

ONE PLANET, ONE NATION: AN ANALYSIS OF THE ACTIONS TAKEN IN RESPONSE TO THE 17 SUSTAINABLE DEVELOPMENT GOALS IN THE 2030 AGENDA OF THE UNITED NATIONS

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ABSTRACT

Upon establishing 17 Sustainable Development Goals (SDGs) in 2015, the United Nations invited countries across the globe to take active roles in addressing challenges faced by our planet. This international calling required actions at individual and collective levels to meet Agenda 2030. Six years later, we intend to take a close look at actions taken by stakeholders, decision-makers, and academics to this call. We analyze the database of published scholarly articles to identify: (1) What is the status of research progress in addressing these SDGs over the course of the past 6 years?; (2) Which countries were actively involved and have pioneered in proposing solutions to the problems of our planet?; (3) What are the subject areas associated with these research projects?; and (4) What is the share of women in addressing these challenges and proposing solutions as opposed to men? The findings of this research suggest SDGs 5, 13, 4, 15, and 2 as the most researched goals, respectively, while SDGs 17 and 16 received the least attention from the research community. Overall, the number of evidenced documents has systematically increased over years since the establishment of the SDGs. This increasing trend has seen a boost in 2019 which has rapidly grown in the window of 2019 to 2020. Female researchers have had a 60% share in research addressing SDGs 5 and 11 as their highest contributions. The second highest involvements of female researchers were in SDGs 8 and 16 with 50% share in the investigation. Male researchers, on the other hand, were fully devoted to addressing SDG 7 (100% involvement) followed by SDGs 13 and 15 (85%), and SDG 10 (75%). Overall, our study aims to shed light on the degree of responsibility we commit to for correcting past mistakes and creating a more sustainable world for inhabitants.

Keywords: Sustainable Development Goals, SDG progress, United Nations, gender inequality, climate change, poverty, data gap.

1 INTRODUCTION

One of the main challenges the humanity faces is to ensure same opportunities for wellbeing, growth and development are provided for all the 7.9 billion inhabitants of this planet. In the year 2000, the United Nations (UN) marked a historic event with the implementation of the Millennium Development Goals (MDGs), a set of global development targets [1]. Ranging from reducing extreme poverty to preventing the widespread of human immunodeficiency virus (HIV) and providing universal primary education, the eight MDGs provided an effective means for global deployment of multitude of strategies to achieve important social priorities throughout the next fifteen years [2]. Indeed, the MDGs played a vital role in securing progress and development in least privileged zones of the planet and met significant milestones. However, after a robust process of community consultation involving governments, civil societies, businesses, knowledge-based institutions, and citizens, it was globally agreed that the goals to fight against poverty, gender inequality and climate change should continue beyond 2015 [3].

In September 2015, the UN assumed the 2030 Agenda for Sustainable Development Goals (SDGs) in response to the previous highlights and the urgent needs of humanity and our



planet by developing a new set of global missions [4]. Signed by all 193 Member States, this agenda proposed 17 goals with 169 specific actions in the economic, social, and environmental spheres which were meant to fundamentally transform and ensure the future for the current and coming generations. The 17 SDGs represented ambitious objectives which required major change in the development of nations, especially those with rather limited resources [4]. These 17 goals designed by the UN to create a sustained transformation were [4]: (1) No Poverty, (2) Zero Hunger, (3) Good Health and Well-being, (4) Quality Education, (5) Gender Equality, (6) Clean Water and Sanitation, (7) Affordable and Clean Energy, (8) Decent Work and Economic Growth, (9) Industry, Innovation and Infrastructure, (10) Reduced Inequalities, (11) Sustainable Cities and Communities, (12) Responsible Consumption and Production, (13) Climate Action, (14) Life Below Water, (15) Life On Land, (16) Peace, Justice, and Strong Institutions, and (17) Partnerships for the Goals.

