

Sustainable Development: Measurable, or Not Measurable, That Is the Question.

Beatriz Silvestre Puchalski

Environmental Engineering, Federal University of Paraná, Curitiba, Brazil, b.silvestre.p@gmail.com.

Abstract. Although the term sustainable development is widely known, there are doubts if humanity is going in this direction. Not only because of the impact of human actions, but in the way it is measured. How to know if there is progress towards sustainability development without metrics? The objective of this article was to carry out a small systematic review about ways to measure sustainable development and its limitations on a global scale. The Web of Science (WoS) was the database used. The keyword "sustainable development" was searched and 26509 articles were found. To refine the search the filter by title and period of time (2019-2021) was applied resulting in 85 articles. After an accurate reading, only 6 of them were useful. Two ways of measurement were found: The Sustainable Development Goals (SDGs) and Sustainable Development Index (SDI). The limitations to measure sustainable development taken were: lack of data, unclear definitions or terminology, the problem with wrong translations, the environmental system simplifications and financial costs. In the period from 1994 to 2021, there was an upward trend in the number of articles published in WoS with the mentioned filters, which indicates progress towards answers. As the planetary boundaries are crossed, it increases the importance of measure and act beyond decisions related to the development of humanity.

Keywords. sustainable development measurement, limits of sustainable development, development environmental metrics.

1. Introduction

The report: *Our Common Future*, published by the World Commission on Environment and Development (WCED) in 1987 into the United Nations General Assembly, was the first time that the term sustainable development appeared. The definition of sustainable development presented was: "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [1]. This means that development has limits based on the current environmental and economic state and on the Earth's ability to recover from the impacts generated by human activities. This term was created as an attempt to unite the environment and the economy, as both are related.

How to know if there is progress towards sustainability development without metrics? To know whether the development of humanity is sustainable or not, it is necessary to carry out a quantitative analysis. Even it is not a simple task.

The famous citation of Galileo Galilei's "Measure what can be measured, and make measurable what cannot be measured" fits well to this question.

In 1990, The Human Development Index (HDI) was created by Mahbub ul Haq [2]. This index was created to measure development, however the environmental aspects are not included. The HDI indicators are the geometric mean of: life expectancy at birth; education and income. With these indicators it is possible for a country to be considered highly developed even if they cause a major environmental impact.

The limits of human development and survival are linked to the limits imposed by the Earth system. However, in the Holocene era it is observed that these terrestrial boundaries can be influenced by human activities. A survey conducted by Johan Rockstrom delimited 9 planetary boundaries: climate change, rate of biodiversity loss, interference with the nitrogen and phosphorus cycles, stratospheric ozone depletion, ocean acidification, global freshwater use, change in land use, chemical

pollution and atmospheric aerosol loading. In 2009, 4 of which were already crossed: climate change, biodiversity loss, interference with the nitrogen and phosphorus cycles and change in land [3].

It is necessary to move against the collapse of the Earth system. As problems related to the environment are not limited by territorial boundaries, this problem is global in scale.

This article aims to carry out a small systematic review, on the measurement of sustainable development on a global scale, focused on ways of measurement and the limitations.

2. Methodology

To understand the limitation of sustainable development metrics on a global scale it is necessary to search for good articles that came from a reliable source.

The entire search was performed in the Web of Science (WoS) database. This database is multidisciplinary, which is fundamental, as measuring sustainable development is a multidisciplinary task. In WoS it is possible to look at the history of publications and observe growth and decline trends of the research line of interest. Besides that, WoS is a consolidated database, used by more than 9,000 teaching and research institutions[4].

In this database, a search was initially carried out with the keywords "measure" and "sustainable development", without any filters. As a result, 26509 articles were found. Given the high number of articles, a keyword search filter was used in the title and then 174 articles were found.

It was noticed that the number of articles published, with these filters, has increased between the times. The first published was in 1994 and goes to 2022, as can be seen in **Figure 01**. Given that in recent years there are more articles, a temporal filter was applied, selecting the last 3 years for analysis. The year 2022 was excluded as it is not complete at the time of finishing this article. Finally, 85 articles were used to perform this search.

All these articles were classified into: relevant or not relevant. The criteria of relevance was if they could give an answer to the question: Is it possible to measure sustainable development on a global scale? To classify, all the abstracts were reviewed. After this first classification 8 articles were selected. Subsequently, these articles were read and the information collected. In the end, only 6 articles were used to answer the proposed question.

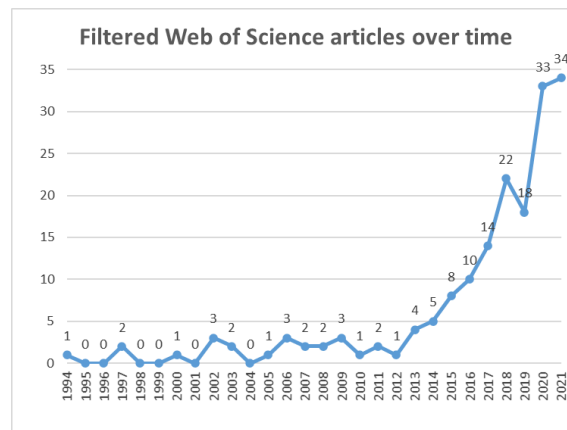


Fig. 1 - Number of articles published in the Web of Science, with the keywords measure and sustainable development in the period from 1994 to 2021.

3. Results

The initial 85 articles belong to 42 different categories in Web of Science, the main ones are: Environmental Sciences, Green Sustainable Science Technology and Environmental Studies. As the interest about these topics was on a global scale, the articles were classified according to their region of origin. They came from 54 different countries/regions, the main one came from China.

