Assessments under the United Nations Sustainable Development Goals: A Bibliometric Analysis

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Abstract – The United Nations announced its 2030 Agenda for Sustainable Development worldwide in 2015. Comprehensive assessments of member states’ performance towards achieving the related UN Sustainable Development Goals (SDGs) have since become a major challenge for national and subnational governments. This article presents a bibliometric analysis on the assessment of SDGs, at both the general and specific levels, based on 418 publications obtained from Scopus. The general level of analysis includes the number, types, and subject areas of documents published each year, as well as considerations such as the most-cited publications and the leading authors, journals, countries, institutional affiliations, and funders. The specific level of analysis includes a study of the relevant concepts in the publications and their relationships, allowing for the identification of predominant assessments under the 2030 Agenda, and of the most-often evaluated SDGs. Results indicated a focus on measuring impacts and risks, with SDGs 3, 6, 13, 7, 8, and 4 having been assessed the most often among the 17 SDGs, which is consistent with findings in prevalent subject areas such as environmental sciences, social sciences, medicine, and energy. Future works should address assessments under the 2030 Agenda more comprehensively, including analyses on trade-offs among the SDGs and on the transversal nature of some of these goals.

Keywords – Appraisal; assessment; evaluation; sustainable development goals; United Nations; 2030 agenda

1. INTRODUCTION

The United Nations introduced the 2030 Agenda for Sustainable Development to the world at the end of 2015, covering 17 Sustainable Development Goals (SDGs) [1]. Its declared overall aim was to guarantee prosperity, end poverty, and preserve the environment globally [2]. However, its implementation has run into obstacles, such as conflicts and contradictions among various goals and targets [3]. The need to coordinate a large number of indicators, 232 in total, has further complicated the public management aspect [4]; this calls for greater prioritization and selection of goals and targets on a case-by-case basis [5]. A comprehensive, global evaluation for the UN SDGs has concurrently represented a major challenge [6], [7].

Before the 2030 Agenda for Sustainable Development, other frameworks had supported methodologies for such performance appraisals [8], [9]. Following the 'Earth Summit' held in Rio de Janeiro in 1992, the standard framework for gauging sustainable development considered its economic, social, and environmental dimensions [10]. Although it was at first static and evaluated the three dimensions separately in most cases, the need to articulate their interactions became clearer over the years [11], generating a ‘triple bottom line’ model which
incorporated them together [12], [13]. Another proposal pertained to the introduction of a fourth, institutional dimension, towards the concept of four sustainability pillars [14], since an institutional framework supported the economic, social, and environmental facets of sustainable development [15].

According to Miola and Schiltz [16], evaluators have employed a broad variety of methods to assess sustainable development, many of which have used frameworks other than the three or four sustainability pillars. For instance, Holden et al. [12] applied to 167 countries a model based on four primary dimensions derived from the Brundtland Report: safeguarding long-term ecological sustainability, satisfying basic needs, promoting intragenerational and intergenerational equity. These four dimensions were, in turn, evaluated through the four indicators of ecological footprint, Human Development Index (HDI), Gini index, and proportion of renewable energy within total primary energy production. To calculate the indicators, Holden et al. [12] recommended the use of maximum or minimum thresholds pertaining to the targets for UN member states to reach. Hickel [17] proposed another alternative in appraising sustainable development, namely through an expansion of the HDI indicator to include measures of education, life expectancy, income, CO2 emissions, and material footprint.

In the same way, frameworks supported from a capital perspective should be considered, towards evaluating sustainable development from the perspectives of weak and strong sustainability [18]. The former finds no incompatibility between economic growth and environmental conservation, considering exhaustible natural resources to be replaceable as technology evolves [19]; the latter includes both natural and human-made capital, seen as complementary and able to defend conservation [20]. Assessments for strong sustainability have focused on critical natural capital, that is, capital which cannot be replaced by other environmental elements or by other capital performing similar functions [21].

Gallopín [22] observed that profiling and the construction of composite indices represented the most conventional methods to assess sustainable development, while Londoño and Cruz [4] counted composite or aggregate indices among the ones most widely used. However, in recent years, alternatives such as climate models [23], risk assessment models [24], and life cycle assessments [25] have been positioned as viable for the appraisal of sustainable development, having been found to offer more robust and comprehensive evaluations [26].

