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Sustainable Human Development Index: an approach to economic blocks from selected countries

Índice de Desenvolvimento Humano Sustentável: uma abordagem para blocos econômicos a partir de países selecionados

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Abstract
This paper proposes to measure the level of sustainable human development for 56 countries and eight economic blocs in 2018. Specifically, it is intended to rate which countries and economic blocs develop in a sustainable way. For this, the Environmental Index (EI) was constructed, proposed by Blancard & Hoarau (2013) and Chansarn (2014), using the Data Envelopment Analysis (DEA). Subsequently, the Sustainable Human Development Index (SHDI) was measured, based on the geometric mean of the dimensions of the Human Development Index (HDI) and EI, according to the formulation suggested by Blancard & Hoarau (2013) and Bravo (2014). The results indicated that, in general, nations have achieved high EI and experienced improvements in their well-being. Therefore, it is concluded that environmental variables were use efficiently in 2018.
Keywords: human development, environmental sustainability, data envelopment analysis, economic blocks.

Resumo
Este trabalho propõe mensurar o nível de desenvolvimento humano sustentável para 56 países, distribuídos em oito blocos econômicos, para 2018. Especificamente, almeja-se avaliar quais países e blocos econômicos se desenvolvem de forma sustentável. Para tal, construiu-se o Índice Ambiental (IA), proposto por Blancard & Hoarau (2013) e Chansarn (2014), utilizando-se a Análise Envoltória de Dados. Posteriormente, mensurou-se o Índice de Desenvolvimento Humano Sustentável (IDHS) considerando a média geométrica das dimensões do IDH e do IA, baseada na formulação sugerida por Blancard & Hoarau (2013) e Bravo (2014). Os resultados indicaram que, em geral, as nações obtiveram elevado IA e experimentaram melhorias em seu bem-estar após a inclusão do IA. Portanto, conclui-se que as variáveis ambientais utilizadas foram empregadas eficientemente em 2018.
Palavras-chave: desenvolvimento humano, sustentabilidade ambiental, análise envoltória de dados, blocos econômicos.

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1. Introduction

The discussion on development is rich in academia, especially regarding the distinction between development and economic growth, as many authors consider only constant increases in income levels as a condition for development to be achieved, without worrying about its distribution (Oliver, 2002). According to Van Den Bergh (2009), the increase in *per capita* income and the growth associated with the consumption of goods is an imperfect counterpart because it does not cover the satisfaction of basic needs, such as serenity, clean air and direct access to nature.

According to Costa & Lustosa (2007), given the limitations of Gross Domestic Product (GDP) *per capita* as a measure of development, a broad conceptual and methodological effort began to build indicators capable of expressing development, which is multidimensional. Thus, to fill the existing gap in the approach used until then, in 1990, the Human Development Index (HDI) was created, proposed by the United Nations Development Program (UNDP). This measure adopts the conception that, at all stages of economic development, some needs are essential for human well-being. Therefore, in addition to income, it includes two important dimensions: longevity and education.

Despite consolidating itself as one of the most relevant development measures, the HDI has been criticized since its inception. Several scholars point to methodological flaws and suggest the incorporation of new dimensions, such as sustainability, efficiency, housing and urbanism, among others, seeking to make it a more complete index. For Martins *et al.* (2006), the limits of the HDI must be considered, above all, those related to sustainability, since this has become one of the major issues of today worldwide, in addition to a huge challenge in the face of climate change. Thus, it is necessary to build indicators that allow understanding and measuring this phenomenon from the perspective of human development.

Barreto (2011) corroborates this thought and highlights the need for a notion of development that considers the environmental dimension, accompanied by the creation of indexes capable of understanding it and that help the government in decision-making. Given the simplicity and wide acceptance of the HDI, Maccari (2014) adds that this situation makes the need to empower this index with the environmental dimension a topic that has been much discussed recently. In this sense, studies such as Martins *et al.* (2006); Barrett (2011); Blancard & Hoarau (2013); Bravo (2014); Maccari (2014); and Hickel (2020) have contributed to the literature that deals with this theme. However, depending on the method used, some care must be taken, such as investigating the existence and influence of discrepant information in the sample and observing the specificities of the analyzed units, so as not to compromise the quality of the results obtained. Even as this study, Blancard & Hoarau (2013) and Maccari (2014) used Data Envelopment Analysis (DEA) but disregarded the heterogeneity between countries.

Nations have different realities, such as territorial and population sizes, economic and social development, among other factors. Therefore, it is important that, when investigating their respective environmental conditions, mainly when based on the relationship between the natural resources used and the resulting social well-being, such divergences are considered and an appropriate parameter is established to group them, so that a fair comparison and that enables the implementation of environmental public policies. Bohn *et al.* (2015) argue that this diversity influences the share of budgetary and human resources available and, therefore, point out that it is not appropriate for locations that are very different from each other to serve as a reference for one another. Thus, this study contributes to the literature by performing an aggregate analysis of countries by *per capita* income groups.

