MAKING A SUSTAINABLE DIFFERENCE

Mapping research output to Sustainable Development Goals

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EXECUTIVE SUMMARY

From promoting health and well-being to tackling climate change, the Sustainable Development Goals (SDGs), set by the United Nations in 2015, provides a blueprint for achieving a better and more sustainable future for all, and requires collaborative efforts. As science and technology have a lot to contribute to achieving these complex goals, the Chinese Academy of Sciences (CAS), as with many other prestigious research institutions, is advancing scientific discoveries to offer solutions.

Analysis of scientific publications from 2008 to 2018, as tracked in Digital Science's Dimensions database, highlights how CAS's research output is aligned with the SDGs. Here are some key findings:

- Out of CAS's nearly 320,000 journal publications from 2008 to 2018, nearly 15,800 are identified as relevant to SDGs, highlighting the important role played by scientific research in achieving them. And among the 11 world's leading institutions studied, CAS has the most SDG-related papers.

- Climate action (goal 13), clean energy (goal 7), good health (goal 3), sustainable cities (goal 11), and life on land (goal 15) stand out as the top five SDGs supported by CAS's research output. Specifically, more than 9,100 articles contribute to climate action, and nearly 7,600 are relevant to clean energy.

- CAS's SDG contribution has grown from fewer than 400 in 2008 to more than 3,000 in 2018, at a compound annual growth rate (CAGR) of 23%, the highest among the 11 peer institutions. Research output associated with responsible consumption and production (goal 12) has the fastest growth among CAS's top 10 SDGs, and publications relevant to its top four goals all grow strongly, with CAGRs of 22% or more.

- Compared with its peer institutions, CAS has the highest research output for six (6, 7, 11, 12, 13, 15) of the 17 goals, and its lead is most pronounced for climate action and clean energy. But CAS is relatively low the ranks in research output relevant to good health, though it's the third-highest SDG.

- Most of CAS's SDG-relevant research output can be categorized into the fields of engineering, chemical, biological, Earth, or environmental sciences, which, except the latter are also fields where CAS has produced most research.

- CAS's primary strengths in chemical sciences and engineering translate to strong contributions to a variety of SDGs, and in particular, account for a large research output relevant to clean energy.

Measuring research contribution to SDGs is not easy. Reviewing CAS's SDG-relevant output helps highlight areas where CAS can grow its research output to better address some SDGs, particularly the social-science oriented ones, and how it can better leverage its research strengths to contribute to more SDGs. As scientific publications are just one aspect, it is also important to drive research innovations that are more transferrable to solutions that support sustainable development.

ADDRESSING GRAND CHALLENGES WITH SCIENCE

SDGs need to be addressed by collaborative efforts, where science and technology play a vital role. Here is an attempt to assess how CAS's research output has contributed.

UN's Sustainable Development Goals focus on the global challenges that humanity faces, highlighting the importance of protecting the planet.

The Sustainable Development Goals (SDGs), outlined in the 2030 Agenda for Sustainable Development by the United Nations (UN), offer a roadmap for a better world. The 17 SDGs aim to eliminate hunger, promote health and well-being, ensure access to clean water and energy, address needs for quality education and equality, tackle climate change, and protect life on land and in the oceans. They address humanity's challenges, and are a universal call to protect the planet and improve lives.

The complexity of the SDGs means that many of the goals need to be addressed through social, political and financial changes. Science and technology are vital to this process, according to the 2016 Global Sustainable Development Report[1]. Advances in nanotechnology could help improve battery storage or water filtration; developments in Earth sciences could inform natural resource policy; and breakthroughs in medicine could impact healthcare. Addressing the SDGs therefore requires interdisciplinary research: collaboration among natural and social scientists, policymakers, and industry leaders. To support this process, the UN established a Technology Facilitation Mechanism, of which the Chinese Academy of Sciences (CAS) is part, to improve sharing of information, experience, best practice and policy advice[2].

In 2016, China released a national plan to help implementation of the SDGs[3], and CAS, the country's leading research institution, is in support of this. An example is a report, Big Earth Data in Support of the Sustainable Development Goals, published by CAS in 2019. In its preface, Chunli Bai, then president of CAS, spoke of his ambition that the project can "provide new analytical tools and data infrastructures for understanding complex and interconnected sustainability issues"[4]. The report was updated in 2020, releasing new findings from the Big Earth Data Science Engineering programme.

The questions then are, how has CAS's research contributed to addressing the SDGs? In which SDGs is it strongest and weakest? And how does CAS compare with other leading research institutions in SDG-related research? This report examines these questions using publication data from the Dimensions database, for 2008 to 2018, to align CAS's research output with the 17 SDGs. It also explores case studies to highlight how CAS's research contributes to developing solutions to some of the most pressing global challenges.

Measuring contribution to SDGs is not easy. Research publications are just one aspect, and may not directly translate into solutions. But reviewing CAS's output in this way can help guide future research, leading to more innovations that support sustainable development. ■

References

1. https://sustainabledevelopment.un.org/content/documents/10789Chapter3_GSDR2016.pdf
2. https://sustainabledevelopment.un.org/tfm
3. http://sdg.iisd.org/news/china-releases-national-implementation-plan-on-2030-agenda/?rdr=sd.iisd.org
4. https://www.fmprc.gov.cn/mfa_eng/topics_665678/2030kcxfzyc/P020190924800116340503.pdf

HOW CAS'S RESEARCH OUTPUT SUPPORTS SDGS

Scientific research has a big role to play in achieving the SDGs, and for the world's leading institutions, including CAS, there are a growing number of publications that address areas associated with these goals.

