Compensation for atmospheric appropriation,* by Fanning and Hickel, 2023 [4]; and, *Possible but rare: Safe and just satisfaction of national human needs in terms of ecosystem services*, by Aleissa and Bakshi, 2023 [5].

2. Literature Review

2.1 Hickel (2020)

The first paper to be presented is *"Quantifying National Responsibility for Climate Breakdown: An Equality-based Attribution Approach for Carbon Dioxide Emissions in excess of the planetary boundary*" by Hickel, 2020. The author discusses the allocation of responsibility for climate change itself and the damage related to it, based on the fact that countries that have contributed more to global emissions should be more responsible for the problems generated than those countries that have contributed less.

In the literature in general, the method adopted to measure the contribution of emissions focuses on current annual territorial emissions or cumulative territorial emissions. As this methodology does not simultaneously take into account the scale of national emissions and the size of the country's population, the paper proposes a new method that looks at national contributions to cumulative CO2 emissions that exceed the planetary limit of atmospheric CO2 concentration and takes into account countries' historical emissions (as far as possible from a final consumption perspective) and the size of the population of the country in question. What matters are the stocks of CO2 in the atmosphere, not the annual flows; and the atmosphere is a finite shared resource, in which everyone is entitled to an equal share.

The results of this new approach show that high-income countries bear a greater degree of responsibility for climate damage than previous methods showed. These new results can guide conceptualizing and quantifying responsibility for ecological, social, and economic damage, which is of particular importance for low-income countries that suffer disproportionately from climate damage despite not having contributed to excess emissions, bringing a fairer framework for assigning national

responsibility for excess emissions.

In this way, high-income countries should not only reduce emissions to zero faster than other countries but should also pay their climate debts, which are conceptualized here concerning the planetary boundary. This is because a small number of high-income countries have appropriated substantially more than their fair share of the atmospheric commons (what the author called the process of atmospheric colonization).

2.2 Wackernagel et al. (2021)

The paper is named "*The importance of resource security for poverty eradication*" and raises the issue of guaranteeing biological resources at safe levels for the Earth's population. According to the authors, the demand for biological resources has exceeded the amount produced by the Earth's ecosystems and has become a bottleneck for the human economy. The key point is that the availability of these resources is not only not evenly distributed across the planet, but how this will affect agents will be unequal. Thus, the paper examines how different populations are exposed to the risks of biological resources, arguing that ignoring the importance of increasing the security of a population's resources undermines its development prospects.

The authors estimate that only 2% of the world's population lives in countries that have resource availability and are high-income (HR). Meanwhile, 72% of the population lived in low-income, resource-deficit (LD) countries - and this is constantly increasing, with a population growth rate well above the world average. The study also shows that people living in high-income, resource-deficit (HD) countries are responsible for consuming 367% of global biocapacity (on a per capita basis). It is worth noting that on average, residents of HR countries use 2.6 times more than residents of LD countries.

This analysis reveals a fundamental change in the determinants of countries' future development success and their ability to eradicate poverty and hunger. Economic activities require material inputs, including energy. In the event of overshoot, these inputs will inevitably have to be reduced, a process called "dematerialization" - it will challenge, to varying degrees, the continuity of these economic activities. The authors believe that success in eradicating poverty will be impossible without a focus on the security of biological resources. It shows that the security of biological resources is becoming a more influential factor, unlike in the past. They also emphasize that conventional development strategies, promoted by the main international institutions or the main development economics textbooks, do not address this issue.

Thus, the most exposed group of countries are those already in the LD quadrant, as the pressures to reduce resources may come faster than the speed with which countries can adapt, considering the delays in adjusting physical infrastructure and the size of human populations. Life-threatening risks may be greater for low-income regions. A rapid and massive reduction in resource use and a decrease in the carbon footprint would probably be catastrophic for low-income countries, where a large part of the footprint is related to the demand for food.

The authors therefore conclude that advancing resource security is becoming an indispensable strategy for eradicating poverty and ensuring development success.

2.3 Hickel et al. (2022)

"*National responsibility for ecological breakdown: a fair-shares assessment of resource use, 1970-2017*" go beyond Hickel's paper (2020) about carbon emissions and address national responsibility for global resource extraction and the consequent ecological collapse. The study starts from the premise that not all nations are equally responsible because some nations have used far more resources per capita than others. For the authors, everyone has the right to a fair and equitable share of the use of global resources at a sustainable level.

