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Sustainable Development Goals Research among AUN Member Universities: A Bibliometric Analysis, 2015-2021

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Abstract: Higher education institutions have a critical role in realizing the 2030 sustainable development goals. Their role and influence are not limited to achieving quality and inclusive education but extend across the 17 SDGs through teaching and learning, scholarly research, and community engagement. This study aims to examine the contribution of ASEAN University Network (AUN) member universities to the scientific knowledge on sustainable development goals. Using VOSViewer, this paper employs bibliometric analysis, particularly citation, co-authorship, and co-occurrence, to present the quantity and quality of AUN produced SDG-related research and analyze the networks of authors, institutions, and keywords. The dataset includes 906 Scopus articles, book chapters, and conference papers published in 2015-2021 and written by authors and researchers affiliated with AUN member universities. The findings show that AUN member universities produced 35% of ASEAN countries' total research productivity on SDGs. The National University of Singapore is the most productive AUN university. The most researched SDGs are SDG3 Good Health and Well-Being; SDG9 Industry, Innovation and Infrastructure, and SDG7 Affordable and Clean Energy. The under-researched SDGs are SDG10 Reduced Inequalities, SDG1 No Poverty, and SDG5 Gender Equality. The top contributors in SDG3 are the University of the Philippines, Mahidol University, and National University of Singapore.

Keywords: Sustainable development goals; research productivity; research collaboration; ASEAN University Network

1. INTRODUCTION

Faculty members and researchers in higher education institutions (HEIs) are critical drivers in advancing the scientific literature on sustainable development, promoting the United Nation's sustainable development goals (SDGs), and teaching sustainable development across all disciplines. Their roles and influence are not limited to achieving quality and inclusive education but extend across the 17 SDGs through teaching and learning, scholarly research, and community engagement. The research outputs produced by faculty, researchers, and scientists in various disciplines have influenced

policy-makers and politicians (Sweileh, 2020). HEIs, directly and indirectly, impact sustainable developments in the spheres of "economy, societal challenges, natural environment, policy making, culture, and demographics" (Findler et al., 2019, p. 31; Holzhaecker & Agussalim, 2019).

In line with the Preamble of the ASEAN Charter that states "resolved to ensure sustainable development for the benefit of present and future generations, and to place the well-being, livelihood and welfare of the peoples at the centre of the ASEAN community building process" (ASEAN, 2007, p. 2), ASEAN University Network (AUN) member



universities support the governments in dealing with globalization issues and finding solutions to achieve the 2030 agenda. AUN facilitates cooperation among 30 universities in Southeast Asian countries and beyond (Rezasyah et al., 2017). This paper aims to examine the contributions of AUN member universities in SDG research by answering the following questions: (1) What are the quantity and quality of SDG-related scholarly publications of AUN member universities?; (2) What are the most influential SDG papers?; (3) Who/which are the most collaborative authors and institutions in SDG research?; and (4) What are the most and least researched SDGs?

2. METHODOLOGY

A bibliometric analysis is a quantitative method of evaluating scientific publications (Gajdzik et al., 2020). This bibliometric analysis was based on three different methods of analysis: citations, co-occurrence, and co-authorship. Co-authorship analysis focuses on the collaborative relationships of authors and organizations as the unit of analysis (Zhu et al., 2016). Co-occurrence of keywords analysis examines the conceptual structure of the author's provided keywords (Rosato et al., 2021).

This study is limited to journal articles, book chapters, and conference proceedings produced by AUN member universities, published between 2015 and 2021, and indexed in Scopus. Relevant bibliographic data were extracted from Scopus on February 8, 2021. Previous bibliometric studies on SDGs used different queries to retrieve data, such as “sustainab*” (Ye et al., 2020), SDG OR “sustainable development goal” (Rosato et al., 2021), “sustainability” OR “sustainable development” (Prashar & Sunder M, 2020). To retrieve the corpus of literature, this study used the query “sustainable development goal” in the ALL field and the institutions' names in the AFFILIATION field in Scopus to include more relevant documents. The search was not confined to the English language. Initially, a total of 1,106 documents were retrieved. The author manually reviewed each entry in Microsoft Excel to exclude duplicate records and documents not written by faculty and researchers from any AUN member universities. Dataset of 906 documents is used for bibliometric analysis (see the summary in Table 1).

