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UNESCO SCIENCE REPORT

The race against time for smarter development

Chapter 2: ARE WE USING SCIENCE FOR SMARTER DEVELOPMENT?

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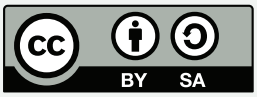

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Cover photo: A medical operator hands a box of Covid-19 test samples collected from rural hospitals to a drone flight operator at Zipline's distribution centre in Omenako for delivery to the Noguchi Memorial Institute for Medical Research in Accra, in this composite image.
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The Rwanda E-Waste Recycling Facility opened in 2017, the second-largest in Africa. The Rwanda Green Fund (FONERWA) has invested close to US$ 1 million in the facility, which can process more than 7 000 tonnes of electrical and electronic waste each year. Three million tonnes of e-waste were generated in Africa in 2019 but only 0.9% was collected and recycled.

AT A GLANCE

- UNESCO analysed 56 research topics of relevance to the Sustainable Development Goals to identify national research priorities and track change since 2011.
- The study found that developing countries showed strong specialization in research related to the Sustainable Development Goals.
- Consumer pressure and policy changes over the past decade have been informed by a growing body of research on floating plastic debris in the ocean, the fastest-growing topic among the 56 analysed.
- Sustainability research has often been reactive, rather than pro-active. For example, national trends in research on new or re-emerging viruses closely track viral disease outbreaks.
- Climate resilience and sustainable environmental management continue to account for the smallest shares of research by volume.
- Innovation in electricity distribution and storage is growing faster than research on alternative forms of non-fossil energy generation.

2 · Are we using science for smarter development?

Tiffany Straza and Susan Schneegans

INTRODUCTION

Tracking research related to the SDGs

In 2015, Brazilian health care workers began noticing a growing number of babies born with abnormally small heads, or microcephaly, a condition that would affect their brain development. Scientists at the Federal University of Pernambuco in Recife were the first to link a rise in the incidence of newborns displaying microcephaly with an outbreak of Zika, transmitted to their mothers by mosquitoes.

This discovery has transformed our understanding of the Zika virus, which had previously been considered relatively benign. The virus has been recorded in Asia, Africa, the Pacific and the Americas, where it has travelled as far north as the USA.

The outbreak in Brazil became an epidemic. By the time it ended in 2018, largely thanks to the control of mosquito populations and human behavioural changes,[1] Zika had spread to over 50 countries and territories in the Americas. It is expected to circulate among mosquitoes and humans for the foreseeable future (Lowe *et al*., 2018).

A study conducted by the São Paulo Research Foundation (FAPESP) found that, as of April 2018, Brazil was second only to the USA for the volume of scientific publications on Zika, accounting for 15% of the global total (see Box 8.6). This means that Brazil had fresh experience of tackling a viral disease epidemic when the Covid-19 crisis struck in 2020.

Brazil's response to the Zika outbreak was not dictated by scientific advice and experience alone, of course. As with any country, it was also influenced by socio-economic, cultural and political factors that direct our human response to any challenge.

In 2015, Brazilian scientists authored 144 publications on the broader topic of new or re-emerging viruses than can infect humans.[2] By 2019, the Zika outbreak had pushed this number up to 479 and Brazilian researchers were contributing to 4% of global output in this broad field. Other countries had also seen a surge in scientific publishing on this topic during outbreaks of the Influenza A subtype H1N1 and Ebola viruses (Box 2.1 and Figure 2.1).

This broad research topic is one of 56 studied in the present report that have been chosen by UNESCO for their linkages to eight of the United Nations' Sustainable Development Goals (SDGs) to 2030, namely zero hunger (SDG2), good health and well-being (SDG3), clean water and sanitation (SDG6), affordable and clean energy (SDG7), industry, innovation and infrastructure (SDG9), climate action (SDG13), life below water (SDG14) and life on land (SDG15). Between six and nine research topics were analysed for each of these eight goals.

The UNESCO study analysed scientific publishing trends in almost 200 countries between 2011 and 2019, to see which topics were being prioritized and to track change over this period (for details, see Annex 4). The aim of the study was three-fold:

- **to assess the volume of scientific articles published** by each country in the world between 2011 and 2019 on 56 key topics of relevance to the SDGs;
- **to identify the degree of specialization in each topic**, by assessing the number of publications produced in a given country over the 2011–2019 period as a proportion of that country's total scientific output, in comparison with the global average for the given topic; and
- **to identify the growth rate of each topic**, in order to monitor change at the national level in the priority accorded to each of these topics since the adoption of *The 2030 Agenda for Sustainable Development* by the 193 member states of the United Nations in 2015. To avoid annual fluctuations, the study compared scientific output between two periods: 2012–2015 and 2016–2019.

To our knowledge, the present study is the first global assessment of scientific publishing across topics related to the SDGs reported for each country. In the following pages, we describe the most striking trends. The complete datasets, country factsheets and related data visualization for each topic and the linkages between them are freely available from the *UNESCO Science Report* web portal.

The volume of output varies among fields

Worldwide, the great majority of scientific publications tend to focus on health research. This is the case for developing countries like Ghana (49%) but also for some of the most developed ones like the USA (48%). Notable exceptions are China (19%) and the Russian Federation (17%), which have specialized up to now in physical sciences. The health-related topics selected for the present study follow this broader pattern, topping the chart by volume (Figure 2.2).

The study of selected SDG-related research topics blended well-established topics and comparably newer ones characterized, logically, by lower output. For instance, in health research (SDG3), the study analysed the traditional topics of reproductive health and neonatology, tuberculosis and the human immunodeficiency virus (HIV) but also relatively new topics like precision medicine and human resistance to antibiotics. In the field of ocean research (SDG14), it analysed trends in the comparably new fields of ocean acidification and floating plastic debris in the ocean, as well as the more traditional topic of coastal eutrophication.

Owing to differences in the scope and history of the selected topics, it is more meaningful to look for signs of investment in a given topic by focusing on growth and

Box 2.1: **Research on new or re-emerging viruses has surged during epidemics**

With the year 2020 having been dominated by the Covid-19 pandemic, one might expect there to be a voluminous research record on new or re-emerging viruses that can infect humans. There is not. There were just 7 471 publications on this topic in 2019, 35% of which were produced by scientists in the USA alone (Figure 2.1). Global output on this broad topic progressed by just 2% per year between 2011 and 2019, slower than global scientific publications overall: 3.8% per year.

Growth was much faster in individual countries which had to marshal science to cope with other viral outbreaks over this period (Figure 2.1). The 2014–2015 Ebola outbreak in Liberia and neighbouring Guinea and Sierra Leone stamped its mark on these countries' scientific output, as did repeated Ebola outbreaks in the Democratic Republic of Congo. For instance, Liberia's publications on new or re-emerging viruses that can infect humans quadrupled from 33 (2012–2015) to 133 (2016–2019), an intensity 144 times the global average (see chapter 18). Liberia, Sierra Leone and Guinea all had the strongest specialization in the world on emerging viruses over the 2011–2019 period. Much of this output involved international collaboration, which accounted for 70% of scientific publications in low-income countries.

USA, Brazil and France have the highest specialization

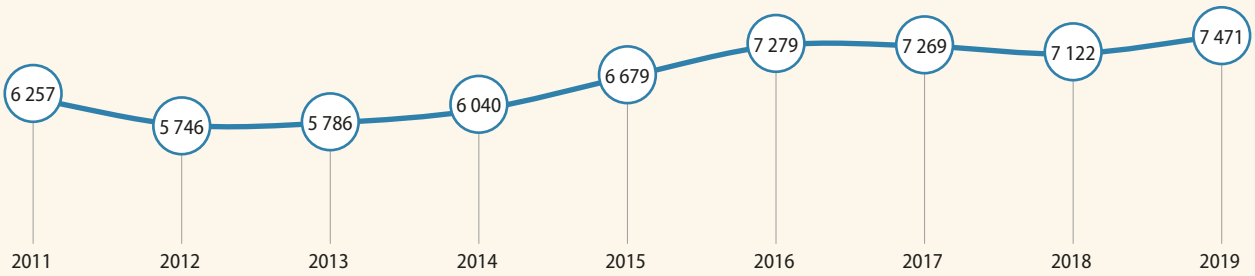
Among the top 10 countries for the volume of output on new or re-emerging viruses that can infect humans, the strongest specialization was found in the USA, Brazil and France. In January 2021, the French government announced the launch of the world's first research institution specializing in this field (see essay, p. 9).

Those countries which showed the fastest growth rates were Brazil and India (Figure 2.1). Brazilian output on viral research surged from 643 (2012–2015) to 1 605 (2016–2019) publications, 1.4 times the global average intensity. It was able to draw on its existing specialization in tropical communicable diseases (four times the global average intensity) in tackling the Zika outbreak in Brazil between 2015 and 2018, which also affected Colombia and the USA, among other countries.

The strong growth in research on this topic in low- and middle-income countries shows the value of

Figure 2.1: **Scientific publications on new or re-emerging viruses that can infect humans**

Global trend in volume of publications on new or re-emerging viruses that can infect humans, 2011–2019



Top 10 countries for volume of scientific publications on new or re-emerging viruses that can infect humans, 2011–2019

	Volume 2011–2019	Growth rate 2012–2019	Specialization index 2011–2019	World share (%) 2011–2019
USA	20 965	1.24	1.46	35.1
China	7 776	1.23	0.59	13.0
UK	4 807	1.28	1.08	8.1
France	3 813	1.24	1.30	6.4
Germany	3 796	1.24	0.88	6.4
Japan	3 635	0.92	1.05	6.1
Canada	2 614	1.15	1.06	4.4
Australia	2 454	1.13	1.22	4.1
Brazil	2 381	2.50	1.37	4.0
India	2 210	1.35	0.66	3.7

international scientific collaboration in tackling pandemics (Figure 2.5). This high level of scientific collaboration augurs well for the fight against Covid-19.

Prevention is better than a cure

The current focus in tackling new or re-emerging viruses tends to be reactive, rather than proactive. A workshop report published in October 2020 by the Intergovernmental Science–Policy Platform on Biodiversity and Ecosystem Services (IPBES), which is co-sponsored by UNESCO and three other United Nations agencies,* observes that the majority (70%) of emerging diseases such as Ebola and Zika and almost all known pandemics (e.g. influenza, HIV/AIDS and Covid-19), are zoonoses, meaning that they are caused by microbes of animal origin. These microbes 'spill over' when humans, wildlife and livestock come into contact with one another, such as through agricultural expansion, deforestation or wildlife trade.

The IPBES report estimates that there are another 1.7 million currently 'undiscovered' viruses in mammals and birds, up to half of which could have the ability to infect people. It predicts that future pandemics will emerge more often, spread more rapidly, do more damage to the global economy and kill more people than Covid-19, unless there is a transformative change in the global approach to dealing with infectious diseases.

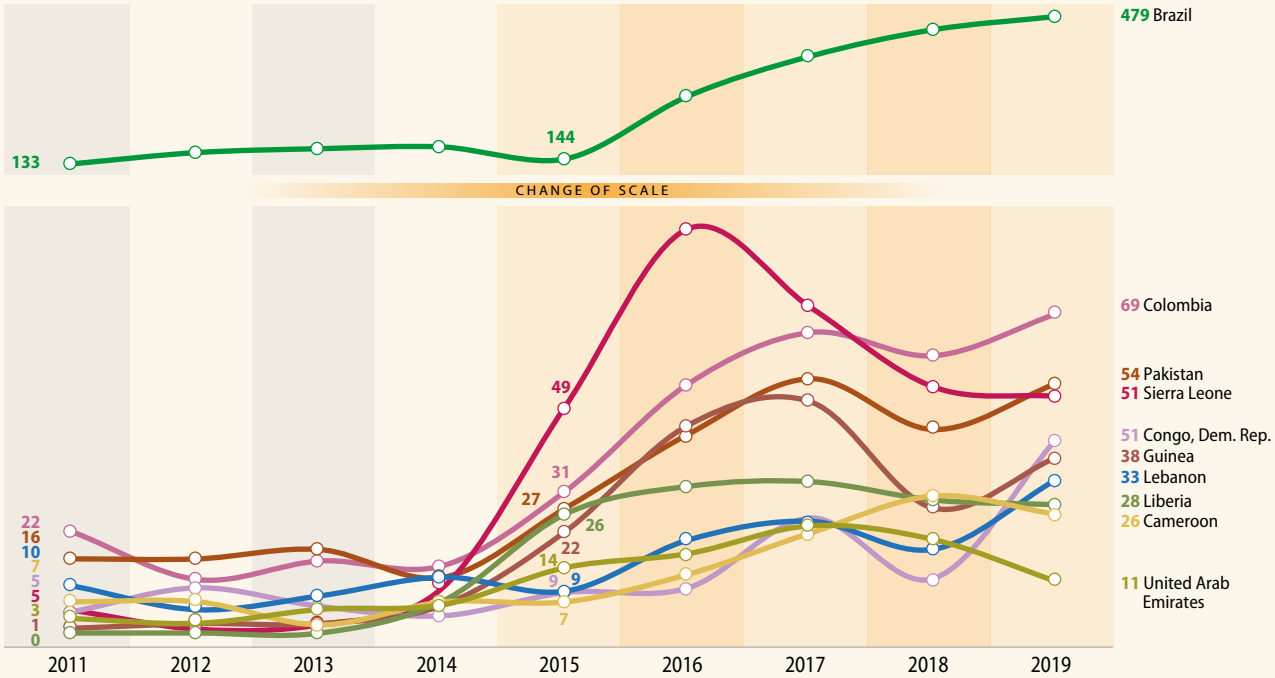
For Dr Peter Daszak, President of the EcoHealth Alliance and IPBES workshop chair, 'we still rely on attempts to contain and control diseases after they emerge, through vaccines and therapeutics. We can escape the era of pandemics but this requires a much greater focus on prevention, in addition to reaction.'

As the report recalls, the risk of a pandemic can be significantly lowered by reducing the human activities that drive the loss of biodiversity, such as agricultural expansion and intensification, the unsustainable exploitation of biodiversity-rich regions and unsustainable production and consumption patterns.

Source: compiled by Susan Schneegans and Tiffany Straza; IPBES (2020) Workshop Report on Biodiversity and Pandemics, October, see: https://ipbes.net/sites/default/files/2020-12/IPBES%20Workshop%20on%20Biodiversity%20and%20Pandemics%20Report_0.pdf

*United Nations Development Programme, United Nations Environment Programme and United Nations' Food and Agricultural Organization

Top 10 countries for growth in scientific publishing on new or re-emerging viruses, 2011–2019
For countries with at least 100 publications

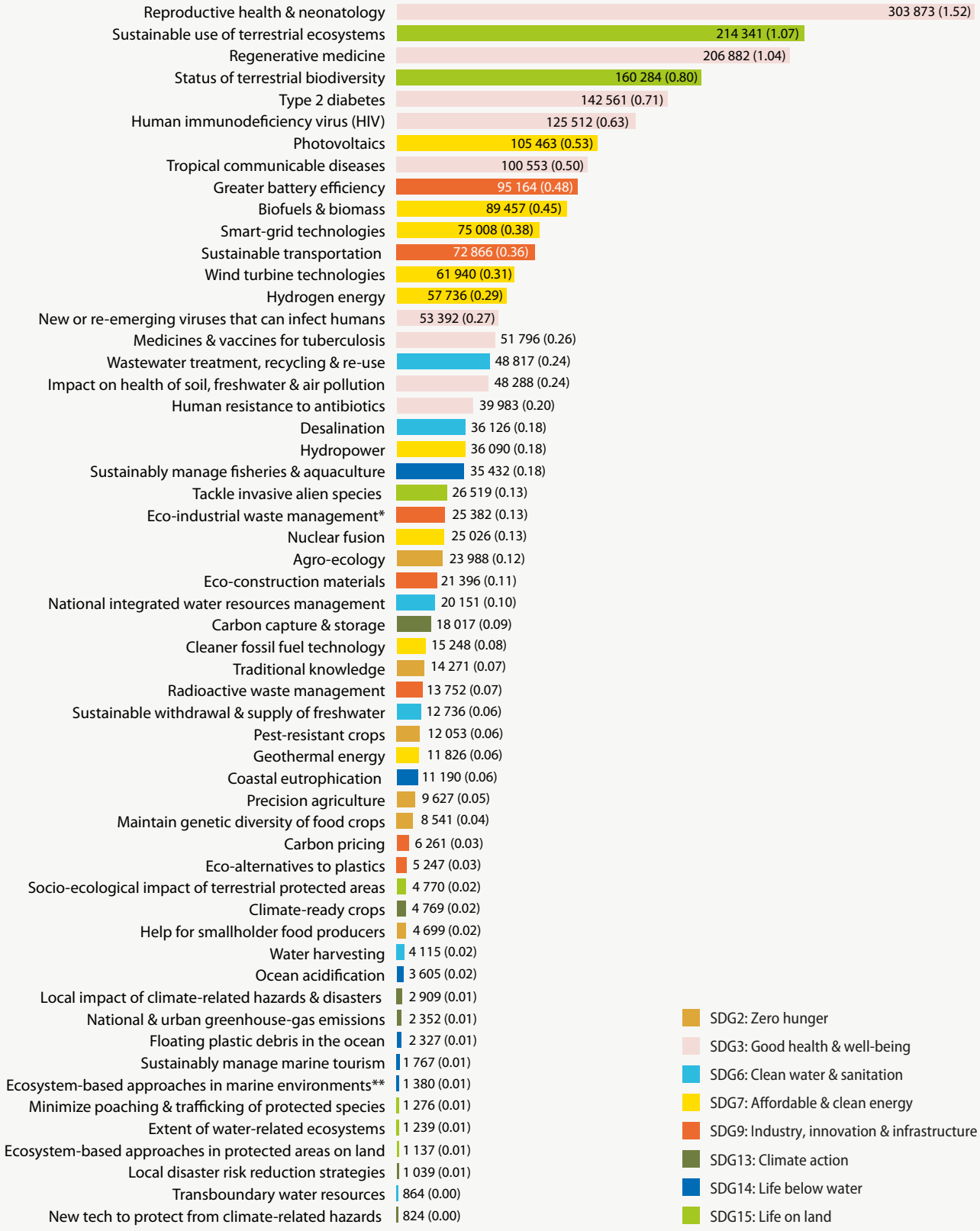


Note: These data exclude HIV, the subject of a separate research topic, and SARS-CoV-2 (Covid-19) which was unknown in 2019. The growth rate is calculated as the number of publications from 2016–2019 divided by the number of publications from 2012–2015. The degree of specialization is calculated by assessing the number of publications produced by a given country over the 2011–2019 period as a proportion of that country's total scientific output. This level of specialization is then compared with the global average to give the specialization index. For details, see Annex 4.

Source: Scopus (Elsevier), including Arts, Humanities and Social Sciences; data treatment by Science-Metrix

Figure 2.2: **Volume of global publications on selected topics related to the SDGs, 2012–2019**

Share of total publications is given within brackets (%)



* Eco-industrial waste management excludes radioactive nuclear waste.
**The topic of ecosystem-based approaches in marine environments covers environments within national exclusive economic zones.

Note: Topics are assigned a colour according to the most closely related Sustainable Development Goal (SDG), even though most of these research topics are relevant to more than one SDG.

Source: Scopus (Elsevier), including Arts, Humanities and Social Sciences; data treatment by Science-Metrix

specialization, or intensity of output on a given topic as a share of overall publishing (Figures 2.2 and 2.3). For instance, the study revealed little growth in research related to tuberculosis and HIV, even though HIV infection rates remain high[3] and the world is not on track to reach the SDG target of ending tuberculosis by 2035 (Merk *et al.*, 2019). HIV research declined as a share of global output between 2012–2015 and 2016–2019 (Figure 2.4).

A country's level of specialization in a given topic is a meaningful indicator, even when the overall volume of output may be low. In fact, it could be argued that it is more striking for a country with low research output to focus on an emerging topic of sustainability research. For example, Rwandan scientists produced 48 publications on the topic of help for smallholder food producers between 2011 and 2019, 56 times the global average publication intensity for this topic.

In general, high-output countries have lower absolute values for the specialization index on a given topic. Even topics that are defined as national priorities, and which make up a substantial body of work, form only a small share of the country's much larger overall output. For lower-output countries, fewer publications are needed to show a trend of specialization on a given topic. For this reason, the USA's specialization in HIV research – 1.9 times the global average intensity – can still be interpreted as meaningful, since the USA contributed 44% of global output on this topic in 2019. For comparison, Uganda contributed 2.4% of publications on HIV research in 2019 but its specialization index value is 37 times the global average intensity for this topic, owing to its overall lower volume of total output.

The path from data to societal change is indirect

In examining growth trends, we have sought to identify those countries that are investing in topics considered vital for sustainable development. That said, the relationship between publication output and development pathway is neither direct, nor a one-way street. Although trends in publication output can reflect government prioritization trickling down through research funding, scientific publications alone are not causative of societal change. Whenever there is an observed decline in research output, this may be because government funding has been diverted to other areas or because the field has moved on. For example, a substantial body of work has been done on the selected topics related to renewable energy (SDG7) but this trend is now showing signs of tapering off, even though the adoption of renewable energy technologies is still limited at the global level (IEA, 2020). In other words, the production of knowledge alone is insufficient to bring about societal change; it must be accompanied by political will (see chapter 1).

Science communication experts have largely discredited the 'information deficit' model, namely, the idea that science can fill knowledge gaps and automatically effect societal change, recommending instead that scientists dialogue with policy-makers (Reincke *et al.*, 2020). Although domestic investment in priority areas of scientific research does bear fruit in the form of publications, the reverse flow of scientific information to policy is neither as direct, nor as assured. There is a need to institutionalize scientific policy advice, in order to foster coherent, stable policies capable of making a sustainable impact. Policies take time to produce results. Institutionalized mechanisms for providing scientific advice have advantages over ad hoc arrangements like those observed during the Covid-19 pandemic, in that they take the long view (see What the Covid-19 pandemic reveals about the evolving landscape of scientific advice, p. 3).

The dominance of high-income economies is waning

Perhaps a more surprising trend is the limited growth observed in high-income economies for the 56 topics selected for the present study. This slow pace of change has been observed by other measures of sustainability science (Elsevier and SciDev, 2015).

High-income economies are losing their monopoly on the majority of these 56 topics, with notable declines in the share of global output on topics related to clean energy and innovation, particularly with regard to battery efficiency and carbon capture and storage (Figures 2.5 and 2.6). By 2019, China was contributing to 53.2% of global publications on greater battery efficiency with 9 944 articles in that year alone.

To take another example, scientists from high-income economies (co-)authored 74.8% of the world's publications on photovoltaics in 2011 but only 50.5% in 2019. Such declines occurred for nearly all of the 56 topics (Figure 2.6). Notwithstanding this, high-income economies still dominate scientific publishing by volume. This demonstrates the need for developing economies to invest more in research infrastructure.

In some cases, national priorities align neatly with trends in research output. For example, Central Asian countries specialize in transboundary water management. Although their total output is small, the expertise of authors from countries such as Kazakhstan and Uzbekistan which border the Aral Sea is essential for managers looking to address the socio-ecological challenges of water rights (see chapter 14). By contrast, Ethiopian-affiliated researchers were involved in only three publications on transboundary water management from 2011 to 2019, compared with 13 for Egypt and five for Sudan, despite Ethiopia's ongoing negotiations with these two downstream users of the Blue Nile on sharing the benefits of the Grand Ethiopian Renaissance Dam (see chapter 19).

Other relationships are less clear-cut, be it due to a gap in research or, alternatively, to an abundance of research but a conflicting national pathway. For example, the absence of authors from small island developing states (SIDS) from the body of research on the impact of climate change may be indicative of both a research gap and the practice of on-site research being driven by an external research agenda. To take another example, despite the sizeable contribution by US (25%) and Australian (14%) scientists to global research on local disaster risk reduction strategies to mitigate climate change, their respective governments have not prioritized climate-mitigation policies in recent years (see chapters 5 and 26).

Figure 2.3: **Growth rate for publications on selected topics related to the SDGs, 2012–2019 (%)**

* Eco-industrial waste management excludes radioactive nuclear waste. The topic of ecosystem-based approaches in marine environments covers environments within national exclusive economic zones.

Note: Topics are assigned a colour according to the most closely related Sustainable Development Goal (SDG), even though most topics examined here are relevant to more than one SDG goal. The growth rate is calculated as the number of publications from 2016–2019 divided by the number of publications from 2012–2015; a growth rate of 1.16 indicates a 16% increase in publication output, the global average for scientific publications overall. For details, see Annex 4 of the *UNESCO Science Report* (2021).

Source: Scopus (Elsevier), including Arts, Humanities and Social Sciences; data treatment by Science-Metrix

It is rare to see strong growth in output on the majority of the 56 SDG-related topics. In this regard, Iraq and Indonesia stand out. Iraqi research is emerging on many of these topics, building on an existing specialization in health, desalination, wastewater treatment and solar photovoltaics. For its part, Indonesia's output at least tripled between 2011 and 2019 for 40 topics. By 2019, Indonesian researchers had published on each of the 56 topics analysed, including the country's first footprint in the international literature on climate action. Contributing to this surge has been the decision by Indonesia, in 2017, to link the publication of research in international, indexed journals to the review of scientists' career performance (see chapters 1 and 26).

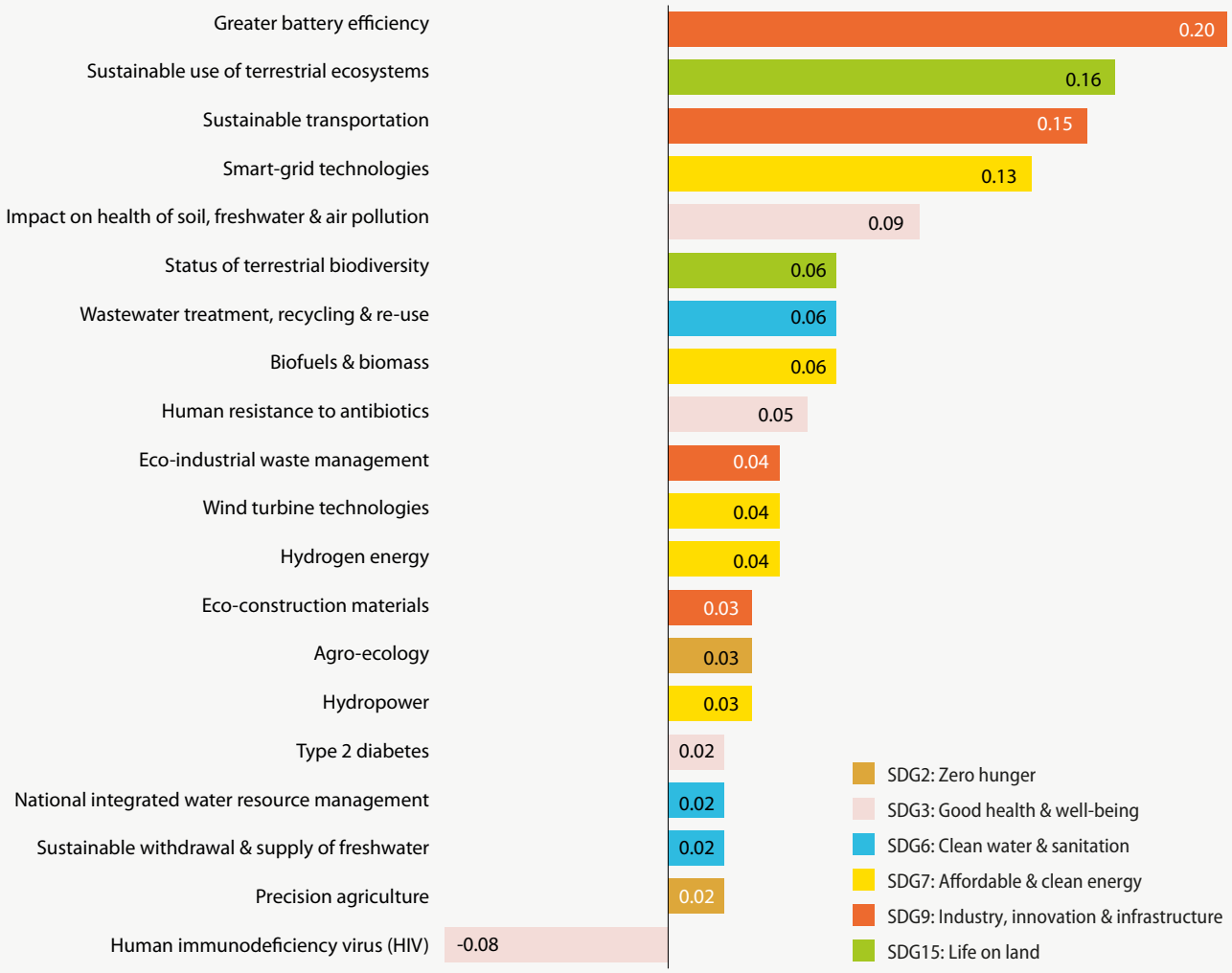
How can we distinguish volatile from flexible research?

Volatile research systems and flexible research systems may leave the same footprint in terms of rapid swings in the number of publications on each subject over time.

When countries with a modest output show strong growth in a particular research topic, this may be because their research is enmeshed with their country's development agenda. For example, Ecuador's output on sustainable transportation has soared from 12 (2012–2015) to 92 papers (2016–2019), that on solar photovoltaics from 3 to 36 papers and that on smart-grid technologies from 35 to 143 papers. Ecuador's rapid specialization in these fields can be traced back to a series of rolling blackouts in 2009 which

Figure 2.4: **Change in the share of 56 SDG-related topics among global publications, 2012–2015 to 2016–2019 (%)**

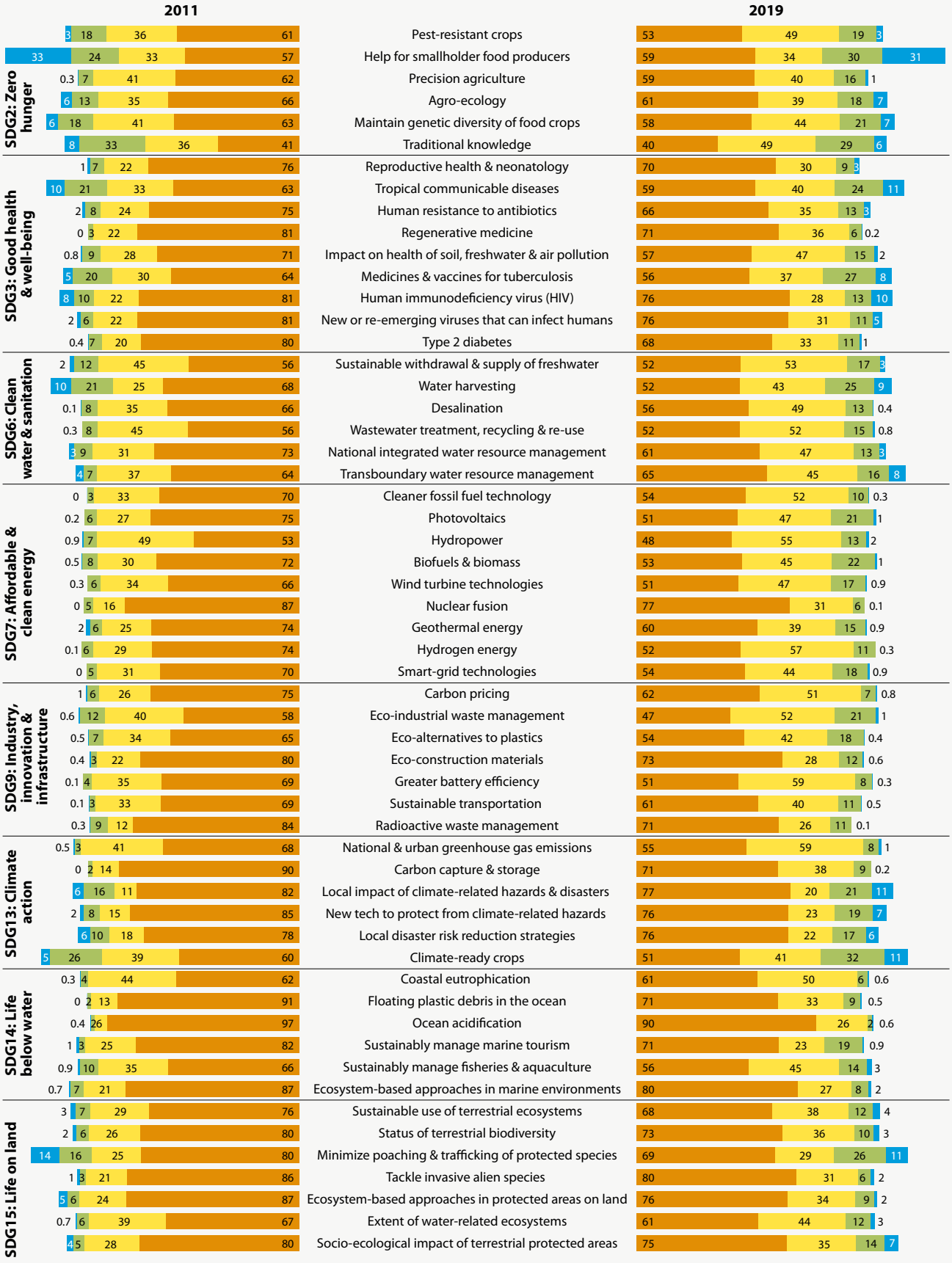
Excluding topics demonstrating change of less than ±0.02%



Note: The topic of floating plastic debris in the ocean has been excluded from this figure, owing to the low volume of publications on this topic.

Source: Scopus (Elsevier), including Arts, Humanities and Social Sciences; data treatment by Science-Metrix

Figure 2.5: **Contribution by income group to global publishing on 56 research topics related to the SDGs, 2011 and 2019 (%)**



Note: See Annex 1 of the *UNESCO Science Report* (2021) for a list of countries by income group. These values reflect the participation of authors from countries in the selected groups. Owing to co-authorship, the sum of the shares may exceed 100%, with larger cumulative totals indicating greater collaboration among income groups.

Source: Scopus (Elsevier), including Arts, Humanities and Social Sciences; data treatment by Science-Metrix

prompted the government to prioritize investment in energy infrastructure and the transition from thermal to hydropower and other renewable sources of energy (see chapter 7).

Alternatively, strong growth in a particular topic may reflect a research agenda dominated by short-term projects and short-term funding or a development agenda determined by international donors – or a combination of two or more of these factors. Not all of these factors are synonymous with the type of stable, predictable ecosystem that is supportive of the scientific enterprise (see Global standards now exist for a healthy ecosystem of research and innovation, p. 24).

In high-output countries, strong growth in a given topic may be explained by the fact that they are the ones driving the development agenda, are more flexible and quicker at producing topical research, or have rapid access to funding and expertise that allows them to react to new trends. Conversely, a slow response may not be a sign of indifference to sustainability topics but, rather, may simply be masked by the sustained high volume of output in established fields. Large research ecosystems may require more time for changes to become visible (see chapter 1).

We shall see these complex interactions in each subject area.

SCIENCE UNDERPINNING DEVELOPMENT

Today, youth the world over are looking to science to solve the multifaceted crises that could compromise their future: the climate emergency, growing demand for energy, the shattering of the Earth's ecological balance and pollution levels that threaten the health and well-being of billions of people. The anxieties of youth are encapsulated in the catchphrase brandished by young demonstrators around the world: 'You'll die of old age; I'll die of climate change'.

Should there remain any subsisting doubt as to the urgency of taking an integrated approach to development, one need only consider the ravages of the Covid-19 pandemic, a prime example of the interconnectedness between ecology, human health and economic prosperity.

As Dr Peter Daszak, one of the authors of an expert report co-sponsored by UNESCO (IPBES, 2020), put it, 'there is no great mystery about the cause of the Covid-19 pandemic, or of any modern pandemic. The same human activities that drive climate change and biodiversity loss also drive pandemic risk through their impact on our environment. Changes in the way we use land, the expansion and intensification of agriculture and unsustainable trade, production and consumption disrupt nature and increase contact between wildlife, livestock, pathogens and people. This is the path to pandemics' (Box 2.1).

Science, technology and innovation will be fundamental to achieving the SDGs. Coupled with strong political will, this should make for a potent combination, as long as there is sustained investment in research and development.

The good news is that global research spending (in PPP$ billions) progressed almost everywhere between 2014 and 2018, with growth being especially strong in upper middle-income countries, in a trend driven largely by China (see chapter 1). At the global level, research expenditure

Young demonstrators in Toronto, September 2019. © K6ka CC BY-SA 3.0

surged by 19%. Progress was visible in all but two regions: Central Asia and Latin America and the Caribbean. However, the proportion of GDP devoted to research expenditure (target SDG9.5.1) progressed only from 1.73 to 1.79.

Researcher density rose in all but Central Asia and Eastern Europe over the same period (see chapter 1).[4] The global density progressed from 1 245 to 1 368 researchers (in full-time equivalents) per million inhabitants (see chapter 1).

One key development is the growing scientific collaboration between developing countries. This trend tends to be most visible within regions but a large diaspora is also boosting co-authorship farther afield, as in the case of Pakistani scientists based in Saudi Arabia (see chapter 21).

In the following pages, we examine publishing trends with regard to research topics that are considered essential for achieving eight of the 17 SDGs.

SELECTED RESEARCH THEMES

Plastic debris research shows fastest growth

Among the 56 topics examined, that of **floating plastic debris in the ocean** showed the fastest growth, albeit from a low starting point (Figure 2.3). Over nine years, global research documenting this phenomenon ballooned from 46 (2011) to 853 (2019) publications (Figure 2.7).

As a result, we know that plastics have penetrated the deepest ocean trenches (Peng *et al.*, 2018). Jamieson *et al.* (2019) found ingested microplastics in the hindguts of crustaceans in six deep ocean trenches around the Pacific Rim,[5] at depths ranging from 7 000 to 10 890 m. Over 72% of the 90 individuals examined contained at least one microparticle. Human beings are not exempt: researchers have found microplastics in human placentas (Ragusa *et al.*, 2021).

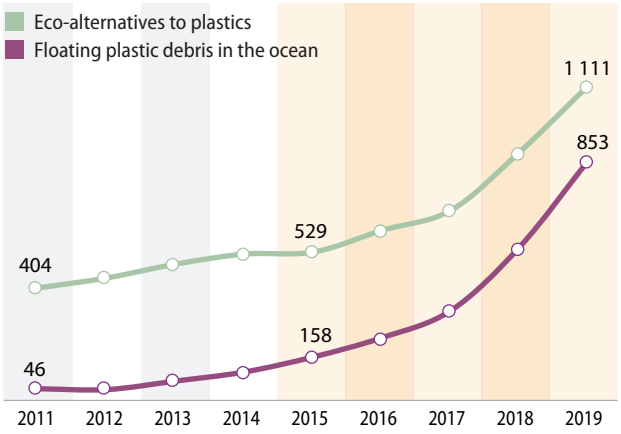
Plastics have been found not only in animals but also in fruit and vegetables, such as apples and carrots (Conti *et al.*, 2020). At the present rate, plastic particles could outweigh fish in the ocean by 2050 (WEF, 2016); experts estimate that plastic pollution will triple by 2040 (Lau *et al.*, 2020). According to British Petroleum, single-use plastics made up just over one-third of all plastics produced in 2017.

Plastics are derived from oil. In the short term, demand for oil has been eroded in 2020 by the vertiginous drop in global travel during the Covid-19 pandemic. However, the long-term prospects for oil production are threatened by the growing affordability of renewables, which is motivating oil companies to step up the production of synthetics. Plastics now make up two-thirds of demand for oil in the petrochemical sector and all of the growth in demand for oil (Bond *et al.*, 2020). At current growth rates, plastic production could account for 20% of global oil consumption by 2050 (UNEP, 2018).

Asia is considered a dominant source of plastic pollution, in part because it is a manufacturing and recycling hub for plastics (WEF, 2016). China's decision in 2017 to stop importing low-quality plastic waste has fundamentally changed global recycling streams, as China had previously accepted 45% of all global plastic that was recycled between 1992 and 2017, according to United Nations Comtrade data. China's publications on floating plastic debris jumped from 7 (2012–2015) to 286 (2016–2019), ranking it third in the world by volume after the USA and UK over this dual period.

For plastics, and consumer goods more generally, the cost of safe disposal during the product's lifecycle is not incorporated in the sales price. This is making it uneconomical to produce rapidly biodegradable alternatives to plastic and placing a burden on public authorities to finance recycling. Were the manufacturer to pay for the cost of recycling, such as through an ecotax, they would be less inclined to produce single-use plastics or to endorse programmed obsolescence (Box 2.2).

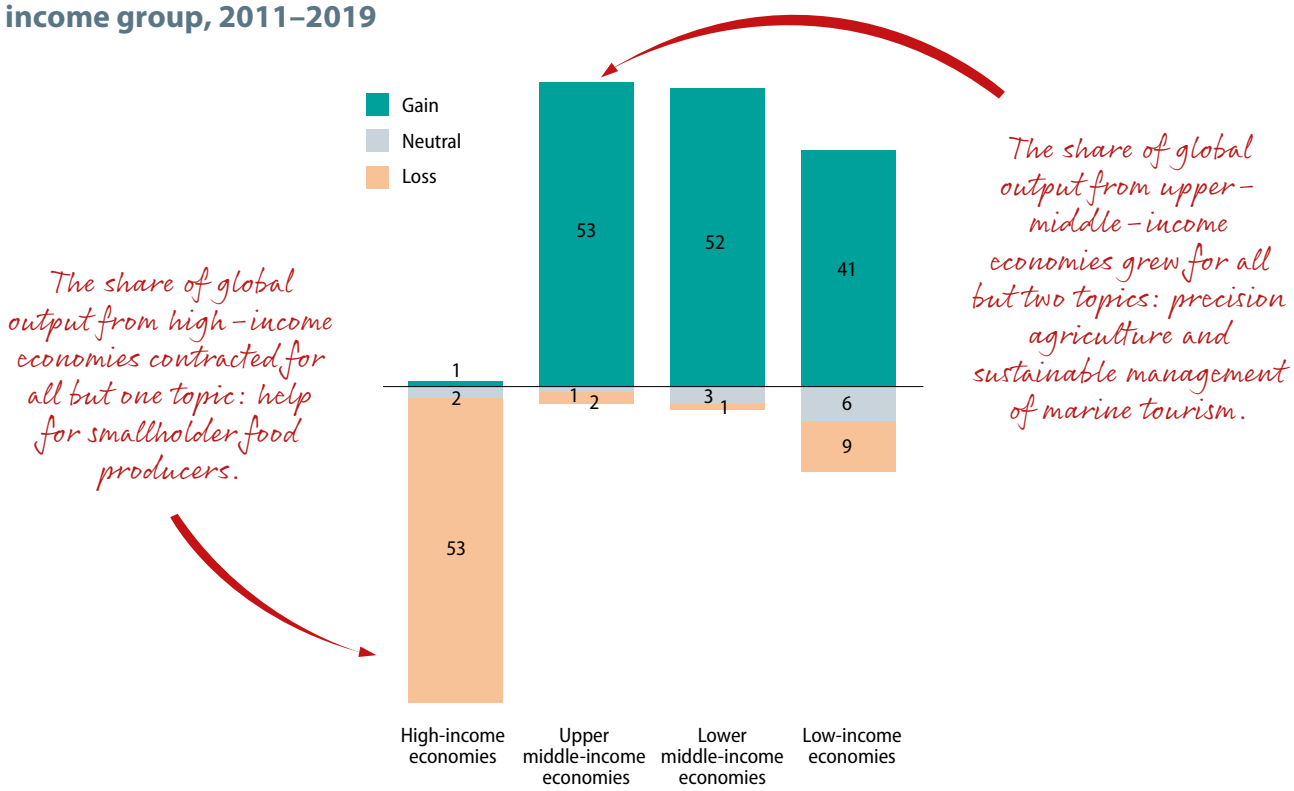
Figure 2.7: **Volume of global publications on plastics, 2011–2019**



Source: Scopus (Elsevier), including Arts, Humanities and Social Sciences; data treatment by Science-Metrix

A growing number of countries are banning or phasing out single-use plastics. In 2019, Panama became the first Central American country to do so. Costa Rica has adopted a five-year *National Strategy for the Substitution of Single-use Plastics by Renewable and Compostable Alternatives 2017–2021*. In other countries, single-use plastics are being banned by local bodies, such as by municipalities in Guatemala (see chapter 7). To date, 11 of the 14 Pacific Island countries have introduced legislation to slow the sale or import of single-use

Figure 2.6: **Number of SDG-related topics with a gain or loss in share of global output, by income group, 2011–2019**



Note: A change of 1% or more was defined as a loss or gain with the exception of low-income economies, for which a threshold of 0.2% was used to account for the proportionately smaller share of global output.

Source: Scopus (Elsevier), including Arts, Humanities and Social Sciences; data treatment by Science-Metrix

plastics or Styrofoam (see chapter 26). China plans to eliminate the use of single-use plastic bags by 2022 and to reduce single-use plastics in the restaurant business by 30% by 2025.

In June 2019, the European Parliament and Council of the European Union adopted a Directive on the Reduction of the Impact of Certain Plastic Products on the Environment (#904).[6] The intention is to eliminate ten single-use pollutants (straws, takeaway food containers, etc.) and to incite producers of others, such as single-use plastic bags, to cover the costs of waste collection and treatment (see chapter 9).

Banning single-use plastics will not suffice on its own (UNEP and WRI, 2019). Given the low recycling rate of plastic (less than 10%), it will be essential to transition to lightweight alternatives (Bond *et al.,* 2020). Rwanda, for instance, has been developing bags made of bamboo, banana and other products since it banned plastic bags in 2008. **Sustainable alternatives to plastics** was the second-fastest growing research topic for sub-Saharan Africa between 2012 and 2019, even though total output did not exceed 100 papers by 2019.

Indonesia, Malaysia and Thailand are boosting their own research output on sustainable alternatives to plastics, which amounted to over five times the global average intensity in 2019. Indonesia went from producing six publications on this topic between 2012 and 2015 to 155 over the next four years. Other countries with greater output that show strong growth include Brazil, China, Germany, India, Iran, Italy, Nigeria and the United Kingdom (UK).

Health topics dominate by volume but little change

At the other end of the scale, **HIV** research had the lowest growth rate of all 56 topics under study. Although the volume of publications on the nine health-related topics examined topped the scale for the volume of output (Figure 2.2), growth rates were either below or on par with the global average of 1.2% per year for all scientific publications. Only the topics on **human resistance to antibiotics** and the **impact on health of soil, freshwater and air pollution** showed strong growth (Figures 2.3 and 2.4).

All of the top countries for the growth rate in research on **new or re-emerging viruses that can infect humans** have been affected by a viral outbreak in the past decade (Box 2.1).

Health remains a strong suit for African researchers, with **tropical communicable diseases**[7] and HIV research among the top five topics for the majority of sub-Saharan countries. However, output on these topics is not growing, which may be a sign that research investment is waning or that other subjects are competing for precedence in Africa's research pathway (Figure 2.10).

Health concerns are evolving as lifestyles and surrounding environments change. **Type 2 diabetes** (also called adult-onset diabetes) is becoming more prevalent. Africa, the Arab States, Asia and Europe are leading the growth in related research. As an identified co-morbidity factor for other illnesses, including Covid-19 (Guo *et al*., 2020), diabetes is likely to receive greater attention in the coming decade. Treatment of diabetes has already benefited from advances in precision medicine, notably in the USA (see chapter 5).

The impact of soil, freshwater and air pollution on human health is gaining in international priority. It enjoyed the highest global growth rate among the examined health topics. The Russian Federation has boosted its own output on this topic from 157 (2012–2015) to 609 (2016–2019) publications. The government has set a target of lowering air pollution by 22%, as part of its national research projects endeavour covering the period from 2013 to 2024 (see chapter 13). Sub-Saharan Africa is also taking up this research, with output having doubled from 523 (2012–2015) to 1 085 (2016–2019) publications, comparable to the pattern observed in the Arab States and Asia.

The intersection of environmental and human health is increasingly obvious. In 2020, this link was most commonly illustrated by the global call for frequent handwashing during the Covid-19 pandemic, which presupposes that freshwater is easily available and pathogen-free.

Freshwater management a growing research focus in Asia

Globally, an estimated 80% of all industrial and municipal wastewater is released into the environment without any prior treatment, placing human health and ecosystems at risk (WWAP, 2017). This ratio is much higher in low-income countries, where sanitation and wastewater treatment facilities are a rare commodity. Countries in this income bracket contributed to 0.8% of global publications on wastewater management in 2019, up from 0.3% in 2011 (Figure 2.5).

In the Arab States, growth in research on **wastewater treatment, recycling and re-use** was surpassed only by that on photovoltaics and smart-grid technology.

In the Philippines, a wastewater management system has been deemed indispensable for making the New Clark City development both smart and green (see chapter 26). Following the announcement of this new smart city, output on this topic by Filipino researchers doubled to more than 30 publications per year in 2018.

Growth in scientific publications on this topic has been strong elsewhere in East and Southeast Asia. For example, Viet Nam's output has quadrupled from 51 (2012–2015) to 206 (2016–2019) publications.

Between 2011 and 2019, global research on the **sustainable withdrawal and supply of freshwater resources** surged by 150% to 13 863 publications. The strongest growth was observed in the Arab States and Central Asia, both of which are experiencing water insecurity.

Nearly 86% of the Arab population, or close to 362 million people, lives under conditions of chronic water scarcity (UNESCWA, 2019). This scarcity has increased dependency on transboundary, non-renewable groundwater resources (fossil water), which is unsustainable. In the past eight years, the region has doubled its research output on **transboundary water management** from 14 (2012–2015) to 31 (2016–2019) publications. Although the numbers are modest, this nevertheless represents 5% of global output on this topic.

The Arab region's research output on **desalination** is much larger. Moreover, it grew by 50% between 2012 and 2019, from 1 468 to 2 218 publications, accounting for 10% of the global total (see chapter 17).

Greater research focus on impact of climate hazards than mitigation

The threats to freshwater supply and the spread of many communicable diseases cannot be separated from the defining crisis of our time: climate change.

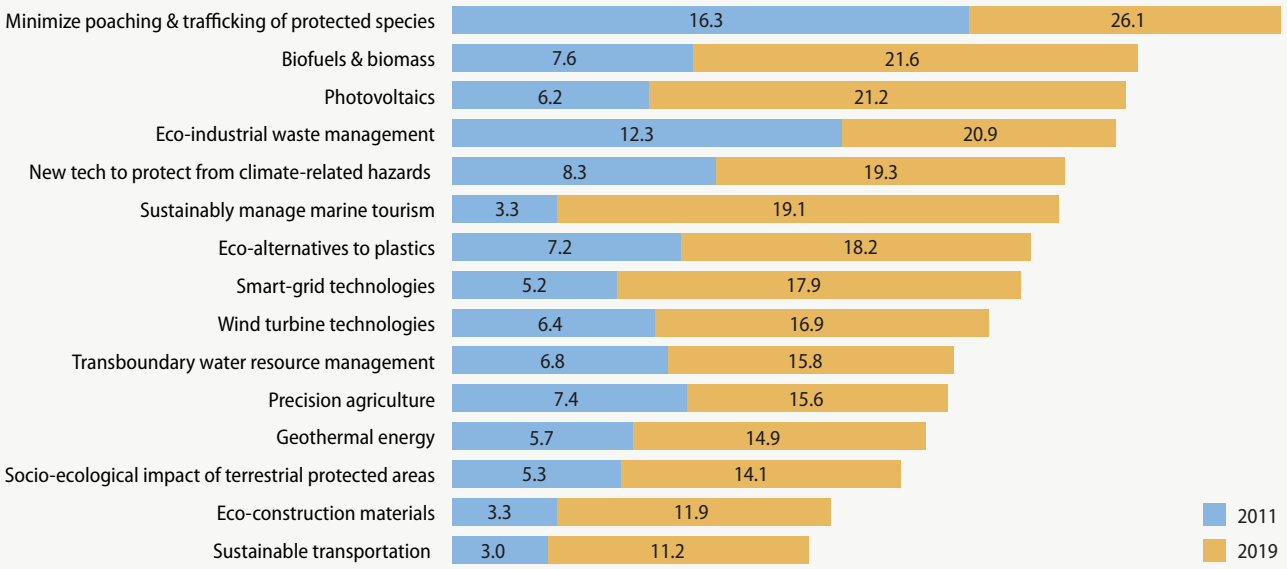
The side-effects of our reliance on fossil fuels are severe, as we shall see in the following pages. Direct economic losses from climate-related disasters rose by 151% between 1998 and 2017 (UNISDR and CRED, 2019). Single events can decimate an economy, as demonstrated in 2015 when Cyclone Pam cost Vanuatu 61% of its national GDP (see chapter 26). In the Caribbean, the particularly destructive Hurricane Maria in 2017 led Ross University's School of Medicine to depart Dominica after 40 years, amputating about 19% of the country's GDP in the process (see chapter 6).

Globally, research still focuses more on understanding the **local impact of climate-related hazards and disasters** than on mitigating such hazards (Figure 2.9).