The reference framework for the UN SDGs comprises 17 goals, 69 targets, and 232 indicators defined in the 2030 Agenda, addressing sustainable development issues such as health and well-being (SDG 3) [27], water quality (SDG 6) [28], clean energy generation (SDG 7) [29], and all the 17 SDGs through a SDG Index [13]. Monitoring the implementation of the SDG targets is a fundamental step for the 2030 Agenda to be put into practice and achieved [30]; with this in mind, we set out to identify the predominant types of assessments proposed by scholars and the most-often evaluated SDGs, as well as to reflect on the most comprehensive assessment methods.

This study presents a bibliometric analysis of the main methodologies used to evaluate performance under the 2030 Agenda for Sustainable Development. Section 2 outlines the methods we employed in the study, which included a general document search for the bibliometric analysis. Section 3 delves into the examination of the results, and Section 4 into a discussion of such findings. Finally, Section 5 illustrates our main conclusions.

2. MATERIALS AND METHODS

Mohadab et al. [31] described Scopus and Web of Science as the primary databases through which to collect information to perform bibliometric analyses and identify new directions of
scientific research. Such analyses must include information on authors, articles, journals, institutions, countries, keywords, number of citations, and other characteristics within the field being studied. We applied these criteria to Scopus search results in gathering data to determine the main types of assessments for sustainable development and SDGs focused on.

We formulated two corresponding guiding questions: 1) What methods have predominated in assessing the UN SDGs? 2) Which SDGs have been evaluated the most often? To address these questions, we applied the following search equation (SE1) on Scopus: TITLE-ABS-KEY (‘UN Sustainable Development Goals’ OR ‘United Nations Sustainable Development Goals’ OR ‘Agenda for Sustainable Development Goals’ OR ‘Sustainable Development Goals Agenda’ OR ‘UN SDG’ OR ‘United Nations SDG’ OR ‘Agenda for SDG’ OR ‘SDG Agenda’) AND (‘Evaluation*’ OR ‘Assessment*’ OR ‘Appraisal*’). SE1 guarantees publications focused on assessments for the 2030 Agenda, within different ways of referring to the agenda, while limiting results via distinct terms related to assessment and evaluation.

| SDG | Search Equation |
|-----|----------------|
| SDG 1 | †SE1 AND (‘No poverty’ OR ‘Poverty’ OR ‘SDG 1’ OR ‘Sustainable development goal 1’) |
| SDG 2 | †SE1 AND (‘Cero hunger’ OR ‘SDG 2’ OR ‘Food security’ OR ‘Malnutrition’ OR ‘undernourishment’ OR ‘Famine’ OR ‘Starvation’) |
| SDG 3 | †SE1 AND (‘Health’ OR ‘Good health’ OR ‘SDG 3’ OR ‘Sustainable development goal 3’) |
| SDG 4 | †SE1 AND (‘Education’ OR ‘Qualit* Educat*’ OR ‘SDG 4’ OR ‘Sustainable development goal 4’) |
| SDG 5 | †SE1 AND (‘Gender equality’ OR ‘Gender’ OR ‘Women’ OR ‘Female’ OR ‘SDG 5’ OR ‘Sustainable Development Goal 5’) |
| SDG 6 | †SE1 AND (‘Water’ OR ‘Clean water’ OR ‘Sanitation’ OR ‘SDG 6’ OR ‘Sustainable development goal 6’) |
| SDG 7 | †SE1 AND (‘Energy’ OR ‘Clean energy’ OR ‘SDG 7’ OR ‘Sustainable development goal 7’) |
| SDG 8 | †SE1 AND (‘Work’ OR ‘SDG 8’ OR ‘Economic Growth’ OR ‘Sustainable development goal 8’) |
| SDG 9 | †SE1 AND (‘Industry innovation and infrastructure’ OR ‘SDG 9’ OR ‘Sustainable development goal 9’ OR ‘Innovation’ OR ‘Infrastructure’) |
| SDG 10 | †SE1 AND (‘Reduced inequalities’ OR ‘SDG 10’ OR ‘Sustainable development 10’ OR ‘Inequalities’) |
| SDG 11 | †SE1 AND (‘Sustainable cities and communities’ OR ‘SDG 11’ OR ‘Sustainable development 11’ OR ‘Smart cities’ OR ‘Sustainable cities’) |
| SDG 12 | †SE1 AND (‘Responsible consumption and production’ OR ‘Sustainable consumption’ OR ‘Sustainable production’ OR ‘SDG 12’ OR ‘SDG 12’ OR ‘Sustainable development goal 12’) |
| SDG 13 | †SE1 AND (‘Climate action’ OR ‘Climate change’ OR ‘SDG 13’ OR ‘Sustainable development goal 13’) |
| SDG 14 | †SE1 AND (‘Life below water’ OR ‘Ocean*’ OR ‘Sea’ OR ‘River*’ OR ‘SDG 14’ OR ‘Sustainable development goal 14’) |
| SDG 15 | †SE1 AND (‘Life on Land’ OR ‘Forest*’ OR ‘SDG 15’ OR ‘Sustainable development goal 15’) |
| SDG 16 | †SE1 AND (‘Peace’ OR ‘justice’ OR ‘strong institutions’ OR ‘SDG 16’ OR ‘Sustainable development goal 16’ OR ‘Institution*’) |
| SDG 17 | †SE1 AND (‘Partnerships for goals’ OR ‘SDG 17’ OR ‘Sustainable development goal 17’ OR ‘Alliance*’ OR ‘AID’ OR ‘Cooperation’) |