Six years after the announcement and implementation of this global action plan, we dedicate our effort to measure the current contributions to the SDG indicators and assess the framework of progress made in each SDGs. While few other studies have attempted to highlight such global achievements [5], [6], the SDGs indicators are neither easy to measure nor straightforward to interpret. As stated by Haishan Fu, the Head of the World Bank's Development Economics Data Group, "Implementing the SDGs and measuring and monitoring progress towards them will require much more data than are currently available, with more accuracy, better timeliness, greater disaggregation, and higher frequency" [7], [8]. Previous studies emphasized on the importance of equally addressing all 17 SDGs while maintaining uniformity within their progress to target differences and inequalities [9]–[11]. Evenness among the development of SDGs is one of the most significant factors that directly affects the achievement of the goals in their entirety hence highlighting the essentiality of studying the gaps in the SDGs accomplishments. The involvement of academia in this subject plays a key role since the number of published scientific research articles serve as a powerful indicator for the assessing progress of the SDGs [12]–[14]. In this article, we rely on the scholarly output to measure the progress made in each SDG, the actively involved countries in addressing these goals, the undertaken subject areas, and the gender of the researchers who are working towards closing these global gaps.

2 BACKGROUND

2.1 Recent progress towards addressing the SDGs

The United Nations with 193 Member States, 17 designed SDGs, and 169 target actions working towards the agenda 2030 is a complex system that involves multiple layers of stakeholders and policy makers to act upon required calls. Although the UN has provided the world with several measurement tools including Global Change Data Lab tracker which can serve as indicators assessors for measuring progress in meeting the targets, this is still an incredibly complex task to accomplish. In 2016, the UN Statistics Division together with the Organization for Economic Co-operation and Development (OECD), operated a global SDG indicator database relying on data compiled through the UN system. The study involved 35 of the member countries and their respective stand on reaching the SDGs milestones. The data obtained from this project has shown a 70% improvement in SDG 3 (Good Health and Well-being) as well as in SDG 6 (Clean Water and Sanitation) and a 50% improvement in SDG 1 (No Poverty), SDG 2 (Zero Hunger), SDG7 (Affordable and Clean Energy), SDG 11 (Sustainable Cities and Communities) and SDG 14 (Life Below Water) [7]. While these



measurements are, to a certain extent, indicative and promising, a significantly in-depth analyses of the milestones are required to understand the actual status of the progress.

2.2 Main partnerships in working towards the SDGs

Although practically all members of the UN have signed the SDG agreement, advances in these goals were not the same for every country. For instance, with respect to SDG2, Zero Hunger, Myanmar, Uzbekistan and Haiti have diminished the extreme poverty from more than 50% of their population prior to 2019 while Angola, Sierra Leone and Ethiopia have successfully tackled undernourishment with 48%, 24% and 23.9%, respectively. In addressing SDG10, Reduced Inequalities, countries such as Peru, Estonia and Chile have marked a milestone in reduced discriminatory practices. While these advances may be influenced by several factors including infrastructure, economic growth, geopolitical setup, and internal politics, the effective action towards addressing SDGs is possible within legal framework, right investment, and collaboration within society and with other countries. The European Climate Law, for example, aims to diminish Europe's carbon emission by 57% by 2030 and The African Union Great Green Wall project aims at stopping the desertification in the Sahel region by planting 8,000 km of trees providing food security and jobs. When it comes to global warming, on the other hand, as stated by Welsby et al. [15], 60% of oil must remain unextracted by 2050 if we expect to maintain the 1.5°C temperature increase. Although the taken actions are remarkable, it is evident that a continuous effort from all nations and in specific most developed ones is required to prevent a global collapse.

2.3 Associated subject areas

Academia plays a significant rule in addressing the global concerns we face collectively. A vast portion of the attempts at addressing these challenges are the translation of what began within the laboratories of the academic institutions. The alliance between policy makers and researchers would lead to more effective outcomes and refined actions. For the countries that work towards achieving the SDGs, the subject areas can be great indicators on what researchers are focusing on. The analysis of trends in current research focused on the SDGs helps identify the strides taken in the past five years towards addressing these challenges. The trends themselves are indicative of allocation of resources, and the changes over time in trends, whether enhancement of the initial conditions or a divergence from them, indicate the level of importance that academia has given to these subjects. While reports of the literature highlight SDGs' milestone in the context of economic factors and health system implications [16], [17], no comprehensive study has so far investigated the SDGs accomplishment in the light of the subject areas in SDG related research.

