



A Scientometric Exploration of Indian Institute of Technology Bhilai's Contributions to Sustainable Development Goals Research

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Abstract

Scientometric and bibliometric analysis of publications in the realm of Sustainable Development Goals (SDGs) from 2017-2024 within the Indian Institute of Technology Bhilai provides a comprehensive overall objective of determining the contributions by IIT Bhilai in the realm of SDG-related research, both in terms of volume of publications, citation impact, collaboration pattern, and thematic focus. The number of SDG-related documents identified in the Clarivate Analytics Web of Science (WoS) database is 164. Analysis tools applied in the process include Bibliometrix R-package and Microsoft Excel for extracting and visualizing data. Publication output growth shows a steady rise at an annual growth rate of 54.78%, showing a growing interest in research with respect to sustainability. The average citation per document was 10.24, indicating that IIT Bhilai's research is well-regarded within the academic community. International collaboration was prominent, with 35.06% of the documents involving co-authorship with global partners, highlighting IIT Bhilai's active engagement in international research networks. The analysis also reveals the prominence of certain SDGs, particularly in areas like health and socio-economic development, while identifying potential research gaps in other SDGs. Findings Thus, the study reflects that IIT Bhilai has been a major contributor to the global agendas of SDGs and stands as an asset for policy and strategic planning and future research. In this context, it refers to academic institutions as founding in the endeavor to face the challenges of the earth through collaborative research and innovation.

Keywords: Sustainable, SDG, Scientometrics, IIT, Citation.

Introduction

IIT Bhilai was established in 2016 by the Ministry of Education, Government of

India, in Chhattisgarh. It began operating from its permanent campus in 2023. The net-zero campus over 362 acres has state-

of-the-art infrastructure like 20 main buildings, 25 auxiliary structures, a central instrument facility, an engineering workshop, a data centre, and a library. The institute offers BTech, MTech, MSc, and PhD programs in diverse disciplines such as Computer Science, Data Science, Artificial Intelligence, Electrical, Mechanical, Materials Science, Mechatronics, Bioengineering, Electric Vehicle Technology, Power Systems, Electronics, Design, Thermal Sciences, Chemistry, Mathematics, Physics, and Liberal Arts. Equipped with advanced facilities like a 3D Printing Lab, fabrication lab, electrical lab, and computer lab, IIT Bhilai emphasizes national growth, fostering technological advancement, innovation, originality, excellence, and core values of righteousness, brilliance, inventiveness, academic finesse, and accountability (https://www.iitbhilai.ac.in/index.php?pid=AnnualReport2023_24).

Sustainable development has been defined as development that meets the needs of the

present without compromising the ability of future generations to meet their own needs. Sustainable development calls for concerted efforts toward building an inclusive, sustainable, and resilient future for people and planet. Implementation and success will rely on countries' own sustainable development policies, plans, and programmes, and will be led by countries. The SDGs will be a compass for aligning countries' plans with their global commitments. The new agenda at the global level will be monitored and reviewed through a set of global indicators in relation to the 17 Sustainable Development Goals (SDGs) and 169 targets. It had been developed by the Inter-Agency and Expert Group on SDG Indicators (IAEG-SDGs) and agreed upon at the 48th session of the United Nations Statistical Commission held in March 2017 (<https://www.un.org/sustainabledevelopment/development-agenda>). The figure 1 shows the 17 parameters of SDG.



Figure 1

A scientometric study of SDGs within the context of an academic institute is the

research output pertaining to the 17 global goals, analyzed in the form of the volume

of publication, citation impact, collaboration patterns, and thematic focus to understand the contribution of the institute towards solving critical global challenges. The strengths and weaknesses of the institute are pinpointed by such research studies mapping publications to the specific SDGs. The areas where there is a need for attention are identified (Armitage et al., 2019). Some of the typical metrics used in measuring the relevance and impact of research include citation metrics, co-authorship networks, and keyword analyses (Armitage et al., 2019). Other studies also observe how the institute's research priorities are aligned with national and global development agendas that reveal the institute's role in advancing sustainable practices (Ferrer and Chalmeta, 2019). Such analyses support strategic decision-making, policy development, and efforts to improve the societal impact of research activities (Ramos et al., 2021).