†SE1: TITLE-ABS-KEY (‘UN Sustainable Development Goals’ OR ‘United Nations Sustainable Development Goals’ OR ‘Agenda for Sustainable Development Goals’ OR ‘Sustainable Development Goals Agenda’ OR ‘UN SDG’ OR ‘United Nations SDG’ OR ‘Agenda for SDG’ OR ‘SDG Agenda’) AND (‘Evaluation*’ OR ‘Assessment*’ OR ‘Appraisal*’)

The search results yielded 418 publications, with the first publications on assessments for the SDGs dating back to 2015, the year in which the UN announced the 2030 Agenda. For the general review, we looked into aspects such as the number of publications per year; publications by type; the most relevant journals and authors; the articles with the most...
citations; the most recurrent subject areas, affiliations, and funders for the research; and the main countries producing the documents. For the more specific analysis, we used the VOSviewer software to generate co-occurrence graphs and detect the density of the concepts, the nodes, and their interactions. These graphs served as the basis to identify the predominant types of assessment for the UN SDGs. We included these terms in the search equation SE1, using the Boolean operator ‘AND’ to find out the exact number of publications under each type of assessment.

Subsequently, we carried out a search for the types of assessments applied to each SDG, to identify the SDGs most-often evaluated. Table 1 shows the corresponding search equations. Moreover, to determine how many studies have conducted analyses on trade-offs among the dimensions of the 2030 Agenda, we introduced the following search equation (SE2): TITLE-ABS-KEY (‘UN Sustainable Development Goals’ OR ‘United Nations Sustainable Development Goals’ OR ‘Agenda for Sustainable Development Goals’ OR ‘Sustainable Development Goals Agenda’ OR ‘UN SDG’ OR ‘United Nations SDG’ OR ‘Agenda for SDG’ OR ‘SDG Agenda’) AND (‘Evaluation*’ OR ‘Assessment*’ OR ‘Appraisal*’) AND (‘Trade off*’ OR ‘Compensation*’ OR ‘Interchange*’ OR ‘Substitution*’ OR ‘Interlinkages’ OR ‘Interaction*’ OR ‘Interrelation*’ OR ‘Matri*’ OR ‘Integrated approach*’).

3. RESULTS

This section presents the general findings from the bibliometric analysis of the methods used to evaluate performance under the 2030 Agenda, and the specific results delving into the predominant types of assessments and the most-often appraised SDGs.

3.1. General Findings

Research and articles assessing SDGs performance from UN member states began in 2015, with only two publications, according to the Scopus search results [32], [33]. This was to be expected, since governments began prioritizing the SDGs in their national agendas as of the announcement of the 2030 Agenda [34], and evaluation and monitoring started after the prioritization process [35]. We found that the number of publications had grown continually each year, with 61% of the scientific production having been concentrated in the last two years.

Among the overall search results, 306 (73.2%) of the publications on UN SDG assessments corresponded to articles, 43 (10.3%) to reviews, 42 (10%) to conference papers, 16 (3.8%) to book chapters, four (1.0%) to books, and seven (1.7%) to other types of data. Most of the works on UN SDG assessments appeared to have been published in indexed journals, since articles and reviews combined represented 83.5% of the publications found on Scopus. The most representative subject areas for the assessments were namely the environmental sciences (23.9%), social sciences (18.0%), medicine (10.1%), energy (9.2%), engineering (7.3%), and agricultural and biological sciences (6.1%). As mentioned earlier in this text, sustainable development appraisals have generally been oriented towards environmental and social dimensions, and specifically focused on sectors such as medicine, energy, and agriculture.