To analyze the dataset, Microsoft Excel was

used to examine the research productivity of AUN member universities. Moreover, VOSViewer was used to analyze and visualize the network connections of scientific publications and keywords based on co-authorship, co-occurrence, citation, bibliographic coupling, and co-citation analyses (Jabeen et al., 2017; Van Eck & Waltman, 2019). Furthermore, the author of this study classified each document according to the 17 SDGs based on the title, abstract, and author keywords.

Table 1. Summary of documents selected in the bibliometric analysis per material type

Material Type	Documents	Percentage
Article	757	83.55
Book Chapter	54	5.96
Conference Paper	95	10.49
Total	906	100.00

3. RESULTS AND DISCUSSIONS

3.1 Research Performance and Citations

AUN member universities produced 35% of ASEAN countries' total research productivity on SDGs (906 of 2,543 documents) from 2015 to the present. Each document in the sample has an average of 18 citations. Forty percent (40%) of the sample documents have zero citations. Figure 1 depicts an increasing interest of faculty and researchers in SDG-related topics. An average of 151 documents per year was recorded. A significant increase in research outputs was observed in 2018 and 2019.

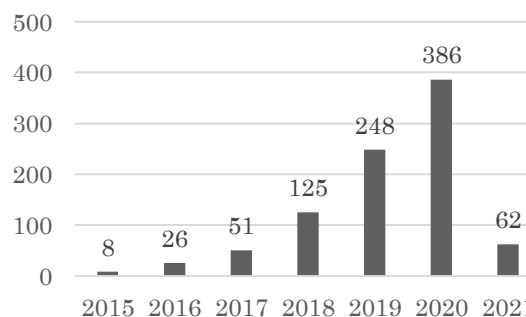


Fig. 1 Research Outputs Per Year

The 906 documents are written by 1,782 authors affiliated with AUN member universities and published in 518 sources. Only 71 authors have published at least three papers. Table 2 shows the



most productive authors of AUN member universities. The most influential author is C.A.T Antonio from the University of the Philippines, with total citations of 12,414. Their research focused on *SDG3 Good Health and Well-Being* (child and adolescent health, disability and life expectancy, access to healthcare), *SDG4 Quality Education* (disparities in education), *SDG6 Clean Water and Sanitation* (water conservation), and *SDG9 Industry, Innovation, and Infrastructure* (carbon footprint, manufacturing strategies). The most cited article entitled *Global, regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015*, (2,926 citations) is a collaborative research of University of the Philippines, Universiti Kebangsaan Malaysia, and other non-AUN universities.

Table 2. Most Productive Authors from AUN Universities

Author	Institution	Documents	Citations
Antonio, C.A.T.	UP	32	12,414
Van Doan, H.	Chiang Mai University	11	115
Tan, R.R.	De La Salle University	8	22
Efendi, F.	Universitas Airlangga	7	25
Jaturasitha, S.	Chiang Mai University	5	78

The most preferred sources for publication are *Sustainability* (30 documents), *IOP Conference Series: Earth and Environmental Science* (28), *The Lancet* (21), *E3S Web of Conferences* (18), and *Journal of Cleaner Production* (17). Table 3 presents the citations, CiteScore, and Scimago Journal Rank of the most preferred sources. When AUN member universities are grouped by country, the top five most productive countries are Malaysia (296 documents, 13,142 citations), Singapore (187 documents, 4,418 citations), Thailand (182 documents, 1,980 citations), Indonesia (161 documents, 304 citations), and Philippines (133 documents, 14,204 citations). Documents produced by authors affiliated with AUN member universities in the Philippines yielded the highest number of citations. As shown in Table 4, the National University of Singapore is the most productive AUN member university (126 documents with an average of 24 citations per document),

followed by the UP, with 98 documents and an average of 122 citations per document.