Publications form considerably the reputation and influence of an academic institution. They are physical evidence of the output of the brain of the institute that illustrates its share in knowledge creation and innovation. With the right kind of journals, this increases international visibility of an institution within the global community of academics and researchers, providing chances for collaboration assistance in securing funding and helping rankings. They influence the institute's ability to attract talented researchers, students, and faculty, thereby creating a virtuous cycle of excellence (Mingers &

Leydesdorff, 2015). Besides, publications play a significant role in solving societal challenges, which aligns with national and global priorities, such as the Sustainable Development Goals (SDGs). Their realization and arrangement of driving progress across disciplines by supporting research from various points of view establish the institute as a highly relevant center for academic and practical activities, and highly contributes to the progress of society and science.

Literature Review

Scientometrics and bibliometrics related to the Sustainable Development Goals (SDGs) is a rapidly growing domain. Various studies examined the development path of SDG-related research applying various quantitative measures of publication, citation, and collaboration networks, usually concentrating on specific key research domains, the share of academic institutions involved, or the impact of other regions or countries in SDG research.

(Armitage et al., 2020) examined many research institutions assess their contributions to the UN's SDGs using tools like Elsevier and Times Higher Education, but these require careful evaluation due to interpretation and query challenges. This study used the Bergen approach to develop SDG-specific queries, revealing significant differences from Elsevier's results. Findings stress cautious use of SDG tools given their current developmental limitations. The authors, Bautista-Puig et al.

(2021), explored how the SDGs build upon the MDGs to be a universal sustainability framework. Using a scientometric analysis of work in the space between 2000 and 2017, it maps global research in M&SDG and thematic specialization; hence, its output is scientifically classified. Research findings indicate more involvement of the higher education sectors, health issues, and interlinked socio-economic themes, contributing towards evidence-based policymaking in relation to interlinked SDGs. (Bautista-Puig et al., 2019) Sustainable Development Goals (SDGs) focus on global cooperation toward sustainability, where higher education institutions (HEIs) are placed at the heart of the endeavor. This article maps HEI research on MDGs and SDGs (2000–2017) through the use of bibliometric analysis of 25,185 records. Findings include increased HEI participation, health, women, and socio-economic issues, as well as growing political interest, with implications for policy-making.

Gehlot et al., 2024, have done a bibliometric review of 580 articles published since 2012, and have found India to be one of the slowest in the adoption of SDGs, thereby requiring more policies and programs of awareness. The study gives information on the emergence of SDG research in India, scope, contributors, and trends. (Ferrer-Estévez and Chalmeta, 2021) assessed the nexus of education and SDGs through systematic review of 160 articles that have appeared over the last

decade. It indicates the best contributors, challenges, and trends, and suggests six categories of research with future outlooks while revealing a framework to enable academic institutions to better implement it in order to focus on the continuous improvement and measurable outcome. (Meschede, 2020) analyzed 4,593 research articles explicitly referring to the SDGs and discussed their thematic focus, research areas, and collaborative nature. Most work centers on SDG 3 (Good Health and Well-being), with contributions mainly from Life Sciences and Social Sciences. Findings emphasize international collaboration (37% co-authored globally) and open access as key drivers of SDG knowledge sharing. (Mishra et al., 2023) analysed 12,176 articles on Sustainable Development Goals (SDGs) from 2015 to 2022, highlighting research trends, challenges, and opportunities. Findings depict high research productivity in the USA, China, and the UK, with key topics that focused on climate change, poverty, global health, and inequality. Collaboration and direct insights into guiding future SDG research and policy efforts are stressed. (Mohd et al., 2024) investigated research grants' alignment with Sustainable Development Goals at University Sains Malaysia. Analyzing 1,495 grants and feedback from 46 principal investigators, the study identifies seven types of research impact on SDGs: economic, social, environmental, cultural, public policy, organizational, and educational. It