In this context and considering that the countries that make up each economic bloc are neighbors, analyzes directed to this area make it possible to identify common problems and, therefore, suggest solutions to be discussed and applied together, increasing the probability of effectiveness of policies, especially those environmental. Therefore, this work proposes to measure the level of human development for 56 countries, belonging to eight economic blocs, incorporating environmental sustainability as a component of the sustainable HDI, for 2018, as it is the most recent period with data availability. Specifically, we seek to assess how the inclusion of sustainability in the HDI can show which countries and economic blocs develop more sustainably and compare their respective levels of human development before and after the inclusion of the dimension of environmental sustainability.

In addition to this introduction, this paper is divided into four sections: the first addresses the context in which the HDI emerged, highlighting its contribution and limitations; the second explains the methodological aspects used to include the dimension of environmental sustainability in the HDI; the third consists of the discussion of the results obtained and, finally, the fourth presents the final considerations.

2 Theoretical Basis

For a long time, the measurement of human development considered only the economic dimension, being based on Gross Domestic Product (GDP), an indicator of the total market value of all final goods and services produced internally in the country in a given period, whose wide acceptance allows comparisons within the scope International. However, such measures cannot reflect the well-being of a nation, since they are based only on transactions that can be measured in monetary terms (Valente *et al.*, 2012).

Todaro (1994) says that the problems of this indicator are well known, in which he highlights the inability to include non-commercialized subsistence production, which covers a large part of the work of housewives, for example, and to incorporate aspects such as well-being. social welfare and income distribution. Henderson (2007) adds that another limitation of GDP/Gross National Product (GNP) is derived from its foundation in production flows, disregarding the level of stocks and ignoring its repercussions on the amount of remaining natural resources. Thus, a given country can degrade the environment excessively without the damages of this action being computed, such as the commercialization of wood, resulting from deforestation. Its sale is reflected in increases in the GDP/GNP, but the losses of national forest area are not accounted for.

In this way, efforts have been made to minimize such deficiencies and create other composite indicators that serve as complements or alternatives to this traditional measure (Todaro, 1994). Over time, there has been significant progress regarding the advantages and limitations of human development indicators. The literature has presented guidelines for society on how to improve its current condition, based on its current level of development, on the use of several well-being indicators, which provide an insight into the degree of development of a country as a whole from different perspectives (Aziz *et al.*, 2015). Among the measures created to replace GDP *per capita*, the following are mentioned: Living Standard Index (1966), Development Index (1972), Physical Quality of Life Index (1979), Social Progress Index (1984) and Index International Society for Human Suffering (1987).

Despite the different angles analyzed by these attempts, none was accepted worldwide. This scenario only changed in 1990, when UNDP launched the HDI, together with the first Human Development Report (HDR), with a clear purpose of human development (Awan *et al.*, 2012). According to the document, the objective of development is to provide more options for individuals. One of them is access to income, considering its role in the acquisition of social well-being and not as an end in itself. However, there are others such as long life, knowledge, political freedom, personal security and guarantee of human rights (UNDP, 1990).

Although its creation represented a significant advance in the measurement of human development, the HDI is constantly criticized. Its main criticisms are associated with the choice of dimensions and indicators, implicit trade-offs and failure to capture inequalities in the distribution of human development across the population (Santos & Santos, 2014; Araújo, 2021). Among these lines of critical thinking, the selection of dimensions is the most discussed, because, according to Barreto (2011), despite the HDI corresponding to an advance in human development measures, replacing GDP *per capita*, and incorporating the economic and *social* dimensions, does not cover other important aspects of human development, such as the environment.

The measurement of human development incorporating environmental sustainability provides a broader perspective of development and the possibility of maintaining it, as there is no point in having high levels of HDI, in a given period, if they cannot be maintained or increased in later periods, due to the limitation of natural resources, derived from their excessive exploitation, which directly affects the well-being of present and future generations. According to Pineda (2012), if no action is taken, environmental problems may jeopardize the progress indicated by the results of the HDI in recent decades, as well as impede the progress of nations that registered low values in this index, because, despite being the least contribute to global warming, are the ones that suffer most significantly, above all, due to climate change and its repercussions on agriculture, which is one of the main ways of survival for the population of less developed countries.

Considering the relevance and international knowledge of the HDI and its use as a reference for the application of public policies, it must portray the reality of each country, not only in terms of economic and social aspects, but also environmental ones, since the difficulty in managing natural resources can be a strong obstacle during the development trajectory (Soares *et al*., 2021).