2.4 Gender and the SDGs

According to reports of the UN and UN Women, the SDGs, in comparison to the MDGs, introduced an entire goal that is solely dedicated (SDG 5) to gender and addressing gender inequalities. This goal expands its roots to other SDGs as well hence presenting a much wider research scope and ambitiously encouraging all countries to empower women and girls [18]. The UN frequently emphasizes on the fact that women are more affected by violence, climate change, and lack of health care, while they greatly contribute to solving these problems alongside men. Only through guaranteeing the rights of women and girls across all SDGs could we achieve justice and inclusion, functional economies for all, and the preservation of our common environment for current and future generations [19].



Nevertheless, progress related to SDG 5 and the inclusion of women in this area has been recently criticized [20]–[23], since gender equality has not seen a considerable progress in most countries. The scepticisms also stem from the agenda's lack of clear language, defined policies and available funding provisions to meet each country's necessities [22]. For instance, women continue to live more likely in poverty than men, and governments still show inability to address the deeply entrenched and interlocking factors that perpetuate women's disadvantage [20]. Perhaps, one of the world's biggest challenges is to develop and integrate a transformative approach where women are in the front line of its implementation.

Regardless of their highest academic credentials, women in academia are no exception when gender equality is concerned. Fewer women are appointed to senior positions at all academic levels and the pandemic effect has shown that women are expected to focus on family and house chores instead of succeeding in their academic missions [24]. It is also anticipated that their academic productivity will present a considerable decline in the face of this situation negatively influencing their contribution to SDGs research [25]. Interestingly, not many articles were found regarding analysis of female production of scientific research in SDGs.

3 METHODOLOGY

The data acquisition of this study consisted of collecting of the bibliographic information related to the 17 SDGs from 2016 to 2020 through the analysis of search results in Scopus database. Since the SDGs were created in 2015, the starting year for this study is the year 2016 and as the current study was conducted in 2021, the last year for complete query was considered to be 2020. The query code was developed in a highly inclusive manner to yield the highest number of results within the database while offering specificity:

```
TITLE-ABS-KEY ( ( ( sustainable AND development AND ( goal OR goals )
) OR sdg ) AND ( 1 OR one ) AND no AND poverty AND united AND nations
) OR { no poverty } AND ( LIMIT-TO ( PUBYEAR , 2020 ) OR LIMIT-TO
( PUBYEAR , 2019 ) OR LIMIT-TO ( PUBYEAR , 2018 ) OR LIMIT-TO (
PUBYEAR , 2017 ) OR LIMIT-TO ( PUBYEAR , 2016 ) ) )
```

This query's string parameters were iterated through for the 17 SDGs, and the results of this search were exported to CSV files. The obtained database was thoroughly scanned and filtered to remove the articles that were unavailable, unrelated, or narrowly related. As a result, a database including the total number of publications by year, the 20 highest contributing authors, the 10 highest contributing countries, and the number of documents by subject area for each SDG was created. The author's sex was recovered from each author's publicly available profile. The database was further analyzed in search of trends amongst the different parameters it contained to generate a descriptive set of inferences. Moreover, by extracting the report of Scopus for all SDGs, and using RStudio, we have generated a heatmap of the world that highlights the 20 highest contributing countries to addressing SDGs across the globe.

The Global Change Data Lab has created a tracker [26] to measure the progress towards the SDGs which presents data from Our World in Data database containing official statistics from the UN. To compare the advances of the SDGs per objective and the published literature, we used the SDG Tracker from Global Change Data Lab to evaluate three main groups of SDGs: A) No poverty (SDG 1), Zero Hunger (SDG 2), Responsible Consumption and Production (SDG 12); B) Clean Water and Sanitation (SDG 6), Affordable and Clean Energy (SDG 7), Climate Action (SDG 13); and C) Gender Equality (SDG 5), Reduced Inequalities (SDG 10), Peace, Justice and Strong Institutions (SDG 16).



4 RESULTS AND DISCUSSION

4.1 Overall achievements of the scientific community in addressing SDGs

When looking in to the overall achievements of countries in addressing SDGs, the heat-map of the world (Fig. 1) highlights the 20 highest contributing nations to research and publication as follows: the USA (8,003), the UK (4,916), Australia (2,402), Germany (2,202), Canada (1,860), Spain (1,648), Sweden (1,506), China (1,292), Italy (1,240), Netherlands (1,177), India (1,074), South Africa (1,006), Norway (771), France (747), Switzerland (680), Finland (620), Brazil (574), Japan (552), Denmark (506), and Austria (502).

