

Uncovering the priorities of scientific research on sustainable development goals: A case study in Ethiopia

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Abstract

The United Nations has defined 17 SDGs aimed at addressing fundamental human needs. While the SDGs are relevant to all countries and communities worldwide, they hold particular significance to Ethiopia. Scientific research dedicated to a specific country, or a region therein plays a crucial role in identifying the necessary interventions, planning appropriate courses of action, and monitoring progress toward achieving the SDGs. A considerable amount of scientific research directly or indirectly related to the SDGs, has been conducted on Ethiopia, but the research is fragmented and a clear overview of its focus and impact on the SDGs is lacking. In this study, we conduct a comprehensive review of all available scientific literature on the former province of Wollo, which was the site of one of the most infamous famines in recent times. We found 1591 relevant studies, classified, and analyzed them based on their relevance to the SDGs. Our results indicate that while there has been a significant increase in scientific research in recent years, the focus has been skewed toward a few goals and limited targets within them. Specifically, SDG 2 (Zero Hunger) and SDG 3 (Good Health and Wellbeing) have received significantly more attention. Further analysis also reveals misplaced priorities indicating a misalignment between scientific research and the needs of the study area. We conclude that while we approach 2030, the deadline for the SDGs, considerable attention must be given to the prioritization of SDGs in scientific research.

KEYWORDS

Ethiopia, SDGs, sustainable development goals, systematic literature review, Wollo

1 | INTRODUCTION

Since 2015, the Sustainable Development Goals (SDGs) have served as a guiding framework for measuring sustainable development and directing global development efforts (Dang & Serajuddin, 2020; Halkos & Gkampoura, 2021; Sachs, 2012; Sachs et al., 2019;

Schmidt-Traub et al., 2017). Although designed to apply to all countries and communities worldwide, the SDGs hold significant relevance for Ethiopia, and particularly the former provinces of Wollo and Tigray. The events in these former administrative provinces were contributing factors in the rise of the Millennium Development Goals (Sachs, 2000), making it intriguing to assess how the scientific

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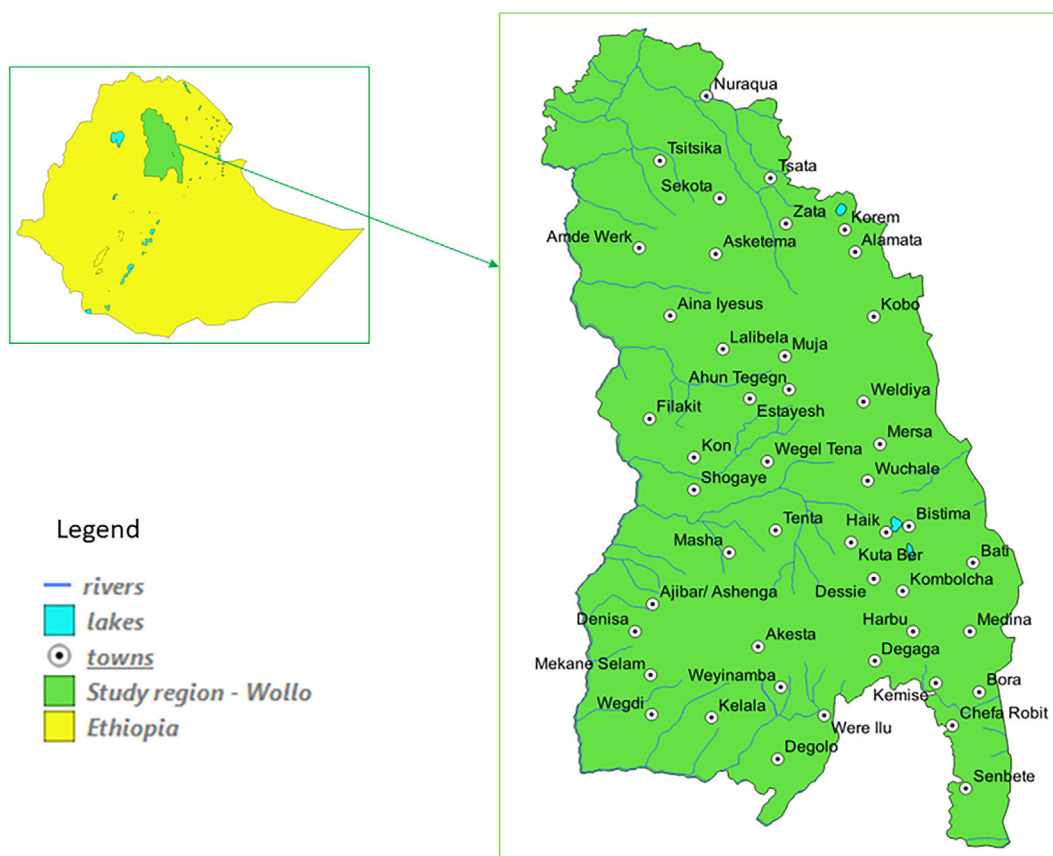


FIGURE 1 The study area and location map.

community has approached sustainable development issues in the area.

The infamous famine of 1984–1985 struck the North-Eastern highlands of Ethiopia, specifically the former province of Wollo, which is the study area of this research. The area, which now comprises the South Wollo, North Wollo, and Wag Himra administrative zones of the Amhara regional state of Ethiopia (see Figure 1), was the epicenter of the drought and famine. Famine had previously occurred in the 1970s, and was one of the factors, which led to the overthrow of the then imperial rule of Haile Selassie. Consequently, Ethiopia has been one of the centers of poverty-focused literature (Devereux, 1988; Rahmato, 1991; Sen, 1981).

A systematic analysis of scientific research played a crucial role in examining factors for achieving SDGs such as regulatory interventions (Camilleri, 2019) or economic activities such as tourism, which drive growth and job creation in Africa (Mtapuri et al., 2022, 2024). Similarly, such a systematic analysis of scientific research also contributed to a better understanding of the influences and roles of businesses in attaining SDGs (Mio et al., 2020; Paetzold et al., 2022; Pizzi et al., 2021). Scientific research dedicated to a specific area within a country with a specific set of challenges plays a crucial role in investigating potential enablers as well as constraints for achieving SDGs, designing appropriate interventions, and a better monitoring of performance on the SDGs. Such a systematic analysis dedicated to specific areas within a country is unfortunately rare.

A number of scientific research studies have been conducted in the Wollo province following the recurrent droughts and famines of the 1970s and 1980s (Agidew & Singh, 2018; Anato et al., 2022; Devereux, 1988; Little et al., 2006). Though the area is mainly associated with drought, conflict, and the associated socioeconomic issues, it encompasses fertile lands along the northern Ethiopian mountain ridges, major towns, and cities, and it has traditionally been a hub of business and cultural activities in northeast Ethiopia. It is also home to tourist destinations including the UNESCO World Heritage site of the Rock-hewn Churches of Lalibela (UNESCO, 2024) and the several highland lakes including Hayq, Ardibo, Maybar, and Golbo (Baxter & Golobitsh, 1970). This is significant as tourism plays key roles in the livelihoods and sustainable development of communities in Africa (Mtapuri et al., 2022, 2024). Prolonged conflicts and wars have however had a significant impact on SDGs in the region. Though the province has a specific set of opportunities and challenges in attaining the SDGs, there is hardly any research regarding the extent and depth of scientific investigations on SDGs related to the area. At the continent level, a recent systematic literature review (Igwe et al., 2023) confirms the lack of scientific reporting on SDGs in Africa in general, and the extent and quality of reporting of SDGs and sustainability in the continent are low and unsatisfactory. As a result, it remains unclear which specific aspects of SDGs both the responsible agencies and researchers should prioritize in their future endeavors.

Despite the significant amount of scientific research being conducted on the study area directly or indirectly related to SDGs, the existing body of research is fragmented, and a clear overview of the focus and impact of research on SDGs is lacking. The absence of a scientific debate on SDGs for the study area has resulted in a lack of comprehensive information that could guide policymakers, donors, researchers, and other stakeholders, such as impact investors in prioritizing SDGs effectively.

The SDGs comprise 17 key development goals that cover a wide range of agendas, namely: hunger, poverty, health, wellbeing, education, gender, water, sanitation, energy, jobs, economic growth, industry, infrastructure, innovation, inequalities, cities, communities, production, consumption, climate, life on land and underwater, peace, justice, institutions, and partnerships. Despite the breadth of these issues, a preliminary search for literature on the study area indicates that researchers have predominantly focused on hunger and health, which reflects the widely perceived vulnerabilities of the area. However, it remains unclear which sustainable development requirements are most pertinent for the area. In addition to food security, health, and wellbeing, other crucial topics, such as quality education, job opportunities, environmental protection, and access to clean water are also of utmost importance. Nevertheless, it is unclear how much attention has been given to the relevant SDGs as reflected in the scientific literature. Therefore, the objective of this study is to employ automated data processing techniques to conduct a Systematic Literature Review (SLR) of all available literature on the study area to evaluate the extent and intensity of scientific research emphasis on the SDGs and identify trends.

Our literature search was based on a geographic area rather than scientific disciplines, as is typically the case in literature review studies. Since we covered all scientific domains that resulted in many publications, we used an automated process to search, filter, and classify scientific studies. We analyzed the most significant studies by carefully reading and analyzing the text. To guide our analysis, we formulated the following research questions (RQs):

RQ1. How does scientific research on SDGs evolve over the years in the study area?

RQ2. Which scientific disciplines have dominated the scientific research conducted in the study area?

RQ3. Which SDGs have gained more focus, and which ones less, and why?

RQ4. To what extent do the publications cover the targets of the SDGs?

RQ5. What are the main topics of scientific research in the study area?

RQ6. How have the focal points of scientific research for each individual SDG evolved over the years?

The reminder of the article is organized as follows: Section 2 presents background information and related work. Section 3 describes the study area and Section 4 presents the details of the methodology applied. In Section 5, we present the results. In Section 6, we discuss the results, which are followed by concluding remarks in Section 7.

2 | THE RATIONALE FOR THE STUDY

Since its establishment, the United Nations (UN) has defined global goals, initially limited to maintaining peace among the nations of the world and creating a platform to address poverty, hunger, disease, and human rights violations at a global scale. Ideological tensions and the threat of nuclear war created the urgency to identify major global concerns and set minimum standards or goals that the world must aspire to (Kates et al., 2012).

Due to catastrophic disasters, such as famines and global health crises, notably HIV/AIDS, the UN formulated a Millennium Declaration in 2000 consisting of eight MDGs that were to be achieved by 2015 (Sachs, 2005; Sachs & McArthur, 2005). These MDGs aimed to (1) eradicate extreme poverty and hunger, (2) provide universal primary education, (3) promote gender equality and empower women, (4) reduce child mortality, (5) improve maternal health, (6) combat HIV/AIDS, malaria, and other diseases, (7) ensure environmental sustainability, and (8) develop a global partnership for development (UN, 2022b). Although the political consensus reached in 2000 after years of disagreement was seen as a breakthrough, the implementation of MDGs has encountered a mixture of achievements and significant challenges (Assefa et al., 2017; Easterly, 2009).

In 2015, the UN unanimously adopted the 17 SDGs, comprising 196 targets and 231 unique and quantifiable indicators, with the aim of addressing the limitations of the MDGs and adopting a more comprehensive perspective on sustainable development issues (Fukuda-Parr, 2016; UN, 2015, 2022a). This transition highlights the necessity of a more extensive approach that encompasses issues beyond poverty and hunger eradication.

Although an extensive set of goals, targets, and indicators are defined as part of the SDGs, sustainable development is understood as consisting of three core pillars: social, environmental, and economic sustainability, also known as the “triple bottom line.” This simple categorization of sustainable development reveals the potential conflicts among the different dimensions of sustainable development. Even though finding a scientific trade-off across the diverse goals remains difficult, the SDGs represent a broad consensus among the nations and communities of the world (Osborn et al., 2015; Sachs, 2012).

The SDGs are a product of consensus among diverse stakeholders, SDG-centric scientific research plays a significant role as it provides tools and methods to measure indicators (Gan et al., 2017), predict the effects (or the lack thereof) of the interventions in the future (Deléglise et al., 2020), monitor the implementation of the SDGs (Biggeri et al., 2019; Nature Editorial, 2021), and shape policy decisions (Gluckman, 2016; Toth et al., 2022). As such, scientific

research has been essential in all phases of implementation initiatives in support of SDGs.

