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Dashboard and Composite Indicator for Monitoring Sustainable Development

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Abstract

Monitoring progress made in attaining sustainable development is a highly debated issue. Starting from the framework defined by the United Nations 2030 Agenda and its 17 Sustainable Development Goals (SDG), in this paper dashboard and multidimensional index were chosen as instruments for assessing and communicating progress made in implementation of SDG. Their contributions have been discussed for Brazil in the years 2000s. Brazil is a federation of 26 States and a Federal District. To take into consideration local differences, data were collected and examined on a State base. By using a dashboard of 13 dimensions, one for each of the selected SDG, as well as a multidimensional index, it was possible to outline a better description of progress made in each Brazilian State over the selected period, as well as to identify specific obstacles to sustainable development.

Keywords: Multidimensional index; Dashboard; Sustainable Development Goals; Methodology; Brazil.

1. Introduction

In recent years, since technological innovations smoothed the collection and storage of data, a growing variety of information has been collected. Along with it rose the need to find useful instruments to deal with such volume of data. Statistics should help by scaling down a huge body of information to a limited set of indicators that are able to identify basic structures or to resume tendencies (Davies, 2017). In other words, "indicators must reduce the complexity of a continuous phenomenon to a very limited number of significant (for the user) categories" (Boulanger, 2018).

Methodological challenges can be found when the selected set of indicators is used to build composite index.

In the last two decades, the number of published academic works referring to composite indicators rose exponentially (fig.1). According to the result of our search in the Scopus database, done in May 2019, while in 2000 only one paper mentioned the term in the title or in the keyword, 99 documents mentioned it in 2018. In the first months of 2019, such number has already reached 49.

These results confirm the findings of Bondura (2005, 2008 and 2011).

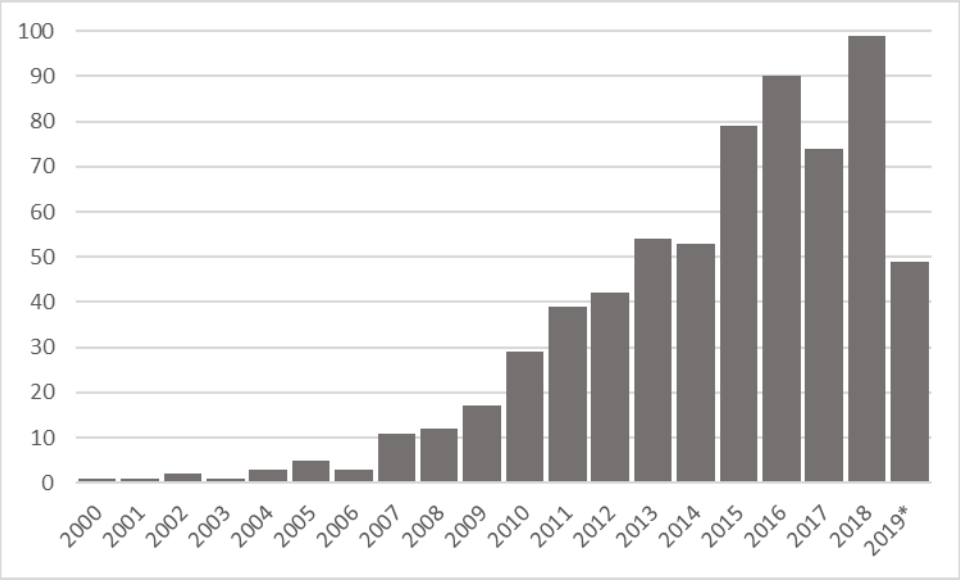

Figure 1. Frequency of the term "composite indicators" in published work, Scopus database, 2000-2019.
Note: Results of the query (KEY ("composite indicator*") OR TITLE ("composite indicator*"))
Source: Search in the Scopus database realized in May 2019.

Bondura elaborated an inventory of multidimensional indices, covering a set of countries or the world, based on reports, websites, books and academics paper. "The aim of the survey is to identify country indices, which assess or rank countries' performance in areas such as openness, competitiveness, development and security" (Bondura, 2005, p. 6). In her first survey published in 2005, she reviewed 135 indicators. The inventory was updated in 2008 to 178 indices. More recently, the same author provided a list of 290 composite indices grouped according to the following fields: Economy: 86; Education: 32; Environment: 28; Governance: 42; Health: 14; Wellbeing: 54; Other: 34 (Bondura, 2011).