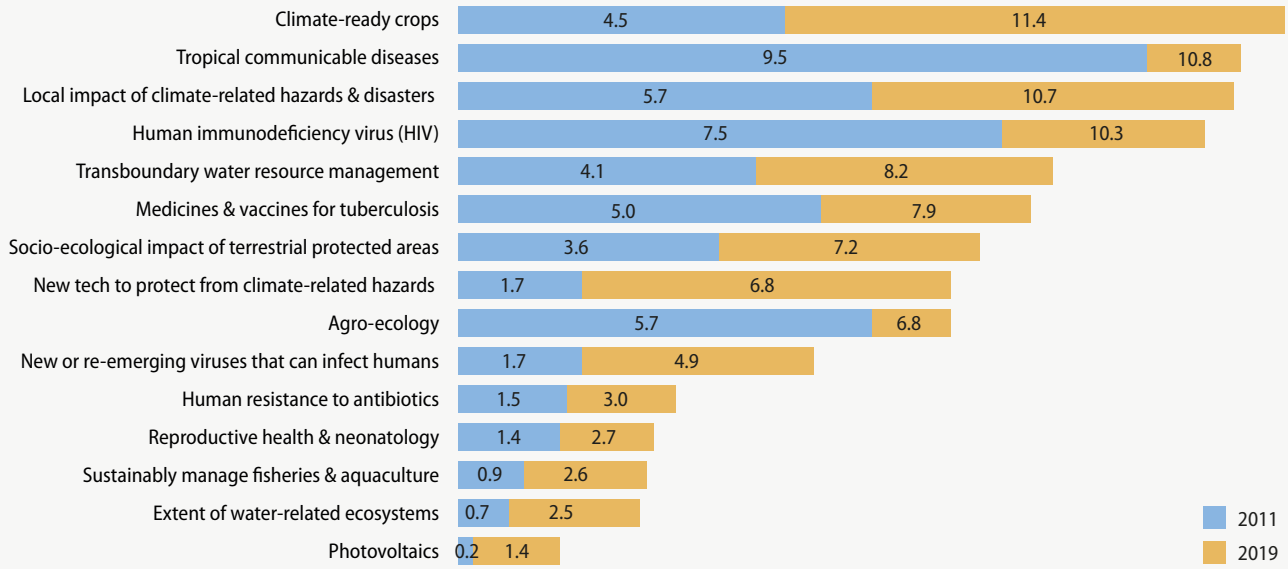
Climate-related disasters have focused attention on rebuilding more resilient infrastructure capable of

Figure 2.8: Top 15 research topics for lower middle-income and low-income countries by increase in their share of global output, 2011–2019

Top 15 topics by increase in the share of global output from lower middle-income economies, 2011 and 2019 (%)



Top 15 topics by increase in the share of global output from low-income economies (%)



Note: See Annex 1 for a list of countries by income group.

Source: Scopus (Elsevier), including Arts, Humanities and Social Sciences; data treatment by Science-Metrix

withstanding the growing intensity and frequency of extreme events (IPCC, 2018). Research on **new technologies to protect from climate-related hazards** is growing in several developed countries (Figure 2.10) but research output is noticeably absent, or static, in the most vulnerable regions like the Caribbean (see chapter 6).

This research topic showed the tenth-fastest growth rate in sub-Saharan Africa. Studies of the local impact of climate-related hazards and disasters was even the eighth-highest priority. These efforts are also being supported at the regional level, such as through the Southern African Development Community's Regional Climate Change Programme (see chapter 20) and the West African Science Service Centre on Climate Change and Adapted Land Use (see chapter 18).

Little growth in research on carbon capture

All of the pathways defined by the Intergovernmental Panel on Climate Change for limiting global warming to 1.5°C rely on technological advances in carbon dioxide (CO_2) removal from the atmosphere to augment the natural process of carbon sequestration (IPCC, 2018). Companies such as Equinor (formerly Statoil), Total and Shell are all developing projects in this area. In Norway, Equinor is developing what may become the first industrial-scale project for **carbon capture and storage** in Europe (see chapter 11).

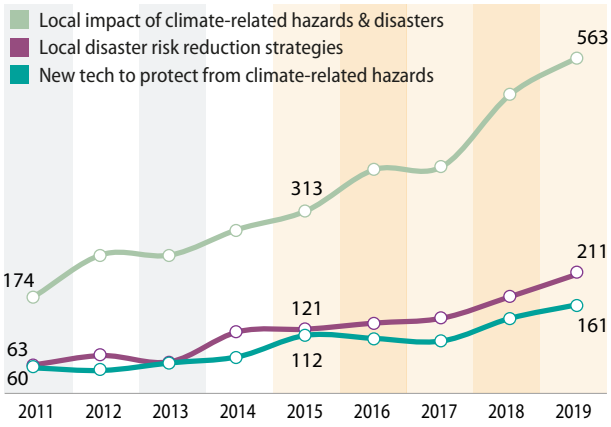
This new industrial sector is still in its infancy. Only a minute quantity of CO_2 is being stored artificially at the global level: 35 million tonnes in 2019, a drop in the ocean compared to global carbon emissions of 40 gigatonnes. The International Energy Agency's clean technology scenario forecasts a cumulative storage capacity of 107 gigatonnes of CO_2 by 2060 (IEA, 2019).

Global scientific output does not match the urgency of finding technical solutions to sequester carbon. The topic of carbon capture and storage has one of the lowest growth rates, with a mere 2 501 publications on this topic produced around the world in 2019. This compares with 12 975 publications on smart-grid technology, up from 4 737 in 2011.

The USA leads the field for the volume of output on carbon capture and storage but its own publications have declined from 2 507 (2012–2015) to 2 098 (2016–2019). In fact, output has been declining in six of the top ten countries for this topic, namely Canada, France, Germany, the Netherlands, Norway and USA. Here, again, China is poised to take the lead, with its publications having surged from 1 300 (2012–2015) to 2 049 (2016–2019).

Both the severity of the impact of climate change and countries' capacity to respond vary around the world, increasing the need for geographical and epistemological diversity in climate-related research. Among small island developing states (SIDS), Fiji dominated output in this area between 2012 and 2019, both in terms of volume and specialization. Fiji hosts the regional University of the South Pacific, which serves 12 countries (see chapter 26). However, even on this existential topic for SIDS, local researchers are not visible in global publishing.

Figure 2.9: **Volume of global publications on climate hazards, 2011–2019**



Source: Scopus (Elsevier), including Arts, Humanities and Social Sciences; data treatment by Science-Metrix

Surge in research on climate-ready crops in developing world

On the topic of **climate-ready crops**, developing regions specializing in agriculture come into their own. By 2019, low-income economies were contributing to 11% of global output on climate-ready crops, up from 4.5% in 2011 (Figure 2.8). Lower middle-income countries contributed another 32% (up from 26%). Mexico doubled its own output and there are encouraging signs from other vulnerable countries, such as Ethiopia, Ghana, India, Kenya, Mali, Mozambique and Senegal.

Climate-ready crops make up one of the fastest-growing research topics for sub-Saharan Africa and take the lead among topics with at least 100 publications (Figure 2.10). This trend is in line with the Comprehensive Africa Agriculture Development Programme and the *Malabo Declaration on Accelerated Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihoods* (see chapters 18, 19 and 20).

The rise in climate-related research in West Africa can also be linked to regional initiatives. Since 2014, the World Bank has supported the Africa Higher Education Centers of Excellence programme, including the West Africa Centre for Crop Improvement at the University of Ghana, which is developing climate-resilient strains of food crops. For its part, Germany has invested over € 50 million (US$ 56 million) in the West African Science Service Centre on Climate Change and Adapted Land Use, including with regard to related doctoral programmes at universities in the region (see chapter 18).

More recently, the World Bank has extended the Centres of Excellence Programme to East Africa. Since 2017, there has been a centre specializing in climate-smart agriculture at Haramaya University in Kenya, for instance, and another in agro-ecology and livelihood systems at the Uganda Martyrs University (see chapter 19).

With the Covid-19 pandemic having altered global flows of food and agricultural workers, the topic of climate-ready crops may become a priority investment for countries wishing to maintain healthy domestic food supplies.

Figure 2.10: **Top SDG-related topics based on specialization and growth in selected regions and countries, 2011–2019**

For topics with at least 100 publications over 2011–2019
The growth rate and specialization index are given within brackets

USA

Top five topics by growth rate
- Floating plastic debris in the ocean (3.62)
- Help for smallholder food producers (2.12)
- Sustainably manage marine tourism (1.84)
- Local impact of climate-related hazards & disasters (1.71)
- Local disaster risk reduction strategies (1.67)

Top five topics by specialization
- Human immunodeficiency virus (HIV) [1.92]
- Tackle invasive alien species (1.61)
- Ocean acidification (1.50)
- New or re-emerging viruses that can infect humans (1.46)
- Extent of water-related ecosystems (1.39)

EUROPEAN UNION

Top five topics by growth rate
- Floating plastic debris in the ocean (5.29)
- New tech to protect from climate-related hazards (1.90)
- Greater battery efficiency (1.76)
- Minimize poaching & trafficking of protected species (1.75)
- Local impact of climate-related hazards & disasters (1.75)

Top five topics by specialization
- Floating plastic debris in the ocean (1.74)
- Ecosystem-based approaches in marine environments* (1.58)
- Eco-construction materials (1.56)
- Nuclear fusion (1.41)
- New tech to protect from climate-related hazards (1.30)

EUROPEAN FREE TRADE ASSOC.

Top five topics by growth rate
- Climate-ready crops (2.19)
- Precision agriculture (1.93)
- Greater battery efficiency (1.87)
- Local impact of climate-related hazards & disasters (1.86)
- Eco-construction materials (1.72)

Top five topics by specialization
- Carbon capture & storage (3.70)
- Sustainably manage fisheries & aquaculture (3.25)
- Geothermal energy (2.72)
- Hydropower (2.10)
- Cleaner fossil fuel technology (1.98)

BRAZIL

Top five topics by growth rate
- Floating plastic debris in the ocean (3.21)
- New or re-emerging viruses that can infect humans (2.50)
- Eco-construction materials (2.02)
- Carbon capture & storage (2.01)
- Sustainable withdrawal & supply of freshwater (2.00)

Top five topics by specialization
- Agro-ecology (4.48)
- Tropical communicable diseases (4.16)
- Traditional knowledge (3.52)
- Help for smallholder food producers (3.08)
- Sustainable use of terrestrial ecosystems (2.60)

SUB-SAHARAN AFRICA

Top five topics by growth rate
- Climate-ready crops (2.85)
- Greater battery efficiency (2.85)
- Eco-construction materials (2.85)
- Smart-grid technologies (2.61)
- Carbon capture & storage (2.48)

Top five topics by specialization
- Help for smallholder food producers (27.35)
- Traditional knowledge (11.75)
- Minimize poaching & trafficking of protected species (11.66)
- Human immunodeficiency virus (HIV) [11.46]
- Tropical communicable diseases (9.04)

ARAB STATES

Top five topics by growth rate
- Sustainable transportation (2.80)
- Climate-ready crops (2.76)
- Smart-grid technologies (2.73)
- Precision agriculture (2.57)
- Eco-construction materials (2.41)

Top five topics by specialization
- Desalination (3.75)
- Wind turbine technologies (2.63)
- Water harvesting (2.36)
- Photovoltaics (2.22)
- Wastewater treatment, recycling & re-use (2.00)

LATIN AMERICA

Top five topics by growth rate
- Floating plastic debris in the ocean (3.62)
- National & urban greenhouse gas emissions (2.58)
- New tech to protect from climate-related hazards (2.45)
- Extent of water-related ecosystems (2.28)
- Eco-construction materials (2.20)

Top five topics by specialization
- Agro-ecology (3.95)
- Tropical communicable diseases (3.77)
- Traditional knowledge (3.34)
- Help for smallholder food producers (2.86)
- Sustainable use of terrestrial ecosystems (2.78)

CARIBBEAN

Top five topics by growth rate
- Human resistance to antibiotics (2.16)
- New or re-emerging viruses that can infect humans (1.78)
- Wastewater treatment, recycling & re-use (1.56)
- Traditional knowledge (1.45)
- Impact on health of soil, freshwater & air pollution (1.38)

Top five topics by specialization
- Tropical communicable diseases (5.40)
- Human immunodeficiency virus (HIV) (3.66)
- Medicines & vaccines for tuberculosis (3.01)
- Reproductive health & neonatology (2.92)
- Traditional knowledge (2.89)

SOUTH AFRICA

Top five topics by growth rate
- Local impact of climate-related hazards & disasters (4.75)
- Climate-ready crops (4.19)
- Human resistance to antibiotics (2.93)
- Eco-industrial waste management (2.77)
- Photovoltaics (2.73)

Top five topics by specialization
- Help for smallholder food producers (10.78)
- Minimize poaching & trafficking of protected species (10.45)
- Human immunodeficiency virus (HIV) [10.23]
- Medicines & vaccines for tuberculosis (9.13)
- Traditional knowledge (8.18)

RUSSIAN FEDERATION

Top five topics by growth rate
- Sustainable transportation (7.31)
- Eco-construction materials (6.95)
- Precision agriculture (6.11)
- Wind turbine technologies (4.95)
- Wastewater treatment, recycling & re-use (4.92)

Top five topics by specialization
- Radioactive waste management (2.58)
- Nuclear fusion (2.11)
- Geothermal energy (1.04)
- Medicines & vaccines for tuberculosis (0.87)
- Hydropower (0.80)

REPUBLIC OF KOREA

Top five topics by growth rate
- Impact on health of soil, freshwater & air pollution (2.02)
- Agro-ecology (1.84)
- Tackle invasive alien species (1.77)
- National integrated water resource management (1.67)
- Eco-industrial waste management (1.65)

Top five topics by specialization
- Photovoltaics (2.50)
- Greater battery efficiency (2.34)
- Hydrogen energy (1.91)
- Sustainable transportation (1.63)
- Radioactive waste management (1.59)

CHINA

Top five topics by growth rate
- Floating plastic debris in the ocean (40.86)
- Transboundary water resource management (2.85)
- Help for smallholder food producers (2.78)
- Water harvesting (2.74)
- Ocean acidification (2.69)

Top five topics by specialization
- Greater battery efficiency (2.12)
- National & urban greenhouse gas emissions (1.73)
- Coastal eutrophication (1.72)
- Hydropower (1.53)
- Cleaner fossil fuel technology (1.52)

THAILAND

Top five topics by growth rate
- Eco-construction materials (3.86)
- Eco-industrial waste management (2.51)
- Sustainable transportation (2.44)
- Greater battery efficiency (2.44)
- Help for smallholder food producers (2.39)

Top five topics by specialization
- Eco-alternatives to plastics (9.12)
- Sustainably manage fisheries & aquaculture (4.00)
- Tropical communicable diseases (3.96)
- Biofuels & biomass (3.67)
- Help for smallholder food producers (3.10)

VIET NAM

Top five topics by growth rate
- Eco-construction materials (12.00)
- Hydrogen energy (7.09)
- Smart-grid technologies (5.54)
- Biofuels & biomass (5.22)
- Eco-industrial waste management (5.17)

Top five topics by specialization
- Sustainably manage fisheries & aquaculture (4.42)
- Help for smallholder food producers (3.60)
- New or re-emerging viruses that can infect humans (2.17)
- Maintain genetic diversity of food crops (1.93)
- Hydropower (1.91)

JAPAN

Top five topics by growth rate
- Impact on health of soil, freshwater & air pollution (1.63)
- Eco-industrial waste management (1.60)
- Geothermal energy (1.48)
- National & urban greenhouse gas emissions (1.46)
- Eco-construction materials (1.43)

Top five topics by specialization
- Nuclear fusion (1.88)
- Radioactive waste management (1.60)
- Regenerative medicine (1.31)
- Hydrogen energy (1.21)
- Photovoltaics (1.21)

INDIA

Top five topics by growth rate
- Sustainable transportation (3.96)
- Smart-grid technologies (3.19)
- Greater battery efficiency (2.92)
- Eco-construction materials (2.70)
- Geothermal energy (2.47)

Top five topics by specialization
- Climate-ready crops (3.07)
- Medicines & vaccines for tuberculosis (2.95)
- Traditional knowledge (2.83)
- Water harvesting (2.74)
- Pest-resistant crops (2.12)

MALAYSIA

Top five topics by growth rate
- Carbon pricing (2.65)
- Sustainable withdrawal & supply of freshwater (2.52)
- Hydropower (2.27)
- Greater battery efficiency (2.24)
- Carbon capture & storage (2.21)

Top five topics by specialization
- Eco-alternatives to plastics (6.11)
- Eco-industrial waste management (3.99)
- Biofuels & biomass (3.71)
- Eco-construction materials (3.24)
- Traditional knowledge (2.99)

AUSTRALIA

Top five topics by growth rate
- Floating plastic debris in the ocean (3.94)
- Minimize poaching & trafficking of protected species (2.18)
- Greater battery efficiency (2.09)
- Help for smallholder food producers (1.98)
- Climate-ready crops (1.94)

Top five topics by specialization
- Ocean acidification (5.63)
- Local disaster risk reduction strategies (5.45)
- Sustainably manage marine tourism (5.38)
- Local impact of climate-related hazards & disasters (4.62)
- Socio-ecological impact of terrestrial protected areas (3.93)

INDONESIA

Top five topics by growth rate
- Eco-alternatives to plastics (25.83)
- Sustainably manage marine tourism (16.83)
- Eco-construction materials (8.52)
- Water harvesting (8.00)
- Traditional knowledge (6.73)

Top five topics by specialization
- Sustainably manage marine tourism (10.50)
- Geothermal energy (6.34)
- Help for smallholder food producers (6.25)
- Eco-alternatives to plastics (5.44)
- Minimize poaching & trafficking of protected species (4.73)

NEW ZEALAND

Top five topics by growth rate
- Greater battery efficiency (3.26)
- Local impact of climate-related hazards & disasters (2.29)
- Hydrogen energy (1.77)
- Human resistance to antibiotics (1.65)
- Agro-ecology (1.63)

Top five topics by specialization
- Tackle invasive alien species (6.52)
- Geothermal energy (6.44)
- Ocean acidification (6.41)
- Status of terrestrial biodiversity (3.04)
- Sustainable use of terrestrial ecosystems (2.78)

* The topic of ecosystem-based approaches in marine environments covers environments within national exclusive economic zones.

Note: Topics with at least 100 publications were considered, with exceptions for the Caribbean, Indonesia, Malaysia, New Zealand, the Russian Federation, Singapore, Thailand and Viet Nam (50 publications).

Source: Scopus (Elsevier), including Arts, Humanities and Social Sciences; data treatment by Science-Metrix

Resilient food systems rely on smart use of land and sea

The world is not on track to achieve SDG2 for zero hunger, according to the UN Food and Agriculture Organization (FAO, 2020a). Innovation in sustainable food systems, such as climate-ready crops, agro-ecology and **precision agriculture**,[8] can make agriculture more productive without depleting soils.

These three approaches were among the fastest-growing research topics in the Russian Federation over the 2012–2019 period (Figure 2.10). Sustainable agriculture features among the seven mission-oriented priorities of the government's *Strategy for the Development of Science and Technology* to 2035 (see chapter 13).

Along with China, India, Israel and the UK, the Russian Federation boosted its output on precision agriculture by 70% or more between 2011 and 2019. On this topic, high-income economies maintained their share (*ca* 60%) of global publications over the period under study, whereas the contribution by lower middle-income economies grew from 10% to 14% of total output over the dual periods 2012–2015 and 2016–2019 (Figure 2.5).

In considering efforts to achieve zero hunger, it would be misguided to consider only advanced technologies. Sub-Saharan African researchers specialize in **helping smallholder food producers**. This topic is a small field globally, with sub-Saharan authors contributing to 361 of the world's 885 publications and the EU 294 articles in 2019.

There are signs that other regions are taking up this research. Between 2011 and 2019, East and Southeast Asia's global share of output increased from 15% to 23% for instance. Sub-Saharan Africa's own share decreased from

Box 2.2: How sustainable is advanced technology?

As you read this, most of you could reach out and touch at least one device containing cobalt that may have been extracted from the Democratic Republic of the Congo, or lithium that may have come from Australia, among scores of other metals and rare earth metals. Over half of the 30 elements in the average smartphone are increasingly scarce and many are being obtained through unsustainable and unjust mining practices.

Mining is having a widespread impact on people and ecosystems. The first study of the effects of mining-related pollution on newborns in sub-Saharan Africa demonstrated a link between birth defects and paternal mining-related work in the Democratic Republic of the Congo (Van Brusselen *et al.*, 2020). The health of miners has grown into a national policy issue but the drivers of resource extraction, namely consumer demand and industry pressure, are international in scope.

Demand for technology is often used as a reason to push for mining, including deep-sea mineral exploration. The transition towards efficient electrification will increase our demand for batteries and, therefore, for rare earth metals. At the same time, technology is transforming mining through automation, reducing the risk to miners and improving efficiency (McKinsey & Company, 2018).

The benefits of the circular economy

To enjoy the benefits of advanced technology, products must be produced more sustainably, last longer and be recycled at their end of life. Our track record in these areas is weak.

Manufacturing waste exceeds post-consumer waste by an order of magnitude (Lepawsky, 2019). E-waste is the fastest-growing waste stream. In 2019, each person produced 7.3 kg, on average, but only 1.3 kg underwent environmentally sound recycling (Forti *et al.*, 2020). In other words, 83% of e-waste is undocumented. Globally, 54 million metric tonnes of e-waste were discarded in 2019 and we shall most likely throw away more than 75 million metric tonnes each year by 2030 (Forti *et al.*, 2020).

The term 'planned obsolescence' refers to the design of a product to ensure that it becomes rapidly outdated, either because it cannot be repaired or is intentionally subject to early failure, obliging the customer to replace the product. The combination of planned obsolescence and repair monopolies has contributed to shorter product lifespans and undermined our ability to understand and fix our own belongings, particularly when they involve advanced technologies.

Although proponents argue that early obsolescence drives rapid innovation and economic growth, consumers and sustainability experts wish products to last longer. Today's buyers pay for products with ever-shorter lifespans: in 2013, 8.3% of appliances were replaced within five years due to a defect, compared to 3.5% in 2004 (Prakash *et al.*, 2016).

In 2015, France made history by passing Hamon's Law, which made planned obsolescence illegal and obliged French manufacturers to identify if, and for how long, replacement parts would be available for a given product.

Recycling is hindered by repair monopolies and the transition away from standardized modular construction that would enable the sale and re-use of parts. Consumers are beginning to demand the 'right to repair' the technology they purchase.

In the USA, right-to-repair legislation is being considered at the federal level for the first time, thanks to the Covid-19 pandemic. The Critical Medical Infrastructure Right-to-Repair Act* of 2020 would permit technicians to perform critical repairs of hospital equipment without fear of a lawsuit if they break a digital lock. In advance of federal legislation, 20 of the 50 US states have considered right to repair bills for specific sectors. However, major corporations have successfully lobbied against several state proposals.

Such lobbying has also stymied repair bills in Canada, despite a 2019 poll by the Innovative Research

46% to 41%, despite a growth rate of 2.0%. Global interest in this topic among all income groups may reflect high levels of international collaboration (Figure 2.5).

Asia and Africa have the most smallholdings in agriculture but large-scale farming is gaining ground around the world, which often involves foreign ownership of arable land. This has consequences for long-term land management. The International Land Coalition estimates that 1% of the world's largest farms manage over 70% of the world's farmland (ILC, 2020).

Less research on sustainably managing fisheries

More than half of the global ocean is harvested on an industrial scale, an area four times greater than land used for intensive agriculture (Kroodsma *et al.*, 2018). Despite this, the volume of scientific research on the **sustainable management of fisheries and aquaculture** declined by 2% annually worldwide, from 3 754 publications in 2011 to 3 135 in 2019.

Fish supply up to 90% of protein in the diets of coastal populations and assure a livelihood for one in ten human beings (Gaines *et al.*, 2018). However, the Food and Agriculture Organization (FAO) has demonstrated that 90% of commercially exploited marine fish stocks are either overfished or fished to their maximum sustainable limits (FAO, 2020b). Researchers have estimated that proactive and adaptive fishery management could boost profits and result in 60% more fish biomass (Gaines *et al.*, 2018).

In this context, the missing research by scientists from the Caribbean, Southeast Asia, sub-Saharan Africa and the islands

Group showing that 75% of Canadians support right-to-repair legislation. Similarly, according to a 2014 Eurobarometer survey, 77% of European Union citizens would rather repair their goods, even though the current cost of repairs and service options leads most to replace or discard their belongings (EU, 2014).

The European Commission is working towards a right to repair for consumers, including a right to update obsolete software (see chapter 9). In 2019, it adopted eco-design measures to increase the energy efficiency and reparability of household appliances.** From 2021, manufacturers will have to make appliances last longer and supply spare parts for machines for up to 10 years.

In Bangladesh in 2020, the Department of the Environment published the draft *Hazardous Waste (E-Waste) Management Rules*, restricting the use of 15 chemical substances in certain electrical products and outlining procedures for company recycling of e-waste. Since 2019, entities seeking to import machinery and other accessories for initiatives with an environmental focus like waste management can access the Green Transformation Fund managed by the national central bank (see chapter 21).

Our choices will define our legacy

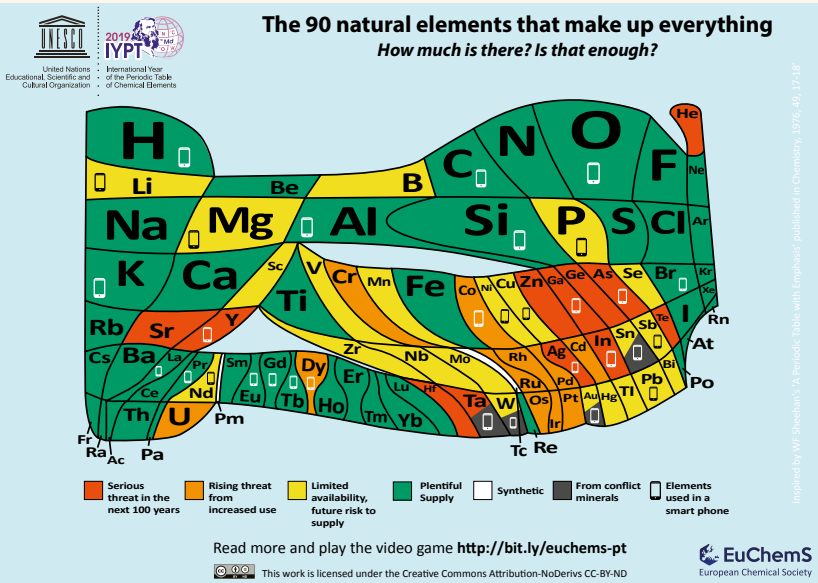
Our choices about technology consumption and production will define our legacy. For example, the process of modern steel production is contaminated with radionuclides carried in the air, as background radiation in the atmosphere has increased since the start of the nuclear era in the 1940s. To meet the demand for uncontaminated, low-background steel, pillagers are seeking to retrieve metals from shipwrecks that predate the nuclear era.

UNESCO is supporting the efforts of countries to identify and manage such sites through the Convention on Underwater Cultural Heritage but pressure is mounting for unregulated retrieval of non-irradiated metals. This begs the age-old question of preservation versus re-use: what are we prepared to give up of our past to create the future we want?

Source: compiled by Tiffany Straza

* See: https://tinyurl.com/congress-USgov-right-to-repair

** See: https://tinyurl.com/EC-rules-sustainableappliances



Graphic produced in 2019 for the International Year of the Periodic Table of Chemical Elements designated by UNESCO to mark the 150th anniversary of the Mendeleev periodic table

Source: European Chemical Society and UNESCO

of Oceania is striking. Indonesia is a notable exception. Its output quadrupled from 115 to 479 publications between 2012–2015 and 2016–2019.

With over 40% of the world's population living within 100 km of the coast and excess nutrients from human activities a known contributor to the loss of oxygen from the global ocean, the 12 231 global publications on **coastal eutrophication** from 2011 to 2019 might seem paltry.

Among major economies, Canada's 37% growth stands out: from 206 to 336 publications. Among least developed countries, output rose by 30% over this nine-year period to a total of 58 publications.

Ocean-dependent countries with traditional connections to the sea are assuming global leadership roles in the sustainable management of oceanic systems. Kenya hosted the first global Sustainable Blue Economy Conference in 2018 and co-hosted the second United Nations Ocean Conference in 2019, following the first such event in 2017 co-hosted by Fiji and Sweden to address SDG14 on oceans. Kenyan scientists published at least three times the global average intensity on sustainable management of fisheries and aquaculture between 2011 and 2019.

In 2018, Kenya joined others[9] in establishing the High-Level Panel for a Sustainable Ocean Economy. This Ocean Panel committed to an ocean action agenda in December 2020 with knowledge forming one of the five priority areas of transformation, leveraging the UN Decade of Ocean Science.

We can expect growth in publishing in ocean science during the United Nations Decade of Ocean Science for Sustainable Development, which got under way in January 2021 under the stewardship of the UNESCO Intergovernmental Oceanographic Commission.[10] With inclusivity being a key principle for the Decade, research is expected to be internationally collaborative and representative of ocean users. The multifarious connections between marine resources and planetary health make this research area a rich source of scientific discovery but also reliant upon technology transfer.

One growth area is the study of **ocean acidification**. The acidity of seawater is increasing, effectively depleting the calcium carbonate which serves to form the skeletons and shells of corals and shellfish. This is imperilling ocean ecosystems, the marine food web and, indirectly, a major source of protein for human populations. The acidification of the ocean stems from the same cause as the climate crisis, namely greenhouse gas emissions driven primarily by fossil fuel-based energy systems.

Will the energy transition keep pace with research?

In 2018, over 80% of world energy production remained based on coal, oil and gas (Figure 2.11) [IEA, 2020]. Nuclear power (5%) and renewable energy (14%) made up the remainder. Among renewables, biofuels and waste (9.3%) dominated; solar photovoltaic and wind power represented less than 2% of total energy production and geothermal plants less than 0.5%.

Even if global coal use were to end immediately, assuming cement emissions remain constant, existing developed oil and gas fields would push the world beyond the target of 1.5°C warming (OCI, 2020). Despite the growing impact of climate change, action by governments and businesses in support of the necessary energy transition is lagging behind. In the four years (2016–2019) following adoption of the *Paris Agreement*, 35 banks from Canada, China, Europe, Japan and the USA together invested US$ 2.7 trillion in fossil fuels (RAN *et al.*, 2020). India's *National Electricity Plan* (2018) foresees adding 46 GW of coal-fired capacity by 2027, even though plans to build nearly 14 GW of coal-fired power plants were cancelled in May 2017 after being deemed uneconomical (see chapter 22). In the USA, factors such as falling costs and federal tax credits have driven growth in renewable energy but the huge legacy investments of large US energy companies have been hindering the deployment of clean energy (see chapter 5).

In 2017, Ireland became the world's first country to commit to divesting public money fully from fossil fuels, when parliament passed legislation to remove investment in coal, oil and gas from the € 8 billion (*ca* US$ 9.5 billion) Ireland Strategic Investment Fund (ECEEE, 2017). In 2019, the Norwegian parliament passed a law requiring the Norwegian Sovereign Wealth Fund, the world's largest with a worth of over US$ 1 trillion, to drop investments of US$ 13 billion in eight coal companies and about 150 oil producers (Ambrose, 2019).

Renewable energy systems have become cheaper to build than fossil fuel power plants across much of the world (IRENA, 2020), thanks to advances in wind and solar energy technology, in particular. Renewable energy was the only energy sector to see growth at the height of the Covid-19 pandemic and demand is projected to grow further (IEA, 2020).

Many countries have set renewable energy targets and some have formalized commitments to a sustainable transition, through instruments such as the *Sustainability Charter* (2016) signed by Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia and Serbia under the *Energy Community Treaty* (2006) [see chapter 10]. Papua New Guinea was the first country to submit its Nationally Determined Contribution (2016) under the *Paris Agreement*, setting out a plan to transition to 100% renewable energy by 2030 and attain carbon neutrality by 2050. At the time of writing in February 2021, at least 110 countries had set themselves the objective of achieving carbon neutrality by 2050. To this end, Costa Rica has developed a *National Decarbonization Plan 2018–2050* (see chapter 7). In March 2020, the European Commission enshrined the target of climate neutrality by 2050 in the European Climate Law. In December 2020, the Commission adopted the target of a 55% reduction in carbon emissions by 2030 over 1990 levels (see chapter 9). China has committed to carbon neutrality by 2060 (see chapter 23).

Smart-grid tech and battery efficiency dominate energy research topics

The UNESCO study assessed scientific publications in relation to energy production via photovoltaics, hydropower, biofuels and biomass, wind-turbine technologies, geothermal energy, hydrogen energy and nuclear fusion. The study also assessed

the extent to which scientific output prioritized cleaner fossil fuel technology, radioactive waste management and smart-grid technology.

Innovation in electricity distribution and storage is growing. Globally, publications on smart-grid technologies grew by nearly 12% per year from 4 737 in 2011 to 12 975 in 2019 (Figure 2.11). This impressive trend was surpassed only by output on **greater battery efficiency**, growing by 16% per year from 4 829 publications in 2011 to 18 692 in 2019. Batteries are expected to support an electrified future free from fossil-fuel consumption. Despite the expected reliance on efficient electrification and government targets for electricity production from renewable energy sources, only one in ten electric utility companies around the world is prioritizing investment in renewable energy over fossil fuels (Alova, 2020). In fact, 60% of the utilities prioritizing renewable energy are simultaneously expanding their investment in fossil fuels (Alova, 2020).

At the global level, output is stabilizing or even showing signs of decline for three of the ten selected clean energy topics, namely **cleaner fossil fuel technology, nuclear fusion** and **radioactive waste management**. Scientific output on renewable energy sources appears to have outpaced political or industrial will to transform energy supplies. Research attention is even levelling off in high-output economies: their share of global output declined by 5% or more for all of the selected energy topics. For example, high-income economies produced 6 805 (74.8% of the world's publications) on photovoltaics in 2011 and 7 928 (50.5%) in 2019.

Some of the strongest growth in research on sources of renewable energy is taking place in lower middle-income countries. For instance, their share of **photovoltaic** research surged from 6.2% to 21.2% between 2011 and 2019, that on **wind turbine technologies** from 6.4% to 16.9% and that on **biofuels and biomass** from 7.6% to 21.6% (Figures 2.5 and 2.8).

Vietnamese research output on biofuels and biomass has increased five-fold from 67 (2012–2015) to 350 publications (2016–2019) following the establishment of a 25% target for the share of biofuels in total vehicle fuel consumption by 2050 in Viet Nam's *Renewable Energy Development Strategy 2016–2030* (2015). The government banned the sale of standard gasoline in late 2017 to spur progress. Simultaneously, to avoid a repeat of price distortions for staple crops following a boom in biofuels, as had occurred in the 2000s, Viet Nam directed its ministries to control the price of biofuel and to define a price floor for cassava, the main raw material in ethanol production.

Photovoltaics formed the largest body of energy research among the topics examined, despite accounting for less than 2% of global energy supply in 2018. Electricity generation from solar photovoltaic systems has grown exponentially, with 32 038 GWh produced globally in 2010, compared to 554 283 GWh in 2018 (IEA, 2020).

Hydropower accounted for two-thirds of Brazil's installed capacity for electricity generation in 2020. Following a report by the Brazilian Agency for Water and Basic Sanitation in 2018 warning that 45 Brazilian dams were at a high risk of failure, the government announced the end of megahydropower projects in the Amazon (see chapter 8.) Research into the sustainable withdrawal and supply of freshwater is Brazil's fifth-fastest-growing topic (Figure 2.10).

The world's largest energy infrastructure project is planned for the Democratic Republic of the Congo, the Grand Inga hydropower dam (see chapter 20). Other African countries are multiplying projects to develop hydropower, wind and solar energy but African researchers are strikingly absent from this body of scientific research, despite the high priority accorded to renewable energy by the African Union's *Agenda 2063: the Africa We Want* (2015). Researchers from the Democratic Republic of Congo contributed to just seven publications on hydropower from 2011 to 2019.

Taken together, Kenya, Ethiopia and Tanzania account for half of the 20 million Africans who gained access each year to electricity between 2014 and 2018. By 2018, geothermal power generated in the Rift Valley had overtaken hydropower as the lead source of electricity in Kenya, powering 35% of households (see chapter 19). Research output has been erratic, however. Kenyan scientists produced 27 publications on **geothermal energy** in 2017 but only seven the following year and one in 2019.

Sub-Saharan researchers contributed to a total of just 829 publications from 2011 to 2019 on smart-grid technologies and 935 publications on solar photovoltaics. This translates into 1.4% and 1.5% of global output, respectively. Although the region showed the strongest specialization in hydropower among the energy topics examined, this research is being driven by only a handful of countries, led by South Africa.

With the opening of its Centre for Renewable Energy and Energy Efficiency in Namibia in 2015 (see chapter 20), the Southern African Development Community may see renewed growth in research on battery efficiency. Sub-Saharan output has already surged from 377 (2012–2015) to 983 (2016–2019) publications, driven by Ethiopia, Nigeria and South Africa.

Meanwhile, countries belonging to the Caribbean Community (Caricom) are striving to transition to clean energy, in a move led by the Caribbean Centre for Renewable Energy and Energy Efficiency established in 2017 (see chapter 6).

Such gains are fragile. Despite calls for green recovery plans, the post-Covid-19 strategies of many governments combine protection for jobs with investment in new high-carbon infrastructure, according to a recent analysis (Vivid Economics and F4B, 2020). One notable exception is the European Union (EU). With 30% of its Next Generation Recovery Fund devoted to green investment (see chapter 9), the EU leads the table for the net Greenness of Stimulus Index. The authors of the chapter on the EU in the present report argue that, 'to maintain its lead in green innovation, the EU will need to translate its vision into higher levels of investment, since the new US administration has pledged to invest massively, itself, in clean tech' (see chapter 9).

The future geoscience and engineering industry is expected to depend significantly less on oil and gas specialists than it does today. This means that both educational institutions and industry will need to begin adapting their training and

hiring practices, in order to tailor the supply of specialists to anticipated demand. To some extent, this process is already under way at the institutional level (OCI, 2020).

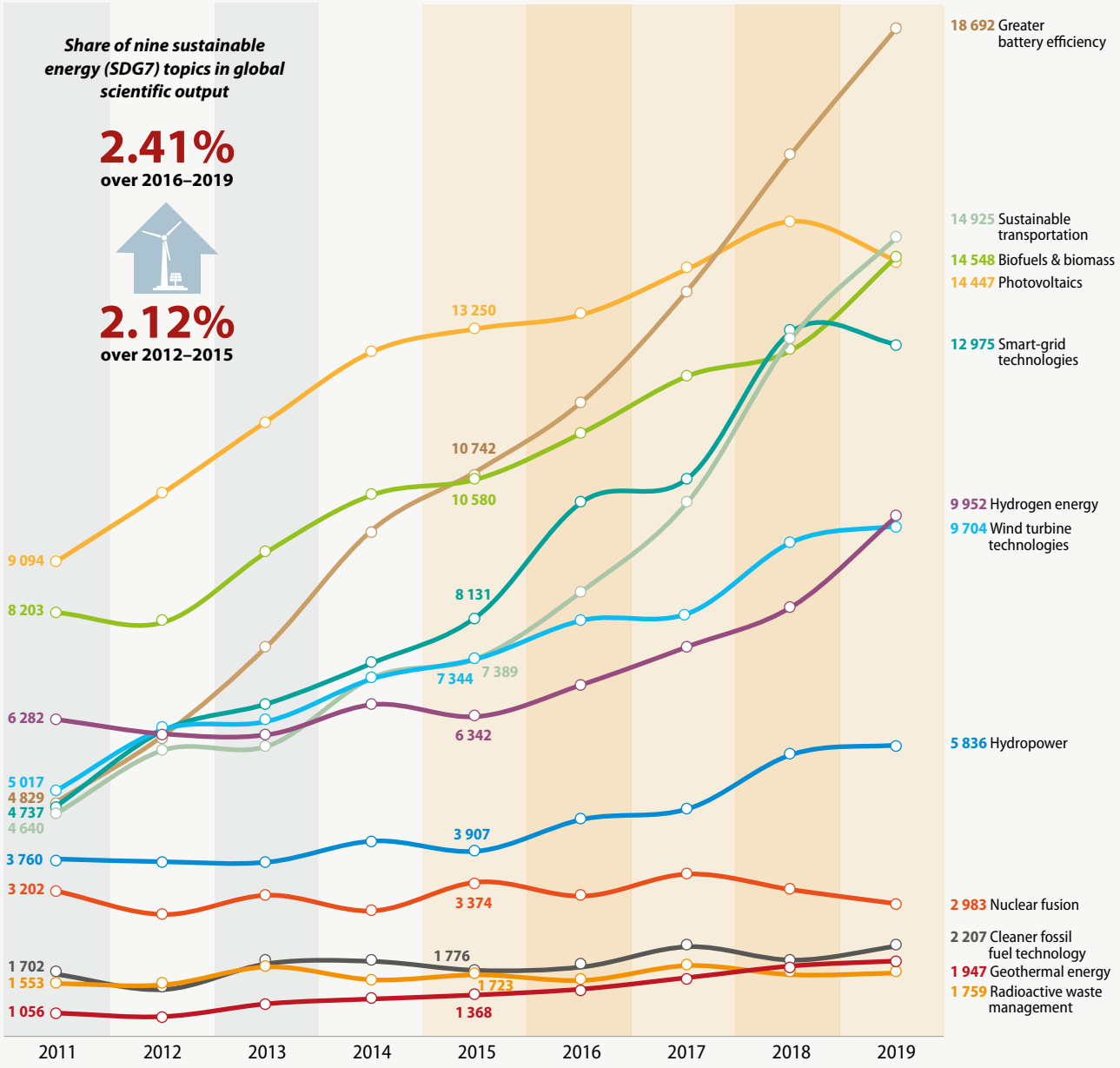
Nuclear energy currently provides 10% of the world's electricity and is the largest source of low-carbon energy (IEA, 2020). Although nuclear power features prominently in low-emission scenarios, uranium is not a renewable resource and nuclear reactors are ageing; by 2025, 25% of existing nuclear capacity in advanced economies will most likely have to be shut down.

Sustainable innovation goes beyond new technology

There are concerns that technological solutionism may become an excuse not to address the climate crisis, such as by investing in geo-engineering techniques to the detriment of transitioning to sustainable forms of energy, or by assuming that problems caused by new technology will be solved by technologies that do not yet exist. Fifty years ago, nuclear power was touted as the solution to the world's energy problems; today, we are still wrestling with the problem of radioactive waste disposal. Despite this, research output on radioactive waste

Figure 2.11: **Trends in energy production and publishing**

Global publications on selected energy and innovation topics, 2011–2019



Note: The line graph presents all topics assigned in this study to SDG7 as well as greater battery efficiency, radioactive waste management and sustainable transportation (SDG9).

Source: Scopus (Elsevier), including Arts, Humanities and Social Sciences; data treatment by Science-Metrix; for energy and electricity by source: International Energy Agency (2020) All rights reserved

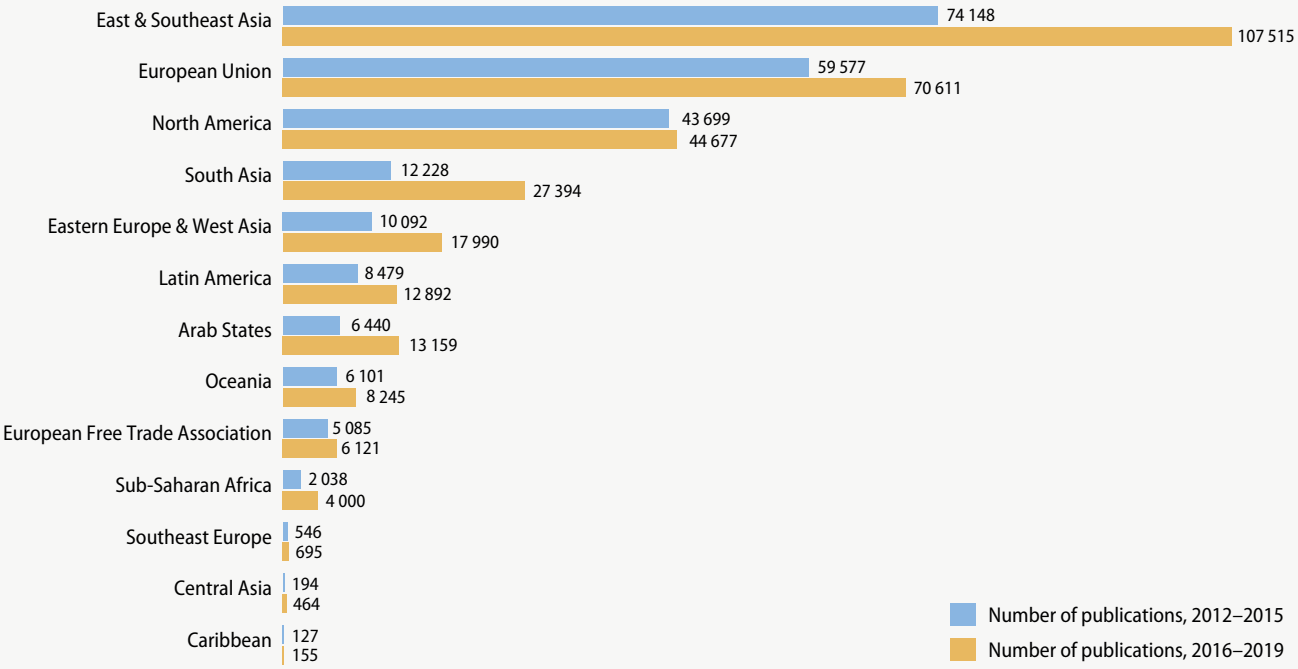
management remains small and is stagnating, even within the European Union where nuclear reactors supply nearly 20% of electricity. Germany is preparing to close down its last nuclear reactor in 2022.

More generally, the management of waste generated by technology poses a major challenge for sustainability. Some solutions will be technological but just as important will be our capacity to adopt sustainable production and consumption patterns. Governments are increasingly adopting policies to reduce waste and encourage the re-use and recycling of industrial products, to foster what is known as the circular economy (Box 2.2).

Mass investment in digital technology such as computers and mobile phones has created a heavy waste burden. Bangladesh generates some of the highest volumes of electronic waste: 2.7 million metric tonnes each year, according to the Environment and Social Development Organization Dhaka (see chapter 21).

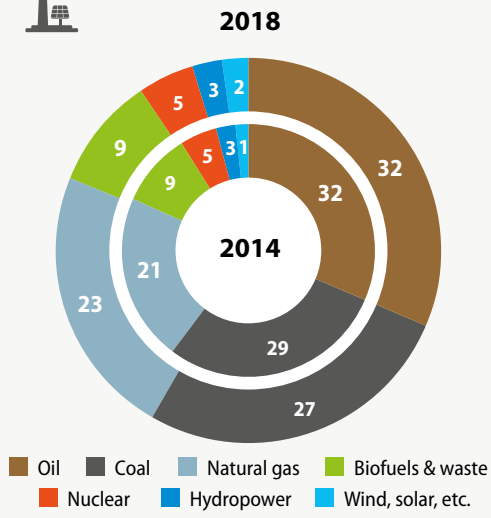
Global output on this topic is modest. For instance, scientists from Bangladesh produced 31 publications on

Volume of scientific publications on nine SDG7 renewable energy topics by selected region, 2012–2015 and 2016–2019

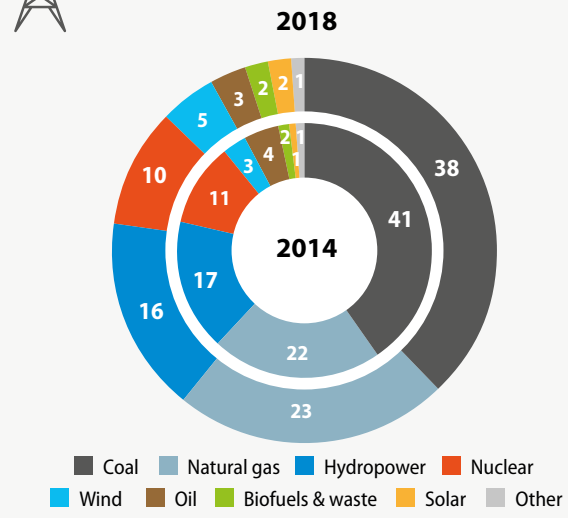


Note: The values for the regions are the number of unique publications and may differ from the sum of the sub-regions owing to potential co-authorship.

Global energy supply by source, 2014 and 2018 (%)



Global electricity generation by source, 2014 and 2018 (%)



Note: Other sources include waste, geothermal, solar thermal and energy derived from the tide..

eco-industrial waste management between 2012–2015 and 53 over 2016–2019 but this corresponded to 1.8 times the average global intensity for this topic.

In 2019, the African continent produced three million tonnes of electronic waste and continued to import it, yet only 13 African countries[11] had national e-waste legislation (Forti *et al.*, 2020). Rwanda approved an e-waste policy in 2016 and the next year launched the second-largest e-waste recycling facility in Africa (see photo, page 78). The facility creates a circular economy, with refurbished computers being sold or donated to schools, steel turned into steel bars for construction purposes and plastic crushed into pellets for re-use. The facility is undertaking a feasibility study with support from the Ministry of Trade and Industry and the EU in the hope of expanding to become the first lithium battery recycling facility in Africa (Kovacevic, 2020).

The Rwandan facility should reduce the widespread practice of informal recycling and burning of e-waste, which place people at great risk. Africans are disproportionately affected by the world's e-waste and mining residues (Forti *et al.*, 2020). Growth in research on the impact on health of air, soil and water pollution is fairly evenly distributed across the continent but sub-Saharan Africa still contributed less than 4% of global output on this topic in 2019.

Maphosa and Maphosa (2020) have demonstrated that e-waste research is gaining traction in Africa, a field they found to be dominated by Ghana, Nigeria and South Africa. This type of research is essential for problem-solving, to complement tracing the record of harm.

The UNESCO study shows a similar trend, with one notable difference. Although the bulk of research in sub-Saharan Africa stems from Nigeria (85/209 publications) and South Africa (77/213), Ethiopia's output on this topic has surged from 4 (2012–2015) to 37 (2016–2019) publications, overtaking Ghana (13/25). Ethiopia shows the subcontinent's fastest growth rate for this topic (9.3%), followed by Mauritius (3.5%), Cameroon and Mozambique (3.0%), South Africa (2.8%), Nigeria, Uganda and Zimbabwe (2.5%). Output has grown by 1.9% in Ghana and remained stable in Rwanda, which has produced four publications on this topic since 2012.

The management of industrial waste remains underrepresented in the world's largest economies. As in the case of viral disease outbreaks, the research effort could be described as being reactive rather than proactive, with output tending to surge after a disaster. For example, Brazil boosted its output on eco-industrial waste management from 332 (2012–2015) to 606 (2016–2019) publications, perhaps in response to the 2015 collapse of the Fundão dam (see chapter 8). Other economies with a strong industrial base witnessed a doubling of output on this topic over the same period, including China, Egypt, India, Iran, the Russian Federation and Saudi Arabia.

A pairing between countries' digital and green agendas

In a world first, sales of electric cars in Norway exceeded those of petrol, diesel and hybrid engines in 2020. Norwegian researchers have doubled their output on **sustainable transportation** from 133 (2012–2015) to 286 (2016–2019) publications with similar gains recorded on the topic of battery efficiency (92/219).

China's global share of publications on sustainable transportation even shot up from 37% in 2011 to 49% in 2019. In the USA, meanwhile, publications on this topic coasted with a growth rate of 1.6, resulting in a contraction from 32% to 26% of global output.

Electric vehicles are a good illustration of efforts by countries to advance their green and digital agendas in tandem. This is the case for India, for instance, which is investing simultaneously in smart cities, electric vehicles and renewable energy. The *National Electric Mobility Mission Plan 2020* (2013) has sought to populate India with a fleet of 6–7 million electric and hybrid vehicles by 2020 (see chapter 22). Sustainable transportation and greater battery efficiency are two of the country's fastest-growing research topics (Figure 2.10).

Achieving a dual green and digital transition is also a policy focus for the European Union, through its new *European Green Deal* (2020) following on the heels of its digital policy, *A Europe fit for the Digital Age* (2019). The top innovators for technologies that combine green and digital elements tend to be European (see chapter 9).

Many countries are developing or planning smart cities which they intend to make sustainable, including Costa Rica, El Salvador, India, Morocco, Saudi Arabia and the United Arab Emirates.

There are concerns that 'smart' development like automation may threaten existing jobs. Whether this change is good or bad depends greatly upon the availability of training and alternative opportunities for those who are replaced by machines. For example, Mani (see chapter 22) notes the benefits of automation in India's automotive sector, where the introduction of robots has made the workplace safer, with fewer repetitive stress injuries and accidents. In the USA (see chapter 5), on the other hand, automation is considered as having contributed to the loss of 5.5 million manufacturing jobs between 2000 and 2017, where a skills mismatch for a more advanced manufacturing sector was not addressed in time through mechanisms such as worker retraining.

Whether our cities are 'smart' (see chapter 1) or not, galloping urbanization and infrastructure development presents a real challenge for sustainability. Every year, new constructions consume 40–50 billion tonnes of sand and gravel. Sand and gravel is now the second-most traded resource after water. About three-quarters of concrete is sand. Sand mining from rivers causes pollution, flooding and aquifer depletion and can exacerbate drought. Sand mining can also destroy beaches, jeopardizing tourism, and disrupt the habitat of marine life (UNEP, 2019a).

Fuelled by a booming cement industry, the floor area of buildings is expanding at nearly 3% per year, offsetting energy efficiency gains from reducing the emissions footprint of buildings (UNEP and IEA, 2017). In 2015, cement accounted for 8% of anthropogenic CO_2 emissions, double the proportion of the airline industry and more than any individual country. Cement demand could grow by 25% by 2030 to meet urban trends.

Eco-construction materials should, thus, be a priority research topic for sustainability. Floor area in India is expected to double by 2035, placing demands on the country's plans for sustainable transportation and green smart cities (see chapter 22). Scientific output from India on eco-construction materials has surged from 205 (2012–2015) to 554 (2016–2019) publications. However, Europe alone accounts for half of global output on this topic.

Environmental protection still the poor relation

Of all the goals related to economic growth, it is those of industry, innovation and infrastructure (SDG9) and sustainable cities and communities (SDG11) which received the most official development assistance between 2000 and 2013, with donors contributing US$ 130 billion and US$ 147 billion, respectively (Sethi *et al.,* 2017).

At the other end of the scale, topics of environmental sustainability, aligned with the SDGs for responsible consumption and production (SDG12), climate action (SDG13), life below water (SDG14) and life on land (SDG15), received the least attention, attracting a cumulative total of less than US$ 25 billion in donor funding over this period.

This funding pattern is reflected in outcomes. On average, national progress around the world has been weakest for the core environmental SDGs for climate action (SDG13), life below water (SDG14) and life on land (SDG15) [Sachs *et al.*, 2019; see Table A1 in the statistical annex of the present report].[12]

This problem persists, according to the platform Aid Atlas, launched in 2019 to monitor global development finance flows. From 2013 to 2017, US$ 28 billion total in aid was directed towards environmental protection, corresponding to only 2% of the total development finance dispersed during that period and less than the amount spent on the administrative costs of donors (Atteridge and Savvidou, 2020).

