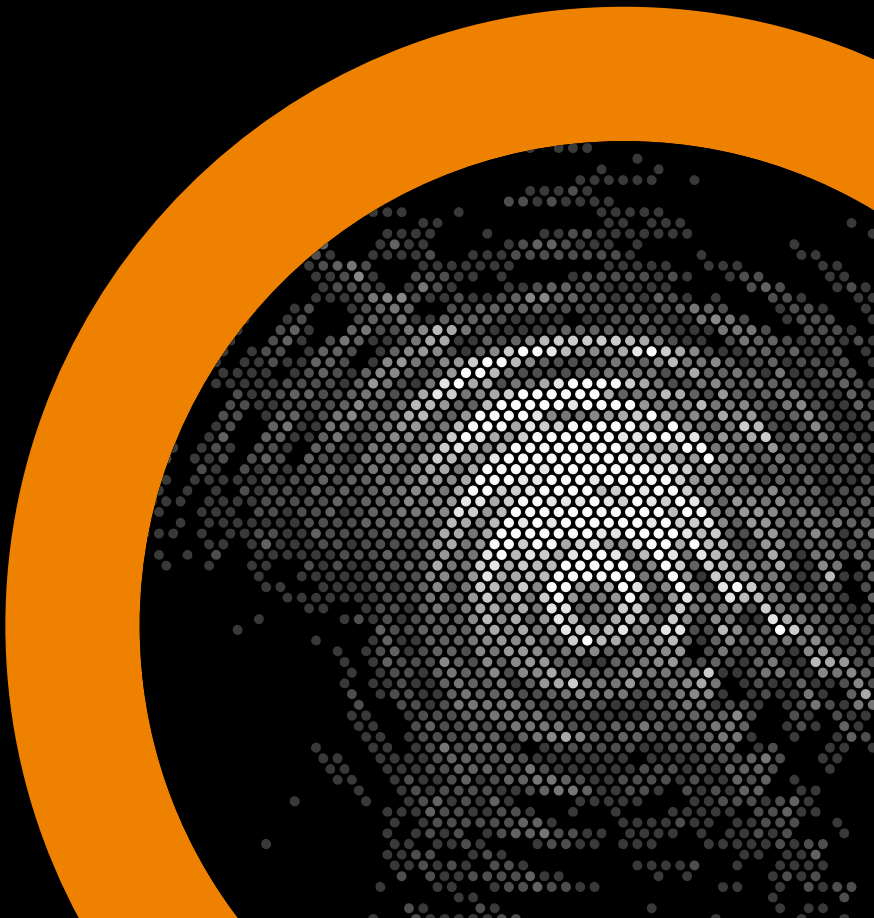
RELX Group

Waterscape: The state of water research



Introduction

In September 2015, world leaders gathered to agree on a new set of global targets – the Sustainable Development Goals (SDGs) – water features prominently.

Seventeen goals and 169 targets set out a plan of action for sustainable development over 15 years, aiming to address various problems, from poverty to climate change. The centrality of water is reflected in SDG 6 dedicated to ensuring "the availability and sustainable management of water and sanitation for all."

Setting out a roadmap to sustainable water is a positive step, but the challenges are significant. The Millennium Development Goal (MDG), to halve the proportion of people without access to improved sources of water, was achieved five years ahead of schedule, in 2010. During the MDGs (which ran from 2000 to 2015), 2.6 billion people gained access to improved sources of drinking water and 2.1 billion to improved sanitation.

However, water challenges are broader than just drinking water and sanitation: the world's population is set to exceed 9 billion by 2050 and the challenges will become even greater.

In 2010, access to safe water was established as a human right by the UN General Assembly through resolution 64/292. But more than 760 million people still have no access to safe drinking water, highlighting the urgent need for increased action. And today almost 1 billion people practice open defecation and one third of the world's population is still living without improved sanitation.