The latter list of fields offers some insight on what is considered relevant for different institutions, since the survey covered indices prepared by public and private, for profit and nonprofit, organizations. Economy, environment and wellbeing represented more than 50% of the surveyed indices. Such dimensions coincide with those of the triple bottom line approach to sustainability, that is Profit, People and Planet, or, in other words, economic, social and environmental facets of sustainability (Elkington, 1994 e 1997).

The original definition of sustainable development appears officially in the 1983 report Our Common Future, also known as the Brundtland Report. Chapter 2 specially deals with sustainable development and presents its well-known definition "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WECD, 1987, p. 41). While recognizing the limits that natural resources impose on economic growth, this report proposed actions to fight against environmental degradation and poverty. In other words, in this report the multidimensional nature of sustainable development was clearly stated.

Agenda 21, the official document adopted by the plenary of the Rio Earth Summit in 1992, called for global action for reaching sustainable development. The new level of international effort and cooperation required instruments (indicators) to monitor and assess all the steps toward sustainable development. More specifically, the two main sections of chapter 40, "Bridging the data gap" and "Improving information

availability", identify objectives and means of implementation to build "sound information", where information encompasses from data to experience and knowledge (UNSD, Chapter 40, 1992). Section 40.4 states "Indicators of sustainable development need to be developed to provide solid bases for decision-making at all levels and to contribute to a self-regulating sustainability of integrated environment and development systems" (UNSD, 1992).

Since then, one can observe an increasing discussion on how to measure sustainable development, along with a growing production of indicators.

After ratifying the Agenda 2030, the Statistics Division of UN began to elaborate a framework for monitoring progress made in the pursuit of Sustainable Development Goals (SDG). Currently a list of 232 indicators is available, along with instructions to national statistical offices on how to calculate and monitor SDG (UNSTAT, 2019). To facilitate the implementation of those Goals, indicators are grouped into three tiers according to their methodology and data availability.

> **Tier 1:** Indicator is conceptually clear, has an internationally established methodology and standards are available, and data are regularly produced by countries for at least 50 per cent of countries and of the population in every region where the indicator is relevant.
>
> **Tier 2:** Indicator is conceptually clear, has an internationally established methodology and standards are available, but data are not regularly produced by countries.
>
> **Tier 3:** No internationally established methodology or standards are yet available for the indicator, but methodology/standards are being (or will be) developed or tested. (UNSTAT, 2019).

Clearly not all of them are available for each country, but undoubtedly the pursuit of the Agenda 2030 is adding a new impulse to data collection on multiple dimensions of sustainability, as well as to refine methodology to gather sound data.

As Boulanger (2018) stated a complex phenomenon can be studied by following a limited number of indicators and the selection is not only based on scientific evidence, but it depends on normative considerations, involving therefore some degree of arbitrariness.

If data selection contains some degree of arbitrariness, the choice of how to measure and to communicate the progress made in the attainment of SDG is still the object of animated discussions. The common debate between those supporting a dashboard of indicators and those proposing a multidimensional index is easily overcome, as Boulanger (2008) states, since they share four steps of scientific measurement procedure.

First, monitoring development requires choosing of a set of relevant dimensions. In this sense, Agenda 2030 represents a relevant tool, by suggesting a set of variables and by defining appropriate criteria (tiers). Then, the effective set of indicators depends on data availability. The third shared step is defining a common unit of measurement. Usually named as the "normalization procedure", it becomes necessary when dealing with different types of data, expressed in different units of measurement. As the final step comes the choice of how report the result achieved.

Those who endorse the dashboard of indicators believe that offering a large set of results is more efficient.

It allows the final user to freely inspect each result, giving more or less attention to specific dimensions. In other words, the user can assign different (arbitrary) weight to each piece of information. This is not much different form the procedure for building a multidimensional index. But in the latter, the weighting procedure must be accurately defined (Boulanger, 2008). More, the weighting and the aggregation procedures must be discussed since they impact on the final result.