In a sample of 30 voluntary national reviews submitted by governments to the High-level Political Forum on Sustainable Development as part of country-level monitoring of progress towards the SDGs, only 20% mentioned biodiversity as a national priority for sustainable development (Pesce *et al.*, 2020). The world has failed to fully meet any of the global biodiversity targets that have defined much of conservation and environmental management over the past decade (CBD, 2020).

The United Nations Environment Programme (UNEP, 2020) predicts that embracing a greener economic model would boost global economic growth by 8% by 2060.[13] The test for the coming years will be whether countries succumb to the temptation to trade long-term benefits for short-term economic relief. Some countries are loosening, at least temporarily, environmental and labour protection laws to compensate for the economic hardship associated with Covid-19. One example of this is Indonesia's 'omnibus law' (see chapter 26).

Publication output gives some indication of interest, funding and workforce expertise. The **sustainable use of terrestrial ecosystems** is a topic with broad scope and one of the most evenly spread in terms of global representation. Largely stable elsewhere, output on this topic is growing in sub-Saharan Africa, the Arab States and Asia. That said, several of the dominant threats to terrestrial ecosystems continue unabated. Research on the use of biodiversity and ecosystems outstrips research on their status, in much the same way that research on extraction outstrips that on conservation (Figure 2.12).

For Dasgupta (2021), 'almost all governments have been exacerbating the biodiversity crisis by paying people more to exploit nature than to protect it. A conservative estimate of the global cost of subsidies that damage nature is US$ 4–6 trillion per year'.

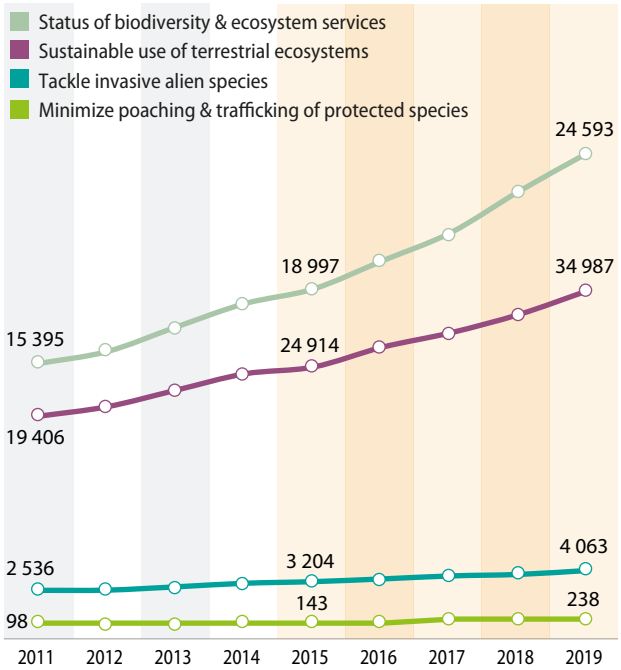
Poaching, trafficking and invasive species growing research fields

The **poaching and trafficking of endangered species** is a lucrative enterprise and now also a small but growing research field (Figure 2.12). Countries with high biodiversity and known vulnerability to the illegal wildlife trade stand out: scientific output has at least doubled in most countries in Southeast Asia, including Indonesia and Viet Nam, in addition to Colombia, Cyprus, Ghana, Mongolia and Saudi Arabia.

Uncontrolled wildlife trade not only threatens the populations of exotic species in their natural habitat but also introduces risks to the destination. Invasive species are considered a leading driver of biodiversity loss alongside climate change, having contributed to 60% of historical species extinctions. Global research on **tackling invasive species** is growing but this field of study remains small compared to the impact of the problem (Figure 2.12).

There are growing efforts to understand and slow the spread of invasive species, such as in Bangladesh, Bosnia and Herzegovina and Viet Nam. Growth has been most notable in sub-Saharan Africa, with surges of 500% or more in publications observed in Botswana, Ghana and Nigeria since 2013.

Figure 2.12: **Volume of global publications on selected biodiversity-related topics, 2011–2019**



Source: Scopus (Elsevier), including Arts, Humanities and Social Sciences; data treatment by Science-Metrix

Botswana's research tackling invasive species has risen from 1 (2012–2015) to 15 (2016–2019) publications. A single invasive water fern, *Salvinia molesta*, was threatening the Okavango Delta, a UNESCO World Heritage site and Africa's largest wetland. By introducing a *Salvinia*-munching weevil in 2002 as an alternative to chemical pesticides, Botswanan scientists managed to bring the invasion under control by 2016 after three decades of effort (see chapter 20). Invasive species threaten livelihoods in 70% of African countries (Makoni, 2020).

In the face of growing transboundary challenges, such as invasive species, air pollution, freshwater management and climate change, countries are taking steps to ensure the survival of natural systems by reducing those pressures under their control.

Little research on ecosystem-based approaches in protected areas

The Convention on Biological Diversity has proposed a target of conserving 30% of the Earth's surface area as natural space by 2030 in its zero draft of the Post-2020 Global Biodiversity Framework, to be finalized in May 2021. The extent of protected areas increased slightly between 2016 and 2020 from 14.7% to 15.0% of the total land area and, at sea, from 10.2% to 17.5% of national waters (UNEP-WCMC *et al.*, 2020).

Globally, there were 5 245 publications between 2011 and 2019 on the **socio-ecological impact of terrestrial protected areas**. The European Union and Latin America each accounted for about 40% of the total. Researchers from sub-Saharan Africa published six times and Oceania four times[14] the global average intensity.

More than half (52%) of Costa Rica's national territory is covered by biosphere reserves; these are designated territories within the UNESCO global network of the same name where communities experiment with novel approaches to sustainable development such as ecotourism and agro-ecology (see chapter 7). Costa Rica's scientific output on the sustainable use of terrestrial ecosystems (760 publications over 2011–2019) and the **status of terrestrial biodiversity** (543) is more than eight times the global average intensity.

Protection of a defined space lends itself to a whole-of-system approach, yet this method is not a common subject of experimentation. The scientific literature on **ecosystem-based approaches in protected areas on land** is small overall, with only 1 243 publications in English at the global level from 2011 to 2019, two of which came from Costa Rica. Canada's intensity of output on this topic was five times the global average, despite modest numbers: 94 (2012–2015) and 88 (2016–2019) publications.

Madagascar is an interesting case study. Scientists published 32 times the average global intensity on the socio-ecological impact of terrestrial protected areas. Madagascar is reliant on revenue from tourism to support conservation efforts. By May 2020, it had lost about US$ 500 million in tourism revenue, as a consequence of travel restrictions linked to the Covid-19 pandemic. One of the founders of Ranomafana National Park lamented that, 'without the US$ 4 million that usually flows into the region from tourism and research, the community will be forced to return to cutting the forest and farming' (see chapter 20).

Monitoring such spaces brings its own challenges. A 2019 agreement between the US National Aeronautics and Space Administration (NASA) and the Central American Integration System (SICA) of eight Central American countries[15] supports the use of remote sensing information from satellites for a range of applications, with a focus on environmental management and mitigation of environmental and disaster risks and with a specific effort to promote open data polices in SICA member countries (see chapter 7).

The world is on track to meet only 23% of the environment-related SDG indicators by 2030. The status of another 68% cannot even be measured for lack of data (UNEP, 2019b).

Research low on local disaster risk reduction strategies

Worldwide, only 1 102 publications between 2011 and 2019 were retrieved from the global literature that pertained to the topic of **local disaster risk reduction strategies**. Given the growing investment in local resilience through the Green Climate Fund, which has gathered pledges worth US$ 10.3 billion since its initial resource mobilization in 2014, the test for related projects will be whether they build local capacity, including in terms of local co-authorship of related research.

Indigenous and local knowledge are now included in a growing number of Latin American policies, in particular. Bolivia and Ecuador have introduced programmes at the national level to facilitate the recovery, safe-keeping and use of local and ancestral knowledge (see chapter 7). Traditional leaders in Pacific island countries such as Niue, Samoa, the Solomon Islands, Tonga and Vanuatu are creating restricted-access digital repositories of local and traditional knowledge pertaining to the climate (see chapter 26).

The top 10 countries ranked by specialization in research on **traditional knowledge** are all situated south of the Sahara. Researchers from high-income economies contributed less than half (40%) of global publications on this topic, the lowest proportion observed for this income group for any of the 56 topics analysed. Even countries with close ties to former colonies, such as France and the UK, produced less than half of the global average intensity on this topic.

CONCLUSION

Sustainability research not yet mainstream

The 56 research topics analysed in the preceding pages are but a subset of broader sustainability research. We can, nevertheless, draw some conclusions from this sample of current trends.

The first conclusion is that sustainability research is not yet mainstream in academic publishing at the global level. Sixteen of the 56 chosen topics accounted for less than 0.03% each of global scientific production between 2011 and 2019. These 'orphan' topics include ecosystem-based approaches in protected areas on land, help for smallholder food producers and climate-ready crops.

Even the largest topics form a small portion of scientific research. Global publications on sustainable energy (SDG7)[16]

accounted for 2.1% of global scientific output over 2012–2015 and 2.4% over 2016–2019. Publications on the health-related (SDG3)[17] topics studied here stagnated at 4.4% of overall scientific output over 2011–2019 (see chapter 1).

The growth rate for some topics tells a more positive story. Research on help for smallholder food producers and on climate-ready crops showed some of the fastest growth rates among these 56 topics: 80–90% over the dual periods of 2012–2015 and 2016–2019.

There are other bright spots. One-third (59) of the 193 countries studied at least doubled their output on battery efficiency between 2011 and 2019. This topic was followed by smart-grid technologies (55 countries), the impact on health of soil, freshwater and air pollution (54) and sustainable transportation (50).

Different levels of engagement

Countries on the frontlines of climate change and those most reliant on natural resources are investing heavily, proportionately, in research on topics such as agro-ecology, climate-ready crops, technologies to reduce the impact of climate hazards and the sustainable management of terrestrial and marine environments. Most are developing countries.

Sustainability topics form far greater shares of national output in small and developing science systems. There are predictable patterns, such as the Caribbean focus on health research and the specialization in agricultural research in Latin America and sub-Saharan Africa. More intriguing is that these regions are branching out from their traditional speciality areas: Latin America is taking up the baton of ocean research and at least doubled its output on topics such as eco-construction materials and new technologies to protect from climate-related hazards. Caribbean scientists are publishing on topics related to energy and freshwater resources. In sub-Saharan Africa, governments are investing in wind and solar energy systems to complement efforts to expand the traditional electrical grid. This investment is reflected in the doubling of research output on smart-grid technologies, photovoltaics and wind turbine technologies.

A decade ago, developing countries were able to leapfrog over costly investment in landlines to develop mobile communication networks. Today, the need to ensure universal access to energy is driving a similar phenomenon.

High-income countries ceding ground

High-income economies are ceding ground to other income groups for most of the 56 topics under study, with the decline in global share of output being most noticeable for battery efficiency and carbon capture and storage. High-income economies still dominate scientific publishing by volume, though. This demonstrates the need for developing countries to invest more in research infrastructure.

Low-income countries are least visible for topics related to SDGs 7 (affordable and clean energy), 9 (industry, innovation and infrastructure) and 14 (life below water). This income group is publishing more than previously on biofuels and biomass, solar and wind energy, in particular, but publications on each topic still amount to less than 1% of global output.

Low-income countries are contributing most to the topic of help for smallholder food producers: 31% of the global total. This is also one of the topics with the highest share of international scientific collaboration, as identified by the sum of contributions from individual income groups exceeding 100% by a wider margin. Other topics that involve a high level of international scientific collaboration concern climate-related hazards and climate-ready crops, the health-related topics on tropical communicable diseases, tuberculosis and HIV, as well as environmental topics relating to transboundary water resource management, the socio-ecological impact of terrestrial protected areas and minimizing the poaching and trafficking of protected species. Future studies tracking the national affiliations of authors for specific topics could identify trends and gaps in collaborative publishing (see chapter 1).

Among **lower middle-income countries**, progress has been most spectacular on problem-solving for development. For instance, their share of publications on the sustainable management of marine tourism has surged from 3% to 19% since 2011. They now account for one-quarter of global publications on minimizing poaching and trafficking of protected species and one-fifth of global output on eco-industrial waste management, photovoltaics, biofuels and biomass. They also show strong growth on smart-grid technologies, precision agriculture, geothermal energy, wind turbine technologies, sustainable alternatives to plastics and transboundary water resource management.

With the notable exception of China, progress among **upper middle-income countries** has been relatively modest. Countries in this income group made their greatest gains in national integrated water management and photovoltaics, where their share of global output grew by 8%.

China boosted its global share of research by more than 10% for a range of topics and even by more than 20% for battery efficiency (to 53%), research on national and urban greenhouse gas emissions (to 47%), hydrogen energy (to 43%) and carbon pricing (to 41%). China also accounted for almost all growth within this income group on geothermal energy, radioactive waste management and floating plastic debris in the ocean.

As a group, other upper middle-income countries contributed a greater share than China only on new or re-emerging viruses that can infect humans, human resistance to antibiotics, the status of terrestrial biodiversity, tackling invasive species and, above all, on traditional knowledge: 32% of global scientific publications.

Scientific collaboration and donor funding: a disconnect

International partnerships are considered fundamental to reaching the SDGs. In broad terms, international collaboration among the major income groups has been rising. This trend is in line with growing international co-authorship in scientific research more generally (see chapter 1). Since 2011, the level of collaboration has been particularly high on environmental management and climate research. This has not prevented climate resilience and sustainable environmental management from accounting for the smallest shares of research by volume.

This finding tallies with trends in official development assistance, where topics related to environmental sustainability attracted a cumulative total of less than US$ 25 billion in donor funding between 2000 and 2013. This funding pattern is reflected in outcomes. On average, national progress around the world has been weakest for the core environmental SDGs for climate action (SDG13), life below water (SDG14) and life on land (SDG15) [Sachs *et al*., 2019].

The present study's findings echo the observation by Atteridge and Savvidou (2020) that research topics related to climate and ecology have received less attention than advanced technology. As we have seen in the preceding pages, innovation in electricity distribution and storage is growing faster than research on alternative forms of non-fossil energy generation.

One exception to the rule is carbon capture and storage. This high-tech industry is still in its infancy. All of the pathways defined by the Intergovernmental Panel on Climate Change for limiting global warming to 1.5°C rely on technological advances in CO_2 removal from the atmosphere to augment the natural process of carbon sequestration. However, carbon capture and storage has one of the lowest growth rates (6%) among the 56 topics studied, with a mere 2 501 publications on this topic produced around the world in 2019. This compares with 12 975 publications on smart-grid technology, where growth has been driven largely by China and India.

Scientific publishing often reactive

There is evidence that much of scientific publishing over the past decade has been reactive, rather than proactive. For example, the volume of output documenting the local impact of climate-related hazards and disasters is larger and growing faster than research output on solutions such as disaster risk reduction strategies and new technologies to mitigate such hazards.

This trend stands out clearly for the topic of new or re-emerging viruses that can infect humans: countries boosted research in this field after being directly affected by an outbreak. We can anticipate a spike in research effort on viral diseases in the years to come. We can also expect governments to augment their stocks of personal protective equipment and medical treatments. What is not yet clear is whether governments will invest in prevention by tackling the root causes of zoonotic epidemics that include unfettered agricultural expansion and urbanization, deforestation and illegal wildlife trade.

To take another example, scientific publications documenting floating plastic in the ocean are growing faster than research into ecological alternatives to plastic, even though less than 10% of plastic is recycled. With the long-term prospects for oil production being threatened by the growing affordability of renewables, oil companies are stepping up the production of synthetics like plastic. At current growth rates, plastic production could account for 20% of global oil consumption by 2050 (UNEP, 2018).

This example highlights a paradox. Even as transitioning to a green economy is gaining in national priority, anxiety over potential job losses from declining industries is leading governments to prop up these very industries. This is reflected, for example, in decisions by public authorities to invest in new coal plants in full knowledge that the expansion of renewables is making coal production uneconomical.

Technological solutionism and the orientation of innovation towards fuelling economic development are, at times, proving incoherent with the demands of sustainable development. This incoherence is making it harder for countries to link existing science systems and strategies with their own sustainable development agenda.

As Dasgupta (2021) has observed, most governments tend to pay people more to exploit nature than to protect it. He has estimated the global cost of subsidies that damage nature at US$ 4–6 trillion per year. One example is plastic goods. These tend to be cheaper than ecological alternatives, as the manufacturer is not held accountable for the full life-cycle of the product; this means that the cost of collection and recycling of waste products tends to fall to public authorities. This disguised subsidy is not only costly for the public purse. It is also holding back the development of more sustainable alternatives.

Scientists and policy-makers may take diverging paths

Scientists and policy-makers are not always taking the same pathway. Some of the biggest academic output on climate change mitigation and adaptation is coming from countries where it is still government policy to minimize the importance of climate change.

This is problematic, since scientific knowledge can only be transformational if backed by political will. Without action at the policy level to embrace problem-solving, there is a risk of research simply documenting environmental decline.

The European Union has taken a decisive step in the direction of transformational change with its *European Green Deal* (2020). This new growth strategy seeks to accelerate the bloc's 'green' transition in all five socio-economic systems simultaneously (energy; agrifood; manufacturing; transportation; and buildings/housing) for greater coherence and credibility, while making sure that jobs lost in one industry can be recreated elsewhere (see chapter 9).

Adopting a 30-year target for carbon neutrality must not become a pretext for putting off until tomorrow what must be done today. Governments need to focus on reaching their 2030 targets. Measures taken today will, in turn, make it easier to reach countries' longer-term carbon neutrality targets. Strategic planning to develop infrastructure or create jobs should be approached through the lens of sustainable development, rather than as a parallel agenda.

The next *UNESCO Science Report* in 2025 should be able to confirm whether the trends observed in the preceding pages are indicative of a time lag between a change in research focus and its impact on the scientific publishing record, or whether national policy frameworks are struggling to adopt a coherent approach to sustainable development.

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ENDNOTES

1 For example, the population was advised to remove sources of stagnant water in residential areas and to use mosquito repellants like lemongrass.
2 These data stem from a global bibliometric study commissioned by UNESCO covering the period 2011–2019. The topic of new or re-emerging viruses that can infect humans covers research papers on Zika, the first Severe Acute Respiratory Syndrome (SARS) and Ebola but not HIV, which is the subject of a separate topic. The study does not cover SARS-CoV-2 (Covid-19), as this outbreak began at the end of 2019. For details of this study, see Annex 4.
3 According to the Joint United Nations Programme on HIV/AIDS (UNAIDS), 1.7 million people worldwide became infected with HIV in 2019 and 38 million are living with the disease.
4 In the present report, the Eastern Europe grouping excludes member states of the European Union.
5 The six deep ocean trenches are the Japan, Izu-Bonin, Mariana, Kermadec, New Hebrides and Peru–Chile trenches.
6 See: https://tinyurl.com/EU-single-use-plastics-2019
7 This dataset covers diseases that figure in the list of neglected tropical diseases established by the World Health Organization, namely: Buruli ulcer, Chagas disease, Dengue and Chikungunya, Dracunculiasis (guinea-worm disease), Echinococcosis, food-borne trematodiases, Human African Trypanosomiasis (sleeping sickness), Leishmaniasis, Leprosy (Hansen's disease), Lymphatic filariasis, Mycetoma, chromoblastomycosis and other deep mycoses, Onchocerciasis (river blindness), Rabies, Scabies and other ectoparasites, Schistosomiasis, soil-transmitted helminthiases, snakebite envenoming, Taeniasis/Cysticercosis, Trachoma and Yaws (endemic treponematoses). Malaria and water-borne diseases such as coliform, giardia, cholera and norovirus are also included in this topic.
8 Precision agriculture uses advanced technologies like remote sensing to monitor soil temperature and humidity, weather patterns, plant growth, irrigation rates and other factors. Crops are also rotated to preserve soils and improve biodiversity.
9 The other members of the High-level Panel for a Sustainable Ocean Economy are Australia, Canada, Chile, Fiji, Ghana, Indonesia, Jamaica, Japan, Mexico, Namibia, Norway, Palau and Portugal, representing 40% of the world's coastlines and 20% of the world's fisheries.
10 See: https://oceandecade.org/
11 These are Cameroon, Cöte d'Ivoire, Egypt, Ghana, Kenya, Madagascar, Nigeria, Rwanda, Sao Tome and Principe, South Africa, Tanzania, Uganda and Zambia.
12 There is a slight tendency for countries with high scientific output on the 56 topics under study to rank higher in the *Sustainable Development Report 2020* (Sachs *et al.*, 2020) but there is no statistically significant relationship (data not shown).
13 Resource extraction was responsible for 90% of species loss and water stress in 2017, as well as half of greenhouse gas emissions (UNEP, 2020).
14 Oceania's output was dominated by Australia.
15 These are Belize, Costa Rica, the Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua and Panama.
16 These topics are cleaner fossil fuel technology, photovoltaics, hydropower, biofuels and biomass, wind turbine technologies, nuclear fusion, geothermal energy, hydrogen energy and smart-grid technologies.
17 These topics are reproductive health and neonatology, tropical communicable diseases, type 2 diabetes, human resistance to antibiotics, regenerative medicine, impact on health of soil, freshwater and air pollution, medicines and vaccines for tuberculosis, human immunodeficiency virus (HIV) and new or re-emerging viruses that can infect humans.

Background information on the bibliometric study of research trends on selected topics related to *The 2030 Agenda for Sustainable Development (Tables F1-F8)*

OVERVIEW

In 2020, UNESCO commissioned a study from Science-Metrix of the volume of scientific publications advancing the sustainable development agenda at the global, regional and national levels between 2011 and 2019. The study was not designed to be exhaustive. Rather, it focused on 56 sample research topics identified by UNESCO that were of particular relevance to eight of the Sustainable Development Goals (SDGs).

The aim of the study was three-fold:

- **to assess the volume of articles published** by each country in the world between 2011 and 2019 on key topics of relevance to the SDGs;
- **to identify the degree of specialization on each topic**, by assessing the number of publications produced by a given country over the 2012–2019 period as a proportion of that country's total scientific output. This level of specialization was then compared with the global average to give the **specialization index**. For example, a country which produced 2% of its output on a specific topic accounting for 1% of all research on that same topic at the global level would score 2.00 on the specialization index for this indicator because it produced twice as many publications as would be expected on this topic (for further details of this analysis, see Annex); and
- **to identify the growth rate of each topic**, in order to monitor change in the priority accorded to these topics since the adoption of *Agenda 2030 for Sustainable Development* in 2015. In order to avoid annual fluctuations, the study compared scientific output between two periods: 2012—2015 and 2016—2019.

This bibliometric study was undertaken in June 2020. Science-Metrix identified publications on each topic through searches for keywords across the complete Scopus (Elsevier) database, including as concerns the Arts, Humanities and Social Sciences. The table that follows describes the scope of each topic. The specific keywords used for each topic are available on the open access *UNESCO Science Report* portal as an online supplement.

The selected topics are grouped by Sustainable Development Goal. In some cases, an individual topic may be relevant to more than one goal, such as that on traditional knowledge. Moreover, as the key words are not mutually exclusive, there may be occasions when the same article has been counted under more than one topic; for instance, an article on the impact of radiation on human health (SDG3) may also be referenced under the topic on radioactive waste management (SDG9).

The complete datasets for this bibliometric study are available from the *UNESCO Science Report* portal. A summary of the key findings for individual countries and regions may be found in chapters 4–26 and a global summary in chapter 2 of the present report.

SCOPE OF THE STUDY

Topics relating to SDG2: Zero hunger

The data are presented in Table F1 of the statistical annex, available online, along with the full dataset

Pest-resistant crops
This dataset includes articles on technology to activate or enhance plant resistance to pathogens. Articles on the genetic engineering of plants to resist pests, essentially *Bacillus thuringiensis* (*Bt*) crops, constitute a large share of the dataset.

Help for smallholder food producers
This dataset covers efforts to increase the agricultural productivity and income of smallholder food producers, including through value addition. The dataset includes articles on the productivity, sustainability, profitability and security of small-scale agriculture and farming, such as community agriculture/farming, family agriculture/farming, subsidence agriculture/farming and smallholders.

Precision agriculture
This dataset includes articles on precision agriculture, precision farming and other synonymous expressions. It also includes articles on data-monitoring technologies whenever articles also mention terms such as crops. Specific precision agriculture aspects such as precision irrigation, seed metering, variable-rate application, soil sensing, yield mapping, precision planting, site-specific management and the like have also been targeted.

Agro-ecology
This dataset focuses on agri-environmental practices and the impact of those practices, including environmentally promising agricultural practices such as reduced tillage, agroforestry, cover crops, crop rotation, low-input agriculture,

conservation agriculture, silvopastures, alley cropping, integrated crop-livestock and more. Publications measuring and comparing the environmental impact of conventional agriculture are included. The topic includes alternatives to chemical pesticides.

Maintain genetic diversity of food crops

This dataset includes articles on maintaining the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species. Articles discussing the genetic diversity and use of wild or heirloom varieties are also included. All studies related to landraces, plant genetic resources, crop varieties, wild relative and germplasm conservation have been included, provided that they refer to agricultural plants or animals.

Traditional knowledge

This dataset includes articles relating to the recording of knowledge from traditional, indigenous or local populations or derived technologies. This topic is grouped under SDG2 but extends to other SDGs. Ethno-disciplines such as ethno-agriculture, ethnomedicine, ethnobotany and ethnomycology are part of the dataset. About 700 indigenous population names from every continent were used to help build this dataset, combined with terms related to traditional knowledge. The keyword 'local knowledge' was used only in combination with 'indigenous'. Ancestral knowledge from very large populations is voluntarily excluded; for instance, traditional Chinese medicine is excluded.

Topics relating to SDG3: Good health and well-being

The data are presented in Table F2 of the Statistical Annex, available online, along with the full dataset.

Reproductive health and neonatology

This dataset includes articles on reproductive health, neonatology and maternal health. It covers women's sexual health, in general. It does not extensively cover research on sexually transmitted diseases and excludes the human immunodeficiency virus, which is analysed as a separate topic.

Human immunodeficiency virus (HIV)

This dataset includes all articles on research into HIV and acquired immune deficiency syndrome (AIDS). For example, this includes articles on the epidemiology, treatment and prevention of the disease and/or its social impact.

Tropical communicable diseases

This dataset covers those diseases that figure in the list of neglected tropical diseases established by the World Health Organization, namely: Buruli ulcer; Chagas disease; dengue and chikungunya; dracunculiasis (Guinea-worm disease); echinococcosis; food-borne trematodiases; human African trypanosomiasis (sleeping sickness); leishmaniasis; leprosy (Hansen's disease); lymphatic filariasis; mycetoma; chromoblastomycosis and other deep mycoses; onchocerciasis (river blindness); rabies; scabies and other ectoparasites; schistosomiasis; soil-transmitted helminthiases; snakebite envenoming; taeniasis/cysticercosis; trachoma; and yaws (endemic treponematoses). Malaria and water-borne diseases such as coliform-caused illness, giardiasis, cholera and norovirus are also included.

Human resistance to antibiotics

This dataset covers all aspects of human resistance to antibiotics, with the exception of papers related to environmental aspects that were more difficult to identify.

Regenerative medicine

This dataset covers articles on stem cell research, as well as on regenerative technologies and therapies such as tissue engineering, biomaterials and nanoscaffolds.

Impact on health of soil, freshwater and air pollution

This dataset contains articles related to the assessment and mitigation of the impact of air, soil and freshwater pollution on the environmental health of humans. Topics covered include pollution monitoring, the assessment and effects of exposure to heavy metals, plastics, particulate matter, radiation and other pollutants.

Medicines and vaccines for tuberculosis

This dataset includes all articles on tuberculosis, except bovine tuberculosis.

New or re-emerging viruses that can infect humans

This dataset covers research on human resistance to new or re-emerging viruses that can infect humans. For example, this dataset includes articles on epidemiology, treatment, prevention and transmission vectors of emerging viruses such as Influenza A subtype H1N1, SARS-CoV, Ebola and hantiviruses. This topic excludes articles on HIV, which is treated separately. Also excluded are articles on SARS-CoV-2 (Covid-19), as it had not yet been identified in 2019.

Type 2 diabetes

This dataset covers research on prevention, effects, treatment and epidemiology of type 2 diabetes, also known as non-insulin-dependent diabetes mellitus or adult-onset diabetes. Efforts were made to include articles which study the impact of socio-economic factors on the development of the disease, such as obesity, malnutrition, lack of education and a sedentary lifestyle. Articles about insulin resistance, prediabetes and maturity onset diabetes of the young were also included. Studies of the genetic factors that play a role in development of the disease were also included. Some articles on other health conditions for which diabetes may be an aggravating condition are included but are not the focus of this dataset. Articles about heart disease were removed, unless they contained diabetes-related terms in their title, as were papers which mentioned diabetes in the abstract when the topic was then found to be peripheral to the dataset. Articles that only addressed type I diabetes or were ambiguous about the type of diabetes studied were excluded.

Articles were included, on the other hand, if the particular type of diabetes was not indicated in the title, keywords or abstract but the publication mentioned risk factors like obesity that are more specific to type 2.

Topics relating to SDG6: Clean water and sanitation

The data are presented in Table F3 of the statistical annex, which is available online, along with the full dataset.

Sustainable withdrawal and supply of freshwater
This dataset includes all articles pertaining to the sustainable governance, management and policy of withdrawal, supply and use of freshwater. Freshwater sources include groundwater, lakes and rivers.

Water harvesting
This dataset includes articles on techniques for harvesting precipitation, stormwater, runoff and fog. It also includes articles on rainfed agriculture and irrigation.

Desalination
This dataset includes articles related to desalination technologies, such as osmosis, membrane distillation, solar distillation and micro- and nanofiltration.

Wastewater treatment, recycling and re-use
This dataset includes articles on the management and treatment of wastewater, sewage water, polluted water and greywater, as well as re-use and recycling techniques.

National integrated water resource management
This dataset includes articles pertaining to the management of water resources and their allocation for domestic, agricultural and industrial use. It includes articles on policies and laws pertaining to water use and allocation (e.g. reservoir management), as well as system modelling (e.g. water use, reservoir or water quality) to enable strategic decision-making and the optimization of processes. Articles about management of water distribution networks or the smart water grid are also part of the dataset. Some articles may analyse the situation at local level, since the use of the key word 'national level' served, above all, to exclude articles on transboundary water resource management, as this topic is treated separately.

Transboundary water resource management
This dataset includes articles on governance, management, co-operation, law, allocation and sharing of transboundary and international freshwater resources, as well as related conflicts and disputes. Water resources analysed encompass aquifers, groundwater, lakes and rivers.

Topics relating to SDG7: Affordable and clean energy

The data are presented in Table F4 of the statistical annex, which is available online, along with the full dataset

Cleaner fossil fuel technology
This dataset includes articles on clean coal technology, integrated carbon capture and storage technology, carbon dioxide (CO_2) capture from fossil fuel power plants, desulfurization of flue gases, the clean production of synthetic fuel, refinery processes to limit contaminants emitted, the clean synthesis of methanol and the conversion of CO_2 to hydrocarbons or fuel.

Photovoltaics
This dataset includes articles relating to stationary hosts, namely, solar cells, solar panels and photovoltaic cells. It also includes larger-scale projects, such as solar farms. Articles about developing materials specifically for solar cells are included.

Hydropower
This dataset includes articles relating to both large and small hydropower projects. It includes articles on the different types of dams but also on other hydropower methods (e.g. tidal and wave energy) and the development of specific hydropower station parts like hydroturbines.

Biofuels and biomass
This dataset includes articles on the main biofuels, such as bioethanol, biomethane, biobutanol and biocrude, as well as their production in biorefineries. Articles on the processing of biomass to create biofuels are also included. Little content was found on the hydraulic head of such processes.

Wind turbine technologies
This dataset includes articles about wind turbines and wind farms, with a focus on both their conception and their use. All main types of wind turbines are included, such as horizontal-axis, vertical-axis, offshore and floating wind turbines. Articles about the main types of generator used in the turbines are also part of this dataset, examples being doubly fed induction and Savonius.

Nuclear fusion
This dataset includes articles relating to studies of nuclear fusion for energy purposes, as well as articles relating to the development of materials, parts and methods to build nuclear fusion reactors. It voluntarily excludes articles focused on nuclear fusion reactions in stars because those are mostly unrelated to energy production on Earth.

Geothermal energy
This dataset contains articles on geothermal energy, the generation of electricity from geothermal energy and different techniques for harnessing this energy, most notably, enhanced geothermal systems and hydraulic stimulation. A small number of articles about the safe digging of wells to access this energy is also included.

Hydrogen energy

This dataset contains articles on most aspects of hydrogen energy harnessing. Machines and systems designed to have hydrogen as their source of power, the industrial production and storage of hydrogen and hydrogen-based fuel cells (i.e. most fuel cells) are all included.

Smart-grid technology

This dataset contains articles on smart grid technology and techniques and protocols to enable smarter, more reliable electrical networks. Articles are included on new devices such as smart power meters and grid-friendly appliances, as well as on protocols related to distributed grids and microgrids, such as islanding detection. Articles relating to the cybersecurity of smart grids are also included in the dataset. Furthermore, articles related to new challenges for the grid, such as electric vehicle (EV) charging on a national scale, are included because many of those articles advocate 'vehicle-to-grid' energy transfers and real-time pricing when mentioning EV charging. An effort was made to exclude papers specific to EVs that do not address the electrical grid. Some articles about renewable energy sources are part of the dataset but they only concern the integration of these new power sources in the grid.

Topics relating to SDG9: Industry, innovation and infrastructure

The data are presented in Table F5 of the statistical annex, which is available online, along with the full dataset

Carbon pricing

This dataset includes articles related to all aspects of the taxation and trading of carbon and other greenhouse gas emissions (also known as cap and trade): the carbon market, carbon allowance, carbon credits, carbon trading, carbon pricing and carbon taxation.

Eco-industrial waste management

This dataset includes articles on the safe treatment and disposal of waste chemicals and other industrial wastes, such as those from the construction, pharmaceutical and electronic industries, reactive waste and wastewater treatment. Articles are also included on the minimization of waste production, such as zero-waste manufacturing and waste-to-energy processes. Articles about remediation techniques for soils contaminated with industrial wastes (heavy metals, petroleum, etc.) are included but these exclude nuclear waste, since it is treated separately.

Radioactive waste management

This dataset contains articles about radioactive waste management, storage and disposal. Articles about methods such as safe geological disposal, transmutation and vitrification of nuclear waste are included.

Eco-alternatives to plastics

This dataset includes articles studying the synthesis, effects and potential applications of ecologically friendly alternatives to traditional fossil fuel-derived plastics. Articles on biodegradable plastics or alternatives based on cellulose, starch or banana fibres are included. Any articles containing terms such as 'sustainable alternative to plastics' or 'environmentally degradable plastics' are also included.

Eco-construction materials

This dataset includes articles relating to 'eco-building', 'green building', 'sustainable construction', 'ecological housing', 'sustainable architecture' and other permutations of those terms. There is also a focus on low-energy and zero-energy buildings, sustainable building certifications (e.g. Leadership in Energy and Environmental Design [LEED] or Passivhaus) and environmentally friendly materials, sustainable materials and recycled materials. Articles on retrofitting buildings and infrastructure are included. The dataset is primarily focused on passive construction practices and materials, rather than active methods such as photovoltaic panels or wind generator integration, covered in other datasets (see Table F4). Sustainability here is almost always defined from an environmental standpoint but some articles are also focused on economic or social sustainability of buildings or infrastructure. For example, an article might tackle the health implications of using sustainable alternatives to traditional materials or designs for the occupants, or buildings that can better withstand the extreme conditions found in poorer countries or anticipated conditions relating to climate change.

Greater battery efficiency

This dataset contains articles on battery efficiency, new battery technologies and battery design and optimization. Since most articles are written to report improvements on batteries, most rechargeable battery types were included as keywords in the dataset, with the greatest contributions coming from more recent battery types such as Li-ion. Articles concerning the recycling of spent batteries and battery integration in the electrical grid are also part of the dataset.

Sustainable transportation

This database focuses on the development and use of sustainable means of transportation, including electric vehicles, solar vehicles, plug-in hybrid vehicles and hydrogen vehicles. Most articles indexed focus on cars but planes, boats, trains and trucks are all included. The dataset includes articles on self-driving cars and associated technologies, such as autonomous intersection management, lane detection and advanced driver assistance. This is because self-driving cars would achieve better fuel economy (or energy economy, if electric) and have the potential to reduce the number of road accidents. Articles are included on other methods of sustainable transportation and policies, such as carsharing, public bicycles, car-free cities and congestion pricing. 'Sustainable transport' is used as a keyword but, with the exception of publications using the terms 'solar boat' and 'electric boat', shipping is not explicitly included in this dataset.

Topics relating to SDG13: Climate action

The data are presented in Table F6 of the statistical annex, which is available online, along with the full dataset

National and urban greenhouse gas emissions
This dataset includes articles on the measurement, assessment and estimation of greenhouse gas emissions at the national and urban levels. It includes articles on national and urban emission sources, such as agricultural, industrial and urban sources, including transportation.

Carbon capture and storage
This dataset includes articles on carbon capture techniques, such as pre-, post- and oxyfuel combustion, direct air capture and carbon sequestration, which is the capture and storage of carbon through natural (biological, chemical and physical) processes that include photosynthesis, oceanic and geological capture. The publications refer to both natural sequestration and human attempts to enhance sequestration. This dataset is restricted to gaseous carbon; it excludes solid-state carbon, namely particulate matter.

Local impact of climate-related hazards and disasters
This dataset focuses on articles assessing climate hazards and climate-related disasters and the impact of these on small and vulnerable communities. Examples are coastal erosion, sea level rise, droughts, floods and extreme weather events.

New technologies to protect from climate-related hazards
This dataset focuses on any technology, innovation or tool that has the potential to mitigate the impact of climate change or climate-related disasters on communities. This includes publications on ways of building more resilient infrastructure, as well as those on better modelling tools to predict the risk of occurrence and consequences of catastrophic events, enabling better preparedness.

Local disaster risk reduction strategies
This dataset focuses on planning processes and techniques that help to reduce the risk faced by local and vulnerable communities with respect to climate change and related disasters, such as drought, flooding, extreme storms and wildfires. The publications included consider communities' strategies, preparation and mitigation efforts as well as their capacity to recover and be resilient.

Climate-ready crops
This dataset includes articles related to agriculture and crops that are tolerant of and resilient to salinity, flooding, drought and other climate-related stressors.

Topics relating to SDG14: Life below water

The data are presented in Table F7 of the statistical annex, which is available online, along with the full dataset

Coastal eutrophication
This dataset includes all articles on coastal eutrophication, phosphorus removal and pollution, algal blooms, water nutrient dynamics and specific harmful algal species.

Floating plastic debris in the ocean
This dataset includes articles related to plastic debris and plastic pollution in the ocean. Search terms cover plastic and plastic types in aquatic environments, plastic consumption by marine wildlife, as well as the identification of plastics and byproducts in marine and coastal environments and food chains.

Ocean acidification
This dataset includes all articles on ocean acidification and seawater acidification, including those assessing the impact on species.

Sustainably manage marine tourism
This dataset includes articles on tourism management and the effects of tourism on oceanic or coastal zones. Articles often focus on the environmental impact but the socio-economic impact is also covered. Whenever there was a focus on sustainability, cruises, diving, recreational fishing and sea animal tourism (watching, swimming and diving) were all specifically included as search terms.

Sustainably manage fisheries and aquaculture
This dataset includes articles on fish farming and aquaculture, as well as commercial fishing as it relates to sustainable resource management. The dataset was constructed using key terms related to sustainable fisheries and aquaculture, as well as species and techniques commonly associated with these practices. When aquatic species names were used, this was done in conjunction with terms related to sustainability, to limit the dataset to the topic as much as possible.

Ecosystem-based approaches in marine environments
This dataset contains articles relating to management of coastal zones using an ecosystem-based approach, meaning the ecosystem and its interactions are considered as a whole in management processes. The dataset includes articles on concepts like integrated coastal zone management, which is closely linked to ecosystem-based approaches. When the dataset was verified, no articles focusing on ecosystems in international waters were found.

Topics relating to SDG15: Life on land

The data are presented in Table F8 of the statistical annex, which is available online, along with the full dataset

Sustainable use of terrestrial ecosystems

This broad dataset includes all papers on the conservation, preservation, restoration and sustainable use of terrestrial ecosystems: forest, habitat, land, wildlife, pond, freshwater, drylands, etc. It includes research on species richness, biodiversity, etc. It also includes articles on ecosystem services.

Status of terrestrial biodiversity

This dataset includes articles on species with a defined conservation status, as well as more fundamental research needed to monitor, predict and protect those species. For example, articles on causes of species endangerment, such as habitat loss, are included.

Minimize poaching and trafficking of protected species

This dataset includes articles on the Convention on the International Trade of Endangered Species (CITES), wildlife trade, poaching, illegal fishing, illegal harvesting, wildlife forensics, etc.

Tackle invasive alien species

This dataset includes all articles related to biological invasions, alien species, invasive plants, etc. Basic research on invasive potential has also been included.

Use of ecosystem-based approaches in protected areas on land

This dataset includes articles on ecosystem-based management of public and private land. An effort was made to exclude marine and freshwater ecosystems, to avoid overlap with other selected topics.

Extent of water-related ecosystems

This dataset includes articles measuring the extent of water-related ecosystems (excluding oceans) such as wetlands, rivers, estuaries, lakes, aquifers, swamps, fens, peatlands, marshes, mangroves and artificial water bodies. It involves articles either measuring or improving delineation protocols of such systems, as well as estimating the water quantity involved. Articles on disappearing systems are included, as well as articles on the inventory of water-based ecosystems. Some articles on ecosystems related to either the water quality or quantity found in ecosystems such as forests and mountains are also included when these are directly related to water.

Socio-ecological impact of terrestrial protected areas

This dataset covers conservation planning, reserve selection and reserve design, as well as the prioritization of protected areas and the future habitat suitability under climate change. The negative and positive impact of protected areas on humans, such as human–wildlife conflict or valuation of ecosystem services, are also targeted.

Table F1: Publications on selected research topics relating to SDG 2: Zero hunger
Volume of output, 2012–2015 and 2016–2019, and specialization index, 2011–2019

	PEST-RESISTANT CROPS			HELP FOR SMALLHOLDER FOOD PRODUCERS			PRECISION AGRICULTURE		
	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019
World	**5 482**	**6 571**	**1.00**	**1 683**	**3 016**	**1.00**	**3 553**	**6 074**	**1.00**
North America	**1 559**	**1 768**	**1.02**	**299**	**594**	**0.55**	**834**	**1 304**	**0.85**
Canada	247	240	1.15	56	82	0.62	131	169	0.90
United States of America	1 366	1 600	1.00	250	531	0.54	737	1 169	0.85
Latin America	**483**	**683**	**1.86**	**300**	**456**	**2.86**	**351**	**580**	**2.03**
Argentina	31	62	1.64	8	26	0.91	32	50	1.92
Belize	0	0	na	0	0	na	0	0	na
Bolivia	1	1	na	7	6	30.28	0	0	na
Brazil	279	400	2.07	182	214	3.08	253	335	2.33
Chile	17	24	0.77	7	18	1.27	16	39	1.21
Colombia	39	40	1.74	31	59	3.98	13	62	2.44
Costa Rica	8	8	2.49	12	21	16.24	5	2	na
Ecuador	6	22	1.85	7	14	5.03	3	24	4.10
El Salvador	0	0	na	0	0	na	0	0	na
Guatemala	1	0	na	3	6	na	0	3	na
Guyana	0	2	na	0	0	na	0	0	na
Honduras	2	1	na	2	0	na	0	2	na
Mexico	98	137	1.73	42	86	2.18	29	62	1.13
Nicaragua	0	0	na	8	8	37.30	0	1	na
Panama	1	4	na	2	4	na	4	1	na
Paraguay	1	1	na	0	1	na	0	0	na
Peru	7	12	1.37	15	33	8.50	4	12	2.33
Suriname	0	0	na	0	1	na	0	0	na
Uruguay	6	15	3.04	3	2	na	2	3	na
Venezuela	3	1	na	3	4	na	1	2	na
Caribbean	**16**	**18**	**2.13**	**8**	**2**	**1.69**	**3**	**2**	**na**
Antigua & Barbuda	0	0	na	0	0	na	0	0	na
Bahamas	0	0	na	0	0	na	0	0	na
Barbados	0	0	na	0	0	na	1	0	na
Cuba	13	7	2.01	3	1	na	0	1	na
Dominica	0	0	na	0	0	na	0	0	na
Dominican Rep.	1	3	na	0	0	na	0	0	na
Grenada	0	0	na	0	0	na	0	0	na
Haiti	1	1	na	0	0	na	0	0	na
Jamaica	0	1	na	1	1	na	0	0	na
St Kitts & Nevis	0	0	na	0	0	na	0	0	na
Trinidad & Tobago	2	7	4.69	4	0	na	2	1	na
European Union	**1 212**	**1 231**	**0.59**	**643**	**1 047**	**0.85**	**1 125**	**1 849**	**0.99**
Austria	23	22	0.36	21	39	1.07	33	24	0.51
Belgium	64	55	0.77	35	75	1.53	52	74	1.26
Bulgaria	12	12	1.03	2	2	na	6	9	0.93
Croatia	3	6	na	4	10	1.45	5	8	0.61
Cyprus	3	0	na	0	3	na	8	17	5.74
Czech Rep.	36	33	0.57	4	13	0.37	29	58	1.24
Denmark	43	43	0.61	30	42	1.15	23	51	0.95
Estonia	7	7	0.68	0	2	na	0	3	na
Finland	19	20	0.42	6	19	0.62	33	42	1.12
France	188	217	0.63	103	121	0.72	121	171	0.67
Germany	262	289	0.59	120	236	0.93	275	339	1.02
Greece	7	21	0.27	4	14	0.39	72	127	3.09
Hungary	36	25	1.23	5	8	0.75	15	26	1.20
Ireland	19	7	0.59	10	14	0.62	10	24	0.89
Italy	138	121	0.48	40	94	0.52	174	385	1.47
Latvia	10	7	1.96	3	3	na	12	9	3.28
Lithuania	7	5	0.55	1	8	na	1	5	na
Luxembourg	2	1	na	0	0	na	5	6	1.40
Malta	0	1	na	1	0	na	0	0	na

AGRO-ECOLOGY			MAINTAIN GENETIC DIVERSITY OF FOOD CROPS			TRADITIONAL KNOWLEDGE			
2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	
9 666	**14 322**	**1.00**	**3 553**	**4 988**	**1.00**	**6 601**	**7 670**	**1.00**	**World**
2 274	**3 384**	**0.88**	**799**	**1 022**	**0.64**	**837**	**986**	**0.41**	**North America**
437	592	1.15	129	166	0.65	246	300	1.11	Canada
1 893	2 895	0.84	702	911	0.64	617	735	0.31	United States of America
1 959	**2 507**	**3.95**	**446**	**593**	**2.25**	**1 026**	**1 181**	**3.34**	**Latin America**
192	292	4.53	55	69	3.24	94	90	2.94	Argentina
1	0	na	0	0	na	5	5	35.54	Belize
14	20	11.61	11	11	24.12	17	27	29.34	Bolivia
1 281	1 472	4.48	153	198	1.43	628	658	3.52	Brazil
62	87	1.57	17	18	0.81	26	55	1.36	Chile
118	196	3.58	65	64	2.83	56	71	2.67	Colombia
73	68	14.76	6	16	5.68	5	14	2.84	Costa Rica
18	59	3.45	9	15	2.93	15	43	4.78	Ecuador
0	1	na	0	1	na	0	0	na	El Salvador
5	8	6.41	0	4	na	11	8	10.67	Guatemala
1	1	na	0	0	na	0	3	na	Guyana
3	4	na	2	2	na	0	0	na	Honduras
217	330	2.50	142	195	4.36	186	215	3.58	Mexico
16	7	18.10	3	1	na	1	0	na	Nicaragua
5	9	3.84	2	0	na	5	6	5.49	Panama
6	7	5.62	3	3	na	1	3	na	Paraguay
21	55	3.15	29	37	8.20	22	36	4.63	Peru
1	0	na	0	1	na	2	5	na	Suriname
17	25	3.32	7	11	2.96	3	6	1.23	Uruguay
24	23	3.22	3	5	na	12	11	3.28	Venezuela
38	**48**	**2.42**	**4**	**10**	**0.92**	**20**	**29**	**2.89**	**Caribbean**
0	0	na	0	0	na	0	0	na	Antigua & Barbuda
0	2	na	0	0	na	1	0	na	Bahamas
0	0	na	0	1	na	0	1	na	Barbados
31	37	3.03	2	7	na	11	16	2.30	Cuba
1	0	na	0	0	na	0	0	na	Dominica
3	2	na	0	0	na	0	1	na	Dominican Rep.
0	0	na	0	0	na	1	0	na	Grenada
1	2	na	0	0	na	0	2	na	Haiti
0	3	na	1	0	na	4	8	6.96	Jamaica
0	0	na	0	0	na	0	0	na	St Kitts & Nevis
2	3	na	1	2	na	4	3	na	Trinidad & Tobago
3 650	**5 185**	**1.13**	**1 197**	**1 546**	**0.94**	**1 219**	**1 475**	**0.49**	**European Union**
119	152	1.08	26	25	0.44	58	41	0.75	Austria
145	260	1.27	43	82	0.78	80	63	0.67	Belgium
21	26	1.04	11	9	1.16	16	22	1.13	Bulgaria
16	38	0.93	13	22	1.30	11	13	0.80	Croatia
5	8	0.75	4	7	1.25	4	2	na	Cyprus
95	160	1.22	51	50	1.23	26	37	0.31	Czech Rep.
155	219	1.30	35	45	0.68	62	71	0.85	Denmark
24	56	3.18	4	7	0.52	10	15	1.57	Estonia
89	113	1.19	26	28	0.68	21	36	0.49	Finland
665	936	1.46	174	179	0.72	126	161	0.37	France
615	918	0.84	210	290	0.70	168	203	0.29	Germany
78	130	1.16	21	46	1.08	13	24	0.33	Greece
61	88	1.33	13	26	0.98	32	31	1.07	Hungary
66	73	1.26	13	15	0.56	13	12	0.28	Ireland
493	816	1.33	263	354	1.66	194	261	0.67	Italy
18	39	3.10	10	12	2.72	0	0	na	Latvia
35	52	3.24	8	6	1.74	2	6	na	Lithuania
3	18	1.12	2	4	na	5	1	na	Luxembourg
2	0	na	0	0	na	0	2	na	Malta

Table F1: Publications on selected research topics relating to SDG 2: Zero hunger
Volume of output, 2012–2015 and 2016–2019, and specialization index, 2011–2019

	PEST-RESISTANT CROPS			HELP FOR SMALLHOLDER FOOD PRODUCERS			PRECISION AGRICULTURE		
	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019
Netherlands	105	105	0.78	142	206	2.93	59	88	0.65
Poland	63	44	0.53	7	18	0.29	20	44	0.38
Portugal	13	21	0.34	8	9	0.37	28	77	1.39
Romania	16	15	0.44	7	12	0.64	11	27	0.88
Slovakia	4	11	0.32	1	5	na	7	10	0.66
Slovenia	8	4	0.37	3	4	na	3	14	0.95
Spain	190	179	0.88	30	58	0.45	224	339	1.90
Sweden	35	37	0.33	38	87	1.49	27	32	0.38
United Kingdom	211	233	0.53	127	225	0.84	100	206	0.44
Southeast Europe	**12**	**7**	**0.37**	**11**	**3**	**0.73**	**6**	**20**	**0.82**
Albania	3	2	na	2	1	na	0	0	na
Bosnia & Herzegovina	0	1	na	3	0	na	0	0	na
Montenegro	0	0	na	0	0	na	0	4	na
North Macedonia	2	0	na	1	0	na	1	5	na
Serbia	10	4	0.36	5	2	na	5	12	0.65
European Free Trade Assoc.	**160**	**146**	**0.95**	**64**	**84**	**1.08**	**45**	**87**	**0.48**
Iceland	1	2	na	0	0	na	3	2	na
Norway	27	28	0.49	22	27	0.99	12	23	0.42
Switzerland	136	118	1.20	42	58	1.15	30	63	0.51
Other Europe & West Asia	**227**	**322**	**0.55**	**18**	**43**	**0.14**	**155**	**334**	**0.61**
Armenia	3	0	na	0	0	na	0	0	na
Azerbaijan	0	3	na	0	0	na	0	0	na
Belarus	0	4	na	0	0	na	1	1	na
Georgia	1	3	na	0	1	na	0	0	na
Iran Islamic Rep.	88	111	0.76	5	19	0.21	49	65	0.51
Israel	33	40	0.68	4	2	na	35	60	1.25
Moldova, Rep.	0	0	na	0	0	na	0	0	na
Russian Federation	40	85	0.35	0	11	0.06	19	116	0.48
Turkey	55	83	0.62	8	8	0.16	50	79	0.74
Ukraine	9	7	0.35	1	7	na	8	21	0.73
Sub-Saharan Africa	**151**	**249**	**2.30**	**592**	**1 194**	**27.35**	**57**	**126**	**1.17**
Angola	0	1	na	1	1	na	0	1	na
Benin	6	9	6.67	24	31	56.32	1	3	na
Botswana	2	0	na	2	8	13.89	1	0	na
Burkina Faso	2	9	4.74	11	35	31.22	0	1	na
Burundi	0	1	na	8	6	93.28	0	0	na
Cameroon	2	6	1.21	16	23	16.10	0	0	na
Cabo Verde	0	0	na	2	0	na	0	1	na
Central African Rep.	0	1	na	1	0	na	0	0	na
Chad	0	0	na	1	1	na	0	0	na
Comoros	0	0	na	0	0	na	0	0	na
Congo	0	2	na	0	3	na	0	0	na
Côte d'Ivoire	1	6	na	2	16	11.37	1	1	na
Congo, Dem. Rep.	0	3	na	5	10	21.23	0	0	na
Djibouti	0	0	na	0	0	na	0	0	na
Eritrea	0	0	na	0	1	na	0	0	na
Eswatini	0	0	na	1	1	na	0	0	na
Ethiopia	13	26	2.48	86	202	63.81	4	11	1.60
Gabon	0	1	na	0	1	na	0	0	na
Gambia	0	0	na	1	4	na	0	0	na
Ghana	6	12	2.48	30	112	42.07	0	3	na
Guinea	0	0	na	1	3	na	0	0	na
Guinea-Bissau	0	0	na	1	1	na	0	0	na
Kenya	34	47	8.61	175	333	123.97	19	14	2.92
Lesotho	0	0	na	0	0	na	0	0	na
Liberia	0	0	na	0	1	na	0	0	na
Madagascar	3	1	na	9	15	42.38	1	1	na