While we were unable to find a literature review specific to Ethiopia or any region within Ethiopia viz-a-viz the SDGs, there are several relevant studies on the topic. These studies can be broadly categorized into two groups: those that focus on categorizing literature related to the SDGs, and those that report on the ranking of countries according to their progress toward achieving them.

A variety of studies have been conducted to identify scientific papers on SDGs. The studies provide a set of keywords that can be used to search for relevant literature in citation databases (Elsevier, 2022a; Jayabalasingham et al., 2019; University of Auckland, 2022). Keywords are also being used to categorize scientific literature by SDGs in general (Elsevier, 2022c), per specific country (Körffgen et al., 2018), economic sector (Nhemachena et al., 2018), financing options (Barua, 2020), or other categorization schemes.

The UN and its branch organizations, such as WHO and UNESCO, as well as other global organizations like the World Bank and IMF, track the progress of SDGs by country. The UN sustainable development report provides indices per country and per SDG, commonly referred to as the SDG index (SDGIndex, 2022). In 2022, Ethiopia was ranked 22nd according to this index, achieving stronger scores on SDG 13 (96%), SDG 12 (83%), and SDG 7 (71%). However, these figures are not consistent with, and mostly significantly higher than, figures from other indices such as those from the UN SDG Data Hub (UNSD, 2023), the World Bank (World bank, 2023), WHO (WHO, 2023), and the Gates Foundation (Gates Foundation, 2023). A more insightful and coherent report on SDGs and specific indicators for African countries is the 2020 Africa SDG Index and Dashboards Report (SDG Center for Africa & Sustainable Development Solutions Network, 2020).

The observed discrepancies in ranking nations according to their SDG target achievements highlight a number of issues. First, there seem to be challenges in reliably measuring indicator values within current reporting practices. Second, while SDG achievements are typically reported at the national level, specific regions of interest receive insufficient attention. Third, the method of reporting generally lacks the inclusion of evidence regarding how stated targets are attained. The approach of analyzing scientific research per SDG through a systematic analysis of the existing literature serves two primary purposes. First, it facilitates evidence-based evaluations of SDG achievements. Second, it can shed light on the varying degrees of attention given to different SDGs, potentially revealing areas neglected in scientific research. This study aims to contribute to the ongoing discourse surrounding systematic approaches to addressing current challenges in measuring SDG achievements and advancing progress toward these goals in the years ahead. This study also contributes to the existing literature on the methodology of automated screening and classification of publications per SDG through the use of a software algorithm. Given the exponential growth in the number of scientific publications, the automated approach employed in this study can be readily adapted and applied to extract and analyze a vast quantity of publications in various other contexts.

3 | THE STUDY CONTEXT

Based on the 2007 national population census of the Central Statistics Agency of Ethiopia, and applying a national growth rate of 4.4%, the province is currently home to more than 8 million people (ESS, 2007). The census data also shows that major urban population centers in the area include Dessie (with current population estimate of about 300,000), Kombolcha industrial city (with current population estimate of more than 150,000), and Woldia (also spelled as Weldiya, with current population estimate of more than 100,000). The population and surface area of cities and towns have rapidly increased since the last official census in 2007, and the actual populations estimate has more than doubled. The province is primarily characterized by rough and hilly terrain. A considerable portion of both the land and inhabited areas have altitudes that exceed 2500 m. The region receives a vast amount of rainfall during two short rainy seasons, and it has various streams as illustrated in Figure 1, which flow into the Blue Nile basin to the west and the Awash River basin to the southeast of Ethiopia.

The high-altitude areas to the west have poor road and other infrastructural connections. Due to the elevation and lack of water reserves, the high-altitude areas are prone to drought and famine during extended dry seasons. The eastern part of the area through which the main highway from the capital city to the northern and eastern part of the country passes is also where the main cities, towns, and business investments are located. Water from the predominantly mountainous regions flows into the adjacent lowlands bringing fertile silt with it to the lowlands to the east. These areas are situated at elevations ranging between 1500 and 2500 meters and are renowned for their fertile croplands and abundant water resources, making them a hub for agricultural and livestock production. The industrial city of Kombolcha, located in the study area, is the only major city in northern Ethiopia with a direct train connection to both the seaport of Djibouti and the capital city.

4 | METHODOLOGY

This study has been conducted through a broad systematic literature search and analysis of all scientific publications in the study context. The SLR methodology (Kitchenham et al., 2009; Xiao & Watson, 2019), rely on manual selection and analysis of literature. An SLR consists of the following steps: defining research questions, formulating a search string, searching for publications in relevant databases, filtering publications based on exclusion and quality criteria to identify primary studies, extracting data from the primary studies, and finally analyzing and reporting the results.

In this study, we adapted the method of Kitchenham et al. (2009). The initial steps of formulating the research questions, the search string, and the searching of publications in relevant databases were done manually. The subsequent methods of selecting primary studies and extracting data from the publications were automated using programming scripts. The final step of the analysis of the primary studies

was done manually supported by automated data analysis. The steps followed are summarized below:

1. Identify place names and formulate a search string.
2. Search for publications on citation databases.
3. Select relevant studies using a software script.
4. Categorize the publication per SDG using keyword matching script.
5. Analyze the publications to systematically identify the topics covered.

In step 1, we identified the place names associated with the province following the research questions. Since we aimed to cover all academic research, we did not exclude research by academic discipline. Therefore, we used place names such as Wollo and Northeast Ethiopia, but also the names of significant administrative subunits, called *zones*, *woredas*, cities, and towns. After several trials, we formulated the following search string based on the Scopus syntax:

(Dessie OR Dese OR Kombolcha OR Combolcha OR (Bati AND Ethiopia) OR (Kobo AND Ethiopia) OR (Wera* AND Ethiopia) OR "Werehim*" OR "Were him*" OR "Wera him*" OR Alamata OR Sekota OR (Borena AND Amhara) OR (Mersa AND Ethiopia) OR Ambassel OR Mekdela OR Woldiya OR Kemise OR Sayint OR (Kobo AND ethiopia) OR Lasta OR Lalibela OR Raya OR Wollo OR Welo OR Wolo OR Wello OR "Northeast Ethiopia" OR "North east Ethiopia" OR "Highlands of Ethiopia") AND NOT("Central Highland").

In step 2, we used the search string to look for publications in Scopus, PubMed, CAB abstracts, and Web of Science. We searched in the titles, abstracts, and keywords of the publications. The above search string, formulated for Scopus, was adapted according to the requirements of the other citation databases. We found 8487 publications but many of which were either unrelated to the study context or were duplicates.

Following the inclusion criteria (i.e., all scientific publications including journal articles, book chapters, conference proceedings concerning the study context in the English language) and exclusion criteria (i.e., duplicates, publications not related to the study context and languages other than English), in step 3, we filtered relevant studies using a software script. Through the automated process, we filtered a total of 1591 relevant studies published in 1438 sources (journals, conference proceedings, etc.) for data extraction and analysis.

Subsequently, in step 4, we used the University of Auckland's comprehensive list of SDG keywords (University of Auckland, 2022) to identify the relevant SDGs covered in each individual publication. We adapted the Auckland keyword list (see the Appendix A) by excluding those that are too generic, such as "development," and thus nondiscriminating. The numbers of keywords used per SDG are: SDG1 (61), SDG2 (153), SDG3 (212), SDG4 (144), SDG5 (131), SDG6 (145), SDG7 (160), SDG8 (140), SDG9 (82), SDG10 (126), SDG11 (162), SDG12 (166), SDG13 (146), SDG14 (128), SDG15 (197), SDG16 (161), and SDG17 (19). We searched for the SDG keywords in the titles and abstracts of the 1591 publications. The publication keywords were not searched, as a substantial number of publications

details we extracted from citation databases do not include the keywords of the publications. We then categorized the publications per SDG. Since there is a significant overlap of keywords across SDGs, the majority of the publications were categorized in more than one SDG.

Finally, in step 5, we further systematically analyzed the publications and the SDG keywords found in the publications manually and through a text matching and analysis script to identify the topics, which garnered significant attention and how the focus in the study context and on the topics progressed over the years.

5 | RESULTS

5.1 | Trends of scientific research over the years

Although the SDGs were defined in 2015, resulting in more publications explicitly targeting the SDGs, our analysis of the literature is also applied retrospectively and thus includes publication predating the publication of the SDGs. Figure 2 shows the number of publications per year since 1973. Only a few publications were discovered that were published before 1973, which is also the year when the major famine in the area started to manifest. The graph illustrates that the scientific research conducted in the study area scarcely increased in the years following the catastrophic drought and famine of 1974. The quantity of scientific publications on the study area experienced a more significant surge since 2010. Over 50% of the publication were from 2019 and onwards and over 30% of the publications were from 2021 and the first 7 months of 2022. In contrast, the number of publications before 2010 accounted only for less than 16% of the total number of publications. The period of rapid growth in the production of publications coincides with the establishment of new universities in the study area as can be confirmed with a quick search in scientific publication trend analysis platform of Elsevier (Elsevier, 2022b).

5.2 | Scientific disciplines

To get an insight into the scientific domains that attracted the attention of scientific investigations, we identified the top 40 scientific journals in which around 27.7% of the publications were published (see Figure 3). Two journals with a broader disciplinary focus area, *PLOS One* and *BMJ Research Notes*, and one topical journal, *Cogent Food and Agriculture*, dominated the list. *PLOS One* is genuinely multidisciplinary journal, which was a target for the latest publications while *BMJ Research Notes*, which is more focused on clinical disciplines, was targeted by older publications. Generally, the medical and clinical disciplines dominate the list. Even when publications target journals such as *PLOS One* and *BMJ Research Notes*, the focus of the publications is often health-related, thus predominantly focused on SDG 3.

The other journals that are included in the top 40, but with significantly fewer numbers of publications, cover the research areas of

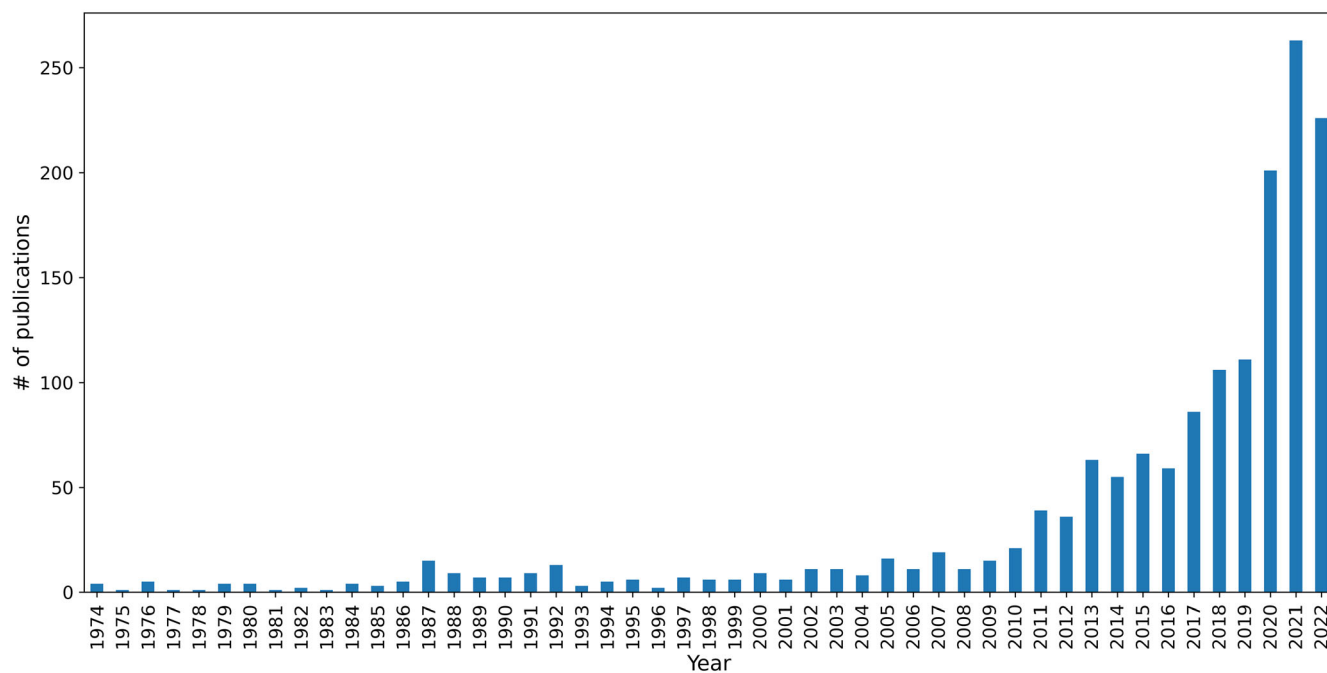


FIGURE 2 Trend of publications.

disasters, hydrology, agriculture, hospitality, and environmental management. Prominently, there is a lack of research in the scientific fields of the basic sciences, engineering, management, innovation, energy, infrastructure, and many other relevant scientific fields that are essential for achieving the SDGs other than SDG3. The scope of the predominant journals shows that there is a significant bias toward SDG 3 (Good Health and Well-Being) and SDG 2 (Zero Hunger) in the research conducted in the study area.