emphasizes the need for structured monitoring to ensure that research is consistently in support of achieving SDGs. (Yamaguchi et al., 2023) conducted a systematic analysis of literature reviews on SDGs from 2015 to 2022. The study indicated that SDG research has been growing rapidly, and the areas of focus have diversified. Key areas that are not well addressed include technology (SDG 9) and economic growth (SDG 8). Research gaps exist in the areas of inequalities, gender, oceans, and peace. SDG research is still evolving, and many areas remain unexplored. An analysis of 2,814 SDG-related papers and 92 reviews between 2013 and 2022 by Yeh et al. 2022 shows that the US and UK lead in publications and citations, with WHO and top universities key contributors. Research is organized into clusters on "synergies and trade-offs," "networking," and "systems analysis." SDG 3 is the most popular, and findings help scholars and policymakers manage the research on SDG.

Methodology

This bibliometric and scientometric descriptive study explores the global research publications based on Sustainable Development Goals by using techniques of bibliometric and scientometric analysis. The data was extracted from the Clarivate Analytics Web of Science database, one of the most extensively used scientific literature repositories in the world. A Boolean search algorithm was used to search for document titles related to SDGs

from the Indian Institute of Technology (IIT)-Bhilai" and was searched for only in the years from 2017 through 2024. Documents like meeting abstracts, editorials, and news items/book reviews were also excluded. Screening for SDG-related content following the initial search gave 329 documents, now reduced to 164. The final search was conducted on January 1, 2025, to ensure consistency and avoid including any outdated evidence. This study carefully examines SDG research, leading to valuable contributions and areas in need of further investigation. The 164 selected documents were analyzed with several statistical tools and software, which included Microsoft Excel 2016 and Bibliometrix R-package Biblioshiny (version 4.1.3) to clean, analyze, extracting, mapping, and visualization of data. The open-source tools used were also widely accepted for academic purposes. They are widely used and allow for a detailed and accessible analysis of the data, yielding clear and interpretable results.

Objective

This research aims to conduct an all-inclusive scientometric and bibliometric analysis of SDG-related publications conducted at the IIT Bhilai between 2017 and 2024. It will review and analyze the output volume, citation impact, collaborative patterns, and thematic focus with the institute's efforts in SDG-related research. Further observations include

1. To check the trend in growth pattern, evaluate annual growth rates and trends in citation numbers of IIT Bhilai, with regard to SDG-related research output.
2. Determine leading authors, affiliated organizations, and countries responsible for SDG-related work, using IIT Bhilai as an exemplar leading institution in SDG.
3. Check trends in international collaborations and involvement of the research initiatives.
4. Thematic direction for the publications related to SDG and the principal domains of research and identification of key gaps that may be explored in this context
5. Views on IIT Bhilai research in the context of global agenda under SDG, useful for strategic planning, policy development and future research directions.

This research will help to understand the role of academic institutions, in particular IIT Bhilai, in research and innovation that could address the challenges of global sustainability, underlining its impact and further scope for contributing to the achievement of the SDGs.