Table 3. Quality of Most Preferred Sources

Source	Citation	Cite Score	SJR	Total link strength
Sustainability	152	3.2	0.581 /Q2	6
IOP Conference Series: Earth and Environmental Science	11	0.4	0.18	1
The Lancet	12,105	73.4	14.55 /Q1	7
E3s Web of Conferences	3	0.4	0.17	0
Journal of Cleaner Production	86	10.9	1.89/ Q1	4

Table 4: Top 5 Most Productive Universities

Institutions	Documents	Citations	Average Citations Per Document
National University of Singapore	126	2,978	24
University of the Philippines	98	11,972	122
Universiti Sains Malaysia	88	4,161	47
Universiti Malaya	88	924	11
Mahidol University	85	1,317	15
Universitas Indonesia	77	155	2
Universiti Putra Malaysia	48	268	6
Nanyang Technological University	45	1,073	24
Chiang Mai University	43	217	5
Universiti Utara Malaysia	39	75	2

3.2 Research Collaboration

Co-authorship analysis using VOSViewer was performed to visualize the network connections between authors and institutions and indicate the structural patterns of research collaboration. A minimum of one article was set to include all AUN universities in the sample. Figure 2 depicts the co-authorship network between 10 AUN member universities. It shows that research collaboration among them is close and strong. Links between two universities denote a co-authorship relationship. The nodes' size is proportional to the number of co-authored papers that a given author or university has in the network (Erfanmanesh et al., 2012). The total link strength indicates the strength of the co-authorship link (Van Eck & Waltman, 2019). The University of the Philippines tends to collaborate more than National University of Singapore, as the former has a total link strength of 51 while the latter has 30. Notice that in the red cluster, Chiang Mai University, Chulalongkorn University, Mahidol University, and Universitas Indonesia have a close collaboration with each other. Universiti Kebangsaan Malaysia tends to collaborate more with the University of the Philippines, Universiti Sains Malaysia, Universiti Malaya, and Nanyang Technological University. University of the Philippines and Universiti Kebangsaan Malaysia have the strongest co-authorship link as they have collaborated with 17 documents on healthcare, diseases, injuries, measles vaccination, life expectancy, among others.

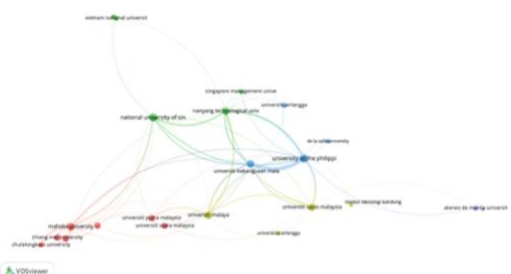


Fig. 2 Institutional Research Collaboration (Co-authorship in VOSViewer)

When research outputs of non-AUN universities were examined as of June 7, 2021, Universiti Teknologi Malaysia (144 documents), Universiti Teknologi MARA, Malaysia (57), Universiti Malaysia Terengganu (46), and Universitas Padjadjaran, Indonesia (31) were the most productive

universities. Note that Universiti Teknologi Malaysia has yielded more research results than Universiti Sains Malaysia. The former was more productive in 2018 and 2019. These two universities have collaborated on eight research papers on SDGs. Furthermore, data revealed that AUN member universities have collaborated with universities and private institutions in the United Kingdom (260 documents), United States (232), Australia (190), and China (133).