This scenario reinforces the need for global community collaboration and adequate intervention by local governments. In this sense, since the 20th century, nations have made joint efforts. After 2010, Rio+20, hosted in 2012; Paris Agreement and establishment of the Sustainable Development Goals (SDGs), signed in 2015; and the Conference of the Parties (COP), held annually. In terms of environmental indicators, the most famous is the Environmental Performance Index (EPI), measured since 2006, replacing the *Environmental* Sustainability Index (ESI). However, researchers – such as Almeida and García-Sánchez (2016), Oţoiu and Ţiţan (2017) and Oţoiu and Grădinaru (2018) – criticize the methodology employed, pointing out flaws in the weights used and in the set of selected variables, which, given its breadth, makes the calculation of the EI complex and more susceptible to errors. Thus, the debate about alternative (and simpler) ways of measuring environmental sustainability remains important.

3 Methodology

The Sustainable Human Development Index (SHDI) was obtained by incorporating environmental sustainability (captured by the Environmental Index, EI) into the calculation of the traditional HDI, which encompasses longevity, education and income. The SHDI was calculated based on the formulation suggested by Blancard & Hoarau (2013) and Bravo (2014), being the result of the geometric mean, which, in the case of this study, considers the dimensions of the HDI and the EI, as expressed by the equation (1):

SHDI = $\sqrt[4]{HDI_{Longevity}.HDI_{Education}.HDI_{Income}.EI}$ (1)

As well as the HDI, the SHDI varies from 0 to 1 and its classification has the following classes: low (up to 0.549), medium (from 0.550 to 0.699), high (from 0.700 to 0.799) and very high (equal to or greater than 0.800).

Data Envelopment Analysis (DEA) model, proposed by Blancard & Hoarau (2013) and Chansarn (2014). For Casado (2007), DEA is a non-parametric method that uses mathematical programming to measure the production frontiers of Decision Making Units (DMUs), which, in this study, were represented by countries, in order to evaluate the relative efficiency of each of them, considering the results of various combinations in the use of inputs and the generation of outputs. Thus, the frontier characterized by efficient production follows the input orientation, when the evaluated units are able to produce more with the same amount of inputs, or the output orientation, when the DMUs are able to produce the same amount using less inputs. In this work, the input orientation was followed, considering the model with constant returns to scale (Constant Return to Scale, CRS), proposed by Chansarn (2014).

According to Bohn *et al*. (2015), not necessarily all the locations analyzed will belong to the same efficiency frontier, since different locations may present considerable differences between them, which, therefore, prevents a fair comparison. To verify whether this condition also occurs with the countries considered, the Mann-Whitney U test was performed, which, according to Kim & Kim (2018), identifies whether different groups are statistically different or not, based on their respective medians. In addition, Dalberto *et al*. (2015) highlight the sensitivity of the DEA to the presence of outliers. Thus, to detect them, the Jackstrap method was used. Furthermore, the test of means was performed to verify whether or not the means of the two groups (with and without outliers) are statistically different. If not, all nations considered will be kept in the analysis.

The parameter used in that test was the GNP *per capita* of each country, following the World Bank cut-off methodology (2018a), shown in Table 1. Therefore, if there is heterogeneity, the EI must be calculated for the members of each group, separately. After this procedure, to carry out the analysis, the countries must be divided into their respective economic blocs (European Union, North American Free Trade Agreement – NAFTA), Southern Common Market (MERCOSUR), Association of Southeast Asian Nations (ASEAN), Central American Common Market (CACM), Southern African Development Community (SADC), Economic Community of West African States (ECOWAS) and Asian Free Trade Agreement (Asian FTA) and subdivided into the four strata considered, allowing the comparison of the performance of a given group among the economic blocs.

Table 1 - Groups broken down by GNP *per capita* and total countries by group (2018)[1]

Group	Description	GNP *per capita*	Total countries
1	low income[2]	Up to US$995.00	11
2		From 996.00 to 3,895.00 USD	22
3		From 3,896.00 to 12,055.00 US$	11
4		More than 12,055.00 US$	12

[1]In the case of Venezuela, the GNP *per capita* of 2014 was considered, since from 2015 onwards the country does not present GNP data or its deflator.
[2]Formed by Malawi, Niger, Mozambique, Guinea-Bissau, Togo, Liberia, Gambia, Burkina Faso, Sierra Leone, Guinea, Mali.

low-middle income[3]
high-middle income[4]
high income[5]

Source: Adapted from World Bank (2018a).

Therefore, based on the described procedures, the EI was obtained and incorporated into the calculation of the HDI, in order to consider the environmental quality of each economic block in the provision of items that make up the traditional index.