Analysis

Main Information about Data	TP	SDGP
Timespan	2017:2024	
Sources (Journals, Books, etc)	329	164

Main Information

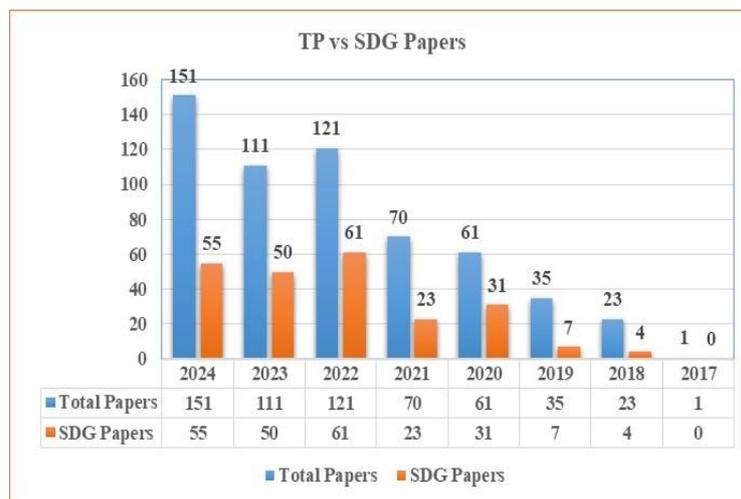
The table 1 and graph 1 represents the comparison of TP and SDGP (Sustainable Development Goals Publication) reveals quite a few positive elements of SDGP that underlines its distinct input to the study arena. However, SDGP has a comparatively smaller dataset size of 231 documents by 164 sources, which nevertheless shows an impressive yearly growth rate of 54.78% and therefore establishes a healthy trend of interest in its theme of research. Notably, SDGP shows a higher average citation per document (10.24) compared to TP, which is at 9.927, thus showing that research outputs of the former are relevant and highly acclaimed within the scientific community. The average age of the documents of SDGP is 2.84 years, which describes a modern body of work timely to discuss issues and trends relevant to the contemporary era. The project also shows a collaborative spirit with 35.06% of its authors being international co-authors, thereby providing a richly diverse and inclusive research environment. Besides, the fact that SDGP has articles and reviews makes it contribute to knowledge and innovation diversely. SDGP is an exciting and influential research initiative in that it caters to its audience's academic needs.

Main Information about Data	TP	SDGP
Documents	573	231
Annual Growth Rate %	104.78	54.78

Main Information about Data	TP	SDGP
Document Average Age	2.97	2.84
Average citations per doc	9.927	10.24
References	0	0
Document Contents		
Keywords Plus (ID)	1790	861
Author's Keywords (DE)	2087	951
Authors		
Authors	1290	546
Authors of single-authored docs	15	7
Authors Collaboration		

Main Information about Data	TP	SDGP
Single-authored docs	23	10
Co-Authors per Doc	4.52	4.3
International co-authorships %	34.03	35.06
Document Types		
Article	533	217
Proceedings Paper	1	1
Book Review	1	0
Correction	2	2
Editorial Material	1	0
Meeting Abstract	7	0
Retraction	1	1
Review	27	10

Table 1: Main Information about Data



Graph 1: Total Papers Vs SDG Papers

Average Citations Per Year

The table 2 breaks down the evolution in the citation impact of documents over the years: TP and SDGP from 2017 to 2024. This section shows mean citations per article per year and thus carries trends for academic recognition as well as the

influence of the published work. For TP, the average citations per article took off at 7.00 in 2017 and peaked at 33.70 in 2018, after which it varied until it plunged to 1.23 in 2024. For SDGP, this pattern is more haphazard with no citations in 2017, a jump

of 64.00 in 2018, and then steadily went down to 1.22 in 2024. This means that although citation for both projects grew initially, for TP, the citation impact has decreased due to time elapsed. SDGP trend is more inconsistent, which implies changing interest and recognition of these

projects among the faculty over the years. In general, this section indicates changes in the citation dynamics of how trends are unfolding, which is crucial for assessing the relevance and impact of research outputs over time.