As shown in Table 2, our results indicated that the most-often cited document on UN SDG assessments – at an average of 53 citations per year – was related both to the environmental and social sciences, and published in the journal Nature Geoscience. The main SDGs addressed in the articles listed in Table 2 correspond to SDG 13 (climate action), SDG 3 (good health), and SDG 12 (responsible consumption and production).
| Title                                                                 | Authors                                      | Source                              | Year | Cites | Cites per year | SDGs addressed |
|----------------------------------------------------------------------|----------------------------------------------|-------------------------------------|------|-------|----------------|----------------|
| Environmental and social footprints of international trade           | [36]                                         | Nature Geoscience                    | 2018 | 146   | 53             | SDG 13         |
| The Lancet Countdown: tracking progress on health and climate change | [37]                                         | The Lancet                           | 2017 | 125   | 33             | SDG 3 SDG 13   |
| Missing Food, Missing Data? A Critical Review of Global Food Losses and Food Waste Data | [38]                                         | Environmental Science and Technology | 2017 | 124   | 33             | SDG 2          |
| Measuring progress from 1990 to 2017 and projecting attainment to 2030 of the health-related Sustainable Development Goals for 195 countries and territories: a systematic analysis for the Global Burden of Disease Study 2017 | [39]                                         | The Lancet                           | 2018 | 91    | 33             | SDG 3          |
| Connecting the sustainable development goals by their energy inter-linkages | [40]                                         | Environmental Research Letters       | 2018 | 75    | 27             | SDG 7          |
| 2 °C and SDGs: United they stand, divided they fall?                   | [23]                                         | Environmental Research Letters       | 2016 | 63    | 13             | SDG 13         |
| Tackling socioeconomic inequalities and non-communicable diseases in low-income and middle-income countries under the Sustainable Development agenda | [41]                                         | The Lancet                           | 2018 | 60    | 22             | SDG 10         |
| Hot Air or Comprehensive Progress? A Critical Assessment of the SDGs   | [42]                                         | Sustainable Development              | 2017 | 56    | 15             | SDG 11 and SDG 13 |
| Ozone pollution will compromise efforts to increase global wheat production | [43]                                         | Global Change Biology                | 2018 | 54    | 19             | SDG 12 SDG 13 |
| Social impact assessment in the mining sector: Review and comparison of indicators frameworks | [44]                                         | Resources Policy                     | 2018 | 51    | 18             | SDG 12         |

Table 3 displays the authors with the most publications on UN SDG assessments, at three or four, respectively, since this research topic emerged in tandem with the 2030 Agenda. The authors with the most publications (four each) were found to be Riahi K. and Sogbanmu T. O., while Gupta R. K. stood out for having the best h-index and a superior number of citations along his research career. Moreover, Table 3 lists New Mexico State University as a recurrent institutional affiliation for the top authors on the topic, with four authors and three co-authored publications among them: Abeyesiriwardana A. I., Delanka-Pedige H. M. K., Munasinghe-Arachchige S. P., and Nirmalakhandan N.
| Name                                                                 | Docs.* | Docs.* | h-index | Citations | Author ID     | Main topics                                                                 | Affiliations                                           | Country         |
|----------------------------------------------------------------------|--------|--------|---------|-----------|--------------|-----------------------------------------------------------------------------|--------------------------------------------------------|-----------------|
| Riahi, Keywan                                                        | 4      | 179    | 64      | 25442     | 6602435618   | Environmental sciences, Energy, Social sciences                             | International Institute for Applied Systems Analysis  | Austria         |
| Sogbanmu, Temitope Olawunni                                          | 4      | 13     | 5       | 76        | 55173859200 | Ecotoxicology, Fish embryotoxicity, Organic pollutants                     | University of Lagos                                    | Nigeria         |
| Abeysiriwardana-Arachchige, Isuru S.A.                               | 3      | 15     | 8       | 85        | 57209258286 | Environmental engineering, Algal wastewater treatment                      | New Mexico State University                            | Mexico          |
| Abhilash, P. C.                                                      | 3      | 78     | 30      | 2890      | 23018182200 | Agroecosystems, Biomass, Land restoration                                    | Banaras Hindu University                                | India           |
| Boxall, Alistair                                                     | 3      | 166    | 59      | 14573     | 7003878520  | Emerging environmental contaminants                                          | University of York                                     | United Kingdom  |
| Delanka-Pedige, Himali Madushani Kanchanamala                        | 3      | 16     | 8       | 114       | 57205219061 | Environmental engineering, Algal wastewater treatment                      | New Mexico State University                            | Mexico          |
| Gupta, Rajeev Kumar                                                 | 3      | 561    | 90      | 64089     | 55705295300 | Prehypertension, Non-communicable diseases                                  | Indian Institute of Technology Kampur                   | India           |
| Krey, Volker                                                         | 3      | 92     | 37      | 9707      | 24332203900 | Energy modelling, Climate change                                            | International Institute for Applied Systems Analysis   | Austria         |
| Longhurst, James W.S.                                               | 3      | 186    | 16      | 1032      | 7103396041  | Air quality, Air quality management, Air pollution                         | University of the West of England                      | United Kingdom  |
| Minx, Jan Christoph                                                 | 3      | 53     | 31      | 4300      | 8513127600  | Integrated assessment models, Climate policy, Global temperature            | Mercator Research Institute on Global Commons and Climate Change | Germany         |
| Munasinghe-Arachchige, Srimali Preethika                             | 3      | 18     | 8       | 118       | 57205225562 | Environmental engineering, Algal wastewater treatment                      | New Mexico State University                            | Mexico          |
| Nirmalakhanda N., Nagamany N.                                        | 3      | 160    | 36      | 4240      | 7004341926  | Environmental engineering, Algal                                            | New Mexico State University                            | Mexico          |
Regarding the leading sources on UN SDGs assessment, these are represented by journals. The journal with the most publications is *Sustainability* (Switzerland) (33 documents), followed by *Journal of Cleaner Production* (13 documents) and *Science of Total Environment* (7 documents). Journals like *Environmental Research Letters*, *International Journal of Environmental Research and Public Health*, and *Remote Sensing of Environment* contribute 6 documents each, *Water Switzerland* and *World Development* contribute 5 documents each, while *Frontiers in Marine Science* and *International Review of Education* contribute 4 documents each.