A close examination of the trend of the research on the study area, measured using the disciplinary category of the journals as a proxy, shows that there is little change over the years. The most dominant journal over the last few years is *PLOS One*. Since 2017, there seems to be a trend that most researchers on the study area target few journals, with *PLOS One* being the leading choice (see Table 1).

5.3 | The focus on SDGs

To determine the significance of a publication to an SDG, we calculated the ratio of the number of keywords present in the publication's title and abstract to the total number of keywords associated with the given SDG. Figure 4 shows the normalized sums of these ratios over all publications for each SDG. The normalized scores are relative scores showing the proportion of keywords found in the retrieved publications for each SDG relative to SDG 3¹ and do not show the actual proportion of keywords found. The result revealed that SDG 3 (Good Health and Well-Being) and SDG 2 (Zero Hunger) were the dominant research areas, which is consistent with the general perception of the global community, and probably that of the researcher community, over the study area.

Additionally, SDG 6 (Clean Water and Sanitation), SDG 11 (Sustainable Cities and Communities), SDG 1 (No Poverty), and SDG 15 (Life on Land) seem to have attracted relatively higher levels of attention compared with other SDGs. However, further analysis provided in subsequent sections offers a more in-depth understanding of the significance of these SDGs and the specific targets these SDGs include.

Notably, our findings revealed a lack of attention toward SDG 17 (Partnership for the Goals), SDG 14 (Life Below Water), and SDG 7 (Affordable Clean Energy). The minimal attention given to SDG 17 may suggest the lack of involvement of local stakeholders in defining the research topics. Similarly, the insufficient attention given to SDG 14 and SDG 7 could be attributed to the perception that these goals may not be of prime concern to people of the study area, which most likely is incorrect.

5.4 | Keyword coverage

Keyword coverage refers to the proportion of keywords of each SDG found in the publications. A more comprehensive representation of the keywords of an SDG (such as is the case for SDG 3, see Figure 5) is indicative of a more thorough coverage of the corresponding targets. There is a better coverage of the keywords for studies on SDG 3 (Good Health and Well-being), SDG 2 (Zero Hunger), and to an extent on SDG 6 (Clean Water and Sanitation) and SDG 15 (Life on Land). On the contrary, a less comprehensive coverage of the keywords is indicative of the lack of coverage of the targets of the SDGs, which is the case for the rest of SDGs. This is particularly telling for SDGs 1, 4, and 11, which were the focus of a relatively higher number

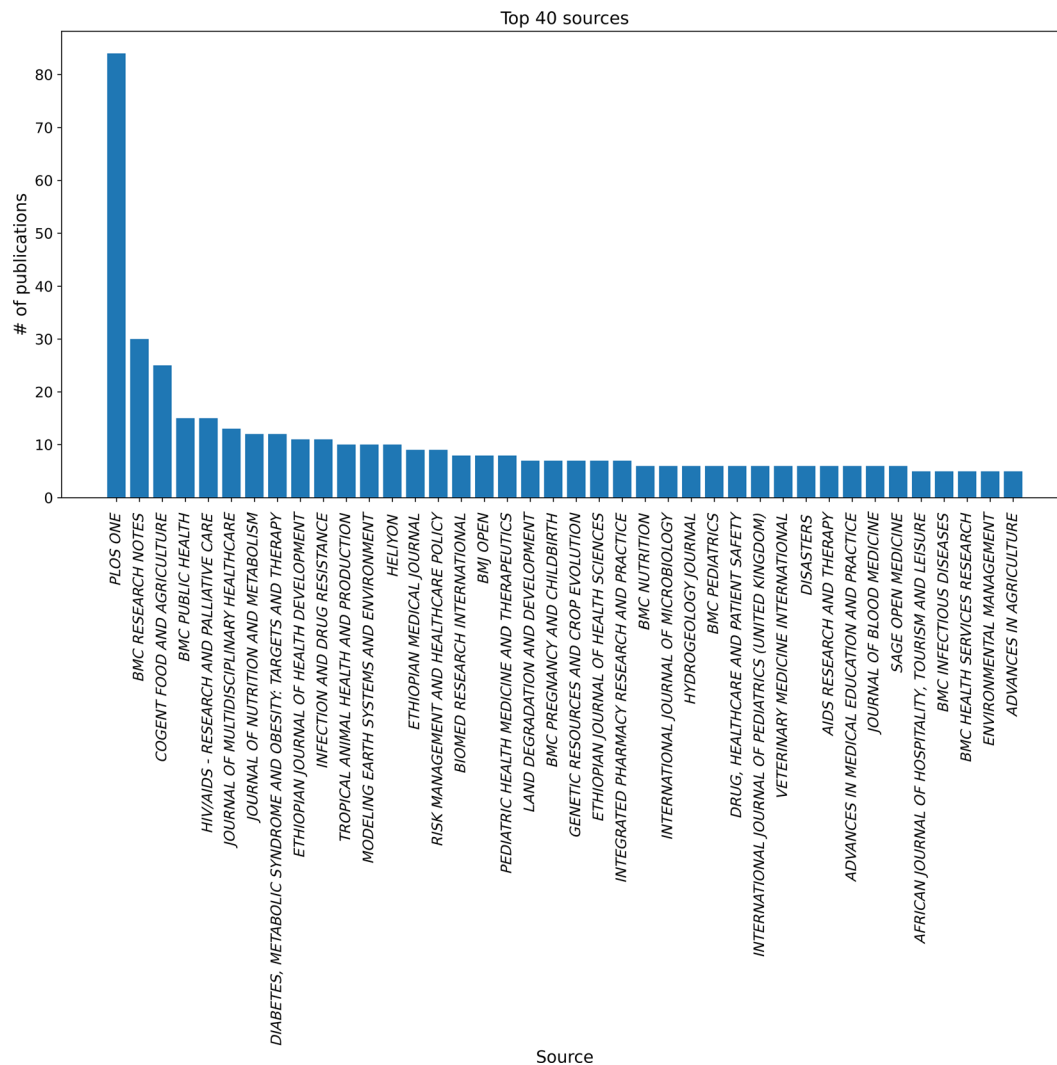


FIGURE 3 The top 40 journals in terms of number of publications in which research on the study area are published.

of studies (see Figure 4) but those studies seem to have a narrow focus with respect to the targets of the SDGs. The remaining SDGs received less attention (see Figure 4), and it is not unexpected that their scope was limited.

5.5 | Target focus

The determination of whether a study pertains to a particular SDG is based on the presence or absence of relevant keywords in its title and abstract. Table 2 shows the top five keywords instances per SDG among the studies, that is, if a particular keyword is found multiple times in a study, it is only counted once in the analysis.

This analysis resulted in some compelling insights, particularly with regard to the keywords that appeared infrequently. The keywords, such as *vulnerable*, *poverty*, *social support*, and *safety net* occurred often in SDG 1, reflecting where the focus targets of SDG 1 (no poverty) were. Conversely, many of the keywords associated with SDG 1, such as *basic services*, *child labor*, *child welfare*,

disadvantaged, *financial inclusion*, *income equality*, *social welfare*, and *wealth distribution* were absent in the studies analyzed. (See Table A1 in the Appendix for the list of keywords found and missing per SDG.)

5.6 | Focus on SDGs over the years

The focus on SDGs has evolved over the years, as illustrated in Figure 6. The trend of publications per SDG follows the general trend of publications over time, with some anomalies. Notably, there were more publications on SDG 15 (Life on Land) in 2017 than in subsequent years, except in 2022. Until 2017, there was hardly any publication on SDG 4 (Quality Education), and until 2020 on SDG 5 (Gender Equality) and SDG 13 (Climate Action). However, the trend in the most recent publications suggests that researchers are gradually paying more attention to SDGs beyond the traditional focus areas of SDG 2 and 3. Nevertheless, SDG 7, 14, and 17 remained overlooked by researchers.

TABLE 1 Major publication targets since 2015.

Year (total number of publications)	Three journals with most publications	# of publications
2015 (n = 66)	<i>Hydrogeology Journal</i>	4
	<i>Comparative Clinical Pathology</i>	2
	<i>BMC Research Notes</i>	2
2016 (n = 59)	<i>Microbial Genomics</i>	2
	<i>International Breastfeeding Journal</i>	2
	<i>BMC Public Health</i>	2
2017 (n = 86)	<i>PLOS One</i>	4
	<i>Modeling Earth Systems and Environment</i>	4
	<i>BMC Research Notes</i>	3
2018 (n = 106)	<i>Cogent Food and Agriculture</i>	7
	<i>BMC Research Notes</i>	7
	<i>PLOS One</i>	6
2019 (n = 111)	<i>PLOS One</i>	11
	<i>BMC Research Notes</i>	10
	<i>Journal of Nutrition and Metabolism</i>	3
2020 (n = 201)	<i>Cogent Food and Agriculture</i>	12
	<i>PLOS One</i>	8
	<i>HIV/AIDS-Research and Palliative Care</i>	6
2021 (n = 263)	<i>PLOS One</i>	33
	<i>Heliyon</i>	6
	<i>Journal of Multidisciplinary Healthcare</i>	6
2022 (n = 226)	<i>PLOS One</i>	21
	<i>BMJ Open</i>	5
	<i>Journal of Multidisciplinary Healthcare</i>	4
	<i>Infection and Drug Resistance</i>	4

6 | DISCUSSION

The results indicate that the focus of the research community is not evenly spread across all the SDGs. It is not surprising that there is a significant number of studies conducted on SDG 2, considering the region's past experiences with drought and famine. Likewise, the large number of publications on SDG 3 is expected considering the substantial number of publications on health in general.

The notable lack of publications on SDG 7 (Affordable and Clean Energy) indicates that there has been limited research attention or funding in exploring energy sources for the communities in the study area. However, affordable energy is as much an issue in the study area as elsewhere in the country and the world. Similarly, lack of attention

on SDG 14 (Life Below Water) is probably due to the lack of large water bodies in the study area. Likewise, despite the presence of lakes, and several rivers and small water bodies, life within these bodies of water has not garnered much attention from researchers. We were able to find only one publication on SDG 17 (Partnership for Goals), which indicates that the local research institutions and communities in the study area had probably little participation in defining collaborative research agenda. This probably also indicates that the research agenda are set elsewhere and there may be a large gap between what has been stipulated in the SDGs (and what the people in the study area need) and what the researcher community focuses on.

A more enlightening insight is obtained when analyzing the publication on SDGs in more detail. For that purpose, we selected and analyzed three publications for each SDG in detail. The top three-ranked publications with the highest ratio of the number of keywords found in the retrieved publications' title and abstract to the total number of keywords associated with the given SDG (see the Table A1 in the Appendix) were selected for further analyses (see Table 3). Accordingly, the major publications in SDG 1 (No Poverty) focus on rural households, extreme poverty (Devereux & Sharp, 2007), and poverty-induced health issues such as wasting (Anato, 2022). The most prominent publications on SDG 2 (Zero Hunger) focus on land management, destitution, social vulnerability, the impacts of climate change on agriculture and health. These studies predominantly focus on rural households and include a focus on women, children, migration, and mental health. Studies on SDG 3 (Good Health and Well-being) primarily focus on women and children. Among the top 20 publications based on the keyword ratio, half were primarily on women, one-fourth on children, and the rest on other general health issues. Publications on health, particularly on women and childbirth, not only dominate publications on SDG 3, but also publications that were categorized within the other publications. These shows the multidisciplinary nature of studies conducted on health and wellbeing, and the broad coverage of SDG 3.

Surprisingly, publications categorized as SDG 4 (Quality Education) focused more on health and nutrition than on the quality of education itself. Publications related to SDG 5 (Gender Equality) largely addressed sexual violence, with some publications focusing on food. Publications related to SDG 6 (Clean Water and Sanitation) addressed diverse topics, such as rain, river and ground water, industrial pollution, health, and irrigation.