Water scarcity is linked to water management practices and climate change. Pollution and water quality are also intrinsically linked: according to the World Health Organisation an estimated 3.5 million people die every year due to inadequate water supply. Water related challenges impact ecosystems and the environment creating social problems that lead to conflict. In South Sudan, two decades of conflict have made potable water scarce and a source of severe tension between communities.

» 17 goals

» 169 targets

Sustainable Development Goals set the sustainable development agenda for the next 15 years

*** More than 760 million people have no access to safe drinking water**

*** Every $1 invested in the water supply will result in a return of $4 - $12**

To achieve SDG 6, cooperation between policy makers, water managers, infrastructure providers and NGOs is critical – supported by research.

Solving the water and sanitation challenge is not only important for people and the environment, but for economies as well. The World Health Organisation estimates that every $1 invested in the water supply will result in a return of between $4 - $12.

Innovations in science and technology will underpin progress on improved water and sanitation. Research is central to this effort.

In 2012, Elsevier collaborated with the Stockholm International Water Institute on a report on water and food security – The Water And Food Nexus: Trends and Development of the Research Landscape – revealing water resource trends. The report focused primarily on developed countries. However the challenges are greatest in the developing world.

In 2015, Elsevier produced a report on the SDGs and sustainability science. Sustainability Science in a Global Landscape grouped the SDGs into six themes – planet, people, dignity, prosperity, justice and partnership – highlighting the most 'popular' areas of sustainability research and the countries with the greatest output, collaboration, and interdisciplinary approaches.

This supplement explores the countries producing and collaboration in water research and its impact.

Research performance data in this report were extracted from Elsevier's SciVal tool which assesses the research performance of 220 countries based on 38 million articles from 5,000 publishers, for the years 2011-2015. Water Resources (the focus of Elsevier's earlier report 'The Water Food Nexus') continues to be an important research area encompassing a wide range of topics as indicated by the chart below.

KEY
- Growing
- ↓
- Declining

Research impact

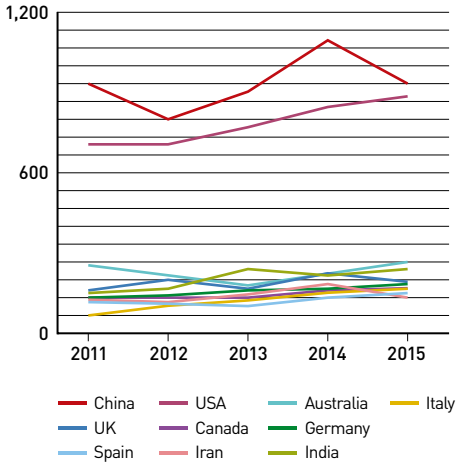
China leads research on water resources with a total of 4,684 publications between 2011 and 2015.

China's primary focus is water pollution - eight of its institutions represented the greatest output in this area. The United States research concentrates on the theme of watershed and water pollution.

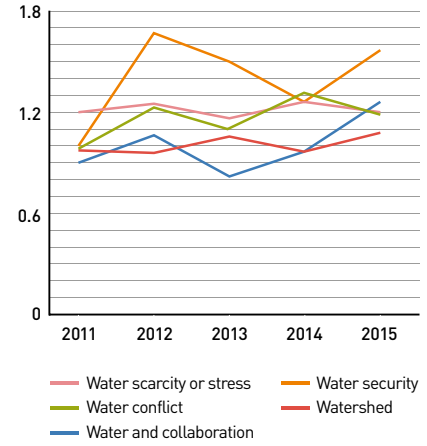
More research is focused on water pollution than any other theme, with a 7% growth in papers between 2011-2015. But overall there was a 4% decline in the number of papers across all water resource categories between 2014 and 2015.

Despite being a big political talking point, water security is a fledgling concept in research terms, with 191 papers in 2015. Water Stewardship is also a new concept, gaining recognition slowly in the research community with nine papers in 2015.

