2024 Volume 2, Issue 1
Lecture Notes in Education, Arts, Management and Social Science
ISSN(Online): 2705-053X

Brazilian Universities' Profiles and the Sustainable Development Goals (2015–2023): Production and Impact on Web of Science

Olga Del-Rio-Sánchez[1], Andrea Oliveira[2]*, Rafael Repiso[2]
[1]University of Girona, Girona 17004, Spain
[2]Faculty of Communications Sciences, University of Málaga, Málaga 29010, Spain

***Corresponding author:** Andrea Oliveira, andrea.oliveira@uma.es

Abstract:

The Sustainable Development Goals as a global policy provide universities with the opportunity to offer information and innovative solutions in international forums. In recent years, scientific research on the SDGs has not only grown but has also diversified. However, the relevant gaps in studies on the subject affect compliance with the Agenda2030. This article aims to evaluate the Brazilian university system's research into SDGs. It also proposes a methodological objective which is to verify whether, through the analysis of scientific production, profiles can be identified, and university entities can be grouped based on their similarity in the priority they give to different topics. A bibliometric analysis is carried out where the production and normalized impact of Brazilian universities are studied, as well as a multidimensional scaling. The results reveal that the Brazilian production of each SDG is concentrated in five universities and that, in general, the entities' contribution to the SDGs achieves a lower impact than the world average except for the theme "Life on Land" (SDG15). This suggests that Brazilian research into the SDGs pursues a contribution of scientific knowledge of the local geographical scope. Furthermore, the data indicate the presence of few universities with unique profiles when it comes to prioritizing scientific contributions to the SDGs. Faced with the global challenge of more diverse and plural knowledge production, Brazilian centers can take advantage of expanding their scientific production on the SDGs on a more strategic scale with the purpose of influencing the universal political agenda. The study enriches the understanding of the scientific contribution to the SDGs by Brazilian universities.

Keywords:

Sustainable development goals
Sustainable development
Brazil
Scientific production
Scientific impact
Bibliometrics
Universities
Multidimensional scaling
SDGs
Brazilian universities
Normalized impact
Science communication
Agenda 2030
Science indicators
United Nations

Online publication: June 28, 2024

1. Introduction

Science develops within specific historical and cultural contexts, influenced by both internal factors of each discipline and external political, social, and cultural dynamics [1,2]. Accordingly, the interactions between scientific subsystems and politics are continuously reconfigured based on the dynamics of the broader social system [3]. In this context, the "2030 Agenda for Sustainable Development"—adopted unanimously by all countries at the United Nations Summit in September 2015 and to be achieved by 2030—emerges as a new universal political agenda aimed at ensuring the future of humanity. This agenda requires the participation and collaboration of all public and private social actors [4].

The 2030 Agenda is complex, comprising 17 goals (**Figure 1**), 169 targets, and 232 indicators [5]. It calls upon nations, businesses, civil society, universities, and others to provide solutions and periodic updates in various national and international forums [6]. The Sustainable Development Goals (SDGs) are interdependent, addressing the three dimensions of sustainable development: economic, social, and environmental [4,7].

Figure 1. Sustainable development goals aggregated by sustainability dimensions [9]

The complexity of this initiative and the need for innovative solutions and continuous reporting position science, technology, and innovation as the key means to achieve the SDGs [6]. In its 2019 Global Sustainable Development Report, The Future is Now: Science for Achieving Sustainable Development, the United Nations advocated for strengthening the science-policy interface to enable policymakers and other stakeholders to make evidence-based decisions when implementing the SDGs [9]. Furthermore, UNESCO declared 2022 the International Year of Basic Sciences for Sustainable Development. In 2023, the Global Sustainable Development Report emphasized the need for a science-policy-society interface, advocating for scientific knowledge production that is inclusive, pluralistic, and responsive to the context in which it is generated, as well as to the challenges it seeks to address [7].

The launch of the 2030 Agenda as a global political framework, combined with the emphasis on science for achieving the SDGs and efforts by the United Nations and other international and national bodies, has led to a steady and exponential growth in scientific output related to the SDGs [9,10]. Mishra *et al.* [11] identified 12,176 articles on the SDGs published between 2015 and 2022, with more than half appearing in the last two years. In October 2022, Yamaguchi *et al.* [12] conducted a simple search using "Sustainable Development Goals" as a keyword on the Web of Science, yielding 37,037 records. This proliferation of studies and the existing body of knowledge on the SDGs enables researchers to explore this domain using various qualitative and quantitative approaches based on the literature. Initial reviews focused on qualitative approaches, addressing objectives such as evaluating national progress, identifying the role of ICT in achieving the SDGs, and analyzing implementation challenges [11]. In recent years, a wave of studies has emerged, analyzing scientific output through meta-analyses and bibliometric methods [10].

Scientific research on the SDGs is not only growing but also diversifying in terms of research areas. As shown in **Figure 2**, the range of topics expanded between 2015 and 2022, with 2022 being the first year to include review articles on all SDGs [12]. However, SDG research cannot yet be considered a consolidated field due to significant research gaps, particularly in SDG 8 (Decent Work), SDG 10 (Reduced Inequalities), SDG 5 (Gender Equality), and SDG 16 (Peace, Justice, and Strong Institutions) [11,12]. UNESCO's Science Report [13] also highlights diversification by country and existing gaps that hinder the achievement of the 2030 Agenda, which requires a balance across the economic, social, and environmental dimensions of sustainable development.

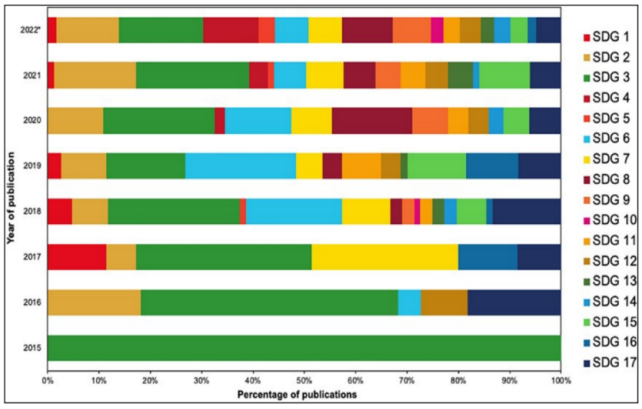

Figure 2. Distribution of review publications on sustainable development goals (SDGs) over time [12]

Bibliometric analyses have also addressed specific SDGs or groups of SDGs. For instance, studies have focused on SDG 1 (No Poverty) [14], SDG 2 (Zero Hunger) [15], SDG 3 (Good Health and Well-being) [16], SDG 4 (Quality Education) [17-19], SDG 9 (Industry, Innovation, and Infrastructure), and SDG 12 (Responsible Consumption and Production) [20], as well as SDG 6 (Clean Water and Sanitation) [21].

