Science-Policy Brief for the UN Multistakeholder Forum on Science, Technology and Innovation for the SDGs, 7 May 2025

How a Changing Geography of Research can accelerate the Advancement of the U.N. SDGs in Low- and Middle Income Countries

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Abstract

In 2024, 60% of the scientific articles published in the World had authors in Low- and Middle-Income Countries (LMIC). This is in striking difference to the situation thirty years ago, when 87% of the scientific publications had authors in High Income Countries (HIC). The number of scientific articles published each year has been growing at a rate of 5% per year, driven, in good part, by the increase in the number of authors working in LMIC. Essential to this Policy Brief, this growth happens because many, if not most, of the LMIC have been busy building scientific and technological capacity. In the last 50 years China, India, Brazil, Russia, Indonesia, Turkey, Pakistan, Iran, and many other countries, created universities, research institutions, research funding organizations, industry R&D, research infrastructures, creating their own path and, in many instances, learning from the experience of countries that have a longer experience in scientific activities.

As a result, the number of authors of scientific publications affiliated to organizations in LMIC is now well above the number of authors in HIC. More than that, the growth rate in the number of authors in LMIC is now at +10% per year, while in HIC it is +5% per year, so that the difference tends to increase in time. The Brief discusses how the growth in the contribution of LMIC countries to research results related to the U.N. SDGs changes the research landscape in the World and requires new approaches to research collaboration for the advancement of the SDGs. Of special interest is the need for LMIC countries to further develop well-structured research funding organizations that are essential to potentialize the results already achieved via capacity building.

1) Introduction

Mobilizing science, technology, and innovation (STI) to improve the lives of those furthest behind and reduce inequalities, while avoiding the perpetuation of the digital divide, requires inclusive access to knowledge. This implies that it is essential to foster not only the capacity of peoples to access knowledge, but also their capacity to contribute to the knowledge pool that humankind has been expanding. Access to knowledge is relevant but only when nations contribute to the pool of knowledge they acquire agency over their strategies and achievements to overcome specific challenges. SDG 17[i] states that "17.6 Enhance North-South, South-South and triangular regional and international cooperation on and access to science, technology and innovation and enhance knowledge sharing on mutually agreed terms, including through improved coordination among existing mechanisms, in particular at the United Nations level, and through a global technology facilitation mechanism". Capacity-building is an important part of SDG 17, as stated by "17.9 Enhance international support for implementing effective and targeted capacity-building in developing countries to support national plans to implement all the Sustainable Development Goals, including through North-South, South-South and triangular cooperation". Chapter 3 of the "Global Sustainable Development Report 2016", highlights that "Scientists see technology as a major factor in achieving the SDGs. It can help build synergies among the goals, realize multiple benefits, and avoid barriers and conflicts on the path to sustainable development". The chapter outlines several promising actions and policy elements for leveraging technology effectively. These include strengthening national systems of innovation, improving technology performance, and increasing investments in research and development.

Eight years after the historic resolution that established the Sustainable Development Goals, it is useful – some might say imperative – to take stock and update our understanding of the landscape for science and technology in the World. This Policy Brief contributes to that, by analyzing bibliometric data in Scopus[ii], a curated bibliography database that covers 25,000 scientific journals and has more than 97 million articles, the oldest ones dating from 1788. The broad international coverage allows for a birds-eye vision of the evolution of several regions in the World, in terms of their contribution to science and technology. All data presented here considers publications of the type "Article", to make sure we are using peer-reviewed contributions.

2) Evolution of the research system in the World as seen via scientific publications

To assess the capacity of global regions to contribute to knowledge creation, we aim at measuring how many researchers are involved in the production of scientific knowledge across the World. The starting point is to count the number of scientific publications, and from the information in each publication determine the number of authors active by country category. The country groups follow the 2024 World Bank categorization of High-Income Countries (HIC) and Low- and Middle- Income Countries (LMIC), where HIC encompasses countries that, in 2022, had a Gross National Income per capita above USD 13,845, while LMIC had a GNI per capita below the same threshold.

Figure 1 shows the number of research articles published yearly that have authors in High-Income Countries (HIC) and authors in Low- and Middle-Income Countries (LMIC). The two sets of articles are not mutually exclusive, as there are many articles (approx. 14%) with authors in both categories of countries.

It is striking in Figure 1 how the distribution among categories of countries has changed. In 1970, 94% of the research articles had authors in HIC and 7% in LMIC. In 2024 the percentages changed to 54% (HIC) and 60% (LMIC).