The results show that high-income nations are responsible for 74% of the world's excess material use. Upper-middle-income countries were responsible for 25% of the cumulative excess use of materials. Lower-middle-income countries and low-income countries together accounted for less than 1%. The Global South is responsible for just 8%. Thus, the authors claim from their analysis that countries that remained within their fair share of the limit between 1970 to 2017 have no responsibility for the overuse of resources.

This implies that high-income nations are primarily responsible for the global ecological collapse and urgently need to reduce resource use to fair and sustainable levels. High-income countries, which represent only 16% of the world's population, are responsible for 74% of resource use that exceeds fair quotas and are therefore the main drivers of global environmental degradation, representing a process of ecological colonization. In addition, most of the ecological pressure caused by overconsumption in rich nations is outsourced to poorer nations. According to a recent analysis, more than 50% of excess consumption in rich nations is appropriated by poorer nations in the Global South. This appropriation not only causes ecological damage in poorer nations but also depletes the material resources they could use to meet human needs and expand their sovereign industrial capacity.

The transition to sustainable levels of resource use will likely require the adoption of transformative post-growth and de-growth approaches, including abandoning GDP growth as a goal, reducing inequality, and organizing the economy around human needs while reducing unnecessary commodity production. However, this change will require confronting the powerful network.

In conclusion, a fair assessment of resource use shows that high-income nations are primarily responsible for global ecological collapse and therefore owe an ecological debt to the rest of the world. These nations should take the lead in radically reducing their resource use to avoid further degradation, which is likely to require transformative post-growth and de-growth approaches.

2.4 Fanning & Hickel (2023)

The paper from Fanning & Hickel is named "*Compensation for atmospheric appropriation*" start from the premise that not all countries are equally responsible for the depletion of carbon budgets and, therefore, historical responsibility should be taken into account so that attribution is fairer.

Thus, countries that exceed the limit owe compensation or reparations to countries that do not reach the limit, for atmospheric appropriation and climate-related damage. The text proposes a procedure for quantifying the level of compensation needed to achieve certain desired scenarios.

The results can be divided into two stages. First, the results show that the Global North is more responsible for depleting the carbon budget than the Global South. This is because the group of Northern countries, with their high level of emissions, exhausted their collective fair share of the carbon budget in 1969, then exceeded their fair share of 1.5 °C in 1986, and then exceeded their fair share of 2 °C in 1995. All the countries of the global North have exceeded their fair shares of 1.5°C and, collectively, are responsible for most (91%) of the accumulated overshoot between 1960 and 2019.

Meanwhile, the South, even though it is home to more than 81% of the total population, its aggregate cumulative emissions exceeded the carbon budget's fair quotas only in 2012 - more than two decades later than the world as a whole. Moreover, the only countries that remain within their fair quotas of 1.5°C over the same period are all from the global South. If this group of countries [South] were to collectively pursue ambitious mitigation following our net zero scenario between 2020 and 2050, they would only use 50% of their fair share of 1.5 °C.

The other set of results involves quantifying the compensation owed by countries that have exceeded the emissions limit to countries that have not exceeded the emissions limit for the appropriation of atmospheric commons. The cumulative financial compensation from the countries that exceed the limits to the ones that do not exceed the limits in a world that reaches net zero between 2020 and 2050 can be valued at US$192 trillion. The results suggest that this monetary value converts into an average compensation of US$ 940 per capita per year in the countries that fell short in the authors' analysis and that would have their fair shares appropriated, which are home to most of humanity.

Therefore, the paper found that almost 70% of the variability between countries in accumulated GDP per capita can be explained exclusively by differences in accumulated emissions about fair quotas. In conclusion, these findings support the view that countries that exceed targets tend to enrich themselves by appropriating more than their fair shares of the atmospheric commons.

2.5 Aleissa & Bakshi's (2023)

The paper "*Possible but rare: Safe and just satisfaction of national human needs in terms of ecosystem services*" uses information from the food-energy-water nexus to study the impact of providing essential food, energy, and water resources in an environmentally safe and socially just way. To be socially just, nations need to guarantee resources to meet their basic needs. To be environmentally secure, meeting these needs must not result in exceeding the capacity of the nation's ecosystems to provide goods and services.