3.1 Variables used and nature of data

The data used are of a secondary nature, and the variables referring to the dimensions of the HDI, which correspond to the outputs, were obtained through the United Nations Development Program (UNDP, 2015-2016). In the case of GNP *per capita*, it was collected from the World Bank database (2018b). As for the variables that make up the EI, equivalent to the inputs, they selected based on the literature that discusses environmental sustainability indicators. As the DEA is a model whose evaluation is based on the perspective of efficiency, in this work, these are called eco-efficiency indicators, which, according to Maciel *et al*. (2018), allow observing whether the country is minimizing the anthropic effects caused during the social welfare process. Given the availability of data, five variables were considered, described in Table 2 and selected based on the following studies: Esty *et al.* (2005); Esty *et al.* (2006); Esty *et al.* (2008); Blancard and Hoarau (2013); Chansarn (2014); Barrett (2015); Brazilian Institute of Geography and Statistics (IBGE, 2015); Ivanov and Peleah (2017) and Soares *et al.* (2021).

Table 2 - Variables and data sources

Variable	Variable description	Sources
V1	Agricultural land (% of total area)	Food and Agriculture Organization (FAO, 2017); World Bank (2018b)
V2	$CO_{2\ emissions}$ (tons *per capita*)	Carbon Dioxide Information Analysis Center (CDIAC), Environmental Sciences Division, Oak Ridge National Laboratory; World Bank (2018b)
V3	Consumption of renewable energy (% of total final energy consumption)	Sustainable Energy for All (SEFORALL), World Bank (2018b)
V4	Forest area (% of total area)	FAO (2017); World Bank (2018b)
V5	Population using at least basic sanitation service (%)	World Health Organization (WHO, 2017)

Source: Elaborated by the author.

They collected information for 56 countries, belonging to eight economic blocs. All these data refer to 2018, as this is the most recent year with data available for all the variables used, since the updating of data concerning the environmental dimension is limited, possibly due to the lack of investment by countries, especially those less favored, in mechanisms for searching and monitoring issues involving the use of natural resources and the difficulty of tracking such information retroactively.

[3]Consisting of Zimbabwe, Senegal, Lesotho, Ivory Coast, Zambia, Nicaragua, Ghana, Honduras, Nigeria, Cape Verde, Indonesia, Swaziland, Benin, El Salvador, Philippines, Bangladesh, Bhutan, India, Pakistan, Angola, Tanzania and Nepal.
[4]Composed of Sri Lanka, Thailand, Paraguay, Botswana, Costa Rica, Mexico, Malaysia, Brazil, China, Guatemala and Maldives.
[5] Venezuela, Uruguay, Italy, France. Belgium, Germany, Canada, Netherlands, Singapore, United States, Luxembourg and Japan are part of this group.

Thus, important aspects related to biodiversity and the health of the seas and oceans, for example, cannot be included in the analysis. Furthermore, such a panorama makes it difficult to monitor the performance of countries over time and, consequently, to verify trends and forecasts.

4 Results and Discussion

4.1 Descriptive statistics

Table 3 presents the descriptive statistics of the eco-efficiency indicators considered for each economic block analyzed, in 2018. As for the proportion of agricultural land in relation to the total area, the CADC reached the highest average, 52, 64%, with the nation that reached the highest proportion of agricultural land in relation to the total area was Lesotho, with 80.15%. On the other hand, the South Asia Free Trade Agreement (SAFTA) recorded the lowest average percentage, 36.92%, with Bhutan, a member country of this bloc, presenting the minimum proportion (13.45%) of agricultural land compared to the total area.

On average, most economic blocs had low values of $CO_{2\ emissions}$, with the ECOWAS accounting for the lowest amount emitted, with only 0.39 tons *per capita*. On the other hand, NAFTA and the European Union diverged from the others, obtaining the worst results, with 9.49 and 8.47 tons *per capita*, respectively. With regard to absolute values, it can be seen that the lowest emitter was Malawi, member of the SADC, with 0.09 tons per person; while the largest emitters were Luxembourg, a member of the European Union, and the United States, a member of NAFTA, which registered 15.33 and 15.24 tons *per capita*, respectively.

Regarding the renewable energy consumption in relation to total energy consumed, African countries achieved the best results. The SADC had an average of 64.31%, with emphasis on Zambia, whose use reached 85.10%; while the ECOWAS consumed 66.45% of energy from renewable sources, with Liberia reaching 87.21%. On the other hand, NAFTA obtained the worst result, with an average percentage of only 9.87%. However, Maldives, a member of the Asian FTA, had the lowest share of renewable energy consumption (1.12%).

With regard to the share of forested area in relation to the total area, the CACM and Mercosur stood out with the highest average coverage, with more than 41% of their territories. On the other hand, Asian FTA had the lowest average, with 29.83%. Considering the minimum and maximum participations, the SADC had the lowest value, since Lesotho obtained a percentage of only 1.14%, while ECOWAS contemplated the highest value, a while Liberia recorded 79.71%.