	Year	2017	2018	2019	2020	2021	2022	2023	2024
Mean TC per Art	TP	7.00	33.70	21.31	15.59	21.67	8.62	4.17	1.23
	SDGP	0	64.00	46.71	16.90	14.04	10.66	4.36	1.22
N	TP	1	23	35	61	70	121	111	151
	SDGP	0	4	7	31	23	61	50	55
Mean TC per Year	TP	0.78	4.21	3.04	2.60	4.33	2.15	1.39	0.62
	SDGP	0	8.00	6.67	2.82	2.81	2.66	1.45	0.61
Ci table Years	TP	9	8	7	6	5	4	3	2
	SDGP	0	8	7	6	5	4	3	2

Table 2: Average Citations Per Year

Most Relevant Authors

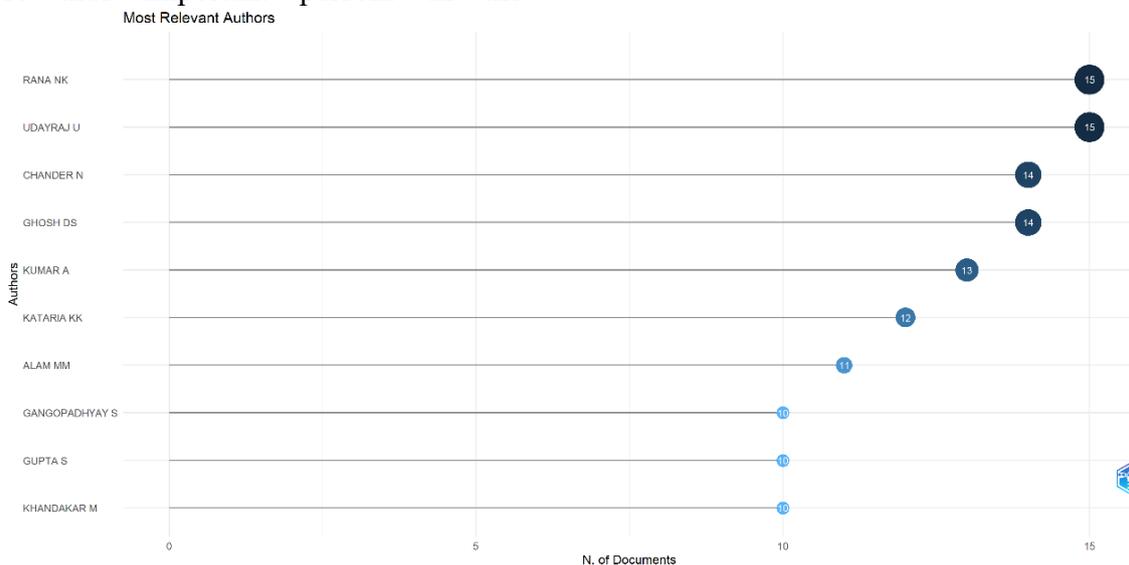
The graph 2 lists leading figures in the research community based on their contribution, through either the number of articles published and their citation impact. The highest authors Rana NK, and Udayraj U is 15 and the higher article fraction of 4.85 by Udayraj U showed more influence about the field is that their output is not just prolific but most cited. Chander N and Ghosh DS with 14 articles each provide a

far better representation of the engagement of research with depth, whereas Kumar A and Kataria KK with 13 and 12 articles respectively have contributed significantly

to the knowledge base. The citation metrics of these authors critically render the measure of relevance and impact of their research, often in relation to the novelty and applicability of their findings. This section underscores the collaborative nature of

research, in which several authors are involved in the progress of knowledge in a multi-disciplinary way. This section's precedence would indicate that these authors were crucial to the definition of trends in research and complex issues and were thus important persons in the

landscape of academia. The insights from recognizing this contribution include knowing how research productivity dynamics are going and how efforts to collaborate could be driving innovation and discovery in the respective domains.