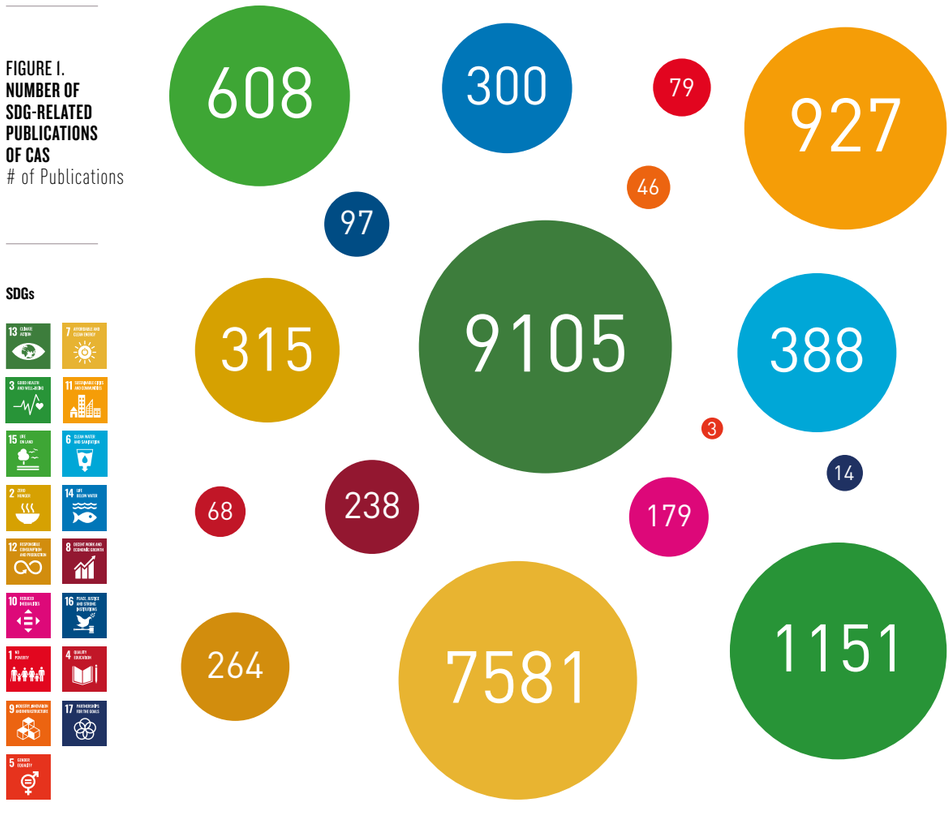
Bibliometric analysis can be used to help assess how research output supports SDGs

From 2008 to 2018, as tracked in Digital Science's Dimensions database, CAS published nearly 320,000 science-related journal papers. Using an algorithm to match article topics and abstracts to descriptions of the 17 SDGs, we identified just under 15,800 papers to be relevant to the goals. Given the interdisciplinary nature of research required for each SDG, each of these papers can contribute to more than one goal.

CAS's SDG contribution has grown over these 10 years. In 2008, there were fewer than 400 relevant papers. By 2018 that had risen to more than 3,000, at a compound annual growth rate (CAGR) of 23%, more than double the rate of growth of CAS's overall research output of 11%. What's more, although primarily a science and engineering-focused research institution, CAS has contributed at least one paper to all 17 goals, speaking to the breadth of its research base. There are 10 goals that have at least 200 relevant publications where these subjects have clearer scientific underpinnings.

Climate action (goal 13), affordable and clean energy (goal 7), good health and well-being (goal 3), sustainable cities and communities (goal 11), and life on land (goal 15) are the top SDGs supported by CAS's output (Figure 1). Goals 13 and 7 dominate: more than 9,100 articles (58%) contribute to climate action; clean energy has nearly 7,600 articles, accounting for 48% of CAS's SDG-relevant papers.

FIGURE I.
NUMBER OF SDG-RELATED PUBLICATIONS OF CAS
# of Publications



HOW CAS'S RESEARCH OUTPUT SUPPORTS SDGS

The high concentration of articles on climate change and clean energy may indicate some top-down influences, in line with China's stated national strategies. CAS has launched several key projects on these topics, such as the Big Earth Data Science Engineering Programme (CASEarth), the Climate Change: Carbon Budget and Relevant Issues project, and the Transformational Technologies for Clean Energy and Demonstration project, all under its Strategic Priority Research Programme (Priority Programme).

Among the top 10 SDGs, output is growing fastest in responsible consumption and production (goal 12) and decent work and economic growth (goal 8), which both have a CAGR of around 30% — albeit starting from a low base. Publications relevant to the top four goals (13, 7, 3, 11) are also growing strongly, with CAGRs of at least 22% (Figure 2).