In this paper, starting from the indicators suggested by the UNSTAT (2019) as those belonging to Tier 1 group, a dashboard and a composite index are presented and applied to asses sustainable development for the Brazilian Federation Units in the years 2001 and 2015. The purpose of this paper is to show how dashboard and multidimensional index can be used together to form a more complete picture of sustainable development achievements.

2. Method

To monitor the progress made towards sustainable development in Brazil, this study compares two years, 2001 and 2015. The first year was chosen because it was the starting year of the Millennial Development Goals agenda; and the latter for being the last year before a relevant national survey (PNAD), a source of a good share of data selected, undertook a profound methodological change. In this research data on 45 indicators for each one of the 27 Brazilian States composed the final data set. Table 1 presents each one of the chosen indicators, along with the relevant SDG, year and source.

Since data are expressed with different scales of measurement, a normalization process is needed. Different types of normalization procedure can be used, and, in this study, we opted for one, like the one used for Human Development Index, that allows data to vary from 0 (lowest contribution to sustainable development) to 1 (maximum contribution). In synthesis data were transformed according to the following formulas:

$$x^* = \frac{x - \min(x)}{\max(x) - \min(x)} \quad (1)$$

$$x^* = \frac{\max(x) - x}{\max(x) - \min(x)} \quad (2)$$

Where x* is the normalized values after rescaling; x is the raw data, min and max represent the lower and upper bounds.

The first formula has been applied to those variables which positively contribute to sustainable development. An example is the proportion of households using safely managed drinking water services, as in SDG 6.

The second formula has been applied to those variables with a negative contribution to sustainable development, like the proportion of children engaged in working activity, as in SDG 8.

Table 1. Selected sustainability indicators

SDG	Indicators	Years	Sources
Goal 1. End poverty in all its forms everywhere	Proportion of population living below the national poverty line (1/4 of the minimum wage)	2001 2015	[6]
	Proportion of population living below the national poverty line (1/2 of the minimum wage)	2001 2015	[6]
Goal 3. Ensure healthy lives and promote well-being for all at all ages	Maternal mortality ratio	2001 2011	[4]
	Under-five mortality rate	2001 2011	[4]
	Neonatal mortality rate	2000 2010	[4]
	Proportion of HIV infections per 1,000 population	2001 2015	[4]
	Tuberculosis incidence per 1,000 population	2001 2012	[4]
	Mortality rate attributed to cancer	2001 2011	[4]
	Suicide mortality rate	2001 2011	[4]
	Death rate due to road traffic injuries	2001 2011	[4]
	Adolescent birth rate (aged 10-14 year)	2001 2011	[4]
	Adolescent birth rate (aged 15-19 years)	2001 2011	[4]
	Health worker (doctors) density (per 1000 inhabitants)	2001 2010	[4]
Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	Proportion of children under 5 years of age who are in kindergarten	2000 2010	[1]
	Proportion of children and young people (6 to 14 years) who are not attending school	2000 2010	[1]
	Proportion of 19 to 21 years old with high school diploma	2000 2010	[1]
	Proportion of those with 25 years or more who have not ended high school	2000 2010	[1]
	Proportion of those with more than 25 years with undergraduate degree	2000 2010	[1]
Goal 5. Achieve gender equality and empower all women and girls	Proportion of seats held by women in national parliaments and local governments	2001 2015	[2]
	Proportion of male time spent on household activities compared to female time	2004 2014	[5]
Goal 6. Ensure availability and sustainable management of water and sanitation for all	Proportion of household using safely managed drinking water services	2001 2015	[6]
	Proportion of household with wastewater safely treated	2001 2015	[6]
	Proportion of local administrative units with established procedures for participation of local communities in environment management (with Conselho de Meio Ambiente)	2001 2013	[6]
	Proportion of local administrative units with established and operational policies on environmental care (with Fundo Municipal de Meio Ambiente)	2001 2013	[6]
Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all	Proportion of population with access to electricity	2000 2010	[6]
Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	Annual growth rate of real GDP	2003 2015	[6]
	Youth (15-24 years) unemployment rate, by sex	2001 2015	[6]
	Proportion of informal employment in non-agriculture employment, by sex	2002 2015	[6]
	Average hourly earnings of female and male employees (proportion)	2001 2015	[6]
	Proportion of youth (aged 15-24 years) not in education, employment or training	2004 2014	[6]
	Proportion of children engaged in child labor, by sex	2001 2011	[6]
	Frequency rates of fatal and non-fatal occupational injuries, by sex	2001 2011	[3]
Goal 10. Reduce inequality within and among countries	Working poor (proportion of those earning half minimum wage)	2001 2015	[6]
	Gini Index, by sex	2000 2010	[1]
Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable	Proportion of household with urban solid waste regularly collected	2001 2015	[6]
	Proportion of urban solid waste regularly collected and with adequate final discharge out of total urban solid waste generated	2000 2008	[6]
	Proportion of local administrative units with environmental law	2002 2013	[6]
	Proportion of urban population living in slums, informal settlements or inadequate housing	2001 2015	[6]
Goal 12. Ensure sustainable consumption and production patterns	Pesticides commercialized by planted area (kilogram per hectare)	2005 2014	[6]
Goal 13. Take urgent action to combat climate change and its impacts	Greenhouse gas emission (carbon dioxide CO2)	2001 2015	[7]
	Greenhouse gas reduction (carbon dioxide CO2)	2001 2015	[7]
Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	Proportion of victims of violence	2001 2015	[4]
	Proportion of children whose births have been registered with a civil authority	2001 2015	[4]
Goal 17. Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development (Technology)	Fixed Internet broadband subscriptions per 100 inhabitants	2003 2015	[6]
	Proportion of 10 years old and more using internet, per 1000 inhabitants	2005 2015	[6]