Among the top journals for such publications, 60% were classified in quartile 1 on the Scopus platform (Q1) and 40% in quartile 2 (Q2), indicating that the documents on UN SDG assessments had been aimed at highly indexed journals. Moreover, 80% of these journals focused on the themes of sustainable development, sustainability, and environmental sciences, while 20% specialized in specific SDGs, such as health- and water-related ones. Most of these journals were published by Elsevier, followed by MDPI. Taken together, this could provide an overview of publication preferences for forthcoming studies on the topic.

The leading institutions in terms of publications on assessments of performance on UN SDGs were identified as Danmarks Tekniske Universitet, the Chinese Academy of Sciences, and the University of New South Wales, with 11 publications each, followed by Wageningen University & Research and the University of Queensland, with 10 each. Publications from Wageningen University & Research, the University of Queensland, Imperial College London, the International Institute for Applied Systems Analysis, University College London, Stockholm University, the University of York, the Potsdam Institut fur Klimafolgenforschung, and the World Health Organization (WHO) altogether accounted for 27.0% (113) of the publications on Scopus related to UN SDG assessments.

Table 4 shows the leading funders (sponsors) for evaluations pertaining to the 2030 Agenda, which altogether supported 14.4% (60) of the publications found on Scopus. The European Commission financed 12 publications, benefiting five of the top universities in publications on this subject. The Economic and Social Research Council funded 11 publications, from four of the institutions seen in Table 4. The National Natural Science Foundation of China financed nine investigations, from one university in Table 4. Finally, the Engineering and Physical Sciences Research Council, Horizon 2020 Framework Program, National Science Foundation, and Natural Environment Research Council supported seven publications each from institutions in different locations.
### Table 4. Funding Sponsors with the Most Financed Documents

| Funding Sponsor                                      | Docs. | Territories     | Main Beneficiary Institutions                                                                 |
|------------------------------------------------------|-------|-----------------|-------------------------------------------------------------------------------------------------|
| European Commission                                  | 12    | European Union  | Stockholm University, Wageningen University & Research, University of New South Wales, Imperial College London, University of York |
| Economic and Social Research Council                 | 11    | United Kingdom  | Imperial College London, University College London, University of York, Potsdam Institut fur Klimafolgenforschun |
| National Natural Science Foundation of China          | 9     | China           | Chinese Academy of Sciences                                                                   |
| Engineering and Physical Sciences Research Council   | 7     | United Kingdom  | University College London, University of York, Organization Mondiale de la Santé, Potsdam Institut fur Klimafolgenforschun. |
| Horizon 2020 Framework Programme                      | 7     | European Union  | International Institute for Applied Systems Analysis, Laxenburg; University of New South Wales |
| National Science Foundation                          | 7     | United States of America | Chinese Academy of Sciences, The University of Queensland.                                      |
| Natural Environment Research Council                  | 7     | United Kingdom  | Chinese Academy of Sciences, Stockholm University, University of York, Potsdam Institut fur Klimafolgenforschung, University College London, University of Queensland |

As shown in Fig. 1, the United States (US) and United Kingdom (UK) represented the countries with the most authors’ institutional affiliations for published documents about the 2030 Agenda assessment.