FIGURE 2.
YEAR-BY-YEAR GROWTH OF SDG-RELATED PUBLICATIONS BY CAS, 2008-2018

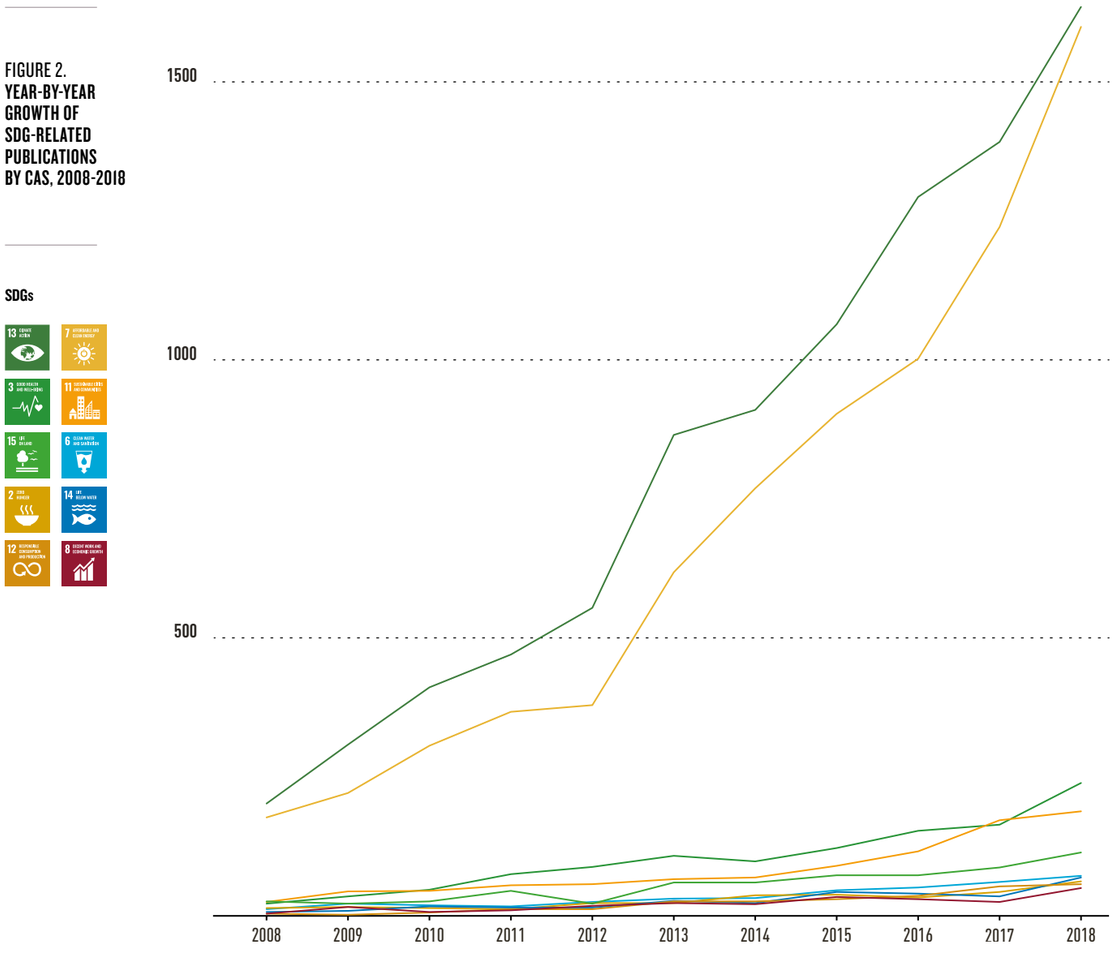
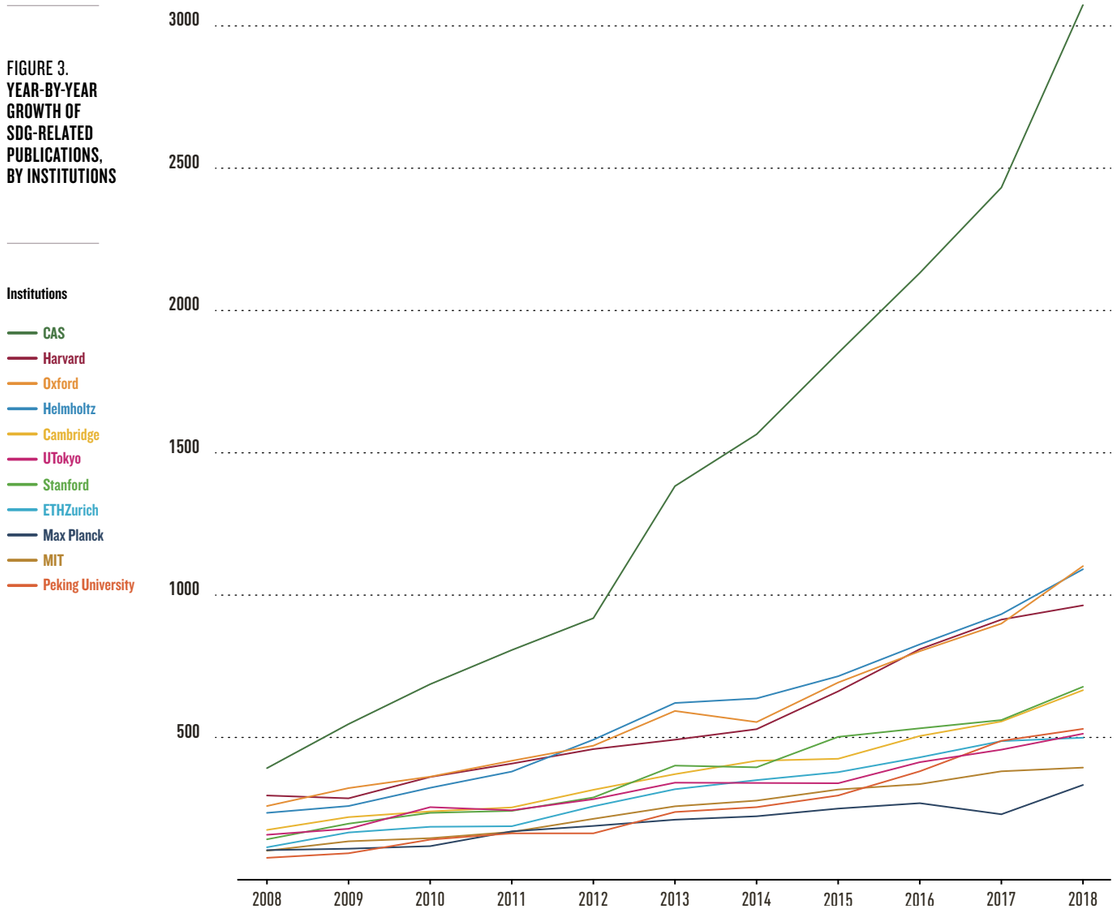


FIGURE 3.
YEAR-BY-YEAR GROWTH OF SDG-RELATED PUBLICATIONS, BY INSTITUTIONS



A GLOBAL COMPARISON

This report compares CAS's SDG-related output with that of 10 other leading research institutions for 2008 to 2018. As the institution with the largest volume of research output overall, it is no surprise that CAS also has the most SDG-related papers, having published more than second-placed Helmholtz Association, in Germany, and third-placed University of Oxford, in the United Kingdom, combined.

Consistent with its rapid growth in total research output, CAS also has the highest growth rate of SDG-related publications over this 10-year period (Figure 3). Peking University is the only other institution with a CAGR above 20%; the others range from 12 to 17%. Like CAS, most institutions have higher growth rates for SDG-related publications than for their overall research output. While this might be partly due to the lower base value for the former, it also suggests the growing attention to the roles of science in supporting the SDGs at these leading research institutions.

HOW CAS'S RESEARCH OUTPUT SUPPORTS SDGS

As a proportion of total research output, however, CAS is further down the group. Its SDG-related papers account for barely 5% of its total output, placing it eighth, ahead of only Peking University, the University of Tokyo, and Germany's Max Planck Group. By contrast, ETH Zurich in Switzerland has the smallest overall volume of research output, but tops the list in terms of the percentage of SDG-related papers at more than 7%. These data suggest that there is more that CAS can do to better align its research with the SDGs to make a greater impact, given the large volume of its output.

Looking at specific SDGs, CAS has the highest research output for six of the 17 goals, namely clean water and sanitation (goal 6), clean energy (goal 7), sustainable cities (goal 11), responsible consumption and production (goal 12), climate action (goal 13), and life on land (goal 15). This lead is most pronounced for goals 13 and 7, more than doubling the output of second-placed Helmholtz Association. In terms of the proportion out of the total SDG-related papers for an institution, ETH Zurich and Helmholtz Association present similar patterns with CAS, also demonstrating focus on climate action and clean energy (Figure 4).