AGRO-ECOLOGY			MAINTAIN GENETIC DIVERSITY OF FOOD CROPS			TRADITIONAL KNOWLEDGE			
2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	
286	390	0.98	118	130	1.17	85	97	0.48	Netherlands
147	218	0.85	28	54	0.49	56	70	0.39	Poland
118	203	1.43	44	57	1.12	46	69	0.84	Portugal
64	92	1.08	7	13	0.33	23	32	0.49	Romania
33	44	1.24	8	14	0.77	7	12	0.34	Slovakia
19	26	0.93	8	10	0.60	9	6	0.45	Slovenia
477	667	1.45	207	251	1.57	140	167	0.63	Spain
172	256	1.12	81	72	0.93	55	67	0.47	Sweden
554	835	0.80	186	282	0.66	223	298	0.44	United Kingdom
23	**44**	**0.64**	**44**	**34**	**2.12**	**35**	**48**	**1.44**	**Southeast Europe**
4	3	na	5	6	4.94	3	0	na	Albania
1	5	na	8	2	1.60	3	1	na	Bosnia & Herzegovina
1	3	na	1	3	na	0	0	na	Montenegro
0	2	na	8	6	3.02	5	0	na	North Macedonia
18	34	0.68	35	27	2.07	26	47	1.73	Serbia
279	**450**	**1.11**	**64**	**91**	**0.61**	**114**	**124**	**0.61**	**European Free Trade Assoc.**
1	6	na	1	2	na	2	5	na	Iceland
75	82	0.70	24	35	0.60	51	55	0.86	Norway
208	379	1.32	42	59	0.63	64	67	0.49	Switzerland
301	**606**	**0.47**	**235**	**429**	**0.94**	**251**	**403**	**0.54**	**Other Europe & West Asia**
1	0	na	2	2	na	0	2	na	Armenia
1	2	na	7	6	3.27	2	3	na	Azerbaijan
2	1	na	1	7	na	1	2	na	Belarus
1	1	na	5	3	na	4	9	1.67	Georgia
151	244	0.84	80	135	1.26	111	190	0.98	Iran Islamic Rep.
31	47	0.37	38	38	0.90	17	20	0.38	Israel
2	3	na	1	0	na	0	0	na	Moldova, Rep.
31	142	0.23	38	121	0.55	17	50	0.12	Russian Federation
70	137	0.49	66	134	1.35	104	140	0.93	Turkey
13	38	0.35	6	8	0.24	3	3	na	Ukraine
737	**1 225**	**5.23**	**257**	**422**	**5.33**	**918**	**1 139**	**11.75**	**Sub-Saharan Africa**
2	1	na	1	0	na	0	9	na	Angola
34	67	28.00	20	30	38.97	25	47	45.72	Benin
1	7	2.12	1	2	na	12	11	14.24	Botswana
26	51	11.59	7	6	5.62	25	20	16.97	Burkina Faso
1	2	na	0	0	na	1	0	na	Burundi
47	65	8.01	5	17	4.51	85	66	22.24	Cameroon
1	0	na	0	0	na	0	0	na	Cabo Verde
0	0	na	0	0	na	0	2	na	Central African Rep.
0	1	na	0	0	na	1	2	na	Chad
2	2	na	0	0	na	0	0	na	Comoros
6	6	5.79	0	2	na	6	6	19.22	Congo
8	28	8.63	3	10	10.36	6	13	10.91	Côte d'Ivoire
9	15	6.56	2	1	na	19	10	16.82	Congo, Dem. Rep.
1	0	na	1	0	na	1	1	na	Djibouti
0	0	na	0	0	na	0	1	na	Eritrea
3	2	na	0	2	na	0	0	na	Eswatini
100	183	10.07	43	94	14.53	101	98	16.68	Ethiopia
2	1	na	1	1	na	7	7	18.50	Gabon
0	0	na	0	0	na	1	0	na	Gambia
41	107	8.15	19	24	6.86	36	62	12.82	Ghana
1	4	na	1	1	na	4	3	na	Guinea
2	1	na	0	0	na	1	1	na	Guinea-Bissau
204	248	17.70	54	80	16.24	80	65	13.87	Kenya
1	0	na	0	0	na	1	3	na	Lesotho
0	2	na	0	0	na	0	0	na	Liberia
23	26	15.95	8	1	na	14	14	19.13	Madagascar

Table F1: Publications on selected research topics relating to SDG 2: Zero hunger
Volume of output, 2012–2015 and 2016–2019, and specialization index, 2011–2019

	PEST-RESISTANT CROPS			HELP FOR SMALLHOLDER FOOD PRODUCERS			PRECISION AGRICULTURE		
	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019
Malawi	0	3	na	27	54	97.21	1	1	na
Mali	1	5	na	15	35	73.77	2	5	na
Mauritius	1	4	na	0	1	na	1	2	na
Mozambique	0	0	na	6	21	36.42	0	4	na
Namibia	0	1	na	4	5	15.90	0	0	na
Niger	1	2	na	7	15	81.78	2	2	na
Nigeria	25	29	1.06	46	95	9.45	3	15	0.86
Rwanda	3	4	na	13	34	55.85	0	4	na
Sao Tome & Principe	0	0	na	0	0	na	0	0	na
Senegal	2	2	na	10	32	16.10	0	6	na
Seychelles	0	0	na	0	0	na	0	0	na
Sierra Leone	1	0	na	0	5	na	0	4	na
Somalia	0	0	na	0	0	na	0	0	na
South Africa	59	101	2.00	89	222	10.78	18	48	1.03
South Sudan	0	0	na	0	0	na	0	0	na
Togo	0	1	na	0	3	na	0	0	na
Uganda	10	27	6.60	38	105	55.62	2	4	na
Tanzania	5	27	4.07	47	123	73.14	3	1	na
Zambia	0	2	na	8	33	49.91	0	0	na
Zimbabwe	4	3	na	79	118	217.05	5	13	8.02
Arab States	**152**	**195**	**0.94**	**50**	**49**	**0.65**	**67**	**172**	**0.78**
Algeria	2	9	0.21	6	3	0.67	1	10	0.38
Bahrain	0	0	na	0	0	na	1	2	na
Egypt	83	74	1.79	10	10	0.52	18	50	0.87
Iraq	4	11	0.46	0	3	na	1	10	0.49
Jordan	5	3	na	6	4	1.20	4	7	0.62
Kuwait	0	2	na	0	1	na	0	1	na
Lebanon	1	6	na	0	0	na	1	8	na
Libya	0	2	na	0	1	na	0	0	na
Mauritania	0	0	na	2	0	na	1	0	na
Morocco	11	26	0.79	9	13	1.60	7	22	1.29
Oman	3	6	na	1	2	na	5	3	1.62
Palestine	0	0	na	0	0	na	0	5	na
Qatar	2	7	0.45	1	2	na	1	4	na
Saudi Arabia	20	42	0.41	3	8	0.19	11	42	0.86
Sudan	3	8	1.96	2	2	na	5	9	2.42
Syrian Arab Rep.	14	8	9.64	10	1	8.51	0	1	na
Tunisia	22	31	1.52	5	3	0.61	13	16	0.74
United Arab Emirates	0	3	na	3	0	na	1	3	na
Yemen	0	1	na	0	1	na	1	0	na
Central Asia	**5**	**14**	**0.77**	**2**	**6**	**1.50**	**4**	**14**	**1.36**
Kazakhstan	1	8	na	0	3	na	1	9	1.40
Kyrgyzstan	1	0	na	0	0	na	0	0	na
Mongolia	0	1	na	0	0	na	0	1	na
Tajikistan	0	0	na	1	0	na	0	0	na
Uzbekistan	3	5	na	1	3	na	3	4	na
South Asia	**819**	**961**	**2.39**	**169**	**315**	**1.33**	**279**	**600**	**1.51**
Afghanistan	1	2	na	0	0	na	0	0	na
Bangladesh	14	37	1.09	15	35	4.52	6	9	0.55
Bhutan	0	1	na	0	4	na	0	1	na
India	645	676	2.12	108	200	1.05	255	535	1.59
Maldives	0	0	na	0	0	na	0	0	na
Nepal	6	12	2.09	16	23	13.79	2	2	na
Pakistan	153	240	5.70	20	50	2.11	15	51	0.94
Sri Lanka	8	9	2.11	17	17	8.42	5	4	1.35

AGRO-ECOLOGY			MAINTAIN GENETIC DIVERSITY OF FOOD CROPS			TRADITIONAL KNOWLEDGE			
2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	
22	46	15.34	2	8	6.41	5	6	8.10	Malawi
32	36	23.86	13	13	24.29	13	9	12.09	Mali
4	1	na	1	3	na	13	26	34.20	Mauritius
5	10	4.06	6	6	10.64	3	4	na	Mozambique
0	3	na	3	2	na	20	23	41.12	Namibia
12	16	22.06	10	9	32.62	5	3	19.62	Niger
66	118	2.87	28	54	3.01	187	267	13.91	Nigeria
11	18	6.63	2	2	na	4	6	7.00	Rwanda
1	1	na	0	0	na	0	0	na	Sao Tome & Principe
18	40	6.26	8	13	3.73	9	6	3.87	Senegal
0	0	na	0	0	na	0	2	na	Seychelles
2	4	na	2	0	na	4	0	na	Sierra Leone
0	0	na	0	0	na	0	1	na	Somalia
119	238	2.21	55	118	3.08	267	387	8.18	South Africa
0	0	na	1	0	na	0	0	na	South Sudan
8	10	10.28	2	0	na	11	8	33.80	Togo
37	54	6.61	13	24	8.84	30	37	12.81	Uganda
31	42	5.85	10	27	5.71	17	35	7.37	Tanzania
10	34	7.08	3	5	na	2	6	4.11	Zambia
72	92	30.21	4	8	4.20	22	23	18.72	Zimbabwe
159	**303**	**0.57**	**135**	**229**	**1.18**	**204**	**335**	**1.23**	**Arab States**
12	21	0.52	12	23	1.10	26	42	1.86	Algeria
1	0	na	0	0	na	0	2	na	Bahrain
31	68	0.44	24	43	0.67	29	70	0.63	Egypt
3	24	0.57	2	9	0.22	5	14	0.56	Iraq
12	17	0.72	12	28	3.42	15	16	2.28	Jordan
1	6	na	0	0	na	0	5	na	Kuwait
7	11	0.74	3	11	0.77	7	12	1.04	Lebanon
2	0	na	0	0	na	0	0	na	Libya
0	1	na	0	1	na	0	0	na	Mauritania
19	53	0.96	22	43	2.00	24	58	2.68	Morocco
8	22	1.17	3	10	1.81	20	6	2.33	Oman
0	2	na	3	4	na	2	12	5.33	Palestine
4	3	na	0	1	na	1	4	na	Qatar
15	50	0.34	16	36	0.67	58	100	1.12	Saudi Arabia
12	14	3.18	5	8	2.49	10	15	4.94	Sudan
17	6	4.58	23	6	15.57	3	0	na	Syrian Arab Rep.
23	33	0.71	26	39	2.17	21	25	1.25	Tunisia
7	9	0.29	4	13	0.62	4	9	0.35	United Arab Emirates
1	2	na	0	1	na	4	5	5.13	Yemen
16	**31**	**1.27**	**8**	**18**	**1.47**	**8**	**15**	**0.44**	**Central Asia**
9	15	1.26	2	5	na	1	0	na	Kazakhstan
2	7	na	2	5	na	2	2	na	Kyrgyzstan
1	0	na	0	0	na	3	5	3.14	Mongolia
0	2	na	0	3	na	0	6	na	Tajikistan
6	12	1.25	4	7	1.93	2	3	na	Uzbekistan
891	**1 483**	**1.51**	**499**	**703**	**2.16**	**1 352**	**1 333**	**3.30**	**South Asia**
1	14	5.31	1	5	na	1	3	na	Afghanistan
62	116	2.96	28	35	3.04	122	62	9.65	Bangladesh
1	4	na	1	0	na	6	7	21.20	Bhutan
697	1 098	1.39	406	554	2.04	975	972	2.83	India
0	0	na	0	0	na	0	1	na	Maldives
28	43	3.26	14	18	6.63	41	41	10.80	Nepal
116	223	2.27	62	80	2.60	202	257	6.18	Pakistan
16	37	2.47	11	22	6.25	14	22	4.18	Sri Lanka

Table F1: Publications on selected research topics relating to SDG 2: Zero hunger
Volume of output, 2012–2015 and 2016–2019, and specialization index, 2011–2019

	PEST-RESISTANT CROPS			HELP FOR SMALLHOLDER FOOD PRODUCERS			PRECISION AGRICULTURE		
	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019
Southeast Asia	**1 809**	**2 611**	**1.04**	**268**	**622**	**0.42**	**1 146**	**1 964**	**0.98**
Brunei Darussalam	0	0	na	0	2	na	0	0	na
Cambodia	0	1	na	9	18	41.35	0	0	na
China	1 309	2 035	1.28	64	178	0.18	910	1 598	1.28
China, Hong Kong SAR	9	12	0.27	0	9	na	4	21	0.30
China, Macao SAR	1	0	na	0	0	na	0	0	na
China, Taiwan Prov.	47	72	0.47	6	15	0.24	22	22	0.32
Indonesia	16	46	0.77	55	152	6.25	9	60	1.11
Japan	205	171	0.52	40	51	0.25	88	98	0.33
Lao PDR	0	0	na	18	28	118.59	1	0	na
Malaysia	42	49	0.73	24	52	1.33	53	71	1.28
Myanmar	0	4	na	2	5	na	0	1	na
Philippines	32	44	4.76	26	52	16.94	11	32	5.05
Korea, DPR	0	0	na	0	0	na	0	0	na
Korea, Rep.	162	203	0.90	1	12	0.08	55	79	0.38
Singapore	10	15	0.19	6	5	0.20	1	4	na
Thailand	38	47	1.20	28	67	3.10	23	33	1.16
Timor-Leste	0	0	na	3	2	na	0	0	na
Viet Nam	10	26	0.84	18	46	3.60	4	13	0.70
Oceania	**278**	**299**	**1.25**	**130**	**252**	**1.80**	**161**	**257**	**1.37**
Australia	240	271	1.28	119	236	1.84	146	233	1.40
New Zealand	41	33	1.10	9	14	0.80	18	28	1.26
Fiji	2	1	na	3	2	na	0	0	na
Kiribati	0	0	na	0	0	na	0	0	na
Marshall Islands	0	0	na	0	0	na	0	0	na
Micronesia	0	0	na	0	0	na	0	0	na
Niue	0	0	na	0	0	na	0	0	na
Palau	0	0	na	0	0	na	0	0	na
Papua New Guinea	1	0	na	5	10	59.41	1	0	na
Samoa	0	0	na	0	0	na	0	0	na
Solomon Islands	0	0	na	0	1	na	0	0	na
Tonga	0	0	na	0	0	na	0	0	na
Vanuatu	1	0	na	3	3	na	0	0	na

$SI_{2011–19}$: The specialization index is measured as the proportion of output of a given country on a given topic, divided by the proportion observed at the global level. For example, a country with 2% of its output being on a research topic that represents 1% of all research worldwide would score 2.00, having twice as much output as expected, relative to the global average.

na = the total number of publications is too low to calculate the specialization index

KEY –: *data unavailable* | -n/+n: *data refer to n years before or after reference year* | 0: *magnitude nil or negligible* | na: *not applicable*

GDP: *gross domestic product* | MF: males and females | PPP$: *purchasing power parity dollars*

Note: Publication counts of articles, reviews and conference papers are based on the full-counting method. Therefore, the sum across countries is higher than the global total because of co-authorship. The selected topics in the present table are examples of research topics furthering the SDG agenda. These topics are not necessarily mutually exclusive. The following are excluded from the present table because they did not publish on these topics over the period under study: Cook Islands, Equatorial Guinea, Liechtenstein, Nauru, St Lucia, St Vincent and the Grenadines, Turkmenistan and Tuvalu. The total for the People's Republic of China excludes its Special Administrative Regions of Hong Kong and Macao and the Taiwan Province of China.

Source: Prepared by Science-Metrix using Scopus data (Elsevier), including those for social sciences, arts and humanities

AGRO-ECOLOGY			MAINTAIN GENETIC DIVERSITY OF FOOD CROPS			TRADITIONAL KNOWLEDGE			
2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	
1 455	**2 911**	**0.48**	**1 007**	**1 431**	**0.78**	**1 865**	**2 348**	**0.88**	**Southeast Asia**
1	0	na	1	0	na	1	6	na	Brunei Darussalam
6	14	4.86	3	4	na	3	1	na	Cambodia
921	1 902	0.53	670	963	0.85	1 035	1 211	0.73	China
4	20	0.10	6	15	0.27	88	70	1.77	China, Hong Kong SAR
0	0	na	1	1	na	22	39	6.63	China, Macao SAR
18	37	0.12	32	31	0.30	111	108	1.07	China, Taiwan Prov.
125	372	3.02	27	53	1.18	44	296	3.86	Indonesia
156	215	0.22	147	190	0.59	92	118	0.18	Japan
13	10	9.69	2	2	na	7	7	11.80	Lao PDR
73	105	0.64	48	40	0.84	209	217	2.99	Malaysia
1	13	3.89	3	9	7.13	5	19	11.24	Myanmar
56	89	4.83	43	61	10.21	25	28	4.57	Philippines
2	1	na	0	0	na	0	0	na	Korea, DPR
69	127	0.19	80	109	0.58	280	294	1.36	Korea, Rep.
4	17	0.06	3	6	na	7	14	0.19	Singapore
54	82	0.87	41	50	1.50	91	93	2.38	Thailand
2	0	na	1	1	na	1	1	na	Timor-Leste
39	73	1.29	18	47	1.93	13	30	1.00	Viet Nam
441	**713**	**1.16**	**190**	**286**	**1.20**	**264**	**310**	**1.10**	**Oceania**
396	621	1.15	165	262	1.23	204	236	0.91	Australia
57	93	1.08	14	18	0.59	47	73	1.88	New Zealand
5	9	4.69	4	3	na	10	10	15.94	Fiji
0	0	na	0	0	na	0	2	na	Kiribati
0	0	na	0	0	na	2	2	na	Marshall Islands
0	1	na	0	0	na	2	2	na	Micronesia
0	0	na	0	0	na	0	2	na	Niue
0	0	na	0	0	na	2	3	na	Palau
3	7	7.36	2	3	na	5	3	na	Papua New Guinea
0	0	na	0	0	na	1	2	na	Samoa
1	2	na	1	0	na	4	4	na	Solomon Islands
0	0	na	0	1	na	0	1	na	Tonga
2	4	na	6	4	167.82	3	2	na	Vanuatu

Table F2: Publications on selected research topics relating to SDG 3: Good health and well-being
Volume of output, 2012–2015 and 2016–2019, and specialization index, 2011–2019

	REPRODUCTIVE HEALTH AND NEONATOLOGY			TROPICAL COMMUNICABLE DISEASES*			HUMAN RESISTANCE TO ANTIBIOTICS			REGENERATIVE MEDICINE			IMPACT ON HEALTH OF SOIL, FRESHWATER AND AIR POLLUTION		
	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019
World	**140 722**	**163 151**	**1.00**	**47 019**	**53 534**	**1.00**	**16 203**	**23 780**	**1.00**	**95 314**	**111 568**	**1.00**	**17 924**	**30 364**	**1.00**
North America	**43 058**	**48 809**	**1.24**	**13 150**	**14 276**	**0.86**	**4 039**	**5 775**	**0.97**	**33 461**	**35 347**	**1.31**	**5 441**	**7 810**	**1.03**
Canada	6 171	7 564	1.22	1 320	1 434	0.57	561	775	0.96	3 222	3 595	0.85	958	1 290	1.20
United States of America	38 297	43 272	1.24	12 235	13 375	0.91	3 602	5 189	0.97	31 109	32 731	1.37	4 750	6 933	1.01
Latin America	**8 368**	**9 700**	**1.24**	**8 256**	**10 056**	**3.77**	**979**	**1 464**	**1.26**	**2 514**	**3 723**	**0.56**	**1 004**	**1 810**	**1.14**
Argentina	759	778	0.92	718	887	3.33	130	182	1.52	226	329	0.49	101	148	1.07
Belize	3	2	na	9	5	13.77	0	1	na	0	0	na	1	0	na
Bolivia	24	23	1.23	92	93	19.37	5	7	1.14	0	1	na	6	10	2.70
Brazil	4 639	5 391	1.23	5 136	6 398	4.16	498	770	1.18	1 594	2 173	0.60	484	881	0.99
Chile	738	861	1.49	173	235	1.02	70	122	1.15	201	365	0.67	87	148	1.21
Colombia	596	755	1.36	737	1 073	5.17	101	149	1.69	121	194	0.42	87	194	1.69
Costa Rica	31	34	0.46	74	82	4.02	13	18	2.45	9	20	0.27	9	13	1.30
Ecuador	64	192	0.94	155	189	3.20	16	51	2.21	12	33	0.13	17	62	2.03
El Salvador	11	13	2.51	15	15	7.00	2	1	na	1	1	na	1	4	na
Guatemala	63	66	3.06	51	79	13.73	2	5	na	1	0	na	5	10	2.40
Guyana	3	5	na	8	5	13.31	0	3	na	0	0	na	0	0	na
Honduras	11	14	1.53	27	39	16.56	3	4	na	1	1	na	4	8	1.81
Mexico	1 301	1 500	1.16	802	985	2.09	125	175	0.91	351	643	0.56	207	388	1.44
Nicaragua	19	12	1.60	34	73	22.97	1	2	na	0	4	na	3	4	na
Panama	34	41	1.70	81	89	10.54	4	5	1.05	7	8	0.33	2	5	na
Paraguay	16	28	1.25	46	60	13.63	0	6	na	2	1	na	0	5	na
Peru	155	247	1.76	354	374	7.68	34	62	3.00	17	43	0.37	27	54	1.50
Suriname	2	14	1.77	23	21	33.20	0	1	na	0	1	na	1	1	na
Uruguay	84	149	1.23	139	145	4.18	24	40	3.04	32	34	0.38	9	15	0.58
Venezuela	267	233	3.46	305	243	8.99	30	27	2.17	29	19	0.39	15	11	0.79
Caribbean	**488**	**484**	**2.92**	**353**	**390**	**5.40**	**38**	**82**	**1.78**	**87**	**87**	**0.69**	**26**	**36**	**0.84**
Antigua & Barbuda	2	1	na	0	0	na	0	0	na	1	5	na	0	0	na
Bahamas	5	5	1.80	0	0	na	0	0	na	1	1	na	0	1	na
Barbados	7	12	1.72	7	10	5.69	0	4	na	2	2	na	1	3	na
Cuba	321	246	3.08	218	190	5.32	23	21	1.41	66	47	0.83	13	14	0.66
Dominica	4	8	2.60	3	1	na	0	0	na	2	5	na	0	0	na
Dominican Rep.	21	28	2.83	12	26	6.72	3	3	na	2	7	na	0	0	na
Grenada	29	55	4.63	6	18	6.45	2	4	na	2	4	na	2	0	na
Haiti	25	24	3.57	58	67	29.71	0	1	na	0	0	na	3	6	na
Jamaica	53	72	3.52	19	24	3.83	7	9	2.87	6	7	0.18	4	7	1.75
St Kitts & Nevis	5	17	2.10	5	33	13.51	5	26	9.08	1	4	na	1	1	na
St Lucia	2	0	na	4	1	na	0	0	na	0	0	na		0	na
St Vincent & Grenadines	0	4	na	0	0	na	0	2	na	1	3	na	0	0	na
Trinidad & Tobago	24	22	1.26	33	28	2.87	3	17	2.82	5	4	0.20	3	5	na
European Union	**48 039**	**51 652**	**1.09**	**15 003**	**16 720**	**0.78**	**5 647**	**7 698**	**1.07**	**30 334**	**34 128**	**1.00**	**6 050**	**8 450**	**0.94**
Austria	1 260	1 481	0.98	280	295	0.47	96	162	0.66	899	1 109	0.91	170	217	0.65
Belgium	2 254	2 608	1.25	983	1 133	1.29	294	355	1.27	1 183	1 468	1.02	267	391	1.11
Bulgaria	295	208	1.12	36	53	0.42	35	43	1.14	81	75	0.42	49	83	1.63
Croatia	534	418	1.46	58	69	0.54	56	90	1.41	103	160	0.45	49	88	1.28
Cyprus	51	136	0.68	27	34	0.53	14	29	1.00	23	57	0.47	38	70	2.16
Czech Rep.	1 054	1 081	0.85	212	270	0.42	131	139	0.77	629	903	0.78	167	253	0.98
Denmark	1 966	2 394	1.57	506	568	0.74	255	392	1.48	687	953	0.71	265	327	1.04
Estonia	93	154	0.71	33	75	0.49	18	24	0.77	44	62	0.36	27	35	1.34
Finland	1 055	1 331	1.06	197	244	0.51	65	115	0.57	582	748	0.82	193	272	1.08
France	5 486	6 161	0.99	2 922	3 104	1.08	838	1 080	1.09	3 665	4 274	0.83	734	961	0.71
Germany	6 335	6 875	0.70	2 182	2 494	0.55	932	1 196	0.82	7 384	8 178	1.14	771	1 089	0.49
Greece	1 388	1 364	1.44	212	231	0.55	203	251	1.71	447	533	0.65	308	314	1.63
Hungary	512	483	0.88	58	89	0.31	60	96	0.99	318	363	0.65	74	85	0.72
Ireland	1 074	1 316	1.80	114	154	0.46	124	191	1.68	544	587	1.22	82	121	0.74
Italy	6 568	7 528	1.22	1 288	1 518	0.56	620	962	0.99	5 232	6 076	1.35	872	1 340	1.10

MEDICINES AND VACCINES FOR TUBERCULOSIS			HUMAN IMMUNODEFICIENCY VIRUS (HIV)			NEW OR RE-EMERGING VIRUSES THAT CAN INFECT HUMANS			TYPE 2 DIABETES			
2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011-2019	
24 616	**27 180**	**1.00**	**61 999**	**63 513**	**1.00**	**24 251**	**29 141**	**1.00**	**64 792**	**77 769**	**1.00**	**World**
5 928	**6 377**	**0.76**	**30 034**	**30 639**	**1.85**	**9 139**	**11 249**	**1.41**	**20 545**	**22 660**	**1.19**	**North America**
711	826	0.61	3 344	3 590	1.34	1 073	1 234	1.06	2 831	3 284	1.09	Canada
5 427	5 832	0.78	27 781	28 340	1.92	8 464	10 459	1.46	18 479	20 414	1.20	United States of America
1 838	**2 192**	**1.53**	**3 724**	**3 979**	**1.18**	**1 276**	**2 582**	**1.33**	**3 433**	**4 462**	**1.13**	**Latin America**
174	181	1.21	375	330	1.04	142	186	1.13	300	305	0.84	Argentina
1	0	na	8	5	4.17	0	4	na	4	2	na	Belize
11	6	2.23	9	6	0.80	7	17	1.98	6	4	0.47	Bolivia
966	1 178	1.46	2 223	2 354	1.30	643	1 605	1.37	1 846	2 257	1.05	Brazil
70	83	0.66	183	204	0.68	95	125	1.02	276	414	1.29	Chile
157	231	2.14	289	340	1.43	74	248	1.58	147	275	0.74	Colombia
5	8	0.14	18	8	0.24	10	29	1.43	10	19	0.47	Costa Rica
12	27	0.80	27	48	0.58	8	48	0.94	28	79	0.96	Ecuador
1	5	na	14	12	5.26	4	7	1.81	6	4	2.99	El Salvador
6	10	4.35	46	43	8.07	17	30	8.49	12	19	3.57	Guatemala
4	2	na	6	8	10.82	0	1	na	1	2	na	Guyana
5	5	3.77	20	32	6.09	5	18	5.34	2	8	2.13	Honduras
334	421	1.64	507	582	0.82	214	293	1.02	818	1 145	1.68	Mexico
0	0	na	8	10	2.86	9	48	21.16	4	5	na	Nicaragua
12	16	2.03	24	30	1.16	20	24	3.41	6	10	0.31	Panama
1	8	1.94	5	5	1.14	5	11	3.08	3	3	na	Paraguay
168	247	8.40	229	324	3.72	93	91	3.76	61	128	1.65	Peru
0	1	na	0	4	na	2	9	16.13	0	10	7.20	Suriname
25	16	1.14	27	21	0.46	18	46	1.84	21	20	0.23	Uruguay
44	28	1.87	47	33	1.10	17	42	1.40	72	83	1.65	Venezuela
116	**100**	**3.01**	**375**	**307**	**3.66**	**67**	**119**	**2.34**	**173**	**146**	**1.81**	**Caribbean**
0	0	na	0	0	na	0	0	na	0	2	na	Antigua & Barbuda
0	0	na	17	12	14.94	0	1	na	1	0	na	Bahamas
3	1	na	17	9	3.80	1	5	na	14	16	5.02	Barbados
73	42	3.23	157	64	2.72	29	29	1.54	82	51	1.29	Cuba
0	0	na	1	1	na	4	3	na	0	2	na	Dominica
5	6	4.03	32	48	13.13	10	16	8.38	3	11	1.42	Dominican Rep.
0	1	na	6	11	2.27	1	13	5.54	6	10	1.35	Grenada
26	32	23.16	78	90	26.89	4	16	7.61	2	2	na	Haiti
8	10	1.25	58	57	5.71	6	12	2.73	38	28	3.85	Jamaica
0	1	na	0	0	na	4	8	10.38	2	1	na	St Kitts & Nevis
1	1	na	4	1	na	0	0	na	3	0	na	St Lucia
0	0	na	0	1	na	0	0	na	0	0	na	St Vincent & Grenadines
6	7	1.24	18	27	2.74	12	22	3.34	26	31	3.53	Trinidad & Tobago
7 100	**7 497**	**0.76**	**19 149**	**18 503**	**0.83**	**7 741**	**9 064**	**0.92**	**21 861**	**24 241**	**1.04**	**European Union**
64	93	0.21	318	361	0.43	227	228	0.80	611	712	0.87	Austria
366	462	0.94	1 366	1 203	1.25	479	637	1.34	803	844	0.89	Belgium
54	37	0.83	66	72	0.38	49	65	0.98	111	185	1.18	Bulgaria
71	33	0.89	107	74	0.50	55	72	1.00	177	213	1.10	Croatia
9	10	0.33	32	65	0.55	2	18	0.42	32	60	0.60	Cyprus
130	128	0.56	205	237	0.36	169	187	0.64	439	513	0.82	Czech Rep.
321	285	0.85	701	694	0.87	160	223	0.57	1 520	2 097	2.66	Denmark
40	37	0.51	73	84	0.79	36	69	0.87	57	72	0.47	Estonia
50	77	0.30	189	173	0.29	272	281	1.43	783	870	1.40	Finland
1 206	1 213	0.82	3 214	3 020	1.05	1 531	1 906	1.30	2 283	2 395	0.71	France
975	1 056	0.46	2 491	2 464	0.51	1 534	1 909	0.88	3 458	3 808	0.74	Germany
93	123	0.60	264	304	0.52	178	191	1.00	703	748	1.49	Greece
68	52	0.52	95	83	0.29	99	123	0.75	307	322	1.04	Hungary
108	135	0.82	281	292	0.78	104	112	0.58	401	437	1.16	Ireland
789	850	0.66	2 410	2 276	0.89	907	976	0.78	3 358	3 637	1.20	Italy

Table F2: Publications on selected research topics relating to SDG 3: Good health and well-being
Volume of output, 2012–2015 and 2016–2019, and specialization index, 2011–2019

	REPRODUCTIVE HEALTH AND NEONATOLOGY			TROPICAL COMMUNICABLE DISEASES*			HUMAN RESISTANCE TO ANTIBIOTICS			REGENERATIVE MEDICINE			IMPACT ON HEALTH OF SOIL, FRESHWATER AND AIR POLLUTION		
	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019
Latvia	39	54	0.26	11	19	0.23	11	35	0.85	35	64	0.49	14	38	1.50
Lithuania	109	132	0.52	28	50	0.39	28	36	1.18	59	110	0.63	48	69	1.80
Luxembourg	26	33	0.15	29	44	0.51	11	10	0.30	54	94	0.90	24	33	1.97
Malta	75	72	2.17	6	4	0.41	8	16	0.76	7	15	0.26	4	8	0.95
Netherlands	4 238	4 663	1.53	1 318	1 496	0.97	460	604	1.24	2 486	2 796	1.16	454	606	0.81
Poland	2 792	2 802	1.16	225	255	0.27	255	320	0.84	1 155	1 689	0.73	389	635	1.29
Portugal	868	1 121	0.78	555	553	0.97	269	334	1.78	940	1 081	1.14	297	361	1.73
Romania	736	844	1.02	64	89	0.23	77	109	0.80	437	474	0.80	241	319	2.31
Slovakia	220	258	0.59	61	78	0.39	32	44	0.71	122	187	0.52	81	107	1.48
Slovenia	252	358	1.05	33	50	0.36	50	61	1.12	153	208	0.81	75	75	1.46
Spain	4 386	5 235	1.03	1 599	1 807	0.85	778	1 024	1.42	2 912	3 577	0.92	763	1 069	1.12
Sweden	2 599	3 348	1.35	793	942	0.79	331	466	1.28	1 432	1 794	0.97	346	463	0.95
United Kingdom	11 244	12 657	1.32	5 280	6 233	1.26	998	1 761	1.07	6 474	7 619	1.05	1 142	1 747	0.81
Southeast Europe	**623**	**641**	**1.23**	**85**	**96**	**0.38**	**69**	**96**	**1.07**	**186**	**241**	**0.49**	**122**	**150**	**1.73**
Albania	34	35	1.95	12	11	1.70	0	7	na	1	7	na	11	12	5.31
Bosnia & Herzegovina	79	123	1.80	3	6	0.16	14	25	2.00	5	14	0.18	6	18	1.29
Montenegro	16	20	0.52	2	5	na	1	6	na	0	6	na	0	6	na
North Macedonia	52	62	1.35	4	7	0.30	6	6	0.58	19	23	0.57	17	24	2.38
Serbia	461	449	1.15	67	79	0.38	54	66	1.04	165	197	0.55	90	103	1.63
European Free Trade Assoc.	**3 643**	**4 675**	**1.05**	**2 098**	**2 444**	**1.24**	**494**	**785**	**1.27**	**2 273**	**2 771**	**0.91**	**547**	**735**	**0.86**
Iceland	116	169	1.15	15	14	0.33	7	14	0.73	28	34	0.48	13	17	0.89
Liechtenstein	1	3	na	0	0	na	0	0	na	0	0	na	0	0	na
Norway	1 488	1 927	1.41	262	315	0.53	107	212	0.96	395	518	0.51	217	299	0.97
Switzerland	2 117	2 733	0.88	1 850	2 162	1.60	385	584	1.44	1 864	2 271	1.12	349	464	0.81
Other Europe & West Asia	**11 323**	**15 365**	**1.20**	**1 860**	**2 473**	**0.54**	**1 290**	**2 097**	**1.14**	**4 740**	**8 356**	**0.77**	**986**	**2 182**	**0.84**
Armenia	13	32	0.35	3	8	0.14	2	8	0.63	2	5	0.09	7	18	1.61
Azerbaijan	34	53	0.94	6	11	0.33	0	11	0.27	1	11	0.10	1	2	na
Belarus	41	47	0.22	3	3	na	3	5	0.28	41	53	0.64	2	13	0.36
Georgia	47	45	0.82	17	14	0.61	4	18	1.19	9	18	0.30	6	15	1.11
Iran Islamic Rep.	3 386	4 847	1.40	1 025	1 323	1.18	592	1 045	2.11	1 757	3 688	1.26	410	876	1.31
Israel	1 733	2 258	2.07	234	232	0.53	165	228	1.41	972	1 119	1.26	99	182	0.60
Moldova, Rep.	15	17	0.46	4	10	0.43	2	2	na	6	7	0.21	1	6	na
Russian Federation	792	2 854	0.41	216	378	0.17	82	281	0.30	1 036	1 988	0.48	157	609	0.54
Turkey	5 187	5 045	2.34	380	512	0.54	447	532	1.60	881	1 508	0.64	285	435	0.95
Ukraine	151	325	0.32	13	46	0.07	5	21	0.13	107	182	0.26	35	85	0.50
Sub-Saharan Africa	**5 158**	**7 297**	**2.91**	**6 847**	**8 161**	**9.04**	**434**	**953**	**2.38**	**221**	**387**	**0.16**	**523**	**1 085**	**2.27**
Angola	7	17	1.66	60	65	25.89	0	2	na	0	0	na	0	0	na
Benin	36	68	1.85	280	212	22.49	5	7	1.73	0	1	na	10	18	2.56
Botswana	45	70	2.01	25	61	3.65	3	8	0.82	0	1	na	5	12	1.54
Burkina Faso	92	151	4.00	384	397	29.94	4	18	1.79	0	3	na	3	8	1.18
Burundi	6	11	1.92	9	17	11.01	1	9	7.84	0	0	na	1	1	na
Cameroon	144	226	2.94	396	562	16.79	15	34	2.23	9	6	0.08	18	28	1.64
Cabo Verde	0	0	na	3	6	na	0	0	na	0	0	na	4	1	na
Central African Rep.	1	8	na	30	31	35.39	4	3	na	0	3	na	1	0	na
Chad	5	5	2.67	10	30	25.03	1	4	na	0	1	na	1	2	na
Comoros	1	1	na	6	14	25.73	0	0	na	0	0	na	1	0	na
Congo	25	44	2.57	83	127	18.29	4	5	na	0	0	na	2	3	na
Côte d'Ivoire	52	42	2.35	175	234	19.83	9	7	2.67	1	1	na	8	16	2.29
Congo, Dem. Rep.	61	139	5.44	144	223	26.46	10	12	3.97	0	3	na	9	24	4.89
Djibouti	4	1	na	5	6	14.64	0	1	na	0	0	na	1	0	na
Equatorial Guinea	0	1	na	20	30	109.88	1	0	na	0	0	na	0	0	na
Eritrea	2	5	na	2	12	13.63	0	2	na	0	0	na	0	2	na
Eswatini	13	10	2.32	8	14	6.76	0	1	na	0	0	na	0	2	na
Ethiopia	358	837	5.15	521	773	13.94	37	122	5.72	7	18	0.05	21	67	1.87
Gabon	17	23	2.81	176	154	41.13	11	6	4.07	0	1	na	1	1	na

MEDICINES AND VACCINES FOR TUBERCULOSIS			HUMAN IMMUNODEFICIENCY VIRUS (HIV)			NEW OR RE-EMERGING VIRUSES THAT CAN INFECT HUMANS			TYPE 2 DIABETES			
2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011-2019	
32	40	0.55	37	35	0.24	10	11	0.20	21	37	0.38	Latvia
18	29	0.40	35	49	0.20	21	26	0.39	36	44	0.34	Lithuania
44	46	1.01	90	83	1.05	25	31	1.00	39	37	0.47	Luxembourg
9	5	1.04	11	11	0.58	8	6	0.45	28	46	3.05	Malta
758	863	1.01	1 860	1 847	1.08	795	819	1.29	1 856	2 050	1.29	Netherlands
283	201	0.56	432	421	0.34	237	234	0.47	1 125	1 343	1.03	Poland
264	356	1.28	485	572	0.85	115	161	0.41	377	520	0.74	Portugal
117	154	0.77	188	199	0.42	54	61	0.24	351	396	1.01	Romania
67	86	0.57	53	85	0.23	63	51	0.55	130	186	0.73	Slovakia
26	23	0.32	71	78	0.36	74	82	1.30	112	152	0.87	Slovenia
745	891	0.94	2 405	2 364	1.19	649	797	0.81	2 425	2 727	1.14	Spain
410	471	0.76	950	987	0.73	473	589	1.06	1 710	2 069	1.68	Sweden
2 177	2 609	1.11	6 015	6 369	1.24	1 923	2 460	1.08	4 936	6 075	1.10	United Kingdom
76	**86**	**0.70**	**117**	**138**	**0.42**	**103**	**91**	**0.79**	**265**	**366**	**1.17**	**Southeast Europe**
11	6	0.50	2	6	0.51	6	15	2.33	6	10	0.79	Albania
10	11	0.91	17	14	0.24	10	6	0.79	43	62	2.01	Bosnia & Herzegovina
1	3	na	5	5	0.49	2	6	na	7	17	0.99	Montenegro
11	13	1.50	5	8	0.30	8	6	0.75	32	40	1.36	North Macedonia
50	61	0.61	98	116	0.45	87	66	0.75	192	264	1.08	Serbia
976	**1 078**	**1.10**	**2 048**	**2 090**	**0.98**	**546**	**927**	**0.89**	**1 478**	**1 820**	**0.82**	**European Free Trade Assoc.**
11	14	0.43	20	26	0.24	7	15	0.55	57	62	0.99	Iceland
0	0	na	0	5	na	2	1	na	14	19	3.03	Liechtenstein
177	197	0.65	396	381	0.56	133	200	0.67	460	634	0.87	Norway
804	902	1.34	1 676	1 748	1.21	426	736	1.01	991	1 157	0.78	Switzerland
1 707	**2 379**	**1.01**	**1 899**	**2 610**	**0.41**	**1 215**	**1 538**	**0.65**	**4 016**	**5 954**	**0.92**	**Other Europe & West Asia**
6	27	1.19	8	23	0.42	5	4	na	8	12	0.46	Armenia
12	23	1.42	5	9	0.18	8	1	na	7	38	0.94	Azerbaijan
31	72	1.33	54	51	0.64	15	5	0.35	6	16	0.24	Belarus
44	45	3.03	46	47	1.46	9	21	0.83	10	15	0.51	Georgia
513	654	1.14	658	870	0.59	266	352	0.56	1 385	2 333	1.33	Iran Islamic Rep.
95	84	0.41	323	272	0.55	139	168	0.78	546	741	1.19	Israel
25	43	4.08	11	8	0.49	5	5	0.33	3	6	0.29	Moldova, Rep.
401	999	0.87	511	927	0.33	438	651	0.68	613	1 125	0.42	Russian Federation
572	448	1.36	284	376	0.31	363	332	0.83	1 401	1 491	1.33	Turkey
57	97	0.52	106	178	0.25	20	36	0.14	87	274	0.58	Ukraine
3 150	**3 920**	**8.74**	**10 585**	**12 318**	**11.46**	**955**	**1 826**	**2.60**	**909**	**1 570**	**1.29**	**Sub-Saharan Africa**
5	14	10.18	18	9	4.87	2	3	na	0	3	na	Angola
26	45	4.64	78	64	4.13	5	6	0.95	14	13	1.07	Benin
51	73	10.22	255	350	23.55	5	8	0.71	8	10	0.90	Botswana
31	34	5.40	163	145	11.33	15	33	2.75	7	11	0.77	Burkina Faso
6	7	9.82	13	25	12.53	0	0	na	1	1	na	Burundi
99	112	7.38	339	441	11.18	23	91	2.67	69	91	2.23	Cameroon
1	0	na	2	2	na	3	3	na	0	0	na	Cabo Verde
6	4	14.36	20	28	23.78	14	15	30.51	0	0	na	Central African Rep.
5	1	na	9	8	10.43	2	6	na	1	1	na	Chad
0	0	na	2	0	na	1	3	na	0	2	na	Comoros
31	31	12.02	54	53	9.76	19	61	14.38	12	13	2.87	Congo
61	41	15.25	154	163	12.53	26	44	3.69	11	15	1.08	Côte d'Ivoire
25	37	7.95	105	120	13.56	29	89	11.94	27	21	3.98	Congo, Dem. Rep.
8	8	26.82	2	1	na	2	1	na	0	0	na	Djibouti
0	3	na	3	4	na	1	2	na	0	0	na	Equatorial Guinea
0	1	na	2	5	na	0	0	na	1	1	na	Eritrea
7	37	24.52	50	110	39.04	1	2	na	0	2	na	Eswatini
289	482	17.46	555	812	13.86	12	60	0.66	38	166	1.96	Ethiopia
22	19	12.42	69	64	15.82	44	34	18.05	4	3	na	Gabon

Table F2: Publications on selected research topics relating to SDG 3: Good health and well-being
Volume of output, 2012–2015 and 2016–2019, and specialization index, 2011–2019

	REPRODUCTIVE HEALTH AND NEONATOLOGY			TROPICAL COMMUNICABLE DISEASES*			HUMAN RESISTANCE TO ANTIBIOTICS			REGENERATIVE MEDICINE			IMPACT ON HEALTH OF SOIL, FRESHWATER AND AIR POLLUTION		
	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019
Gambia	26	42	3.00	177	161	41.45	0	12	5.47	1	0	na	3	4	na
Ghana	280	473	3.93	523	760	17.65	17	61	2.88	4	15	0.08	35	88	4.16
Guinea	27	36	6.70	40	80	31.94	0	2	na	1	0	na	0	1	na
Guinea-Bissau	5	5	1.55	22	25	16.39	2	1	na	0	1	na	0	0	na
Kenya	414	623	2.98	942	985	19.48	25	55	2.24	4	9	0.04	43	73	1.91
Lesotho	7	6	2.28	1	3	na	0	0	na	0	0	na	1	1	na
Liberia	8	20	4.83	10	31	17.32	0	1	na	0	1	na	0	1	na
Madagascar	39	35	2.36	121	107	13.84	10	10	4.44	1	2	na	2	3	na
Malawi	107	253	5.17	228	312	21.02	5	24	2.53	1	2	na	12	32	4.53
Mali	45	33	2.96	247	268	48.88	1	7	na	0	0	na	4	3	na
Mauritius	12	7	0.58	8	17	1.74	4	0	na	7	13	1.25	1	6	na
Mozambique	40	95	3.56	161	223	30.74	6	12	2.77	1	1	na	1	10	1.37
Namibia	14	27	0.99	27	48	5.75	3	5	na	1	5	na	5	7	2.38
Niger	17	25	2.32	52	43	11.85	2	4	na	0	1	na	2	1	na
Nigeria	839	971	2.66	872	1 047	7.99	98	164	2.44	25	53	0.13	111	338	3.70
Rwanda	70	128	5.30	75	101	11.93	3	7	2.33	1	0	na	4	16	2.21
Sao Tome & Principe	0	2	na	6	4	38.87	0	0	na	0	0	na	0	0	na
Senegal	89	104	2.45	293	276	17.81	12	24	2.36	2	0	na	13	15	1.28
Seychelles	1	1	na	3	1	na	0	0	na	0	0	na	1	0	na
Sierra Leone	17	46	5.03	33	52	26.84	2	4	na	0	0	na	0	3	na
Somalia	6	20	8.27	1	9	10.32	0	0	na	0	0	na	0	1	na
South Africa	2 027	2 615	2.42	843	1 235	2.41	122	358	1.76	151	246	0.24	213	377	1.81
South Sudan	3	15	5.78	16	19	53.10	0	0	na	0	0	na	0	2	na
Togo	24	33	3.12	46	60	15.12	2	3	na	0	2	na	0	0	na
Uganda	331	476	4.95	566	694	20.66	16	38	3.06	3	2	na	19	35	1.41
Tanzania	279	426	4.61	670	741	26.55	32	75	5.61	3	12	0.10	16	48	2.33
Zambia	135	206	4.53	175	200	21.13	7	12	2.82	1	1	na	9	14	2.88
Zimbabwe	80	171	2.92	91	112	7.16	4	15	1.65	1	2	na	6	25	2.53
Arab States	**3 326**	**4 868**	**1.03**	**1 635**	**2 095**	**1.23**	**669**	**1 334**	**1.87**	**1 265**	**2 404**	**0.45**	**582**	**1 163**	**1.27**
Algeria	55	90	0.17	47	82	0.40	57	96	1.23	13	49	0.05	35	80	1.00
Bahrain	59	96	2.98	14	23	0.64	8	12	2.14	1	6	na	4	8	1.55
Egypt	1 251	1 782	1.55	602	646	1.59	189	406	2.01	473	986	0.82	141	299	1.34
Iraq	83	497	1.37	25	178	1.31	18	153	2.88	20	113	0.23	24	114	1.69
Jordan	156	241	1.17	37	54	0.51	35	50	2.11	58	59	0.36	27	55	1.17
Kuwait	102	76	0.94	27	14	0.72	26	37	2.23	30	36	0.22	20	43	2.60
Lebanon	170	258	1.39	39	54	0.82	53	97	4.21	75	174	0.92	31	54	1.79
Libya	25	17	0.90	16	19	1.58	14	13	4.77	3	10	0.16	7	11	1.63
Mauritania	2	4	na	15	29	28.24	0	2	na	0	0	na	2	3	na
Morocco	245	213	0.80	120	141	1.19	41	56	1.15	29	41	0.11	24	57	0.79
Oman	111	122	1.53	39	53	1.08	11	14	1.15	16	34	0.23	31	43	2.24
Palestine	25	61	1.13	27	31	2.54	14	15	4.06	0	10	0.11	12	12	2.13
Qatar	128	258	1.26	27	77	0.80	9	26	0.58	73	126	0.62	26	65	1.80
Saudi Arabia	679	934	0.80	410	582	1.08	189	352	1.95	521	865	0.61	169	286	1.21
Sudan	80	118	2.90	222	209	15.88	9	24	2.39	1	5	na	4	12	0.41
Syrian Arab Rep.	22	24	0.61	22	22	1.68	6	4	1.68	12	9	0.40	6	9	1.26
Tunisia	303	312	0.81	159	154	1.03	88	123	1.81	39	51	0.11	51	75	0.81
United Arab Emirates	158	246	0.66	29	67	0.35	23	64	0.77	48	131	0.30	51	83	1.59
Yemen	11	23	0.97	68	68	9.24	2	6	na	1	7	na	4	5	na
Central Asia	**79**	**145**	**0.41**	**18**	**38**	**0.25**	**10**	**33**	**0.60**	**31**	**54**	**0.21**	**20**	**86**	**1.48**
Kazakhstan	40	99	0.41	7	19	0.16	6	22	0.67	19	43	0.27	8	50	1.38
Kyrgyzstan	6	13	0.96	1	7	0.41	0	2	na	3	0	na	1	6	na
Mongolia	20	22	0.63	5	9	0.80	4	9	2.17	5	7	0.11	10	27	6.71
Tajikistan	3	6	na	3	5	na	0	1	na	2	1	na	0	2	na
Turkmenistan	1	1	na	0	0	na	0	0	na	0	0	na	0	0	na
Uzbekistan	10	10	0.22	2	3	na	0	1	na	3	3	na	1	4	na

MEDICINES AND VACCINES FOR TUBERCULOSIS			HUMAN IMMUNODEFICIENCY VIRUS (HIV)			NEW OR RE-EMERGING VIRUSES THAT CAN INFECT HUMANS			TYPE 2 DIABETES			
2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011-2019	
69	73	39.29	74	45	12.91	7	20	6.43	4	4	na	Gambia
64	133	4.58	267	374	5.99	56	91	2.83	51	135	2.06	Ghana
14	12	17.81	21	25	14.42	32	160	87.30	5	8	2.51	Guinea
28	22	57.86	45	52	34.51	3	9	11.98	2	2	na	Guinea-Bissau
135	210	6.47	1 142	1 359	17.36	125	186	5.82	33	68	0.73	Kenya
11	10	23.08	45	58	43.62	0	0	na	2	0	na	Lesotho
1	8	na	10	13	12.65	33	122	143.79	0	4	na	Liberia
21	18	10.70	16	16	2.11	35	37	9.58	0	6	na	Madagascar
85	130	17.93	499	686	40.97	4	12	0.56	5	25	0.95	Malawi
21	24	13.29	69	67	10.23	15	28	5.07	1	9	0.41	Mali
4	5	na	6	6	0.88	6	6	1.03	12	26	1.88	Mauritius
47	89	19.45	207	243	31.49	13	41	7.89	2	13	0.57	Mozambique
30	42	8.14	78	92	11.36	6	5	1.42	3	5	na	Namibia
6	12	6.16	7	15	3.12	5	6	4.75	0	2	na	Niger
208	216	3.24	832	888	5.34	132	227	2.00	224	377	1.84	Nigeria
24	32	8.14	189	165	21.14	9	17	2.75	9	13	1.42	Rwanda
0	0	na	0	0	na	0	3	na	0	0	na	Sao Tome & Principe
35	50	6.34	180	143	7.54	67	114	8.29	17	25	1.31	Senegal
0	0	na	0	0	na	3	2	na	3	5	na	Seychelles
6	9	5.25	8	32	7.57	62	261	139.34	0	3	na	Sierra Leone
2	2	na	2	3	na	0	2	na	0	1	na	Somalia
1 614	2 015	9.13	4 406	5 359	10.23	251	372	1.25	398	654	0.97	South Africa
1	0	na	2	5	na	1	4	na	0	0	na	South Sudan
16	17	13.26	74	94	21.26	3	7	0.97	3	9	2.03	Togo
263	287	18.46	1 259	1 466	36.68	57	111	4.15	27	81	1.14	Uganda
189	217	13.97	705	722	22.04	44	66	3.44	36	55	1.32	Tanzania
84	124	19.30	445	537	36.98	42	35	5.86	6	12	0.77	Zambia
61	99	9.63	407	644	25.48	10	24	1.38	7	10	0.34	Zimbabwe
745	**930**	**1.19**	**768**	**1 067**	**0.43**	**670**	**1 150**	**1.00**	**1 867**	**3 244**	**1.32**	**Arab States**
12	22	0.20	13	34	0.09	7	17	0.10	90	104	0.46	Algeria
4	9	0.89	9	13	0.26	2	12	1.18	52	62	4.44	Bahrain
110	175	0.64	166	218	0.33	243	398	1.21	514	886	1.53	Egypt
20	73	1.00	28	75	0.38	5	45	0.50	38	296	1.66	Iraq
16	27	0.34	31	45	0.40	22	33	0.54	107	184	1.87	Jordan
25	21	2.08	20	23	0.58	12	13	0.77	95	169	2.78	Kuwait
17	27	0.69	66	71	0.68	34	95	1.31	98	129	1.28	Lebanon
6	5	1.04	10	15	1.17	5	9	1.46	14	16	1.09	Libya
0	4	na	2	8	6.17	10	10	15.93	2	0	na	Mauritania
136	141	3.07	77	126	0.72	26	48	0.45	69	88	0.49	Morocco
20	25	1.14	25	42	0.75	37	21	0.81	52	72	1.54	Oman
5	9	0.54	11	23	0.74	2	11	0.78	19	40	2.20	Palestine
30	39	1.15	63	105	0.74	26	54	1.18	130	305	2.54	Qatar
229	283	1.26	234	308	0.52	230	449	1.84	575	950	1.49	Saudi Arabia
38	50	5.70	38	33	1.77	15	39	2.96	30	46	1.88	Sudan
11	6	1.13	8	8	0.42	2	4	na	11	9	0.59	Syrian Arab Rep.
122	139	2.16	50	47	0.25	44	53	0.58	134	141	0.72	Tunisia
22	42	0.51	66	67	0.42	27	71	0.59	133	285	1.46	United Arab Emirates
7	18	2.84	8	11	0.82	4	8	1.41	14	16	1.48	Yemen
46	**119**	**1.77**	**56**	**111**	**0.61**	**51**	**49**	**1.03**	**32**	**72**	**0.51**	**Central Asia**
24	59	1.47	24	77	0.59	27	26	1.04	12	48	0.42	Kazakhstan
7	24	5.30	8	17	1.45	3	0	na	10	10	3.18	Kyrgyzstan
6	18	3.59	10	10	1.02	20	20	4.32	7	6	0.54	Mongolia
3	15	5.57	9	14	2.06	6	2	na	1	3	na	Tajikistan
0	1	na	0	0	na	2	0	na	1	0	na	Turkmenistan
9	14	0.91	9	6	0.17	2	1	na	2	8	0.32	Uzbekistan