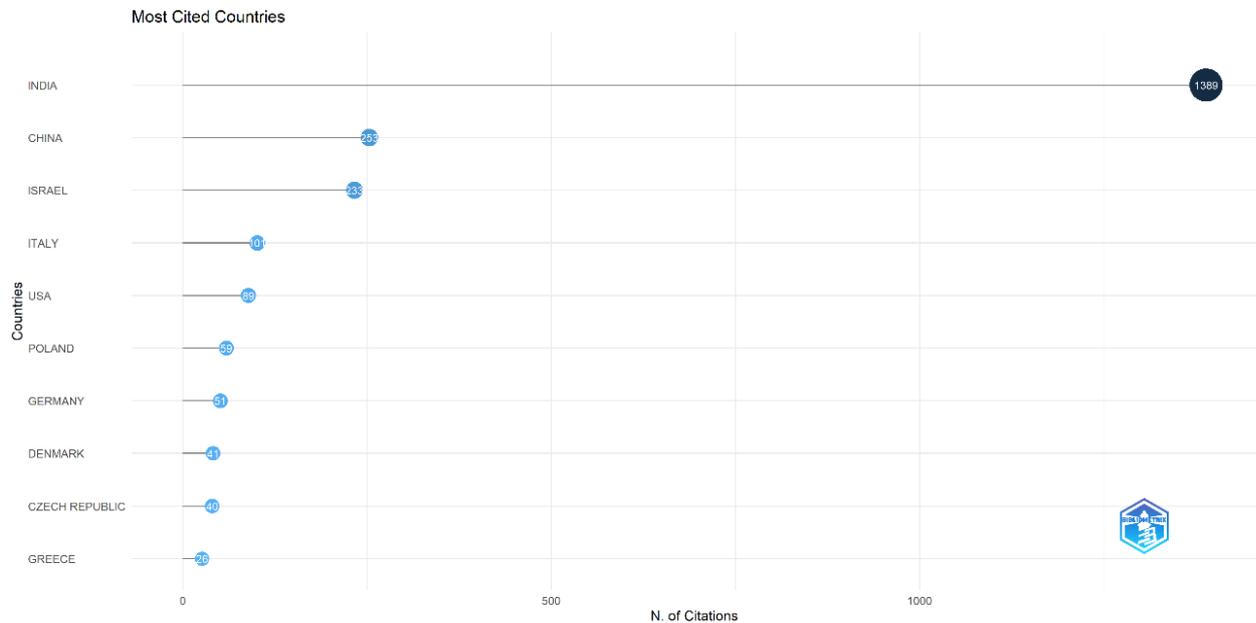


Graph 2:

Most Relevant Affiliations

The Figure 3 shows IIT Bhilai as the one with the most significant contribution in research output with 329 articles, a number significantly more than all of the other affiliations listed here. It stands IIT Bhilai at the apex of academic pursuit and innovation through its healthy environment for research, and dedication toward building knowledge from disciplines. In comparison, Indian Institute of Technology has 63 articles, whereas Prabhat Kumar College, Technical University of Denmark,

and Utkal University each have 13 articles, so this has fewer outputs. This gap points out that IIT Bhilai is the leader in the academic atmosphere, which reflects the attraction of faculty toward high research talent and resources, thereby promoting an environment favorable to quality and quantity growth in research work. This lead in article production puts IIT Bhilai not only on top in terms of the research output but also gives it a glimpse at influence at the policy and practice level within the larger scientific community at large.



Graph 3: Most Cited Countries

Countries' Collaboration of country

The figure 4 presents a detailed mesh of international research collaboration, as illustrated by the high number of collaborative research between various countries. For example, India stands out with the number of collaborations: with China, 13; Germany, 10; and the USA, 21; showing an overwhelming inclination toward collaborative research based on the availability of diverse expertise and resources. It clearly shows the world's perspective and how different nations like China, Germany are collaborative with a wide number of nations, that proves scientific study as a worldwide discipline and it calls for more collaboration across

international boundaries to find the solutions of more complex issues. The high intensity of collaboration as seen with the cases between India and Italy, France, Saudi Arabia also highlights the strategic nature of research output and innovation. This collaborative landscape fosters knowledge exchange and strengthens the global research community, allowing the sharing of ideas and methodologies that can lead to significant advancements in various fields. In general, this section emphasizes the critical role of international collaboration in driving scientific progress and enhancing the impact of research on a global scale.