This leaves 11 goals where CAS lags behind some, or all, of its peer group. One of these is good health (goal 3), which is actually CAS's third-largest SDG. Here it is outstripped by Harvard, Oxford, and Stanford; these are also the top three institutions in this group for output in medical and health-related research, which helps explain their advantage in this goal.

Nevertheless, CAS is catching up. For overall life science and medical research, CAS's CAGR is 13%, whereas its SDG-related research on good health has a CAGR of 27%. This health-related focus is in line with the national strategy to improve health, as outlined in the Healthy China 2030 plan[1]. Health challenges have never been as great as in 2020, with the COVID-19 pandemic, and CAS has been a major player in this regard.

In general, there is strong concordance among the universities in terms of the spread of SDG-related research (Figure 5). The primarily science-related goals, such as good health (goal 3), clean energy (goal 7), and climate action (goal 13), tend to have a lot of papers from each institution. Goals that are more social, political or industrial, such as gender equality (goal 5), decent work and economic growth (goal 8), no poverty (goal 1), and partnerships for the goals (goal 17), have very little output from most institutions. This may also reflect the nature of the data used for the analysis, which focuses on scientific bibliometrics.

FIGURE 4.
PROPORTION OUT OF TOTAL SDG PAPERS FOR SELECTED SDGS, BY INSTITUTIONS

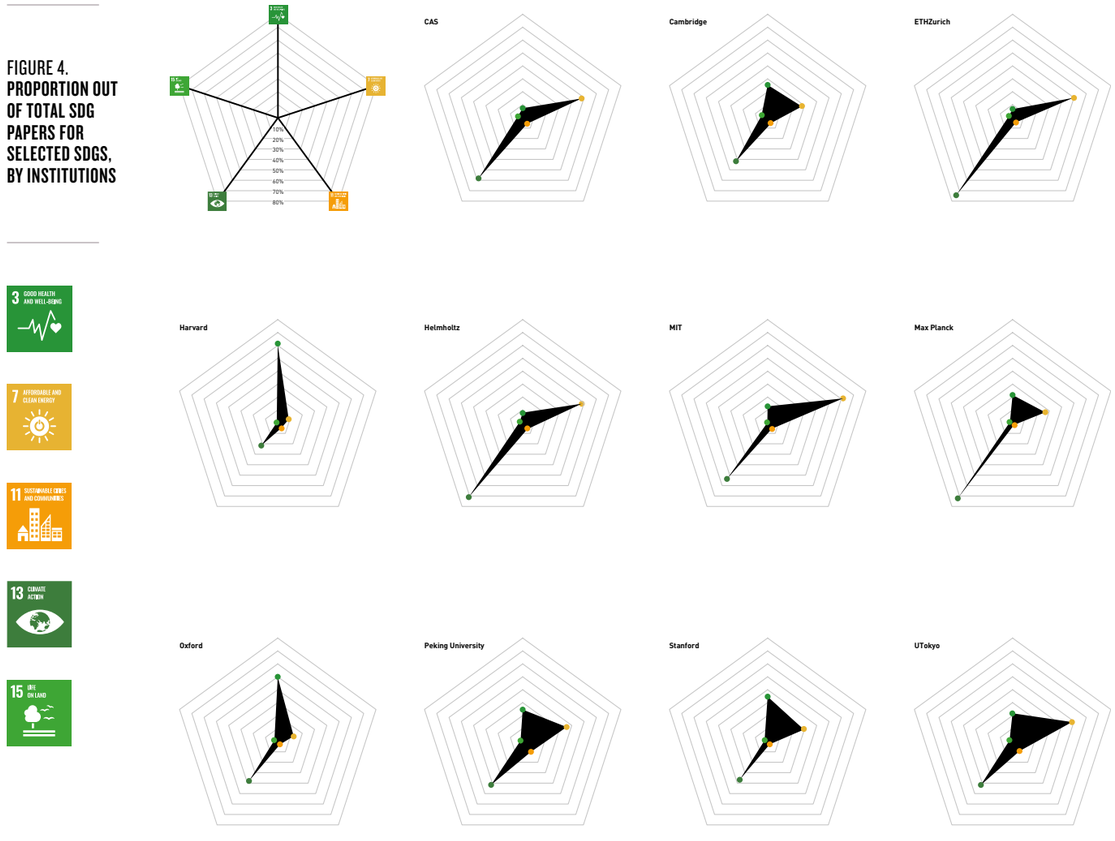


FIGURE 5.
HEAT MAP OF SDG-RELATED PUBLICATIONS, BY INSTITUTIONS

% out of the total SDG publications by each institution

0-5% | 5-10% | 10-15% | 15-20% | 20-30% | 30-40% | 40-50% | >50%

Goal	CAS	Cambridge	ETHZurich	Harvard University	Helmholtz	MIT	Max Plank	Oxford	PekingU	Stanford	UTokyo
1	79	69	19	154	16	10	4	184	32	49	43
2	315	133	119	398	86	32	43	333	64	156	129
3	1151	1051	222	3757	519	350	477	3231	695	1447	766
4	69	144	22	344	55	85	39	201	94	256	110
5	3	93	12	149	9	10	15	151	28	100	36
6	388	29	79	105	158	33	28	90	46	92	64
7	7575	1158	1665	553	3135	1678	589	841	1012	1231	1705
8	239	184	53	268	52	86	35	365	141	182	148
9	46	32	35	31	54	39	5	30	19	28	15
10	179	344	60	645	52	59	67	688	261	300	144
11	927	208	154	301	391	153	42	190	292	117	327
12	263	76	100	32	135	60	39	72	35	59	73
13	9185	1732	2509	1342	4628	1463	1593	2455	1177	1535	1469
14	300	95	44	25	502	42	59	110	30	282	127
15	610	208	104	50	158	7	48	176	49	105	87
16	97	640	104	1052	53	69	69	977	95	394	142
17	14	16	4	23	7	8	0	16	8	15	16

There are a couple of exceptions, however, that almost certainly reflect the contribution of specialized social science and humanities centres within institutions. For instance, University of Oxford is the only institution to have sizeable proportion of its output contributing to goal 1: no poverty, and the Oxford Poverty and Human Development Initiative[2], an economic research and policy centre housed within its Department of International Development may have played an important role here. Oxford, along with Harvard, Cambridge and Stanford has also published hundreds of papers (Harvard more than 1,000) for goal 16: peace, justice and strong institutions. In contrast, for both goals 1 and 16, CAS has published fewer than 100 papers.