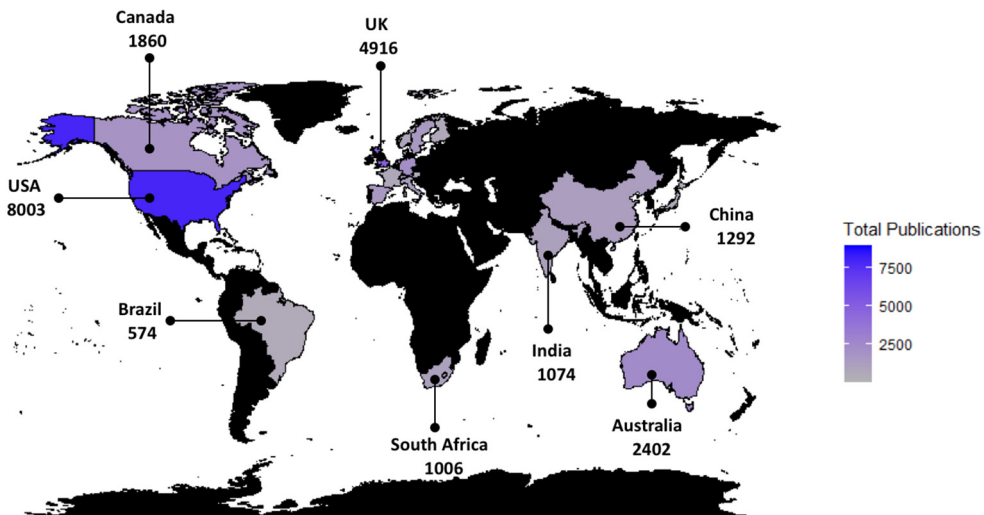


Figure 1: The heat-map of the world highlighting the highest contributing countries to research and publication on SDGs.

The total number of scholarly evidence on the progress of SDGs vary drastically from one goal to another. Despite the global criticism on the progress of SDG 5, the highest number of scholarly output (22,517) was observed for this goal followed by SDG 13 (6,115 articles) and SDG 4 (5,203 articles). This a clear proof for profundity of gender inequality across the world and the ample need for actions in this regard. The wide disparity in the total number of published scholarly articles for each SDG also speaks for perceived urgency and priorities the nations may give to addressing these challenges. For instance, despite the great importance of peace and justice and the essentiality of partnership is securing both, SDG 17 (Partnerships to achieve the Goal) and SDG 16 (Peace, Justice, and Strong Institutions) are the least explored areas of research by academia.

4.2 Gender distribution across SDG research

While academic women seem to have a powerful presence in addressing SDG 5 (60% share in the first-authorship), SDG 8 (60% share in the first-authorship), SDG 11 (50% share in the first-authorship), and SDG 16 (50% share in the first-authorship), the have zero first-author (perceived as active involvement in research) in SDG 7 with is concerned with Affordable

and Clean Energy and the participation is rather low (15%) in SDG 13 focused on Climate Action as well. While SDG 5 (Gender Equality) is the main area of interest for women in academia (60% participation), SDG 10 (Reduced Inequalities) has not received sufficient attention by female researcher (15% participation). The demographics for male researchers are drastically different. Men in academia are heavily involved (100% involvement) in SDG 7 (Affordable and Clean Energy) as opposed to 0% participation of their female counterparts in this SDG. Other major areas of interest for academic men are SDG 13 (Climate Action) and SDG 15 (Life on Land) with 85% research participation in each area followed by 75% active involvement in SDG 10 research (Reduced Inequalities).

4.3 Countries involvement in addressing individual SDGs

As shown in Table 1, the United States is the largest contributor to academic research and literature related to SDGs with a total of 9,129 publications pertaining to these areas within past 6 years [27]. The contribution is then followed by the United Kingdom with 5,471 publications and Australia with the scholarly output of 2,738. China has seemingly deviated its efforts to three main goals including SDG 7 (Affordable and Clean Energy) with 33% worldwide contribution; SDG 12 (Responsible Consumption and Production) with 20% worldwide contribution and SDG 9 (Industry, Innovation and Infrastructure) with 20% worldwide contribution. Even from a simple summary such as Table 1, it can be concluded that there is a significant gap between the contributing countries to these common goals hence the necessary means and resources and active involvement of other countries appears to be essential to closing this gap.