Table F2: Publications on selected research topics relating to SDG 3: Good health and well-being
Volume of output, 2012–2015 and 2016–2019, and specialization index, 2011–2019

	REPRODUCTIVE HEALTH AND NEONATOLOGY			TROPICAL COMMUNICABLE DISEASES*			HUMAN RESISTANCE TO ANTIBIOTICS			REGENERATIVE MEDICINE			IMPACT ON HEALTH OF SOIL, FRESHWATER AND AIR POLLUTION		
	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019
South Asia	**7 381**	**8 779**	**0.87**	**6 038**	**6 797**	**2.02**	**1 133**	**1 985**	**1.25**	**2 558**	**3 970**	**0.47**	**1 186**	**2 553**	**1.17**
Afghanistan	34	26	2.38	28	41	8.27	2	3	na	0	1	na	1	4	na
Bangladesh	413	386	1.39	385	393	3.49	49	102	2.18	21	60	0.13	69	163	2.32
Bhutan	3	8	0.93	16	22	6.76	1	5	na	0	0	na	2	5	na
India	5 613	6 691	0.77	4 812	5 211	1.86	893	1 431	1.09	2 370	3 554	0.49	893	1 895	1.05
Maldives	1	1	na	0	1	na	0	1	na	0	0	na	1	1	na
Nepal	206	337	4.12	147	199	6.31	37	93	8.68	16	28	0.18	32	66	2.73
Pakistan	1 112	1 344	1.56	514	755	2.32	156	358	2.34	148	322	0.31	177	411	1.97
Sri Lanka	122	157	1.41	270	367	10.11	15	36	1.61	6	24	0.20	25	64	2.21
Southeast Asia	**24 838**	**34 186**	**0.58**	**8 835**	**11 580**	**0.53**	**3 691**	**6 109**	**0.73**	**34 540**	**43 201**	**1.09**	**4 747**	**11 393**	**0.97**
Brunei Darussalam	21	10	1.02	13	13	2.06	2	6	na	1	3	na	0	6	na
Cambodia	28	44	2.19	190	256	30.37	8	29	6.44	0	0	na	4	8	1.53
China	12 505	19 745	0.50	3 377	4 335	0.34	1 586	3 342	0.58	19 406	26 982	1.03	3 105	8 254	1.08
China, Hong Kong SAR	636	860	0.78	116	162	0.32	109	190	1.10	756	950	1.06	202	422	1.56
China, Macao SAR	33	83	0.43	7	24	0.53	0	8	na	28	100	0.73	10	21	1.01
China, Taiwan Prov.	1 819	1 720	0.80	375	449	0.45	343	358	1.23	1 726	1 773	1.07	308	545	1.11
Indonesia	203	814	0.52	384	1 177	2.10	33	102	0.44	65	417	0.37	70	371	1.46
Japan	5 484	5 978	0.74	1 472	1 552	0.43	729	849	0.73	7 300	7 510	1.31	424	690	0.35
Lao PDR	22	31	2.25	93	134	21.74	4	8	2.49	0	0	na	4	3	na
Malaysia	599	747	0.38	709	1 100	1.60	193	266	1.06	511	773	0.54	312	599	1.91
Myanmar	13	47	1.37	64	183	15.39	1	20	2.92	0	7	na	0	9	na
Philippines	122	208	0.74	220	262	3.60	24	42	1.38	8	26	0.09	24	64	1.90
Korea, DPR	0	0	na	0	0	na	0	0	na	0	0	na	0	2	na
Korea, Rep.	2 807	3 346	0.67	757	913	0.48	569	724	1.08	4 649	5 086	1.47	401	812	0.71
Singapore	544	670	0.50	651	750	1.58	105	179	0.94	1 372	1 329	1.71	76	178	0.57
Thailand	853	1 073	1.16	1 358	1 624	3.96	155	353	1.92	298	550	0.63	119	227	1.24
Timor-Leste	3	9	3.71	6	7	8.21	0	3	na	0	1	na	0	1	na
Viet Nam	124	211	0.40	240	394	1.80	64	124	1.61	47	166	0.36	35	119	0.97
Oceania	**7 044**	**8 766**	**1.53**	**2 486**	**2 845**	**1.23**	**568**	**951**	**1.01**	**2 694**	**3 339**	**0.75**	**621**	**1 150**	**0.92**
Australia	6 334	7 900	1.56	2 266	2 623	1.26	526	865	1.04	2 537	3 081	0.80	546	1 044	0.93
New Zealand	952	1 195	1.32	204	207	0.60	65	107	0.82	188	306	0.47	94	130	0.80
Cook Islands	2	0	na	0	1	na	0	0	na	0	0	na	0	0	na
Fiji	14	7	0.52	16	39	3.12	0	1	na	0	2	na	1	5	na
Kiribati	0	1	na	0	4	na	0	0	na	0	0	na	1	0	na
Marshall Islands	0	1	na	2	3	na	0	0	na	0	0	na	0	0	na
Micronesia	0	7	na	7	9	13.01	0	0	na	0	0	na	0	1	na
Nauru	0	0	na	0	0	na	0	0	na	0	0	na	0	0	na
Niue	0	0	na	0	1	na	0	0	na	0	0	na	0	0	na
Palau	0	2	na	0	0	na	0	0	na	0	0	na	0	0	na
Papua New Guinea	40	48	4.14	159	137	37.80	0	6	na	1	1	na	1	2	na
Samoa	2	3	na	3	2	na	0	0	na	0	0	na	0	1	na
Solomon Islands	1	11	2.84	22	54	46.49	0	2	na	0	0	na	0	0	na
Tonga	0	2	na	1	2	na	0	0	na	0	0	na	0	0	na
Tuvalu	0	0	na	1	0	na	0	0	na	0	0	na	0	0	na
Vanuatu	2	0	na	18	18	22.54	0	0	na	0	0	na	0	0	na

*All diseases in the list of the neglected tropical diseases from the World Health Organization were included: Buruli ulcer, Chagas disease, Dengue and Chikungunya, Dracunculiasis (guinea-worm disease), Echinococcosis, Foodborne trematodiases, Human African trypanosomiasis (sleeping sickness), Leishmaniasis, Leprosy (Hansen's disease), Lymphatic filariasis, Mycetoma, chromoblastomycosis and other deep mycoses, Onchocerciasis (river blindness), Rabies, Scabies and other ectoparasites, Schistosomiasis, Soil-transmitted helminthiases, Snakebite envenoming, Taeniasis/Cysticercosis, Trachoma and Yaws (Endemic treponematoses). Malaria and water-borne diseases, such as coliform, giardia, cholera and norovirus, were also included.

SI2011–2019: The specialization index is measured as the proportion of output of a given country on a given topic, divided by the proportion observed at the global level. For example, a country with 2% of its output being on a research topic that represents 1% of all research worldwide would score 2.00, having twice as much output as expected, relative to the global average.

MEDICINES AND VACCINES FOR TUBERCULOSIS			HUMAN IMMUNODEFICIENCY VIRUS (HIV)			NEW OR RE-EMERGING VIRUSES THAT CAN INFECT HUMANS			TYPE 2 DIABETES			
2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	
4 331	**5 025**	**2.96**	**3 585**	**4 167**	**0.95**	**1 095**	**1 560**	**0.72**	**3 395**	**4 963**	**0.94**	**South Asia**
6	12	4.89	12	14	1.77	5	9	3.55	5	5	0.73	Afghanistan
157	129	2.84	104	93	0.70	117	151	2.20	159	230	1.45	Bangladesh
3	6	na	1	5	na	7	10	7.29	4	3	na	Bhutan
3 781	4 325	2.95	3 225	3 686	0.97	859	1 159	0.66	2 742	3 847	0.86	India
1	0	na	0	1	na	0	0	na	0	7	na	Maldives
63	109	6.46	81	102	3.02	32	36	1.98	43	69	1.83	Nepal
346	512	3.02	195	316	0.68	73	196	0.77	426	795	1.58	Pakistan
34	47	2.63	26	29	0.42	25	38	1.12	77	124	2.06	Sri Lanka
5 763	**6 605**	**0.70**	**8 611**	**9 478**	**0.37**	**7 100**	**8 121**	**0.80**	**16 050**	**22 479**	**0.79**	**Southeast Asia**
4	3	na	6	8	0.98	4	5	1.53	6	8	0.60	Brunei Darussalam
57	35	17.07	115	158	16.37	59	71	21.02	5	12	0.74	Cambodia
2 507	3 295	0.53	4 193	4 693	0.30	3 199	3 928	0.59	7 108	11 993	0.61	China
168	150	0.79	314	337	0.65	496	418	2.50	395	556	0.93	China, Hong Kong SAR
4	11	0.33	18	40	0.43	12	25	0.30	29	82	0.97	China, Macao SAR
449	373	1.03	524	516	0.49	396	377	0.96	1 226	1 326	1.19	China, Taiwan Prov.
122	496	1.80	150	558	0.74	113	165	0.58	104	534	0.68	Indonesia
848	755	0.57	1 518	1 267	0.36	1 644	1 520	1.05	4 211	4 193	1.16	Japan
9	8	5.04	33	16	4.27	27	31	10.60	2	8	0.50	Lao PDR
236	316	0.91	388	505	0.52	136	221	0.57	515	686	0.73	Malaysia
12	64	12.02	25	78	6.85	7	13	1.43	2	26	1.25	Myanmar
104	121	3.28	85	132	0.99	47	72	1.14	66	121	1.15	Philippines
0	0	na	0	0	na	0	0	na	0	0	na	Korea, DPR
1 041	822	1.22	565	686	0.26	738	1 043	1.08	2 374	2 873	1.20	Korea, Rep.
197	272	1.05	302	371	0.54	396	492	1.83	423	711	0.86	Singapore
277	317	1.84	977	995	2.03	431	419	2.22	326	587	1.10	Thailand
2	1	na	4	1	na	0	0	na	0	1	na	Timor-Leste
115	172	1.68	274	356	1.53	200	177	2.17	48	114	0.43	Viet Nam
686	**934**	**0.68**	**2 527**	**2 751**	**0.97**	**1 109**	**1 244**	**1.16**	**2 996**	**3 807**	**1.28**	**Oceania**
550	782	0.60	2 321	2 564	1.02	1 022	1 156	1.22	2 666	3 440	1.29	Australia
147	181	1.07	222	224	0.58	110	112	0.68	403	475	1.24	New Zealand
1	0	na	0	0	na	0	0	na	1	0	na	Cook Islands
6	6	2.39	9	5	1.07	5	6	1.50	3	14	1.26	Fiji
5	1	na	1	0	na	0	0	na	1	0	na	Kiribati
0	1	na	0	0	na	0	2	na	1	0	na	Marshall Islands
1	7	na	0	8	na	3	3	na	0	1	na	Micronesia
0	0	na	0	0	na	0	0	na	2	1	na	Nauru
0	0	na	0	0	na	0	0	na	0	0	na	Niue
0	0	na	0	0	na	0	0	na	3	4	na	Palau
17	29	12.64	57	31	10.43	12	4	4.40	3	0	na	Papua New Guinea
1	0	na	1	0	na	0	0	na	1	4	na	Samoa
3	1	na	0	0	na	0	0	na	4	1	na	Solomon Islands
0	0	na	0	0	na	0	0	na	0	1	na	Tonga
0	0	na	0	0	na	0	0	na	0	0	na	Tuvalu
3	1	na	3	2	na	0	0	na	1	0	na	Vanuatu

na = the total number of publications is too low to calculate the specialization index

KEY –: *data unavailable* | -n/+n: *data refer to n years before or after reference year* | 0: *magnitude nil or negligible* | na: *not applicable*

GDP: *gross domestic product* | MF: males and females | PPP$: *purchasing power parity dollars*

Note: Publication counts of articles, reviews and conference papers are based on the full-counting method. Therefore, the sum across countries is higher than the global total because of co-authorship. The selected topics in the present table are examples of research topics furthering the SDG agenda. These topics are not necessarily mutually exclusive. The total for the People's Republic of China excludes its Special Administrative Regions of Hong Kong and Macao and the Taiwan Province of China.

Source: Prepared by Science-Metrix using Scopus data (Elsevier), including those for social sciences, arts and humanities

Table F3: Publications on selected research topics relating to SDG 6: Clean water and sanitation
Volume of output, 2012–2015 and 2016–2019, and specialization index, 2011–2019

	SUSTAINABLE WITHDRAWAL AND SUPPLY OF FRESHWATER			WATER HARVESTING			DESALINATION		
	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019
World	**4 959**	**7 777**	**1.00**	**1 615**	**2 500**	**1.00**	**15 973**	**20 153**	**1.00**
North America	**1 197**	**1 692**	**0.80**	**340**	**504**	**0.69**	**2 988**	**3 521**	**0.67**
Canada	184	272	0.82	41	59	0.46	496	604	0.84
United States of America	1 051	1 479	0.80	308	455	0.72	2 567	2 979	0.65
Latin America	**395**	**652**	**1.61**	**135**	**214**	**1.62**	**600**	**810**	**0.82**
Argentina	44	38	1.43	16	20	1.97	58	49	0.67
Bolivia	2	3	na	2	1	na	0	2	na
Brazil	202	405	1.71	50	95	1.20	319	442	0.80
Chile	31	61	1.82	12	11	1.55	72	114	1.55
Colombia	20	30	1.11	11	15	1.55	33	37	0.53
Costa Rica	6	8	1.65	1	2	na	2	4	na
Ecuador	5	14	1.45	0	3	na	3	20	0.37
El Salvador	0	0	na	0	0	na	0	1	na
Guatemala	0	0	na	1	0	na	0	1	na
Honduras	0	1	na	0	0	na	1	1	na
Mexico	72	78	1.36	39	63	2.98	117	150	0.93
Nicaragua	0	0	na	1	0	na	0	0	na
Panama	8	11	6.23	1	0	na	1	1	na
Paraguay	1	1	na	1	0	na	1	0	na
Peru	9	14	1.56	5	4	na	4	10	0.55
Uruguay	2	6	na	0	7	na	2	0	na
Venezuela	14	10	3.17	2	1	na	5	6	0.47
Caribbean	**3**	**6**	**0.53**	**3**	**4**	**na**	**12**	**11**	**0.39**
Bahamas	0	0	na	0	0	na	0	0	na
Barbados	0	1	na	0	2	na	2	1	na
Cuba	2	3	na	2	0	na	7	6	0.27
Dominican Rep.	1	0	na	0	0	na	0	0	na
Haiti	0	0	na	0	0	na	0	1	na
Jamaica	0	1	na	0	0	na	1	0	na
Trinidad & Tobago	0	1	na	1	2	na	2	3	na
European Union	**1 365**	**1 917**	**0.75**	**474**	**607**	**0.75**	**4 393**	**4 725**	**0.79**
Austria	41	52	0.65	12	18	0.50	85	88	0.57
Belgium	47	71	0.61	23	28	0.82	239	303	1.23
Bulgaria	8	11	0.97	0	0	na	25	25	0.88
Croatia	5	13	0.60	1	0	na	37	26	0.83
Cyprus	10	9	1.63	4	8	4.27	24	16	2.01
Czech Rep.	27	29	0.45	6	12	0.48	97	118	0.73
Denmark	44	60	0.71	9	15	0.39	149	195	1.03
Estonia	12	16	1.33	1	2	na	6	7	0.36
Finland	28	38	0.57	9	9	0.54	101	113	0.87
France	136	182	0.41	68	69	0.64	536	507	0.64
Germany	244	361	0.60	78	124	0.64	606	737	0.56
Greece	59	83	1.76	16	20	1.30	176	143	1.60
Hungary	25	23	0.98	0	3	na	52	49	0.83
Ireland	8	15	0.39	10	7	0.89	54	59	0.65
Italy	217	339	1.08	45	72	0.67	435	560	0.66
Latvia	0	0	na	0	0	na	6	6	0.68
Lithuania	4	13	1.31	1	0	na	8	10	0.27
Luxembourg	2	4	na	0	0	na	4	7	0.29
Malta	1	1	na	0	1	na	6	7	1.36
Netherlands	113	167	0.83	56	84	1.33	378	367	1.05
Poland	28	57	0.36	5	11	0.20	301	345	1.14
Portugal	43	77	1.07	18	24	1.23	139	142	0.98
Romania	16	22	0.51	2	4	na	68	83	0.77
Slovakia	5	10	0.44	5	2	na	18	15	0.38
Slovenia	7	4	0.36	0	2	na	24	34	0.73

WASTEWATER TREATMENT, RECYCLING AND RE-USE			NATIONAL INTEGRATED WATER RESOURCE MANAGEMENT			TRANSBOUNDARY WATER RESOURCE MANAGEMENT			
2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	
19 417	**29 400**	**1.00**	**8 281**	**11 870**	**1.00**	**367**	**497**	**1.00**	**World**
3 708	**4 447**	**0.62**	**2 429**	**3 218**	**1.04**	**94**	**132**	**0.91**	**North America**
784	1 054	1.05	448	648	1.41	20	45	1.71	Canada
3 049	3 522	0.56	2 021	2 663	0.99	79	94	0.80	United States of America
1 096	**1 912**	**1.27**	**409**	**726**	**1.02**	**16**	**27**	**0.97**	**Latin America**
53	77	0.59	18	27	0.43	2	1	na	Argentina
3	11	2.84	7	14	7.34	0	0	na	Bolivia
631	1 093	1.32	226	392	1.06	4	13	0.69	Brazil
62	157	1.08	34	68	1.18	2	2	na	Chile
79	161	1.44	33	58	1.12	1	1	na	Colombia
8	18	1.55	4	22	3.81	1	1	na	Costa Rica
6	51	1.33	6	41	2.05	1	0	na	Ecuador
1	1	na	0	0	na	0	0	na	El Salvador
1	0	na	1	0	na	1	0	na	Guatemala
0	2	na	0	0	na	0	0	na	Honduras
251	355	1.60	74	104	0.98	4	12	2.31	Mexico
0	5	na	1	0	na	0	0	na	Nicaragua
1	2	na	1	3	na	0	0	na	Panama
0	2	na	1	0	na	0	0	na	Paraguay
3	29	0.77	13	25	1.62	1	1	na	Peru
7	11	0.72	3	5	na	1	2	na	Uruguay
18	6	0.80	3	3	na	0	0	na	Venezuela
18	**28**	**0.68**	**10**	**18**	**1.05**	**0**	**1**	**na**	**Caribbean**
0	0	na	1	0	na	0	0	na	Bahamas
3	6	na	4	4	na	0	1	na	Barbados
11	20	0.65	3	6	0.55	0	0	na	Cuba
0	4	na	1	1	na	0	0	na	Dominican Rep.
1	0	na	0	3	na	0	0	na	Haiti
1	1	na	0	1	na	0	0	na	Jamaica
2	1	na	2	3	na	0	0	na	Trinidad & Tobago
6 055	**8 173**	**0.95**	**2 785**	**3 506**	**0.95**	**162**	**197**	**1.20**	**European Union**
114	141	0.56	84	120	1.02	7	10	1.72	Austria
282	298	0.98	76	92	0.68	0	3	na	Belgium
31	60	1.27	9	11	0.62	1	0	na	Bulgaria
54	89	1.32	10	17	0.46	2	1	na	Croatia
39	42	2.09	18	21	3.22	0	1	na	Cyprus
174	274	1.08	27	49	0.43	2	4	na	Czech Rep.
210	302	1.01	71	79	0.84	2	2	na	Denmark
31	33	1.78	7	5	0.62	1	1	na	Estonia
134	208	1.07	44	72	0.83	11	12	3.76	Finland
649	719	0.62	262	359	0.62	16	19	0.65	France
703	1 028	0.55	465	563	0.75	21	42	0.92	Germany
234	265	1.70	139	170	2.42	17	13	5.06	Greece
59	78	0.81	34	21	0.65	7	6	3.45	Hungary
102	156	1.33	43	36	0.85	1	3	na	Ireland
628	985	0.81	399	518	1.11	10	18	0.51	Italy
5	25	0.83	2	4	na	0	1	na	Latvia
25	40	1.28	3	7	0.40	1	3	na	Lithuania
18	34	2.01	5	5	0.68	1	2	na	Luxembourg
0	0	na	2	1	na	0	0	na	Malta
342	438	0.67	358	440	1.80	22	41	3.01	Netherlands
504	991	2.00	98	166	0.80	10	5	1.03	Poland
253	411	1.73	86	108	1.14	6	5	1.24	Portugal
258	309	2.38	79	70	1.39	3	2	na	Romania
70	90	1.31	15	26	0.78	3	2	na	Slovakia
62	73	1.49	15	24	0.86	4	3	na	Slovenia

Table F3: Publications on selected research topics relating to SDG 6: Clean water and sanitation
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	SUSTAINABLE WITHDRAWAL AND SUPPLY OF FRESHWATER			WATER HARVESTING			DESALINATION		
	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019
Spain	294	390	1.75	73	88	1.35	801	769	1.51
Sweden	48	63	0.33	18	36	0.76	108	168	0.54
United Kingdom	209	315	0.53	100	105	0.78	572	691	0.55
Southeast Europe	**19**	**27**	**1.12**	**2**	**1**	**na**	**48**	**42**	**0.69**
Albania	3	1	na	0	0	na	0	1	na
Bosnia & Herzegovina	2	1	na	0	0	na	5	3	na
Montenegro	1	3	na	0	0	na	0	1	na
North Macedonia	1	3	na	0	1	na	4	0	na
Serbia	13	22	1.10	2	0	na	42	38	0.81
European Free Trade Assoc.	**78**	**117**	**0.44**	**26**	**34**	**0.43**	**196**	**175**	**0.42**
Iceland	0	1	na	0	0	na	2	6	na
Liechtenstein	0	0	na	0	0	na	0	0	na
Norway	9	12	0.10	6	8	0.33	64	73	0.50
Switzerland	71	106	0.61	20	26	0.49	131	97	0.38
Other Europe & West Asia	**268**	**428**	**0.70**	**65**	**129**	**0.57**	**1 359**	**2 031**	**1.22**
Armenia	1	1	na	0	0	na	1	3	na
Azerbaijan	1	2	na	0	0	na	4	8	0.71
Belarus	1	0	na	0	0	na	13	20	1.10
Georgia	0	1	na	0	0	na	2	3	na
Iran Islamic Rep.	109	202	1.20	34	66	1.15	576	950	2.07
Israel	54	50	1.21	17	37	1.93	215	255	2.12
Moldova, Rep.	0	0	na	0	0	na	0	0	na
Russian Federation	21	49	0.15	5	12	0.11	240	433	0.64
Turkey	85	118	1.05	8	18	0.29	297	343	1.05
Ukraine	2	7	na	2	0	na	29	61	0.55
Sub-Saharan Africa	**141**	**304**	**2.40**	**188**	**306**	**8.74**	**171**	**302**	**0.75**
Angola	0	0	na	0	0	na	0	0	na
Benin	4	9	6.23	4	3	na	1	0	na
Botswana	1	4	na	3	4	na	0	1	na
Burkina Faso	3	6	na	6	14	19.58	2	2	na
Burundi	1	0	na	2	0	na	1	8	na
Cameroon	1	5	na	4	4	na	6	3	na
Cabo Verde	0	0	na	0	0	na	0	1	na
Central African Rep.	1	0	na	0	0	na	0	0	na
Chad	0	1	na	0	0	na	0	0	na
Congo	3	0	na	1	0	na	0	0	na
Côte d'Ivoire	0	5	na	2	2	na	5	1	na
Congo, Dem. Rep.	1	1	na	0	0	na	0	0	na
Djibouti	0	0	na	0	0	na	1	0	na
Eritrea	1	1	na	3	1	na	0	2	na
Eswatini	0	0	na	2	0	na	2	3	na
Ethiopia	16	32	4.33	25	68	21.34	4	7	0.27
Gabon	0	1	na	1	0	na	0	0	na
Gambia	0	0	na	0	0	na	0	0	na
Ghana	10	21	3.67	10	19	10.75	2	4	na
Guinea	0	0	na	0	1	na	0	0	na
Kenya	13	33	3.14	25	49	22.48	2	6	na
Lesotho	0	0	na	0	0	na	0	0	na
Madagascar	0	0	na	2	3	na	0	0	na
Malawi	2	2	na	6	3	23.51	2	2	na
Mali	1	2	na	5	3	20.82	1	1	na
Mauritius	0	1	na	0	1	na	0	0	na
Mozambique	0	4	na	1	2	na	0	0	na
Namibia	1	1	na	2	10	20.12	1	1	na
Niger	4	2	na	6	4	45.95	1	0	na
Nigeria	15	36	1.36	15	30	4.27	23	23	0.36

WASTEWATER TREATMENT, RECYCLING AND RE-USE			NATIONAL INTEGRATED WATER RESOURCE MANAGEMENT			TRANSBOUNDARY WATER RESOURCE MANAGEMENT			
2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	
1 210	1 447	1.88	303	462	1.22	7	15	0.51	Spain
295	384	1.02	86	175	0.72	11	17	1.93	Sweden
587	873	0.45	596	712	0.97	41	48	1.49	United Kingdom
57	**79**	**0.83**	**30**	**38**	**0.91**	**5**	**3**	**2.74**	**Southeast Europe**
2	1	na	1	0	na	2	0	na	Albania
6	3	0.45	2	2	na	1	0 0	na	Bosnia & Herzegovina
2	2	na	1	2	na	1		na	Montenegro
2	3	na	4	5	na	1	0	na	North Macedonia
47	70	0.91	23	31	0.96	2	3	na	Serbia
322	**389**	**0.62**	**204**	**313**	**0.96**	**11**	**13**	**1.01**	**European Free Trade Assoc.**
2	4	na	2	0	na	0	0	na	Iceland
0	1	na	0	1	na	0	0	na	Liechtenstein
81	138	0.54	60	134	1.09	3	2	na	Norway
243	251	0.67	145	182	0.91	8	11	1.41	Switzerland
1 083	**2 251**	**0.89**	**524**	**949**	**0.87**	**48**	**49**	**1.32**	**Other Europe & West Asia**
1	1	na	0	2	na	1	0	na	Armenia
2	3	na	1	1	na	0	1	na	Azerbaijan
3	13	0.40	1	1	na	2	0	na	Belarus
1	2	na	1	38	2.09	0	0	na	Georgia
501	930	1.44	327	684	2.18	6	8	0.62	Iran Islamic Rep.
123	175	0.96	72	33	0.82	5	7	1.75	Israel
2	5	na	0	0	na	0	0	na	Moldova, Rep.
108	531	0.46	40	57	0.15	16	23	1.36	Russian Federation
320	501	1.06	84	150	0.66	15	5	1.52	Turkey
30	109	0.56	10	21	0.29	5	6	2.10	Ukraine
322	**723**	**1.58**	**290**	**558**	**3.01**	**21**	**37**	**4.26**	**Sub-Saharan Africa**
0	1	na	0	0	na	0	0	na	Angola
0	8	na	7	7	3.69	1	2	na	Benin
1	19	1.50	7	24	14.87	3	4	na	Botswana
13	10	3.17	14	9	5.24	0	1	na	Burkina Faso
0	4	na	1	1	na	1	0	na	Burundi
5	9	0.60	3	5	1.11	0	0	na	Cameroon
0	0	na	0	1	na	0	0	na	Cabo Verde
0	0	na	0	1	na	0	0	na	Central African Rep.
0	1	na	1	1	na	1	0	na	Chad
2	0	na	0	2	na	0	0	na	Congo
1	8	1.24	3	2	na	0	0	na	Côte d'Ivoire
3	4	na	0	3	na	0	0	na	Congo, Dem. Rep.
3	0	na	1	0	na	0	0	na	Djibouti
0	1	na	0	3	na	0	0	na	Eritrea
1	1	na	1	2	na	0	0	na	Eswatini
7	50	1.30	22	51	2.93	1	2	na	Ethiopia
0	1	na	0	0	na	0	0	na	Gabon
0	1	na	0	0	na	0	0	na	Gambia
14	24	1.11	22	37	4.24	1	1	na	Ghana
0	0	na	0	0	na	0	0	na	Guinea
18	29	1.11	22	41	3.69	2	2	na	Kenya
2	2	na	0	3	na	0	0	na	Lesotho
1	0	na	1	2	na	1	0	na	Madagascar
0	3	na	3	10	4.22	0	1	na	Malawi
1	1	na	7	5	4.76	0	0	na	Mali
1	0	na	1	1	na	0	0	na	Mauritius
3	4	na	7	5	8.83	0	0	na	Mozambique
2	1	na	4	13	9.98	3	3	na	Namibia
1	0	na	4	2	na	0	0	na	Niger
50	118	1.11	16	46	1.13	0	0	na	Nigeria

Table F3: Publications on selected research topics relating to SDG 6: Clean water and sanitation
Volume of output, 2012–2015 and 2016–2019, and specialization index, 2011–2019

	SUSTAINABLE WITHDRAWAL AND SUPPLY OF FRESHWATER			WATER HARVESTING			DESALINATION		
	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019
Rwanda	1	2	na	1	5	na	1	0	na
Senegal	4	10	2.87	8	10	12.41	3	3	0.47
Sierra Leone	0	0	na	0	1	na	0	0	na
South Africa	64	128	2.61	67	78	5.89	105	231	1.21
South Sudan	0	0	na	0	0	na	0	0	na
Togo	0	5	na	1	1	na	0	0	na
Uganda	2	7	1.29	2	13	6.29	0	2	na
Tanzania	2	11	1.40	9	28	18.30	12	14	1.15
Zambia	0	3	na	0	4	na	0	0	na
Zimbabwe	9	9	6.52	17	25	55.07	0	0	na
Arab States	**221**	**420**	**1.83**	**126**	**149**	**2.36**	**1 468**	**2 218**	**3.75**
Algeria	11	29	1.03	4	5	1.09	163	117	3.35
Bahrain	2	3	na	0	1	na	8	18	5.25
Egypt	69	120	2.17	19	25	1.04	270	462	2.86
Iraq	3	38	2.02	5	23	3.01	46	129	2.26
Jordan	15	27	2.97	19	21	11.40	37	83	2.79
Kuwait	6	9	2.26	0	3	na	40	99	6.90
Lebanon	3	16	1.54	0	3	na	22	21	1.31
Libya	0	0	na	1	0	na	17	24	6.00
Mauritania	2	1	na	0	0	na	0	0	na
Morocco	17	19	0.88	13	13	2.01	46	108	2.19
Oman	6	17	2.52	2	4	na	26	55	4.24
Palestine	4	5	na	3	10	20.30	13	20	4.25
Qatar	7	7	1.25	0	1	na	90	202	9.19
Saudi Arabia	60	91	1.84	40	30	2.92	516	726	5.11
Sudan	1	10	1.77	6	6	16.63	2	6	na
Syrian Arab Rep.	10	5	6.67	11	3	13.64	1	2	na
Tunisia	25	49	1.90	12	13	1.45	183	185	3.55
United Arab Emirates	5	27	1.49	3	9	1.72	135	253	6.83
Yemen	0	2	na	0	0	na	1	4	na
Central Asia	**11**	**31**	**2.02**	**2**	**2**	**na**	**14**	**42**	**1.31**
Kazakhstan	2	15	1.26	0	0	na	5	31	1.38
Kyrgyzstan	1	1	na	0	0	na	0	0	na
Mongolia	3	7	3.16	0	1	na	2	1	na
Tajikistan	2	0	na	1	0	na	0	0	na
Turkmenistan	1	0	na	0	0	na	0	0	na
Uzbekistan	6	8	3.40	1	1	na	7	10	1.90
South Asia	**511**	**850**	**1.66**	**299**	**425**	**2.81**	**1 030**	**1 436**	**1.10**
Afghanistan	1	6	na	0	0	na	0	0	na
Bangladesh	25	50	2.82	22	26	6.96	9	27	0.42
Bhutan	0	1	na	0	0	na	0	0	na
India	358	603	1.44	246	348	2.74	937	1 252	1.15
Nepal	10	15	2.25	8	10	8.09	0	1	na
Pakistan	115	171	3.62	13	34	1.88	80	152	0.92
Sri Lanka	10	20	2.91	12	12	6.46	5	8	0.42
Southeast Asia	**1 553**	**3 110**	**1.07**	**334**	**747**	**0.73**	**5 888**	**8 639**	**1.19**
Brunei Darussalam	2	2	na	1	1	na	1	3	na
Cambodia	1	5	na	2	3	na	0	1	na
China	1 291	2 642	1.49	183	502	0.75	3 473	5 631	1.21
China, Hong Kong SAR	22	38	0.49	5	16	0.81	74	173	0.77
China, Macao SAR	1	1	na	0	0	na	8	9	0.69
China, Taiwan Prov.	19	41	0.28	16	13	0.46	258	251	0.93
Indonesia	22	81	1.21	6	48	2.21	47	279	1.43
Japan	98	115	0.22	37	47	0.27	476	588	0.51
Lao PDR	0	5	na	5	2	na	0	1	na
Malaysia	33	83	0.83	28	61	2.15	423	501	2.32

WASTEWATER TREATMENT, RECYCLING AND RE-USE			NATIONAL INTEGRATED WATER RESOURCE MANAGEMENT			TRANSBOUNDARY WATER RESOURCE MANAGEMENT			
2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	
2	1	na	2	4	na	0	1	na	Rwanda
4	5	0.50	4	11	1.62	0	2	na	Senegal
1	0	na	0	0	na	0	0	na	Sierra Leone
176	447	2.16	144	276	3.37	9	23	4.84	South Africa
0	1	na	0	0	na	0	0	na	South Sudan
0	1	na	1	3	na	0	1	na	Togo
19	16	1.10	6	14	1.47	0	2	na	Uganda
8	13	0.96	12	27	4.78	0	1	na	Tanzania
2	0	na	3	4	na	0	0	na	Zambia
8	22	2.87	10	22	8.23	0	0	na	Zimbabwe
916	**1 778**	**2.00**	**305**	**571**	**1.49**	**14**	**31**	**1.31**	**Arab States**
96	169	2.25	19	48	1.34	1	2	na	Algeria
6	14	1.78	4	5	2.59	0	0	na	Bahrain
193	413	1.87	60	125	1.05	5	8	1.73	Egypt
49	154	2.28	5	61	1.38	1	2	na	Iraq
58	86	2.70	24	36	2.55	2	4	na	Jordan
11	32	2.00	9	12	2.05	0	0	na	Kuwait
10	32	0.85	4	29	1.27	0	5	na	Lebanon
4	3	na	6	2	na	0	0	na	Libya
1	1	na	3	2	na	0	0	na	Mauritania
41	149	1.86	19	42	1.36	0	0	na	Morocco
41	62	4.17	10	29	3.06	0	2	na	Oman
25	28	4.73	10	12	5.52	1	0	na	Palestine
29	126	3.18	7	18	1.46	0	1	na	Qatar
205	369	1.53	70	95	1.28	2	2	na	Saudi Arabia
3	9	0.64	11	10	2.42	1	4	na	Sudan
10	7	1.34	5	7	3.01	1	0	na	Syrian Arab Rep.
147	200	2.27	40	60	1.62	1	2	na	Tunisia
70	110	2.22	24	52	2.36	1	1	na	United Arab Emirates
5	5	1.16	2	3	na	0	0	na	Yemen
9	**50**	**0.82**	**35**	**49**	**2.90**	**18**	**24**	**38.04**	**Central Asia**
6	33	0.94	6	26	1.48	8	17	32.67	Kazakhstan
0	0	na	4	10	4.68	2	2	na	Kyrgyzstan
2	11	1.18	3	11	2.69	0	2	na	Mongolia
0	1	na	5	1	na	4	1	na	Tajikistan
0	0	na	0	1	na	0	0	na	Turkmenistan
1	6	na	20	7	6.22	7	6	51.25	Uzbekistan
1 088	**2 163**	**1.04**	**464**	**792**	**0.91**	**20**	**43**	**0.95**	**South Asia**
0	1	na	4	3	na	0	1	na	Afghanistan
31	46	0.72	22	60	1.92	3	8	6.09	Bangladesh
0	2	na	1	0	na	0	0	na	Bhutan
917	1 733	1.01	343	577	0.83	6	21	0.50	India
12	16	0.87	35	35	5.56	4	6	24.08	Nepal
119	348	1.47	43	95	0.86	2	9	2.28	Pakistan
11	32	1.04	38	35	4.73	6	2	7.90	Sri Lanka
7 199	**12 284**	**1.22**	**2 089**	**3 876**	**0.85**	**61**	**126**	**0.59**	**Southeast Asia**
4	12	1.79	0	2	na	0	0	na	Brunei Darussalam
2	5	na	2	9	3.10	3	1	na	Cambodia
5 149	8 904	1.43	1 434	2 731	0.97	33	94	0.69	China
204	335	1.46	33	86	0.73	0	5	na	China, Hong Kong SAR
7	13	0.94	4	7	1.15	1	0	na	China, Macao SAR
251	359	0.72	103	126	0.76	1	0	na	China, Taiwan Prov.
64	411	1.61	34	144	1.43	1	1	na	Indonesia
532	697	0.41	135	193	0.26	10	12	0.38	Japan
2	3	na	10	12	14.55	3	0	na	Lao PDR
411	797	2.46	129	218	1.57	1	1	na	Malaysia

Table F3: Publications on selected research topics relating to SDG 6: Clean water and sanitation
Volume of output, 2012–2015 and 2016–2019, and specialization index, 2011–2019

	SUSTAINABLE WITHDRAWAL AND SUPPLY OF FRESHWATER			WATER HARVESTING			DESALINATION		
	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019
Myanmar	3	5	na	1	0	na	0	2	na
Philippines	20	22	2.49	3	8	2.83	18	29	1.12
Korea, DPR	0	0	na	0	0	na	0	0	na
Korea, Rep.	60	83	0.28	40	46	0.62	891	1 071	1.59
Singapore	13	27	0.29	4	26	0.98	435	540	4.03
Thailand	31	54	1.22	11	6	0.56	73	111	0.92
Timor-Leste	1	0	na	0	1	na	0	0	na
Viet Nam	6	28	0.72	5	9	0.84	23	78	0.74
Oceania	**437**	**517**	**2.02**	**135**	**183**	**2.16**	**831**	**1 006**	**1.47**
Australia	409	467	2.15	124	169	2.28	805	978	1.64
New Zealand	34	53	1.13	13	14	1.26	30	39	0.36
Fiji	0	1	na	0	0	na	0	0	na
Micronesia	0	0	na	0	0	na	0	0	na
Palau	0	0	na	0	0	na	0	0	na
Papua New Guinea	0	0	na	1	2	na	0	0	na
Solomon Islands	1	0	na	0	0	na	0	0	na
Vanuatu	0	4	na	1	0	na	0	0	na

$SI_{2011–19}$: The specialization index is measured as the proportion of output of a given country on a given topic, divided by the proportion observed at the global level. For example, a country with 2% of its output being on a research topic that represents 1% of all research worldwide would score 2.00, having twice as much output as expected, relative to the global average.

na = the total number of publications is too low to calculate the specialization index

KEY –: *data unavailable* | -n/+n: *data refer to n years before or after reference year* | 0: *magnitude nil or negligible* | na: *not applicable*

GDP: *gross domestic product* | MF: males and females | PPP$: *purchasing power parity dollars*

Note: Publication counts of articles, reviews and conference papers are based on the full-counting method. Therefore, the sum across countries is higher than the global total because of co-authorship. The selected topics in the present table are examples of research topics furthering the SDG agenda. These topics are not necessarily mutually exclusive. The following are excluded from the present table because they did not publish on these topics over the period under study: Antigua and Barbuda, Belize, Cook Islands, Comoros, Dominica, Equatorial Guinea, Grenada, Guinea-Bissau, Guyana, Kiribati, Liberia, Maldives, Marshall Islands, Nauru, Niue, Samoa, Sao Tome and Principe, Seychelles, Somalia, St Kitts and Nevis, St Lucia, St Vincent and the Grenadines, Suriname, Tonga and Tuvalu. The total for the People's Republic of China excludes its Special Administrative Regions of Hong Kong and Macao and the Taiwan Province of China.

Source: Prepared by Science-Metrix using Scopus data (Elsevier), including those for social sciences, arts and humanities

WASTEWATER TREATMENT, RECYCLING AND RE-USE			NATIONAL INTEGRATED WATER RESOURCE MANAGEMENT			TRANSBOUNDARY WATER RESOURCE MANAGEMENT			
2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	
0	5	na	1	2	na	0	0	na	Myanmar
21	50	1.48	7	29	1.76	0	1	na	Philippines
1	1	na	0	2	na	0	0	na	Korea, DPR
589	865	0.85	156	261	0.57	2	6	na	Korea, Rep.
182	285	1.21	62	101	1.00	1	9	1.57	Singapore
146	272	1.67	55	121	1.45	9	3	1.44	Thailand
0	0	na	0	1	na	0	0	na	Timor-Leste
51	206	1.89	22	74	1.35	3	3	na	Viet Nam
752	**1 155**	**1.03**	**744**	**760**	**2.32**	**19**	**21**	**1.03**	**Oceania**
677	1 063	1.05	699	698	2.48	17	16	1.02	Australia
81	108	0.93	50	71	1.22	1	5	na	New Zealand
1	0	na	2	3	na	0	0	na	Fiji
0	0	na	1	0	na	0	0	na	Micronesia
0	0	na	0	0	na	1	0	na	Palau
0	0	na	0	0	na	0	0	na	Papua New Guinea
0	0	na	0	0	na	0	0	na	Solomon Islands
0	0	na	0	0	na	0	0	na	Vanuatu

Table F4: Publications on selected research topics relating to SDG 7: Affordable and clean energy
Volume of output, 2012–2015 and 2016–2019, and specialization index, 2011–2019

	CLEANER FOSSIL FUEL TECHNOLOGY			PHOTOVOLTAICS			HYDROPOWER			BIOFUELS AND BIOMASS			WIND TURBINE TECHNOLOGIES		
	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019
World	**7 051**	**8 197**	**1.00**	**48 011**	**57 452**	**1.00**	**15 413**	**20 677**	**1.00**	**38 221**	**51 236**	**1.00**	**26 638**	**35 302**	**1.00**
North America	**1 556**	**1 387**	**0.81**	**9 376**	**8 488**	**0.65**	**3 168**	**3 611**	**0.73**	**9 898**	**9 171**	**0.90**	**5 079**	**4 983**	**0.66**
Canada	243	295	1.05	857	950	0.48	710	825	1.19	1 425	1 563	1.00	892	981	0.90
United States of America	1 334	1 116	0.78	8 661	7 647	0.67	2 593	2 930	0.67	8 675	7 820	0.88	4 289	4 092	0.62
Latin America	**178**	**241**	**0.52**	**921**	**1 602**	**0.47**	**1 172**	**1 719**	**1.71**	**3 549**	**4 934**	**2.01**	**705**	**1 233**	**0.64**
Argentina	12	18	0.41	65	81	0.26	81	76	0.93	212	298	1.22	76	89	0.58
Belize	0	0	na	0	0	na	1	0	na	0	0	na	0	0	na
Bolivia	3	0	na	0	1	na	3	13	3.11	7	6	0.98	1	3	na
Brazil	93	126	0.49	382	599	0.32	827	1 191	2.11	2 433	3 222	2.36	324	621	0.57
Chile	9	12	0.29	60	160	0.54	56	89	0.97	149	202	0.99	77	118	0.84
Colombia	34	39	1.50	111	181	0.83	63	119	1.54	320	410	2.64	49	110	0.77
Costa Rica	0	2	na	1	11	0.39	13	5	2.29	6	29	1.59	3	9	0.38
Ecuador	0	0	na	3	36	0.56	11	75	2.82	13	72	0.96	12	57	1.43
El Salvador	0	0	na	0	1	na	0	0	na	0	1	na	0	0	na
Guatemala	0	0	na	0	3	na	2	1	na	3	5	1.26	0	0	na
Guyana	0	0	na	0	1	na	0	0	na	0	0	na	0	0	na
Honduras	0	0	na	0	0	na	1	3	na	1	6	na	0	2	na
Mexico	24	44	0.50	314	559	1.01	121	155	0.96	457	762	1.69	153	224	0.79
Nicaragua	0	0	na	1	0	na	1	1	na	0	2	na	5	0	na
Panama	0	4	na	1	4	na	3	8	2.05	9	8	0.84	1	5	na
Paraguay	1	0	na	2	1	na	6	15	12.24	8	10	1.26	3	5	na
Peru	0	4	na	0	14	0.17	12	36	1.31	22	28	0.57	3	10	0.17
Suriname	0	0	na	0	0	na	0	3	na	0	0	na	1	0	na
Uruguay	1	3	na	6	26	0.65	8	13	1.07	18	71	2.15	16	24	1.59
Venezuela	8	5	0.57	7	10	0.23	13	6	0.81	8	17	0.39	10	8	0.21
Caribbean	**9**	**6**	**0.63**	**31**	**24**	**0.26**	**7**	**15**	**0.48**	**56**	**54**	**0.72**	**13**	**23**	**0.44**
Bahamas	0	0	na	1	0	na	0	0	na	1	2	na	0	1	na
Barbados	0	0	na	1	0	na	0	0	na	0	9	na	2	1	na
Cuba	8	6	0.80	25	21	0.30	6	10	0.50	51	34	0.75	5	12	0.27
Dominica	0	0	na	0	0	na	1	0	na	0	0	na	0	0	na
Dominican Rep.	0	0	na	0	0	na	0	1	na	2	0	na	0	2	na
Haiti	0	0	na	0	0	na	0	1	na	0	1	na	0	0	na
Jamaica	0	0	na	2	2	na	0	1	na	0	2	na	1	5	na
St Lucia	0	0	na	0	0	na	0	1	na	0	0	na	0	0	na
St Vincent & Grenadines	0	0	na	0	0	na	0	0	na	0	1	na	0	0	na
Trinidad & Tobago	1	0	na	2	1	na	0	2	na	4	5	na	5	4	1.54
European Union	**2 351**	**2 476**	**1.05**	**12 213**	**12 622**	**0.73**	**3 737**	**4 966**	**0.74**	**11 609**	**14 986**	**0.96**	**9 546**	**11 109**	**1.11**
Austria	43	67	0.96	232	196	0.46	193	248	1.49	403	447	1.16	116	112	0.44
Belgium	56	56	0.59	541	406	0.85	83	153	0.54	395	446	0.82	306	344	1.10
Bulgaria	6	6	0.41	53	52	0.55	31	27	1.03	54	72	0.92	20	42	0.67
Croatia	8	17	0.47	23	46	0.27	51	38	1.27	30	81	0.44	106	106	1.57
Cyprus	0	0	na	49	62	1.46	17	8	1.00	8	33	0.80	14	31	0.93
Czech Rep.	27	47	0.58	225	212	0.42	123	142	0.96	256	373	0.82	83	74	0.37
Denmark	70	82	1.21	289	314	0.59	51	79	0.27	557	728	1.58	1 360	1 442	5.67
Estonia	3	8	0.81	62	63	1.33	4	21	0.47	54	69	1.39	39	37	1.56
Finland	58	59	1.32	236	295	0.68	64	81	0.55	591	643	2.26	126	204	0.85
France	199	150	0.59	1 568	1 667	0.64	437	607	0.64	1 183	1 403	0.65	714	910	0.54
Germany	401	387	0.90	3 559	3 224	1.06	512	725	0.51	1 662	2 170	0.64	1 658	2 182	1.08
Greece	50	37	0.90	289	318	0.83	99	95	0.87	305	423	1.28	343	327	1.82
Hungary	6	16	0.33	70	80	0.35	35	30	0.52	133	209	0.93	37	47	0.39
Ireland	8	11	0.26	117	114	0.45	31	44	0.42	235	290	1.29	235	238	1.86
Italy	334	386	1.23	1 610	1 486	0.72	411	562	0.66	1 502	2 199	1.06	753	972	0.70
Latvia	13	8	2.26	25	30	0.78	34	26	2.39	151	218	6.52	51	40	2.30
Lithuania	3	8	0.71	107	95	1.25	17	16	1.00	93	134	2.47	37	38	1.13
Luxembourg	0	0	na	66	80	2.76	2	4	na	25	30	1.16	5	8	0.30

NUCLEAR FUSION			GEOTHERMAL ENERGY			HYDROGEN ENERGY			SMART GRID TECHNOLOGY			
2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011-2019	
12 174	**12 852**	**1.00**	**4 883**	**6 943**	**1.00**	**24 946**	**32 790**	**1.00**	**28 025**	**46 983**	**1.00**	**World**
3 023	**3 340**	**0.89**	**1 480**	**1 541**	**1.05**	**4 999**	**4 958**	**0.68**	**7 006**	**9 051**	**0.87**	**North America**
140	147	0.19	264	258	1.16	976	1 023	1.02	1 328	1 869	1.27	Canada
2 941	3 266	0.99	1 265	1 323	1.03	4 115	4 034	0.63	5 801	7 369	0.82	United States of America
171	**148**	**0.20**	**223**	**313**	**0.85**	**959**	**1 186**	**0.73**	**1 146**	**2 316**	**0.96**	**Latin America**
24	19	0.28	24	35	0.68	185	155	1.18	77	75	0.44	Argentina
0	0	na	0	0	na	0	0	na	0	0	na	Belize
0	0	na	2	0	na	0	0	na	0	4	na	Bolivia
80	69	0.16	31	38	0.18	438	541	0.58	723	1 394	1.04	Brazil
20	16	0.24	18	59	1.65	38	65	0.40	68	176	0.80	Chile
2	9	0.09	10	27	0.80	59	81	0.64	171	366	2.31	Colombia
11	15	4.21	5	5	2.80	3	5	na	2	22	0.87	Costa Rica
4	1	na	3	11	1.58	6	24	0.44	35	143	3.27	Ecuador
0	0	na	0	1	na	0	0	na	0	0	na	El Salvador
0	0	na	0	0	na	0	0	na	1	1	na	Guatemala
0	0	na	0	1	na	0	0	na	0	1	na	Guyana
0	0	na	0	1	na	0	0	na	0	0	na	Honduras
40	24	0.26	127	143	3.06	250	358	1.32	86	170	0.43	Mexico
0	0	na	1	2	na	0	0	na	2	2	na	Nicaragua
0	0	na	0	0	na	0	1	na	1	3	na	Panama
0	0	na	0	0	na	5	2	na	5	12	3.69	Paraguay
0	4	na	2	3	na	1	0	na	5	18	0.35	Peru
0	0	na	1	0	na	0	0	na	0	0	na	Suriname
3	1	na	0	1	na	13	20	1.06	6	32	1.45	Uruguay
4	1	na	3	2	na	8	4	0.29	5	16	0.25	Venezuela
1	**0**	**na**	**2**	**4**	**na**	**12**	**16**	**0.30**	**13**	**29**	**0.47**	**Caribbean**
0	0	na	0	0	na	0	0	na	0	0	na	Bahamas
0	0	na	0	0	na	0	0	na	0	0	na	Barbados
1	0	na	0	0	na	10	14	0.33	4	8	0.12	Cuba
0	0	na	0	0	na	0	0	na	0	0	na	Dominica
0	0	na	0	0	na	0	0	na	0	2	na	Dominican Rep.
0	0	na	0	0	na	0	0	na	0	2	na	Haiti
0	0	na	0	0	na	1	1	na	0	1	na	Jamaica
0	0	na	1	0	na	0	0	na	0	0	na	St Lucia
0	0	na	0	0	na	0	0	na	0	0	na	St Vincent & Grenadines
0	0	na	2	4	na	1	1	na	9	16	3.37	Trinidad & Tobago
5 703	**5 611**	**1.41**	**1 709**	**2 287**	**1.07**	**6 863**	**7 680**	**0.80**	**8 989**	**12 796**	**0.96**	**European Union**
143	151	0.59	20	47	0.61	148	179	0.73	269	342	1.10	Austria
370	358	1.28	37	63	0.78	116	149	0.37	298	332	0.93	Belgium
22	41	0.66	8	6	0.69	65	52	1.18	17	66	0.65	Bulgaria
11	17	0.21	15	26	1.64	16	34	0.29	80	130	1.33	Croatia
4	2	na	6	13	2.88	6	18	0.52	25	87	2.32	Cyprus
228	279	1.37	39	40	0.69	125	174	0.59	154	208	0.64	Czech Rep.
81	115	0.38	43	81	0.98	346	325	1.29	693	1 191	2.60	Denmark
15	20	0.74	4	9	1.17	35	21	1.16	41	73	1.70	Estonia
236	256	1.43	22	29	0.56	119	161	0.71	276	448	1.51	Finland
1 810	1 640	2.09	188	279	0.85	1 004	982	0.76	667	1 036	0.52	France
2 215	2 377	2.27	550	612	1.59	1 401	1 708	0.84	1 401	1 778	0.74	Germany
52	68	0.39	47	42	1.06	214	218	1.09	313	510	1.72	Greece
97	118	0.84	44	47	2.41	63	83	0.53	46	84	0.54	Hungary
39	36	0.19	16	32	0.71	51	101	0.46	192	248	1.34	Ireland
1 201	1 302	1.92	351	433	1.71	1 116	1 197	1.05	1 606	2 119	1.34	Italy
18	17	1.14	3	2	na	30	17	1.18	54	74	2.45	Latvia
22	30	1.16	6	6	1.03	17	33	0.71	13	19	0.44	Lithuania
0	0	na	2	4	na	7	5	0.27	17	36	1.35	Luxembourg