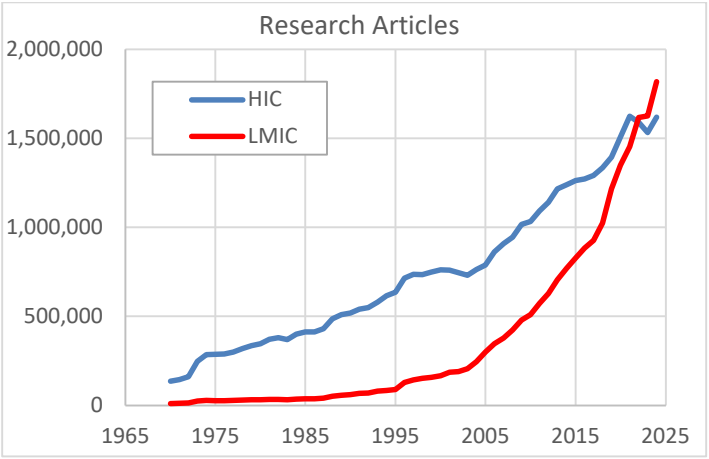

Figure 1, Number of scientific articles published yearly with authors in High-Income Countries (HIC) and authors in Low- and Middle- Income Countries (LMIC). (Source: Elsevier SCOPUS).

A similar evolution is found for the distribution of authors (Figure 2), as defined by the affiliation addresses informed in each one of the articles. In 2024, there were 7,524,840 authors of research articles in the World. Of these, 3,458,228 (46%) worked in research entities in HIC and 4,184,095 (56%) worked in research entities in LMIC. This data leads us to consider that one of the main drivers in the increase of the number of research articles published in the World is the growth in the number of researchers active in LMIC countries, as a result of capacity building efforts enacted for many years.

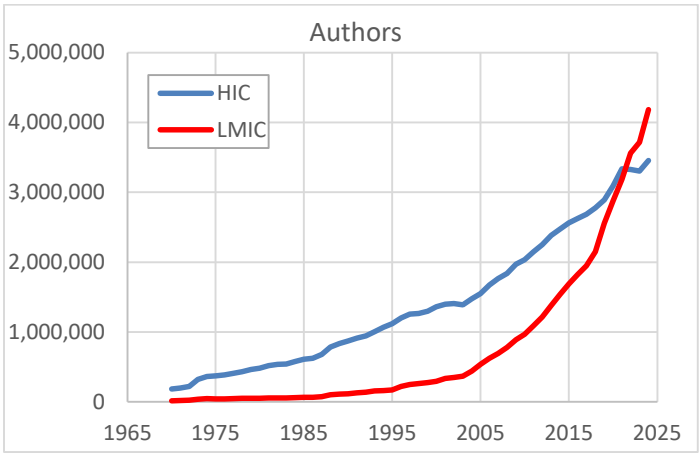

Figure 2. Number of authors of scientific articles published yearly, according to the country where the affiliation institution informed by the authors in each publication is localized. (Source: Elsevier SCOPUS).

Figure 3 shows how the percentages evolved over the years. The present trend points to a future increase in the difference between the two country-groups. In fact, analysis of the last 30 years of the data shown in Figure 2 shows that, for LMIC the number of authors is growing at a rate of +11% per year, while for HIC the growth rate is +4% per year. For the case of the LMIC, even excluding China from the set (because it is the largest one and might skew the trend), still the growth rate remains strong at +10% per year.

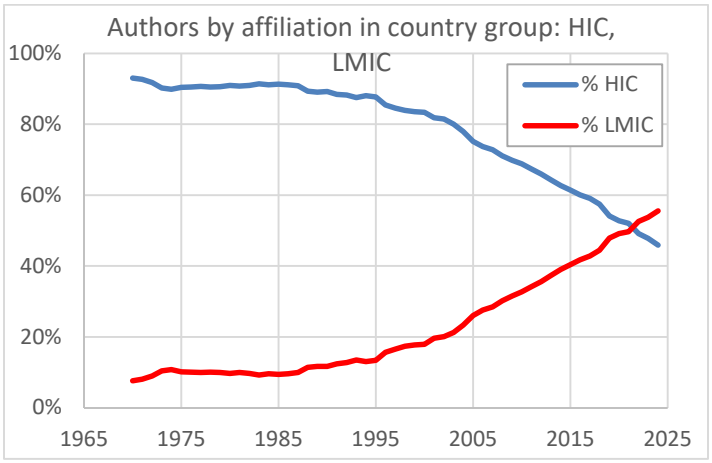

Figure 3. Distribution of authors of research articles among HIC and LMIC countries. (Source: Elsevier SCOPUS).