![Fig. 1. Countries with the most authors’ institutional affiliations.](image)

These results are notable due to the fact that four of the leading sponsors belonged to these countries, indicating that these territories have invested resources into research related to UN SDG assessments and consequently published a more considerable number of documents.
These countries were followed by Germany and Australia, which published more than 50 documents on UN SDG assessments. As Fig. 1 shows, the only emerging economies appearing among the countries with the most publications were China (32) and India (2), highlighting that China has benefited from a top research funder mentioned in Table 4 (Natural Science Foundation of China).

3.2. Specific Findings

As described in Section 2, we entered the information from the publications obtained with search equation SE1 into the VOSviewer program to identify the density of the concepts and the clusters around UN SDG assessments. Fig. 2 displays four clusters, highlighting the one related to sustainable development—the red cluster—as dominant, as it contains the highest-density nodes. The red cluster’s nodes are related to planning, environmental impact appraisals, socioeconomic effects, and SDG performance indicators, mainly for developing countries. Concepts such as life cycle studies, greenhouse gas monitoring, and the use of remote sensing tools are found in the most remote nodes of this cluster. Thus, this cluster allows for the identification of types of UN SDG assessments, such as performance, impact (mainly environmental), and life cycle assessments.

Fig. 2. Density of the main concepts and nodes.

The second most important cluster – the green cluster – contains two essential nodes, corresponding to the ‘human’ or ‘humans’ concept and the ‘female’ concept. The former concept pertains to human rights and global health and to SDGs 16 (peace, justice, and strong institutions) and 3 (good health). The latter relates to the well-being of population groups such as children, youth, and older adults, and gender issues under SDG 2 (zero hunger), 3 (good health), and 5 (gender equality). The main types of evaluations identified in this cluster are namely controlled studies, cost-benefit assessments, and cost-effectiveness assessments.
The third cluster – blue cluster – concerns the public policy issues of health and food safety, under SDGs 3 (good health) and 2 (zero hunger). The fourth and last cluster – yellow cluster – covers issues such as water quality, drinking water, and water management from SDG 6 (clean water and sanitation), with risk assessments to monitor water quality being predominant.

We found that the most widely used UN SDG assessments pertained to impacts, risks, life cycle, performance, controlled studies, and cost-benefit and cost-effectiveness analyses. Via search equation SE1, we obtained the number of publications by type of assessment, led by impact (143 publications) and risk assessments (96). Other common assessment types corresponded to levels of adaptation, learning, pollution, development, among others (35). Assessments on life cycle corresponded to 29 of the publications, ecosystem services to 28, footprint to 20, cost effectiveness to 19, and performance to 16. Finally, clinical evaluations and cost-benefit analyses each corresponded to seven of the publications.

Some publications among the 143 evaluating the impacts of the UN SDGs concurrently addressed other issues. Fig. 3 shows that 28 of these publications also appraised risk measurements; 22 appraised life cycles; 13 assessed impacts on the levels of adaptation, learning, pollution, and development, among other aspects; and 12 evaluated impacts on ecosystem services. To a lesser extent, six of the impact assessment publications included performance appraisals, four evaluated the impacts of cost-effectiveness analyses, and three studied the impacts of cost-benefit analyses. However, no documents were found which analyzed clinical assessments focused on measuring impacts.

Likewise, we observed that some among the 96 publications evaluating risks for UN SDGs also included impact measurements (28); ecosystem services (seven); levels of adaptation, learning, pollution, development, and other aspects (seven); cost-effectiveness analyses (six); performance and clinical assessments (three); life cycles (two); footprint (two); and cost-benefits analyses (two).