The year with the most publications was 2021 (34), followed by 2020 (33) and 2019 (18).

Most of the articles were applied only on a local scale, then they were classified as not relevant. Only 6 articles were used in this part of the work. From the initial search, approximately 0.3% were used in this article, which highlights the importance of choosing the keywords.

3.1 Ways to Measure

In this review only two indicators appear to achieve the task to measure sustainable development on a global scale. The Sustainable Development Goals (SDGs) and Sustainable Development Index (SDI) [5,6].

The SDGs or 2030 Agenda, is a set of indicators and targets to achieve an improvement in social, environmental and economic issues globally. It is composed of 17 goals, 169 targets and 244 indicators. This agenda was approved by all the United Nations (UN) in 2015 [7]. It was noticed that climate mitigation actions are related to the progress of the SDGs. For example, a reduction in the emission of CO₂ can prevent deaths related to air pollution [8].

The SDI was developed to improve the HDI indicator: it incorporated ecology key indicators into the HDI, as a result 5 indicators are used to describe if a country has or not an sustainable development:

education, life expectancy, income, CO2 emissions and material footprint. Furthermore, the addition of the ecological indicators can expose the negative effects of countries that are in a good position in HDI ranking, but are not developed on the environmental side [6].

3.2 Limitations of measurement

A problem frequently encountered with those who work with indexes is the lack of available data, either due to a failure or unavailability of information. It was shown that to overcome the lack of data, it is necessary to make some assumptions, which directly affect the results. [9] In the SDG case, there are 244 indicators, which makes it a great challenge for countries to obtain this entire database.

The lack of clear definitions and contradictory uses of terminology, make it difficult to know what to measure. In the SDG case, the term “sustainable” is used without complements, which is pretty vague. The term sustainable by itself could refer to environmental, economy or social problems [9]. This ambiguity present in the terms makes it necessary to generate assumptions to measure the indicators. That is, returning to the first problem mentioned.

As a global scale, it is expected that the indicators will be translated and these could be an additional source of errors. The language can present differences that influence the metrics. The difference between languages can influence decision making. For example, the order of priority of spending towards the SDGs may change depending on how each target is written [10].

Another problem presented in the analysed indices is the simplicity of the computed environmental data. In the SDI, only two indicators represent the entire environment. For example, if a country pollutes water, that region cannot be considered sustainable. However, this index cannot cover many important variables.

To be able to measure different aspects related to sustainable development, a high financial investment is necessary. It has been estimated that the annual cost to measure the SDG, for example, can cost from 3.5 trillion to 5.0 trillion dollars [9,11]. Given the high amount of information needed, the price can make it immeasurable, or with less quality and precision.

4. Conclusion

In the period from 1994 to 2021, the published articles using the keyword sustainable development in the title presents a growing trend. More than ever, it is necessary to reflect on the question: Is it possible to measure sustainable development on a global scale?

This systematic review exposed more limitations

than examples of measurement, which explains the difficulty of this task.

It is notable the evolution of measurement between the HDI and SDGs for example, and this is what is expected from now on.

Lack of data or clear definitions, the language, the simplifications of the environmental system, the financial costs or other factors, can be overtaken by research investment and support. As soon as the importance to these metrics is given, sooner it is possible to make informed decisions related to the development of humanity.

The planetary boundaries are crossed, even with the limitations, a multidisciplinary effort is necessary to measure sustainable development, for us as humanity to trace the next steps and for the next generations to learn from our mistakes.

5. Acknowledgement

I would like to thank CAPES for encouraging and making available research in Brazil, the INCBAC for promoting the UNIGOU Remote Scientific Training Course and especially Doc. Mgr. Miroslav Syrovátka, Ph.D, for all the knowledge acquired.

6. References

- [1] United Nations General Assembly. Our Common Future. Rep World Comm Environ Dev. 1987; (43)
- [2] UNDP. Human Development Report 1990: Concept and Measurement of Human Development. 1990.
- [3] Johan Rockström. A safe operating space for humanity. Nature. 2009;461(September).
- [4] Cristina T. Carneiro J. Bibliometric analysis of the Brazilian scientific production on Building and Construction Technologies in the Web of Science database. 2016;175–85.
- [5] Shinwell M, Cohen G. Measuring countries' progress on the Sustainable Development Goals : methodology and challenges. *Evol Institutional Econ Rev* [Internet]. 2019;(0123456789).
- [6] Hickel J. The sustainable development index: Measuring the ecological efficiency of human development in the anthropocene. *Ecol Econ* [Internet]. 2020;167(March 2019):106331.
- [7] United Nations. Transforming our world: the 2030 Agenda for Sustainable Development. United Nations. Vol. 16301. 2015.

- [8] Fujimori S, Hasegawa T, Takahashi K, Dai H, Liu JY, Ohashi H, et al. Measuring the sustainable development implications of climate change mitigation. *Environ Res Lett.* 2020;15(8).
- [9] MacFeely S. Measuring the Sustainable Development Goal Indicators: An Unprecedented Statistical Challenge. *J Off Stat.* 2020;36(2):361–78.
- [10] Luis V, Nicol D, Nicol D, Consuelo M, Blanco Y, Labrador J. Semantic network analysis of sustainable development goals to quantitatively measure their interactions. 2021;37(January 2020).
- [11] Deen T. UN targets trillions of dollars to implement sustainable development agenda. [Internet]. Global Policy Forum. 2015. Available at: <http://www.ipsnews.net/2015/08/u-n-targets-trillions-of-dollars-to-implement-sustainable-development-agenda/>