Notes: [1] PNUD, Fundação João Pinheiro, IPEA. [2] Brasil, Câmara dos Deputados. [3] Ministério da Economia, Secretária da Previdência. [4] Ministério da Saúde. [5] IBGE-PNAD. [6] IBGE-SIDRA. [7] SEEG.

After rescaling the indicators, the following step is grouping variables related to the same SDG. When dealing with aggregation, the weighting issue also appears. It reflects the implicit importance of single variables to compose the index. Different weighting schemes have been suggested in the literature, from no weight to equal weight, or a plurality of systems, following the Analytic Hierarchy Process or Factor Analysis, among others (Greco et al., 2019).
In this paper, the weighting decision followed Sachs et al (2018, p. 42):

> The results of several rounds of expert consultations on earlier drafts of the SDG Index made clear that there was no consensus across different epistemic communities on assigning higher weights to some SDGs over others. As a normative assumption, we therefore opted for fixed, equal weight to every SDG to reflect policymakers' commitment to treat all SDGs equally and as an "integrated and indivisible" set of goals.

Therefore, all the variables related to the same SDG were added by using the arithmetic mean. Then 13 partial indexes were calculated, for each Brazilian Federation Unit. The second and last step was calculating the global composite index of sustainable development by averaging all partial indexes. Opting for the arithmetic mean, and therefore attributing the same weight to any goal, means that for improving the global score, each Brazilian Federation Unit must consider all dimensions, with special attention to those with the lowest score, that is those that are utmost distant from the target.

3. Results

According to the Bellagio Sustainability Assessment and Measurement Principles (STAMP) one of the basic aims of a standardized measurement method is to make communication effective. More precisely, the Principle 6 states:

> In the interest of effective communication, to attract the broadest possible audience and minimize the risk of misuse, assessment of progress toward sustainable development will:
> - use clear and plain language
> - present information in a fair and objective way that helps to build trust
> - use innovative visual tools and graphics to aid interpretation and tell a story
> - make data available in as much detail as is reliable and practicable (Pintér et al., 2018).

To better communicate the result of this research, this section is divided into two parts. In the first one, a dashboard for the 13 SDG selected is presented. For communication purposes, each partial index was named after the corresponding SDG and assessed for each one of the 26 States plus the Federal District that compose the Brazilian Federation.
In the second part the Sustainable Development Index (SD Index) is presented and used to complete the study.
Dashboard easily delivers its message. When a colorful table is used it allows to visualize which dimension and which Brazilian Federation Unit is scoring better or facing more obstacles to reach the sustainable development goals. Composite index, on the other side, are often used to rank countries (see Sachs et al, 2018 for an interesting worldwide study). In this paper the SD Index has been used to build chromatic maps,

a useful tool to visualize relative positions as well as changes occurred when comparing the 2001 and 2015 results.