Table F4: Publications on selected research topics relating to SDG 7: Affordable and clean energy
Volume of output, 2012–2015 and 2016–2019, and specialization index, 2011–2019

	CLEANER FOSSIL FUEL TECHNOLOGY			PHOTOVOLTAICS			HYDROPOWER			BIOFUELS AND BIOMASS			WIND TURBINE TECHNOLOGIES		
	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019
Malta	0	0	na	1	4	na	3	3	na	1	3	na	24	49	7.04
Netherlands	185	157	1.14	751	705	0.71	191	297	0.49	768	914	0.90	490	745	1.05
Poland	257	248	2.15	320	520	0.42	211	294	0.89	442	870	0.86	306	484	0.80
Portugal	35	54	0.71	209	267	0.49	197	272	1.51	452	612	1.49	384	411	1.69
Romania	65	60	1.63	229	339	1.00	177	247	2.44	224	280	1.03	264	350	2.07
Slovakia	20	22	1.40	80	86	0.54	56	51	1.14	112	117	0.99	17	27	0.27
Slovenia	10	17	1.16	84	76	0.70	49	42	1.45	64	86	0.81	18	23	0.33
Spain	274	295	1.28	1 296	1 403	0.74	410	564	0.95	1 477	1 948	1.22	1 006	1 157	1.19
Sweden	171	156	1.85	635	859	0.86	162	293	0.90	923	1 168	1.90	342	377	0.95
United Kingdom	372	517	1.00	1 944	2 342	0.61	612	907	0.61	1 691	2 289	0.71	2 107	2 355	1.30
Southeast Europe	**12**	**22**	**0.53**	**47**	**76**	**0.33**	**90**	**92**	**1.59**	**136**	**158**	**0.97**	**100**	**114**	**0.95**
Albania	1	1	na	1	6	na	2	5	na	3	3	na	2	5	na
Bosnia & Herzegovina	0	2	na	4	11	0.25	6	6	1.27	7	5	0.26	15	22	1.87
Montenegro	0	0	na	3	2	na	5	9	2.48	0	2	na	12	7	1.28
North Macedonia	0	1	na	1	4	na	12	15	2.38	3	7	0.20	14	11	1.43
Serbia	11	19	0.63	40	61	0.35	70	63	1.48	126	147	1.17	60	74	0.78
European Free Trade Assoc.	**295**	**266**	**1.98**	**1 197**	**1 249**	**0.99**	**576**	**875**	**2.10**	**542**	**708**	**0.58**	**914**	**972**	**1.60**
Iceland	1	3	na	5	10	0.15	19	18	2.53	19	13	1.09	15	11	1.02
Liechtenstein	0	0	na	3	0	na	0	1	na	0	0	na	0	0	na
Norway	221	184	4.68	234	229	0.63	239	421	2.81	275	390	0.96	681	694	3.71
Switzerland	75	81	0.71	961	1 018	1.19	327	449	1.74	255	310	0.38	223	278	0.60
Other Europe & West Asia	**246**	**423**	**0.56**	**2 085**	**3 600**	**0.64**	**1 142**	**1 919**	**1.14**	**1 373**	**2 769**	**0.56**	**1 284**	**2 439**	**0.77**
Armenia	0	0	na	12	11	0.45	3	7	0.88	13	17	1.20	1	1	na
Azerbaijan	0	0	na	15	14	0.65	1	4	na	2	12	0.25	2	5	na
Belarus	1	1	na	34	68	0.93	1	2	na	15	17	0.34	0	4	na
Georgia	0	1	na	4	4	na	8	22	2.06	3	0	na	2	4	na
Iran Islamic Rep.	117	192	0.99	664	1 331	0.89	539	769	1.79	420	1 034	0.71	778	1 357	1.66
Israel	2	6	na	242	292	0.70	27	25	0.16	112	133	0.36	40	44	0.20
Moldova, Rep.	0	0	na	18	20	1.84	0	3	na	6	4	0.55	1	10	1.42
Russian Federation	64	139	0.45	460	895	0.37	212	607	0.80	274	686	0.35	86	426	0.26
Turkey	47	59	0.38	501	839	0.73	346	459	1.48	482	763	0.85	351	554	0.89
Ukraine	20	28	0.73	183	216	0.79	18	47	0.41	64	145	0.43	27	58	0.28
Sub-Saharan Africa	**66**	**94**	**0.78**	**267**	**642**	**0.60**	**414**	**680**	**2.40**	**671**	**1 265**	**1.50**	**252**	**543**	**0.95**
Angola	0	0	na	0	0	na	0	1	na	1	5	na	1	0	na
Benin	0	1	na	3	0	na	7	15	2.36	6	7	0.78	0	8	na
Botswana	0	2	na	3	5	na	2	14	2.96	8	35	2.63	2	4	na
Burkina Faso	3	2	na	15	15	1.71	12	8	2.93	21	25	2.84	0	3	na
Burundi	0	0	na	0	0	na	1	0	na	2	1	na	0	0	na
Cameroon	1	0	na	14	24	0.71	10	24	2.18	13	29	0.70	7	20	1.10
Cabo Verde	0	0	na	0	0	na	2	1	na	0	1	na	1	0	na
Central African Rep.	0	0	na	0	1	na	1	0	na	0	0	na	0	0	na
Chad	0	0	na	0	1	na	0	1	na	0	0	na	0	2	na
Congo	0	0	na	0	1	na	3	2	na	1	1	na	0	0	na
Côte d'Ivoire	0	1	na	1	7	na	12	11	4.65	6	5	0.60	2	1	na
Congo, Dem. Rep.	0	0	na	0	0	na	1	5	na	1	3	na	0	0	na
Djibouti	0	0	na	0	5	na	0	1	na	0	0	na	0	2	na
Eritrea	0	0	na	0	1	na	0	0	na	0	1	na	0	0	na
Eswatini	0	0	na	0	0	na	0	0	na	0	0	na	0	0	na
Ethiopia	1	4	na	30	48	0.52	43	69	2.79	25	105	1.22	8	39	0.85
Gambia	0	0	na	0	0	na	0	0	na	0	0	na	0	0	na
Ghana	0	3	na	10	21	0.33	17	49	3.46	26	60	1.41	4	15	0.38
Guinea	0	0	na	1	0	na	1	1	na	1	2	na	0	0	na
Kenya	2	3	na	7	13	0.27	21	35	1.83	45	44	0.86	12	25	0.73
Lesotho	0	0	na	1	0	na	1	1	na	0	0	na	1	0	na
Liberia	0	0	na	0	0	na	0	0	na	0	1	na	0	0	na

NUCLEAR FUSION			GEOTHERMAL ENERGY			HYDROGEN ENERGY			SMART GRID TECHNOLOGY			
2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	
1	1	na	0	3	na	0	0	na	9	17	1.45	Malta
399	319	0.70	88	140	0.93	282	409	0.56	436	641	0.82	Netherlands
256	297	0.67	69	105	0.89	382	500	0.86	252	358	0.52	Poland
308	309	1.41	33	48	0.75	179	191	0.76	487	776	2.08	Portugal
80	143	0.78	45	89	2.15	121	117	0.71	217	410	1.59	Romania
17	34	0.30	38	22	2.14	16	32	0.27	33	70	0.58	Slovakia
45	87	1.47	6	19	1.17	38	57	0.86	61	52	0.84	Slovenia
811	879	1.28	104	170	0.74	851	896	0.96	1 001	1 280	1.02	Spain
320	323	0.92	38	72	0.52	317	365	0.77	336	482	0.83	Sweden
1 144	1 205	1.01	171	363	0.60	1 054	1 340	0.67	1 376	2 186	0.82	United Kingdom
5	**10**	**0.08**	**27**	**28**	**1.57**	**60**	**53**	**0.57**	**89**	**191**	**1.03**	**Southeast Europe**
0	0	na	2	0	na	0	0	na	0	1	na	Albania
0	0	na	1	5	na	1	4	na	16	51	2.22	Bosnia & Herzegovina
0	0	na	1	1	na	0	0	na	4	7	0.99	Montenegro
3	3	na	0	5	na	3	1	na	8	19	1.25	North Macedonia
3	7	0.07	23	19	1.49	57	52	0.67	63	116	0.90	Serbia
394	**483**	**0.93**	**302**	**420**	**2.72**	**516**	**592**	**0.87**	**552**	**819**	**0.86**	**European Free Trade Assoc.**
1	2	na	123	144	59.19	14	11	0.92	4	7	0.21	Iceland
0	0	na	0	0	na	0	1	na	0	0	na	Liechtenstein
19	31	0.10	53	85	1.44	180	221	0.88	218	315	0.96	Norway
377	452	1.36	135	204	1.78	327	369	0.86	334	501	0.84	Switzerland
1 164	**1 381**	**1.09**	**405**	**687**	**1.19**	**1 480**	**2 725**	**0.93**	**1 576**	**3 413**	**0.84**	**Other Europe & West Asia**
4	1	na	2	1	na	26	21	2.74	1	1	na	Armenia
1	0	na	3	4	na	1	16	0.59	1	5	na	Azerbaijan
1	7	na	1	2	na	7	9	0.37	0	5	na	Belarus
4	4	0.66	0	0	na	5	0	na	0	0	na	Georgia
106	142	0.49	76	171	0.96	517	972	1.23	1 136	2 158	2.14	Iran Islamic Rep.
21	29	0.16	14	5	0.18	58	163	0.53	44	58	0.20	Israel
1	0	na	0	0	na	1	4	na	0	3	na	Moldova, Rep.
869	1 042	2.11	117	246	1.04	376	749	0.63	136	549	0.30	Russian Federation
66	62	0.31	184	246	2.36	435	750	1.29	235	567	0.54	Turkey
135	154	1.71	13	20	0.52	81	99	0.66	29	99	0.39	Ukraine
18	**23**	**0.06**	**81**	**134**	**1.45**	**180**	**320**	**0.61**	**222**	**580**	**0.81**	**Sub-Saharan Africa**
1	0	na	0	1	na	0	0	na	1	0	na	Angola
0	0	na	1	1	na	0	0	na	0	3	na	Benin
0	0	na	0	1	na	0	7	na	0	7	na	Botswana
0	0	na	1	0	na	1	4	na	1	1	na	Burkina Faso
0	3	na	0	0	na	0	0	na	0	0	na	Burundi
1	0	na	2	4	na	2	1	na	0	1	na	Cameroon
0	0	na	0	0	na	0	0	na	1	0	na	Cabo Verde
0	0	na	0	0	na	0	0	na	0	0	na	Central African Rep.
0	0	na	0	0	na	0	0	na	0	0	na	Chad
0	0	na	0	0	na	0	0	na	0	0	na	Congo
0	0	na	0	0	na	0	3	na	0	0	na	Côte d'Ivoire
0	0	na	0	1	na	0	0	na	0	1	na	Congo, Dem. Rep.
0	0	na	3	4	na	1	0	na	0	0	na	Djibouti
0	0	na	0	0	na	0	0	na	0	0	na	Eritrea
0	0	na	0	0	na	0	1	na	0	1	na	Eswatini
6	2	na	6	15	1.54	2	12	0.13	0	18	0.22	Ethiopia
0	0	na	0	0	na	0	0	na	0	0	na	Gambia
0	0	na	0	2	na	4	4	na	4	24	0.63	Ghana
0	0	na	0	0	na	0	1	na	0	0	na	Guinea
0	0	na	38	40	15.12	2	5	na	3	13	0.33	Kenya
0	0	na	0	0	na	0	0	na	0	2	na	Lesotho
0	0	na	0	0	na	0	0	na	0	0	na	Liberia

Table F4: Publications on selected research topics relating to SDG 7: Affordable and clean energy
Volume of output, 2012–2015 and 2016–2019, and specialization index, 2011–2019

	CLEANER FOSSIL FUEL TECHNOLOGY			PHOTOVOLTAICS			HYDROPOWER			BIOFUELS AND BIOMASS			WIND TURBINE TECHNOLOGIES		
	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019
Madagascar	0	0	na	0	2	na	0	4	na	2	5	na	3	2	na
Malawi	0	1	na	0	1	na	4	4	na	5	11	0.96	2	1	na
Mali	0	0	na	0	2	na	5	4	2.02	4	2	na	0	2	na
Mauritius	0	0	na	1	9	1.37	1	4	na	12	31	4.92	3	8	2.50
Mozambique	1	0	na	0	0	na	3	8	1.32	8	18	1.43	2	4	na
Namibia	0	0	na	1	7	na	6	6	2.61	0	2	na	1	3	na
Niger	1	0	na	1	1	na	0	4	na	4	1	na	0	1	na
Nigeria	6	19	0.53	52	169	0.77	36	94	1.73	155	397	2.16	60	119	1.04
Rwanda	1	0	na	0	2	na	1	10	2.49	2	4	na	0	3	na
Senegal	0	0	na	12	19	1.28	12	9	1.78	6	8	0.55	6	8	0.85
Seychelles	0	0	na	0	0	na	1	0	na	0	1	na	0	0	na
Sierra Leone	0	0	na	0	0	na	0	3	na	2	1	na	0	1	na
Somalia	0	0	na	0	0	na	0	1	na	0	0	na	0	0	na
South Africa	48	62	1.28	124	339	0.67	203	315	2.62	295	524	1.51	142	297	1.16
South Sudan	0	0	na	0	1	na	0	1	na	0	3	na	0	0	na
Togo	0	0	na	6	3	0.78	0	1	na	1	2	na	0	2	na
Uganda	4	1	na	1	2	na	11	7	0.99	20	26	0.87	2	2	na
Tanzania	1	1	na	10	8	0.30	15	19	2.43	29	25	1.29	4	3	na
Zambia	0	1	na	1	3	na	6	15	3.60	8	5	0.74	2	5	na
Zimbabwe	0	0	na	0	4	na	13	34	7.89	5	23	2.06	1	1	na
Arab States	**142**	**271**	**0.81**	**2 208**	**4 537**	**2.22**	**406**	**691**	**1.11**	**790**	**1 743**	**0.78**	**1 379**	**2 600**	**2.63**
Algeria	8	8	0.35	442	806	5.03	79	129	2.45	37	73	0.42	343	561	6.48
Bahrain	0	1	na	12	19	1.53	1	4	na	0	3	na	4	7	1.55
Egypt	13	32	0.34	381	792	1.43	114	128	0.91	218	510	0.92	297	605	2.23
Iraq	5	12	0.45	82	384	2.32	27	113	1.88	42	145	1.07	18	94	0.91
Jordan	5	4	na	62	130	1.68	21	28	1.49	26	49	0.64	30	74	1.50
Kuwait	7	4	1.23	28	52	0.86	4	6	0.62	8	16	0.26	17	40	1.20
Lebanon	1	3	na	49	43	0.97	13	18	0.93	25	43	0.58	45	44	1.70
Libya	0	3	na	12	14	1.55	8	5	2.61	3	4	na	19	22	6.19
Mauritania	0	0	na	0	5	na	1	0	na	0	0	na	3	5	na
Morocco	1	0	na	145	569	3.31	24	83	1.35	22	92	0.48	148	477	5.58
Oman	2	7	na	24	40	0.94	14	22	1.99	37	68	1.45	28	53	2.81
Palestine	0	0	na	35	55	4.30	0	1	na	1	6	na	9	12	1.69
Qatar	22	31	3.77	85	229	2.90	2	7	0.24	28	76	0.74	41	48	1.39
Saudi Arabia	45	107	1.33	711	1 314	1.98	64	91	0.60	257	469	0.79	168	301	1.12
Sudan	2	2	na	11	30	1.08	10	19	2.52	8	20	0.59	3	12	0.85
Syrian Arab Rep.	0	0	na	9	1	0.76	4	5	1.62	6	4	0.47	2	6	0.56
Tunisia	2	4	na	260	356	2.03	40	52	0.92	63	143	0.59	179	284	2.87
United Arab Emirates	39	64	4.36	128	229	2.11	11	38	0.71	77	172	1.65	128	171	3.09
Yemen	0	4	na	7	22	1.23	1	1	na	6	10	0.68	1	3	na
Central Asia	**6**	**26**	**1.47**	**62**	**136**	**1.39**	**39**	**82**	**2.80**	**11**	**46**	**0.39**	**30**	**59**	**1.09**
Kazakhstan	4	19	1.65	27	78	0.92	8	41	1.59	8	30	0.43	21	49	1.26
Kyrgyzstan	0	2	na	0	1	na	10	12	8.56	2	2	na	1	1	na
Mongolia	1	2	na	6	4	1.02	2	2	na	1	2	na	2	2	na
Tajikistan	0	2	na	3	8	0.90	12	10	17.15	0	4	na	1	0	na
Turkmenistan	0	0	na	0	1	na	0	0	na	0	0	na	0	0	na
Uzbekistan	1	2	na	26	47	3.34	10	22	4.25	0	8	na	5	7	0.95
South Asia	**248**	**458**	**0.68**	**3 614**	**8 242**	**1.74**	**732**	**1 276**	**0.88**	**3 038**	**6 341**	**1.65**	**1 645**	**3 703**	**1.46**
Afghanistan	0	0	na	0	1	na	0	2	na	1	0	na	0	9	na
Bangladesh	7	12	0.62	192	411	4.03	32	32	1.08	99	158	1.34	117	163	3.18
Bhutan	0	0	na	0	0	na	6	11	23.70	0	0	na	0	0	na
India	207	357	0.67	3 144	7 042	1.75	560	986	0.81	2 679	5 514	1.70	1 421	3 195	1.47
Maldives	0	0	na	0	0	na	0	0	na	1	0	na	0	2	na
Nepal	2	1	na	7	12	0.30	45	88	7.86	19	34	0.60	5	12	0.54
Pakistan	32	86	0.84	207	711	1.07	75	151	0.98	239	617	1.26	89	294	0.99

NUCLEAR FUSION			GEOTHERMAL ENERGY			HYDROGEN ENERGY			SMART GRID TECHNOLOGY			
2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011-2019	
0	0	na	0	1	na	0	1	na	0	0	na	Madagascar
0	0	na	1	0	na	0	0	na	0	0	na	Malawi
0	0	na	0	1	na	0	1	na	0	2	na	Mali
0	0	na	0	2	na	2	15	2.50	1	9	2.14	Mauritius
0	0	na	0	1	na	0	0	na	0	2	na	Mozambique
0	0	na	1	0	na	0	0	na	1	7	na	Namibia
0	0	na	0	0	na	1	0	na	0	4	na	Niger
1	0	na	14	25	1.36	18	50	0.35	28	93	0.56	Nigeria
0	0	na	0	1	na	1	0	na	0	7	na	Rwanda
0	0	na	1	0	na	0	2	na	0	5	na	Senegal
0	0	na	0	0	na	0	0	na	0	0	na	Seychelles
0	0	na	0	0	na	0	0	na	0	0	na	Sierra Leone
0	1	na	0	0	na	0	0	na	0	0	na	Somalia
9	16	0.08	14	31	0.56	149	224	1.06	177	373	1.26	South Africa
0	0	na	0	0	na	0	0	na	0	0	na	South Sudan
0	0	na	0	0	na	0	0	na	0	0	na	Togo
0	1	na	0	5	na	1	4	na	4	1	na	Uganda
0	1	na	1	1	na	3	4	na	5	21	0.63	Tanzania
0	0	na	0	0	na	0	2	na	0	8	na	Zambia
0	0	na	0	1	na	0	2	na	1	1	na	Zimbabwe
62	**82**	**0.17**	**173**	**245**	**1.27**	**793**	**1 443**	**1.19**	**884**	**2 415**	**1.53**	**Arab States**
5	4	0.14	18	38	1.97	107	161	2.07	51	172	1.17	Algeria
0	0	na	0	0	na	7	7	1.09	1	11	0.68	Bahrain
27	21	0.24	35	46	0.91	176	275	0.94	223	587	1.50	Egypt
2	21	0.65	3	21	1.03	20	46	0.51	9	79	0.45	Iraq
1	3	na	4	9	1.35	15	18	0.48	23	91	1.22	Jordan
0	0	na	4	4	na	22	27	1.43	11	33	0.85	Kuwait
6	3	na	4	6	1.17	19	37	0.75	30	72	1.27	Lebanon
0	0	na	1	2	na	4	6	1.24	11	32	5.40	Libya
0	0	na	1	0	na	0	0	na	0	1	na	Mauritania
3	3	na	7	15	0.73	26	57	0.62	42	252	2.03	Morocco
0	0	na	4	5	1.38	11	17	0.53	19	44	1.42	Oman
0	0	na	3	1	na	1	7	na	11	23	1.83	Palestine
1	3	na	9	8	1.24	37	88	2.50	100	192	4.10	Qatar
15	18	0.12	52	77	1.37	295	596	1.65	185	458	1.17	Saudi Arabia
3	0	na	1	3	na	1	6	na	1	4	na	Sudan
0	2	na	2	0	na	1	1	na	2	13	0.43	Syrian Arab Rep.
1	1	na	27	9	1.27	65	145	1.10	65	187	1.22	Tunisia
3	6	na	22	33	2.56	62	123	1.58	193	402	4.48	United Arab Emirates
0	0	na	3	4	na	6	4	0.24	0	2	na	Yemen
19	**31**	**1.28**	**10**	**14**	**1.68**	**20**	**35**	**0.53**	**8**	**65**	**0.62**	**Central Asia**
14	25	1.76	6	11	1.54	15	26	0.63	5	53	0.73	Kazakhstan
0	0	na	2	1	na	0	0	na	0	0	na	Kyrgyzstan
0	0	na	2	0	na	2	1	na	3	5	na	Mongolia
0	0	na	0	1	na	0	2	na	0	1	na	Tajikistan
0	0	na	0	1	na	0	0	na	0	0	na	Turkmenistan
5	6	0.47	0	0	na	3	6	na	0	6	na	Uzbekistan
534	**594**	**0.67**	**123**	**295**	**0.54**	**1 318**	**2 395**	**0.98**	**1 852**	**6 192**	**1.78**	**South Asia**
0	0	na	0	1	na	0	0	na	0	4	na	Afghanistan
5	5	0.25	12	11	0.99	17	57	0.60	51	194	2.09	Bangladesh
0	0	na	0	0	na	0	0	na	2	0	na	Bhutan
517	564	0.73	99	245	0.52	1 229	2 069	1.03	1 624	5 177	1.76	India
0	0	na	0	0	na	0	0	na	0	1	na	Maldives
2	1	na	0	1	na	3	7	0.18	6	10	0.47	Nepal
10	24	0.22	10	31	0.56	67	266	0.65	147	756	1.90	Pakistan

Table F4: Publications on selected research topics relating to SDG 7: Affordable and clean energy
Volume of output, 2012–2015 and 2016–2019, and specialization index, 2011–2019

	CLEANER FOSSIL FUEL TECHNOLOGY			PHOTOVOLTAICS			HYDROPOWER			BIOFUELS AND BIOMASS			WIND TURBINE TECHNOLOGIES		
	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019
Sri Lanka	0	4	na	66	99	2.63	22	25	1.85	12	44	0.92	13	29	1.27
Southeast Asia	**2 671**	**3 825**	**1.28**	**23 157**	**27 739**	**1.46**	**5 767**	**8 127**	**1.20**	**12 031**	**18 816**	**1.00**	**8 409**	**12 692**	**1.04**
Brunei Darussalam	0	3	na	23	34	4.62	2	3	na	13	49	3.88	12	14	2.84
Cambodia	0	0	na	1	2	na	12	28	5.79	4	2	na	0	0	na
China	1 959	2 870	1.52	11 060	16 367	1.21	4 617	6 200	1.53	6 383	10 822	0.88	5 764	9 487	1.22
China, Hong Kong SAR	13	35	0.30	562	919	1.80	73	111	0.56	139	266	0.51	135	238	0.76
China, Macao SAR	0	0	na	3	36	0.36	3	4	na	6	15	0.38	10	17	0.53
China, Taiwan Prov.	73	83	0.64	2 675	1 798	3.05	153	133	0.49	656	759	0.94	392	424	0.92
Indonesia	22	88	0.99	139	770	1.48	61	365	2.05	361	1 409	3.09	75	391	1.30
Japan	279	250	0.61	3 574	3 472	1.21	450	539	0.50	1 406	1 561	0.55	763	829	0.48
Lao PDR	0	2	na	0	0	na	37	33	23.72	5	8	1.84	0	0	na
Malaysia	75	153	1.42	835	1 270	1.92	139	316	1.18	1 351	2 122	3.71	311	477	1.12
Myanmar	0	1	na	1	7	na	1	7	na	3	7	0.63	2	0	na
Philippines	3	11	0.79	22	66	1.00	16	39	1.91	82	191	3.19	29	50	1.47
Korea, DPR	0	0	na	3	10	3.57	0	1	na	0	3	na	0	1	na
Korea, Rep.	258	328	1.23	4 311	3 861	2.50	234	377	0.52	1 437	1 764	1.05	849	789	0.86
Singapore	53	82	1.17	956	834	2.42	57	80	0.38	335	316	1.10	144	244	0.86
Thailand	50	100	1.81	265	383	1.21	78	128	1.05	627	1 051	3.67	120	164	0.95
Timor-Leste	0	0	na	0	0	na	0	1	na	0	2	na	0	1	na
Viet Nam	3	20	0.62	75	208	1.11	46	128	1.91	67	350	1.27	39	121	1.13
Oceania	**271**	**285**	**1.05**	**1 524**	**1 802**	**0.85**	**528**	**688**	**0.96**	**1 041**	**1 466**	**0.73**	**810**	**952**	**0.85**
Australia	264	270	1.17	1 484	1 736	0.95	474	600	0.97	893	1 311	0.73	719	854	0.87
New Zealand	8	16	0.31	48	76	0.20	56	91	0.84	157	165	0.72	80	85	0.67
Cook Islands	0	0	na	0	0	na	0	0	na	0	0	na	0	0	na
Fiji	0	0	na	2	9	1.04	2	4	na	5	4	na	14	14	8.17
Micronesia	0	0	na	0	0	na	0	0	na	14	0	na	0	0	na
Papua New Guinea	0	0	na	0	0	na	0	2	na	14	2	na	0	4	na
Samoa	0	0	na	0	0	na	0	0	na	2	0	na	0	0	na
Solomon Islands	0	0	na	0	0	na	0	3	na	0	0	na	0	0	na
Tonga	0	0	na	0	0	na	0	0	na	0	0	na	0	0	na
Vanuatu	0	0	na	0	0	na	0	0	na	0	0	na	0	0	na

$SI_{2011–19}$: The specialization index is measured as the proportion of output of a given country on a given topic, divided by the proportion observed at the global level. For example, a country with 2% of its output being on a research topic that represents 1% of all research worldwide would score 2.00, having twice as much output as expected, relative to the global average.

na = the total number of publications is too low to calculate the specialization index

KEY –: *data unavailable* | -n/+n: *data refer to n years before or after reference year* | 0: *magnitude nil or negligible* | na: *not applicable*

GDP: *gross domestic product* | MF: males and females | PPP$: *purchasing power parity dollars*

Note: Publication counts of articles, reviews and conference papers are based on the full-counting method. Therefore, the sum across countries is higher than the global total because of co-authorship. The selected topics in the present table are examples of research topics furthering the SDG agenda. These topics are not necessarily mutually exclusive. The following are excluded from the present table because they did not publish on these topics over the period under study: Antigua and Barbuda, Comoros, Equatorial Guinea, Gabon, Grenada, Guinea-Bissau, Kiribati, Marshall Islands, Nauru, Niue, Palau, Sao Tome and Principe, St Kitts and Nevis and Tuvalu. The total for the People's Republic of China excludes its Special Administrative Regions of Hong Kong and Macao and the Taiwan Province of China.

Source: Prepared by Science-Metrix using Scopus data (Elsevier), including those for social sciences, arts and humanities

NUCLEAR FUSION			GEOTHERMAL ENERGY			HYDROGEN ENERGY			SMART GRID TECHNOLOGY			
2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	
0	0	na	2	6	na	3	9	0.21	22	64	2.01	Sri Lanka
4 232	**4 806**	**1.02**	**986**	**2 175**	**0.77**	**11 374**	**17 654**	**1.50**	**8 525**	**16 246**	**1.00**	**Southeast Asia**
0	0	na	1	1	na	5	33	3.94	18	31	2.58	Brunei Darussalam
0	0	na	0	0	na	1	0	na	1	2	na	Cambodia
2 379	3 082	0.97	593	1 339	0.77	6 539	12 342	1.52	5 437	11 532	1.09	China
4	4	na	9	22	0.31	164	326	1.08	288	442	1.38	China, Hong Kong SAR
1	0	na	1	5	na	5	64	1.15	18	62	1.21	China, Macao SAR
34	32	0.13	34	59	0.44	746	669	1.69	399	485	0.81	China, Taiwan Prov.
7	14	0.14	68	378	6.34	71	224	0.74	67	309	0.86	Indonesia
1 456	1 279	1.88	170	251	0.58	1 791	2 018	1.21	907	1 013	0.50	Japan
0	0	na	0	0	na	0	0	na	0	1	na	Lao PDR
19	28	0.13	27	54	0.53	367	664	1.67	329	650	1.27	Malaysia
1	1	na	0	0	na	0	1	na	0	3	na	Myanmar
3	4	na	9	17	2.02	13	32	0.79	5	66	1.34	Philippines
0	1	na	0	2	na	0	5	na	1	5	na	Korea, DPR
575	605	1.27	92	120	0.55	1 703	1 811	1.91	839	1 234	0.91	Korea, Rep.
13	16	0.13	10	17	0.26	307	417	1.62	378	804	2.26	Singapore
17	21	0.32	6	14	0.36	269	316	1.98	171	272	1.24	Thailand
0	0	na	0	0	na	0	0	na	0	0	na	Timor-Leste
4	5	na	3	16	0.42	23	163	1.05	26	144	0.95	Viet Nam
122	**149**	**0.20**	**380**	**401**	**1.99**	**599**	**1 055**	**0.65**	**1 084**	**1 871**	**1.23**	**Oceania**
109	137	0.20	243	233	1.33	568	1 003	0.72	959	1 711	1.27	Australia
14	12	0.26	150	177	6.44	35	62	0.22	129	155	0.93	New Zealand
0	0	na	0	0	na	0	0	na	0	1	na	Cook Islands
0	0	na	0	2	na	0	2	na	1	12	3.25	Fiji
0	0	na	0	0	na	0	0	na	0	0	na	Micronesia
0	0	na	1	0	na	0	0	na	0	0	na	Papua New Guinea
0	0	na	0	0	na	0	0	na	0	0	na	Samoa
0	0	na	0	0	na	0	0	na	0	0	na	Solomon Islands
0	0	na	0	0	na	0	0	na	0	1	na	Tonga
0	0	na	0	2	na	0	0	na	0	0	na	Vanuatu

Table F5: Publications on selected research topics relating to SDG 9: Industry, innovation and infrastructure
Volume of output, 2012–2015 and 2016–2019, and specialization index, 2011–2019

	CARBON PRICING			ECO-INDUSTRIAL WASTE MANAGEMENT*			RADIOACTIVE WASTE MANAGEMENT			ECO-ALTERNATIVES TO PLASTIC		
	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019
World	**2 725**	**3 536**	**1.00**	**9 501**	**15 881**	**1.00**	**6 752**	**7 000**	**1.00**	**1 977**	**3 270**	**1.00**
North America	**750**	**837**	**0.95**	**1 564**	**1 970**	**0.50**	**1 955**	**1 862**	**1.19**	**366**	**408**	**0.62**
Canada	132	188	1.49	349	510	0.90	218	263	1.01	85	86	1.13
United States of America	641	681	0.88	1 261	1 517	0.44	1 770	1 639	1.21	287	328	0.55
Latin America	**97**	**127**	**0.69**	**566**	**1 050**	**1.37**	**118**	**90**	**0.29**	**201**	**358**	**2.32**
Argentina	6	2	na	55	75	1.25	27	16	0.59	23	29	2.30
Belize	0	0	na	0	0	na	0	0	na	0	0	na
Bolivia	0	2	na	2	2	na	0	0	na	0	0	na
Brazil	65	62	0.72	332	606	1.39	62	41	0.28	126	206	2.42
Chile	10	25	1.48	26	67	0.96	8	15	0.20	8	21	1.23
Colombia	12	9	0.91	31	91	1.51	2	4	na	20	37	3.46
Costa Rica	2	0	na	2	7	na	0	0	na	0	3	na
Ecuador	1	4	na	4	24	1.31	1	1	na	5	7	3.70
El Salvador	0	0	na	0	1	na	0	0	na	0	0	na
Guatemala	0	0	na	0	0	na	0	0	na	0	0	na
Guyana	0	0	na	0	0	na	0	0	na	0	0	na
Honduras	0	1	na	0	0	na	0	0	na	0	2	na
Mexico	5	22	0.55	126	182	1.59	19	16	0.31	25	54	1.97
Nicaragua	0	0	na	0	0	na	0	0	na	0	0	na
Panama	0	1	na	0	0	na	0	0	na	0	0	na
Paraguay	0	0	na	0	1	na	0	1	na	0	0	na
Peru	5	2	na	4	19	1.04	0	1	na	0	6	na
Suriname	0	0	na	0	0	na	0	0	na	0	0	na
Uruguay	0	1	na	1	5	na	0	0	na	1	1	na
Venezuela	0	2	na	4	5	na	1	2	na	5	8	2.57
Caribbean	**4**	**1**	**na**	**12**	**15**	**0.57**	**6**	**1**	**na**	**0**	**0**	**na**
Barbados	0	0	na	1	2	na	0	0	na	0	0	na
Cuba	1	1	na	9	10	0.60	5	1	na	0	0	na
Dominican Rep.	0	0	na	0	0	na	0	0	na	0	0	na
Grenada	0	0	na	0	1	na	0	0	na	0	0	na
Haiti	0	0	na	1	0	na	0	0	na	0	0	na
Jamaica	0	0	na	0	0	na	0	0	na	0	0	na
St Lucia	0	0	na	0	1	na	0	0	na	0	0	na
Trinidad & Tobago	3	0	na	1	2	na	1	0	na	0	0	na
European Union	**1 010**	**1 090**	**1.05**	**3 019**	**4 053**	**0.89**	**2 501**	**2 279**	**1.15**	**649**	**1 054**	**1.07**
Austria	50	76	1.77	53	86	0.70	51	44	0.64	26	28	1.35
Belgium	25	28	0.92	134	133	0.95	166	141	1.96	30	35	1.43
Bulgaria	2	4	na	20	29	1.30	19	26	1.30	1	3	na
Croatia	7	3	0.49	26	33	1.28	20	15	0.84	6	7	1.28
Cyprus	1	4	na	15	17	1.82	2	2	na	0	1	na
Czech Rep.	19	27	0.89	120	185	1.45	100	128	1.61	21	52	1.75
Denmark	30	25	0.79	95	116	0.83	13	13	0.12	5	24	0.47
Estonia	2	4	na	14	11	1.45	6	15	1.52	1	3	na
Finland	44	44	2.50	68	100	1.11	112	143	2.80	16	17	0.91
France	125	131	0.91	278	370	0.55	724	641	2.43	99	102	0.82
Germany	188	208	0.97	299	407	0.38	497	510	1.08	71	141	0.64
Greece	23	31	1.36	123	143	1.67	12	17	0.23	10	16	0.86
Hungary	3	9	0.52	46	47	1.11	40	64	1.59	10	13	1.42
Ireland	19	21	1.52	19	54	0.68	2	11	0.19	7	12	0.94
Italy	111	119	0.83	458	674	1.15	130	133	0.37	103	234	1.65
Latvia	7	7	3.64	9	23	1.57	3	2	na	5	4	2.76
Lithuania	1	6	na	16	33	1.80	43	29	5.54	3	2	na
Luxembourg	1	2	na	5	3	na	3	8	1.21	2	6	na

ECO-CONSTRUCTION MATERIALS			GREATER BATTERY EFFICIENCY			SUSTAINABLE TRANSPORTATION			
2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	
8 407	**12 989**	**1.00**	**34 053**	**61 111**	**1.00**	**26 004**	**46 862**	**1.00**	**World**
2 172	**2 067**	**0.87**	**8 339**	**12 098**	**0.84**	**5 814**	**9 475**	**0.85**	**North America**
392	479	1.31	1 039	1 708	0.82	1 076	1 831	1.18	Canada
1 825	1 634	0.80	7 479	10 647	0.84	4 871	7 869	0.81	United States of America
215	**472**	**0.61**	**374**	**815**	**0.24**	**636**	**1 319**	**0.54**	**Latin America**
10	25	0.34	65	107	0.42	44	75	0.35	Argentina
0	0	na	0	0	na	0	1	na	Belize
0	0	na	2	4	na	1	0	na	Bolivia
106	214	0.51	188	359	0.20	351	631	0.47	Brazil
44	81	1.59	29	90	0.32	40	120	0.54	Chile
29	48	1.10	32	96	0.39	96	206	1.27	Colombia
0	3	na	2	4	na	2	12	0.55	Costa Rica
2	22	1.14	3	39	0.51	12	92	2.08	Ecuador
0	1	na	0	1	na	0	2	na	El Salvador
0	0	na	0	0	na	1	2	na	Guatemala
0	0	na	0	1	na	0	1	na	Guyana
0	0	na	0	0	na	0	0	na	Honduras
25	66	0.51	58	127	0.22	102	198	0.52	Mexico
0	0	na	0	1	na	2	0	na	Nicaragua
0	6	na	0	5	na	3	8	1.09	Panama
0	0	na	1	3	na	1	6	na	Paraguay
3	18	1.21	2	3	na	8	27	0.80	Peru
0	0	na	0	0	na	0	1	na	Suriname
0	3	na	1	16	0.38	4	23	0.62	Uruguay
4	0	na	2	9	0.09	5	7	0.13	Venezuela
4	**5**	**0.38**	**7**	**15**	**0.14**	**10**	**15**	**0.28**	**Caribbean**
0	0	na	1	0	na	0	0	na	Barbados
2	2	na	4	9	0.11	5	6	0.10	Cuba
0	0	na	0	2	na	0	0	na	Dominican Rep.
0	0	na	0	0	na	0	0	na	Grenada
0	0	na	0	0	na	0	1	na	Haiti
1	1	na	0	2	na	2	2	na	Jamaica
0	0	na	0	0	na	0	0	na	St Lucia
1	2	na	2	2	na	3	8	1.74	Trinidad & Tobago
3 790	**5 824**	**1.56**	**6 694**	**11 748**	**0.61**	**9 088**	**14 557**	**1.10**	**European Union**
109	162	1.78	167	243	0.56	333	417	1.51	Austria
138	150	1.54	209	474	0.64	350	424	1.10	Belgium
6	18	0.55	43	81	0.76	25	88	1.01	Bulgaria
10	28	0.88	31	55	0.39	61	129	1.21	Croatia
33	49	6.80	3	37	0.70	19	36	1.25	Cyprus
113	199	1.99	141	206	0.42	171	276	0.80	Czech Rep.
125	201	1.93	229	410	0.72	238	437	1.03	Denmark
28	67	5.85	29	49	0.81	45	52	1.39	Estonia
116	172	2.27	109	191	0.53	179	304	1.05	Finland
248	296	0.63	1 074	1 441	0.62	1 088	1 618	0.92	France
303	397	0.53	2 024	3 669	1.02	2 188	3 288	1.38	Germany
144	217	2.74	74	152	0.36	156	324	1.03	Greece
39	42	1.08	20	62	0.21	89	284	1.54	Hungary
38	85	1.51	77	153	0.59	124	172	0.94	Ireland
815	1 453	3.03	832	1 253	0.57	1 092	1 961	1.13	Italy
26	72	7.23	21	31	0.89	55	91	3.14	Latvia
56	64	5.59	13	12	0.17	33	47	1.08	Lithuania
6	10	1.70	6	17	0.25	28	68	2.57	Luxembourg

Table F5: Publications on selected research topics relating to SDG 9: Industry, innovation and infrastructure
Volume of output, 2012–2015 and 2016–2019, and specialization index, 2011–2019

	CARBON PRICING			ECO-INDUSTRIAL WASTE MANAGEMENT*			RADIOACTIVE WASTE MANAGEMENT			ECO-ALTERNATIVES TO PLASTIC		
	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019
Malta	0	0	na	0	0	na	0	0	na	0	1	na
Netherlands	99	109	1.42	147	150	0.47	66	71	0.35	37	54	0.88
Poland	45	44	0.94	214	391	1.50	60	67	0.43	42	93	1.51
Portugal	25	23	0.95	142	205	1.78	10	14	0.14	37	50	2.13
Romania	8	5	0.41	134	181	2.43	40	52	1.08	24	21	1.60
Slovakia	10	2	0.47	36	50	1.50	43	32	2.04	2	19	1.56
Slovenia	4	3	na	45	34	2.02	13	10	0.82	2	6	na
Spain	79	97	0.87	512	625	1.55	174	211	0.79	119	184	1.93
Sweden	79	101	2.03	112	182	0.81	252	195	2.50	41	40	1.10
United Kingdom	223	252	1.16	346	526	0.47	489	501	1.30	51	100	0.42
Southeast Europe	**6**	**1**	**na**	**57**	**71**	**1.60**	**18**	**14**	**0.78**	**4**	**9**	**0.61**
Albania	0	0	na	2	1	na	0	1	na	0	0	na
Bosnia & Herzegovina	0	0	na	4	5	na	0	1	na	0	1	na
Montenegro	0	0	na	0	2	na	1	0	na	0	0	na
North Macedonia	2	0	na	4	2	na	0	0	na	0	0	na
Serbia	4	1	na	48	67	1.82	17	13	0.91	4	9	0.78
European Free Trade Assoc.	**115**	**123**	**1.65**	**122**	**151**	**0.44**	**244**	**270**	**1.48**	**13**	**35**	**0.34**
Iceland	3	8	3.40	0	1	na	0	0	na	0	0	na
Liechtenstein	0	0	na	0	0	na	0	0	na	0	0	na
Norway	57	53	2.54	32	59	0.45	29	35	0.45	7	13	0.42
Switzerland	56	63	1.17	90	94	0.44	216	236	2.02	6	22	0.31
Other Europe & West Asia	**62**	**108**	**0.31**	**584**	**1 260**	**0.95**	**528**	**807**	**1.27**	**89**	**191**	**0.69**
Armenia	0	0	na	0	6	na	3	2	na	0	0	na
Azerbaijan	0	2	na	2	6	na	0	2	na	0	0	na
Belarus	0	0	na	3	9	0.30	10	12	2.34	0	1	na
Georgia	0	0	na	0	0	na	1	0	na	0	0	na
Iran Islamic Rep.	29	38	0.46	269	511	1.56	24	53	0.26	49	100	1.38
Israel	3	4	na	39	52	0.55	7	11	0.16	3	9	0.30
Moldova, Rep.	0	0	na	1	3	na	1	0	na	0	0	na
Russian Federation	7	28	0.14	79	338	0.58	387	607	2.58	12	40	0.36
Turkey	23	34	0.54	172	301	1.15	41	47	0.37	22	39	0.68
Ukraine	1	4	na	21	49	0.53	65	86	2.45	3	2	na
Sub-Saharan Africa	**65**	**62**	**1.50**	**214**	**524**	**2.25**	**42**	**39**	**0.45**	**17**	**53**	**0.85**
Angola	0	0	na	0	0	na	0	0	na	0	0	na
Benin	0	0	na	0	3	na	0	0	na	0	0	na
Botswana	0	1	na	0	13	2.46	1	0	na	0	0	na
Burkina Faso	0	0	na	2	3	na	0	0	na	0	0	na
Burundi	0	0	na	0	3	na	0	0	na	0	0	na
Cameroon	1	2	na	2	6	na	0	1	na	0	1	na
Cabo Verde	0	0	na	0	0	na	0	0	na	0	0	na
Central African Rep.	0	0	na	0	0	na	0	0	na	0	0	na
Comoros	0	1	na	0	2	na	0	0	na	0	0	na
Congo	0	0	na	1	1	na	0	0	na	0	0	na
Côte d'Ivoire	0	1	na	3	2	na	0	0	na	2	0	na
Congo, Dem. Rep.	0	0	na	3	1	na	0	0	na	0	1	na
Djibouti	0	0	na	0	0	na	0	0	na	0	0	na
Equatorial Guinea	0	0	na	0	1	na	0	0	na	0	0	na
Eswatini	0	0	na	0	1	na	0	0	na	0	0	na
Ethiopia	3	5	na	4	37	1.99	2	2	na	0	3	na
Gabon	1	0	na	0	0	na	0	0	na	0	0	na
Gambia	0	1	na	0	1	na	0	0	na	0	0	na
Ghana	2	2	na	13	25	2.36	9	4	2.04	1	0	na
Guinea	0	0	na	0	1	na	0	0	na	0	0	na
Kenya	15	3	2.96	15	10	1.08	0	1	na	0	0	na
Lesotho	0	0	na	0	0	na	0	0	na	0	0	na

ECO-CONSTRUCTION MATERIALS			GREATER BATTERY EFFICIENCY			SUSTAINABLE TRANSPORTATION			
2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	
1	9	2.17	3	5	na	5	7	0.57	Malta
149	170	0.83	171	390	0.29	420	698	0.83	Netherlands
99	315	1.22	212	453	0.40	262	664	0.80	Poland
178	323	3.25	176	297	0.60	434	549	1.83	Portugal
116	193	2.88	99	174	0.55	231	445	1.79	Romania
89	102	4.06	26	30	0.20	46	134	0.98	Slovakia
43	68	3.08	39	73	0.49	47	82	0.95	Slovenia
305	573	1.42	618	1 138	0.54	758	1 126	0.88	Spain
188	282	1.98	340	605	0.75	421	733	1.37	Sweden
737	981	1.52	897	2 088	0.47	1 391	2 396	0.92	United Kingdom
55	**74**	**1.83**	**24**	**52**	**0.23**	**59**	**146**	**0.82**	**Southeast Europe**
1	3	na	1	0	na	2	0	na	Albania
3	13	1.98	1	8	na	10	22	1.06	Bosnia & Herzegovina
0	1	na	0	1	na	2	4	na	Montenegro
1	13	2.05	0	2	na	6	12	0.79	North Macedonia
50	49	1.83	22	42	0.26	42	112	0.82	Serbia
219	**376**	**1.33**	**368**	**687**	**0.55**	**417**	**658**	**0.71**	**European Free Trade Assoc.**
3	9	0.80	5	2	na	7	11	0.57	Iceland
0	0	na	0	0	na	2	1	na	Liechtenstein
108	171	2.06	92	219	0.48	133	286	0.82	Norway
108	197	0.99	276	471	0.60	278	364	0.66	Switzerland
308	**786**	**0.66**	**902**	**2 107**	**0.38**	**751**	**2 044**	**0.48**	**Other Europe & West Asia**
2	2	na	3	1	na	0	0	na	Armenia
1	2	na	0	0	na	0	1	na	Azerbaijan
0	2	na	0	7	na	3	7	0.25	Belarus
0	0	na	0	1	na	4	5	na	Georgia
108	201	0.67	248	635	0.45	356	686	0.68	Iran Islamic Rep.
27	59	0.67	152	239	0.59	62	118	0.39	Israel
1	1	na	0	5	na	1	5	na	Moldova, Rep.
37	257	0.48	222	691	0.30	83	607	0.32	Russian Federation
123	241	1.06	237	444	0.40	229	533	0.62	Turkey
11	27	0.38	52	114	0.35	21	96	0.35	Ukraine
84	**239**	**1.18**	**109**	**311**	**0.29**	**140**	**302**	**0.44**	**Sub-Saharan Africa**
1	1	na	0	0	na	0	0	na	Angola
0	0	na	0	1	na	1	0	na	Benin
0	0	na	0	2	na	1	2	na	Botswana
2	0	na	0	3	na	0	1	na	Burkina Faso
0	0	na	0	0	na	0	2	na	Burundi
1	7	0.87	1	4	na	1	5	na	Cameroon
1	0	na	0	0	na	0	0	na	Cabo Verde
0	0	na	0	0	na	0	1	na	Central African Rep.
0	0	na	0	0	na	0	0	na	Comoros
0	0	na	0	0	na	0	0	na	Congo
0	1	na	0	0	na	0	1	na	Côte d'Ivoire
0	0	na	1	6	na	0	4	na	Congo, Dem. Rep.
0	1	na	0	0	na	0	0	na	Djibouti
0	0	na	0	1	na	0	0	na	Equatorial Guinea
0	1	na	0	0	na	0	0	na	Eswatini
0	6	na	5	29	0.22	2	24	0.33	Ethiopia
0	0	na	0	0	na	0	1	na	Gabon
0	0	na	1	0	na	0	0	na	Gambia
3	24	2.13	0	7	na	6	14	0.33	Ghana
0	0	na	0	0	na	0	0	na	Guinea
1	4	na	5	9	0.21	10	14	0.30	Kenya
0	0	na	0	0	na	0	0	na	Lesotho

Table F5: Publications on selected research topics relating to SDG 9: Industry, innovation and infrastructure
Volume of output, 2012–2015 and 2016–2019, and specialization index, 2011–2019

	CARBON PRICING			ECO-INDUSTRIAL WASTE MANAGEMENT*			RADIOACTIVE WASTE MANAGEMENT			ECO-ALTERNATIVES TO PLASTIC		
	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019
Madagascar	1	0	na	0	1	na	0	0	na	0	0	na
Malawi	1	2	na	0	1	na	0	0	na	0	1	na
Mali	0	0	na	0	0	na	0	0	na	0	0	na
Mauritius	1	0	na	2	7	na	0	0	na	0	1	na
Mozambique	0	1	na	1	3	na	0	0	na	0	1	na
Namibia	0	1	na	0	2	na	0	1	na	0	0	na
Niger	0	0	na	0	0	na	0	0	na	0	0	na
Nigeria	11	5	0.92	85	209	4.75	5	6	0.29	5	27	1.92
Rwanda	0	0	na	2	2	na	0	0	na	0	1	na
Senegal	0	2	na	4	2	na	0	0	na	0	0	na
Sierra Leone	0	0	na	1	1	na	0	0	na	0	0	na
South Africa	26	37	1.91	77	213	1.85	25	24	0.63	8	19	0.69
South Sudan	0	0	na	0	1	na	0	0	na	0	1	na
Togo	0	0	na	0	1	na	0	1	na	0	0	na
Uganda	1	3	na	4	10	1.45	0	0	na	2	3	na
Tanzania	3	3	na	4	8	1.34	0	0	na	0	1	na
Zambia	0	0	na	0	1	na	0	0	na	0	0	na
Zimbabwe	1	0	na	6	15	4.11	0	0	na	0	0	na
Arab States	**42**	**84**	**0.65**	**447**	**852**	**1.79**	**96**	**140**	**0.68**	**56**	**114**	**1.02**
Algeria	2	1	na	42	49	1.47	4	5	0.34	6	8	1.06
Bahrain	0	0	na	0	3	na	0	1	na	0	0	na
Egypt	2	6	na	99	227	1.77	40	66	1.38	12	34	1.15
Iraq	0	0	na	31	80	2.74	6	6	0.50	1	10	1.54
Jordan	3	6	1.31	14	37	1.57	0	5	na	1	0	na
Kuwait	0	2	na	13	19	2.83	0	0	na	2	3	na
Lebanon	1	5	na	13	17	1.34	4	1	na	3	1	na
Libya	2	0	na	3	4	na	2	2	na	0	1	na
Mauritania	0	0	na	0	0	na	0	0	na	0	0	na
Morocco	0	1	na	21	47	1.15	4	8	0.44	2	8	0.57
Oman	0	2	na	14	41	3.81	1	4	na	0	4	na
Palestine	0	0	na	6	11	2.66	0	0	na	0	1	na
Qatar	1	8	na	22	43	2.40	3	3	na	0	6	na
Saudi Arabia	15	29	0.99	101	209	1.51	29	37	0.45	18	33	1.06
Sudan	1	1	na	1	2	na	1	1	na	0	1	na
Syrian Arab Rep.	0	0	na	5	5	1.70	3	7	7.49	6	2	na
Tunisia	4	6	0.38	59	73	1.87	3	1	na	3	13	0.72
United Arab Emirates	16	23	3.73	34	71	2.68	8	8	0.80	5	2	na
Yemen	0	0	na	0	6	na	0	5	na	0	0	na
Central Asia	**1**	**2**	**na**	**13**	**33**	**1.42**	**7**	**19**	**1.59**	**0**	**0**	**na**
Kazakhstan	1	2	na	10	25	1.75	3	14	1.70	0	0	na
Kyrgyzstan	0	0	na	0	1	na	0	1	na	0	0	na
Mongolia	0	0	na	1	2	na	1	2	na	0	0	na
Tajikistan	0	0	na	0	1	na	1	0	na	0	0	na
Turkmenistan	0	0	na	0	1	na	0	0	na	0	0	na
Uzbekistan	0	0	na	3	3	na	3	2	na	0	0	na
South Asia	**123**	**171**	**0.72**	**908**	**1 883**	**1.75**	**417**	**357**	**0.98**	**131**	**323**	**1.41**
Afghanistan	0	0	na	0	2	na	0	0	na	0	0	na
Bangladesh	10	1	1.05	31	53	1.78	2	4	na	3	11	1.51
Bhutan	0	0	na	0	2	na	0	0	na	0	0	na
India	102	146	0.73	727	1 391	1.60	387	334	1.04	114	272	1.40
Maldives	0	0	na	0	1	na	0	0	na	0	0	na
Nepal	2	6	na	6	5	0.83	1	0	na	1	1	na
Pakistan	5	14	0.29	132	412	3.25	27	19	0.59	14	38	1.50
Sri Lanka	6	5	2.19	18	35	3.40	0	2	na	0	3	na