Publications related to SDG 7 (Affordable and Clean Energy) were largely found to be irrelevant to achieving the SDG. Only two significant publications (related to solar energy) were found among the top 20. Similarly, SDG 9 (Industry, Innovation, and Infrastructure) also appeared to have attracted far less interest among the scientific community working in the study area, as most of the studies were largely irrelevant to achieving the SDG.

Studies related to SDG 10 (Reduced Inequality) mainly focused on women and health-related issues. Notably, relatively more relevant studies were found on SDG 11 (Sustainable Cities and Communities), particularly on waste management. However, no

FIGURE 4 The normalized proportions of keywords found per SDG using SDG3, which has the highest coverage of keywords, as a reference category. The proportion of keywords found is derived as the sum of the ratios of the number of keywords found in the retrieved publications' title and abstract to the total number of keywords associated with the given SDG (see the Appendix A for the list found and not-found keywords per SDG). These proportions are then normalized by using the SDG 3's sum of ratios as the reference category for producing Figure 4. SDG 3 is considered as the reference SDG as it has the highest sum of ratios of the number of keywords as described in the next sub section.

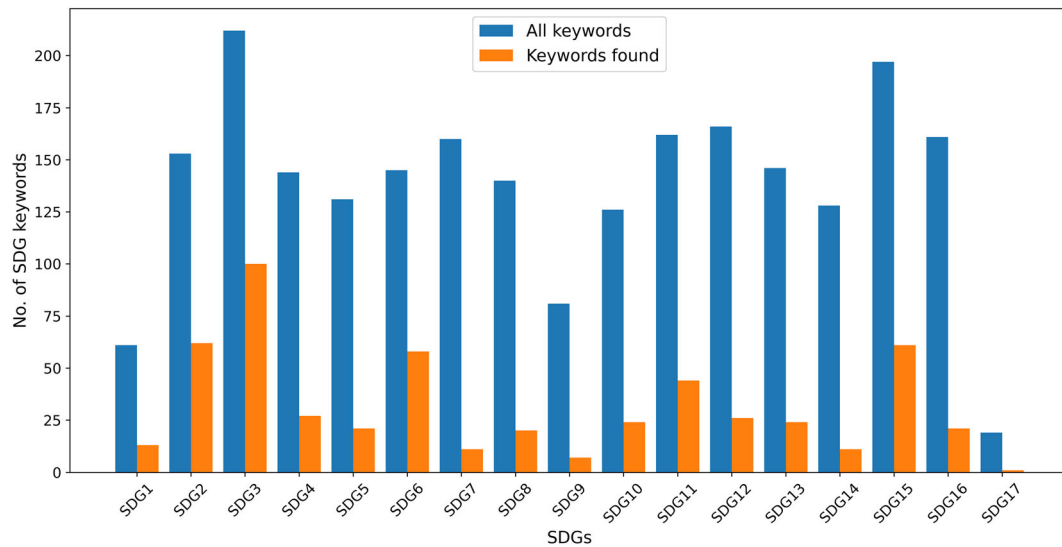
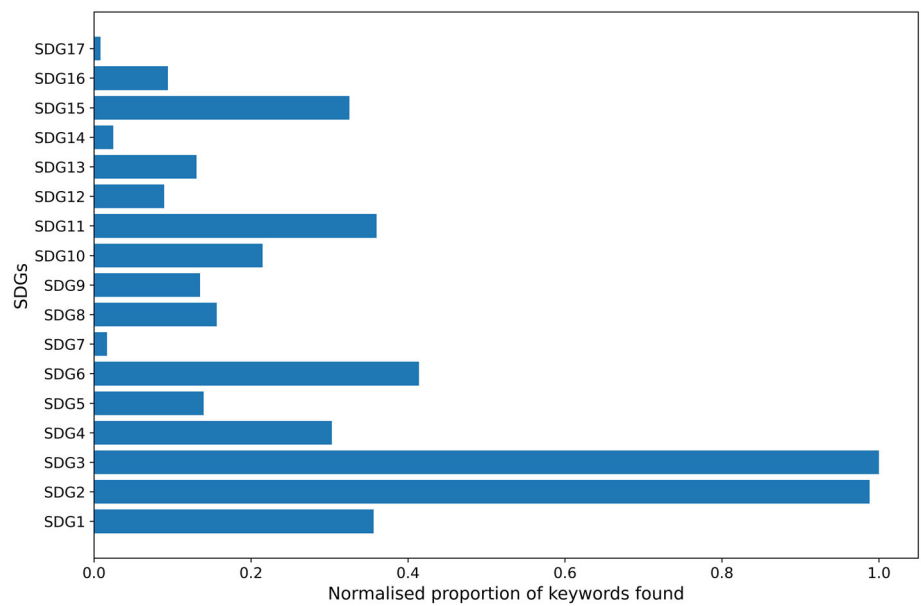


FIGURE 5 The keywords found versus total number of keywords per SDG.

meaningful publications were found on sustainable communities. Publications on SDG 12 (Responsible Production and Consumption) had many overlapping themes with SDG 11, and only a few relevant publications were found on production, except on the production of beer. Moreover, no relevant publications were found on consumption.

Another notable SDG is SDG 13 (Climate Action), in which all the top 20 studies were highly relevant and meaningful, making it difficult to select the three top publications among the 20. On the contrary, there were very few relevant publications on SDG 14 (Life Below Water) as only two papers in low-impact journals were found on the SDG. Publications on SDG 15 (life on land) were highly relevant and mainly focused on land use, with some studies on woodlands and very few on wildlife.

Most publications related to SDG 16 (peace, justice, and strong institutions) covered diverse topics such as women, violence, war, political economy, prison, and religion. However, we could not find any publication that focused on building strong institutions, which is one of the two main aspects of the goal. We only found one publication related to SDG 17 (Partnership for the Goals). Though SDG 17 does not have quantitative targets and is included within other SDGs, the fact that we were able to find only one publication that contains keywords associated with this SDG suggests that decision-making on the SDG goals in the study area may have been largely centralized and made outside the region.

The study under consideration is not without validity threats (Cooper, 1982; Zhou et al., 2016). These threats include internal, construct, and external validity threats. Internal validity threats might

TABLE 2 Top five keywords per SDG.

SDG	Keyword	Count
1	Developing countries	43
1	Vulnerable	30
1	Poverty	21
1	Social support	17
1	Safety net	10
2	Agricultural	151
2	Crop	133
2	Irrigation	90
2	Grain yield	56
2	Crops	55
3	Public health	144
3	HIV	71
3	Health care	64
3	Antenatal	53
3	COVID-19	48
4	Education	151
4	Educational status	31
4	Secondary school	14
4	Primary school	13
4	Secondary education	11
5	Health care	64
5	Family planning	16
5	Reproductive health	7
5	Contraceptive use	4
5	Gender discrimination	4
6	Irrigation	90
6	Hygiene	31
6	Groundwater	27
6	Water conservation	23
6	Water quality	18
7	Solar radiation	4
7	Solar energy	3
7	Alternative energy	2
7	Biofuel	1
7	Photovoltaic	1
8	Productivity	67
8	Tourism	21
8	Employment	8
8	Economic impact	6
8	Economic development	5
9	Development	187
9	Developing countries	43
9	Infrastructure	13
9	Enterprises	5
9	Industrialization	4
10	Indigenous	63

(Continues)

TABLE 2 (Continued)

SDG	Keyword	Count
10	Culture	33
10	Social support	17
10	Empowerment	10
10	Discrimination	10
11	Public health	144
11	Exposure	34
11	Tourism	21
11	Accessibility	21
11	Pollution	18
12	Consumption	47
12	Natural resources	5
12	Waste management	4
12	Heavy metals	4
12	Sustainable tourism	4
13	Climate change	42
13	Carbon	16
13	Climate variability	16
13	Emission	8
13	Climate change adaptation	6
14	Ecotourism	4
14	Eutrophication	3
14	Sustainable yield	3
14	Species richness	2
14	Protected areas	2
15	Drought	65
15	Land use	38
15	Dry season	26
15	Biodiversity	21
15	Land cover	19
16	Institutional	39
16	Conflict	18
16	Violence	5
16	Politics	5
16	Prison	4
17	Development assistance	1

have been caused by incomplete search strings or because a major citation database is missed, as well as selection bias resulting from inappropriate inclusion and exclusion criteria. Construct validity threats are mainly related to the keyword selection and external validity threats relate to how representative the study area is to other regions in Ethiopia and other developing countries.

To mitigate internal validity threats, we used the broadest possible search string and searched for literature in all major citation databases. Additionally, all researchers performed several trial searches with different search strings and compared results to ensure that all relevant scientific publications in the study area were captured.

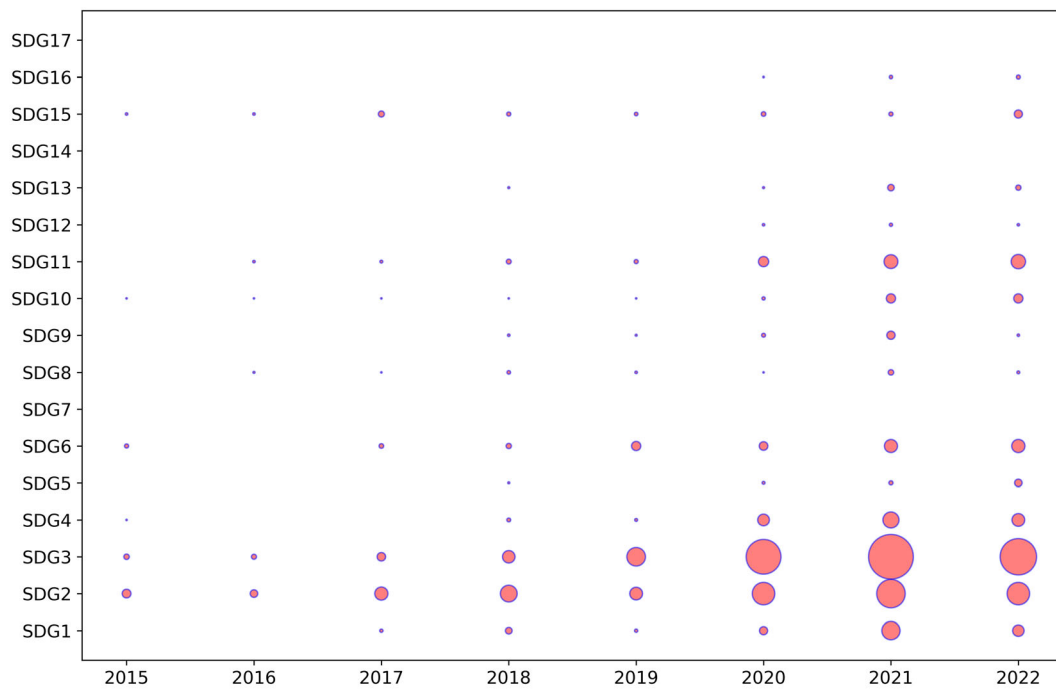


FIGURE 6 The quantity of publications per SDG over the years.

Nonetheless, it is possible that some scientific publications, particularly scientific articles published in non-indexed African journals, may have been missed. It is also worth noting that there could be internally circulating, unpublished surveys, and reports on some of the SDGs by governmental and nongovernmental organizations engaged in diverse sectors within the province. Any inference from our study regarding the focus on the various SDGs by stakeholders must consider this. There is however little threat of selection bias as no significant publicly accessible publication was excluded and the initial filtering was done through a fully automated process.

Construct validity was mitigated by using an extensive list of keywords. There are many overlapping keywords, which may have affected the results, particularly Figures 4 and 5. To mitigate this threat, we analyzed the top 20 publications of each SDG, of which the three most representatives shown in Table 3 were thoroughly analyzed to obtain an in-depth insight.

Since this study focuses on a specific area with significant sustainability challenges, the findings may not be representative of other regions within or beyond Ethiopia, potentially posing a threat to external validity. The purpose of this study, however, is not to draw generalizable conclusions, but rather to pioneer investigations that target specific focus areas within countries.

Accordingly, our findings indicate that scientific research in the study area has insufficiently focused on the issues that matter most to all stakeholders of the area. Other external factors, such as the impact factor, may well have influence on the distribution of SDG-focused research. It is, therefore, plausible that some SDGs are less represented not merely due to a lack of interest but as a result of these external influences. This aspect, though not the primary focus of the

current study, highlights a crucial area for future research, suggesting a deeper investigation into how publication trends might be shaped by factors beyond the immediate scope of academic inquiry.