3.1 Dashboard

The initial decision was to present all variables, that is 45 indicators, for the 27 geographical units, in the two years of study. Unfortunately, the large amount of information was difficult to visualize and investigate. The dashboard of table 2 shows 13 partial SD Index, one for each goal with available information for Brazil.

Table 2. Data related to selected SDG for each Brazilian State and the Federal District, 2001 and 2015

	SDG1	SDG3	SDG4	SDG5	SDG6	SDG7	SDG8	SDG10	SDG11	SDG12	SDG13	SDG16	SDG17
						2001							
Rondônia	0,68	0,49	0,46	0,22	0,40	0,37	0,54	0,62	0,43	0,85	0,40	0,62	0,07
Acre	0,49	0,52	0,41	0,25	0,36	0,05	0,55	0,39	0,44	0,99	0,51	0,73	0,07
Amazonas	0,47	0,45	0,34	0,58	0,43	0,30	0,54	0,39	0,48	1,00	0,79	0,66	0,03
Roraima	0,58	0,39	0,58	0,49	0,60	0,45	0,58	0,58	0,54	0,69	0,55	0,53	0,06
Pará	0,49	0,50	0,52	0,22	0,36	0,09	0,44	0,29	0,47	0,96	0,46	0,70	0,03
Amapá	0,85	0,45	0,51	0,64	0,49	0,81	0,51	0,44	0,58	0,99	0,52	0,56	0,08
Tocantins	0,36	0,49	0,51	0,26	0,24	0,11	0,45	0,29	0,32	0,86	0,47	0,67	0,04
Maranhão	0,01	0,46	0,58	0,06	0,20	0,16	0,35	0,17	0,17	0,87	0,44	0,68	0,00
Piauí	0,06	0,49	0,61	0,06	0,10	0,00	0,49	0,21	0,16	0,96	0,49	0,78	0,02
Ceará	0,14	0,50	0,64	0,18	0,18	0,54	0,41	0,16	0,46	0,99	0,48	0,75	0,05
Norte	0,31	0,54	0,62	0,13	0,26	0,77	0,51	0,40	0,46	0,96	0,50	0,82	0,06
Paraíba	0,16	0,60	0,63	0,09	0,20	0,78	0,53	0,26	0,47	0,96	0,50	0,88	0,05
Pernambuco	0,20	0,51	0,60	0,11	0,21	0,82	0,40	0,29	0,67	0,86	0,49	0,58	0,06
Alagoas	0,01	0,52	0,55	0,20	0,19	0,60	0,40	0,19	0,40	0,84	0,49	0,63	0,01
Sergipe	0,24	0,53	0,66	0,37	0,37	0,68	0,52	0,34	0,45	0,98	0,50	0,73	0,06
Bahia	0,18	0,54	0,58	0,18	0,24	0,25	0,43	0,22	0,43	0,80	0,45	0,89	0,05
Minas Gerais	0,64	0,69	0,56	0,16	0,50	0,83	0,48	0,35	0,63	0,69	0,38	0,94	0,12
Espírito Santo	0,59	0,62	0,52	0,33	0,49	0,95	0,43	0,41	0,66	0,75	0,43	0,71	0,17
Rio de Janeiro	0,84	0,51	0,59	0,40	0,57	0,99	0,63	0,56	0,73	0,79	0,47	0,77	0,24
São Paulo	0,88	0,63	0,52	0,25	0,52	0,99	0,51	0,55	0,76	0,22	0,39	0,81	0,28
Paraná	0,72	0,56	0,49	0,07	0,45	0,91	0,48	0,42	0,64	0,74	0,47	0,88	0,21
Santa Catarina	0,88	0,54	0,53	0,21	0,54	0,95	0,43	0,61	0,65	0,65	0,48	0,96	0,25
Sul	0,79	0,52	0,48	0,23	0,55	0,92	0,43	0,58	0,67	0,72	0,46	0,91	0,18
Sul	0,72	0,46	0,50	0,11	0,33	0,83	0,48	0,40	0,57	0,65	0,45	0,78	0,16
Mato Grosso	0,70	0,45	0,49	0,23	0,36	0,59	0,50	0,44	0,50	0,64	0,09	0,61	0,12
Goiás	0,70	0,54	0,54	0,27	0,41	0,90	0,45	0,39	0,63	0,66	0,41	0,80	0,12