CAS is primarily a science and engineering research institution that does not have the same focus on social sciences and humanities programmes as a comprehensive university does. But, given the growing global importance of interdisciplinary research that melds the social, natural and applied sciences, enhancing its expertise in these fields might help CAS better address global challenges like the SDGs with its research.

CONNECTING SDGS TO RESEARCH FIELDS

As might be expected, CAS's strongest SDGs are largely aligned with its overall research strengths. Most of its SDG-related research falls into the fields of engineering, or chemical, biological, Earth, and environmental sciences (Figure 6). With the exception of the latter, these are also CAS's top overall research fields. The main outlier is physical science, which makes a relatively small contribution to the SDGs, yet is CAS's fourth-largest subject. This suggests the opportunity for CAS to better leverage its physical science strength to contribute to SDGs, including the clean energy goal, for instance.

CAS's primary strengths in chemical sciences and engineering translate to strong contributions to many SDGs. For instance, chemical sciences accounts for 34% of CAS's clean energy (goal 7) papers, and also contributes to 11 other SDGs. Engineering, as an applied subject, contributes to 15 SDGs, most notably providing 45% to goal 7. It is also the largest contributor to four other SDGs, including sustainable cities (goal 11), responsible consumption (goal 12), industry, innovation and infrastructure (goal 9), and quality education (goal 4). This result reflects the global pattern, where the majority of clean energy papers can be categorized in engineering or chemical sciences.

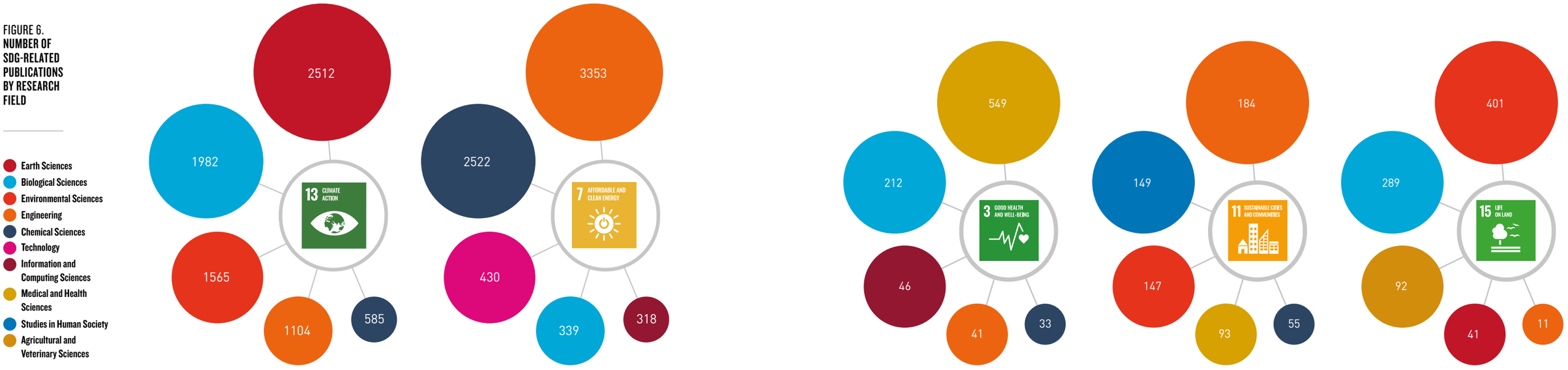
Engineering and chemistry make more modest contributions to CAS's other top SDG of climate action (goal 13) though. Here more than half of papers are in Earth and biological sciences. Indeed, compared with their share of CAS's overall output, both biological and environmental sciences make outsized contributions to all SDG-related output. This suggests there is untapped potential for CAS to leverage its strengths in chemical, engineering and physical sciences to address various SDGs. Growth opportunities in biological and environmental sciences research will also pay dividends in terms of accelerated SDG output.

Connecting SDGs with research fields highlights the multidisciplinary nature of both the SDGs and CAS's research. For the goal on climate action, for example, Earth science papers unsurprisingly make up the largest share (28%) followed by biological sciences papers (22%) and environmental sciences (17%). But there are also 12% of climate action papers that can be categorized as engineering. In total, CAS's climate action and clean energy output each includes papers from 20 research fields, which also speaks to the strength of CAS to mobilize its multidisciplinary research forces to work on these goals.

References

1. http://english.www.gov.cn/policies/latest_releases/2016/10/25/content_281475475062678.htm
2. https://ophi.org.uk/