From a geographical perspective, bibliometric studies reveal disparities in productivity and impact across regions and countries. Research on the SDGs is more prevalent in developed countries than in developing ones. Generally, Western countries (notably the United States and the United Kingdom) and China are the leading producers of science and SDG-related research [11,12,22]. However, regarding impact, the United States and the United Kingdom significantly surpass China, with comparable productivity but nearly triple the impact [11].

Regional thematic preferences also vary. Meschede [23] identified SDG 4 (Quality Education) as the second-most-researched SDG in Europe and South America, the fourth in Africa, and absent from the Top 5 in other regions.

In Latin America, scientific output related to the SDGs has also grown significantly. Less-developed countries in the region (e.g., Nicaragua, Guatemala, the Dominican Republic, and El Salvador) focused more intensively on specific SDGs, with 53% of their output concentrated on them during 2016–2019. In contrast, wealthier countries like Brazil, Mexico, Argentina, and Chile had a concentration of 30% during the same period [24]. Notable regional trends include a fourfold increase in research on SDG 4 and a 3.6-fold increase in SDG 16 compared to global trends. Research on SDG 1 and SDG 10 also grew nearly three times faster in the region than globally.

The SDGs as a global policy provide universities an opportunity to contribute to their core missions: education, research, and knowledge transfer. Although this integration remains in its early stages in many cases [25], universities and research centers are among the leading producers of knowledge in SDG-related fields [15]. The amount of SDG-related research produced by universities also influences their international rankings, such as the Times Higher Education Impact Rankings, which evaluate universities based on their research and impact on the SDGs. For instance, the University of Brasília ranked highest in Brazil for SDG 4 in 2023, placing 95th globally, while São Paulo State University ranked 25th worldwide for SDG 9 [26].

Some studies have specifically analyzed university-level SDG research. For example, Körfgen *et al.* [27] examined articles from 13 Austrian universities, Machado and Davim [28] conducted a bibliometric analysis on "higher education for sustainability," and Repiso *et al.* [10] analyzed Spanish universities' SDG-related scientific output. Global studies also incorporate university-based research and impact, highlighting North American and UK universities as leaders and occasionally including the University of São Paulo in the Top 10 [11,29].

In Brazil, bibliometric studies have addressed specific aspects of SDG-related research, such as environmental sustainability [30], sustainability in small businesses [31], sustainable development in the Amazon [32], and tourism [33]. However, no comprehensive bibliometric analyses have been conducted on SDG-related scientific output from Brazilian universities.

The objective of this study is to characterize the Brazilian university system's research on SDGs by analyzing the production and impact of each university across 16 SDGs. Additionally, this study seeks to determine whether the analysis of this output can identify profiles and group universities based on their thematic priorities.

2. Methodology

This study is a bibliometric analysis of the scientific

production of Sustainable Development Goals (SDGs) by Brazilian universities in the Web of Science Core Collection for the period 2015–2023 (up to June 2023). It utilizes filters implemented by Clarivate Analytics in the InCites platform as of February 2022. To identify works related to each SDG, Clarivate Analytics has developed a set of Micro Citation Topics, carefully curated by analysts from the company's Institute of Scientific Information™ (ISI) through a combination of bibliometric analysis and manual review [34]. This production identification methodology has been employed in other studies, such as that of Repiso *et al*. [10], which conducted a similar analysis for Spanish universities. It is worth noting that SDG 17 is conceptualized as the conjunction of pursuing two or more goals; thus, neither Web of Science nor Scopus identifies it, which is why it is excluded from this study and existing literature.

The study provides a descriptive analysis of the production of Brazilian universities for each of the 16 SDGs. Additionally, it identifies the Normalized Impact of these outputs, allowing for an understanding of both the number of publications and the average scientific impact of these areas. The Normalized Impact calculated by InCites contextualizes the citations each article receives according to its category and publication year [35].

Furthermore, leveraging the diversity of SDGs (16), the universities are characterized. Multidimensional Scaling (MDS) is employed to visually assess similarities between institutions based on their focus on SDG-related themes. MDS is a tool that enables researchers to obtain quantitative estimates of similarity between groups of elements, offering a visual representation of the relational structures underlying the studied system [36]. The Kendall rank correlation coefficient was used for its superior discrimination of results. This coefficient evaluates the ordinal element of the cases to analyze the order of preferences each university exhibits for the 16 SDGs, treating them as a ranking [37]. MDS plots the studied elements—in this case, Brazilian universities—on a Cartesian plane according to their similarity.

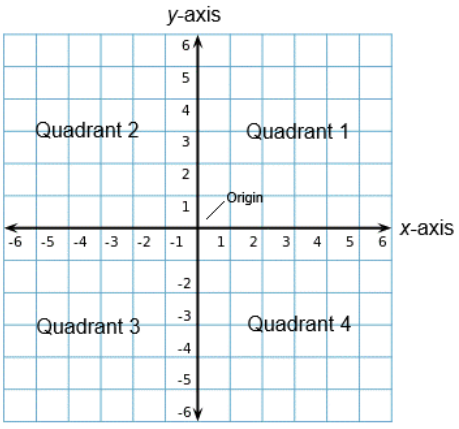

Figure 3. Cartesian plane ordered by quadrants

Table 1. Phases of data collection and analysis of Brazilian universities' SGD production

Phase	Phases of the study
1	Identification of Brazilian universities in Web of Science (176 universities identified; only the top 25 most productive are shown in the tables, but the full dataset contains values for all universities).
2	Search and identification of the SDG-related production of Brazilian universities for each of the 16 SDGs (InCites: 16 values for 176 universities = 2,816 identified values).
3	Calculation of the Normalized Impact for each dataset (InCites: 16 values for 176 universities = 2,816 calculated values).
4	Multidimensional Scaling: A comparative study of similarity among the top 25 most productive universities in SDGs, using the 16 values as analytical elements. Software: Xlstat [38]. Kendall rank correlation coefficient was applied. Visualization was conducted using Tableau.