Additionally, the study acknowledges the need for a more prudent understanding of the alignment between research agendas, and associated grants, and community needs. The minimal focus on certain SDGs, despite their relevance to the study area, indicates a possible gap in addressing what is essential for sustainable development from a community perspective. This observation underscores the necessity for a research approach that is more responsive to the diverse and specific needs of local communities, ensuring that scientific endeavors contribute meaningfully to all facets of sustainable development. As we approach 2030, the deadline for achieving the SDGs, this study shows the need for similar research to provide insights and guidance to the research community and policy makers.

7 | CONCLUSION

Since 2015, the United Nation's 17 SDGs have been adopted to harmonize the assessment, evaluation, and monitoring sustainable development across all countries of the world. In this regard, scientific research plays a crucial role in measuring and analyzing the targets of the SDGs, identifying, and defining programs for interventions, planning appropriate courses of actions, and monitoring progress toward achieving the targets. It is therefore important to analyze the focus, extent, and trends of scientific research.

In this study, we conducted a comprehensive review of available scientific literature on the former province of Wollo in Ethiopia, which

TABLE 3 Top three publications per SDG and the number of the SDG keywords found in the title and abstract of the publication.^a

SDG	Title	# keywords found
1	Trends in poverty and destitution in Wollo, Ethiopia (Devereux & Sharp, 2007)	3
1	Depression remains a neglected public health problem among pregnant women in Northwest Ethiopia (G. M. Beyene et al., 2021)	2
1	Predictors of wasting among children under-5 years in largely food insecure area of north Wollo, Ethiopia: A cross-sectional study (Anato, 2022)	2
2	Land Preservation Uptakes in the Escarpments of North-eastern Ethiopia: Drivers, sustainability, and constraints (Tesfaye et al., 2022)	9
2	Dietary diversity, nutritional status, and associated factors among lactating mothers visiting government health facilities at Dessie town, Amhara region, Ethiopia (Seid & Cherie, 2022)	8
2	Modeling spatial and temporal soil organic carbon dynamics under climate and land management change scenarios, northern Ethiopia (Mesfin et al., 2021)	7
3	Depression remains a neglected public health problem among pregnant women in Northwest Ethiopia (G. M. Beyene et al., 2021)	9
3	Determinants of anemia among pregnant mothers attending antenatal care in Dessie town health facilities, northern central Ethiopia, unmatched case-control study (Tadesse et al., 2017).	7
3	Determinant factors for adherence to antiretroviral therapy among adult HIV patients at Dessie Referral Hospital, South Wollo, Northeast Ethiopia: A case-control study (Abdu & Walegn, 2021).	6
4	Knowledge, attitude, and practices of parents about immunization of infants and its associated factors in Wadla Woreda, North East Ethiopia, 2019 (GebreEyesus et al., 2021)	5
4	Nutritional status and educational performance of school-aged children in Lalibela Town Primary Schools, Northern Ethiopia (Ayalew et al., 2020)	4
4	Prevalence of anemia and its associated factors among children under 5 years of age attending at Gugufu health center, South Wollo, Northeast Ethiopia (Gebreweld et al., 2019)	3
5	Parenting perspective on the psychosocial correlates of adolescent sexual and reproductive health behavior among high school adolescents in Ethiopia (B. Yimer & Ashebir, 2019)	2
5	The relationship between sexual violence and human immunodeficiency virus (HIV) infection among women using voluntary counseling and testing services in South Wollo Zone, Ethiopia (Hassen & Deyassa, 2013)	2
5	Undernutrition and associated factors among children aged 6–59 months in East Belesa District, northwest Ethiopia: a community based cross-sectional study (Fentahun et al., 2016)	2
6	Performance efficiency and water quality index of a two-stage horizontal subsurface flow constructed wetland system polishing anaerobically treated brewery effluent (Alayu & Leta, 2021)	6
6	Bacteriological and physicochemical quality of drinking water in kobo town, Northern Ethiopia (Sitotaw & Nigus, 2021)	6
6	Performance of mungbean under deficit irrigation application in the semi-arid highlands of Ethiopia (Ambachew et al., 2014)	4
7	A comparative evaluation of artificial neural network and sunshine based models in prediction of Daily Global Solar Radiation of Lalibela, Ethiopia (Woldegiyorgis et al., 2021)	2
7	Solar disinfection: an approach for low-cost household water treatment technology in Southwestern Ethiopia (Dessie et al., 2014)	1
7	Design and evaluation of solar parabolic trough collector system integrated with conventional oil boiler (Taha et al., 2021)	1
8	Socioeconomic determinants of micro and small enterprise growth in North Wollo and Waghimira Zone selected towns (Kassa, 2021)	4
8	Exploring internal business factors and their impact on firm performance: small business perspective in Ethiopia (Engidaw, 2021)	3
8	Living and working as a domestic worker in the Middle East: the experience of migrant returnees in Girana town, North Wollo, Ethiopia (Dessiye & Emirie, 2017)	1
9	The effect of external factors on industry performance: the case of Lalibela City micro and small enterprises, Ethiopia (Ebabu Engidaw, 2021)	3
9	Modern health services utilization and associated factors in North East Ethiopia (Bazie & Adimassie, 2017)	2
9	Views and attitudes of local people toward community versus state forest governance in Tehulederi District, South Wollo, Ethiopia (Woldie & Tadesse, 2019)	2
10	Menstrual hygiene management and school absenteeism among female adolescent students in Northeast Ethiopia (Tegegne & Sisay, 2014)	3

TABLE 3 (Continued)

SDG	Title	# keywords found
10	Latrine access and factors associated with it among people with physical disability in Kombolcha Town, Northeast Ethiopia: A mixed cross-sectional study (Getahun et al., 2022)	3
10	"Homelessness and Health Problems Are Not Distinct:" the Challenges of Rural–Urban Migrant Homeless Older People in Ethiopia (Gebeyaw et al., 2021)	2
11	Urban Sprawl or Urban Development? Peri-Urbanism in Metropolitan Areas of Amhara Region, Ethiopia (Abera et al., 2022)	6
11	Municipal solid waste management in Dessie City, Ethiopia (Rai Sharma et al., 2013)	5
11	A neglected source of household air pollution: a preliminary, mixed methods study of purposely produced household smoke in Wollo, Ethiopia (Wilkinson et al., 2021)	3
12	Municipal solid waste management in Dessie City, Ethiopia (Rai Sharma et al., 2013)	5
12	Performance evaluation of a brewery wastewater treatment plant in Ethiopia: Implications for wetland ecosystem management (Daba et al., 2022)	3
12	Health risk assessment and determination of some heavy metals in commonly consumed traditional herbal preparations in Northeast Ethiopia (Meseret et al., 2020)	2
13	Irrigation and shifting planting date as climate change adaptation strategies for sorghum (Getachew et al., 2021)	4
13	Climate change repercussions on meteorological drought frequency and intensity in South Wollo, Ethiopia (Mohammed et al., 2022)	4
13	Contributions of urban green spaces for climate change mitigation and biodiversity conservation in Dessie city, Northeastern Ethiopia (Muluneh & Worku, 2022)	3
14	Abundance and fish species composition of Gerado and Dirma Rivers, South Wollo, Ethiopia (Tessema & Mohamed, 2016)	3
14	Urban impact on ecological integrity of nearby rivers in developing countries: the Borkena River in highland Ethiopia (A. Beyene et al., 2009)	1
14	Evaluating the effect of diffuse and point source nutrient transfers on water quality in the Kombolcha River Basin, an industrializing Ethiopian catchment (Zinabu et al., 2018)	1
15	Mapping land use land cover changes and their determinants in the context of a massive free labor mobilization campaign: Evidence from South Wollo, Ethiopia (Tsfaye et al., 2021)	6
15	The effect of the surrounding landscape and socioeconomic characteristics on woody species diversity in Homegardens of Shewarobit District, Northeast Ethiopia (Woldeamanual et al., 2018)	4
15	Modeling the Spatio-temporal dynamics and evolution of land use and land cover (1984–2015) using remote sensing and GIS in Raya, Northern Ethiopia (Gidey et al., 2017)	4
16	Abegar indigenous conflict resolution system: a community based reconciliation (B. L. Yimer, 2022)	3
16	Incarcerated women's lived experience: a study in Dessie and Woldia correctional centers, Ethiopia (Alemineh et al., 2022)	3
16	A predeparture vulnerability context to human trafficking in North Wollo, Ethiopia (Asfaw, 2018)	1
17	The Ketto resettlement: a brief comparative survey of the land tenure system, 1985/86 and 1993 (Ayenew, 1994)	1

^aThe top three publications refer to publications with the highest ratio of the number of keywords found in the retrieved publication's title and abstract to the total number of keywords associated with the given SDG (see also the Appendix A).

was the site of one of the most infamous famines in recent times. We selected 1591 relevant studies, classifying them based on their relevance to the 17 SDGs, and used an automated process to analyze them. Our results indicate that while there has been a significant increase in scientific research in recent years, the focus has been skewed toward SDG 2 (Zero Hunger) and SDG 3 (Good Health and Wellbeing) while SDG 7 (Affordable and Clean Energy), SDG 14 (Life Under Water), and SDG17 (Partnership for the Goals) have received significantly less attention in the literature. The results further reveal misplaced priorities, indicating a misalignment between the focus of scientific research and the needs of the study area in relation to the SDGs.

From a theoretical perspective, this brings up the issue of governance of the SDGs. Scientific research plays a crucial role in not only

helping achieve the individual SDGs but also in prioritizing, evaluating, and monitoring progress toward the SDGs. Some aspects of the governance of SDGs are partly addressed in SDG 17, but for other aspects, such as the prioritization of the goals and targets, there is a lack of clear guidance. Therefore, significant attention must be given by the scientific community in developing a systematic approach for prioritizing the SDGs and on how to better inform policymakers in achieving all the SDGs.

From a practical perspective, unbalanced priorities indicate that research funding agencies should take a closer look at the existing body of knowledge and prioritize funding toward the SDGs that have received insufficient attention. Additionally, universities and research institutions may need to assess their research outputs along the SDGs and direct their researchers to prioritize under-researched SDGs in

their future investigations. Rigorous scientific evidence on progress toward achieving SDGs as well as understanding of the relevant barriers and drivers would allow policymakers to prioritize SDGs, for example, by incentivizing investments that contribute to SDGs with minimal progresses.

The findings indicate the importance of a holistic approach to SDG-related research. The findings also show that in order to help meet the SDGs, it is imperative for research entities, including funding agencies and academic institutions, to consider the broader impact of their research prioritization. Particular emphasis is a call for a more equitable distribution of research focus, ensuring that all SDGs receive adequate attention, particularly those that are currently underrepresented yet critical to specific regions or communities. The study also highlights the potential for future research to explore the reasons behind the selective focus of scientific journals on certain SDGs. Such inquiries could reveal insights into the intersection of academic interests, funding dynamics, and editorial policies, ultimately contributing to a more balanced and comprehensive understanding of sustainable development challenges. As the pursuit of the SDGs continues, aligning scientific research with the full range of these goals becomes increasingly crucial for effective and inclusive progress toward global sustainability. In order to bring the necessary attention to the issues identified in this research, future research could replicate this study in diverse study areas and help achieve the SDGs by 2030. Researchers could also adopt the automated technique of literature review used in this study to investigate the role of scientific research for SDGs in other geographic areas.

AUTHOR CONTRIBUTIONS

Ayalew Kassahun: Conceptualization; data acquisition; writing—original draft; formal analysis; review and editing; software scripting; writing—review and editing; supervision. **Seid Muhie Yimam:** Conceptualization; data acquisition; writing—original draft; formal analysis; software scripting; writing—review and editing. **Yonas Seifu Muanenda:** Conceptualization; data acquisition; formal analysis; writing—review and editing. **Beshir Melkaw Ali:** Conceptualization; data acquisition; formal analysis; writing—review and editing. **Seleshi Getahun Yalew:** Conceptualization; data acquisition; writing—original draft; formal analysis; writing—review and editing.

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ENDNOTE

¹ SDG 3 is considered as the reference SDG as it has the highest sum of ratios of number of keywords found compared with the other SDGs.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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APPENDIX A

TABLE A 1 Found and missing keywords per sustainable development goal (SDG).