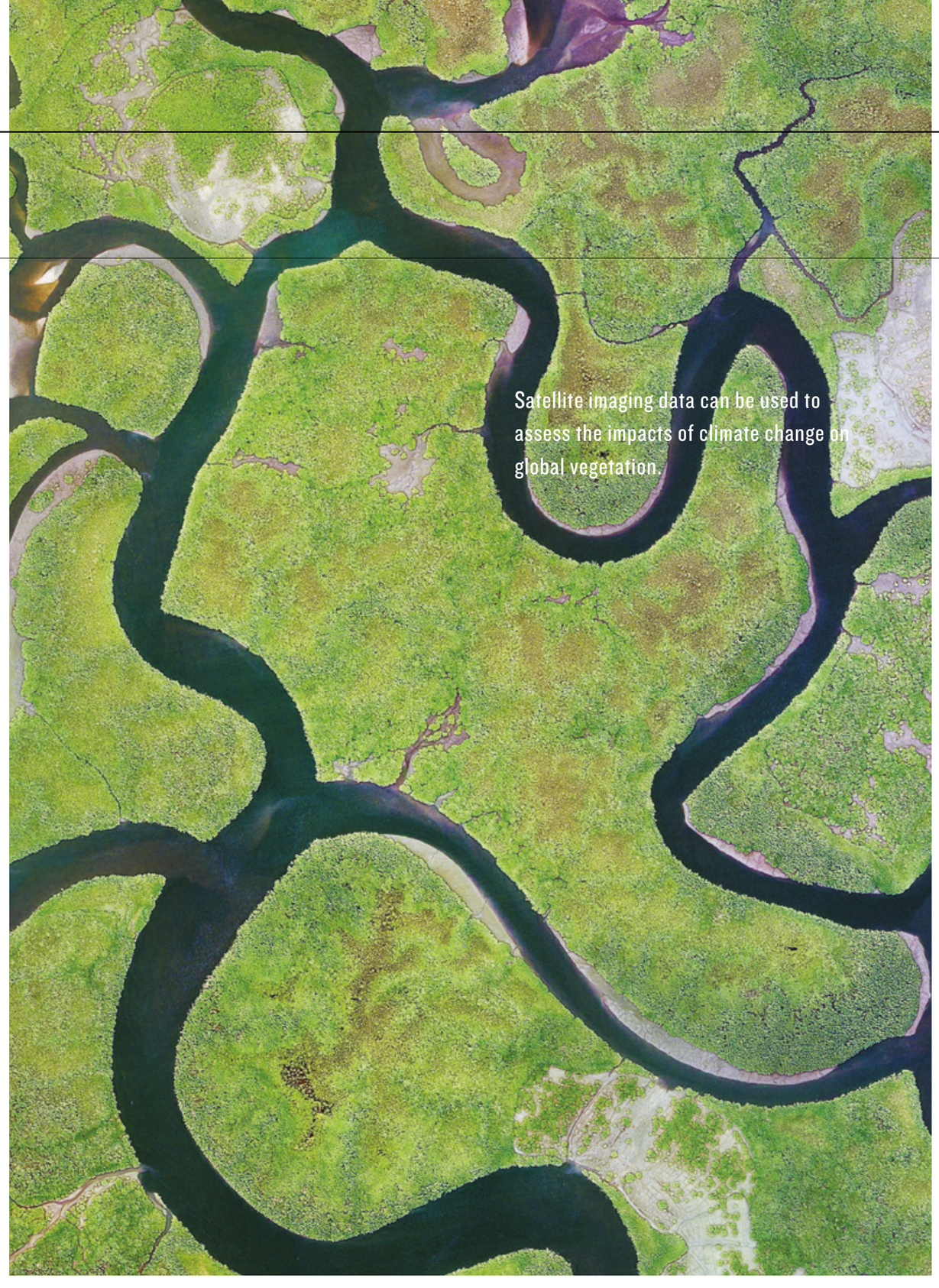
FIGURE 6.
NUMBER OF SDG-RELATED PUBLICATIONS BY RESEARCH FIELD



CASE STUDIES FOR A QUALITATIVE REVIEW OF CAS'S SUPPORT TO SDGS

Many research projects are being conducted at CAS to address climate change, clean energy and good health challenges. Some of them bring potential solutions.

Bibliometric data offer top-line figures about how much of CAS's research contributes to SDGs. A qualitative analysis allows a closer look at specific examples. Here are some of CAS's high-impact publications, as determined by the Altmetric score (which measures the online news and social media coverage of each paper), as well as major research projects that contribute to its top three SDGs: climate action, clean energy, and good health.



Satellite imaging data can be used to assess the impacts of climate change on global vegetation.

CLIMATE CHANGE: MAKING THE CASE FOR EARTH

Climate action is CAS's highest profile SDG. Not only does it account for more than half of CAS's SDG-related output (2008 to 2018), but it is also associated with the highest Altmetric scores. Of all the SDG-related content of CAS, the paper with the highest Altmetric score, of 2428, was published in *Nature Climate Change* in 2016, and examines how terrestrial plants are responding to the changing environment[1].

Led by researchers from CAS's Institute of Tibetan Plateau Research, and part-funded by CAS's Priority Programme, the study used satellite records and ecosystem models to discover how global vegetation changed from 1982 to 2009. The researchers found a persistent and widespread greening across 25% to 50% of vegetated lands. They suggested that carbon dioxide fertilization explained 70% of this greening effect, by driving up the rate of photosynthesis and stimulating plant growth. The second contributing factor is the deposition of nitrogen as nitrate in forests, which can stimulate plant growth.

The study, an international effort, used global data sources to untangle the planet-wide impacts of climate change, and highlighted the demand for this type of comprehensive dataset. To better support studies like this, CAS initiated the CASEarth programme in 2018, which includes a portal for sharing data concerning the whole-Earth system.

"In monitoring our achievement of the SDGs, our biggest challenge arises from the lack of data," says Huadong Guo, a CAS member who leads the CASEarth programme. "Big data are important resources for addressing SDGs, and particularly, big data about the Earth play a key role in driving the development of the Earth Sciences."

Guo explains that CASEarth is not simply about data sharing; it also involves development of an integrated Big Earth Data platform, bringing together environmental, ecosystem, and biological data as well as data mining tools. It will help evaluate climate-change interventions, and facilitate cross-disciplinary, global collaboration. CASEarth

Technologies that can better harvest solar power offer renewable energy solutions, and are studied at CAS.

also provides tools for monitoring and evaluating performance on other SDGs, including zero hunger, clean water, sustainable cities, and life below water and on land, which also require large-scale, long-term data.

In 2020, CASEarth reported that China's extreme heat waves have become more frequent and more severe since the 1990s.[2] In addition, the changing climate may cause earlier maturation of crops in China, potentially decreasing yields.

CAS has another Priority Programme directly related to climate action, which focuses on carbon budget and relevant issues. Results of the project were published as a special feature in *PNAS* in 2018[3], offering a systematic review of the structure and functional characteristics of China's land ecosystem, its responses to climate change and human activities, and its carbon sequestration capabilities. One paper described the role played by forest ecosystems in China, which it calculated as storing 80% of the atmospheric carbon dioxide. Another provided national-scale evidence, demonstrating the effects of human intervention, such as forest protection, on improving carbon sequestration capabilities. These findings from China provide an important perspective for evaluating progresses on achieving the climate action goal.

Other notable high-scoring Altmetric papers involve CAS researchers as part of international teams. These include investigation of how terrestrial ecosystems have changed under climate change[4], and the effects of warming on soil carbon losses[5]. After all, climate change is a global issue, and large-scale international studies yield big results, and greater societal attention. Meanwhile, as highlighted by the CASEarth programme, data infrastructure is a lasting commitment for climate action, as well as other SDGs.

ENERGIZING RESEARCH

Developing affordable and clean energy technologies is CAS's second largest SDG-related output. Research in this area also helps feed the overall rising demand for new sources of energy, given China's rapid economic development, which makes the country the world's largest energy producer and consumer.