Table 3 - Descriptive statistics of eco-efficiency indicators, by economic block (2018)

Variable	Economic Bloc	Minimum	Average	Maximum	Coefficient of variation (%)
Agricultural lands	European Union	41.67	48.95	54.14	11.39
	NAFTA	44.36	49.67	54.99	15.12
	Mercosur	24.38	46.93	80.08	55.25
	ASEAN	26.09	40.07	56.08	28.24
	CACM	29.99	42.87	71.39	38.51
	SADC	32.06	52.64	80.15	28.87
	ECOWAS	19.60	48.27	75.90	39.90
	Asian FTA	13.45	36.92	60.43	46.27
$CO_{2\ emissions}$	European Union	4.62	8.47	15.33	57.62
	NAFTA	3.74	9.49	15.24	85.67
	Mercosur	1.21	2.48	4.78	63.53
	ASEAN	1.33	4.44	7.60	65.49
	CACM	0.81	1.13	1.65	27.81

	SADC	0.09	0.95	3.64	114.57
	ECOWAS	0.13	0.39	1.14	73.59
	Asian FTA	0.43	1.62	3.70	70.94
Renewable energy consumption	European Union	15.25	16.04	17.07	4.76
	NAFTA	9.63	9.87	10.11	3.45
	Mercosur	14.56	45.40	60.73	47.24
	ASEAN	5.31	17.25	23.72	45.85
	CACM	23.21	44.65	64.10	35.01
	SADC	28.20	64.31	85.10	31.17
	ECOWAS	23.00	66.45	87.21	29.98
	Asian FTA	1.12	47.01	81.09	62.63
Forest area	European Union	31.20	33.04	36.50	7.23
	NAFTA	33.87	33.90	33.92	0.12
	Mercosur	11.36	41.39	59.71	51.48
	ASEAN	22.94	38.81	58.48	40.35
	CACM	28.61	41.55	58.80	36.40
	SADC	1.14	38.04	60.79	49.85
	ECOWAS	9.63	31.72	79.71	71.27
	Asian FTA	2.73	29.83	71.35	85.72
Population that uses at least basic sanitation service	European Union	97.60	98.84	99.89	0.98
	NAFTA	91.04	95.38	99.71	6.43
	Mercosur	88.49	93.02	97.48	4.44
	ASEAN	79.44	89.54	99.58	10.37
	CACM	67.44	80.53	97.59	14.25
	SADC	26.00	44.12	78.51	39.81
	ECOWAS	15.86	34.14	75.82	54.64
	Asian FTA	64.75	14.42	97.21	18.64

Source: Elaborated based on research.

As for the participation of the population that uses at least basic sanitation services, in average terms, with the exception of the SADC and the ECOWAS, which did not reach even 50%, all economic blocks were above 70%. The data also reveal that Italy, a member of the European Union, stands out with the best result, with 99.89%, while Sierra Leone, a member of the ECOWAS, obtained the worst percentage, 15.86%.

With regard to the coefficient of variation, the member countries of each economic bloc recorded very heterogeneous results among themselves, indicating that, despite their geographic proximity, the analyzed nations act independently in relation to environmental issues, which compromises individual and sustainable development set. Thus, this result emphasizes the need for partnership [6]between countries for the creation and application of environmental laws and policies.

4.2 Environmental Index (EI)

Jackstrap test was performed to identify outliers, which identified 9 countries (Bangladesh, Belgium, Benin, Canada, Ghana, Holland, Japan, Niger and Singapore) as outliers. Subsequently, the mean test was performed, which indicated the presence of a

[6]In contemporary times, there are some joint initiatives underway, while others were finalized recently. In 2020, the Decade of Biodiversity ended, created by the United Nations (UN) to protect the planet's biodiversity, whose balance sheet indicated that no goal was met. In 2021, the Decade of Ocean Science for Sustainable Development began, which aims to improve the environmental conditions of the oceans. In the same year, there were also the Conferences of the Parties, 15 (on biodiversity) and 26 (on climate) (Santana, 2021).

statistical difference between the group with discrepant information and the one that did not include such information. Therefore, the final sample consisted of the remaining 47 nations.

To obtain the EI, the countries' efficiency scores were measured for the model with CRS. Then, the Mann-Whitney U test was performed, considering their division into groups, according to their respective GNPs *per capita*, specified in Table 1. It was found that not all groups share the same efficiency frontier, which is that is, they are statistically different, and, consequently, nations cannot be analyzed and compared among themselves, without distinction of group. Therefore, the calculation of the EI was disaggregated, considering the groups in Table 1 for the 47 countries included in this study, whose results shown by economic blocks are found in Table 4.