SDG	Keywords found in the literature	Keywords not found in the literature
1	Developing countries, vulnerable, poverty, social support, safety net, low income, poverty reduction, poverty alleviation, poverty levels, social security, low income countries, low socioeconomic status, and refugee	Asylum seeker, basic services, child labor laws, child labor regulations, child labor, child support grant, child welfare, conditional cash transfer, conditional cash transfer program, development aid, development assistance committee, disadvantaged, disaster risk reduction, disaster risk reduction strategies, distributional effect, economic resource, end poverty, eradicate extreme poverty, extreme poverty, financial aid, financial empowerment, financial inclusion, food bank, global poverty, income equality, income poverty, international poverty line, low income population, micro finance institutions, microfinance, no poverty, nondiscrimination, official development assistance, poor countries, poverty alleviation program, poverty eradication, poverty line, poverty reduction strategy paper, resilience of the poor, Sendai framework for disaster risk reduction, small island developing states, social assistance, social protection, social safety net, social welfare, third world, urban poverty, and wealth distribution
2	Agricultural, crop, irrigation, grain yield, crops, farming, smallholder, fertilizer, food security, soil fertility, nutritional status, malnutrition, dietary diversity, food insecurity, smallholder farmers, stunting, land management, fertilizers, land tenure, obesity, agricultural production, agricultural productivity, farming systems, food production, soil fertility management, rural development, manure, crop yield, farming system, agricultural land, food availability, sustainable land management, agricultural practices, severe acute malnutrition, agricultural systems, malnourished, household food security, food security status, household food insecurity, agroforestry practices, crop management, agricultural development, hunger, fertilizer, farmyard manure, household food security status, maternal undernutrition, crop growth, crop productivity, smallholder farming, sustainable agriculture, arable land, cropping systems, food prices, food supply, food system, household food insecurity access scale, integrated soil fertility management, land reform, smallholder farms, agricultural markets, and undernourished	Agricultural management, agricultural production system, agricultural soils, agri-food supply chain, common agricultural policy, conservation agriculture, European food safety authority, fertilizer application rates, food production systems, food security policy, food security survey module, food supply chain, food supply chain management, genetically modified food, global food security, global food supply, global food system, good agricultural practices, household dietary diversity score, land rights, local food production, low food security, malnutrition universal screening tool, mini nutritional assessment, nutritional risk screening, smallholder farming systems, supplemental nutrition assistance program, urban food security, acute severe maternal undernutrition, agricultural export subsidies, agricultural innovation, agriculture and potassium, agroforestry management, Doha development round, early life nutrition, end hunger, fertilizer application rates, food commodity market, food commodity markets, food gap, food governance, food insecurity experience scale, food market and access, food market and development governance, food market and north south divide, food market and restriction, food market and tariff, food nutrition improvement, food price anomalies, food price volatility, food productivity, food reserves, food security and genetic diversity, food value chain, genetic diversity and cultivated plants, genetic diversity and domesticated animals, genetic diversity and farmed animals, genetic diversity and seeds, GMO and food, hidden hunger, high nutrition risk, indicator of food price anomalies, land right, livestock and gene bank, local breeds and extinction, malnutrition risk, maternal nutrition, maternal periconceptual undernutrition, nutrition risk, periconceptual undernutrition alters fetal growth, plant and gene bank, plant bank, prenatal nutrition, pre-pregnancy nutritional status, productive agriculture, resilient agricultural practices, resilient agriculture, small-scale food producers, sustainable food production, total official flows and agriculture, zero hunger, agriculture and sustainable, crop diversity, Doha round, food poverty, hungry, soil pollution, stunted growth, sufficient food, trade diversity, and wasting and food
3	Public health, HIV, health care, antenatal, COVID-19, diabetes, antenatal care, pregnancy, antiretroviral therapy, pregnant women, tuberculosis, hypertension, world health organization, pandemic, diet, neonatal, medicine, malaria, depression, diarrhea, anemia, body mass index, vaccine, vaccination, schistosomiasis, health services, pollution, epidemiology, family planning, hepatitis, health service, maternal health, health-care, contamination, mental health, cancer, pneumonia, blood pressure, HIV infection, maternal mortality, low birth weight, epidemic, obesity, neonatal mortality, child health, chronic disease, reproductive health, health risk, health system, alcohol use, intensive care unit, sanitation and hygiene, disability, aids,	Acute coronary syndrome, acute respiratory distress syndrome, acute rheumatic fever, adolescent birth rate, affordable medicines, alcohol abuse, alcohol use disorder, Alzheimer's disease, antineoplastic agent, basic health, battered child syndrome, brain injury, breast neoplasms, cancer cell, cardiovascular risk, cardiovascular risk factors, Chagas, child abuse, child death, child disease, child illness, child neglect, child well-being index, childbirth complications, chronic obstructive pulmonary disease, chronic respiratory disease, communicable disease, congenital heart disease, coronary artery disease, death rate, dengue, diabet, disease transmission, district health boards, drug users, dysentery, Ebola, emerging infectious disease, essential vaccines, fetal growth restriction, gestational diabetes, good health & wellbeing, h1n1, health care quality, health emergency preparedness, health system access, health worker density, heart disease, human medicine, Huntington's disease, immunology, inclusive health, infant mortality, inflammatory bowel disease, international health policy, international health

TABLE A 1 (Continued)

SDG	Keywords found in the literature	Keywords not found in the literature
4	<p>Education, educational status, secondary school, primary school, secondary education, formal education, literacy, primary education, higher education, high school, academic achievement, educational attainment, vocational training, discriminatory, access to education, teacher education, education institutions, elementary school, higher education institutions, learning environment, school attendance, school enrollment, completion rate, schooling, school enrolment, tertiary institutions, and women empowerment behavior, tobacco use</p>	<p>regulations, life expectancy, live birth rate, lung cancer, lung disease, mental disease, mental disorder, mental health service, MERS, myocardial infarction, narcotic drug abuse, neonatal mortality rate, neoplasm, non-small cell lung cancer, nonalcoholic fatty liver disease, Parkinson's disease, polio, posttraumatic stress disorder, premature birth, preventable death, preventable deaths, psychological harm, psychological wellbeing, quality adjusted life year, reducing mortality, reproductive health care, reproductive health-care, respiratory tract infection, rheumatic heart disease, SARS, severity of illness index, sexual health-care, sexually transmitted disease, sexually transmitted infection, sleeping sickness, social determinants of health, substance abuse, substance addiction, substance use disorders, sudden infant death syndrome, suicide mortality rate, the trips agreement, tobacco addiction, tobacco control, traffic accident, traffic injury, traumatic brain injury, tumor, tumor necrosis factor, typhoid fever, under-5 mortality, vaccine preventable diseases, water-borne disease, world health organization, world obesity federation, youth well-being index, and Zika virus</p>
	<p>Education, educational status, secondary school, primary school, secondary education, formal education, literacy, primary education, higher education, high school, academic achievement, educational attainment, vocational training, discriminatory, access to education, teacher education, education institutions, elementary school, higher education institutions, learning environment, school attendance, school enrollment, completion rate, schooling, school enrolment, tertiary institutions, and women empowerment</p>	<p>Adult basic education, basic education, basic education development index, compulsory secondary education, dynamic indicators of basic early literacy skills, early childhood development, early childhood education, early childhood education policy, early childhood special education, early years learning framework, education policy, education reform, education research, educational inequality, European higher education area, global citizenship education, global education reform movement, high school education, high school graduation rates, higher education policy, higher education reform, inclusive education, individualized education program, individuals with disabilities education improvement act, initial teacher education, inservice teacher training, learning opportunities, learning outcomes, lifelong learning, literacy skills, lower secondary education, massive open online courses, numeracy, open educational resources, pedagogical content knowledge, preservice teacher education, professional development, program for international student assessment, public education, public schools, science technology engineering mathematics, special education, teacher training, tertiary education, the Dundee ready educational environment measure, universal primary education, upper secondary education, upper secondary school, vocational education, technical education, adult literacy, affordable education, child labor, childhood curriculum, culturally diverse students, curriculum reform, school effects, early childhood care, early childhood curriculum, early childhood pedagogy, education dropouts, education exclusion, education expenditure, education facilities, education indicators, education quality, educational access, educational enrolment, educational environment, educational financial aid, educational gap, educational governance, educational outcomes, educational reform, environmental education, equal access to education, equal education, equal opportunities, foreign aid, global citizenship, inclusive education system, information and communications technology skills, international education, lifelong learning opportunities, national education policies, nonformal education, numeracy rate, scholarship, organized learning, Pacifica early childhood education, preprimary education, preservice early childhood education, professional learning, safety in school, scholarships, school curriculum, school safety, schooling disparities, special education needs, special education policy, student assessment, sustainable development education, te whāriki, teacher attrition, technology education, universal education, youth empowerment, quality education, education for sustainability, education in developing countries, equitable education, gender disparities in education, global education, numeracy skills, post primary education, qualified teachers, and refugees and learning</p>

(Continues)

TABLE A 1 (Continued)

SDG	Keywords found in the literature	Keywords not found in the literature
5	<p>Health care, family planning, reproductive health, contraceptive use, gender discrimination, gender equality, intimate partner violence, adolescent sexual, child marriage, empowerment of women, sexual violence, human trafficking, female sex workers, early marriage, sexual education, women's rights, empower women, women empowerment, gender participation, sexual exploitation, and human rights</p>	<p>Battered women, child sexual abuse, child sexual exploitation, commercial sexual exploitation of children, domestic minor sex trafficking, domestic violence, domestic violence abuse, family violence, female genital mutilation, female labor force, female labor force participation, feminism, gender disparities, gender equity, gender gap, gender inequality, gender wage gap, gender-based violence, international human rights law, intimate partner violence against women, lesbian gay bisexual transgender, psychological physical sexual emotional violence, reproductive rights, sex offenses, sexism, sexual abuse, sexual assault, sexual crime, sexual gender-based violence, spouse abuse, violence against women act, women's empowerment, reproductive healthcare, agrarian feminism, antiwomen, benevolent sexism, contraceptive behavior, discrimination against women, discrimination against girls, employment equity, empower girls, divorce rights, sexual rights, female entrepreneurship, female exploitation, female infanticide, female leader, female managers, female ownership, female political participation, female politician, female smallholder, feminist critiques, forced marriage, forced marriages, forced prostitution, gender injustice, gender mainstreaming, gender parity, gender quota, gender segregation, gender-responsive budgeting, honor killing, hostile sexism, household equity, information and communications technology and women, information and communications technology and female, intra-household allocation, managerial positions and women, female managerial position, microfinance, misogyny, occupational segregation, psychological violence against, reproductive health care, reproductive health rights, reproductive primary care, unpaid care work, unpaid work, violence against women, violence against girls, women and violence, women in leadership, women labor force participation, women's autonomy, women's economic development, women's employment, women's livelihood, women's ownership, women's power, women's sexual health, women's sexual reproductive, women's underrepresentation, women's unemployment, empower and women, empowering girls, empowering women, empowerment and women, exploitation and girls, exploitation and women, gender and discrimination, governance and gender, marginalized, sexual health, social inclusion, violence and girls, violence and women, women in work, and workplace equality</p>
6	<p>Irrigation, hygiene, groundwater, water conservation, water quality, sanitation, irrigation water, drinking water, contaminated, filtration, toilet, wastewater, water resources, wetland, water supply, water harvesting, water management, water sources, water scarcity, aquifer, water bodies, water source, ecosystems, hydropower, groundwater quality, waste water, water treatment, freshwater, safe water, wastewater treatment, water quality index, chemical oxygen demand, water resource, clean water, groundwater resources, water demand, water pollution, water quality parameters, water shortage, open defecation, defecation, tap water, urban wastewater, wastewater treatment plant, hand-washing facility, clean drinking water, quality water, sustainable water management, total suspended solids, water availability, water contamination, water quality standards, water resource management, water stress, industrial wastewater, water resources management, water-related, and river basins</p>	<p>Safe drinking water, activated sludge process, advanced wastewater treatment, aquatic ecosystems, aquatic environment, desalination, domestic wastewater treatment, fresh water, freshwater resources, groundwater pollution, integrated water resources management, membrane bioreactor, moving bed biofilm reactor, potable water, quality drinking water, recycled water, reverse osmosis, sewage treatment, soil water assessment tool, treated water, urban wastewater treatment, urban wastewater treatment plants, waste water management, waste water treatment, wastewater effluent, wastewater reclamation, wastewater reuse, wastewater treatment facility, wastewater treatment process, wastewater treatment system, wastewater treatment technology, water analysis, water desalination, water distribution system, water efficiency, water environment, water filtration, water footprint, water pollutant, water purification, water recycling, water reuse, water supply system, water treatment plants, water treatment processes, affordable drinking water, black water, blue water, dairy farm wastewater, domestic wastewater, drinking water services, equitable sanitation, sewerage, waste treatment, water infrastructure, water security, water ecosystems, green water, gray water, inadequate water supply, industrial wastewater treatment, lake water quality, pit lake water quality, river bank, sustainable freshwater supply, sustainable withdrawals, transboundary cooperation, ultrafiltration, untreated wastewater, endocrine disruptor, antifouling membrane, aquatic ecotoxicology, aquatic toxicology, hygienic toilet, water-use, water-use efficiency, sanitation management, water pollutant removal, pollution remediation, water cooperation, water supplies, water supply resilience, water supply systems, diarrheal diseases, sewers, and water access</p>