Distrito Federal	0,80	0,76	0,58	0,39	0,97	0,99	0,63	0,43	0,77	0,58	0,50	0,76	0,40
BRASIL	**0,59**	**0,55**	**0,54**	**0,22**	**0,41**	**0,75**	**0,47**	**0,37**	**0,60**	**0,68**	**0,46**	**0,78**	**0,16**
						2015							
Rondônia	0,90	0,53	0,51	0,39	0,60	0,90	0,54	0,92	0,63	0,16	0,50	0,78	0,49
Acre	0,65	0,52	0,49	0,56	0,56	0,65	0,49	0,57	0,59	0,56	0,53	0,81	0,37
Amazonas	0,69	0,45	0,44	0,52	0,62	0,70	0,49	0,34	0,68	0,98	0,94	0,71	0,42
Roraima	0,85	0,50	0,41	0,49	0,85	0,64	0,66	0,71	0,79	0,00	0,57	0,62	0,57
Pará	0,76	0,50	0,57	0,34	0,70	0,68	0,47	0,33	0,68	0,58	0,81	0,68	0,34
Amapá	0,83	0,54	0,48	0,86	0,51	0,94	0,63	0,34	0,70	0,62	0,56	0,68	0,47
Tocantins	0,85	0,50	0,51	0,49	0,60	0,80	0,67	0,39	0,69	0,40	0,49	0,48	0,42
Maranhão	0,51	0,46	0,63	0,22	0,46	0,85	0,50	0,21	0,44	0,51	0,49	0,77	0,27
Piauí	0,66	0,50	0,66	0,26	0,46	0,73	0,51	0,42	0,40	0,64	0,44	0,92	0,34
Ceará	0,64	0,57	0,62	0,34	0,54	0,97	0,61	0,37	0,74	0,98	0,47	0,80	0,43
Rio Grande do Norte	0,73	0,58	0,59	0,47	0,40	0,98	0,53	0,55	0,70	0,91	0,49	0,79	0,57
Paraíba	0,72	0,61	0,64	0,16	0,37	0,98	0,51	0,30	0,69	0,83	0,49	0,86	0,55
Pernambuco	0,70	0,58	0,63	0,36	0,44	0,98	0,51	0,55	0,56	0,71	0,47	0,82	0,50
Alagoas	0,62	0,55	0,62	0,37	0,34	0,96	0,51	0,28	0,50	0,69	0,49	0,75	0,41
Sergipe	0,74	0,54	0,67	0,15	0,43	0,97	0,55	0,51	0,52	0,86	0,49	0,72	0,48
Bahia	0,71	0,61	0,60	0,18	0,63	0,86	0,55	0,30	0,69	0,41	0,41	0,83	0,50
Minas Gerais	0,92	0,70	0,59	0,15	0,67	0,98	0,54	0,41	0,75	0,38	0,34	0,94	0,67
Espírito Santo	0,92	0,65	0,54	0,51	0,72	1,00	0,59	0,44	0,89	0,46	0,46	0,83	0,69
Rio de Janeiro	0,96	0,63	0,56	0,50	0,96	1,00	0,62	0,60	0,86	0,58	0,44	0,90	0,81
São Paulo	0,98	0,73	0,57	0,35	0,80	1,00	0,58	0,74	0,95	0,09	0,39	1,00	0,88
Paraná	0,96	0,64	0,53	0,26	0,67	0,99	0,56	0,50	0,80	0,45	0,46	0,92	0,75
Santa Catarina	1,00	0,60	0,54	0,41	0,64	1,00	0,55	0,72	0,81	0,33	0,47	0,97	0,81
Rio Grande do Sul	0,96	0,57	0,50	0,33	0,91	0,99	0,52	0,77	0,95	0,35	0,43	0,93	0,75
Mato Grosso do Sul	0,97	0,48	0,53	0,27	0,65	0,95	0,48	0,52	0,67	0,35	0,46	0,91	0,70
Mato Grosso	0,97	0,52	0,53	0,36	0,60	0,92	0,51	0,54	0,67	0,32	0,48	0,81	0,58
Goiás	0,96	0,65	0,50	0,41	0,71	0,98	0,58	0,51	0,75	0,25	0,43	0,80	0,68
Distrito Federal	0,97	0,82	0,57	0,47	1,00	1,00	0,72	0,57	0,77	0,56	0,50	0,82	1,00
BRASIL	**0,86**	**0,62**	**0,57**	**0,33**	**0,66**	**0,95**	**0,55**	**0,51**	**0,77**	**0,32**	**0,50**	**0,89**	**0,66**