4.4 Most researched SDGs

Fig. 2 reports the progression of the top five SDGs through years 2016 and 2020. The graph clearly illustrates the predominance of SDG 5 (Gender Equality) in the number of scholarly publications compared to the remaining SDGs. While since 2016 the number of scholarly outputs in each SDG has seen a constant increase, from 2019 onwards there is a noticeable peak in the research performed on SDG 5, SDG 13 and SDG 4. Moreover, SDG 15 and SDG 2 have received a lower overall attention as the number of publications increased at a steadily lower rate compared to the other three SDGs.

4.5 Subject areas in SDGs investigations

Fig. 3 provides a detailed breakdown of the subject area for each of the five most investigated SDGs. As can be seen, the most predominant areas of interest for SDG 5 (Gender Equality) were Social Sciences, Environmental Sciences, and Agricultural and Biological Sciences. As expected, the impact of social scientists on the advancements of this specific topic, gender equality, far surpasses that of environmental and/or agricultural and biological researchers. Furthermore, SDG 13 (Climate Action) was mostly explored in the areas of Social Sciences, Environmental Sciences followed by Energy.

SDG 4, Quality Education heavily relies in Engineering, Computer Sciences and most definitely Social Sciences. Such knowledge areas greatly contribute to the development of new pedagogical tools and supports the teaching and learning processes over distance via E-learning or remote-learning. A great number of learning apps, games, interactive websites and platforms that facilitate learning in every corner of the world even within remote and rural areas not only contribute to SDG 5 but also to SDG 10 (Reduced Inequalities) which is



Table 1: Summary of total published documents, female and male authors, country contributions, and subject areas.

Sustainable Development Goal	Total published documents	Female authors' contribution	Male authors' contribution	Highest contributing countries	Shared contribution worldwide	Subject area
SDG 5: Gender Equality	22517	60%	40%	USA	24%	Social sciences
SDG 13: Climate Action	6115	15%	85%	USA	27%	Environmental science
SDG 4: Quality Education	5203	45%	55%	USA	19%	Social sciences
SDG 15: Life on Land	1059	15%	85%	USA	38%	Agricultural and biological sciences
SDG 2: Zero Hunger	626	30%	70%	USA	24%	Social sciences
SDG 11: Sustainable Cities and Communities	415	60%	40%	USA	17%	Environmental science
SDG 3: Good Health and Well-being	415	30%	70%	USA	26%	Medicine
SDG 7: Affordable and Clean Energy	402	0%	100%	China	33%	Environmental science
SDG 6: Clean Water and Sanitation	297	25%	75%	USA	28%	Environmental science
SDG 12: Responsible Consumption and Production	240	35%	65%	China	20%	Environmental science
SDG 1: No Poverty	209	30%	70%	USA	23%	Social sciences
SDG 14: Life Below Water	113	30%	70%	UK	32%	Environmental science
SDG 8: Decent Work and Economic Growth	107	50%	50%	UK	16%	Social sciences
SDG 10: Reduced Inequalities	62	25%	75%	USA	27%	Social sciences
SDG 9: Industry, Innovation and Infrastructure	44	40%	60%	China	20%	Environmental science
SDG 17: Partnerships to Achieve the Goal	15	40%	60%	USA	40%	Engineering
SDG 16: Peace, Justice, and Strong Institutions	6	50%	50%	USA	33%	Social sciences