TABLE A1 (Continued)

SDG	Keywords found in the literature	Keywords not found in the literature
7	Solar radiation, solar energy, biofuel, photovoltaic, solar power, clean energy, concentrated solar power, renewable energy, wind turbine, and electricity	Alternative energy sources, battery electric vehicles, battery energy storage system, blade element momentum theory, bulk heterojunction solar cells, compressed air energy storage, dye-sensitized solar cells, energy conversion system, energy efficiency, energy management system, energy storage system, fuel cell, home energy management system, horizontal axis wind turbine, hybrid electric vehicles, hybrid energy storage system, hybrid energy system, hybrid power generation system, hybrid renewable energy system, hydroelectric power, intermittent renewable energy, intermittent renewable energy sources, large scale wind power, large-scale wind power integration, lithium ion battery, maximum power point tracking, national renewable energy laboratory, offshore wind energy, offshore wind farm, offshore wind turbines, organic solar cells, permanent magnet synchronous generator, perovskite solar cells, photocatalytic water splitting, photoelectrochemical pec water splitting, photoelectrochemical water splitting, photovoltaic cells, photovoltaic system, plugin electric vehicles, plugin hybrid electric vehicle, polymer solar cells, renewable energy generation, renewable energy production, renewable energy source, renewable energy system, renewable energy technologies, smart grid, smart grid technology, smart meter, smart power grids, solar cell, solar energy conversion, solar energy conversion efficiency, superconducting magnetic energy storage, sustainable energy, thermal energy, thermal energy storage, thermal power plants, variable speed wind turbine, vertical axis wind turbine, water splitting, wind energy, wind energy conversion, wind energy conversion system, wind energy system, wind farm, wind power development, wind power generation, wind power generation system, wind power generator, wind power integration, wind power penetration, wind power plants, wind power system, wind turbine blade, wind turbine generator, wind turbine generator system, wind turbine power curve, 2000 watt society, advanced fossil-fuel technology, affordable electricity, affordable energy, battery energy storage, clean cooking fuel, clean energy development, clean energy research, clean energy technology, clean fuel, clean fuel technology, clean fuels, cleaner fossil fuel technology, cleaner fossil-fuel technology, dielectric elastomer generators, diffuser-augmented wind turbine, district heat, domestic energy consumption, electric vehicle, electricity consumption, electromagnetic energy harvester, energiewende, energy access, energy conservation, energy consumption, energy development, energy equity, energy governance, energy infrastructure, energy intensity, primary energy, energy justice, energy ladder, energy policy, energy poverty, energy research, energy security, energy storage, energy technology, energy transition, fuel poverty, fuel switching, galloping-based piezoelectric energy harvester, heat network, hybrid energy, hybrid energy storage, hydroelectric, hydrogen production, life-cycle assessment, lithium-ion battery, low-carbon society, modern electricity, modern energy, photocatalytic activity, photochemistry, power consumption, reliable electricity, reliable energy, renewable energy resources, renewable power, residential energy consumption, rural electrification, smart microgrid, sustainable energy services, wind power, wind turbine system, fossil fuel, green economy, natural gas, sustainable power, and wave power
8	Productivity, tourism, employment, economic impact, economic development, ecotourism, small business, sustainable tourism, entrepreneurship, small enterprise, small enterprises, unemployment, job creation, micro and small enterprises, human trafficking, rural economy, GDP, gross domestic product, socio-economic development, and sustainable economic	Active labor market policies, circular economy, computable general equilibrium, computable general equilibrium model, economic activity, economic development level, economic growth, trade openness, electricity consumption, financial development, general equilibrium model, job destruction, labor market institutions, labor market, local economic development, micro, small and medium enterprises, micro-enterprises, microfinance, microfinance institutions, small and medium enterprise, small, medium and micro enterprises, sustainable growth, trade union, access to banking, aid for trade, average hourly earnings, carbon offset, child labor, child soldier, child soldiers, climate action, community-based tourism, cradle to cradle, decent job, decent work, domestic financial institutions, domestic material consumption, economic benefits, economic decoupling, economic development policy, economic development strategy, economic diversification, economic globalization, economic productivity, equal income, equal pay, equal wages, fatal occupational injuries, financial access, financial inclusion, forced labor, foreign development investment, full employment, global jobs, global jobs pact, global trade, inclusive economic growth, inclusive economy, inclusive growth, informal employment, international labor organization, labor right, living wage, local economic development policy, low-carbon economy, material footprint, medium enterprise,

(Continues)

TABLE A1 (Continued)

SDG	Keywords found in the literature	Keywords not found in the literature
9	Development, developing countries, infrastructure, enterprises, industrialization, small enterprise, industrial development, and infrastructural development	medium entrepreneur, micro finance, microcredit, microenterprise, migrant workers, minimum wage, modern slavery, nonfatal occupational injuries, not in education, employment, or training, offset project, per capita gross domestic product, precarious employment, precarious job, productive employment, quality job, quality jobs, rate of economic growth, resource efficiency, safe work, safe working environment, safe working environments, secure work, secure working environments, small entrepreneur, social entrepreneurship, stable employment, stable jobs, starting entrepreneur, sustainable tourism policy, total factor productivity, tourism economics, tourism employment, unemployment rate, work opportunities, working poor, world trade, youth employment, youth minimum wage, youth unemployment, employment policy, employment protection, equal pay for work of equal value, decent work & economic growth, development oriented policy, financial services, GDP growth, global resource efficiency, labor rights, poverty eradication, poverty line, slavery, social policies, and sustainable economic growth
10	Indigenous, culture, social support, empowerment, discrimination, disability, equality, economic empowerment, gender equality, socioeconomic status, intimate partner violence, disabilities, low socioeconomic, social security, universal health coverage, religion, race, least developed countries, gender differences, human rights, low socioeconomic status, development assistance, household expenditure, and discriminate	Information technology, communications technology, access to the internet, accessible transportation, Asian infrastructure investment bank, clean industrial processes, clean technologies, closed loop supply chain, community innovation survey, conducive policy, industrial diversification, value addition, cradle to cradle and industry, small medium enterprises, domestic technology development, environmentally sound industrial processes, environmentally sound technologies, foster innovation, green product, ICT infrastructure, inclusive innovation, inclusive transportation, industrial emissions, industrial growth, industrial performance, industrial waste management, industrial waste treatment, industrial innovation, industry 4.0, infrastructure development, infrastructure investment, innovation management, innovation processes, innovation system, manufacturing employment, manufacturing firms, manufacturing industry, manufacturing innovation, manufacturing investment, manufacturing value, medium enterprise, medium entrepreneur, microenterprises, official development assistance, official international support, process innovation, product innovation, public infrastructure, R&D investment, regional infrastructure, regional innovation system, resilient infrastructure, resource-use efficiency, retrofit industries, small entrepreneur, small-scale industries, sustainable industrialization, sustainable infrastructure, sustainable manufacturing, sustainable transportation, technological innovation, technology innovation, the national innovation system, traffic congestion, transborder infrastructure, transportation services, value chain management, data banks, financial services, industrialization, internet access, mobile networks, resource use efficiency, and technological capabilities
		Affordable housing, ageism, bilateral foreign direct investment, bilateral investment treaties, corporate social responsibility, economic inequality, equal opportunities, female genital mutilation, financial assistance, foreign aid, gender inequality, health care access, health disparities, health disparity, health inequalities, health status disparities, healthcare disparities, homophobia, homosexuality, household income inequality, human rights law, human rights violations, income inequality, international human rights, international human rights law, international human rights standards, international human rights treaties, international humanitarian law, LGBT, official development assistance, preferential trade agreements, racism, sex difference, sexism, sexual minority, social class, social discrimination, social dominance orientation, social economic, social exclusion, social inclusion, social inequality, social isolation, social justice, social policy, social protection, social stigma, social welfare, socioeconomic inequality, socioeconomic position, ambivalent sexism, ambivalent sexism theory, benevolent sexism, duty-free access, tariff, zero-tariff, development gap, discriminatory law, discriminatory policy, discriminatory practices, economic inclusion, economic marginalization, economic marginalization, economic reform policy, economic transformation, emigration, immigration, equal opportunity, ethnic minority, feminism, financial soundness indicators, fiscal protection policies, foreign direct investment, foreign investment, global market, health care disparity, hostile sexism, human dignity, human rights abuse, income growth, labor share, migrant remittance, migrant remittances, migration policies, migration policy, north-south divide, political

TABLE A 1 (Continued)

SDG	Keywords found in the literature	Keywords not found in the literature
11	<p>Public health, exposure, tourism, accessibility, pollution, waste, control measures, urban areas, municipal, governance, disaster, cultural heritage, housing, waste management, UNESCO, urbanization, population growth, urbanization, solid waste, urban development, pollutant, waste water, air pollution, transportation, atmospheric, wastewater treatment, overcrowding, human health, local materials, green space, wastewater treatment plant, suburban, urban green spaces, development planning, green spaces, solid wastes, sustainable urban development, total suspended solids, transportation system, urban planning, congestion, recycling, urban growth, and natural disasters</p>	<p>Air pollutant, particulate matter, pollution index, pollution levels, pollution monitoring, air quality, monitoring network, monitoring station, ambient air, bus rapid transit, city planning, disaster risk reduction, fine particulate matter, greenhouse gas emissions, health effects and air pollution, indoor air quality, intelligent transportation system, local air quality, multiscale air quality model, waste generation, waste incineration, landfill, municipal wastewater, aerodynamic diameter, pm10, pm2.5, public transport, smart city, sustainable city, sustainable urban planning, the Sendai framework for disaster risk reduction, traffic congestion and air pollution, urban air pollution, urban air quality, urban environment, urban planning development, urban planning management, urban policy, urban public transport, urban sustainability, urban traffic, urban transport, volatile organic compound, waste management system, waste treatment, water pollutant, activated sludge, aerosol optical thickness, affordable housing, air pollution model, basic service, black carbon, building design, circular economy, citizen participation, collaborative planning, disaster management, disaster risk management, disaster risk reduction strategies, disaster strategy, ecological footprint, environmental footprint, gentrification, human settlements, inadequate housing, inclusive urbanization, inclusiveness, informal settlements, land consumption, local air pollution, local fiscal space, low impact urban design development, membrane bioreactor, moving bed biofilm reactor, natural heritage, nature inclusive, nature inclusive building, participatory planning, public space, public spaces, public transit, public transport users, residential areas, residential development, resilient building, resilient buildings, resource efficiency, Sendai framework, slum, slums, sustainable building, sustainable urbanization, territorial development, total municipal waste, total solids, town planning, transport systems, urban air, urban design, urban housing, urban morphology, urban policies, urban transportation, urbanization, waste water management, wastewater treatment plants, zero energy building, sustainable cities, sustainable communities, arts and heritage, decentralization, impact of cities, risk reduction strategy, road safety, shanty, smart cities, sustainable buildings, and urbanization</p>
12	<p>Consumption, natural resources, waste management, heavy metals, sustainable tourism, solid waste, efficient use, wastewater treatment, solid waste management, energy utilization, environmental pollution, overconsumption, water pollution, wastewater treatment plant, municipal solid waste, municipal solid waste management, sustainable tourism development, corporate sustainability, postharvest losses, environmental policy, resource use, pollutants, sustainable management, sustainable resource use, food supply, and procurement</p>	<p>Anaerobic digestion, biochemical methane potential, building energy efficiency, circular economy, combined heat and power, education for sustainable development, energy efficiency buildings, energy saving, environmental impact assessment, environmental impact categories, environmental life cycle assessment, environmental technology, food waste, green supply chain management, hazardous chemicals, hazardous waste, hazardous waste management, heavy metal and pollutants, heavy metal pollution, household food waste, hydraulic retention time, industrial waste, integrated solid waste management, life cycle energy analysis, life cycle impact assessment, low carbon economy, low carbon economy, material flow analysis, municipal solid waste generation, municipal solid waste incineration, municipal wastewater treatment, municipal wastewater treatment plant, organic fraction of municipal solid waste, persistent organic pollutants, phase change materials, potential environmental impacts, power conversion efficiency, renewable energy technologies, sewage sludge, solid waste disposal, solid waste generation, solid waste incineration, solid waste management system, sustainable production, sustainable consumption, sustainable consumption production, sustainable supply chain, the resource conservation recovery act, volatile fatty acid, waste management system, waste recycling, waste treatment, water pollutants, water chemical, bio-based economy, building energy management, chemical pollution, consumer behavior, resource spill, food spillage, corporate social responsibility, cradle to cradle, deep decarbonization, domestic material consumption, efficient use of natural resources, efficient use of resources, energy conservation, energy efficiency, energy efficient, energy management, energy management systems, environmental footprint, food loss, food loss index, food spill, food waste index, fossil fuel subsidies, fossil-fuel expenditure, fossil-fuel subsidies, global citizenship education, global food waste, global resource extraction, green computing, green consumption, harvest efficiency, harvest losses, hazardous chemical, pollute, life cycle analysis, life cycle assessment, low power</p>