Though the volume of publications with authors in LMICs grew, some challenges remain

Table 1 shows some of the bibliometric indicators for the scholarly output in the two country-groups (HIC and LMIC) and in the World, for the period 2021-2024. While the trend, as shown above, shows convergence for the number of articles and for the number of authors, some metrics show that there is progress still to be achieved for the research output with authors in LMIC.

Table 1. Some bibliometric characteristics of the articles published with authors in each country-group (HIC, LMIC). (Source: Elsevier SCOPUS).

2021-2024	World	HIC	LMIC
Articles published (millions)	14.243	7.877	7.869
Number of Authors (millions)	18.918	8.404	10.474
% Intern. co-authorship	22.7	37.4	25.2
FWCI	1.00	1.15	0.98
Articles in Top 10% by citations	10.2	11.2	11.3
Articles in Top 10% Journals	25.7	30.9	23.0
Acad.-Corp. co-authors.	2.6%	3.6%	1.9%

One challenge is international collaboration, as indicated by the co-authorship in publications. A second one is the value for the Field Weighted Citation Impact (FWCI). Interestingly, the percentage of each country-group articles that is among the 10% most cited is very similar, though articles with authors in LMIC do not appear as frequently as those with authors in HIC in the 10% most cited journals. Finally, a very important gap exists in the share of publications that have co-authors in academia and in the business sector.

The evolution in the number of authors in LMIC countries

Figure 4 shows how the growth in the number of authors affiliated to entities in LMIC countries has changed the research landscape since 1999, for the 25 countries that had the larger number of authors in 2024. In 1999 there were 6 LMIC countries among the 25 countries with more authors, while, in 2024, there were 11. As is well known, China had large growth rates and overcame the United States in number of authors in 2015. Less known is the fact that the, in 2024, the 28 larger LMIC countries except China had more authors than the 27 European Union countries plus the UK.

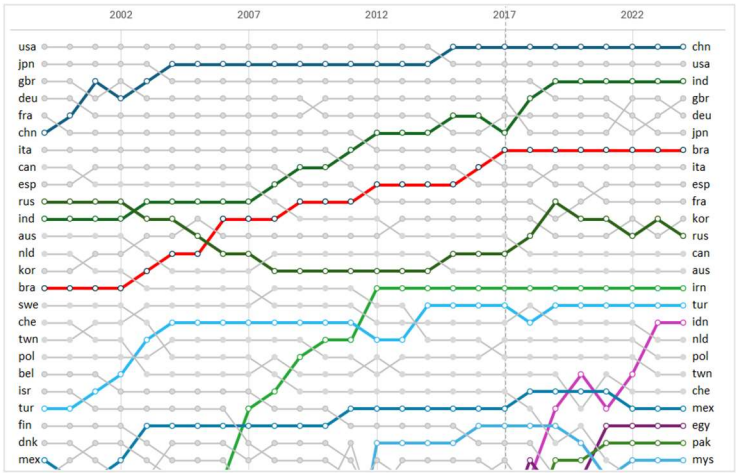

Figure 4. Changes in the ranking by number of authors for the 25 countries with more authors, from 1999 to 2024. (Source: Elsevier Scopus).

3) Publications targeting SDGs

Figure 5 shows the number of research publications of type "article" publisher yearly on themes that target any SDG, from 2000 to 2024, with authors in High-Income Countries, Low- and Middle- Income Countries, and the World total.

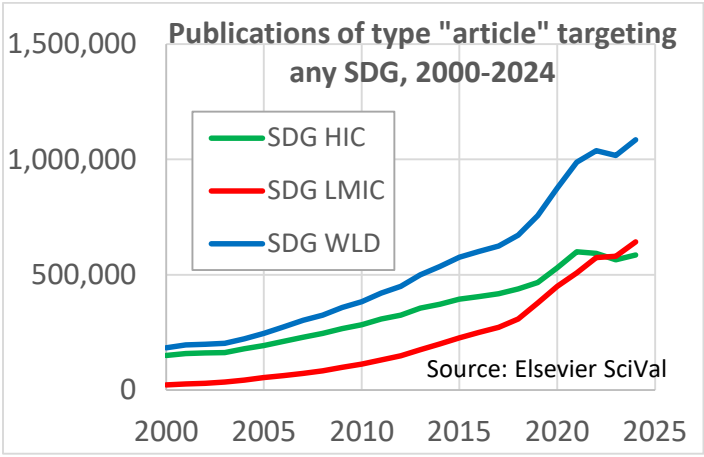

Figure 5. Number of publications of type "article" published yearly on themes targeting any SDG, from 2000 to 2024, with authors in High-Income Countries and Low- and Middle- Income Countries, and the total for the World.. (Source: Elsevier SciVal).