The results are presented from two perspectives: carbon sequestration and water supply. Regarding carbon sequestration, only 16 countries (9%) currently meet the security and justice requirements. The social justice requirement is met by 175 countries (98%), which means that their GHG emissions exceed the minimum emissions needed to guarantee their population's food, energy, and water resources using current approaches.

Countries emit significantly more than the carbon sequestration capacity of their national ecosystems. The results reinforce findings in the literature on the relationship between environmental degradation and human development. Despite the ability of safe spaces to meet the just requirement, some people do not have access to these services, which draws attention to a critical distribution issue.

Quantifying nations' emissions concerning their sequestration capacity reveals that most countries are operating unsustainably. The safe and fair space defined in the research confirms that low- and lower-middle-income countries with high ecological supply have a range of operating conditions under which they can develop and improve the well-being of their population. In contrast, high-income countries with high levels of emissions must reduce their current levels of demand. Countries where security and justice requirements cannot be met simultaneously need more critical transformations.

In addition to reducing the environmental impact of human activities worldwide, it is crucial to ensure that these reductions do not prevent societies from guaranteeing basic food, energy, and water needs and levels of well-being. Notably, social and ecological limits can overlap as a result of the trade-offs between human development objectives and environmental conservation.

3. Checking the similarities:

premises, results and implications

3.1 From the Beggining

This brief note will start with the paper "*Possible but rare: Safe and just satisfaction of national human needs in terms of ecosystem services*" by Aleissa and Bakshi, 2023.

Aleissa and Bakshi (2023) use information from the food-energy-water nexus to study the impact of providing essential food, energy, and water resources in an environmentally **safe** and socially **just** way, using a framework based on biophysical models and data to determine these minimum requirements. The paper starts from the premise that there is a social basis based on the minimum consumption of these resources to guarantee the basic needs of a population. It uses these indicators in terms of water consumption and greenhouse gas emissions.

Similarly, the papers "*Quantifying national responsibility for climate breakdown: an equality-based attribution approach for carbon dioxide emissions in excess of the planetary boundary*", by Hickel, 2020, and "*National responsibility for ecological breakdown: a fair-shares assessment of resource use, 1970-2017*", by Hickel et al., 2022, also start from a premise based on social **justice**. Hickel (2020) discusses the allocation of responsibility for climate change and its damage and believes that countries that have contributed more to carbon emissions should be held more responsible for the problems generated by these emissions than those that have emitted less. In order to achieve this and seek a fairer approach, he presents a method that looks at cumulative historical CO2 emissions and takes into account the size of the population of the countries in question.

Hickel et al. (2022) address national responsibility for global resource extraction and its consequent ecological collapse more broadly than quantifying carbon emissions. According to the authors, everyone should have the right to a **fair share** of the use of global resources in a sustainable way, and therefore, starts from the premise that not all nations are equally responsible for the ecological collapse since certain nations have used far more resources in per capita terms.

Complementing the premises presented in the paper by Aleissa and Bakshi (2023) concerning the **secure** supply of resources, the paper "*The importance of resource security for poverty eradication*" by Wackernagel et al., 2021, raises the issue of guaranteeing biological resources at secure levels for the Earth's population. The paper starts from the premise that the demand for such resources has become a bottleneck for the human economy. And given that their availability is not distributed equitably across the planet, this will have an unequal impact on agents and could disproportionately harm some nations, including in terms of development prospects.

3.2 Discussing the Results

Wackernagel et al. (2021) estimated results show that only 2% of the world's population lives in countries with an availability of resources and are high-income (which they called the HR group), while 72% of the population lives in countries with a deficit of resources and are low-income (which they called LD). They also pointed out that the population of this group has been growing steadily, with population growth rates well above the world average. Another group presented in the results is the group of people who live in resource-deficit and high-income countries (called HD). These people are responsible for the resource consumption of 367% of global biocapacity per capita – about 2.6 times more than residents of LD countries.

The results of Hickel (2020) and Hickel et al. (2022) also point to the **excessive** use of resources/emissions by high-income countries. The historical and per capita method Hickel (2020) used generated results showing that high-income countries bear a greater degree of responsibility for climate damage than previous studies stated. For example, the US and the EU have seen an increase in their share of responsibility, while China's has fallen. Hickel et al. (2022) show that high-income nations are responsible for 74% of the world's excess materials, while lower-middle-income countries are responsible for less than 1%. Looking only at the countries of the Global South, their contribution was only 8%.