(Continues)

TABLE A1 (Continued)

SDG	Keywords found in the literature	Keywords not found in the literature
13	Climate change, carbon, climate variability, emission, climate change adaptation, change adaptation strategies, greenhouse gas, climate adaptation, greenhouse gas, climate adaptation, climate change scenarios, climate change mitigation, climate models, climate change effects, climate risk, climate change impact, climate change risk, $el\ ni^{\vee} \pm o$, global temperature, climate hazards, climate service, Indian ocean dipole, natural disasters, warming	<p>Anthropogenic climate, anthropogenic climate change, anthropogenic greenhouse gas, anthropogenic greenhouse gas emissions, atmospheric carbon dioxide, carbon capture, carbon emissions, carbon footprint, clean development mechanism, natural disaster, climate change adaptation measures, climate change adaptation planning, climate change adaptation policy, climate change adaptation strategy, climate change mitigation policy, climate change mitigation strategies, climate change policy, climate forcing, climate impacts, climate mitigation, climate policy, disaster risk reduction, $el\ ni^{\vee} \pm o$ southern oscillation, extreme weather, global climate model, global warming, global warming potential, greenhouse gas emission, IPCC, nitrous oxide emissions, regional climate model, regional climate model, sea ice loss, sea level, sea level change, sea level rise, the Kyoto protocol, the Paris agreement, acclimatization thermal strain index, acidification, seawater, Antarctic cold reversal, average global temperature, carbon dioxide emissions, climate action, climate adaptive management, Anthropocene, atmosphere, clean development mechanism, disaster risk reduction, energy conservation, environmental education, extreme climate, glacier retreat, climate hazard, ice-ocean interaction, nitrogen cycle, ocean acidification, ozone, climate politics, radiative forcing, sea ice, sea level, small island developing states, sustainable development education, thermal expansion, UNFCCC, climate warming, climate capitalism, climate change, climate change financing, climate change management, climate change planning, climate early warning, climate effect, climate equity, climate feedback, climate finance, climate governance, climate impact, climate investment, climate justice, climate model, climate prediction, climate related hazards, climate signal, climate tipping point, climate variation, climate warming, $cop\ 21$, $cop\ 22$, disaster risk reduction strategies, ecoclimatology, extreme weather events, green climate fund, greenhouse gas emissions, ice loss, interdecadal pacific oscillation, $la\ ni^{\vee}$, marine isotope stage, ocean warming, regional climate, sea surface temperature, southern oscillation index, urban climate, carbon emissions, climate refugees, climate resilience, cyclone, drought, extreme weather, forest fire, global temperature, greenhouse gasses, hurricanes, low-carbon economy, methane emissions, nitrogen oxide emissions, Paris agreement, rising sea, and rising sea level</p>
14	Ecotourism, eutrophication, sustainable yield, species richness, protected areas, fish species, aquaculture, fishery management, fisheries, fishery, and nutrient pollution	Aquatic ecosystems, aquatic food webs, Baltic sea action plan, coastal environment, coastal habitat, coastal management, coastal marine ecosystems, common fisheries policy, convention for the conservation of Antarctic marine living resources, coral bleach, coral reef, coral reef ecosystem, coral reef fish, ecosystem-based fisheries management, exclusive economic zone, fish populations, fish stocks, fisheries management, fishing effort, fishing pressure, great barrier reef, harmful algal bloom, integrated coastal zone management, integrated multi-trophic aquaculture, large marine ecosystem, marine, marine ecosystem, marine environment, marine fish, marine food web, marine habitats, marine life, marine mammals, marine organisms, marine protected area, marine resource management, marine spatial planning, marine species, marine stewardship council, no-take marine protected area, no-take marine reserve, ocean acidification, plastic debris, regional fisheries management organizations, seagrass bed, the marine strategy framework directive, total allowable catch, united nations convention on the law of the sea, artisanal fishers, biogeochemical cycle, coastal areas, coastal biodiversity, coastal ecosystem, coastal

TABLE A1 (Continued)

SDG	Keywords found in the literature	Keywords not found in the literature
15	<p>Drought, land use, dry season, biodiversity, land cover, land degradation, plant species, dryland, land management, soil erosion, vegetation cover, mountain, normalized difference vegetation index, deforestation, wetland, wildlife, land use and land cover, environmental degradation, genetic resources, species diversity, sustainable land management, mountainous, ecosystem, drylands, ecotourism, biodiversity conservation, environmental management, forest management, afforestation, reforestation, soil degradation, human-wildlife conflict, universal soil loss equation, forest cover, land cover change, leaf area index, natural vegetation, protected area, species richness, endangered species, revised universal soil loss equation, vegetation types, habitat loss, land use change, land degradation neutrality, land use/land cover change, native species, wetlands, extinct, biological diversity, forest degradation, IUCN red list, soil and water assessment, tropical forests, wetland ecosystem, degradation of natural, degraded soil, exotic species, riparian vegetation, tree cover, and desertification</p>	<p>ecosystems, coastal ecotourism, coastal eutrophication, coastal habitats, community based conservation, coral bleaching, coral reef system, coral triangle region, destructive fishing, ecological marine units, ecosystem-based and marine areas, eutrophication, fish stocks and fisheries management, fisheries rights, fisheries subsidies, fishing practices, Hauraki gulf marine park, healthy oceans, ice-ocean, illegal fishing, kelp, law of the sea, local fisheries, marine acidity, marine areas, marine biodiversity, marine conservation, marine debris, marine economy, marine ecosystems, marine fisheries, marine herbivorous fish, marine invertebrate, marine land slide, marine natural product, marine parks, marine pollution, marine quota, marine reserve, marine resources, marine technology, nutrient runoff, ocean biogeographic information system, oceanic circulation model, Okakari point marine reserve, overfishing, unreported fishing, unregulated fishing, plastic density debris, productive oceans, sea grasses, small island development states, small-scale artisanal fishers, small-scale fisheries, sustainable fisheries, traditional ecological knowledge, water cycle, life below water, coastlines, conserve oceans, fish stock, ocean temperature, overexploitation of fish, and fish overexploitation</p> <p>Biodiversity loss, corine land cover, deforestation, deforest, desertify, desertification, earth system model, ecosystem function, ecosystem service, endangered species act, enhanced vegetation index, environmental change, environmental factor, environmental impact, EU water framework directive, fire-fallow cultivation, forest ecosystem, gross primary production, habitat fragmentation, invasive species, land cover type, land data assimilation system, low impact development, net ecosystem exchange, net ecosystem productivity, palmer drought severity index, plant functional types, plant species richness, soil & water assessment, soil quality, soil quality index, soil water content, species distribution, terrestrial ecosystem, terrestrial water storage, threatened species, topographic wetness index, trophic web, tropical rainfall measuring mission, wastewater treatment plants, yellow river delta, AICHI biodiversity target 2, biodiversity-inclusive, bioeconomy, biological indicators, biological invasion, biological production, community based conservation, degradation of habitats, degraded forests, degraded land, earth system, ecological health, ecological resilience, ecosystem health, ecosystem protection, ecosystem restoration, environmental stress, estuarine ecosystems, extinct species, extinction risk, extinction wave, forest auditing, forest certification, forest cover change, forest stewardship council, freshwater biodiversity, freshwater ecosystems, freshwater species, habitat restoration, illegal logging, illegal wildlife products, inland freshwater ecosystems, invasive alien species, invasive plant species, land conservation, land loss, land restoration, local environmental factors, low impact urban design, low impact urban development, LULUCF, mountain biodiversity, mountain ecosystems, mountain green cover index, mountain vegetation, mountainous cover, Nagoya protocol on access to genetic resources, national nature reserve, native forest, naturalized species richness, official development assistance for conservation, official development assistance for biodiversity, poach, poaching, protected species, priority species, protected fauna, protected flora, rainforest alliance, red list index, red list species, REDD, riparian zone management, silviculture, slash-and-burn, soil restoration, strategic plan for biodiversity 2011-2020, stream ecosystem health, swamp forest, system of environmental-economic accounting, terrestrial biodiversity, terrestrial ecosystems, terrestrial freshwater ecosystems, terrestrial species, threatened native species, timber harvest, trafficking protected species, species trafficking, animal trafficking, trophic cascade, trophic level, vegetation communities, water sensitive design, wildlife market, wildlife product, wildlife traffic, life on land, alien species, illicit trafficking, manage forest, managed forests, permaculture, rewilding, sub-species, and wetland conservation</p>

(Continues)



TABLE A 1 (Continued)

SDG	Keywords found in the literature	Keywords not found in the literature
16	Institutional, conflict, violence, politics, prison, peaceful, conflict resolution, prisons, intimate partner violence, good governance, murder, sexual violence, police, human trafficking, physical violence, human rights, political decision, refugees, war, democracy, and peace	Physical abuse, emotional abuse, sexual abuse, emotional violence, child abuse, childhood sexual abuse, childhood trauma, crime, humanity, criminal activity, criminal justice, criminal justice system, criminal law, domestic violence, human rights abuses, fundamental freedoms, human rights violations, international human rights law, international humanitarian law, organized crime, sexual assault, sexual crime, terrorism, terrorist attack, terrorist attacks, transnational organized crime, violent crime, war crimes, Aarhus convention, accountable institution, accountable institutions, actual innocence, arbitrary detention, arbitrary justice, armed conflict, arms flow, arms trafficking, birth registration, bribery, civil conflict, combat crime, combat terrorism, conflict-related deaths, corruption, government institution, public official, criminal tribunal, cybercrime, democratization, democratization, financial aid, democratic deficit, democratic institution, effective institution, effective rule of law, ethnic conflict, exonerated, extremism war crime, fair society, false confession, family violence, formal dispute resolution, freedom of information, freedom of speech, fundamental freedom, genocide, homicide, human rights activists, human rights institution, human rights law, illegal arms, illicit arms flows, illicit financial flows, illicit money, illicit transfer, inclusive institution, inclusive institutions, inclusive societies, inclusive society, independence of judiciary, informal dispute resolution, insurgency, intentional homicide, judicial system, justice for all, justice system, legal identity for all, legal remedy, nondiscriminatory laws, Paris principles, peaceful societies, peaceful society, sustainable development policy, inclusive decision, participatory decision, representative decision, responsive decision, political instability, press freedom, prevent violence, psychological abuse, psychological violence, responsive institution, rule of law, separation of powers, spouse abuse, terrorism, terrorist, torture, torture of children, transparent institution, unsentenced detention, violent death, violence risk, violent acts, violent conflict, Geneva convention, peacekeeping, treaty, warfare, corruption and bribery, violent death rates, justice, strong institutions, enforced disappearance, hate crime, judiciary, legal identity, national security, nonviolence, representative decision-making, security threats, stolen assets, tax evasion, theft, unsentenced detainees, unstable societies, victims of violence, weapon, and weapons
17	Development assistance	Partnership for the goals, civil society partnerships, Doha development agenda, foreign direct investments, free trade, global partnership, global stability, international aid, international cooperation, international population, international support, knowledge sharing, multi-stakeholder partnerships, public-private partnerships, science cooperation agreements, technology cooperation agreements, weighted tariff average, and world trade organization