For the three curves the growth is strong, especially after 2018. The curve for the case of authors in HIC levels-off after 2021, while the curve for authors in LMIC shows a small decrease in growth speed in 2023 and then picks-up again. The growth rates (expressed in % per year) between the approval of the SDGs at the U.N.,

in 2015, and 2024 is show in Table 2. For the World and for the two country groups studied here the average growth rate in the number of articles was higher for articles targeting SDGs than for articles in any topic. Additionally, the average growth rate for the LMIC group was larger than that for the HIC group for both thematic selections, reaching 12.7% per year for articles related to SDGs.

Table 2. Average yearly growth rates for the number of articles in each country group (World, HIC, LMIC) between 2015 and 2024, for articles on any topic and articles targeting SDG themes. (Source: Elsevier SciVal).

Country Group	Articles in any topic	Articles on SDG themes
World	5.6%	8.1%
HIC	3.2%	5.4%
LMIC	9.3%	12.7%

The growing relevance of Low- and Middle- Income Countries in research publications targeting SDGs

Figure 6 shows how the share of publications with authors in LMIC and in HIC and targeting themes related to any of the SDGs evolved since 2000. The change in the World landscape for research related to the SDGs is remarkable – in 2024 59% of the research publications related to any SDG had authors in LMIC, and 54% had authors in HIC (the sum differs from 100% because there are publications with authors in both groups).

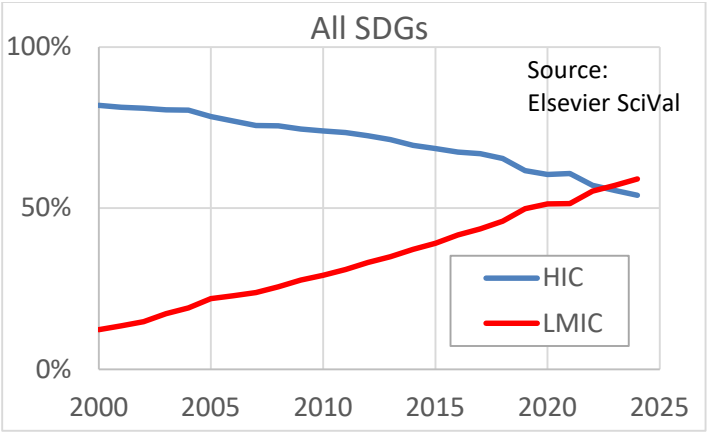

Figure 6. Share of publications targeting themes related to any SDG and with authors in LMIC and in HIC. (Source: Elsevier SciVal).

The trend for all SDGs is similar to the one shown in Figure 6, with two variations: (1) there is a variation of the crossing year for each SDG; and (2) for some SDGs the crossing point has not been reached, though the trend points to a future crossing, given that conditions remain the same (which might be a stretch in today's World). For illustration purposes, two cases are shown in Figure 7: for SDG 02 (No Hunger) the crossover point was reached around 2018, while for SDG 1 (No poverty) it has not yet been reached. When analysing the drivers of the number of research publications, it is important to bear in mind that many times relevant research results are published in local languages and the SCOPUS database covers better the sub-set of World publications that appear in English.

Figure 8 shows how the balance between HIC and LMIC changed between 2015 (blue bars) and 2024 (orange bars). In 2015 the share of publications related to each and all SDGs and to the case covering any SDG was higher when the article had authors in HIC than when the article had authors in LMIC. In 2024, for ten SDGs, and for the case of articles covering any SDG, the share of articles having authors in LMIC was higher than the share of articles having authors in HIC.

Table 3 shows the 30 countries that have more authors contributing to research related to any SDG in each country-group (LMICs are highlighted). In 1999, among 30 countries, only 7 were LMICs. In 2024, among 30 countries, the number of LMICs grew to 12. Table 3 shows also the total number of authors in the 30 countries listed for each year, which reached 3,412,914 in 2024. This number of authors represents 44% of the authors of all research articles in the World.