Table 4 - Absolute (fi) and relative (%) frequencies of economic blocks, according to technical efficiency intervals with EI CRS (2018)

Economic block	**Group**	**Low**		**Medium**		**High**		**Very high**	
		0.549 ≤ EI		**0.550 ≤ EI ≤ 0.699**		**0.700 ≤ EI ≤ 0.799**		**EI ≥ 0.800**	
		fi	**-**	**fi**	**-**	**fi**	**-**	**fi**	**-**
European Union	1	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-
	3	-	-	-	-	-	-	-	-
	4	-	-	-	-	-	-	4	100.00
NAFTA	1	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-
	3	-	-	-	-	-	-	1	50.00
	4	-	-	-	-	-	-	1	50.00
Mercosur	1	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-
	3	-	-	-	-	-	-	2	50.00
	4	-	-	-	-	-	-	2	50.00
ASEAN	1	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	2	40.00
	3	-	-	-	-	-	-	3	60.00
	4	-	-	-	-	-	-	-	-
CACM	1	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	3	60.00
	3	-	-	-	-	-	-	2	40.00
	4	-	-	-	-	-	-	-	-
SADC	1	-	-	-	-	-	-	2	22.22
	2	-	-	-	-	-	-	6	66.67
	3	-	-	-	-	-	-	1	11.11
	4	-	-	-	-	-	-	-	-
ECOWAS	1	-	-	-	-	-	-	8	66.67
	2	-	-	-	-	-	-	4	33.33
	3	-	-	-	-	-	-	-	-
	4	-	-	-	-	-	-	-	-
Asian FTA	1	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	4	66.67
	3	-	-	-	-	-	-	2	33.33
	4	-	-	-	-	-	-	-	-
Total	-	0	0.00	0	0.00	0	0.00	47	100.00

Source: Elaborated based on research.

The data in Table 4 indicate that, in general, all countries have very high technical efficiency, of which only 6 (Nigeria, Mozambique, Nepal, Swaziland, Thailand and Paraguay) did not obtain EI equal to unity. The excellent performances registered by some of these nations were also verified by Emerson *et al*. (2010) and Emerson *et al*. (2012), in the case of the European Union; by Esty *et al.* (2006) and Esty *et al.* (2008), for NAFTA; by Esty *et al*. (2005) and Esty *et al.* (2006), referring to Mercosur; by Emerson *et al*. (2012), regarding ASEAN; by Emerson *et al*. (2010), with regard to the CACM and the Asian FTA; by Martins *et al*. (2006) and Chansarn (2014), for SADC and ECOWAS. These results can be justified by the similarity in the proportion of natural resources used, and in the results obtained in the dimensions of the HDI, between countries that belong to the same income group. Given this homogeneous character, the nation identified with the best performance and, therefore, taken as a parameter by the DEA, did not present substantial differences regarding the proportion of resources used and the corresponding HDI, when compared with the others, and, therefore, these inevitably, they concentrated close to the calculated efficiency frontier.

4.3 Human Development Index (HDI) of economic blocks

Table 5 shows the HDI distribution for the economic blocks, by group, referring to 2018, it can be inferred that the majority of countries have low human development, totaling 31.91%. In addition, it is emphasized that these are exclusively African. On the other hand, about 17% of nations recorded very high well-being, with the European Union being the only bloc with all its members in this category. Furthermore, the Southern SACD, the ECOWAS and the SAFTA did not have any membership in such a class.

Table 5 - Absolute (fi) and relative (%) frequencies of economic blocks, according to HDI (2018)

Economic block	Group	Low 0.549 ≤ HDI		Medium 0.550 ≤ HDI≤ 0.699		High 0.700 ≤ HDI≤ 0.799		Very high HDI ≥ 0.800	
		fi	-	fi	-	fi	-	fi	-
European Union	1	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-
	3	-	-	-	-	-	-	-	-
	4	-	-	-	-	-	-	4	100.00
NAFTA	1	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-
	3	-	-	-	-	1	50.00	-	-
	4	-	-	-	-	-	-	1	50.00
Mercosur	1	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-
	3	-	-	-	-	2	50.00	-	-
	4	-	-	-	-	1	25.00	1	25.00
ASEAN	1	-	-	-	-	-	-	-	-
	2	-	-	-	-	2	40.00	-	-
	3	-	-	-	-	2	40.00	1	20.00
	4	-	-	-	-	-	-	-	-
CACM	1	-	-	-	-	-	-	-	-
	2	-	-	3	60.00	-	-	-	-
	3	-	-	1	20.00	-	-	1	20.00
	4	-	-	-	-	-	-	-	-
SADC	1	2	22.22	-	-	-	-	-	-
	2	2	22.22	4	44.44	-	-	-	-
	3	-	-	-	-	1	11.11	-	-
	4	-	-	-	-	-	-	-	-
ECOWAS	1	8	66.67	-	-	-	-	-	-
	2	3	25.00	1	8.33	-	-	-	-

	3	-	-	-	-	-	-	-	-
	4	-	-	-	-	-	-	-	-
Asian FTA	1	-	-	-	-	-	-	-	-
	2	-	-	4	66.67	-	-	-	-
	3	-	-	-	-	2	33.33	-	-
	4	-	-	-	-	-	-	-	-
Total	-	15	31.91	13	27.66	11	23.40	8	17.02

Source: Elaborated based on research.