ECO-CONSTRUCTION MATERIALS			GREATER BATTERY EFFICIENCY			SUSTAINABLE TRANSPORTATION			
2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	
2	1	na	0	0	na	1	0	na	Madagascar
0	2	na	2	1	na	0	1	na	Malawi
0	3	na	0	0	na	0	1	na	Mali
1	3	na	0	0	na	2	2	na	Mauritius
0	1	na	0	2	na	3	7	1.11	Mozambique
1	0	na	0	0	na	1	1	na	Namibia
0	0	na	0	1	na	0	1	na	Niger
23	95	2.07	17	46	0.22	17	47	0.32	Nigeria
1	2	na	0	4	na	0	4	na	Rwanda
0	0	na	1	3	na	1	2	na	Senegal
0	1	na	0	0	na	1	1	na	Sierra Leone
47	103	1.27	76	195	0.45	95	181	0.60	South Africa
0	0	na	0	0	na	0	1	na	South Sudan
1	0	na	0	0	na	1	0	na	Togo
0	2	na	0	3	na	6	2	na	Uganda
1	1	na	1	4	na	4	7	0.34	Tanzania
0	1	na	0	2	na	2	4	na	Zambia
1	2	na	1	3	na	2	6	na	Zimbabwe
281	**678**	**1.72**	**559**	**1 322**	**0.60**	**512**	**1 435**	**0.96**	**Arab States**
18	43	1.23	62	114	0.77	91	129	1.23	Algeria
2	8	1.88	4	2	na	4	4	na	Bahrain
68	149	1.64	120	257	0.45	67	207	0.46	Egypt
13	36	1.29	8	46	0.27	8	77	0.60	Iraq
10	44	2.37	6	56	0.40	13	47	0.69	Jordan
6	23	2.58	1	10	0.16	15	18	0.65	Kuwait
28	36	3.90	24	36	0.56	35	69	1.43	Lebanon
2	4	na	1	5	na	9	7	1.38	Libya
0	0	na	0	0	na	0	0	na	Mauritania
14	50	1.47	38	195	1.09	25	182	1.43	Morocco
10	23	3.32	3	8	0.19	11	27	0.92	Oman
1	8	na	1	8	0.37	6	8	0.88	Palestine
18	36	3.30	55	110	1.49	34	118	2.42	Qatar
50	104	1.14	178	341	0.54	88	242	0.60	Saudi Arabia
0	4	na	0	5	na	2	4	na	Sudan
3	0	na	1	6	na	4	7	0.85	Syrian Arab Rep.
0	10	0.15	48	112	0.61	89	218	1.53	Tunisia
51	138	6.52	58	123	1.15	57	186	2.06	United Arab Emirates
0	3	na	0	6	na	0	2	na	Yemen
8	**21**	**0.98**	**28**	**113**	**0.79**	**4**	**39**	**0.46**	**Central Asia**
5	19	1.30	26	104	1.12	3	35	0.65	Kazakhstan
2	0	na	0	0	na	0	1	na	Kyrgyzstan
0	2	na	1	6	na	1	2	na	Mongolia
0	0	na	0	2	na	0	0	na	Tajikistan
0	0	na	0	0	na	0	0	na	Turkmenistan
1	0	na	1	1	na	0	1	na	Uzbekistan
244	**695**	**0.68**	**1 187**	**3 586**	**0.79**	**849**	**3 438**	**0.96**	**South Asia**
0	1	na	0	0	na	0	0	na	Afghanistan
11	29	1.21	28	93	0.81	35	133	1.43	Bangladesh
0	0	na	0	0	na	1	0	na	Bhutan
205	554	0.65	1 091	3 188	0.82	754	2 989	0.97	India
0	0	na	0	0	na	0	0	na	Maldives
6	7	0.93	1	1	na	4	7	0.25	Nepal
15	65	0.56	54	263	0.43	42	272	0.66	Pakistan
8	40	4.06	14	48	0.98	18	40	1.42	Sri Lanka

Table F5: Publications on selected research topics relating to SDG 9: Industry, innovation and infrastructure
Volume of output, 2012–2015 and 2016–2019, and specialization index, 2011–2019

	CARBON PRICING			ECO-INDUSTRIAL WASTE MANAGEMENT*			RADIOACTIVE WASTE MANAGEMENT			ECO-ALTERNATIVES TO PLASTIC		
	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019
Southeast Asia	**757**	**1 629**	**1.11**	**3 315**	**6 794**	**1.20**	**1 749**	**2 247**	**0.86**	**655**	**1 190**	**1.08**
Brunei Darussalam	0	1	na	0	11	2.02	0	1	na	0	0	na
Cambodia	1	1	na	1	6	na	0	0	na	0	0	na
China	527	1 312	1.35	2 186	4 574	1.28	803	1 174	0.67	230	442	0.62
China, Hong Kong SAR	29	41	1.41	123	211	1.58	14	14	0.23	4	18	0.61
China, Macao SAR	0	1	na	8	18	1.32	0	0	na	0	1	na
China, Taiwan Prov.	33	63	0.93	163	239	1.04	40	68	0.54	36	32	0.74
Indonesia	12	26	0.69	55	341	2.67	17	47	0.76	6	155	5.44
Japan	95	105	0.49	183	293	0.30	571	563	1.60	156	143	1.08
Lao PDR	3	0	na	1	0	na	0	0	na	0	0	na
Malaysia	17	45	0.87	331	671	3.99	21	33	0.35	102	206	6.11
Myanmar	0	0	na	0	1	na	0	0	na	1	0	na
Philippines	4	5	na	14	47	2.56	2	4	na	6	13	4.52
Korea, DPR	0	0	na	0	0	na	0	0	na	0	0	na
Korea, Rep.	59	92	0.74	300	495	0.88	315	402	1.59	62	101	0.96
Singapore	12	27	0.66	53	174	1.22	5	4	na	7	13	0.57
Thailand	20	30	1.44	79	198	2.19	7	9	0.23	83	145	9.12
Timor-Leste	0	0	na	0	1	na	0	0	na	0	0	na
Viet Nam	2	8	0.39	18	93	1.63	7	12	0.43	1	9	0.53
Oceania	**270**	**221**	**2.38**	**373**	**658**	**1.05**	**87**	**103**	**0.29**	**71**	**81**	**0.91**
Australia	248	197	2.48	335	617	1.12	83	95	0.32	51	60	0.75
New Zealand	27	28	1.66	40	47	0.59	5	8	0.09	20	21	2.01
Fiji	1	0	na	1	1	na	0	0	na	0	1	na
Micronesia	1	0	na	0	0	na	0	0	na	0	0	na
Papua New Guinea	0	0	na	0	1	na	0	0	na	0	0	na
Samoa	0	0	na	1	0	na	0	0	na	0	0	na
Solomon Islands	0	0	na	0	0	na	0	0	na	0	0	na

*Eco-industrial waste management excludes nuclear waste

$SI_{2011–19}$: The specialization index is measured as the proportion of output of a given country on a given topic, divided by the proportion observed at the global level. For example, a country with 2% of its output being on a research topic that represents 1% of all research worldwide would score 2.00, having twice as much output as expected, relative to the global average.

na = the total number of publications is too low to calculate the specialization index

KEY –: *data unavailable* | -n/+n: *data refer to n years before or after reference year* | 0: *magnitude nil or negligible* | na: *not applicable*

GDP: *gross domestic product* | MF: males and females | PPP$: *purchasing power parity dollars*

Note: Publication counts of articles, reviews and conference papers are based on the full-counting method. Therefore, the sum across countries is higher than the global total because of co-authorship. The selected topics in the present table are examples of research topics furthering the SDG agenda. These topics are not necessarily mutually exclusive. The following are excluded from the present table because they did not publish on these topics over the period under study: Antigua and Barbuda, Bahamas, Chad, Cook Islands, Dominica, Eritrea, Guinea-Bissau, Kiribati, Liberia, Marshall Islands, Nauru, Niue, Palau, Sao Tome and Principe, Seychelles, Somalia, St Kitts and Nevis, St Vincent and the Grenadines, Tonga, Tuvalu and Vanuatu. The total for the People's Republic of China excludes its Special Administrative Regions of Hong Kong and Macao and the Taiwan Province of China.

Source: Prepared by Science-Metrix using Scopus data (Elsevier), including those for social sciences, arts and humanities

ECO-CONSTRUCTION MATERIALS			GREATER BATTERY EFFICIENCY			SUSTAINABLE TRANSPORTATION			
2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	
1 583	**3 214**	**0.66**	**19 461**	**37 844**	**1.84**	**9 929**	**19 502**	**1.25**	**Southeast Asia**
0	6	na	2	6	na	12	22	1.92	Brunei Darussalam
1	4	na	1	5	na	0	5	na	Cambodia
614	1 493	0.45	12 946	29 008	2.12	5 613	12 871	1.25	China
185	305	4.00	451	1 020	1.99	228	506	1.46	China, Hong Kong SAR
0	13	0.81	7	41	0.52	27	47	1.37	China, Macao SAR
126	156	0.91	634	828	1.03	529	631	1.13	China, Taiwan Prov.
25	213	1.91	92	429	0.93	114	610	1.83	Indonesia
197	282	0.41	2 241	2 742	0.99	1 534	1 945	0.94	Japan
1	0	na	1	0	na	0	0	na	Lao PDR
212	449	3.24	212	475	0.68	369	700	1.53	Malaysia
1	0	na	0	2	na	0	10	2.06	Myanmar
7	23	1.62	10	44	0.63	13	67	1.40	Philippines
0	0	na	1	8	na	0	0	na	Korea, DPR
195	294	0.68	2 866	4 164	2.34	1 406	2 138	1.63	Korea, Rep.
86	162	1.77	923	1 215	3.11	349	542	1.73	Singapore
22	85	0.89	86	210	0.60	97	237	0.89	Thailand
0	0	na	0	0	na	0	0	na	Timor-Leste
4	48	0.80	36	122	0.64	30	124	1.00	Viet Nam
438	**719**	**1.65**	**1 013**	**2 140**	**0.78**	**847**	**1 314**	**0.85**	**Oceania**
364	618	1.57	992	2 077	0.87	731	1 135	0.84	Australia
86	113	2.22	19	62	0.18	124	192	0.96	New Zealand
0	0	na	3	5	na	3	2	na	Fiji
0	0	na	0	0	na	0	0	na	Micronesia
0	2	na	0	1	na	3	0	na	Papua New Guinea
0	0	na	0	0	na	0	0	na	Samoa
0	1	na	0	0	na	0	0	na	Solomon Islands

Table F6: Publications on selected research topics relating to SDG 13: Climate action
Volume of output, 2012–2015 and 2016–2019, and specialization index, 2011–2019

	NATIONAL AND URBAN GREENHOUSE GAS EMISSIONS			CARBON CAPTURE AND STORAGE			LOCAL IMPACT OF CLIMATE-RELATED HAZARDS AND DISASTERS		
	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019
World	**857**	**1 495**	**1.00**	**8 731**	**9 286**	**1.00**	**1 079**	**1 830**	**1.00**
North America	**244**	**335**	**0.85**	**2 907**	**2 480**	**1.25**	**437**	**733**	**1.53**
Canada	37	65	1.17	482	451	1.50	119	200	3.06
United States of America	209	285	0.81	2 507	2 098	1.21	341	582	1.32
Latin America	**33**	**85**	**0.87**	**156**	**274**	**0.41**	**75**	**143**	**1.15**
Argentina	1	3	na	21	17	0.37	7	7	0.81
Bolivia	0	1	na	0	0	na	2	1	na
Brazil	19	50	0.86	77	155	0.40	20	38	0.56
Chile	1	3	na	8	15	0.23	7	19	2.34
Colombia	2	10	1.02	10	22	0.43	8	20	2.04
Costa Rica	0	2	na	0	4	na	2	7	na
Ecuador	2	2	na	2	1	na	3	6	2.97
El Salvador	0	0	na	0	0	na	0	1	na
Guatemala	0	0	na	0	0	na	4	0	na
Guyana	0	0	na	0	0	na	0	1	na
Honduras	0	1	na	0	0	na	0	0	na
Mexico	9	16	1.20	38	67	0.62	20	29	1.77
Nicaragua	0	0	na	0	0	na	0	0	na
Panama	1	3	na	1	5	na	3	5	na
Paraguay	0	0	na	2	0	na	0	0	na
Peru	0	5	na	0	2	na	8	13	5.85
Uruguay	0	0	na	1	1	na	0	4	na
Venezuela	0	1	na	1	1	na	2	4	na
Caribbean	**0**	**2**	**na**	**10**	**4**	**0.75**	**6**	**11**	**3.23**
Bahamas	0	0	na	0	0	na	0	2	na
Barbados	0	0	na	0	1	na	1	1	na
Cuba	0	1	na	1	1	na	1	3	na
Dominica	0	0	na	0	0	na	0	1	na
Dominican Rep.	0	0	na	0	0	na	0	1	na
Haiti	0	0	na	0	0	na	0	1	na
Jamaica	0	1	na	1	0	na	0	1	na
Trinidad & Tobago	0	0	na	8	2	6.32	4	1	na
European Union	**260**	**400**	**0.82**	**3 311**	**3 197**	**1.17**	**361**	**632**	**0.89**
Austria	18	21	1.20	46	90	0.65	8	16	0.49
Belgium	1	10	0.20	78	110	0.87	9	36	0.93
Bulgaria	1	0	na	5	5	0.22	1	3	na
Croatia	1	1	na	12	12	0.62	1	0	na
Cyprus	0	2	na	3	9	1.09	1	3	na
Czech Rep.	2	7	na	17	36	0.26	5	9	0.27
Denmark	12	20	1.20	94	86	0.95	13	34	1.34
Estonia	2	2	na	13	12	1.53	3	4	na
Finland	22	12	2.38	75	90	1.46	16	23	1.39
France	25	40	0.47	446	309	0.98	34	81	0.67
Germany	46	81	0.66	637	506	1.01	47	100	0.57
Greece	2	17	1.37	62	54	0.76	7	14	1.09
Hungary	0	3	na	13	21	0.47	2	5	na
Ireland	13	9	2.26	22	35	0.47	8	7	0.98
Italy	25	46	0.68	334	344	0.86	23	61	0.55
Latvia	9	11	13.67	2	2	na	0	0	na
Lithuania	2	2	na	5	5	0.36	1	1	na
Luxembourg	1	0	na	1	3	na	0	0	na
Malta	0	0	na	0	0	na	1	0	na
Netherlands	16	51	1.00	396	262	1.89	39	71	1.30
Poland	5	14	0.47	136	122	0.88	6	16	0.46
Portugal	5	5	0.59	52	56	0.64	21	20	1.31
Romania	6	7	0.90	64	57	1.28	7	10	1.24

NEW TECHNOLOGIES TO PROTECT FROM CLIMATE-RELATED HAZARDS			LOCAL DISASTER RISK REDUCTION STRATEGIES			CLIMATE-READY CROPS			
2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	
314	**510**	**1.00**	**384**	**655**	**1.00**	**1 660**	**3 109**	**1.00**	**World**
95	**136**	**1.10**	**117**	**204**	**1.17**	**396**	**625**	**0.65**	**North America**
18	31	1.58	16	47	1.72	46	66	0.43	Canada
82	108	1.04	101	169	1.10	364	581	0.68	United States of America
11	**27**	**0.69**	**24**	**36**	**0.77**	**189**	**378**	**1.90**	**Latin America**
0	2	na	3	0	na	8	20	1.12	Argentina
0	0	na	1	1	na	1	2	na	Bolivia
4	8	0.41	3	11	0.36	71	133	1.50	Brazil
1	0	na	0	4	na	11	2	0.67	Chile
2	5	na	5	4	na	45	78	4.45	Colombia
0	2	na	1	0	na	3	3	na	Costa Rica
0	0	na	2	1	na	0	2	na	Ecuador
1	0	na	0	0	na	0	0	na	El Salvador
0	1	na	1	0	na	0	0	na	Guatemala
0	0	na	0	0	na	0	0	na	Guyana
1	1	na	0	0	na	1	2	na	Honduras
4	11	1.38	3	12	1.49	57	133	3.42	Mexico
1	0	na	2	0	na	1	4	na	Nicaragua
1	0	na	1	0	na	0	1	na	Panama
0	1	na	0	0	na	0	0	na	Paraguay
1	3	na	3	1	na	9	13	3.27	Peru
1	0	na	2	3	na	2	3	na	Uruguay
0	0	na	0	1	na	3	2	na	Venezuela
2	**2**	**na**	**2**	**6**	**na**	**1**	**5**	**na**	**Caribbean**
0	0	na	0	2	na	0	0	na	Bahamas
1	0	na	1	1	na	0	1	na	Barbados
1	1	na	0	2	na	1	2	na	Cuba
0	0	na	0	0	na	0	0	na	Dominica
0	0	na	0	0	na	0	0	na	Dominican Rep.
0	0	na	0	0	na	0	0	na	Haiti
1	1	na	0	0	na	0	1	na	Jamaica
0	0	na	1	1	na	0	1	na	Trinidad & Tobago
118	**224**	**1.30**	**157**	**265**	**1.20**	**504**	**864**	**0.78**	**European Union**
6	3	na	13	15	2.91	11	14	0.36	Austria
4	18	1.85	4	16	1.80	32	48	1.35	Belgium
0	2	na	0	0	na	2	2	na	Bulgaria
0	1	na	1	0	na	3	5	na	Croatia
1	4	na	0	0	na	1	8	na	Cyprus
1	1	na	4	0	na	11	23	0.51	Czech Rep.
5	19	2.30	11	7	1.25	27	29	0.89	Denmark
1	1	na	1	1	na	2	2	na	Estonia
5	3	na	0	3	na	5	22	0.58	Finland
11	18	0.60	13	25	0.73	57	78	0.45	France
19	37	0.96	33	44	0.95	81	142	0.54	Germany
9	11	3.59	1	2	na	5	15	0.46	Greece
2	0	na	1	1	na	4	10	0.74	Hungary
1	2	na	3	4	na	4	20	1.08	Ireland
18	39	1.55	21	26	0.98	78	137	0.98	Italy
1	0	na	0	2	na	0	0	na	Latvia
3	0	na	0	0	na	0	1	na	Lithuania
2	0	na	0	1	na	3	1	na	Luxembourg
1	1	na	0	0	na	0	0	na	Malta
19	36	2.92	20	45	2.74	38	79	0.86	Netherlands
1	7	na	5	5	0.31	38	60	1.40	Poland
4	5	na	3	12	1.17	27	30	1.37	Portugal
2	2	na	6	5	1.99	4	10	0.54	Romania

Table F6: Publications on selected research topics relating to SDG 13: Climate action
Volume of output, 2012–2015 and 2016–2019, and specialization index, 2011–2019

	NATIONAL AND URBAN GREENHOUSE GAS EMISSIONS			CARBON CAPTURE AND STORAGE			LOCAL IMPACT OF CLIMATE-RELATED HAZARDS AND DISASTERS		
	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019
Slovakia	2	0	na	11	6	0.25	0	2	na
Slovenia	0	0	na	5	9	0.29	0	3	na
Spain	19	34	0.64	301	360	1.16	33	57	0.61
Sweden	18	35	1.34	186	196	1.60	21	32	0.95
United Kingdom	64	124	1.09	999	1 204	2.13	160	232	1.84
Southeast Europe	**6**	**1**	**1.41**	**3**	**10**	**0.14**	**2**	**2**	**na**
Albania	1	0	na	1	0	na	0	1	na
Bosnia & Herzegovina	0	0	na	0	0	na	1	1	na
Montenegro	0	0	na	0	0	na	0	1	na
North Macedonia	1	0	na	0	0	na	0	0	na
Serbia	4	1	na	2	10	0.18	1	1	na
European Free Trade Assoc.	**25**	**45**	**1.18**	**673**	**654**	**3.70**	**36**	**67**	**0.96**
Iceland	2	0	na	21	16	5.49	2	2	na
Norway	13	22	1.81	533	470	9.16	18	41	1.65
Switzerland	10	24	0.84	128	185	1.01	19	24	0.62
Other Europe & West Asia	**18**	**51**	**0.39**	**148**	**306**	**0.27**	**13**	**39**	**0.18**
Armenia	0	0	na	2	0	na	0	0	na
Azerbaijan	0	0	na	0	0	na	0	0	na
Belarus	0	0	na	0	1	na	0	0	na
Georgia	0	0	na	0	0	na	0	1	na
Iran Islamic Rep.	8	11	0.40	80	173	0.58	4	7	0.14
Israel	2	3	na	14	20	0.20	7	6	0.62
Moldova, Rep.	0	1	na	1	0	na	0	0	na
Russian Federation	6	15	0.31	18	59	0.12	2	17	0.19
Turkey	2	15	0.56	30	48	0.24	0	6	na
Ukraine	0	6	na	4	7	0.09	0	2	na
Sub-Saharan Africa	**14**	**35**	**1.44**	**42**	**104**	**0.46**	**112**	**236**	**8.12**
Benin	1	3	na	0	1	na	3	1	na
Botswana	0	1	na	1	2	na	2	9	21.12
Burkina Faso	0	1	na	0	0	na	1	3	na
Burundi	0	0	na	0	0	na	1	1	na
Cameroon	0	2	na	0	1	na	11	3	9.35
Cabo Verde	0	0	na	0	0	na	0	0	na
Central African Rep.	0	0	na	0	0	na	1	1	na
Chad	0	0	na	0	0	na	1	0	na
Comoros	0	0	na	0	0	na	0	3	na
Congo	0	0	na	0	0	na	1	1	na
Côte d'Ivoire	0	1	na	0	0	na	0	2	na
Congo, Dem. Rep.	0	0	na	0	0	na	1	0	na
Eritrea	0	0	na	0	1	na	0	0	na
Ethiopia	0	4	na	0	1	na	13	30	13.79
Gabon	0	0	na	0	0	na	1	0	na
Gambia	0	0	na	0	0	na	0	0	na
Ghana	3	6	na	0	9	na	15	25	21.75
Guinea	0	0	na	0	0	na	0	0	na
Kenya	1	3	na	0	4	na	19	34	18.30
Lesotho	0	0	na	0	0	na	0	1	na
Madagascar	1	0	na	0	2	na	2	5	na
Malawi	1	1	na	0	0	na	3	6	na
Mali	0	1	na	0	0	na	3	3	na
Mauritius	2	1	na	0	0	na	0	2	na
Mozambique	0	1	na	0	0	na	1	1	na
Namibia	0	0	na	0	0	na	2	1	na
Niger	0	0	na	0	0	na	3	1	na
Nigeria	0	7	na	8	25	0.52	13	23	3.76
Rwanda	0	0	na	0	0	na	0	2	na

NEW TECHNOLOGIES TO PROTECT FROM CLIMATE-RELATED HAZARDS			LOCAL DISASTER RISK REDUCTION STRATEGIES			CLIMATE-READY CROPS			
2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	
1	2	na	2	1	na	3	9	0.65	Slovakia
1	1	na	0	0	na	3	4	na	Slovenia
11	26	1.28	9	16	0.46	56	83	0.86	Spain
11	13	1.93	20	23	3.21	7	34	0.41	Sweden
37	56	1.71	48	92	2.01	138	227	0.99	United Kingdom
1	**2**	**na**	**1**	**4**	**na**	**13**	**15**	**1.24**	**Southeast Europe**
1	1	na	0	0	na	1	0	na	Albania
0	1	na	0	0	na	1	1	na	Bosnia & Herzegovina
0	0	na	0	0	na	0	0	na	Montenegro
0	0	na	0	1	na	0	1	na	North Macedonia
0	0	na	1	3	na	12	14	1.43	Serbia
15	**25**	**1.67**	**20**	**36**	**1.94**	**31**	**68**	**0.78**	**European Free Trade Assoc.**
1	0	na	1	1	na	0	1	na	Iceland
9	12	2.69	3	12	1.49	7	16	0.48	Norway
7	14	1.21	17	24	2.08	24	52	0.95	Switzerland
7	**18**	**0.30**	**5**	**15**	**0.21**	**90**	**214**	**0.71**	**Other Europe & West Asia**
0	1	na	0	0	na	1	2	na	Armenia
0	0	na	0	0	na	0	1	na	Azerbaijan
0	0	na	0	0	na	1	1	na	Belarus
0	1	na	0	0	na	0	1	na	Georgia
3	4	na	0	7	na	42	67	1.10	Iran Islamic Rep.
0	2	na	3	2	na	13	34	1.20	Israel
0	0	na	0	0	na	1	0	na	Moldova, Rep.
1	4	na	0	2	na	10	44	0.30	Russian Federation
3	5	na	2	3	na	25	69	0.90	Turkey
0	1	na	0	2	na	0	5	na	Ukraine
26	**54**	**6.57**	**22**	**51**	**4.07**	**144**	**411**	**7.20**	**Sub-Saharan Africa**
0	1	na	0	0	na	7	7	17.20	Benin
0	2	na	2	1	na	2	3	na	Botswana
1	3	na	1	0	na	3	10	10.77	Burkina Faso
1	0	na	0	0	na	0	4	na	Burundi
0	2	na	0	0	na	1	5	na	Cameroon
0	1	na	0	0	na	0	0	na	Cabo Verde
0	0	na	0	0	na	0	0	na	Central African Rep.
0	0	na	0	0	na	0	0	na	Chad
0	0	na	0	0	na	0	0	na	Comoros
0	0	na	0	0	na	0	1	na	Congo
1	0	na	1	0	na	0	5	na	Côte d'Ivoire
0	0	na	0	0	na	0	5	na	Congo, Dem. Rep.
0	0	na	0	0	na	0	0	na	Eritrea
2	6	na	4	5	na	16	48	9.76	Ethiopia
0	0	na	0	0	na	0	0	na	Gabon
0	0	na	0	1	na	0	3	na	Gambia
0	7	na	1	7	na	6	28	10.65	Ghana
0	0	na	0	0	na	1	0	na	Guinea
8	10	25.38	7	6	11.26	39	93	23.62	Kenya
0	0	na	0	0	na	0	0	na	Lesotho
0	0	na	0	0	na	1	1	na	Madagascar
0	1	na	2	3	na	5	18	14.53	Malawi
0	2	na	2	2	na	4	22	50.02	Mali
0	0	na	0	0	na	0	4	na	Mauritius
0	0	na	1	2	na	2	9	11.79	Mozambique
1	0	na	1	0	na	1	2	na	Namibia
0	0	na	0	1	na	8	2	30.95	Niger
5	2	na	2	4	na	25	60	5.14	Nigeria
0	0	na	0	1	na	3	14	15.30	Rwanda

Table F6: Publications on selected research topics relating to SDG 13: Climate action
Volume of output, 2012–2015 and 2016–2019, and specialization index, 2011–2019

	NATIONAL AND URBAN GREENHOUSE GAS EMISSIONS			CARBON CAPTURE AND STORAGE			LOCAL IMPACT OF CLIMATE-RELATED HAZARDS AND DISASTERS		
	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019
Senegal	0	0	na	0	0	na	1	7	na
Seychelles	0	0	na	0	0	na	0	1	na
Sierra Leone	0	0	na	0	0	na	0	1	na
Somalia	0	0	na	0	1	na	0	0	na
South Africa	7	7	0.94	31	60	0.69	20	95	5.54
South Sudan	0	0	na	0	0	na	0	0	na
Togo	0	0	na	0	0	na	0	1	na
Uganda	1	0	na	2	0	na	1	12	7.09
Tanzania	0	1	na	1	1	na	10	19	21.37
Zambia	0	1	na	0	0	na	4	2	na
Zimbabwe	1	3	na	0	0	na	6	8	23.45
Arab States	**15**	**19**	**0.50**	**207**	**338**	**0.87**	**16**	**17**	**0.35**
Algeria	0	1	na	10	9	0.39	2	1	na
Bahrain	0	0	na	0	1	na	0	0	na
Egypt	1	2	na	6	21	0.13	4	5	na
Iraq	0	0	na	5	28	0.26	0	0	na
Jordan	0	2	na	0	12	0.37	1	0	na
Kuwait	0	0	na	7	7	1.48	0	0	na
Lebanon	1	0	na	0	2	na	2	1	na
Libya	0	0	na	1	1	na	1	0	na
Morocco	0	1	na	4	2	na	2	2	na
Oman	1	1	na	7	4	0.65	1	1	na
Palestine	0	0	na	0	0	na	1	0	na
Qatar	3	0	na	26	49	4.30	0	2	na
Saudi Arabia	7	8	1.01	69	145	1.83	1	4	na
Sudan	1	0	na	0	1	na	1	1	na
Syrian Arab Rep.	0	0	na	1	1	na	1	0	na
Tunisia	1	1	na	3	5	na	4	2	na
United Arab Emirates	2	4	na	76	76	4.47	0	2	na
Yemen	0	0	na	0	1	na	0	0	na
Central Asia	**0**	**2**	**na**	**1**	**6**	**na**	**4**	**4**	**na**
Kazakhstan	0	2	na	0	6	na	0	1	na
Kyrgyzstan	0	0	na	0	0	na	1	4	na
Mongolia	0	0	na	1	0	na	0	0	na
Tajikistan	0	0	na	0	0	na	0	0	na
Uzbekistan	0	0	na	0	0	na	4	0	na
South Asia	**22**	**59**	**0.49**	**245**	**474**	**0.55**	**83**	**200**	**1.29**
Afghanistan	0	0	na	0	0	na	0	0	na
Bangladesh	2	5	na	1	7	na	18	43	10.19
Bhutan	0	1	na	0	0	na	0	3	na
India	16	41	0.43	230	397	0.58	48	104	0.90
Maldives	0	0	na	0	0	na	0	0	na
Nepal	2	2	na	0	1	na	9	21	17.44
Pakistan	4	12	0.78	14	63	0.41	7	33	1.90
Sri Lanka	0	4	na	0	6	na	2	7	na
Southeast Asia	**364**	**800**	**1.46**	**2 218**	**3 239**	**0.83**	**143**	**316**	**0.36**
Brunei Darussalam	0	1	na	0	6	na	0	0	na
Cambodia	1	1	na	0	0	na	1	2	na
China	240	614	1.73	1 300	2 049	0.79	32	79	0.13
China, Hong Kong SAR	14	17	1.61	14	21	0.19	4	15	0.75
China, Macao SAR	0	2	na	0	1	na	0	2	na
China, Taiwan Prov.	11	18	0.93	87	104	0.64	5	9	0.27
Indonesia	9	27	2.11	9	59	0.51	24	69	4.21
Japan	39	57	0.60	354	302	0.62	38	51	0.45
Lao PDR	0	0	na	1	1	na	1	1	na
Malaysia	14	23	1.38	98	217	1.51	16	28	1.19

NEW TECHNOLOGIES TO PROTECT FROM CLIMATE-RELATED HAZARDS			LOCAL DISASTER RISK REDUCTION STRATEGIES			CLIMATE-READY CROPS			
2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	
0	1	na	0	1	na	2	10	5.33	Senegal
0	0	na	0	0	na	0	0	na	Seychelles
0	0	na	0	0	na	0	1	na	Sierra Leone
0	0	na	0	0	na	0	0	na	Somalia
6	18	4.25	7	18	2.82	26	109	4.11	South Africa
0	0	na	0	0	na	1	0	na	South Sudan
0	0	na	0	0	na	0	1	na	Togo
1	2	na	1	2	na	9	39	16.40	Uganda
2	3	na	1	1	na	5	24	8.13	Tanzania
0	0	na	0	1	na	12	27	28.45	Zambia
1	5	na	1	1	na	11	42	38.44	Zimbabwe
7	**12**	**0.72**	**4**	**8**	**0.40**	**50**	**138**	**0.90**	**Arab States**
0	1	na	0	0	na	0	5	na	Algeria
0	2	na	0	0	na	0	0	na	Bahrain
2	2	na	2	3	na	8	26	0.65	Egypt
0	3	na	0	0	na	2	9	0.93	Iraq
1	0	na	0	1	na	2	10	1.75	Jordan
0	0	na	0	0	na	0	0	na	Kuwait
1	1	na	0	0	na	1	4	na	Lebanon
0	0	na	0	0	na	0	1	na	Libya
2	1	na	1	1	na	9	18	1.06	Morocco
0	1	na	1	0	na	0	19	1.93	Oman
0	0	na	0	0	na	0	0	na	Palestine
0	1	na	0	1	na	0	2	na	Qatar
1	0	na	0	2	na	12	39	1.10	Saudi Arabia
0	0	na	0	0	na	5	6	5.12	Sudan
0	0	na	0	0	na	8	1	10.36	Syrian Arab Rep.
0	0	na	0	0	na	3	8	0.69	Tunisia
0	0	na	0	0	na	4	7	1.11	United Arab Emirates
0	0	na	0	0	na	0	0	na	Yemen
1	**2**	**na**	**1**	**1**	**na**	**3**	**24**	**3.47**	**Central Asia**
0	2	na	0	0	na	2	15	4.11	Kazakhstan
0	0	na	0	0	na	0	1	na	Kyrgyzstan
0	0	na	1	1	na	0	1	na	Mongolia
0	0	na	0	0	na	0	1	na	Tajikistan
1	0	na	0	0	na	1	8	3.01	Uzbekistan
21	**44**	**1.07**	**26**	**51**	**0.97**	**367**	**752**	**3.53**	**South Asia**
0	0	na	0	0	na	0	1	na	Afghanistan
4	10	6.34	6	13	10.11	25	46	5.85	Bangladesh
0	0	na	0	0	na	0	0	na	Bhutan
17	33	1.00	14	26	0.58	271	567	3.07	India
0	0	na	0	0	na	0	1	na	Maldives
1	3	na	4	5	17.30	10	17	6.01	Nepal
0	1	na	2	11	1.65	71	146	7.92	Pakistan
0	1	na	1	2	na	6	5	2.89	Sri Lanka
57	**96**	**0.48**	**71**	**117**	**0.45**	**442**	**793**	**0.68**	**Southeast Asia**
0	0	na	0	1	na	0	0	na	Brunei Darussalam
0	1	na	0	0	na	2	2	na	Cambodia
10	32	0.22	17	41	0.21	253	520	0.72	China
3	5	na	0	7	na	7	10	0.52	China, Hong Kong SAR
0	0	na	0	1	na	0	0	na	China, Macao SAR
4	5	na	7	7	0.88	8	9	0.15	China, Taiwan Prov.
3	10	2.35	4	16	2.75	9	31	1.16	Indonesia
13	21	0.54	19	18	0.52	70	73	0.37	Japan
0	2	na	1	0	na	2	2	na	Lao PDR
6	5	1.43	2	9	0.84	23	25	0.84	Malaysia

Table F6: Publications on selected research topics relating to SDG 13: Climate action
Volume of output, 2012–2015 and 2016–2019, and specialization index, 2011–2019

	NATIONAL AND URBAN GREENHOUSE GAS EMISSIONS			CARBON CAPTURE AND STORAGE			LOCAL IMPACT OF CLIMATE-RELATED HAZARDS AND DISASTERS		
	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019
Myanmar	0	0	na	0	1	na	1	3	na
Philippines	7	12	5.37	27	39	3.56	11	23	13.85
Korea, DPR	0	1	na	0	1	na	0	0	na
Korea, Rep.	38	53	1.25	359	484	1.46	4	21	0.18
Singapore	8	11	0.66	59	80	1.08	8	12	0.40
Thailand	6	19	2.17	24	56	0.75	9	18	1.42
Timor-Leste	0	0	na	0	0	na	2	0	na
Viet Nam	2	5	na	3	13	0.29	11	26	4.78
Oceania	**57**	**99**	**1.66**	**607**	**673**	**2.09**	**192**	**247**	**4.59**
Australia	46	80	1.49	595	658	2.35	180	213	4.62
New Zealand	13	20	2.81	24	19	0.37	14	32	2.57
Fiji	0	0	na	1	0	na	6	15	73.47
Kiribati	0	0	na	0	0	na	0	1	na
Marshall Islands	0	0	na	0	0	na	0	1	na
Micronesia	0	0	na	0	0	na	2	4	na
Niue	0	0	na	0	0	na	0	1	na
Palau		0	na	0	0	na	0	2	na
Papua New Guinea	0	0	na	0	0	na	1	4	na
Samoa	0	0	na	0	0	na	1	1	na
Solomon Islands	0	0	na	0	0	na	3	5	na
Tonga	0	0	na	0	0	na	0	2	na
Tuvalu	0	0	na	0	0	na	0	0	na
Vanuatu	0	0	na	0	0	na	1	4	na

$SI_{2011–19}$: The specialization index is measured as the proportion of output of a given country on a given topic, divided by the proportion observed at the global level. For example, a country with 2% of its output being on a research topic that represents 1% of all research worldwide would score 2.00, having twice as much output as expected, relative to the global average.

na = the total number of publications is too low to calculate the specialization index

KEY –: *data unavailable* | -n/+n: *data refer to n years before or after reference year* | 0: *magnitude nil or negligible* | na: *not applicable*

GDP: *gross domestic product* | MF: males and females | PPP$: *purchasing power parity dollars*

Note: Publication counts of articles, reviews and conference papers are based on the full-counting method. Therefore, the sum across countries is higher than the global total because of co-authorship. The selected topics in the present table are examples of research topics furthering the SDG agenda. These topics are not necessarily mutually exclusive. The following are excluded from the present table because they did not publish on these topics over the period under study: Angola, Antigua and Barbuda, Belize, Cook Islands, Djibouti, Equatorial Guinea, Eswatini, Grenada, Guinea-Bissau, Liberia, Liechtenstein, Mauritania, Nauru, Sao Tome and Principe, St Kitts and Nevis, St Lucia, St Vincent and the Grenadines, Suriname and Turkmenistan. The total for the People's Republic of China excludes its Special Administrative Regions of Hong Kong and Macao and the Taiwan Province of China.

Source: Prepared by Science-Metrix using Scopus data (Elsevier), including those for social sciences, arts and humanities

NEW TECHNOLOGIES TO PROTECT FROM CLIMATE-RELATED HAZARDS			LOCAL DISASTER RISK REDUCTION STRATEGIES			CLIMATE-READY CROPS			
2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	
2	0	na	0	0	na	0	3	na	Myanmar
8	10	20.08	3	12	18.44	35	71	17.68	Philippines
0	0	na	0	0	na	0	0	na	Korea, DPR
3	9	0.49	8	4	0.31	40	44	0.45	Korea, Rep.
1	1	na	3	2	na	5	8	0.33	Singapore
8	9	2.27	9	3	1.47	20	34	1.69	Thailand
0	0	na	0	0	na	0	1	na	Timor-Leste
3	4	na	6	8	3.97	14	24	2.61	Viet Nam
36	**47**	**2.96**	**61**	**104**	**5.28**	**138**	**250**	**1.74**	**Oceania**
31	42	3.07	54	95	5.45	121	235	1.79	Australia
6	5	2.24	8	10	2.88	14	15	1.17	New Zealand
0	1	na	4	4	na	1	2	na	Fiji
0	0	na	0	1	na	0	0	na	Kiribati
0	0	na	0	0	na	0	0	na	Marshall Islands
0	1	na	0	0	na	0	1	na	Micronesia
0	0	na	0	0	na	0	0	na	Niue
0	0	na	0	0	na	0	0	na	Palau
0	0	na	0	1	na	0	2	na	Papua New Guinea
0	0	na	1	0	na	0	1	na	Samoa
0	0	na	0	0	na	0	0	na	Solomon Islands
0	0	na	0	1	na	0	0	na	Tonga
0	0	na	0	1	na	0	0	na	Tuvalu
0	0	na	2	1	na	2	0	na	Vanuatu

Table F7: Publications on selected research topics relating to SDG 14: Life below water
Volume of output, 2012–2015 and 2016–2019, and specialization index, 2011–2019

	COASTAL EUTROPHICATION			FLOATING PLASTIC DEBRIS IN THE OCEAN			OCEAN ACIDIFICATION		
	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019
World	**4 876**	**6 314**	**1.00**	**379**	**1 948**	**1.00**	**1 535**	**2 070**	**1.00**
North America	**1 320**	**1 714**	**1.04**	**90**	**328**	**0.66**	**660**	**843**	**1.46**
Canada	206	336	1.15	24	79	1.18	87	161	1.19
United States of America	1 173	1 463	1.02	74	268	0.58	599	744	1.50
Latin America	**268**	**414**	**1.11**	**45**	**163**	**1.70**	**73**	**154**	**0.76**
Argentina	32	47	1.24	3	12	1.49	3	8	0.18
Belize	0	0	na	0	0	na	0	1	na
Bolivia	0	2	na	0	0	na	1	0	na
Brazil	144	201	1.00	29	93	1.80	17	59	0.49
Chile	45	51	2.06	11	28	4.04	31	46	4.57
Colombia	6	17	0.44	1	12	1.38	3	3	na
Costa Rica	3	7	3.16	0	6	na	2	2	na
Ecuador	1	9	0.89	0	3	na	0	8	na
El Salvador	0	2	na	0	0	na	0	0	na
Guatemala	0	1	na	0	0	na	1	0	na
Honduras	0	0	na	0	0	na	0	0	na
Mexico	37	67	1.03	0	13	0.49	17	25	0.85
Nicaragua	1	1	na	0	0	na	0	0	na
Panama	3	2	na	0	0	na	3	10	9.38
Paraguay	0	0	na	0	0	na	0	0	na
Peru	1	11	1.57	0	6	na	0	2	na
Suriname	0	0	na	0	0	na	0	0	na
Uruguay	10	20	6.19	3	3	na	1	0	na
Venezuela	0	3	na	0	0	na	1	1	na
Caribbean	**5**	**7**	**0.68**	**1**	**3**	**na**	**1**	**3**	**na**
Bahamas	0	0	na	0	1	na	0	0	na
Barbados	0	1	na	0	0	na	0	2	na
Cuba	4	6	0.69	0	0	na	0	1	na
Dominica	0	0	na	0	0	na	0	0	na
Dominican Rep.	0	0	na	0	0	na	0	0	na
Grenada	0	0	na	1	0	na	0	0	na
Haiti	0	0	na	0	0	na	0	0	na
Jamaica	1	0	na	0	1	na	0	0	na
St Kitts & Nevis	0	0	na	0	0	na	0	0	na
St Lucia	0	0	na	0	0	na	0	0	na
Trinidad & Tobago	0	0	na	0	1	na	1	0	na
European Union	**1 387**	**1 655**	**0.81**	**196**	**1 036**	**1.74**	**730**	**928**	**1.28**
Austria	18	44	0.47	4	20	1.40	3	3	na
Belgium	47	59	0.66	19	29	1.57	30	25	1.20
Bulgaria	6	10	0.87	1	1	na	0	0	na
Croatia	9	8	0.59	2	16	2.12	1	2	na
Cyprus	1	7	na	2	6	na	1	1	na
Czech Rep.	17	27	0.42	1	10	0.33	1	4	na
Denmark	93	141	1.92	8	38	1.77	17	27	0.71
Estonia	12	16	2.33	0	1	na	2	5	na
Finland	66	77	1.75	0	19	1.43	11	29	0.86
France	204	232	0.76	30	127	1.28	123	171	1.12
Germany	205	260	0.49	38	183	1.42	250	284	1.83
Greece	51	44	1.30	9	31	2.09	11	17	0.72
Hungary	19	9	0.64	0	2	na	1	0	na
Ireland	49	52	1.76	10	34	3.57	10	11	0.51
Italy	140	211	0.69	31	183	2.28	77	130	0.99
Latvia	1	2	na	0	0	na	0	0	na
Lithuania	15	11	2.13	1	0	na	0	0	na
Luxembourg	1	2	na	0	0	na	0	0	na
Malta	1	1	na	1	4	na	0	1	na

SUSTAINABLY MANAGE MARINE TOURISM			SUSTAINABLY MANAGE FISHERIES AND AQUACULTURE			ECOSYSTEM-BASED APPROACHES IN MARINE ENVIRONMENTS			
2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	
644	**1 123**	**1.00**	**16 278**	**19 154**	**1.00**	**671**	**709**	**1.00**	**World**
203	**349**	**1.19**	**3 122**	**3 040**	**0.66**	**217**	**175**	**1.02**	**North America**
64	109	2.32	767	771	1.19	50	36	1.37	Canada
155	285	1.03	2 498	2 410	0.59	179	151	0.98	United States of America
73	**115**	**2.11**	**2 037**	**2 473**	**2.76**	**60**	**111**	**2.22**	**Latin America**
11	6	2.34	100	100	1.08	6	3	0.94	Argentina
1	3	na	1	0	na	4	3	na	Belize
0	0	na	2	1	na	0	0	na	Bolivia
24	44	1.46	992	1 299	2.46	20	68	1.95	Brazil
10	18	4.41	419	449	7.29	11	12	3.46	Chile
4	9	1.30	63	78	1.32	4	12	2.08	Colombia
2	1	na	18	24	4.61	4	1	na	Costa Rica
2	7	6.72	22	61	2.73	2	3	na	Ecuador
0	0	na	2	1	na	0	0	na	El Salvador
0	0	na	4	1	na	1	0	na	Guatemala
0	1	na	2	3	na	0	0	na	Honduras
21	33	3.33	465	534	3.72	11	15	2.14	Mexico
0	0	na	3	1	na	0	0	na	Nicaragua
2	1	na	2	7	1.20	1	0	na	Panama
0	0	na	1	1	na	0	0	na	Paraguay
0	4	na	32	48	3.12	2	5	na	Peru
0	0	na	1	0	na	1	0	na	Suriname
2	2	na	11	17	1.07	6	0	na	Uruguay
0	1	na	23	21	2.01	2	1	na	Venezuela
7	**12**	**6.66**	**50**	**48**	**1.78**	**8**	**8**	**7.52**	**Caribbean**
1	3	na	1	0	na	0	0	na	Bahamas
1	4	na	0	0	na	3	2	na	Barbados
1	4	na	30	32	1.90	2	2	na	Cuba
0	0	na	1	0	na	0	0	na	Dominica
0	0	na	1	0	na	0	0	na	Dominican Rep.
0	0	na	2	9	3.04	0	0	na	Grenada
0	0	na	1	0	na	0	0	na	Haiti
0	1	na	2	0	na	1	1	na	Jamaica
0	0	na	7	3	14.05	0	0	na	St Kitts & Nevis
0	0	na	0	0	na	0	1	na	St Lucia
4	1	na	6	4	1.66	2	3	na	Trinidad & Tobago
258	**401**	**1.12**	**4 639**	**5 015**	**0.84**	**350**	**348**	**1.58**	**European Union**
6	6	0.56	74	78	0.43	1	7	na	Austria
5	5	0.50	210	239	0.97	14	18	1.71	Belgium
1	4	na	25	37	1.06	5	2	na	Bulgaria
7	11	4.64	77	72	1.82	8	3	3.88	Croatia
1	4	na	7	12	0.60	0	1	na	Cyprus
2	8	0.69	114	187	0.97	0	1	na	Czech Rep.
13	9	0.87	310	358	1.76	13	17	1.56	Denmark
5	5	4.96	12	16	0.53	1	7	na	Estonia
8	14	1.55	87	112	0.81	8	11	1.23	Finland
26	45	0.65	648	660	0.75	60	57	1.47	France
43	43	0.54	426	572	0.35	24	51	0.54	Germany
8	28	2.43	203	169	1.55	26	21	4.30	Greece
2	0	na	66	67	0.91	0	0	na	Hungary
3	11	1.37	129	117	1.34	4	15	2.57	Ireland
31	76	1.47	503	606	0.76	58	64	1.92	Italy
1	3	na	4	12	0.60	2	5	na	Latvia
2	4	na	9	17	0.40	6	6	3.55	Lithuania
0	0	na	4	1	na	0	0	na	Luxembourg
0	6	na	6	9	1.14	1	3	na	Malta

Table F7: Publications on selected research topics relating to SDG 14: Life below water
Volume of output, 2012–2015 and 2016–2019, and specialization index, 2011–2019

	COASTAL EUTROPHICATION			FLOATING PLASTIC DEBRIS IN THE OCEAN			OCEAN ACIDIFICATION		
	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019
Netherlands	151	155	1.13	25	122	2.55	57	63	0.84
Poland	88	119	1.09	1	22	0.57	7	15	0.19
Portugal	82	88	1.70	17	87	5.03	34	84	3.28
Romania	10	14	0.35	3	6	na	1	1	na
Slovakia	5	7	0.38	0	1	na	0	0	na
Slovenia	4	15	0.52	3	20	4.18	2	2	na
Spain	210	210	1.06	24	135	1.96	88	105	1.17
Sweden	114	114	1.25	6	40	1.38	83	95	2.32
United Kingdom	196	278	0.53	52	242	2.07	278	294	2.16
Southeast Europe	**15**	**15**	**0.81**	**1**	**6**	**na**	**0**	**0**	**na**
Albania	0	0	na	0	1	na	0	0	na
Bosnia & Herzegovina	0	0	na	0	1	na	0	0	na
Montenegro	1	3	na	0	6	na	0	0	na
North Macedonia	1	2	na	1	0	na	0	0	na
Serbia	15	10	0.88	0	1	na	0	0	na
European Free Trade Assoc.	**114**	**92**	**0.70**	**14**	**71**	**1.18**	**114**	**168**	**1.94**
Iceland	2	2	na	1	1	na	4	7	2.62
Norway	79	53	1.39	8	51	2.31	92	124	4.54
Switzerland	34	40	0.37	6	19	0.65	21	40	0.66
Other Europe & West Asia	**124**	**209**	**0.37**	**3**	**75**	**0.36**	**32**	**45**	**0.15**
Armenia	0	0	na	0	0	na	0	0	na
Azerbaijan	0	0	na	0	0	na	0	0	na
Belarus	0	3	na	0	0	na	0	0	na
Georgia	0	0	na	0	0	na	0	0	na
Iran Islamic Rep.	37	50	0.40	0	22	0.39	0	1	na
Israel	25	21	0.60	0	11	0.52	25	27	1.27
Moldova, Rep.	0	1	na	0	0	na	0	0	na
Russian Federation	35	77	0.31	0	15	0.17	3	11	0.09
Turkey	25	48	0.41	3	27	0.75	4	6	0.09
Ukraine	3	13	0.28	0	0	na	0	0	na
Sub-Saharan Africa	**59**	**92**	**0.83**	**12**	**47**	**1.72**	**8**	**16**	**0.19**
Angola	0	0	na	0	0	na	0	0	na
Benin	0	0	na	0	0	na	0	0	na
Botswana	0	2	na	0	0	na	0	1	na
Burkina Faso	2	1	na	0	0	na	0	0	na
Burundi	0	0	na	0	0	na	0	0	na
Cameroon	0	1	na	0	0	na	0	1	na
Cabo Verde	0	1	na	1	0	na	0	0	na
Comoros	1	0	na	0	0	na	0	0	na
Congo	0	0	na	0	0	na	0	0	na
Côte d'Ivoire	3	7	4.32	0	1	na	0	1	na
Congo, Dem. Rep.	0	1	na	0	0	na	0	0	na
Eritrea	0	0	na	0	0	na	0	0	na
Ethiopia	2	8	0.96	0	0	na	0	0	na
Gabon	1	0	na	0	0	na	0	0	na
Gambia	0	1	na	0	0	na	0	0	na
Guinea	0	0	na	0	0	na	0	0	na
Guinea-Bissau	0	0	na	0	0	na	0	0	na
Kenya	4	5	na	0	3	na	1	3	na
Liberia	0	0	na	0	1	na	0	0	na
Madagascar	0	0	na	0	0	na	0	0	na
Malawi	0	0	na	0	1	na	0	0	na
Mali	0	0	na	0	0	na	0	0	na
Mauritius	2	1	na	0	1	na	0	0	na
Mozambique	0	1	na	0	0	na	0	0	na
Namibia	0	1	na	0	0	na	1	0	na