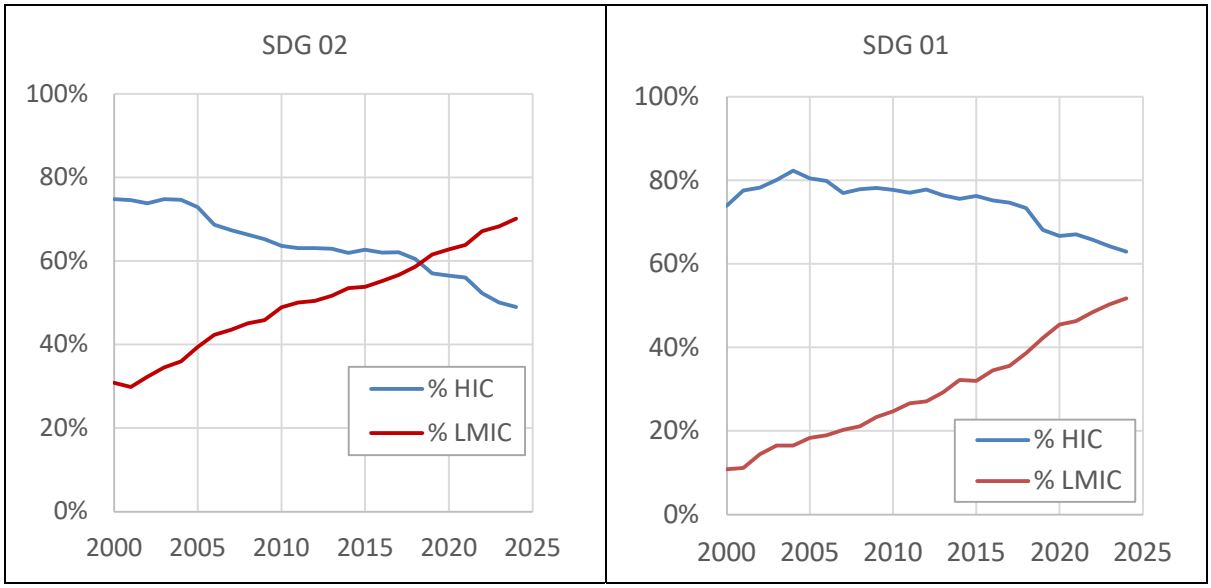

Figure 7. Converging trends in the share of research publications, showing a case (SDG 2) where the crossover point has been reached and another (SDG 01) where it has not been. (See text for discussion). (Source: Elsevier SciVal).

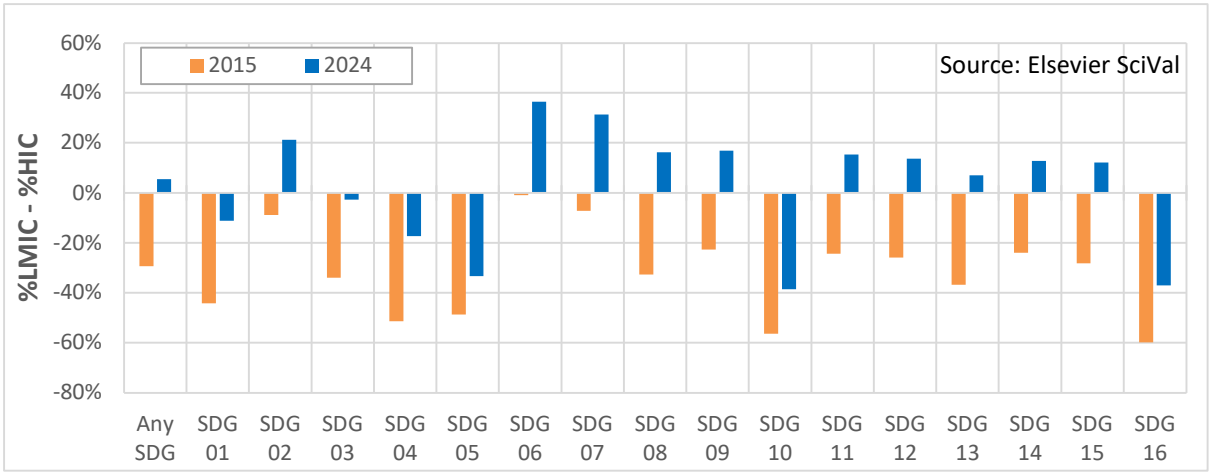

Figure 8. For publications targeting each SDG, the bars show the difference between the share that has authors in LMIC and the share that has authors in HIC in 2015 (orange bars) and in 2024 (blue bars). (Source: Elsevier SciVal).

Still considering publications in topics related to any SDG, Table 3 shows that the number of authors of these publications in the 30 countries with more authors corresponded, in 2024 to 88.9% of the authors of SDG related research. In 1999 this share was 95.7%, indicating a small decrease in the concentration of capacity.

The contribution of each country to the pool of authors publishing in SDG topics changes according to the SDG. An example is the case for SDG 2: No Hunger, shown in Table 4. In this case it can be seen that in 2024 there are 17 LMIC countries among the 30 with more authors and, among the 5 with more authors there are three LMICs (China, India, Brazil).