When analyzing the results by group, it is noted that, in group 1, no country was able to achieve human development higher than the low level, indicating, therefore, that countries with lower income are the ones that are most faced with social problems related to education, health and income. With regard to group 2, most nations achieved medium HDI and only Indonesia and the Philippines achieved a high level of well-being. Group 3 did not have any nation with low HDI and only Guatemala) present in the middle class of such index. Group 4 registered all its members, excluding Venezuela, classified in the very high category. Therefore, it is inferred that the greater the GNP *per capita* of countries, the greater their human development.

4.4 Sustainable Human Development Index (SHDI) of economic blocks

Table 6 shows the distribution of the SHDI for the economic blocks, by group, considering the CRS model in 2018. Despite the excellent performances in the EI, it is clear that the countries had little action in promoting development sustainable human. Only 13 nations (Germany, United States, Luxembourg, Italy, France, Uruguay, Malaysia, Costa Rica, Thailand, Sri Lanka, Mexico, China and Brazil), which corresponds to 27.66%, recorded very high sustainable development. In addition, it should be noted that these are, for the most part, nations considered, at least, as high-middle income. This can be explained by its excellent performance in the EI and in the three dimensions of the HDI, which is already expected, since many of them are developed. Results for Uruguay, United States and Germany were verified by Martins *et al*. (2006), Barreto (2011). The first job also saw good performances for Italy, France, Brazil and Malaysia. The excellent performance of Costa Rica and Sri Lanka was also verified by Hickel (2020).

On the other hand, only 8.51% of the countries classified themselves as having a low SHDI. This class is formed exclusively by African nations (Mali, Burkina Faso, Mozambique and Sierra Leone). This is mainly justified by the precarious inferences obtained in all areas of the HDI. This scenario was also observed by Martins *et al*. (2006); Barrett (2011); and Blancard & Hoarau (2013).

Analyzing the economic blocs, only the European Union and NAFTA had full participation in the very upper class. On the other hand, the blocks of African countries were the only ones not to have nations in this class. The majority (77.77%) of the members of the SADC are concentrated in the middle category, as well as the majority (66.67%) of the members of the ECOWAS. With regard to the other blocs, except Asian FTA, which recorded 50% of its nations with high sustainable human development, and ASEAN, which had 60% in the very high class, all had most of their members with high SHDI.

Table 6 - Absolute (fi) and relative (%) frequencies of economic blocks, according to intervals of technical efficiency measures with SHDI CRS (2018)

Economic block	**Group**	**Low**		**Medium**		**High**		**Very high**	
		0.549 ≤ SHDI		**0.550 ≤ SHDI≤ 0.699**		**0.700 ≤ SHDI≤ 0.799**		**SHDI ≥ 0.800**	
		fi	**-**	**fi**	**-**	**fi**	**-**	**fi**	**-**
	1	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-

European Union	3	-	-	-	-	-	-	-	-
	4	-	-	-	-	-	-	4	100.00
NAFTA	1	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-
	3	-	-	-	-	-	-	1	50.00
	4	-	-	-	-	-	-	1	50.00
Mercosur	1	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-
	3	-	-	-	-	1	25.00	1	25.00
	4	-	-	-	-	1	25.00	1	25.00
ASEAN	1	-	-	-	-	-	-	-	-
	2	-	-	-	-		40.00	-	-
	3	-	-	-	-	-	-	3	60.00
	4	-	-	-	-	-	-	-	-
CACM	1	-	-	-	-	-	-	-	-
	2	-	-	-	-	3	60.00	-	-
	3	-	-	-	-	1	20.00	1	20.00
	4	-	-	-	-	-	-	-	-
SADC	1	1	11.11	1	BR	-	-	-	-
	2	-	-	6	66.67	-	-	-	-
	3	-	-	-	-	1	11.11	-	-
	4	-	-	-	-	-	-	-	-
ECOWAS	1	3-	25.00-	5	41.67	-	-	-	-
	2	-	-	3	25.00	1	8.33	-	-
	3	-	-	-	-	-	-	-	-
	4	-	-	-	-	-	-	-	-
Asian FTA	1	-	-	-	-	-	-	-	-
	2	-	-	2	33.33	2	33.33	-	-
	3	-	-	-	-	1	16.67	1	16.67
	4	-	-	-	-	-	-	-	-
Total	-	4	851	17	36.17	13	27.66	13	27.66