3. Results

3.1. Scientific production on SDG topics

The majority of Brazil's scientific production on each SDG is concentrated in five universities. The most productive are the University of São Paulo, São Paulo State University, State University of Campinas, Federal University of Rio de Janeiro, Federal University of Rio Grande do Sul, and Federal University of Minas Gerais (**Table 2**). These large, generalist universities stand out in the number of publications across nearly all SDGs. However, it is important to identify the areas where

these institutions do not excel. The University of São Paulo is the leader in all areas, followed by São Paulo State University, which also performs strongly in most areas but shows lower production in SDG 8 (Decent Work and Economic Growth) and SDG 10 (Reduced Inequalities), both related to social issues. Beyond the top five, significant differences between universities are observed, allowing the articulation of similarities and differences between institutions based on patterns identified throughout the article.

In general, SDGs related to Natural Sciences show the highest levels of scientific production. The most developed SDG, SDG 3 (Good Health and Well-Being), accounts for 46% of the production by these institutions. In contrast, SDGs related to Social Sciences have relatively lower production, except for SDG 2 (Zero Hunger) and SDG 5 (Gender Equality), the latter ranking as the sixth most developed goal (3.9%). SDG 16 (Peace, Justice, and Strong Institutions) and SDG 8 (Decent Work and Economic Growth) have minimal production, jointly representing only 0.8%. Other areas with proportionally lower output in Brazilian research include SDG 10 (Reduced Inequalities) and SDG 1 (No Poverty).

The University of Brasília is among the top five producers of research on SDG 1, 8, 10, and 16, while the Federal University of Minas Gerais excels in SDG 1, 6, 7, 10, 11, and 16. Similarly, the Federal University of Santa Catarina stands out in three areas (SDG 4, 9, and 11), while the Federal University of Viçosa and Federal University of Paraná are recognized in two (SDG 2 and 13, and SDG 14 and 15, respectively). The Federal University of Pernambuco is among the top five institutions in SDG 16, and the Federal University of Lavras in SDG 2.

Except for the University of São Paulo, all other top-producing universities drop out of the top five rankings in at least five SDGs. For instance:

(1) São Paulo State University underperforms in SDG 8, 9, 10, 11, and 16.

(2) State University of Campinas is less prominent in SDG 2, 10, 13, 14, and 16.

(3) The Federal University of Rio de Janeiro shows lower output in SDG 2, 4, 5, 6, and 16.

(4) Federal University of Rio Grande do Sul underperforms in SDG 1, 7, 14, 15, and 16.

However, SDG 16 highlights several institutions apart from the University of São Paulo, such as the University of Brasília, Federal University of Minas Gerais, Rio de Janeiro State University, and Federal University of Pernambuco.

3.2. Impact of Brazilian universities by SDG

When analyzing the normalized impact of the publications from Brazil's Top 25 universities by specialty and SDG (**Table 3**), it is evident that most of their contributions fall below the global citation average (below 1). Out of 400 cases, the Top 25 universities matched or exceeded the global citation average in only 81 instances (roughly 1 in 5). The worst-performing area is SDG 4 (Quality Education), where no university comes close to the global average citation rate, followed by SDG 9 (Industry, Innovation, and Infrastructure), with only one institution (the Federal University of Rio Grande do Sul) surpassing the global average. Similarly, for SDG 16 (Peace, Justice, and Strong Institutions), only one institution (Federal University of Pelotas) exceeds the global average, although some universities with high impact values, such as the Federal University of ABC (average impact of 2.42), also perform strongly. SDG 5 (Gender Equality) is another underperforming area, with only four universities meeting the global average.

On the other hand, SDG 15 (Life on Land) is the area where Brazilian universities outperform the global average most consistently, with 17 institutions from the Top 25 achieving values above the global average. Notable among these are smaller universities such as Pontifical Catholic University of Rio de Janeiro (IN = 2.62) and Vega de Almeida University (IN = 2.86).

The impact of universities on SDG research varies significantly across areas, with the influence concentrated in 12 institutions. The University of Southern Santa Catarina achieves the highest impact in three SDGs (SDG 3: 1.7; SDG 6: 1.17; SDG 11: 2.77), while the State University of Campinas (SDG 2: 1.09; SDG 4: 0.82), Vega de Almeida University (SDG 1: 5.4; SDG 15: 2.86), Federal University of ABC (SDG 14: 3.02; SDG 16: 2.42), and Federal University of Pelotas (SDG 5: 1.72; SDG 7: 1.29) lead in two SDGs each. Seven universities achieve the highest impact in only one SDG:

(1) Federal University of São Carlos in SDG 8 (1.17)

(2) Federal University of Minas Gerais and Federal University of Rio Grande do Sul in SDG 9 (1.06)

(3) Pontifical Catholic University of Rio de Janeiro in SDG 13 (1.47)

(4) Federal University of Rio Grande do Norte in SDG 10 (1.55)

(5) Federal University of Ceará in SDG 12 (1.48)

Only the last two universities are located in Brazil's northern and northeastern regions; the rest are situated in the southern and southeastern parts of the country.

The multidimensional scaling technique, used to analyze similarities and groupings, places the most generalist universities near the center of the graph. The Federal University of Minas Gerais, the Federal University of Ceará, and the Federal University of Rio Grande do Sul are among the most generalized institutions (**Figure 4**). Typically, the universities with higher total production are positioned closer to the center, while smaller universities with unique scientific profiles are on the periphery, such as the Federal University of Pelotas and Federal Fluminense University, which are strikingly complementary.

While the overall production distribution among universities is similar, subtle nuances allow for clear groupings. The similarity matrix shows that SDG 2 (Zero Hunger) is the most commonly represented across universities, followed by SDG 16 (Peace, Justice, and Strong Institutions) and SDG 8 (Decent Work and Economic Growth). Conversely, SDG 9 (Industry, Innovation, and Infrastructure) shares the most similarities with other SDGs, making it less discriminative.

An example of grouping by priorities includes the Federal Universities of Viçosa, Santa Maria, and Lavras, which share low production in SDG 4 (Quality Education) and SDG 5 (Gender Equality). This selective focus drives their positioning in the multidimensional scaling graph.