As a testament to the importance of energy in China, CAS has several Priority Programmes in this area, many of which make the most of its expertise in the chemical sciences. These include projects to make more efficient and cleaner use of traditional coal resources, regulate energy conversion to enhance its efficiency, and explore nuclear fission energy.

One such programme, which is on energy chemistry, focuses on the chemical processes underlying techniques such as high-efficiency combustion, catalysis, and photo-catalysis for solar energy. The aim is to better manipulate and regulate energy transfer processes at the molecular and atomic levels[6]. An experimental device based on the tuneable extreme ultraviolet coherent light source is already installed at CAS's Dalian Institute of Chemical Physics, with funding from the National Natural Science Foundation of China. The device can reveal details of combustion reaction products, helping researchers to better understand energy chemistry processes. The project has also developed surface photochemistry devices and femtosecond time-resolved probing systems to study photosynthesis processes and improve energy conversion from the Sun.

Solar energy is the subject of another intriguing project led by Zhonglin Wang, director of CAS's Beijing Institute of Nanoenergy and Nanosystems, who is also a professor at Georgia Institute of Technology. Wang's team has developed a novel fabric that can generate electricity from the Sun and from mechanical movement at the same time[7]. This micro-cable power textile is woven with tiny solar cells made from polymer fibres to harvest sunlight, and fibre-based triboelectric nanogenerators to turn motion into electricity. The fabric is very thin, lightweight and foldable, making it a potential portable power source for wearable electronics or cell phones. The study, published in *Nature Energy*, attracted an Altmetric score of 491, one of the highest for CAS's clean energy-related papers.

CAS researchers have developed many other energy technologies as results from projects funded by its Priority Programmes, from water splitting for hydrogen generation and efficient coal combustion, to new fuel cell stacks and nuclear power system design, although not all have garnered global media coverage. Some of these may not have been published in leading international journals, but have already been used in industry.

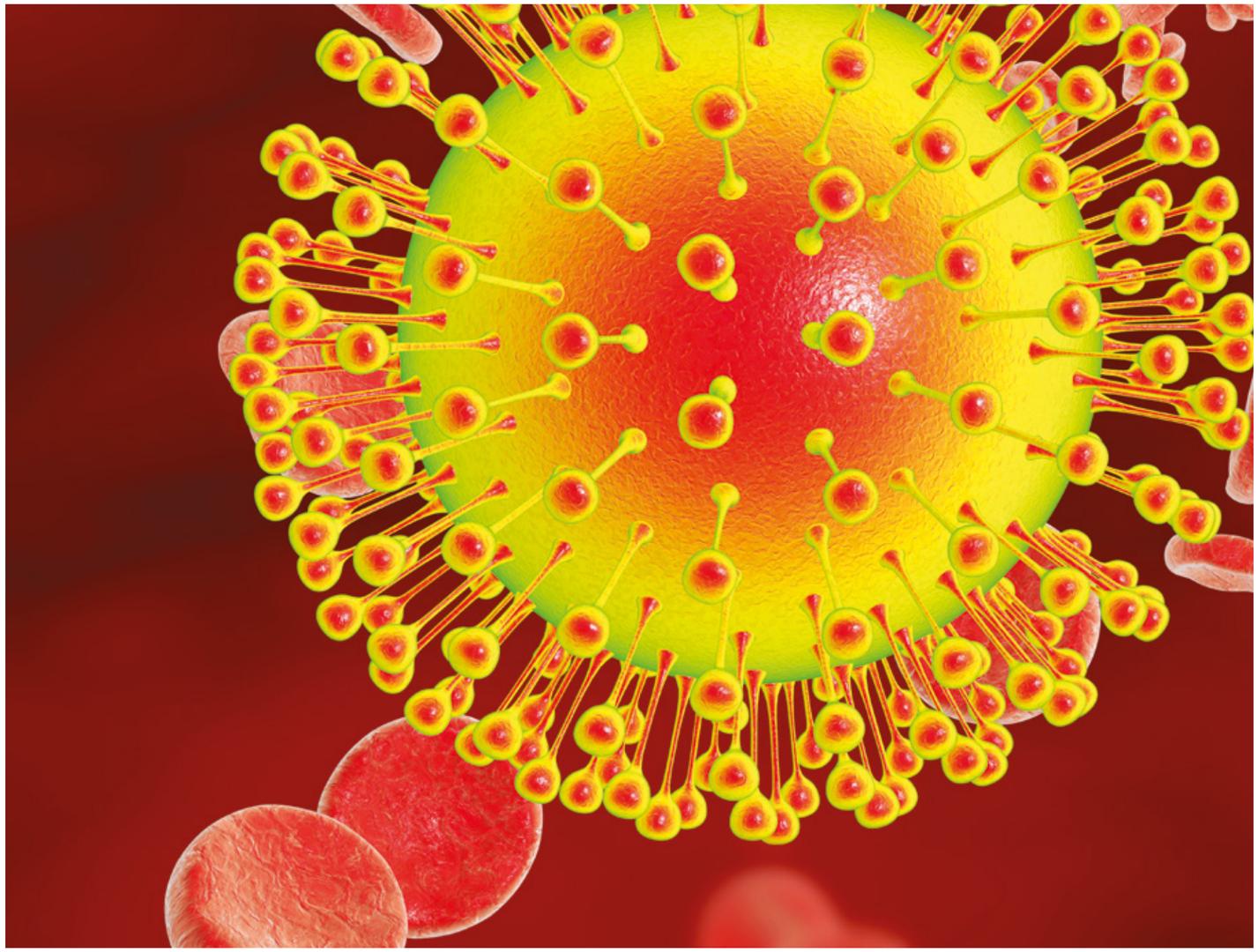
Whether furthering understanding in basic sciences, or focusing on solving technological issues, there are many ways that science can help address the needs of sustainable economic development. This is in line with CAS's stated development strategy. As demonstrated in CAS's research contribution to the clean energy goal, translating research to tangible solutions to global challenges is probably even more important than simply increasing relevant publications, as CAS draws on its subject matter strengths to address SDGs.

IMPROVING GLOBAL HEALTH

Globally, good health and well-being is the SDG with the largest amount of research behind it, but it is only the third-largest for CAS. Though life sciences and biomedicine are not CAS's traditional strengths, they are growing in importance. Particularly, as the world realized only too keenly in 2020, emerging infectious diseases are one of the biggest public health threats. And it is an area where basic and applied scientific research can make a massive contribution.