Looking more globally, the results by Aleissa and Bakshi (2023) are presented from two perspectives – carbon sequestration and water supply. They are measured through the parameters of environmental **justice** and **security**. It was found that 67% of the nations studied operate within their safe and just space for water supply, but only 9% do carbon sequestration properly, and only 6% meet both requirements. Thus, the study reveals that most countries operate **unsustainably**, especially in their carbon sequestration capacity. Furthermore, the study reinforces the relationship between environmental degradation and human development.

3.3 Discussion and Implications

As briefly presented previously, Wackernagel (2021) talks about the development prospects of the populations most exposed to the risks of biological resources. His study implies that there should be fundamental changes in the determinants of countries' development success in the future. Conventional development strategies must adequately address the new challenges of the dematerialization process, and the current economic activities will inevitably have to be reduced. The authors argue that the countries most exposed to this

process are those belonging to the LD quadrant (resource deficit and low income). This is because the pressures to reduce resources may come faster than the speed with which countries can adapt. Moreover, a large part of this group's footprint is related to the demand for food.

However, the accumulated ecological debt, which has left the carbon concentration higher than the level needed for a global warming ceiling of 2°C, has brought catastrophic and unequal consequences. The point is that not all nations have been equally responsible for this excess and should not have to share the same responsibilities. This is what Hickel (2020) argues. The results presented in his paper provide guidelines for making ecological, social, and economic damage accountable. In general, low-income countries suffer disproportionately from climate damage even if they have not contributed significantly to excess carbon emissions, for example. Thus, high-income countries should reduce emissions to zero faster than other countries and pay their climate debts since they would have appropriated a substantially larger share than their fair share of the atmospheric commons – what the author called the process of atmospheric colonization.

Similarly, Hickel et al. (2022) can draw the same implication. High-income nations are primarily responsible for the global ecological collapse and urgently need to reduce their use of resources to fair and sustainable levels. In addition to the disproportionate consumption of resources by nations, the authors also state that low-income countries appropriate more than 50% of the excess consumption of high-income nations, which causes damage to poorer nations, characterizing a process of ecological colonization. These low-income (or lower-middle-income) nations will be further harmed and need to adopt new development models, given that the activities of the current development pattern are carbon-intensive and make excessive use of ecological resources. Thus, complementing Wackernagel et al. (2021) suggestion of new development patterns, Hickel et al. (2022) states that the transition to sustainable levels of resource use will probably require the adoption of transformative post-growth and de-growth approaches, including the abandonment of GDP growth as a goal.

Finally, Aleissa and Bakshi (2023) suggest two action plans to help nations move closer to a safe and fair operating space scenario for nations to operate in. These are drastic changes in food and energy production practices, rehabilitation, and restoration of local ecosystems. The point is, as discussed in all the papers presented so far, low-income countries have less capacity to adapt and invest in the technological changes needed for the transition. It may be because these nations need more financial resources, because they are home to a more significant part of the population, or because their demand is basically to meet basic needs. The critical point is the finding made by Hickel (2020) and Hickel et al. (2022) that these nations bear very little responsibility for the environmental damage caused in recent years.

Here we can introduce the 2023 paper by Fanning and Hickel, "Compensation for atmospheric appropriation". For example, to comply with the suggestions of Aleissa and Bakshi (2023), low-income countries would need external financial resources. Fanning and Hickel (2023) quantify the level of compensation that high-income countries should provide if the world is to achieve specific desired scenarios. Firstly, the authors find that the Global North is more responsible for depleting the carbon budget than the Global South, with the North even having appropriated half of the South's share (climate colonialism). There should, therefore, be compensation owed by countries that have exceeded the emissions limit to countries that have not exceeded the emissions limit for the appropriation of the atmospheric commons.

The results suggest that this monetary value converts into an average compensation of US$ 940 per capita per year in the countries that fell short and would have their fair shares appropriated, home to most of humanity. Fanning & Hickel (2023) state that almost 70% of the variability between countries in accumulated GDP per capita can be explained exclusively by differences in accumulated emissions in relation to fair shares, which reiterates the idea put forward by Wackernagel et al. (2021) of abandoning GDP as a development target.

4. Final Considerations

The present paper emphasized the disproportionate responsibility of high-income countries in terms of resource consumption and climate change, highlighting the need for more equitable policies and resource distribution. Although the papers differentiate in measurement approaches, all of them shows the unequal impact and unequal responsibility from richer and poorer countries.

5. References

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