More than 50% of the sample papers (531 out of 906 documents) are written by at least two authors. Figure 3 illustrates the co-authorship network of authors of the sample documents. A link between two authors is shown if they have co-authored at least one paper. Since several documents included in this study have too many authors, the maximum number of authors per document for co-authorship analysis was set to 75, and the authors must have at least two documents. Of the 3,234 authors (including non-AUN authors), 407 authors from 105 documents met the threshold for authors' co-authorship analysis. The co-authorship networks of the selected papers are grouped into 11 clusters. The red network represents the largest cluster with 18 authors from eight countries, followed by the green network with 17 authors from 13 countries, and then the blue network with 15 items from four countries. The figures suggest that the green network tends to collaborate more with other countries than the red cluster. The blue cluster tends to collaborate with authors from the same university. M. Mckee of the London School of Hygiene & Tropical Medicine has the highest total strength link (43), which indicates the strength of his institutional and international collaboration.

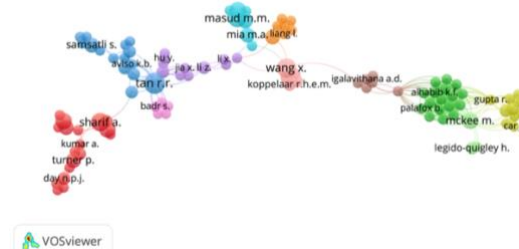


Fig. 3 Network of authors collaboration (Co-authorship in VOSViewer)

3.3 SDG Themes and Keywords

In general, the most prevalent research area is Environmental Science (364 documents), followed

by Medicine (306) and Social Sciences (303). Scopus tagged 41 documents as Multidisciplinary. Co-occurrence analysis was also performed to analyze the relationship between all keywords used in the sample documents. The 906 documents have a total of 7,353 keywords. For this co-occurrence analysis, the minimum number of keyword occurrences is ten, and the full-counting method was used. Some common keywords were excluded in the analysis, such as sustainable development goals, article, questionnaire, controlled study, survey, interviews. Figure 4 shows the network of 142 author and index keywords, with four clusters (total links = 4,313; total link strength = 14,129).

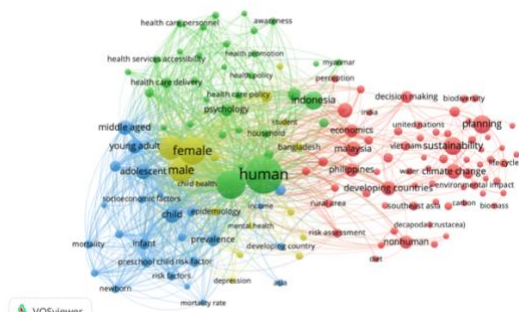


Fig. 4 Network Analysis of Keywords (Co-occurrence in VOSViewer)

The top SDG-related keywords are planning (59), sustainability (57), climate change (42), education (32), and poverty (27). The red cluster (67 keywords) focuses on sustainability, climate change, environmental impact, environment protection, and sustainable cities. The green cluster (34 keywords) emphasizes studies on the management and access to health care services. The blue cluster (25 keywords) includes various demographics, socioeconomic factors, risk factors, and epidemiology. Finally, the yellow cluster (16 keywords) can be classified into the following themes: female, male, human experience, and quality of life.

As shown in Table 5, the 906 documents were classified by SDGs. *SDG3 Good Health and Well-Being* is the most researched one, with 249 documents, followed by *SDG9 Industry, Innovation and Infrastructure* (77) and *SDG7 Affordable and Clean Energy* (73). Studies on SDG3 focused on health care, HIV, diseases, maternal health, and health policy. Under-researched SDGs are *SDG10 Reduced Inequalities* (6), *SDG1 No Poverty* (10), and *SDG5 Gender Equality* (11). The most productive AUN universities in SDG3 are UP, Mahidol University, and

NUS. Significant contributors in SDG9 are NUS, Universitas Indonesia, and Universiti Utara Malaysia. In terms of SDG4 Quality Education, Universiti Sains Malaysia (15 documents), University Utara Malaysia (9), and University of the Philippines (9) are the top three contributors. Sweileh's findings (2020) reveal that SDG3 is the most researched SDG among Southeast Asian countries, while the least researched is SDG7 (affordable and clean energy).