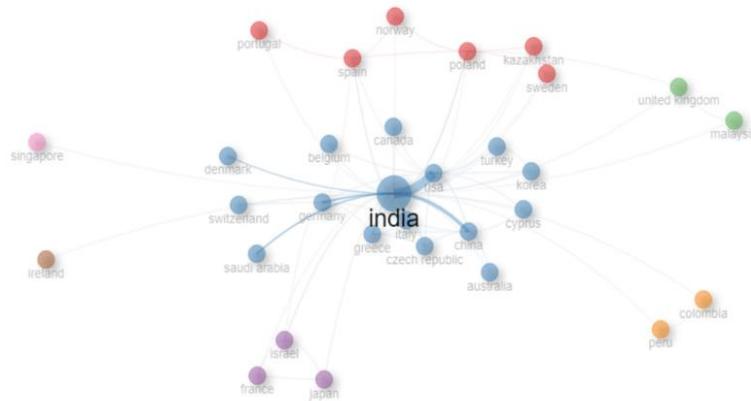


Figure 4: Countries' Collaboration of country

Three Plot diagram

The figure 5 graphifies the relations among authors, affiliations, and represented countries. On the first plot, individual authors, along with the affiliations, stand out as contributing leaders: there are Rana NK and Udayraj U at the Indian Institute of Technology Bhilai, for example. In the second plot, one is allowed to be plotted against his or her own country; here, for instance, an overwhelming dominance in

the number of Indian researchers within a global landscape is vividly displayed. The last plot gives the output of different institutions in a particular country but focusing on the important contributions of IIT Bhilai among others. Together, these plots give a holistic view of the collaborative dynamics in research, showing how authors and institutions from different countries engage in scientific inquiry and innovation.

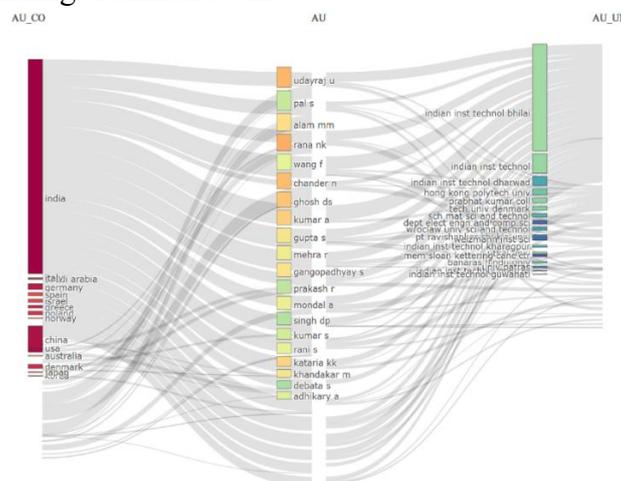


Figure 5: Three Plot diagram

knowledge exchange across borders. Moreover, the thematic focus of the research at IIT Bhilai reflects a diversified and interdisciplinary approach, covering a wide range of SDGs, though some areas call for further exploration. Trends of citations and key authors and affiliations reveal that IIT Bhilai has a high academic presence, which can significantly influence national as well as global SDG agendas. The institute's research output places it among the most significant entities in shaping the future of sustainable development through innovation, knowledge creation, and collaborative efforts. Lastly, the contributions of IIT Bhilai, in the context of this SDG, advance academic outcomes and are part of the larger march toward alignment with global sustainability goals. Findings here will help inform research strategy in the years ahead, provide still greater collaboration that can facilitate further policy development, and make IIT Bhilai a leader in facing the big sustainability challenges it addresses for the world.

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