Legend: < 0,4 | [0,4 - 0,6) | [0,6 - 0,8) | ≥ 0,8

Source: The authors.

Now, the information resumed in the dashboard allows to visualize relative position of each Brazilian Federation Unit in each goal as well as the change occurred over the period under study.

From the comparison of the 2001 and 2015 results, figure 2 clearly shows a widespread improvement in the SDG17 and SDG1. The former is here measured by communication technology variables. The result is mainly due to the diffusion of mobile phone and internet in Brazil over this period of time. The SDG1 enhancement is the result of public policies aimed to fight poverty, specially the social welfare program known as Bolsa Família, a conditional cash transfer program implemented by the Brazilian government since 2005.

Insufficient improvement is shown in SDG5 and SDG10, both related to inequality, with the former aimed to promote women equality and empowerment. This result confirms that inequality is still the major challenge for Brazil, especially when the gender dimension is considered.

A quite different tendency is shown by the SDG12 indicator. Related to the pesticide use in the agricultural activities, it was the only one where, for many of the Federation Units, the 2015 results averaged below the 2001 score. This is a very negative finding for a country like Brazil, known internationally for its strong agricultural sector, which represents a growing share in the national GDP as well as in its export flow.

3.2 Multidimensional Index

After investigating the specific dynamic of each SDG, a global composite SD Index was calculated for each state of the Brazilian Federation. Since the SD Index ranges from 0 to 1, a value of 0,5 can be interpreted as the Federation Unit is on average halfway to reach a full economic, social and environmental development. Table 3 presents the scores of the SD Index for each Federation Unit. The same results were used to produce the chromatic maps of Figure 2, with the help of the software Philcarto.

Table 3. The composite SD Index for each Brazilian State and the Federal District, 2001 and 2015

	2001	2015		2001	2015
Rondônia	0,475	0,604	Alagoas	0,388	0,545
Acre	0,443	0,565	Sergipe	0,495	0,587
Amazonas	0,498	0,614	Bahia	0,402	0,560
Roraima	0,510	0,590	Minas Gerais	0,536	0,618
Pará	0,425	0,573	Espírito Santo	0,542	0,667
Amapá	0,570	0,627	Rio de Janeiro	0,624	0,725
Tocantins	0,391	0,561	São Paulo	0,563	0,696
Maranhão	0,320	0,484	Paraná	0,541	0,652
Piauí	0,341	0,534	Santa Catarina	0,591	0,680
Ceará	0,421	0,620	Rio Grande do Sul	0,572	0,690
Rio Grande do Norte	0,487	0,639	Mato Grosso do	0,495	0,611
Paraíba	0,471	0,593	Mato Grosso	0,440	0,600
Pernambuco	0,446	0,601	Goiás	0,524	0,631
			Federal District	0,658	0,751

Source: The authors.

In the spirit of the Bellagio STAMP, the second option seems a much more effective communication tool than table 3.

In a glimpse, it is clear the overall improvement made in implementation the SDG, as the greening of the Brazilian map suggests. In 2001, 16 out of 27 Federation Units score below 0,5. In 2015 only one (Maranhão, the orange State in the second map) was recording a SD Index less than 0,5. On the other side, only the Federal District recorded a score slightly higher than 0,75 in 2015. That is, despite the greening of the maps, much more effort is demanded to reach the sustainable development goals in Brazil. This is true for all the Federation Units, with special attention for the Northeastern states of Maranhão, Piauí and Alagoas (the orange and yellow spots in the second map).