Through the concept network generated in VOSviewer, we detailed the direct relationships among the most relevant UN SDG assessments on impacts and risks. As seen in Fig. 3, the publications on impact assessments were mainly oriented towards environmental and health impacts. On the one hand, environmental impact assessments were found to be mainly related to the assessment of SDGs, sustainability, and life cycles, and, to lesser extent, to natural resource conservation and the effects on human beings and their households. On the other hand, assessments of health impacts appeared to focus on human health and public health.

![Fig. 3. Environmental impact assessments (a) and health impact assessments (b).](image)

Fig. 4 shows that risk assessments were mainly oriented towards issues of water quality monitoring, public health management, biodiversity planning, SDGs, and sustainability.
Based on the search equations from Table 1, we examined the publications obtained to arrive at the most-often evaluated SDG, namely SDG 3 (good health and well-being), as it was present in 143 of the 418 documents (34.2%). This is followed by SDG 6 (clean water and sanitation), present in 96 of them (23.0%). SDGs 13 (climate action), 7 (affordable and clean energy), 8 (decent work and economic growth), and 4 (quality education) were addressed in 76 (18.2%), 73 (17.5%), 71 (17.0%), and 68 (16.3%) of the publications, respectively. Less often addressed, in order of frequency, were SDGs 16, 5, 14, 15, 9, 1, 2, 17, 11, 12, and 10. It is worth noting, however, that in some cases, several SDGs were mentioned in the same publication. Finally, search equation SE2 led to 52 documents (12.4% of the total) considering trade-offs among SDG assessments.

These results are consistent with the fact that the impact and risk assessments associated with health and drinking water prevail in the specific findings, and the environmental assessments prevail in the general findings. Our research indicate that UN SDG assessments have been robust in terms of addressing interactions among various SDGs and have also been of a largely quantitative nature, due to the considerable number of documents performing impact and risk assessments. Hence, the need to integrate quantitative tools to define, identify and establish the trade-offs among the goals, targets, and indicators of the 2030 Agenda should be better integrated in future research.

4. DISCUSSION

According to Mohadab et al. [31], review articles should include information on authors, institutions, countries, types of document, and domain areas. The present work contains these elements, alongside a graphic analysis identifying the dominant topics and classifying them through nodes, from which the most relevant types of UN SDG assessments are extracted, as well as their relationships with other nodes and frequency in evaluation.

The search equations we applied uncovered the prevalent issues in UN SDG assessments since the 2030 Agenda was launched in 2015. Moreover, we found that despite a considerable number of publications (418 documents), the leading authors on this subject had each
published at most four documents, as with Riahi K. and Sogbanmu T. O. However, it should be noted that the most-often cited document (146 citations) was published in 2018 [36], with an average of 53 citations per year; this indicates that assessments of the 2030 Agenda are increasingly attracting attention, and that as the current agenda expires, greater interest can be expected in developing more robust and integrative methodologies to evaluate SDGs [40].

We also demonstrated that, in general, the countries with the most authors’ institutional affiliations had the corresponding funding to support research in diverse universities and institutions. Likewise, the authors with the most publications tended to be located in institutions in these countries or territories. This means that cutting-edge knowledge has been concentrated in certain countries, institutions, and authors. The institutional affiliations of Delanka-Pedige et al. [45], [46] and Munasinghe-Arachchige et al. [47] show that co-authorship can represent an efficient strategy for institutions in developing countries to generate high-impact publications on issues related to SDGs assessments, since these rank among the top authors presented in Table 3.

Most of the publications found were articles, and most of these articles had been published in highly indexed journals, such as Sustainability, the Journal of Cleaner Production, and Science of the Total Environment, whose scopes, as their names suggest, include sustainable development, sustainability, and environmental issues. These journals have mainly published comprehensive assessments pertaining to the 17 SDGs or topics such as climate change (SDG 13) and energy (SDG 7). Journals oriented towards more specific sectors e.g., health (International Journal of Environmental Research and Public Health and The Lancet) and water (Water Switzerland) – indicate the relevance of SDGs 3 and 6, found to be the most-often evaluated SDGs (in 143 and 96 of the studies published, respectively).

The predominant types of appraisals were identified as impact and risk assessments. The former focused on environmental issues, the life cycle of carbon dioxide emissions [48], effects related to the environmental life cycle [49], and the environmental effects of urban growth [50]. The latter assessments aimed at monitoring water quality [51], dangers to public and global health [24], and threats to health from poor water quality, specifically [52].