Considering the SDGs focused at STI Forum 2025, SDG 3, SDG 5, SDG 8, SDG 14 and SDG 17, Table 5 shows the 30 countries with more authors in publications targeting any of these SDGs. For SDG 5, 8 and 17, 50% or more of the countries with most authors are LMICsxx

Table 3. Evolution among the 30 countries that have, for each year, more authors in publications targeting themes related to any SDG (Countries in the LMIC group are highlighted). (Source: Elsevier Scopus).

Any SDG	1999	2004	2009	2014	2019	2024
Sum authors in 30 largest	415,193	595,170	960,255	1,513,549	2,222,057	3,412,914
% of World authors	95.7%	94.4%	92.4%	91.9%	90.3%	88.9%
Number of countries selected	30	30	30	30	30	30
LMIC	7	7	7	9	12	12
HIC	23	23	23	21	18	18
Countries listed in descending order of number of authors (highlight shows LMICs)	usa	usa	usa	usa	chn	chn
	jpn	jpn	chn	chn	usa	usa
	gbr	chn	jpn	jpn	jpn	ind
	deu	gbr	gbr	gbr	gbr	gbr
	chn	deu	deu	deu	ind	deu
	ita	ita	ita	ita	deu	ita
	fra	fra	fra	ind	ita	jpn
	esp	esp	esp	fra	bra	bra
	can	can	can	esp	esp	esp
	aus	aus	bra	bra	fra	kor
	ind	ind	kor	kor	kor	can
	kor	kor	ind	can	can	fra
	nld	nld	aus	aus	aus	aus
	bra	bra	nld	nld	rus	irn
	tur	tur	twn	tur	irn	rus
	swe	twn	tur	twn	nld	idn
	twn	swe	swe	irn	tur	tur
	pol	pol	pol	pol	twn	nld
	che	che	che	swe	pol	pol
	rus	bel	irn	rus	swe	twn
	bel	isr	grc	che	mex	egy
	isr	rus	bel	mex	che	mex
	grc	grc	mex	bel	idn	pak
	aut	fin	rus	dnk	mys	mys
	fin	dnk	dnk	mys	pak	che
	dnk	aut	isr	prt	egy	sau
	mex	mex	fin	grc	prt	swe
	nor	nor	aut	zaf	bel	tha
	zaf	hkg	nor	aut	dnk	prt
	nzl	arg	prt	fin	zaf	bel

Table 4. Evolution among the 30 countries that have, for each year, more authors in publications targeting themes related to SDG 2: No Hunger (Countries in the LMIC group are highlighted). (Source: Elsevier Scopus).

SDG 2: No Hunger	1999	2004	2009	2014	2019	2024
Sum auth. in 30 largest	113,84	16,681	32,952	56,300	100,282	194,107
% of World total	89.3%	89.6%	87.8%	86.9%	85.4%	84.8%
Number of countries selected	30	30	30	30	30	30
LMIC	11	11	12	14	15	17
HIC	19	19	18	16	15	13
Countries listed in descending order of number of authors (highlight shows LMICs)	usa	usa	usa	usa	chn	chn
	gbr	gbr	chn	chn	usa	usa
	ind	ind	bra	bra	bra	ind
	bra	chn	ind	ind	ind	bra
	chn	bra	gbr	fra	ita	ita
	fra	fra	ita	gbr	gbr	idn
	deu	can	fra	ita	esp	gbr
	can	jpn	deu	deu	deu	esp
	jpn	deu	esp	esp	fra	deu
	ita	ita	aus	aus	aus	fra
	aus	esp	jpn	can	jpn	pak
	esp	aus	can	jpn	can	aus
	nld	nld	nld	nld	mex	jpn
	che	mex	irn	irn	pak	eth
	mex	zaf	mex	mex	irn	can
	zaf	swe	tur	pak	nld	irn
	swe	che	kor	kor	idn	mex
	kor	isr	swe	zaf	zaf	kor
	dnk	dnk	bel	tur	rus	tur
	tur	pol	che	arg	kor	egy
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	arg	arg	ken	bel	tur	bgd
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	nzl	ken	zaf	egy	ken	tha
	pol	nga	nzl	mys	nga	mys
	fin	rus	egy	dnk	swe	rus
	phl	aut	dnk	nga	mys	sau
	tha	col	prt	col	bel	ken

Table 5. The 30 countries trat have more authors in research publications targeting the SDGs targeted in STI Forum 2025: SDG 3, SDG 5, SDG 8, SDG 15, and SDG 17. (Source: Elsevier Scopus).