Universities in each quadrant demonstrate distinct SDG contributions:

(1) First Quadrant: Focus on SDGs 1, 3, 5, 7, 8, 13, 15, 16, with notable contributions to SDGs 1, 2, and 13 and medium production in SDGs 5, 7, 13, 15. Institutions here are located in the south (2) and southeast (3).

(2) Second Quadrant: Focus on SDGs 5, 7, 8, 11, and 15, with medium production in SDGs 5, 7, and 11 and low production in SDGs 8 and 15, except for the Federal University of Pernambuco and Federal University of Minas Gerais. Institutions are in the northeast (3) and southeast (2).

(3) Third Quadrant: Broad SDG focus, especially on SDGs 1, 2, 3, 6, 8, 10, 11, 12, 13, 14, 15, 16, with high contributions to SDGs 2, 13, and 15. Institutions are distributed across the northeast (1), southeast (3), central-west (2), and south (1).

(4) Fourth Quadrant: Contributions to SDGs 1, 6, 7, 8, 13, 15, and 16, with medium production in SDGs 6 and 7 and low production in SDGs 8 and 16, except for SDGs 1, 13, and 15. Institutions are in the northeast (1), southeast (3), central-west (2), and south (1).

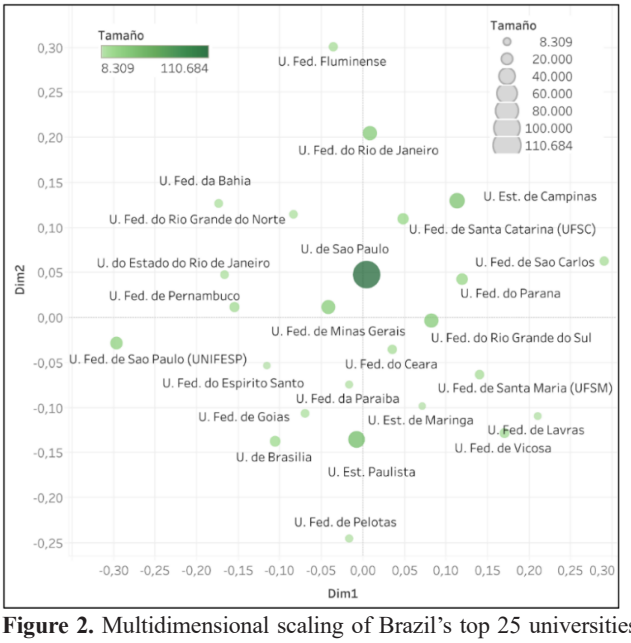

Figure 2. Multidimensional scaling of Brazil's top 25 universities by SDG scientific production (2015–2023)

Table 2. Scientific production on SDG topics in Brazil (2015–2023, top 25 universities)

	ODS1	ODS2	ODS3	ODS4	ODS5	ODS6	ODS7	ODS8	ODS9	ODS10	ODS11	ODS12	ODS13	ODS14	ODS15	ODS16
University of Sao Paulo	809	4,658	60,640	1,570	5,164	2,293	3,186	366	1,472	431	5,601	2,296	9,675	3,075	9,088	360
University of São Paulo	218	3,567	18,100	654	1,339	1,327	1,539	35	430	60	1,274	1,086	4,780	1,696	5,172	57
University of Campinas	218	1,312	17,854	651	1,818	1,090	1,700	159	858	116	2,316	1,196	2,559	616	2,676	79
Federal University of Rio de Janeiro	268	704	14,150	453	1,072	841	1,095	202	793	194	2,029	856	2,863	1,218	3,181	94
Federal University of Rio Grande do Sul	195	1,608	14,336	578	1,289	1,089	601	165	615	153	2,245	850	2,890	750	2,509	119
Federal University of Minas Gerais	280	926	15,919	570	1,244	939	776	157	449	179	1,582	542	2,127	460	2,435	153
University of Sao Paulo	97	315	18,006	366	1,844	210	170	32	72	21	373	179	650	417	660	63
Federal University of Paraná	105	1,372	7,656	322	564	607	627	73	372	97	830	622	2,434	854	2,890	72
University of Santa Catarina	143	875	7,448	687	734	743	924	78	606	142	1,319	840	1,745	913	1,471	81
University of Brasilia	322	1,066	6,346	486	532	416	495	168	379	216	1,009	329	2,214	362	2,211	217
Federal University of Pernambuco	116	684	6,548	332	567	490	444	55	382	104	695	236	1,532	825	1,978	125
Federal University of Vicosa	132	3,045	3,447	71	187	499	315	46	84	53	440	275	3,347	184	2,641	8
University of Santa Maria	81	1,513	5,335	172	250	680	650	42	187	30	831	298	1,665	332	1,129	31
Federal University of Ceara	115	883	6,161	266	530	498	407	53	288	58	672	331	1,430	438	939	
University of Sao Carlos	92	706	4,745	340	394	810	798	43	411	56	553	1,017	1,066	317	1,659	45
Univ. Fed. Fluminense	158	208	6,377	288	507	303	477	152	528	129	958	341	1,159	553	632	77
Federal University of Rio Grande do Norte	112	411	4,709	292	412	567	438	30	286	60	758	217	1,082	491	1,204	41
Federal University of Goias	97	866	5,110	203	454	293	277	36	119	90	373	111	1,235	199	1,601	37
Federal University of Bahia	102	239	5,963	280	409	294	285	40	251	48	439	180	1,120	469	908	49
Rio de Janeiro State University	107	210	5,551	186	626	292	186	78	124	91	831	147	1,067	499	916	135
Federal University of Pelotas	94	1,171	5,103	103	574	171	118	11	53	36	411	115	1,166	96	458	54
Federal University of Paraiba	95	601	3,803	238	336	271	569	73	160	109	378	192	1,081	316	1,106	65
Federal University of Lavras	49	1,996	1,845	63	78	310	190	18	76	21	277	172	2,069	133	1,891	5
Federal University of Espírito Santo	49	530	3,353	172	331	276	305	46	114	55	440	165	961	416	1,169	57
Maringa State University	47	788	3,315	101	235	562	156	28	82	59	337	170	1,072	298	1,035	24

Table 3. Normalized impact of Brazil's top universities by SDG (2015–2023)