Our literature review revealed that 43 of the documents published (10.3 %) were review articles, the vast majority of which studied specific topics such as air quality [53], health-related issues [54], [55], and dietary metrics and nutrition issues [56]–[58]. Some authors evaluated the entire 2030 Agenda, with an emphasis on implementation costs [59], while others highlighted the importance of integration and synergy among the different dimensions of sustainable development [26]. Certain studies proposed comprehensive assessments on the progress made with SDGs: in Australia [7], Bulgaria [60], and Romania [61], and at the subnational level in Colombia [62], [63].

In some of the publications obtained, leading international organizations—the Bertelsmann Foundation, the UN Sustainable Development Solutions Network (SDSN), the OECD, Eurostat, and the UN – proposed approaches for monitoring the achievement of SDGs based on the latest available data, and for assessing whether the various SDG targets could be met by the year 2030 [30]. Using the most recent data, the Bertelsmann Foundation and SDSN measured countries’ percentage of achievement of the 17 SDGs [64], and the OECD assessed SDG achievement based on the distance which countries needed to ‘travel’ to meet the goals and targets by 2030, tracing trends over time [65]. Eurostat [66] analyzed the progress made towards the SDGs in the European Union, assessing whether the deadline could be met based on quantitative targets, and evaluating the speed of progress for the remaining indicators. The UN [67] appraised achievements in selected 2030 Agenda targets and related trends over time, providing a summary of the progress made at the global and regional levels [68].
Our primary contribution to the literature lies in ours being, as far as we know, the first review to focus on the most-often evaluated SDGs, and one of only two, alongside [30], to identify the recurrent types of assessments pertaining to the 2030 Agenda for Sustainable Development. We concur here with Ahner-Mchaffie et al. [26], who highlighted the need for research promoting more comprehensive assessments on the agenda. To achieve this, we find it necessary to transcend independent SDG assessments and recognize the thresholds of each dimension [69], allowing for the consideration of trade-offs among the SDGs [70], [71]. This would include evaluations of targets’ achievement and of progress made towards targets, accompanied by averages calculated at aggregated levels with measures of associated variability [30]. New assessment typologies for the 2030 Agenda should therefore include such elements, as well as analyses on the transversal nature of some of the SDGs.

5. **CONCLUSION**

This work comprised a systematic and analytical review of the literature available on the incipient and dynamic theme of UN SDG assessments. A Scopus search yielded a total of 418 publications: 306 articles, 43 reviews, 42 conference papers, 16 book chapters, four books, three editorials, two letters, and one note. Based on these documents, we performed both general- and specific-level analyses on the literature. The former included the number of publications per year; types of documents; subject areas; number of citations; leading authors and journals in terms of publication volume; recurrent institutional affiliations; major funding sponsors; and the countries with the most authors’ institutional affiliations. The latter analysis included use of the **VOSviewer** software to identify the density and relevance of concepts, relationships among concepts, the main assessments for the 2030 Agenda, and the most-often evaluated SDGs.

We found that most UN SDG appraisals focused on measuring impacts (i.e., environmental and sustainability impact assessments) and risks (i.e., health and water quality monitoring). Predominant in these assessments were SDGs 3 (good health), 6 (clean water and sanitation), 13 (climate action), 7 (affordable energy), 8 (decent work and economic growth), and 4 (quality education). These results are consistent with the main subject areas identified, namely environmental sciences, social sciences, medicine, and energy, and with the journals with the most articles and citations on sustainable development, environmental issues, and medicine.

As mentioned in this study, publications related to UN SDGs assessments began in 2015, the year in which the 2030 Agenda was launched, and have increased considerably since then—especially in the last two years. Such publications have tended to appear in high-impact journals such as **Sustainability**, the **Journal of Cleaner Production**, and **Science of the Total Environment**. Hence, it is a cutting-edge topic still under development, as only six years have passed since the start of the ambitious SDG agenda.

Furthermore, this study detected correlations among the number of publications by institutional affiliation, the funders involved, and the countries with the most prominent contributions to UN SDG assessments. Authors from developing countries are encouraged to use co-authoring strategies to participate in more research and publications on this topic.

Future research should delve into assessments integrating the entire 2030 Agenda, as done by international organizations such as the Bertelsmann Foundation, SDSN, OECD, Eurostat, and UN. Researchers should consider trade-offs among SDGs and provide results which complement rather than contradict one another. Likewise, forthcoming works should adopt a transversal approach to studying SDGs, since some goals operate as means or intermediate objectives for the achievement of other goals, as is the case with SDGs 4 (quality education), 8 (decent work and economic growth), and 9 (innovation, technology, and infrastructure).
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