	SDG 3	SDG 5	SDG 8	SDG 14	SDG 17
	2024	2024	2024	2024	2024
Number of countries selected	30	30	30	30	30
LMIC	11	15	16	13	16
HIC	19	15	14	17	14
	chn	usa	chn	chn	chn
	usa	chn	usa	usa	usa
	ind	gbr	ind	ind	ind
	jpn	esp	idn	bra	gbr
	ita	can	gbr	ita	idn
	gbr	ind	bra	idn	ita
	deu	aus	ita	gbr	bra
	esp	bra	esp	esp	deu
	bra	ita	deu	fra	esp
	can	deu	aus	aus	aus
	fra	idn	mys	can	mys
	kor	zaf	can	deu	can
	aus	fra	pak	kor	pak
	irn	eth	rus	jpn	irn
	tur	nld	irn	rus	zaf
	rus	irn	kor	egy	nga
	nld	nga	tur	nor	tur
	twn	tur	pol	mex	nld
	egy	swe	fra	prt	fra
	pol	jpn	zaf	mys	ukr
	idn	mys	sau	bgd	sau
	che	uga	jpn	irn	vnm
	sau	ken	ukr	tur	kor
	pak	che	nld	tha	bgd
	swe	prt	vnm	nld	rus
	mex	chl	nga	chl	pol
	tha	gha	prt	vnm	gha
	dnk	pak	tha	twn	prt
	bel	mex	mex	sau	jpn
	prt	sau	bgd	pol	tha

4) What funders are supporting these advances?