	ODS1	ODS2	ODS3	ODS4	ODS5	ODS6	ODS7	ODS8	ODS9	ODS10	ODS11	ODS12	ODS13	ODS14	ODS15	ODS16
University of Sao Paulo	1.14	1.08	1.21	0.77	1.06	0.82	0.88	0.78	0.78	0.8	1.17	0.99	1.09	0.98	1.19	0.78
University of São Paulo	0.73	0.69	0.87	0.4	0.85	0.76	0.71	1.02	0.89	0.56	0.87	0.87	0.78	0.85	1	0.36
University of Campinas	0.99	1.09	1.07	0.82	0.94	0.93	0.92	0.82	0.94	0.41	1.1	1.02	1.13	0.93	1.32	0.82
Federal University of Rio de Janeiro	1.22	0.82	1.03	0.52	0.83	0.85	0.84	0.75	0.92	0.57	1	0.92	0.95	0.96	1.07	0.58
Federal University of Rio Grande do Sul	1.25	0.9	1.4	0.59	0.97	1.02	0.78	0.62	1.06	1.11	1.3	1.08	0.93	0.93	1.11	0.6
Federal University of Minas Gerais	1.65	0.97	1.31	0.6	0.87	0.75	0.75	1.16	0.75	1.15	1.06	0.79	0.94	0.93	1.24	0.38
University of Sao Paulo	0.77	0.85	1.21	0.56	0.96	0.87	0.65	0.52	0.54	0.39	0.93	0.92	0.99	1.11	1.05	0.48
Federal University of Paraná	0.54	0.65	0.96	0.45	0.82	0.7	0.88	0.73	0.6	0.36	0.6	0.77	0.72	0.81	0.87	0.48
University of Santa Catarina	0.76	0.72	1.52	0.56	0.87	0.83	0.81	0.45	0.64	0.49	0.97	1.14	0.98	0.97	1.05	0.39
University of Brasilia	1.01	0.87	1.33	0.41	0.79	0.81	0.72	0.95	0.6	0.55	0.94	0.69	0.93	0.82	1.08	0.48
Federal University of Pernambuco	0.73	0.92	0.83	0.66	0.65	0.71	0.8	0.79	0.68	0.6	0.7	0.55	0.89	0.8	1.11	0.72
Federal University of Vicosa	0.64	0.88	0.83	0.51	0.57	0.78	0.69	0.28	0.45	0.28	0.87	0.81	0.83	0.65	0.93	0.62
University of Santa Maria	0.66	0.76	0.88	0.32	0.55	1.09	0.69	0.22	0.53	0.44	0.99	0.74	0.58	0.85	0.74	0.17
Federal University of Ceara	1	0.66	0.87	0.45	0.61	0.88	0.61	0.36	0.87	0.49	0.71	1.48	0.67	0.83	0.84	0
University of Sao Carlos	0.81	0.79	0.89	0.48	1.04	0.79	0.79	1.17	0.83	0.37	0.72	1.14	0.77	0.76	1.01	0.77
Univ. Fed. Fluminense	0.99	0.76	0.89	0.39	0.85	0.69	0.95	0.9	0.86	0.55	0.75	1.08	0.89	0.87	1.01	0.39
Federal University of Rio Grande do Norte	1.04	0.77	0.85	0.81	0.76	0.83	1.02	0.68	0.82	1.55	0.71	0.79	1.02	0.98	1.18	0.75
Federal University of Goias	1.35	0.78	0.96	0.43	0.91	0.69	0.56	0.34	0.69	0.9	0.79	0.61	0.89	1.07	1.11	0.45
Federal University of Bahia	0.82	0.78	1.38	0.54	0.85	0.77	0.86	1.08	0.99	1.08	0.98	0.72	0.79	0.78	1.09	0.41
Rio de Janeiro State University	0.79	0.83	0.96	0.48	0.88	0.73	0.63	1.07	0.46	0.21	0.79	0.57	0.91	0.88	0.89	0.59
Federal University of Pelotas	1.8	0.94	1.27	0.36	1.72	0.82	1.29	1.06	0.56	1.11	0.87	0.68	0.68	0.77	0.79	1.22
Federal University of Paraiba	0.69	0.55	0.77	0.48	0.8	0.88	0.82	0.43	0.36	0.72	0.9	0.74	0.8	0.99	0.97	0.44
Federal University of Lavras	0.51	0.72	0.75	0.71	1.06	0.67	0.76	0.4	0.46	0.2	0.6	0.58	0.73	0.73	1.09	0.22
Federal University of Espírito Santo	0.26	0.57	1.19	0.36	0.74	0.75	0.74	0.34	0.44	0.11	1.04	0.74	0.69	0.99	0.87	0.47
Maringa State University	0.73	0.59	0.84	0.58	0.67	1	0.63	0.67	0.36	1.12	1.1	0.66	0.7	0.73	1.02	0.46
ABC Federal University	1.73	0.84	0.99	0.74	0.89	0.66	0.96	0.28	0.73	0.47	1.08	0.65	1.05	3.02	1.09	2.42
Pont. Catholic University of Rio de Janeiro	0.82	0.96	0.91	0.76	0.81	0.73	0.65	0.94	0.75	0.83	0.9	1.1	1.47	1.69	2.62	1.1
University of Southern Santa Catarina	0.55	1	1.7	0.34	0.89	1.17	0.29	1.1	0.88	0.04	2.77	1.01	1.16	0.94	1.24	1.06
Veiga de Almeida University	5.4	0.14	0.75	0.68	0.31	0	0	0.63	0.05	1.16	2	0.16	1.44	0.44	2.86	0

Four universities are included which, without being in the top 25 productive universities, stand out for having a great international impact in some of the SDGs studied. Values below 1 are shown in red letters, except for exceptions for reasons of contrast.

4. Discussion and conclusions

The Sustainable Development Goal (SDG) with the highest development in Brazilian universities is SDG 3 (Health and Well-being), accounting for 46% of the scientific output, followed by SDG 13 (Climate Action) and SDG 15 (Life on Land), each contributing slightly more than 10%. The fourth most productive goal is SDG 2 (Zero Hunger) with 6.3%, while SDG 5 (Gender Equality) and SDG 7 (Affordable and Clean Energy) rank fifth and sixth, with 3.9% and 3.1%, respectively. These proportions change slightly when considering only the top 25 universities, where the output on Gender Equality surpasses that of Zero Hunger in many cases. The four SDGs with the least scientific output are, in descending order, SDG 1 (No Poverty) with 0.8%, SDG 10 (Reduced Inequalities) with 0.48%, and SDG 16 (Peace, Justice, and Strong Institutions) and SDG 8 (Decent Work and Economic Growth), each with 0.4%.