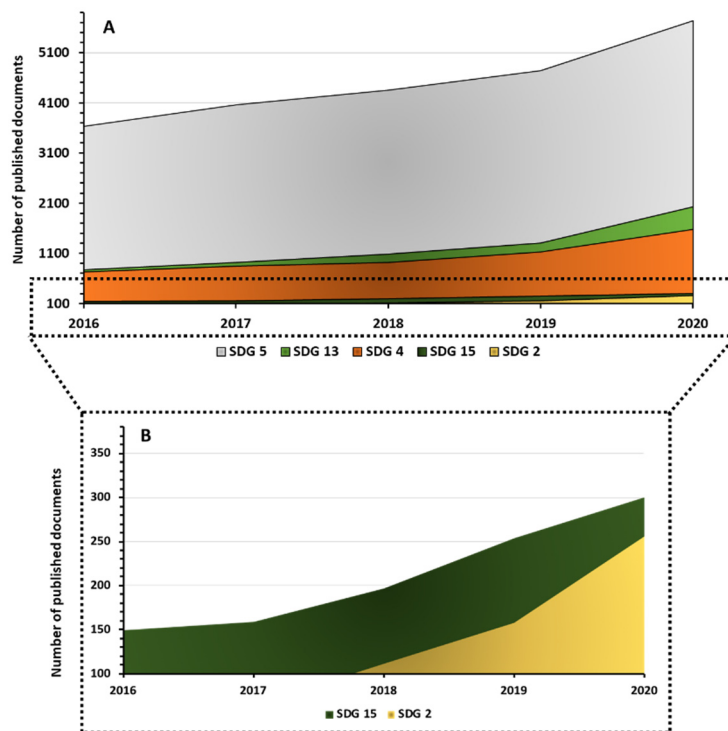


Figure 2: Annual scholarly output for the top five researched SDGs.

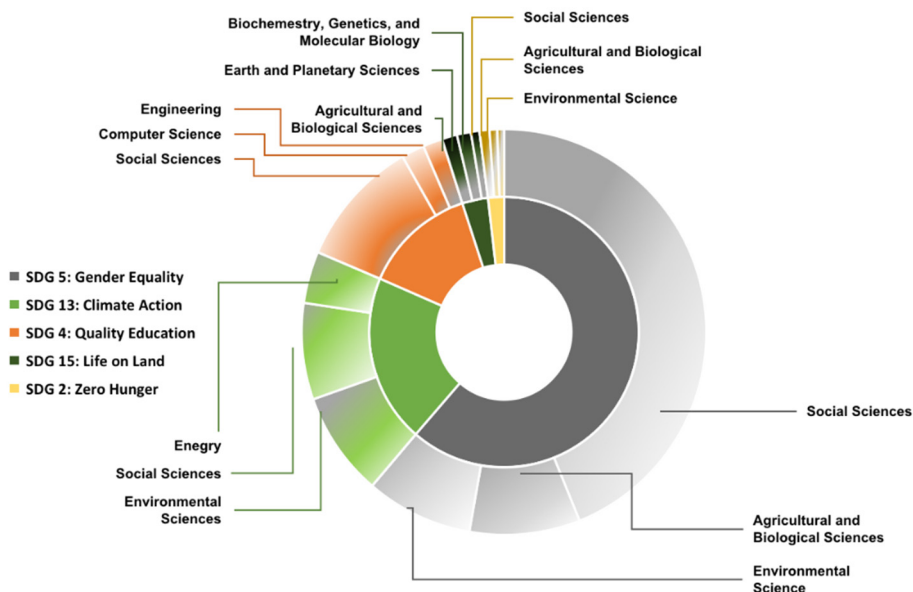


Figure 3: Top three areas of interest for the five most investigated SDGs.

rather left behind compared to the rest. Lastly, SDG 15 research has mostly taken place around the topics of Biochemistry, Genetics, and Molecular Biology, Earth, and Planetary Sciences, and Agricultural and Biological Sciences.

5 DISCUSSION AND FURTHER REMARKS

The even progress among the priorities of the 17 SDGs plays a vital role and the lack of parallel advancement is believed to result in inefficient implementation or failure to fulfil the high-reaching ambitions of the 2030 Agenda [28], [29]. The COVID-19 widespread and the consequences of a global pandemic has slowed down the research progress in all areas while in this sensitive period in the history of humanity it is crucial to remain highly attentive of certain concerns covered by SDGs. According to a report provided by the UN, during the years 2019 to 2020, the frequent lockdowns have significantly increased the risk of violence against women and girls highlighting a 30% higher rate of domestic violence in some countries. Within the education sector and with over 90% of the students out of their regular schooling system, the teaching and learning challenges are tremendous to face. Those within under-privileged setups bear a larger burden as their access to internet and smart devices through which sustained learning can be assured is conditional [30]. Students and professors in more privileged settings are not immune to depression, frustration, anxiety and stress as well [31]. In such ambient of fear and uncertainty, Reduced Inequalities and Quality Education became the major concern of the education crew across the world. Under the umbrella of SDG 4, specifically in the Free Primary and Secondary Education goal, Finland and the Netherlands have fulfilled a 100% of the task in the Minimum Proficiency Reading goal indicator whereas Hong Kong and South Korea have achieved the same result regarding the Minimum Math Proficiency level [32].