SUSTAINABLY MANAGE MARINE TOURISM			SUSTAINABLY MANAGE FISHERIES AND AQUACULTURE			ECOSYSTEM-BASED APPROACHES IN MARINE ENVIRONMENTS			
2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	
15	17	0.65	246	311	0.64	23	29	1.45	Netherlands
5	9	0.34	225	208	0.74	6	9	0.30	Poland
31	41	4.28	318	432	2.36	34	50	6.22	Portugal
2	2	na	43	40	0.53	14	7	2.79	Romania
0	2	na	10	15	0.17	0	0	na	Slovakia
1	0	na	40	31	0.79	0	1	na	Slovenia
48	92	2.30	1 034	1 024	1.80	59	77	2.71	Spain
13	22	1.13	172	207	0.63	21	27	1.98	Sweden
70	117	1.12	809	906	0.67	95	87	1.51	United Kingdom
2	**6**	**0.99**	**44**	**53**	**0.69**	**1**	**1**	**na**	**Southeast Europe**
0	1	na	4	9	2.89	1	0	na	Albania
0	0	na	2	7	0.28	0	0	na	Bosnia & Herzegovina
0	3	na	3	9	1.01	0	1	na	Montenegro
0	0	na	4	5	na	0	0	na	North Macedonia
2	2	na	34	36	0.66	0	0	na	Serbia
23	**41**	**1.37**	**1 117**	**1 185**	**3.25**	**23**	**30**	**0.91**	**European Free Trade Assoc.**
1	3	na	54	65	5.70	0	1	na	Iceland
17	27	3.18	1 024	1 064	9.34	15	19	2.06	Norway
5	11	0.32	84	100	0.24	8	10	0.34	Switzerland
24	**46**	**0.46**	**815**	**963**	**0.63**	**21**	**31**	**0.46**	**Other Europe & West Asia**
0	0	na	3	1	na	0	0	na	Armenia
0	0	na	0	0	na	0	0	na	Azerbaijan
0	0	na	3	4	na	0	0	na	Belarus
0	1	na	2	2	na	4	0	na	Georgia
7	6	0.33	345	418	1.03	4	9	0.46	Iran Islamic Rep.
4	7	0.69	102	131	0.89	4	5	na	Israel
0	0	na	1	1	na	0	0	na	Moldova, Rep.
5	8	0.20	111	148	0.21	3	10	0.21	Russian Federation
8	24	1.13	238	255	0.90	6	8	0.65	Turkey
0	1	na	20	20	0.20	2	1	na	Ukraine
27	**49**	**2.97**	**309**	**439**	**1.45**	**30**	**33**	**2.45**	**Sub-Saharan Africa**
0	0	na	0	1	na	0	0	na	Angola
0	1	na	8	11	3.12	0	0	na	Benin
0	0	na	2	1	na	0	0	na	Botswana
0	0	na	0	8	na	0	0	na	Burkina Faso
0	0	na	1	1	na	0	0	na	Burundi
0	0	na	5	10	0.88	3	0	na	Cameroon
0	1	na	0	1	na	0	0	na	Cabo Verde
0	0	na	1	0	na	0	0	na	Comoros
0	0	na	1	0	na	0	0	na	Congo
0	0	na	4	11	3.95	0	0	na	Côte d'Ivoire
0	0	na	0	4	na	0	0	na	Congo, Dem. Rep.
0	0	na	3	0	na	0	0	na	Eritrea
1	2	na	6	14	0.41	1	0	na	Ethiopia
0	0	na	1	0	na	0	0	na	Gabon
1	1	na	17	31	2.17	1	2	na	Gambia
0	1	na	0	0	na	0	1	na	Guinea
0	0	na	0	0	na	0	2	na	Guinea-Bissau
2	6	na	40	52	3.46	8	3	4.37	Kenya
0	0	na	0	0	na	0	0	na	Liberia
0	1	na	5	7	2.87	0	0	na	Madagascar
0	0	na	10	9	3.03	0	0	na	Malawi
0	0	na	1	2	na	0	0	na	Mali
2	0	na	3	1	na	0	0	na	Mauritius
2	2	na	4	10	1.47	1	2	na	Mozambique
0	1	na	6	5	3.13	0	0	na	Namibia

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	COASTAL EUTROPHICATION			FLOATING PLASTIC DEBRIS IN THE OCEAN			OCEAN ACIDIFICATION		
	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019
Niger	0	0	na	0	0	na	0	0	na
Nigeria	3	2	na	0	12	1.60	0	0	na
Rwanda	1	0	na	0	0	na	0	0	na
Sao Tome & Principe	0	1	na	0	0	na	0	0	na
Senegal	1	0	na	0	0	na	0	0	na
Seychelles	0	0	na	1	0	na	1	1	na
Sierra Leone	0	0	na	0	0	na	0	0	na
Somalia	0	0	na	0	0	na	0	0	na
South Africa	35	55	1.16	10	29	2.60	5	8	0.34
Togo	0	0	na	0	0	na	0	0	na
Uganda	2	3	na	0	0	na	0	0	na
Tanzania	2	4	na	0	3	na	0	1	na
Zambia	1	0	na	0	0	na	0	0	na
Zimbabwe	2	0	na	0	0	na	0	0	na
Arab States	**148**	**174**	**0.95**	**3**	**39**	**0.56**	**26**	**57**	**0.30**
Algeria	7	13	0.78	0	2	na	0	2	na
Bahrain	1	1	na	0	0	na	0	0	na
Egypt	29	37	0.81	0	2	na	3	7	0.20
Iraq	12	10	0.81	0	0	na	0	0	na
Jordan	1	5	na	0	0	na	1	0	na
Kuwait	4	3	na	0	1	na	1	3	na
Lebanon	3	13	1.16	0	3	na	1	4	na
Libya	0	0	na	0	0	na	0	0	na
Mauritania	0	0	na	0	0	na	0	0	na
Morocco	3	10	0.55	0	5	na	1	3	na
Oman	7	6	2.32	0	2	na	3	1	na
Qatar	0	17	1.58	0	4	na	2	2	na
Saudi Arabia	36	33	0.61	2	11	0.83	12	33	0.75
Sudan	0	0	na	0	0	na	0	0	na
Syrian Arab Rep.	1	0	na	0	0	na	0	0	na
Tunisia	37	22	1.67	0	6	na	2	0	na
United Arab Emirates	18	15	2.05	1	3	na	1	5	na
Yemen	1	1	na	0	0	na	0	0	na
Central Asia	**0**	**4**	**na**	**1**	**2**	**na**	**0**	**0**	**na**
Kazakhstan	0	4	na	0	1	na	0	0	na
Kyrgyzstan	0	0	na	0	0	na	0	0	na
Mongolia	0	0	na	1	1	na	0	0	na
Tajikistan	0	0	na	0	0	na	0	0	na
Uzbekistan	0	0	na	0	0	na	0	0	na
South Asia	**112**	**185**	**0.40**	**6**	**45**	**0.31**	**20**	**23**	**0.13**
Bangladesh	7	8	0.33	0	3	na	1	2	na
India	90	151	0.40	5	33	0.29	18	18	0.14
Maldives	0	0	na	0	3	na	0	0	na
Nepal	0	0	na	0	0	na	0	0	na
Pakistan	14	21	0.36	1	2	na	1	2	na
Sri Lanka	1	7	1.12	1	5	na	0	1	na
Southeast Asia	**2 070**	**2 951**	**1.37**	**50**	**479**	**0.67**	**225**	**467**	**0.45**
Brunei Darussalam	2	0	na	0	1	na	2	4	na
Cambodia	0	2	na	0	0	na	0	1	na
China	1 573	2 311	1.72	7	286	0.61	104	280	0.43
China, Hong Kong SAR	34	64	1.09	2	31	2.04	22	37	1.87
China, Macao SAR	5	6	2.03	0	0	na	0	1	na
China, Taiwan Prov.	47	45	0.40	2	9	0.28	20	22	0.36
Indonesia	7	37	0.50	1	41	3.24	3	8	0.18
Japan	201	196	0.57	17	43	0.41	69	97	0.63
Lao PDR	0	0	na	0	0	na	0	0	na

SUSTAINABLY MANAGE MARINE TOURISM			SUSTAINABLY MANAGE FISHERIES AND AQUACULTURE			ECOSYSTEM-BASED APPROACHES IN MARINE ENVIRONMENTS			
2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	
0	0	na	2	0	na	0	0	na	Niger
0	4	na	62	95	1.89	1	0	na	Nigeria
0	0	na	2	1	na	0	0	na	Rwanda
0	0	na	0	0	na	0	0	na	Sao Tome & Principe
0	0	na	4	8	0.79	2	5	na	Senegal
2	1	na	0	1	na	2	1	na	Seychelles
0	0	na	2	1	na	0	0	na	Sierra Leone
0	0	na	0	1	na	0	0	na	Somalia
17	31	4.28	101	117	1.09	12	19	3.19	South Africa
0	1	na	1	0	na	0	0	na	Togo
0	1	na	16	23	1.44	0	0	na	Uganda
2	2	na	17	47	3.29	2	3	na	Tanzania
0	0	na	7	10	2.18	0	0	na	Zambia
0	0	na	2	3	na	0	0	na	Zimbabwe
10	**20**	**0.58**	**358**	**544**	**0.82**	**16**	**22**	**0.82**	**Arab States**
0	4	na	9	21	0.21	1	3	na	Algeria
0	1	na	2	3	na	0	0	na	Bahrain
4	5	0.92	148	326	1.86	9	3	1.41	Egypt
0	0	na	8	26	0.43	0	0	na	Iraq
1	1	na	4	6	0.17	0	0	na	Jordan
0	0	na	11	6	0.90	1	2	na	Kuwait
0	0	na	9	10	0.62	1	1	na	Lebanon
0	0	na	2	2	na	0	0	na	Libya
0	1	na	0	0	na	0	2	na	Mauritania
1	2	na	10	14	0.24	2	4	na	Morocco
0	0	na	13	12	1.00	0	0	na	Oman
0	1	na	10	8	0.23	0	2	na	Qatar
2	4	na	75	91	0.47	2	3	na	Saudi Arabia
0	1	na	2	1	na	0	0	na	Sudan
1	1	na	2	1	na	0	0	na	Syrian Arab Rep.
0	1	na	70	56	1.16	2	4	na	Tunisia
1	2	na	4	10	0.13	0	1	na	United Arab Emirates
1	0	na	2	3	na	0	0	na	Yemen
0	**0**	**na**	**5**	**12**	**0.33**	**0**	**0**	**na**	**Central Asia**
0	0	na	1	7	na	0	0	na	Kazakhstan
0	0	na	1	0	na	0	0	na	Kyrgyzstan
0	0	na	1	2	na	0	0	na	Mongolia
0	0	na	0	2	na	0	0	na	Tajikistan
0	0	na	2	1	na	0	0	na	Uzbekistan
14	**24**	**0.26**	**1 068**	**1 233**	**1.03**	**14**	**17**	**0.28**	**South Asia**
2	6	na	114	165	3.68	2	3	na	Bangladesh
9	9	0.15	850	940	0.98	12	13	0.30	India
1	2	na	2	0	na	0	1	na	Maldives
0	0	na	5	8	0.67	0	0	na	Nepal
1	2	na	87	104	0.93	0	0	na	Pakistan
1	5	na	20	30	1.33	1	0	na	Sri Lanka
69	**221**	**0.46**	**5 156**	**7 625**	**1.06**	**83**	**103**	**0.32**	**Southeast Asia**
2	0	na	8	2	1.14	1	0	na	Brunei Darussalam
0	0	na	7	15	2.31	1	0	na	Cambodia
11	34	0.13	2 817	4 538	1.02	36	38	0.23	China
6	9	1.14	61	95	0.54	0	1	na	China, Hong Kong SAR
0	1	na	0	5	na	0	0	na	China, Macao SAR
14	11	1.06	216	229	0.79	3	4	na	China, Taiwan Prov.
6	101	10.50	115	479	2.50	12	22	2.70	Indonesia
7	18	0.20	742	795	0.76	12	18	0.32	Japan
0	1	na	2	4	na	1	0	na	Lao PDR

Table F7: Publications on selected research topics relating to SDG 14: Life below water
Volume of output, 2012–2015 and 2016–2019, and specialization index, 2011–2019

	COASTAL EUTROPHICATION			FLOATING PLASTIC DEBRIS IN THE OCEAN			OCEAN ACIDIFICATION		
	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019
Malaysia	40	73	0.96	7	23	1.33	3	10	0.23
Myanmar	3	0	na	0	1	na	0	0	na
Philippines	17	19	4.00	1	7	na	3	4	na
Korea, DPR	0	0	na	0	0	na	0	0	na
Korea, Rep.	184	283	1.31	15	45	0.85	12	35	0.34
Singapore	24	55	0.91	1	4	na	5	6	0.11
Thailand	23	29	0.80	1	7	na	3	4	na
Timor-Leste	0	0	na	0	0	na	0	0	na
Viet Nam	12	27	1.12	0	10	0.92	0	1	na
Oceania	**280**	**314**	**1.40**	**40**	**159**	**2.22**	**351**	**443**	**5.74**
Australia	231	264	1.25	36	142	2.30	311	405	5.63
New Zealand	61	67	2.33	8	25	1.63	56	83	6.41
Cook Islands	1	2	na	0	0	na	0	0	na
Fiji	1	1	na	1	0	na	2	1	na
Kiribati	1	0	na	0	0	na	0	0	na
Marshall Islands	0	0	na	0	0	na	0	0	na
Micronesia	0	0	na	0	0	na	0	0	na
Palau	1	0	na	0	0	na	4	4	na
Papua New Guinea	0	0	na	0	0	na	0	1	na
Samoa	0	0	na	0	2	na	0	0	na
Solomon Islands	0	0	na	0	0	na	0	2	na
Tonga	0	1	na	0	0	na	0	0	na
Tuvalu	0	0	na	0	0	na	0	0	na
Vanuatu	0	0	na	0	0	na	0	1	na

$SI_{2011–19}$: The specialization index is measured as the proportion of output of a given country on a given topic, divided by the proportion observed at the global level. For example, a country with 2% of its output being on a research topic that represents 1% of all research worldwide would score 2.00, having twice as much output as expected, relative to the global average.

na = the total number of publications is too low to calculate the specialization index

KEY –: *data unavailable* | -n/+n: *data refer to n years before or after reference year* | 0: *magnitude nil or negligible* | na: *not applicable*

GDP: *gross domestic product* | MF: males and females | PPP$: *purchasing power parity dollars*

Note: Publication counts of articles, reviews and conference papers are based on the full-counting method. Therefore, the sum across countries is higher than the global total because of co-authorship. The selected topics in the present table are examples of research topics furthering the SDG agenda. These topics are not necessarily mutually exclusive. The following are excluded from the present table because they did not publish on these topics over the period under study: Afghanistan, Antigua and Barbuda, Bhutan, Central African Republic, Chad, Djibouti, Equatorial Guinea, Eswatini, Gambia, Guyana, Lesotho, Liechtenstein, Nauru, Niue, Palestine, South Sudan, St Vincent and the Grenadines and Turkmenistan. The total for the People's Republic of China excludes its Special Administrative Regions of Hong Kong and Macao and the Taiwan Province of China.

Source: Prepared by Science-Metrix using Scopus data (Elsevier), including those for social sciences, arts and humanities

SUSTAINABLY MANAGE MARINE TOURISM			SUSTAINABLY MANAGE FISHERIES AND AQUACULTURE			ECOSYSTEM-BASED APPROACHES IN MARINE ENVIRONMENTS			
2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	
13	21	1.65	372	487	2.14	7	4	0.47	Malaysia
0	0	na	2	6	na	0	0	na	Myanmar
3	10	8.25	103	180	9.02	11	4	8.75	Philippines
0	0	na	1	0	na	0	0	na	Korea, DPR
6	11	0.30	430	549	0.85	4	7	0.25	Korea, Rep.
1	4	na	68	84	0.49	2	3	na	Singapore
5	9	1.00	346	426	4.00	7	5	0.99	Thailand
0	0	na	0	1	na	0	0	na	Timor-Leste
2	3	na	208	270	4.42	3	4	na	Viet Nam
122	**173**	**5.17**	**991**	**1 064**	**1.66**	**92**	**96**	**3.43**	**Oceania**
108	160	5.38	830	909	1.57	83	82	3.30	Australia
19	17	3.15	176	190	2.17	8	16	3.90	New Zealand
0	0	na	0	0	na	0	0	na	Cook Islands
1	5	na	11	11	4.54	2	1	na	Fiji
0	0	na	0	0	na	0	0	na	Kiribati
0	0	na	0	1	na	0	0	na	Marshall Islands
0	0	na	2	0	na	1	0	na	Micronesia
0	2	na	0	0	na	1	0	na	Palau
1	2	na	0	5	na	1	0	na	Papua New Guinea
0	0	na	0	0	na	0	0	na	Samoa
0	1	na	2	5	na	0	1	na	Solomon Islands
0	0	na	0	5	na	0	0	na	Tonga
0	0	na	1	0	na na	0	0	na	Tuvalu
1	0	na	0	0	na	0	0	na	Vanuatu

Table F8: Publications on selected research topics relating to SDG 15: Life on land
Volume of output, 2012–2015 and 2016–2019, and specialization index, 2011–2019

	SUSTAINABLE USE OF TERRESTRIAL ECOSYSTEMS			STATUS OF TERRESTRIAL BIODIVERSITY			MINIMIZE POACHING AND TRAFFICKING OF PROTECTED SPECIES			TACKLE INVASIVE ALIEN SPECIES		
	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019
World	**91 137**	**123 204**	**1.00**	**70 888**	**89 396**	**1.00**	**458**	**818**	**1.00**	**11 644**	**14 875**	**1.00**
North America	**29 355**	**35 473**	**1.13**	**24 106**	**28 445**	**1.24**	**151**	**267**	**0.94**	**4 953**	**5 657**	**1.63**
Canada	5 238	6 418	1.35	4 616	5 390	1.56	20	54	1.26	853	982	1.75
United States of America	25 639	31 041	1.10	20 832	24 748	1.19	138	229	0.89	4 371	4 991	1.61
Latin America	**12 670**	**17 738**	**2.78**	**9 567**	**13 327**	**2.77**	**53**	**99**	**2.20**	**1 086**	**1 596**	**1.84**
Argentina	1 477	1 975	3.26	1 260	1 628	3.60	11	13	2.59	279	353	4.67
Belize	15	23	13.93	11	21	16.01	0	0	na	3	1	na
Bolivia	144	153	11.80	97	113	11.02	1	3	na	3	6	2.85
Brazil	6 560	9 280	2.60	4 825	6 942	2.55	24	48	2.06	449	742	1.48
Chile	785	1 168	2.21	667	944	2.43	5	6	2.51	165	197	3.00
Colombia	788	1 356	2.50	608	998	2.47	1	8	na	42	75	1.04
Costa Rica	289	400	8.91	214	286	8.14	2	2	na	14	21	3.62
Ecuador	345	760	5.00	246	520	4.27	2	3	na	34	55	2.88
El Salvador	7	11	3.41	6	6	3.05	0	0	na	1	1	na
Guatemala	51	59	5.44	29	49	5.04	2	1	na	1	4	na
Guyana	12	32	8.83	10	16	6.42	0	0	na	1	0	na
Honduras	30	33	7.18	20	19	5.02	0	1	na	0	4	na
Mexico	2 320	3 136	2.92	1 715	2 334	2.86	6	17	1.41	121	204	1.23
Nicaragua	25	21	5.77	13	13	3.90	0	0	na	1	0	na
Panama	279	354	11.13	227	330	12.35	1	2	na	30	37	9.52
Paraguay	24	58	4.20	12	40	3.32	1	2	na	0	3	na
Peru	283	526	3.59	181	378	3.44	2	10	11.19	6	11	0.55
Suriname	12	21	5.58	7	14	3.92	0	0	na	0	1	na
Uruguay	130	185	2.65	121	162	3.18	1	0	na	25	25	3.44
Venezuela	213	195	2.60	182	161	2.80	1	5	na	26	15	1.80
Caribbean	**195**	**256**	**1.22**	**168**	**218**	**1.32**	**2**	**3**	**na**	**43**	**48**	**2.02**
Antigua & Barbuda	0	2	na	1	3	na	0	0	na	0	1	na
Bahamas	10	19	4.18	8	16	4.63	0	0	na	6	4	13.71
Barbados	7	12	1.90	2	6	0.69	0	0	na	2	1	na
Cuba	102	104	0.86	87	90	0.94	0	2	na	12	23	1.30
Dominica	1	4	na	3	2	na	0	0	na	0	0	na
Dominican Rep.	23	27	4.40	15	23	4.39	0	0	na	4	1	na
Grenada	5	4	na	7	5	0.75	1	1	na	6	0	na
Haiti	7	7	1.36	3	4	na	0	0	na	0	1	na
Jamaica	21	27	1.93	20	19	1.67	1	0	na	4	5	3.32
St Kitts & Nevis	4	9	2.50	3	13	3.68	0	0	na	0	3	na
St Lucia	3	4	na	1	4	na	0	0	na	1	0	na
St Vincent & Grenadines	0	1	na	1	1	na	0	0	na	1	1	na
Trinidad & Tobago	24	48	1.99	25	43	2.54	0	0	na	13	9	2.63
European Union	**34 953**	**44 703**	**1.11**	**28 312**	**34 053**	**1.16**	**198**	**347**	**1.12**	**4 176**	**5 563**	**1.10**
Austria	1 142	1 563	1.05	873	1 156	1.00	6	7	0.58	101	217	0.92
Belgium	1 519	2 003	1.17	1 230	1 593	1.22	3	14	0.74	196	267	1.17
Bulgaria	275	338	1.42	261	271	1.61	0	2	na	56	74	2.65
Croatia	269	404	1.21	229	347	1.28	4	4	na	65	101	2.30
Cyprus	49	115	0.85	34	94	0.70	1	0	na	8	26	0.94
Czech Rep.	1 571	2 022	1.60	1 343	1 745	1.79	1	8	na	270	402	2.07
Denmark	1 176	1 706	0.91	1 068	1 455	1.07	8	14	1.04	115	169	0.67
Estonia	308	395	2.92	304	366	3.83	0	0	na	39	66	2.76
Finland	1 277	1 750	1.82	1 139	1 383	1.95	3	7	0.98	113	169	1.23
France	4 588	5 782	0.88	4 136	5 130	1.08	25	25	0.58	633	861	1.04
Germany	6 520	8 819	0.92	5 296	6 879	0.95	26	54	0.62	657	926	0.72
Greece	624	797	0.88	504	590	0.84	2	2	na	98	151	0.95
Hungary	651	815	1.57	553	706	1.79	1	4	na	95	144	1.88
Ireland	435	601	0.85	342	490	0.90	2	0	na	91	113	1.31
Italy	3 968	5 651	1.03	3 061	4 170	1.02	19	30	0.71	634	919	1.30

USE OF ECOSYSTEM-BASED APPROACHES IN PROTECTED AREAS ON LAND			EXTENT OF WATER-RELATED ECOSYSTEMS			SOCIO-ECOLOGICAL IMPACT OF TERRESTRIAL PROTECTED AREAS			
2012–2015	2016–2019	SI 2011-2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	
523	**614**	**1.00**	**514**	**725**	**1.00**	**2 033**	**2 737**	**1.00**	**World**
249	**221**	**1.65**	**201**	**275**	**1.51**	**791**	**979**	**1.29**	**North America**
94	88	4.96	44	62	2.35	152	171	1.46	Canada
170	157	1.18	168	226	1.39	697	886	1.26	United States of America
40	**63**	**1.57**	**18**	**41**	**0.75**	**229**	**368**	**2.27**	**Latin America**
3	3	na	1	8	na	22	51	2.82	Argentina
0	0	na	0	0	na	1	3	na	Belize
1	1	na	0	0	na	5	5	21.71	Bolivia
18	24	1.16	8	20	0.61	120	174	1.92	Brazil
4	6	2.26	2	4	na	15	30	2.39	Chile
5	6	1.22	2	4	na	18	33	2.29	Colombia
1	1	na	0	1	na	11	6	8.63	Costa Rica
1	2	na	0	0	na	12	26	6.74	Ecuador
0	0	na	0	0	na	0	0	na	El Salvador
0	1	na	0	0	na	3	2	na	Guatemala
0	0	na	0	0	na	1	1	na	Guyana
0	0	na	0	0	na	1	1	na	Honduras
7	16	2.17	5	4	0.77	36	73	2.48	Mexico
0	0	na	0	0	na	1	0	na	Nicaragua
0	1	na	0	0	na	1	5	na	Panama
0	2	na	0	0	na	1	2	na	Paraguay
1	3	na	0	0	na	8	15	3.80	Peru
2	0	na	0	0	na	1	1	na	Suriname
1	1	na	0	0	na	2	7	na	Uruguay
0	2	na	0	0	na	2	5	na	Venezuela
1	**3**	**na**	**0**	**0**	**na**	**4**	**4**	**na**	**Caribbean**
0	0	na	0	0	na	0	0	na	Antigua & Barbuda
0	0	na	0	0	na	0	0	na	Bahamas
0	0	na	0	0	na	0	0	na	Barbados
0	0	na	0	0	na			na	Cuba
0	0	na	0	0	na	0	0	na	Dominica
0	0	na	0	0	na	0	0	na	Dominican Rep.
0	0	na	0	0	na		0	na	Grenada
0	0	na	0	0	na	0	0	na	Haiti
0	1	na	0	0	na			na	Jamaica
0	0	na	0	0	na	0	0	na	St Kitts & Nevis
0	1	na	0	0	na	0	0	na	St Lucia
0	0	na	0	0	na	0	0	na	St Vincent & Grenadines
1	1	na	0	0	na	0	0	na	Trinidad & Tobago
192	**264**	**1.18**	**129**	**154**	**0.66**	**817**	**1 108**	**1.11**	**European Union**
6	8	1.17	7	7	0.84	29	39	0.91	Austria
6	14	1.78	7	8	1.12	24	42	0.77	Belgium
1	3	na	1	1	na	3	7	0.64	Bulgaria
2	0	na	0	2	na	3	11	0.72	Croatia
0	0	na	1	0	na	1	2	na	Cyprus
7	4	1.31	0	2	na	30	36	1.16	Czech Rep.
6	10	0.71	7	5	0.90	39	37	0.84	Denmark
1	3	na	1	1	na	5	6	2.89	Estonia
6	10	1.20	3	3	na	64	61	3.09	Finland
23	37	0.78	17	23	0.65	91	125	0.69	France
21	59	0.81	37	40	0.80	157	222	0.92	Germany
2	7	na	9	5	1.76	26	23	1.36	Greece
0	9	na	7	4	1.76	16	19	1.59	Hungary
1	5	na	1	2	na	6	10	0.46	Ireland
15	24	0.83	13	14	0.42	73	143	0.96	Italy

Table F8: Publications on selected research topics relating to SDG 15: Life on land
Volume of output, 2012–2015 and 2016–2019, and specialization index, 2011–2019

	SUSTAINABLE USE OF TERRESTRIAL ECOSYSTEMS			STATUS OF TERRESTRIAL BIODIVERSITY			MINIMIZE POACHING AND TRAFFICKING OF PROTECTED SPECIES			TACKLE INVASIVE ALIEN SPECIES		
	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019
Latvia	117	232	2.01	94	142	1.54	0	0	na	10	31	1.85
Lithuania	135	242	1.27	110	199	1.45	0	0	na	53	83	3.52
Luxembourg	88	110	0.97	69	77	0.93	1	3	na	6	11	0.48
Malta	14	44	0.89	17	35	0.90	0	1	na	19	13	4.43
Netherlands	2 588	3 296	0.99	1 965	2 310	0.94	18	37	1.65	212	261	0.65
Poland	1 856	2 945	1.25	1 475	2 195	1.25	3	9	0.46	239	430	1.36
Portugal	1 467	2 157	1.54	1 179	1 612	1.48	4	12	0.82	270	368	2.22
Romania	630	835	1.12	387	489	0.78	1	2	na	46	69	0.59
Slovakia	422	641	1.64	331	451	1.57	0	0	na	46	78	1.64
Slovenia	252	400	1.17	197	338	1.20	0	0	na	38	66	1.35
Spain	4 462	6 034	1.34	3 841	4 607	1.43	16	28	0.91	607	841	1.43
Sweden	1 908	2 689	1.20	1 623	2 117	1.31	8	14	0.54	174	211	0.67
United Kingdom	8 036	10 230	1.12	6 606	7 994	1.17	98	192	3.27	801	1 124	0.90
Southeast Europe	**410**	**544**	**1.06**	**308**	**406**	**1.01**	**2**	**3**	**na**	**59**	**99**	**1.28**
Albania	31	33	1.90	29	30	2.28	0	0	na	3	10	2.53
Bosnia & Herzegovina	41	82	0.99	34	56	1.03	0	0	na	3	14	0.98
Montenegro	23	52	1.47	21	49	1.66	0	0	na	8	20	3.61
North Macedonia	47	42	0.66	34	39	0.70	1	0	na	2	7	na
Serbia	327	418	1.07	236	287	0.97	2	3	na	50	63	1.24
European Free Trade Assoc.	**3 428**	**4 545**	**1.23**	**3 021**	**3 763**	**1.39**	**16**	**40**	**1.40**	**431**	**542**	**1.17**
Iceland	90	137	1.58	71	100	1.56	1	1	na	12	15	1.20
Liechtenstein	7	4	0.89	4	5	na	0	0	na	0	1	na
Norway	1 114	1 500	1.25	1 047	1 298	1.58	11	21	2.56	105	148	0.93
Switzerland	2 313	3 063	1.21	1 973	2 486	1.30	5	19	0.86	320	389	1.29
Other Europe & West Asia	**3 184**	**6 562**	**0.53**	**2 935**	**5 074**	**0.57**	**16**	**27**	**0.34**	**468**	**828**	**0.52**
Armenia	22	41	0.57	21	40	0.66	0	0	na	3	4	na
Azerbaijan	10	20	0.28	11	10	0.29	0	0	na	2	3	na
Belarus	26	81	0.47	31	67	0.55	0	0	na	13	23	1.34
Georgia	45	79	1.33	42	64	1.44	1	1	na	9	8	1.28
Iran Islamic Rep.	798	1 400	0.46	510	886	0.38	2	13	0.35	33	52	0.11
Israel	412	582	0.54	417	539	0.73	2	1	na	108	142	1.02
Moldova, Rep.	13	14	0.59	13	9	0.67	0	0	na	1	4	na
Russian Federation	1 118	3 002	0.60	1 251	2 445	0.72	12	8	0.47	180	420	0.70
Turkey	715	1 145	0.50	584	844	0.49	0	3	na	101	143	0.40
Ukraine	150	419	0.46	190	375	0.62	0	1	na	51	85	0.94
Sub-Saharan Africa	**5 119**	**7 537**	**3.60**	**3 637**	**5 096**	**3.24**	**81**	**169**	**11.66**	**569**	**1 003**	**3.95**
Angola	12	23	3.38	10	21	3.88	0	0	na	0	0	na
Benin	92	177	8.05	75	105	6.90	0	2	na	6	18	3.08
Botswana	78	180	6.36	81	151	6.79	1	5	na	1	15	3.03
Burkina Faso	64	127	4.13	53	71	3.27	0	2	na	3	3	na
Burundi	13	15	8.14	9	10	6.25	1	0	na	1	3	na
Cameroon	249	322	3.68	165	214	2.93	0	7	na	7	11	0.90
Cabo Verde	8	5	4.74	5	3	na	0	1	na	0	1	na
Central African Rep.	22	23	5.47	14	9	4.49	0	1	na	2	1	na
Chad	4	13	2.72	2	9	2.77	0	0	na	0	1	na
Comoros	2	8	7.91	2	8	11.39	0	0	na	0	0	na
Congo	57	58	5.60	37	44	5.30	1	1	na	1	3	na
Côte d'Ivoire	85	141	5.16	58	76	3.90	3	4	na	3	4	na
Congo, Dem. Rep.	86	104	5.23	63	82	4.80	1	2	na	2	1	na
Djibouti	1	6	na	1	5	na	0	0	na	1	1	na
Equatorial Guinea	6	7	7.03	5	5	7.75	0	1	na	0	0	na
Eritrea	4	12	4.53	2	3	na	0	0	na	0	0	na
Eswatini	24	29	6.67	26	26	8.85	0	0	na	1	5	na
Ethiopia	342	721	4.82	199	325	3.11	0	2	na	14	20	1.47
Gabon	69	84	7.37	47	65	7.17	0	7	na	4	5	2.87

USE OF ECOSYSTEM-BASED APPROACHES IN PROTECTED AREAS ON LAND			EXTENT OF WATER-RELATED ECOSYSTEMS			SOCIO-ECOLOGICAL IMPACT OF TERRESTRIAL PROTECTED AREAS			
2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	
1	0	na	0	0	na	2	2	na	Latvia
1	2	na	0	0	na	2	10	1.10	Lithuania
0	0	na	1	2	na	0	2	na	Luxembourg
0	0	na	0	1	na	0	0	na	Malta
24	22	1.65	15	15	0.78	62	86	0.98	Netherlands
1	11	0.24	6	2	na	39	51	0.98	Poland
10	17	1.77	1	4	na	57	78	2.54	Portugal
5	3	na	5	4	1.67	23	20	1.62	Romania
2	4	na	1	2	na	10	20	2.09	Slovakia
0	3	na	2	1	na	8	13	1.49	Slovenia
24	43	1.47	13	7	0.43	105	158	1.37	Spain
20	37	3.22	7	9	0.76	36	50	1.02	Sweden
67	65	1.59	18	25	0.44	256	334	1.27	United Kingdom
0	**2**	**na**	**1**	**4**	**na**	**4**	**20**	**1.12**	**Southeast Europe**
0	0	na	0	0	na	0	1	na	Albania
0	0	na	0	0	na	1	3	na	Bosnia & Herzegovina
0	0	na	0	0	na	0	1	na	Montenegro
0	0	na	0	0	na	0	2	na	North Macedonia
0	2	na	1	4	na	3	18	1.32	Serbia
26	**28**	**1.74**	**12**	**15**	**0.50**	**73**	**115**	**1.09**	**European Free Trade Assoc.**
1	2	na	0	0	na	1	2	na	Iceland
0	0	na	0	0	na	0	0	na	Liechtenstein
13	18	3.13	3	2	na	30	40	1.36	Norway
13	8	1.00	10	13	0.67	44	79	0.96	Switzerland
20	**19**	**0.41**	**26**	**28**	**0.50**	**47**	**117**	**0.33**	**Other Europe & West Asia**
0	0	na	0	0	na	0	5	na	Armenia
0	0	na	0	0	na	0	2	na	Azerbaijan
0	0	na	0	0	na	1	0	na	Belarus
0	0	na	1	1	na	1	5	na	Georgia
5	1	na	11	11	0.84	14	39	0.43	Iran Islamic Rep.
5	4	1.34	1	1	na	11	18	0.77	Israel
0	0	na	0	0	na	0	0	na	Moldova, Rep.
8	7	0.37	10	10	0.33	10	35	0.22	Russian Federation
2	7	0.49	3	6	na	9	14	0.25	Turkey
0	1	na	0	0	na	3	8	0.27	Ukraine
25	**34**	**3.41**	**16**	**26**	**2.75**	**200**	**291**	**6.15**	**Sub-Saharan Africa**
0	0	na	0	0	na	0	3	na	Angola
1	0	na	1	0	na	2	7	17.63	Benin
0	0	na	0	1	na	5	21	19.33	Botswana
0	1	na	0	1	na	1	5	na	Burkina Faso
0	0	na	0	0	na	0	0	na	Burundi
1	1	na	0	0	na	2	14	4.44	Cameroon
0	0	na	0	0	na	0	0	na	Cabo Verde
0	1	na	0	0	na	0	0	na	Central African Rep.
0	0	na	0	0	na	0	1	na	Chad
0	0	na	0	0	na	2	0	na	Comoros
0	0	na	0	0	na	2	4	na	Congo
0	0	na	0	0	na	1	6	na	Côte d'Ivoire
0	1	na	0	0	na	2	5	na	Congo, Dem. Rep.
0	0	na	0	0	na	0	0	na	Djibouti
0	0	na	0	0	na	1	0	na	Equatorial Guinea
0	0	na	0	1	na	0	0	na	Eritrea
1	0	na	0	0	na	0	0	na	Eswatini
0	1	na	1	1	na	4	17	3.87	Ethiopia
0	0	na	0	0	na	1	3	na	Gabon

Table F8: Publications on selected research topics relating to SDG 15: Life on land
Volume of output, 2012–2015 and 2016–2019, and specialization index, 2011–2019

	SUSTAINABLE USE OF TERRESTRIAL ECOSYSTEMS			STATUS OF TERRESTRIAL BIODIVERSITY			MINIMIZE POACHING AND TRAFFICKING OF PROTECTED SPECIES			TACKLE INVASIVE ALIEN SPECIES		
	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019
Gambia	4	5	0.59	5	7	0.84	0	2	na	0	0	na
Ghana	160	316	3.28	84	179	2.19	2	9	11.63	3	18	0.82
Guinea	10	18	3.21	7	23	4.80	0	1	na	0	0	na
Guinea-Bissau	6	7	2.84	5	8	3.65	0	3	na	0	1	na
Kenya	624	857	6.61	402	559	5.55	15	28	40.11	30	71	3.48
Lesotho	2	7	2.80	0	5	na	0	0	na	1	2	na
Liberia	6	14	2.35	7	15	3.89	0	0	na	0	0	na
Madagascar	227	254	16.72	156	179	15.08	2	4	na	7	25	7.79
Malawi	49	67	2.55	25	25	1.21	0	0	na	1	1	na
Mali	32	59	3.25	19	21	1.66	0	0	na	2	4	na
Mauritius	37	43	3.11	25	29	2.70	0	0	na	14	14	8.93
Mozambique	35	105	4.23	25	60	3.30	1	1	na	2	3	na
Namibia	88	130	8.41	78	105	10.23	1	1	na	1	6	na
Niger	32	41	5.61	16	20	2.66	0	0	na	1	6	na
Nigeria	264	506	1.19	166	298	0.90	3	8	1.34	5	32	0.32
Rwanda	38	85	4.81	26	38	3.16	1	2	na	3	6	3.03
Sao Tome & Principe	2	4	na	2	3	na	0	0	na	0	1	na
Senegal	65	89	1.74	60	74	2.03	0	3	na	6	18	2.21
Seychelles	17	15	8.84	15	14	12.19	1	2	na	5	7	36.75
Sierra Leone	12	18	3.08	11	14	2.71	0	1	na	0	0	na
Somalia	0	1	na	0	2	na	0	0	na	0	0	na
South Africa	2 214	3 243	3.49	1 752	2 504	3.50	35	81	10.45	451	775	6.75
South Sudan	3	3	na	1	1	na	0	0	na	0	0	na
Togo	26	55	4.71	18	32	3.32	0	6	na	0	1	na
Uganda	229	259	3.79	146	155	2.85	4	8	13.75	9	13	1.52
Tanzania	316	422	6.13	216	269	5.53	13	12	43.11	10	20	2.06
Zambia	71	126	5.21	59	82	5.01	4	1	na	1	6	na
Zimbabwe	177	252	9.09	108	188	8.67	6	9	56.18	6	23	5.65
Arab States	**1 303**	**2 265**	**0.53**	**914**	**1 491**	**0.46**	**4**	**16**	**0.38**	**143**	**238**	**0.38**
Algeria	166	296	0.81	105	221	0.74	0	3	na	8	19	0.30
Bahrain	9	17	0.61	4	5	0.29	0	0	na	0	2	na
Egypt	239	437	0.38	173	316	0.34	1	1	na	34	58	0.40
Iraq	35	151	0.47	15	82	0.32	0	0	na	9	9	0.37
Jordan	82	126	0.73	48	57	0.46	0	2	na	7	7	0.27
Kuwait	27	47	0.50	12	17	0.21	0	1	na	3	1	na
Lebanon	38	88	0.50	25	52	0.34	0	1	na	18	17	0.71
Libya	11	27	0.46	11	20	0.62	0	0	na	4	7	1.51
Mauritania	6	9	2.27	5	11	3.87	0	2	na	0	0	na
Morocco	162	289	0.69	115	193	0.55	2	2	na	6	13	0.15
Oman	42	73	0.83	31	51	0.80	0	0	na	2	7	na
Palestine	15	28	1.07	5	17	0.67	0	0	na	0	0	na
Qatar	39	82	0.57	31	44	0.39	0	0	na	3	5	na
Saudi Arabia	246	406	0.34	209	301	0.35	1	2	na	29	61	0.31
Sudan	25	42	0.87	21	26	0.83	0	0	na	2	6	na
Syrian Arab Rep.	32	17	0.91	14	11	0.65	0	0	na	4	9	2.76
Tunisia	207	246	0.63	170	204	0.71	0	1	na	34	41	0.69
United Arab Emirates	100	192	0.67	53	106	0.40	0	2	na	3	10	0.21
Yemen	10	12	0.52	6	8	0.44	0	0	na	1	2	na
Central Asia	**165**	**352**	**1.27**	**126**	**222**	**1.11**	**3**	**5**	**na**	**12**	**22**	**0.51**
Kazakhstan	38	150	0.92	32	91	0.76	0	2	na	7	7	0.38
Kyrgyzstan	15	32	2.03	11	21	1.92	0	1	na	0	2	na
Mongolia	85	130	5.77	62	76	4.98	1	2	na	4	6	1.68
Tajikistan	7	13	1.15	6	12	1.55	2	1	na	0	3	na
Turkmenistan	3	1	na	2	3	na	0	0	na	0	0	na
Uzbekistan	21	39	0.74	15	24	0.62	0	0	na	1	6	na

USE OF ECOSYSTEM-BASED APPROACHES IN PROTECTED AREAS ON LAND			EXTENT OF WATER-RELATED ECOSYSTEMS			SOCIO-ECOLOGICAL IMPACT OF TERRESTRIAL PROTECTED AREAS			
2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	
0	0	na	0	0	na	1	0	na	Gambia
2	1	na	2	1	na	9	11	4.84	Ghana
0	0	na	0	0	na	1	3	na	Guinea
0	0	na	0	0	na	0	0	na	Guinea-Bissau
6	2	na	1	6	na	19	29	8.03	Kenya
0	0	na	0	0	na	0	1	na	Lesotho
0	0	na	0	0	na	1	3	na	Liberia
0	0	na	0	0	na	12	14	32.09	Madagascar
0	0	na	1	0	na	1	3	na	Malawi
0	0	na	0	1	na	0	0	na	Mali
0	0	na	1	0	na	1	2	na	Mauritius
0	1	na	0	0	na	1	5	na	Mozambique
0	0	na	0	0	na	5	10	19.23	Namibia
0	1	na	0	0	na	1	4	na	Niger
0	0	na	1	4	na	5	7	0.67	Nigeria
0	0	na	0	0	na	2	3	na	Rwanda
0	0	na	0	0	na	0	0	na	Sao Tome & Principe
1	1	na	0	0	na	1	6	na	Senegal
0	0	na	0	0	na	1	0	na	Seychelles
0	0	na	0	0	na	0	4	na	Sierra Leone
0	0	na	0	0	na	0	0	na	Somalia
12	20	4.66	9	10	3.22	96	132	7.08	South Africa
0	0	na	0	0	na	0	0	na	South Sudan
0	Ø	na	0	0	na	1	0	na	Togo
0	3	na	0	1	na	9	17	6.56	Uganda
2	1	na	0	0	na	27	18	16.29	Tanzania
0	0	na	0	1	na	4	9	15.40	Zambia
0	1	na	1	1	na	6	18	18.88	Zimbabwe
6	**6**	**0.24**	**6**	**11**	**0.46**	**15**	**38**	**0.25**	**Arab States**
1	0	na	0	2	na	3	3	na	Algeria
1	0	na	0	1	na	0	1	na	Bahrain
3	1	na	1	3	na	2	5	na	Egypt
0	0	na	2	2	na	0	6	na	Iraq
0	1	na	0	0	na	2	2	na	Jordan
0	0	na	0	0	na	0	0	na	Kuwait
0	0	na	1	1	na	1	4	na	Lebanon
0	0	na	0	0	na	0	1	na	Libya
0	0	na	0	0	na	0	1	na	Mauritania
0	3	na	0	0	na	3	8	0.25	Morocco
0	0	na	0	1	na	0	1	na	Oman
0	0	na	0	1	na	0	0	na	Palestine
0	1	na	0	0	na	1	0	na	Qatar
4	2	na	1	2	na	3	1	na	Saudi Arabia
0	0	na	1	0	na	1	1	na	Sudan
0	0	na	0	0	na	0	0	na	Syrian Arab Rep.
1	0	na	0	1	na	1	6	na	Tunisia
1	0	na	0	0	na	2	4	0.68	United Arab Emirates
0	0	na	0	0	na	0	0	na	Yemen
0	**2**	**na**	**1**	**2**	**na**	**4**	**10**	**1.46**	**Central Asia**
0	1	na	0	0	na	1	2	na	Kazakhstan
0	0	na	0	1	na	0	0	na	Kyrgyzstan
0	1	na	0	0	na	2	8	13.36	Mongolia
0	0	na	0	0	na	0	0	na	Tajikistan
0	0	na	0	0	na	0	0	na	Turkmenistan
0	0	na	1	1	na	1	1	na	Uzbekistan

Table F8: Publications on selected research topics relating to SDG 15: Life on land
Volume of output, 2012–2015 and 2016–2019, and specialization index, 2011–2019

	SUSTAINABLE USE OF TERRESTRIAL ECOSYSTEMS			STATUS OF TERRESTRIAL BIODIVERSITY			MINIMIZE POACHING AND TRAFFICKING OF PROTECTED SPECIES			TACKLE INVASIVE ALIEN SPECIES		
	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019
South Asia	**4 094**	**6 735**	**0.77**	**2 776**	**4 033**	**0.64**	**29**	**82**	**1.23**	**191**	**371**	**0.28**
Afghanistan	3	11	1.09	4	5	1.16	1	1	na	0	0	na
Bangladesh	238	349	1.43	120	214	0.98	2	4	na	3	17	0.29
Bhutan	22	72	12.56	15	51	14.10	0	2	na	0	3	na
India	3 159	5 094	0.71	2 170	3 036	0.59	21	61	1.15	151	273	0.26
Maldives	3	8	5.55	1	3	na	0	0	na	0	0	na
Nepal	234	427	5.25	125	210	3.41	3	9	21.72	9	27	2.60
Pakistan	398	676	0.85	314	446	0.84	2	5	na	18	47	0.27
Sri Lanka	123	254	2.34	84	160	1.89	0	2	na	14	19	1.74
Southeast Asia	**15 190**	**27 849**	**0.55**	**10 117**	**17 174**	**0.46**	**70**	**184**	**0.43**	**1 345**	**2 208**	**0.35**
Brunei Darussalam	35	63	1.88	24	49	1.92	0	0	na	3	6	na
Cambodia	64	128	6.55	42	85	5.51	2	7	na	0	6	na
China	8 995	17 152	0.56	5 935	10 610	0.46	20	46	0.21	856	1 463	0.37
China, Hong Kong SAR	257	521	0.45	165	330	0.36	7	16	2.12	21	44	0.28
China, Macao SAR	26	29	0.39	18	14	0.26	0	0	na	0	1	na
China, Taiwan Prov.	569	727	0.33	396	461	0.27	3	6	na	59	54	0.21
Indonesia	791	2 949	2.47	382	1 276	1.33	11	45	4.73	29	73	0.47
Japan	2 249	2 812	0.36	1 788	2 239	0.40	8	21	0.15	282	366	0.39
Lao PDR	106	123	11.42	56	67	7.59	1	2	na	2	3	na
Malaysia	1 050	1 668	1.06	595	930	0.73	16	31	2.31	33	51	0.24
Myanmar	34	134	5.37	26	112	5.92	0	5	na	1	3	na
Philippines	267	448	3.02	175	294	2.69	4	5	na	19	31	1.98
Korea, DPR	5	2	na	2	1	na	0	0	na	0	0	na
Korea, Rep.	834	1 322	0.28	618	937	0.27	2	3	na	74	131	0.20
Singapore	332	619	0.45	242	419	0.39	5	12	1.13	37	45	0.32
Thailand	582	909	1.05	389	598	0.88	4	13	1.48	24	46	0.32
Timor-Leste	5	9	5.56	1	3	na	0	0	na	0	1	na
Viet Nam	302	625	1.30	152	369	0.97	1	17	3.75	6	35	0.31
Oceania	**7 843**	**9 529**	**2.28**	**6 201**	**7 215**	**2.33**	**46**	**91**	**2.45**	**1 353**	**1 672**	**3.32**
Australia	6 607	8 154	2.20	5 148	6 120	2.22	39	85	2.53	1 043	1 287	2.84
New Zealand	1 464	1 676	2.78	1 269	1 347	3.04	9	12	1.98	386	501	6.52
Cook Islands	3	1	na	2	1	na	0	0	na	0	1	na
Fiji	36	60	3.78	28	39	3.42	0	0	na	9	10	6.36
Kiribati	1	1	na	1	1	na	0	0	na	0	0	na
Marshall Islands	1	2	na	1	0	na	0	0	na	0	1	na
Micronesia	6	4	6.42	3	1	na	0	0	na	0	0	na
Niue	1	0	na	0	0	na	0	0	na	0	0	na
Palau	6	5	6.85	2	2	na	0	0	na	0	2	na
Papua New Guinea	46	68	5.93	30	68	5.65	0	0	na	3	5	na
Samoa	6	4	3.65	4	2	na	0	0	na	3	2	na
Solomon Islands	10	17	6.71	7	8	4.90	0	0	na	3	3	na
Tonga	0	2	na	0	0	na	0	0	na	0	0	na
Tuvalu	0	1	na	0	0	na	0	0	na	0	1	na
Vanuatu	6	5	4.47	3	2	na	0	0	na	0	0	na

$SI_{2011–19}$: The specialization index is measured as the proportion of output of a given country on a given topic, divided by the proportion observed at the global level. For example, a country with 2% of its output being on a research topic that represents 1% of all research worldwide would score 2.00, having twice as much output as expected, relative to the global average.

na = the total number of publications is too low to calculate the specialization index

KEY –: *data unavailable* | -n/+n: *data refer to n years before or after reference year* | 0: *magnitude nil or negligible* | na: *not applicable*

GDP: *gross domestic product* | MF: males and females | PPP$: *purchasing power parity dollars*

USE OF ECOSYSTEM-BASED APPROACHES IN PROTECTED AREAS ON LAND			EXTENT OF WATER-RELATED ECOSYSTEMS			SOCIO-ECOLOGICAL IMPACT OF TERRESTRIAL PROTECTED AREAS			
2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	2012–2015	2016–2019	SI 2011–2019	
12	**18**	**0.39**	**26**	**49**	**0.77**	**98**	**163**	**0.67**	**South Asia**
0	0	na	0	0	na	0	0	na	Afghanistan
2	1	na	2	2	na	3	10	1.13	Bangladesh
0	1	na	0	0	na	4	8	53.21	Bhutan
9	16	0.36	20	39	0.71	75	103	0.56	India
0	0	na	0	0	na	3	0	na	Maldives
1	2	na	3	3	na	11	38	17.09	Nepal
0	0	na	2	5	na	7	9	0.54	Pakistan
1	0	na	2	0	na	1	4	na	Sri Lanka
77	**106**	**0.42**	**176**	**282**	**1.09**	**282**	**486**	**0.40**	**Southeast Asia**
1	0	na	0	0	na	0	4	na	Brunei Darussalam
1	0	na	1	1	na	2	5	na	Cambodia
47	58	0.41	143	210	1.39	167	248	0.37	China
0	0	na	2	1	na	5	13	0.46	China, Hong Kong SAR
0	0	na	0	0	na	0	0	na	China, Macao SAR
1	2	na	2	2	na	6	12	0.19	China, Taiwan Prov.
5	14	2.40	2	23	2.86	28	80	2.71	Indonesia
14	18	0.50	5	12	0.25	38	51	0.25	Japan
1	0	na	1	0	na	0	4	na	Lao PDR
2	6	na	8	12	1.85	24	33	0.85	Malaysia
1	0	na	0	0	na	4	4	na	Myanmar
1	1	na	2	6	na	4	9	1.58	Philippines
0	0	na	0	0	na	0	0	na	Korea, DPR
5	3	na	5	9	0.37	11	18	0.15	Korea, Rep.
0	3	na	3	4	na	9	20	0.46	Singapore
2	3	na	4	2	na	12	22	0.98	Thailand
0	0	na	0	0	na	0	0	na	Timor-Leste
0	2	na	1	12	2.69	4	19	1.05	Viet Nam
35	**52**	**1.94**	**30**	**38**	**1.67**	**295**	**349**	**3.71**	**Oceania**
29	45	1.73	28	36	1.80	267	326	3.93	Australia
8	7	2.60	2	5	na	33	27	2.17	New Zealand
0	0	na	0	0	na	0	0	na	Cook Islands
2	1	na	0	0	na	2	2	na	Fiji
0	0	na	0	0	na	0	0	na	Kiribati
0	0	na	0	0	na	0	0	na	Marshall Islands
0	0	na	0	0	na	0	0	na	Micronesia
0	0	na	0	0	na	0	0	na	Niue
0	0	na	0	0	na	0	0	na	Palau
0	0	na	0	0	na	1	0	na	Papua New Guinea
2	0	na	0	0	na	0	0	na	Samoa
0	0	na	0	0	na	3	0	na	Solomon Islands
0	0	na	0	0	na	0	0	na	Tonga
0	0	na	0	0	na	0	0	na	Tuvalu
0	0	na	0	0	na	0	0	na	Vanuatu

Note: Publication counts of articles, reviews and conference papers are based on the full-counting method. Therefore, the sum across countries is higher than the global total because of co-authorship. The selected topics in the present table are examples of research topics furthering the SDG agenda. These topics are not necessarily mutually exclusive. Nauru was excluded from this table because no Nauruan researchers published on these topics in the period under study. The total for the People's Republic of China excludes its Special Administrative Regions of Hong Kong and Macao and the Taiwan Province of China.

Source: Prepared by Science-Metrix using Scopus data (Elsevier), including those for social sciences, arts and humanities

UNESCO SCIENCE REPORT

The race against time for smarter development

It is striking how development priorities have aligned over the past five years. Countries of all income levels are prioritizing their transition to digital and 'green' economies, in parallel. This dual transition reflects a double imperative. On the one hand, the clock is ticking for countries to reach their Sustainable Development Goals by 2030. On the other, countries are convinced that their future economic competitiveness will depend upon how quickly they transition to digital societies. The UNESCO Science Report's subtitle, 'the race against time for smarter development', is an allusion to these twin priorities.

This seventh edition of the report monitors the development path that countries have been following over the past five years from the perspective of science governance. It documents the rapid societal transformation under way, which offers new opportunities for social and economic experimentation but also risks exacerbating social inequalities, unless safeguards are put in place.

The report concludes that countries will need to invest more in research and innovation, if they are to succeed in their dual digital and green transition. More than 30 countries have already raised their research spending since 2014, in line with their commitment to the Sustainable Development Goals. Despite this progress, eight out of ten countries still devote less than 1% of GDP to research, perpetuating their dependence on foreign technologies.

Since the private sector will need to drive much of this dual green and digital transition, governments have been striving to make it easier for the private sector to innovate through novel policy instruments such as digital innovation hubs where companies can 'test before they invest' in digital technologies. Some governments are also seeking to improve the status of researchers through pay rises and other means. The global researcher population has surged since 2014.

The Covid-19 pandemic has energized knowledge production systems. This dynamic builds on the trend towards greater international scientific collaboration, which bodes well for tackling this and other global challenges such as climate change and biodiversity loss. However, sustainability science is not yet mainstream in academic publishing, according to a new UNESCO study, even though countries are investing more than before in green technologies.

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