In general, Brazilian universities do not stand out for their impact on SDGs, with the exception of smaller, peripheral universities where lower output achieves relatively high impact. In most cases, the impact remains below the global average. This trend is partly attributed to the national focus of much Brazilian research, published in domestic journals addressing local issues [39]. A significant portion of the output aims for local impact, though one national theme surpassing the global average is "Life on Land" (SDG 15), followed by Health and Well-being (SDG 3).

The thematic profiles of Brazilian universities show disparities in output quantity, while normalized impacts are mostly similar and below 1. The distribution of SDG contributions is also quite uniform, requiring Kendall's coefficient to highlight differences in priorities among the universities. Larger universities tend to align more closely with the overall profile, exemplified by the University of São Paulo. Conversely, smaller universities occupy the extremes, with unique profiles, such as the Federal Universities of Fluminense, São Carlos, Pelotas, and São Paulo, which display uncommon output distributions.

Studies measuring and comparing scientific output on SDGs have consistently shown similar overall trends. Most research focuses on life sciences, biomedicine [23], natural sciences, engineering/technology [40], and environmental sciences [12]. Social sciences follow in productivity [41] and impact [42]. The primary focus areas include SDG 3 (Health and Well-being) [16,22,23,43] and SDG 13 (Climate Action) [44], along with climate-related SDGs such as SDG 7 (Affordable and Clean Energy), SDG 11 (Sustainable Cities and Communities), and SDG 12 (Responsible Consumption and Production) [12,22,40].

The top 5 universities identified for SDG-related scientific output largely coincide with global rankings. As in this study, the University of São Paulo leads among Brazilian universities in rankings such as Times Higher Education [26], SCImago Institutions Rankings [45], and QS World University Rankings [46]. The SCImago Institutions Rankings agree on the top four universities: São Paulo, UNESP, Campinas, and Federal University of Rio de Janeiro. The QS World University Rankings align in university presence but differ in order due to incorporating sustainability parameters: São Paulo, Campinas, Federal University of Rio de Janeiro, and UNESP. The Times Higher Education Impact Rankings, which include university research output and impact on SDGs, rank São Paulo, Campinas, Federal University of Rio Grande do Sul, and UNESP in the top four, differing slightly in the positions.

The SDGs have been subject to critical reviews since their inception, exacerbated by the slow progress in meeting the established targets regarding their ambition (too many in too short a time for some and insufficiently ambitious in structural terms for others) [47]; their content (including the weak presence of human rights and the weakening of global governance and democracy, particularly in SDG 16, Peace, Justice, and Strong Institutions) [48,49]; their targets, both in formulation and attainability [50]; their indicators [51]; and their funding [52]. They have also been widely criticized as a global public agenda by Trumpist right-wing movements, national-populist parties, climate change deniers, some multinationals dissatisfied with accountability mechanisms and the role assigned to corporations, and even by governments in developed countries reluctant to allocate the necessary resources for financing the SDGs, as outlined in SDG 17 and the Addis Ababa Action Agenda [4] on development financing. In summary, they have faced resistance from a reactionary

status quo [52].

On the other hand, there is broad consensus that the 2030 Agenda faces systemic risks (humanitarian, economic, environmental, and governance-related) that must be managed at a planetary level [7,47,52]. Thus, while the SDGs are an imperfect tool, they outline a way of understanding the world with a long-term, multilateral, and globally cooperative vision that should endure, as the alternatives are isolationism, autocracy, and short-termism, which are gaining traction across much of the world [53]. Therefore, these criticisms cannot be ignored when using scientific production on SDGs to characterize a university system and the institutions within it.

Bibliometric analyses enable an understanding of the evolution of research on the topic, provide an overview, and identify trends, gaps, and imbalances among the SDGs studied [11]. However, the databases used [54,55], the keywords selected, the tools employed, as well as the approach [56] or method applied [57], can result in different outcomes and inconsistencies [54]. These factors can even perpetuate inequalities based on the level of development of countries, the capacity of their scientific systems to appear in major journals and databases, as well as the overrepresentation of certain countries, languages, and approaches [23,43], alongside the underrepresentation of other countries or development objectives.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Shapere D, 1986, External and Internal Factors in the Development of Science. Science & Technology Studies, 4(1):1–9.

[2] Smelser NJ, 1989, External Influences on Sociology. International Sociology, 4(4): 419–429. https://doi.org/10.1177/026858089004004005

[3] Schmalzbauer B, Visbeck M, 2016, The Contribution of Science in Implementing the Sustainable Development Goals. German Committee Future Earth, Stuttgart/Kiel.

[4] United Nations - General Assembly, 2015, Resolution Adopted by the General Assembly on 25 September 2015, 70/1 Transforming Our World: The 2030 Agenda for Sustainable Development. Seventieth Session Agenda Items 15 and 116, A/RES/70/1. https://sdgs.un.org/2030agenda

[5] United Nations - General Assembly, 2017, Resolution Adopted by the General Assembly on 6 July 2017. 71/313. Work of the Statistical Commission Pertaining to the 2030 Agenda for Sustainable Development. Seventy-First Session Agenda Items 13 and 117, A/RES/71/313. https://ggim.un.org/documents/a_res_71_313.pdf

[6] EU and UN Team Inter-Agency-Task, 2021, Guidebook for the Preparation of Science, Technology and Innovation (STI) for SDGs Roadmaps. Publications Office of the European Union, Luxembourg. https://doi.org/10.2760/724479

[7] United Nations, 2023, Progress Towards the Sustainable Development Goals. Special Edition. United Nations, New York. https://unstats.un.org/sdgs/report/2023

[8] Delli-Paoli A, Addeo F, 2019, Assessing SDGs: A Methodology to Measure Sustainability. Athens Journal of Social Sciences, 6(3): 229–250. https://doi.org/10.30958/ajss.6-3-4