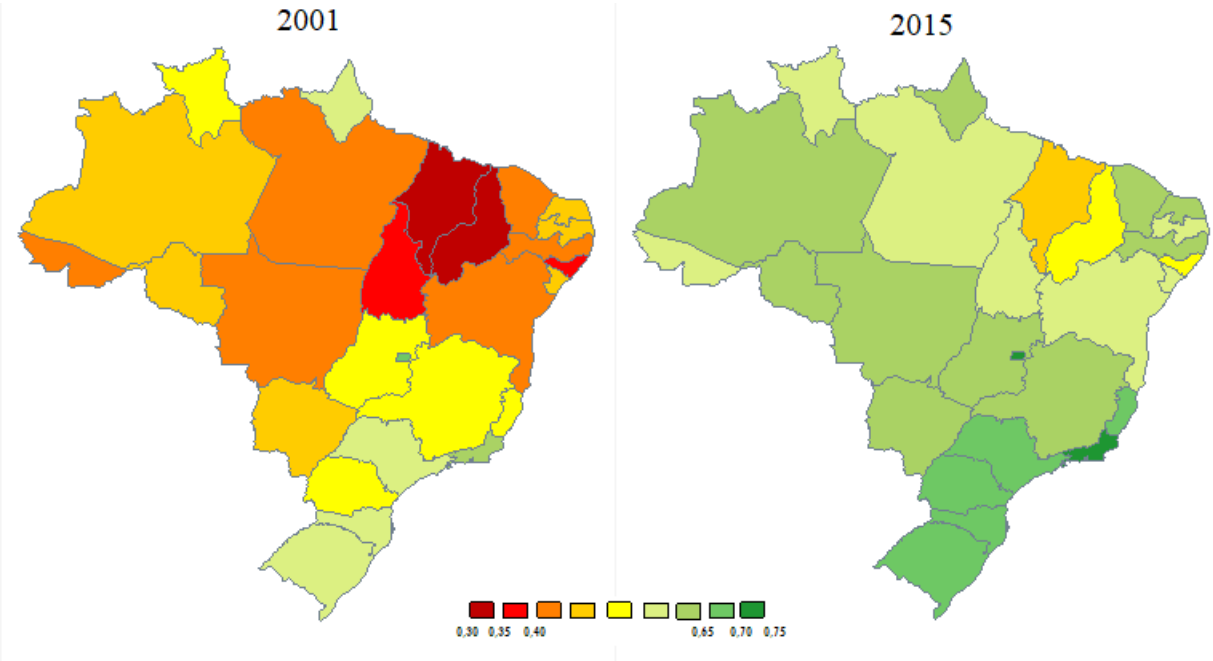

Figure 2. The composite SD Index in 2001 and 2015, Brazilian Federation Units.

Source: The authors. Maps produced with *Philcarto*: http://philcarto.free.fr

To identify their main obstacles to reach better result on the composite SD Index, the dashboard helps (table 2). All the three units share poor results on gender equality (SDG5). Two of them (Maranhão e Alagoas) show low records on inequality (SDG10). Maranhão must also improve communication technology (SDG17). While Alagoas' results point to precarious sustainable management of water and sanitation (SDG6).

4. Conclusion

The call for monitoring progress toward sustainable development faces the typical challenges of a multidimensional phenomenon. That is, the selection of relevant indicators and the choice of appropriate tools of assessment.

In this paper the UNSTAT framework of sustainable indicators was the starting point for variables selection. The Bellagio STAMP oriented the choice of communication tools as well as the description of the method,

given the importance of making the research replicable. After detailing and justifying each methodological step followed to build de SD Index, the results were discussed using two different tools. The dashboard showed to be a convenient device to describe and analyze individual SDG, while the chromatic maps proved to be an interesting alternative to the usual ranking application of a global SD Index. Together they helped to easily assess the quality of sustainable development of the Brazilian Federation Units, making communication more effective.

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