On the bright side, however, SDG 13 has had a positive outcome over the course of pandemic. While 2019 was reportedly the second warmest year in history, the COVID-19 pandemic resulted in a 6% drop in the greenhouse emissions in 2020 (an annual reduction of 7.6% is required to combat the global warming) [33]. This is while the scholarly output for each of the three main subject areas of SDG 13 (Climate Change) has not seen a considerable change from 2018 to 2020 (Fig. 2). In 2019 and at the age 16, Greta Thunberg became the face of Climate Change activism revolutionizing schools and empowering girls to act upon the problems global warming has imposed [34].

Another important consideration is the differences between the assessment matrices and the justice they may do to impact measurement. While scholarly output is an important matrix to evaluate the status of ongoing research on each SDG, the UN Tracker measures advances per SDG per country based upon individual tasks designed for each goal. For example, according to the SDG Tracker, China does not appear in the list of Green Climate Fund although it is one of the countries with the highest emission of CO₂. Yet, according to the UN's SDG Tracker, from 2016 to 2020 China and the Philippines were the countries with the most yearly displaced people due to natural disasters tracker [26], [35]. While certain countries are stretching their human and financial resources across all SDGs to contribute to a broader range of goals, others have seemingly doubled down their focus to tackling specific topics pertaining to their individual needs and context.

As mentioned before, Gender Equality has achieved great milestones due to the great contribution of female researchers and academic (60%) to SDG 5 working alongside their male counterparts (40%). Nonetheless, gender-based discriminations remain a global challenge across nations [36]. Women are underrepresented in full professor, editor, editor-in-chief, executive, leadership, and principal investigator positions across academic domain [37]. Great role models such as Esther Duflo, the second and youngest woman to receive a



Nobel Prize in Economics, or Katie Bouman, the scientist who made the first-ever image of a black hole possible set examples for what female can accomplish [38]. These record-breaking accomplishments scale a new branch of role-models for girls and women breaking through the barriers on the way to Gender Equality [39]. Nevertheless, despite the global efforts to meet SDG 5, currently no country has achieved Gender Equality. This inequality spans across various sub-topics such as age, socioeconomic background, and geo-demography of the females [40]. In that light, women's organizations have continuously raised crucial inquiries on how equality, inclusion, and participation will be anchored in a world built on inequities and exclusions [41].

According to the SDG Tracker, gender equality data varies among countries due to the legal frameworks or laws within each country, and timeframe and priorities defined in each. While Spain, Albania, Croatia, El Salvador, and Poland, among others have the right legal support to meet SDG 5, yet none of these countries accomplished the expected social equality for both sexes. Surprisingly, the overall Gender Equality Index for Albania reached 60.4 in 2017, indicating a substantial gender gap [42]. As the Indicator 5.1.1 states “whether or not legal frameworks are in place to promote, enforce and monitor equality and non-discrimination on the basis of sex”, the success can only be guaranteed when nations act as one for the flourishing of the one planet that host us all, the inhabitants.

6 CONCLUSION

In this article, we take a close look into the progress made in the 17 SDGs developed by the UN in 2015 to study the status of research progress in each SDG over the past 6 years. We also analyzed the involvement of countries in addressing these international challenges and analyzed the subject areas in which the research has mostly been conducted. We also asked the essential question of what is the share of women in these global missions and in proposing strategies to overcome the challenges we collectively face? Moreover, we critically reviewed the accomplishment of these mutual tasks across nations and analyzed these milestones in the context of the matrices the UN SDG Tracker considered essential. This article provides an overview of SDG progress across academia. Our findings demonstrate that Gender Equality (SDG 5), Climate Change (SDG 13), and Quality Education (SDG 2) have received the highest attention from the research community. Since the establishment of the SDGs, the documented research on all areas has increased over years with a noticeable boost in the number of articles in 2019 and 2020. Female researchers have highly contributed (60%) to addressing Gender Equality while male researchers dedicated their highest efforts (100%) to providing Affordable and Clean Energy. Nevertheless, in a general overview, the involvement of female researchers in addressing SDGs is considerably lower than their male counterparts. It is highly important to note that an even advancement of all 17 SDGs is a key player in securing the 2030 Agenda and creating a sustainable planet for all inhabitants.

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