[9] United Nations, 2020, Global Sustainable Development Report 2019: The Future is Now – Science for Achieving Sustainable Development. United Nations - Independent Group of Scientists appointed by the Secretary-General, New York. https://sdgs.un.org/publications/future-now-science-achieving-sustainable-development-gsdr-2019-24576

[10] Repiso R, Segado F, Gómez-García S, 2023, La Universidad Española y la Investigación en Web of Science Sobre los Objetivos de Desarrollo Sostenible 2017–2021. Revista Española de Documentación Científica, 46(2): e359. https://doi.org/10.3989/redc.2023.2.1980

[11] Mishra M, Desul S, Santos CAG, et al., 2023, A Bibliometric Analysis of Sustainable Development Goals (SDGs): A Review of Progress, Challenges, and Opportunities. Environment, Development and Sustainability, 26(5): 11101–11143. https://doi.org/10.1007/s10668-023-03225-w

[12] Yamaguchi NU, Bernardino EG, Ferreira MEC, et al., 2023, Sustainable Development Goals: A Bibliometric Analysis of Literature Reviews. Environmental Science and Pollution Research, 30(3): 5502–5515. https://doi.org/10.1007/s11356-022-24379-6

[13] UNESCO, 2021, UNESCO Science Report the Race Against Time for Smarter Development. UNESCO, Paris. https://www.unesco.org/reports/science/2021/en

[14] Yu Y, Huang J, 2021, Poverty Reduction of Sustainable Development Goals in the 21st Century: A Bibliometric Analysis. Frontiers in Communication, 6: 754181. https://doi.org/10.3389/fcomm.2021.754181

[15] Herrera-Calderon O, Yuli-Posadas RÁ, Peña-Rojas G, et al., 2021, A Bibliometric Analysis of the Scientific Production Related to "Zero Hunger" as a Sustainable Development Goal: Trends of the Pacific Alliance Towards 2030. Agriculture & Food Security, 10(1): 34. https://doi.org/10.1186/s40066-021-00315-8

[16] Sweileh WM, 2020, Bibliometric Analysis of Scientific Publications on "Sustainable Development Goals" with Emphasis on "Good Health and Well-Being" Goal (2015–2019). Globalization and Health, 16(1): 68. https://doi.org/10.1186/s12992-020-00602-2

[17] Estrada-Molina O, Repiso R, Aguaded I, 2023, Producción Académica del Objetivo de Desarrollo Sostenible Educación de Calidad un Reporte Introductorio Desde la WoS (2017–2021), in Mejorando la Enseñanza a Través de la Innovación Educativa. Dykinson, 239–250.

[18] Prieto-Jiménez E, López-Catalán L, López-Catalán B, et al., 2021, Sustainable Development Goals and Education: A Bibliometric Mapping Analysis. Sustainability, 13(4): 2126. https://doi.org/10.3390/su13042126

[19] De-La-Cruz-Ramos R-M, Yupanqui-Villanueva C-J, Yupanqui-Villanueva H-R, 2023, Producción Científica Relacionada al ODS 4: Un Análisis Bibliométrico Global. Ciencia Latina Revista Científica Multidisciplinar, 6(6): 13805–13823. https://doi.org/10.37811/cl_rcm.v6i6.4368

[20] Pizzi S, Caputo A, Corvino A, et al., 2020, Management Research and the UN Sustainable Development Goals (SDGs): A Bibliometric Investigation and Systematic Review. Journal of Cleaner Production, 276: 124033. https://doi.org/10.1016/j.jclepro.2020.124033

[21] Dibbern TA, Rampasso IS, Serafim MP, et al., 2022, Bibliometric Study on SDG 6: Analysing Main Content Aspects by Using Web of Science Data from 2015 to 2021. Kybernetes, 52(9): 3119–3135. https://doi.org/10.1108/K-05-2021-0393

[22] Garai N, Roy A, Pramanick K, 2023, Understanding the Research Interlinkages Between Anthropocene, Millennium and Sustainable Development Goals: A Global Bibliometric Analysis. Anthropocene Science, 2(2): 123–140. https://doi.org/10.1007/s44177-023-00055-3

[23] Meschede C, 2020, The Sustainable Development Goals in Scientific Literature: A Bibliometric Overview at the Meta-Level. Sustainability, 12(11): 4461. https://doi.org/10.3390/su12114461

[24] Anlló G, Barrere R, De-Brito-Cruz C-H, et al., 2022, La Producción Científica Sobre los ODS en América Latina, in El Estado de la Ciencia: Principales Indicadores de Ciencia y Tecnología Iberoamericanos / Interamericanos. Observatorio Iberoamericano de la Ciencia, la Tecnología y la Sociedad de la Organización de Estados Iberoamericanos (OEI), Buenos Aires, 28–40.

[25] Leal Filho W, Shiel C, Paço A, et al., 2019, Sustainable Development Goals and Sustainability Teaching at Universities: Falling Behind or Getting Ahead of the Pack? Journal of Cleaner Production, 232: 285–294. https://doi.org/10.1016/j.jclepro.2019.05.309

[26] Times Higher Education, 2023, Impact Rankings 2023. https://www.timeshighereducation.com/impactrankings

[27] Körfgen A, Förster K, Glatz I, et al., 2018, It's a Hit! Mapping Austrian Research Contributions to the Sustainable Development Goals. Sustainability, 10(9): 3295. https://doi.org/10.3390/su10093295

[28] Machado CF, Davim JP, 2022, Higher Education for Sustainability: A Bibliometric Approach—What, Where and Who is

Doing Research in This Subject? Sustainability, 14(8): 4482. https://doi.org/10.3390/su14084482

[29] Indana F, Pahlevi RW, 2023, A Bibliometric Approach to Sustainable Development Goals (SDGs) Systematic Analysis. Cogent Business & Management, 10(2): 2224174. https://doi.org/10.1080/23311975.2023.2224174

[30] Rohrich SS, Takahashi ARW, 2019, Environmental Sustainability in Higher Education Institutions, a Bibliometric Study on National Publications. Gestão & Produção, 26: e2861. https://doi.org/10.1590/0104-530X2861-19

[31] Silva-de-Oliveira R, Rosa-Georges M-R, Mina-Falsarela O, 2020, A Produção Científica em Sustentabilidade e Micro e Pequenas Empresas: um estudo bibliométrico. Periódico Eletrônico Fórum Ambiental da Alta Paulista, 16(7): 170–182. https://doi.org/10.17271/1980082716720202690