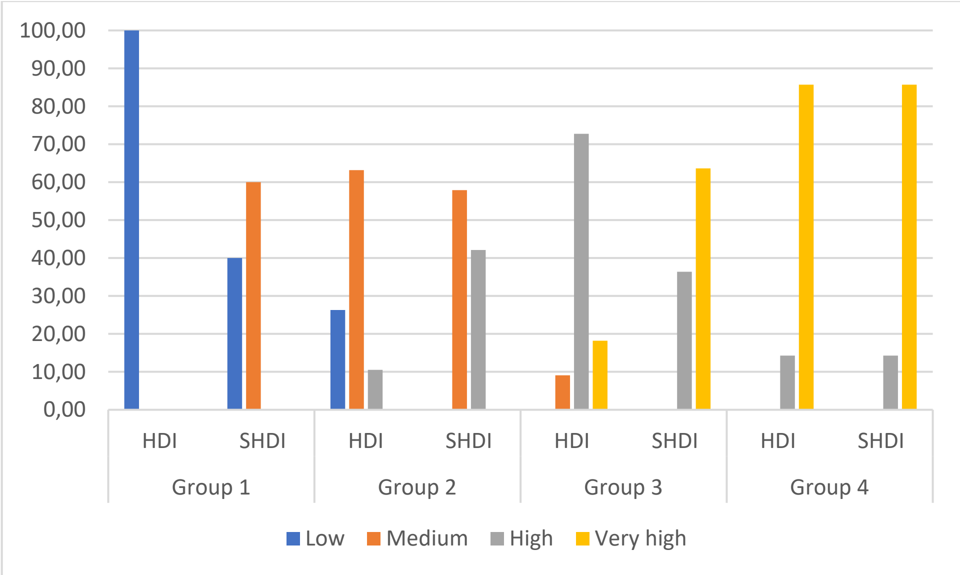
Source: Elaborated based on research.

Analyzing the results by group of nations, it appears that, with regard to the members of group 1, all classified themselves with low SHDI. Regarding the members of group 2, none obtained a very high SHDI and only the Philippines, Indonesia, El Salvador, Nicaragua, Honduras, Cape Verde, Bhutan and India achieved a high classification. Blancard & Hoarau (2013) also found similar results for these countries. As for the participants of group 3, all obtained such an index, at least, high. Martins *et al*. (2006) also obtained similar findings for such nations. With regard to group 4, all the members that constitute it, excluding Venezuela, which obtained a high SHDI, reached the highest level of this index. Martins *et al*. (2006) and Barreto (2011) also observed high HDI values, considering the environmental sustainability dimension, for developed and high-income countries.

4.5 Comparative analysis between HDI and SHDI in economic blocks

Graph 1 shows the relative distribution of HDI and SHDI for the four groups analyzed for 2018. Although the results differed from expectations and some countries obtained similar values in both indexes, or even better after considering environmental sustainability in the HDI, this it is not uncommon, since Barreto (2011) found that, in some cases, the level of well-being of nations has not changed significantly, while Blancard & Hoarau (2013) found situations of improvement in results.

Graph 1 - Relative distribution of HDI and SHDI by group (2018)



Source: Developed based on research.

When observing the two indexes, we can notice that the countries had better results in the SHDI. However, it is noteworthy that, for the members of groups 1, 2 and 3, what is perceived is that, in all categories, there was a redistribution, so that the total relative participation decreases in the lowest development class covered by the members of each group, as they migrate to subsequent levels. This is due to the excellent results obtained from the EI, which were considerably higher than those recorded in the dimensions of the HDI. A similar inference was also found by Soares *et al.* (2021). With regard to group 4, the relative frequencies also remained the same before and after the inclusion of the EI, indicating the presence of similar performances in the HDI and in the EI.

5 Final considerations

The results of this study allow us to infer that, in general, countries and economic blocs are being efficient in terms of the use of their natural resources, especially the more developed nations. This is clearly noticed by the increase in the level of social well-being when considering the dimension of environmental sustainability in the HDI. Although the economic blocs are formed by nations that are geographically close, a large variation was noticed between the values of the environmental variables of its members. This means that, despite the differences in their GNPs *per capita*, in practice, when it comes to environmental issues, they are not acting together and, therefore, are not achieving results as good as they could. Therefore, a partnership is necessary for the creation of environmental laws and policies, as well as the commitment of the countries and the use of effective instruments for the inspection and guarantee of their fulfillment.

It is emphasized that the method used to measure efficiency identifies the countries with the best results in environmental variables, to then compare them with the others. Thus, the best performance is not necessarily exempt from waste of natural resources, since, given the inexistence of exogenous parameters, it is possible that everyone is using excessive amounts. Therefore, what is captured is, in fact, those nations that waste more in relation to those that waste less.

It should be noted that the inferences made, although relevant, cannot capture the entire environmental panorama of the countries, since, despite the advances in the discussion on sustainability, the available databases are still limited, in the sense that not all nations have data for all variables and that the recording of this information is not continuous over time, which makes it impossible to analyze their performance over the years. Another limitation lies in the fact that environmental degradation in a country may not be directly reflected in its development (such as the export of wood, in which the importing nation uses such a product without accounting for deforestation, carried out in another nation), and may generate a bias.

This study contributes to the literature that discusses new ways of measuring human development, but in later studies, it is interesting to include other dimensions that are not being measured by the HDI, such as leisure and happiness, as well as to consider other locations and analytical methods.

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