A 2017 *Science* paper, reporting on the Zika virus[8], was one of CAS's highest Altmetric papers published between 2008 and 2018, and is aligned with the good health goal. In this study, a team that included researchers from CAS's Institute of Genetics and Developmental Biology investigated mutations in the Zika virus genome, finding that just one mutation could have catastrophic consequences for pregnant women: causing microcephaly (small head and under-developed brain) in the developing foetus. They showed that a single amino acid substitution turned an ancestral Zika strain, causing only mild microcephaly, to the one that that causes severe birth defects. The work helps explain why Zika-caused microcephaly outbreaks appeared suddenly, rather than at the discovery of the virus in 1947. It may also have implications for Zika control, as it suggests that scientists should be watching for this mutation when selecting strains for testing efficacy of potential vaccines or antiviral drugs.

Although it falls outside our study period of 2008 to 2018, it's worth addressing COVID-19 in discussions of global health as it was so dominant in 2020. Facing this global crisis, CAS researchers were among the first to react. In January 2020, a research team from CAS's Wuhan Institute of Virology analysed full-length genome sequences obtained from five pneumonia patients, and identified the virus causing the pneumonia outbreak in Wuhan. The novel coronavirus, now called SARS-CoV-2, is similar to the one that caused SARS. They also identified the receptor for this virus, revealing how it infects cells. The



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work, first published as a preprint on bioRxiv[9], and later, in *Nature*[10], set the foundation for future COVID-19 research.

CAS researchers also contributed to understanding the evolutionary mechanisms of SARS-CoV-2[11], determining the crystal structure of a primary protease of the virus, and identifying its inhibitors, along with colleagues[12]. CAS is also making progress in translational biomedical research, by contributing to the development of diagnostic kits as well as potential drugs and a recombinant protein vaccine for COVID-19.

At a press conference held in September 2020, then CAS president, Chunli Bai, summarized the institution's research efforts in COVID-19. He explained that the next focus will be on developing early detection and monitoring systems, and integrated treatment strategies for all coronaviruses[13]. CAS is developing various information service platforms to share data relevant to COVID-19 research, like those on viral strains and nucleic acid sequences. Such data-sharing or facility-sharing practices are essential for addressing global health challenges like COVID-19, and serve as another key aspect of CAS's contribution to the SDGs.

References

1. Zhu, Z., Piao, S., Myneni, R. et al. Greening of the Earth and its drivers. Nature Clim Change 6, 791–795 (2016).
2. https://www.fmprc.gov.cn/mfa_eng/topics_665678/2030kcxfzyc/P020200927650108183958.pdf
3. https://www.pnas.org/content/115/16/4015
4. Nolan, C., Overpeck, J.T., Allen, J.R. et al. Past and future global transformation of terrestrial ecosystems under climate change. Science 361(6405), 920-923(2018).
5. Crowther, T., Todd-Brown, K., Rowe, C. et al. Quantifying global soil carbon losses in response to warming. Nature 540, 104–108 (2016).
6. http://www.bulletin.cas.cn/publish_article/2016/Z2/2016Z234.htm#outline_anchor_1
7. Chen, J., Huang, Y., Zhang, N. et al. Micro-cable structured textile for simultaneously harvesting solar and mechanical energy. Nat Energy 1, 16138 (2016).
8. Yuan, L., Huang, X.Y., Liu, Z.Y. et. al. A single mutation in the prM protein of Zika virus contributes to fetal microcephaly. Science 358(6365), 933-936(2017).
9. https://www.biorxiv.org/content/10.1101/2020.01.22.914952v1
10. Zhou, P., Yang, XL., Wang, XG. et al. A pneumonia outbreak associated with a new coronavirus of probable bat origin. Nature 579, 270–273 (2020).
11. Wei, X., Li, X., & Cui, J. Evolutionary perspectives on novel coronaviruses identified in pneumonia cases in China. National Science Review 7(2), 239–242(2020).
12. Jin, Z., Du, X., Xu, Y. et al. Structure of Mpro from SARS-CoV-2 and discovery of its inhibitors. Nature 582, 289–293 (2020).
13. http://www.nbd.com.cn/articles/2020-09-16/1506261.html

TOWARDS A SUSTAINABLE FUTURE

Bibliometric analysis offers just one way to assess science's contribution to addressing the SDGs, and it suggests some approaches for CAS and other research institutions to better address the global challenges with their research.

Scientific research may offer tools that enable sustainable development.

Science and technology play an important role in addressing the SDGs, either via enhancing our knowledge about the mechanisms underlying certain goals, or offering tools that can be used directly. Scientists are increasing their participation in providing solutions as they seek to drive greater societal impact for their research. Measuring research contribution to SDGs is not easy though. The exercise of mapping scientific publications to the SDGs is just one way to quantify such contribution.

As the global leader in publishing research, CAS also has the largest number of scientific publications relevant to SDGs, which is growing fast. While it has broad research coverage, CAS primarily concentrates its contribution to the more science-related goals, notably those on climate change, energy and health. It makes a more limited contribution to goals that are social-science oriented, such as education, poverty alleviation, or social equality. In line with the global trend for interdisciplinary research, there might be new perspectives that scientists can bring to address these goals, which may present opportunities for CAS.

Even within the science realm, compared to its peers, CAS has room to grow its research output to better address some goals, such as good health. It now aims to strengthen the field of medical and health sciences by opening new facilities and launching targeted programmes. CAS is already leveraging its strengths in chemical sciences and engineering, which contribute strongly to the clean energy goal, for example. But these might be brought to bear on more SDGs, such as good health, climate change, or sustainable cities.

There is more to research than scientific papers. To aid the global SDGs push, CAS is also developing platforms to share data and to help monitor progress, such as its CASEarth programme. Such platforms also support research tackling the global challenges with data, and promote greater awareness of science's role in addressing SDGs by sharing relevant research work, and encourage broader collaboration. The collaboration may involve multidisciplinary research teams, international teams, or partners from government bodies, corporates, or non-profits.

Of course, as the current analysis only looks at publication data, broader societal impacts may not be captured. CAS's stated Priority Programmes include major research efforts that do not necessarily result in publications, but may create new technologies or key industrial facilities, bring public good, or serve sustainable development needs. These research results, more transferable to solutions for real-world problems, are important contributions.

Achieving the SDGs is a global agenda. Collaborative research efforts, across institutions and among the scientific disciplines, will drive insights and innovations, to create a more sustainable future, for the benefit of all.