[32] Assunção SS, da Fonseca LDPA, de Azevedo Carvalho R, et al., 2022, Artigos Científicos Indexados na Base BRAPCI Sobre Desenvolvimento Sustentável na Amazônia no Contexto da Ciência da Informação. Informação@ Profissões, 11(1): 1–28. https://doi.org/10.5433/2317-4390.2022v11n1p1

[33] Di Napoli ESK, Levenhagen BS, de Andrade CP, et al., 2023, Objetivos de Desenvolvimento Sustentável e Relação com as Pesquisas de Turismo: Revisão da Literatura em Periódicos no Brasil". Revista Rosa dos Ventos-Turismo e Hospitalidade, 15(1): 85–104. https://doi.org/10.18226/21789061v15i1p85

[34] García M, 2022, A More Sustainable Future For All: Introducing the UN Sustainable Development Goals in InCites. Clarivate. https://clarivate.com/blog/a-more-sustainable-future-for-all-introducing-the-un-sustainable-development-goals-in-incites

[35] Bornmann L, Leydesdorff L, Mutz R, 2013, The Use of Percentiles and Percentile Rank Classes in the Analysis of Bibliometric Data: Opportunities and Limits. Journal of Informetrics, 7(1): 158–165. https://doi.org/10.1016/j.joi.2012.10.001

[36] Hout MC, Papesh MH, Goldinger SD, 2013, Multidimensional Scaling. Wiley Interdisciplinary Reviews: Cognitive Science, 4(1): 93–103. https://doi.org/10.1002/wcs.1203

[37] Field A, 2005, Kendall's Coefficient of Concordance, in Encyclopedia of Statistics in Behavioral Science. John Wiley & Sons. https://doi.org/10.1002/0470013192.bsa327

[38] Addinsoft, 2022, XLSTAT Statistical and Data Analysis Solution. https://www.xlstat.com

[39] Strehl L, Calabró L, Souza DO, et al., 2016, Brazilian Science between National and Foreign Journals: Methodology for Analyzing the Production and Impact in Emerging Scientific Communities. PLoS One, 11(5): e0155148. https://doi.org/10.1371/journal.pone.0155148

[40] Yeh S-C, Hsieh Y-L, Yu H-C, et al., 2022, The Trends and Content of Research Related to the Sustainable Development Goals: A Systemic Review. Applied Sciences, 12(13): 6820. https://doi.org/10.3390/app12136820

[41] Sianes A, Vega-Muñoz A, Tirado-Valencia P, et al., 2022, Impact of the Sustainable Development Goals on the Academic Research Agenda. A Scientometric Analysis. PLoS One, 17(3): e0265409. https://doi.org/10.1371/journal.pone.0265409

[42] Sianes A, 2021, Academic Research on the 2030 Agenda: Challenges of a Transdisciplinary Field of Study. Global Policy, 12(3): 286–297. https://doi.org/10.1111/1758-5899.12912

[43] Diaz-Lopez C, Martin-Blanco C, De la Torre Bayo JJ, et al., 2021, Analyzing the Scientific Evolution of the Sustainable Development Goals. Applied Sciences, 11(18): 8286. https://doi.org/10.3390/app11188286

[44] Salvia AL, Leal Filho W, Brandli LL, et al., 2019, Assessing Research Trends Related to Sustainable Development Goals: Local and Global Issues. Journal of Cleaner Production, 208: 841–849. https://doi.org/10.1016/j.jclepro.2018.09.242

[45] SCImago Institutions Rankings, 2023, Overall Rank. SCImago Journal Country Rank. https://www.scimagoir.com/rankings.php

[46] QS World University Rankings, 2023, Top Global Universities 2023. QS TopUniversities. https://www.topuniversities.com/university-rankings/world-university-rankings/2023?&countries=br&sort_by=rank&order_by=asc

[47] Easterly W, 2015, The Trouble with the Sustainable Development Goals. Current History, 114(775): 322–324. https://doi.org/10.1525/curh.2015.114.775.322

[48] Gómez-Gil C, 2018, Objetivos de Desarrollo Sostenible (ODS): Una Revisión Crítica. Papeles de Relaciones Ecosociales y Cambio Global, 140: 107–118.

[49] Sengupta M, 2018, Transformational Change or Tenuous Wish List? A Critique of SDG 1 ('End Poverty in All Its Forms Everywhere'). Social Alternatives, 37(1): 12–17.

[50] Nature, 2020, Time to Revise the Sustainable Development Goals. Nature, 583(7816): 331–332. https://doi.org/10.1038/d41586-020-02002-3

[51] ICSU-ISSC, 2015, Review of the Sustainable Development Goals: The Science Perspective. International Science Council. https://council.science/publications/review-of-targets-for-the-sustainable-development-goals-the-science-perspective-2015

[52] Sachs J, Schmidt-Traub G, Lafortune G, 2020, Speaking Truth to Power About the SDGs. Nature, 584(7821): 344. https://doi.org/10.1038/d41586-020-02373-7

[53] Sachs J, Lafortune G, Fuller G, et al., 2023, Implementing the SDG Stimulus. Sustainable Development Report 2023. Dublin University Press, Dublin. https://doi.org/10.25546/102924

[54] Armitage CS, Lorenz M, Mikki S, 2020, Mapping Scholarly Publications Related to the Sustainable Development Goals: Do Independent Bibliometric Approaches Get the Same Results? Quantitative Science Studies, 1(3): 1092–1108. https://doi.org/10.1162/qss_a_00071

[55] Bordignon F, 2021, Dataset of Search Queries to Map Scientific Publications to the UN Sustainable Development Goals. Data in Brief, 34: 106731. https://doi.org/10.1016/j.dib.2021.106731

[56] Rafols I, Noyons E, Confraria H, et al., 2021, Visualising Plural Mappings of Science for Sustainable Development Goals (SDGs), in 2021 Conference, International Society for Scientometrics and Informetrics. Center for Open Science. https://doi.org/10.31219/osf.io/yfqbd

[57] Purnell PJ, 2022, A Comparison of Different Methods of Identifying Publications Related to the United Nations Sustainable Development Goals: Case Study of SDG 13—Climate Action. Quantitative Science Studies, 3(4): 976–1002. https://doi.org/10.1162/qss_a_00215