Table 5 Number of publications per SDG

SDG	Documents	Research Topics
Goal 1	10	Health care, HIV, diseases, maternal health, health policy
Goal 2	30	Green consumption, waste, environmental impact
Goal 3	249	NGOs, public participation, collaborative governance
Goal 4	66	Governance, justice, management, conflict
Goal 5	11	Climate change, disasters, environment
Goal 6	58	Household food, food security, supply chain
Goal 7	73	Marriage, women, peer, empowerment
Goal 8	47	Poverty, poverty index, poverty education
Goal 9	77	Income inequalities, women, children
Goal 10	6	Tourism industry, environmental performance, green buildings
Goal 11	67	Renewal energy, carbon emission, environmental change
Goal 12	38	Urbanization, housing, land use, city building
Goal 13	30	Higher education, educational development, education policy
Goal 14	59	Nile tilapia, aquaculture, biofloc, antimicrobial resistance
Goal 15	57	Water source management, water distillation, water quality
Goal 16	32	Farmers, agriculture, deforestation
Goal 17	34	Green economy, green growth, microfinance, investment



4. CONCLUSIONS AND RECOMMENDATIONS

Five years after the birth of 2030 UN Agenda, the Asia-Pacific region showed considerable progress on no poverty, zero hunger, good health and well-being, quality education, affordable and clean energy, gender equality, clean water and sanitation, life on land, and partnership for the goals (United Nations Economic and Social Commissions for Asia and the Pacific, 2020). However, the region needs to accelerate its actions and transformation to achieve the targets of 17 SDGs. The current study's findings are consistent with other studies (Rosato et al., 2021; Sweileh, 2020), whereas the SDGs academic literature published in Scopus-indexed journals, books, and conference proceedings are growing exponentially.

AUN member universities have focused their research on providing good health and well-being, dealing with industry, innovation and infrastructure, and promoting affordable and clean energy. Despite the recorded progress on reducing inequalities, ending poverty, and ensuring gender equality in ASEAN countries, there has been little research to investigate and provide solutions to these goals' problems and challenges. AUN member universities are less productive in SDG research than the top ten most productive universities in Australia in 2016-2021 (2,165 documents in Scopus). They have only produced 2.2% of all published articles, book chapters, and conference proceedings worldwide. Selected AUN universities dominate research productivity and citations in SDGs.

Although institutional collaboration among AUN member universities and transnational collaboration is evident, collaboration can still be broadened in future SDG research to increase knowledge co-creation and co-production. AUN member universities should develop and maintain long-term sustainable partnerships with government institutions, private organizations, and non-government organizations because they are a valuable source of expertise and research across all areas of the SDGs (El-Jardali et al., 2018). AUN member universities need to conduct more research on the least researched goals, such as SDG10 reduced inequalities, SDG5 gender equality, and SDG1 no poverty. There is a pressing need to conduct research on reducing inequalities in terms of age, disability, race, ethnicity, religion, and economic status and reduce poverty among ASEAN member countries.

Data and knowledge from research findings can help decision-makers, and other stakeholders identify strategic priorities and evaluate policy options.

This study has some limitations. The body of literature used in this study was extracted from Scopus; therefore, the scholarly articles available in Web of Science and other non-Scopus journals were not included. In an effort to download more documents, the term "sustainable development goal" used to retrieve documents may consist of documents that are not relevant to SDGs. These limitations could be explored in future studies by broadening the data source to include Web of Science Microsoft Academics and Google Scholar as well as by using "sustainable development" and sustainability in the abstract and title field. Further investigation on the national and institutional research policies of highly productive AUN universities must be conducted and see how these policies can be adopted by low-performing universities from Brunei, Cambodia, Laos, and Myanmar. Future research should also examine the research gaps per SDG sub-topic and the impact of the AUN-produced research in policymaking and governance to achieve the goals of the 2030 UN Agenda.

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