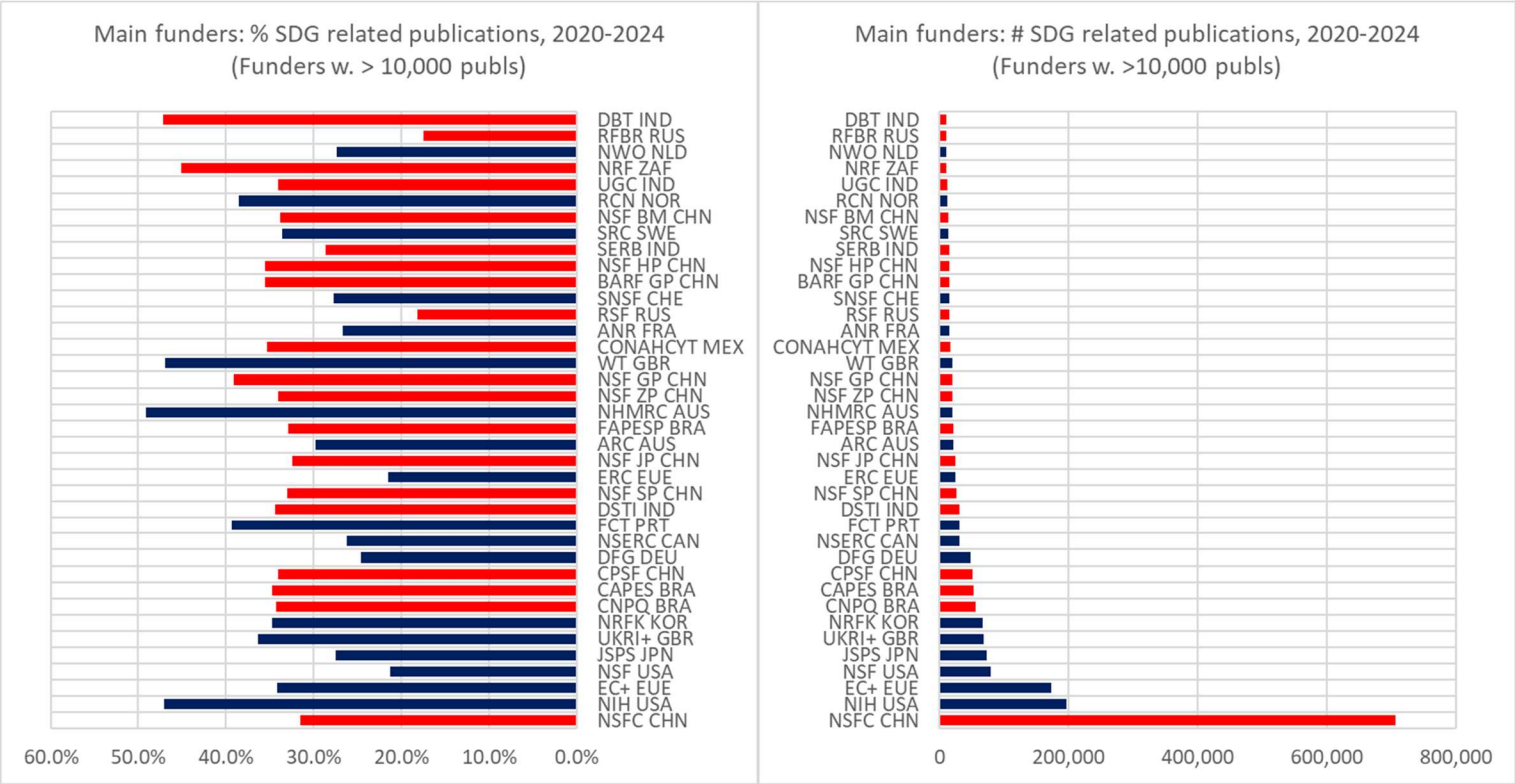

Figure 9. Number and percentage in portfolio, of the publications targeting SDGs, that acknowledge support from RFOs. (Source: Elsevier Scopus).

Figure 9 shows the 38 RFOs that were acknowledged in more than 10,000 research publications targeting SDGs from 2020 to 2024. The figure categorizes in red the RFOs in Low-and-Middle Income Countries (LMIC)[iii] and in blue the RFOs in High Income Countries (HIC). Nine HICs (plus the European Commission) and 5 LMICs are represented in the set of RFOs.

This categorization allows for the identification of a growingly relevant fact about research in the World: LMICs are stepping up their research efforts, benefiting from decades of capacity building efforts.

The panel to the left in Figure 9 shows the percentage of the funder portfolio that relates to any SDG. In most cases this percentage is above 30%, and for funders targeting Health Research the percentage tends to be higher, reaching almost 50% for the case of the NHMRC (Australia), DBT (India) and NIH (USA). This is not surprising, considering these are funders that focus health research, in many cases related to SDG 3.

Among the LMICs, China has a towering role, with nine funders in the list. India four, Brazil three, Russia two, and Mexico and South Africa one each, so that 20 funders (out of 38) in LMICs are among the main funders of SDG related research – the World of research might be changing.

5) Policy consequences

The changes in the geography of research instigate us to think about how policies could be adjusted to adequate to this new reality. It is clear that capacity building – in research personnel and in institutions building – is bearing fruit. The geography of research in the World is changing rapidly, and this paves the way for advances in SDG advancement through scientific and technological research. The TFM roadmaps must take note of this important development. When the SDGs were approved, 10 years ago, only 37% of the authors of scientific publications worked in LMI Countries and, in 2024, the share of authors working in LMIC countries rose to 56%. Additionally, funders in LMIC have been active in SDG related research, including in collaborative ways.

Some points to be considered would be:

a) The LMIC countries that appear with more authors in all fields and more authors targeting SDGs are the ones that, beyond creating

universities and national laboratories, created and implemented effective institutions for funding research (research funders, research councils). Supporting LMIC countries' efforts to organize solid research funding organizations[iv] seems to be a relevant action that can potentialize the efforts made by the countries to create universities and national laboratories.

b) The size and results of the efforts by LMIC countries targeting many SDGs demonstrate that there is room to develop much more LMIC-LMIC collaborations driven by partnerships among funders in multiple LMIC countries (as Brazil, China and South Africa have been promoting)[v,vi,vii] via specific programs, perhaps with the assistance of the U.N. or other international organizations. In these collaborations, instead of a donor-recipient relation, common in North -South interactions, gives room to a balanced interaction between similar[viii] countries.

c) The international governance of research does not (yet?) reflect the advances by LMIC countries in creating national research systems that contribute in a relevant way to knowledge around the U.N. SDGs, as described in this note. For example, international committees and international organizations tend to have membership from LMICs disproportionate to the country category participation in the World research enterprise, reflecting an international distribution of authors that probably made sense many years ago. The involvement of the U.N. and its associated entities in obtaining a better balance would be entirely justified by the data shown here and by the objectives of strengthening the World commitment and actions to advance the SDGs.

Endnotes and references

[i] "Resolution adopted by the General Assembly on 25 September 2015 - Transforming our world: the 2030 Agenda for Sustainable Development". https://docs.un.org/en/A/RES/70/1

[ii] "Scopus Content", https://www.elsevier.com/en-gb/products/scopus/content

[iii] Using the World Bank categorization, described in https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups

[iv] IRDC (Canada) did some work on this in partnership with UKRI (UK) to foster the development of funding councils in Africa, a few years ago.

[v] Brazil-China research collaborations are strategic to combat adverse effects of climate change

[vi] FAPESP and the National Natural Science Foundation of China plan to expand research cooperation

[vii] Sustainable Development Goals (SDGs) Collaborative Funding Call – National Research Foundation

[viii] Empowering Development Organisations in the Global South through South- South Development Cooperation: Insights from Brazil, India, and South Africa | The Political Studies Association (PSA)