Research output by country



Impact by research area



IMPACT

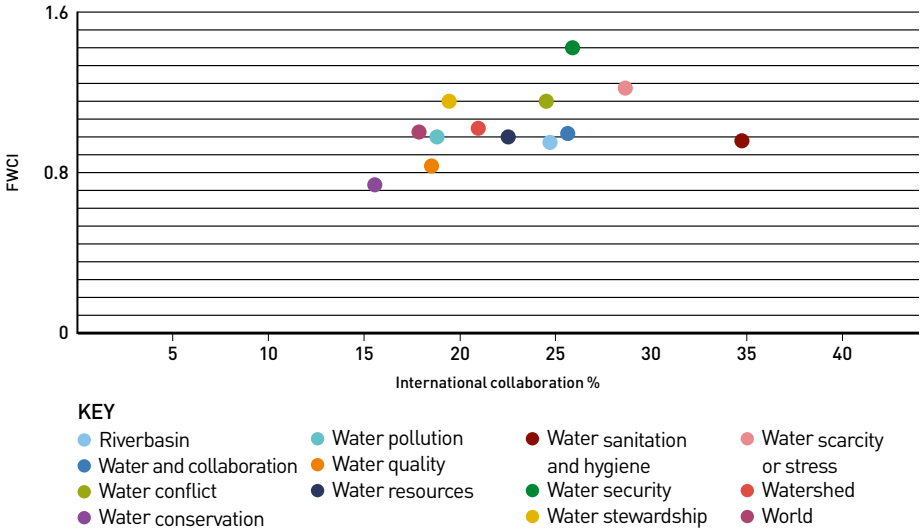
Water scarcity (or water stress), correlated with water security, grew 19% between 2011-2015. However, water security ranked 10th of 11 water research categories in number of articles published, yet the majority of articles appeared in the top 10% of journals with water and conflict (ranked 7th), and water scarcity (ranked 5th).

In 2015, 1.56 water security was the area garnering the highest field-weighted citation impact (FWCI – a measure of article quality) – followed by water collaboration at 1.25 – its highest since 2011. Between 2011 and 2015, FWCI increased by water resources by 26% and water pollution by 25%.

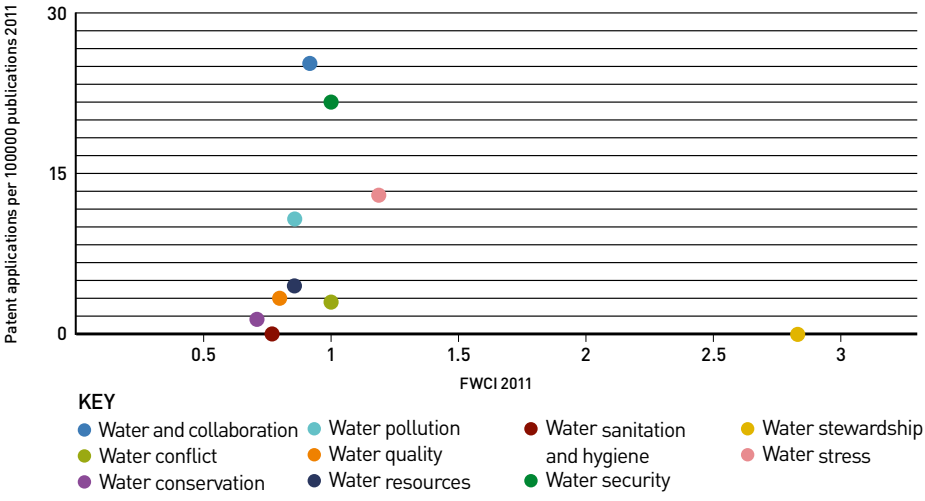
Research conducted by international teams tends to have a greater impact

Field-Weighted citation impact (FWCI) is a measure of how often the research is referenced in other research papers, compared to the average for that field. An FWCI of above 1.0 shows the impact is greater than average

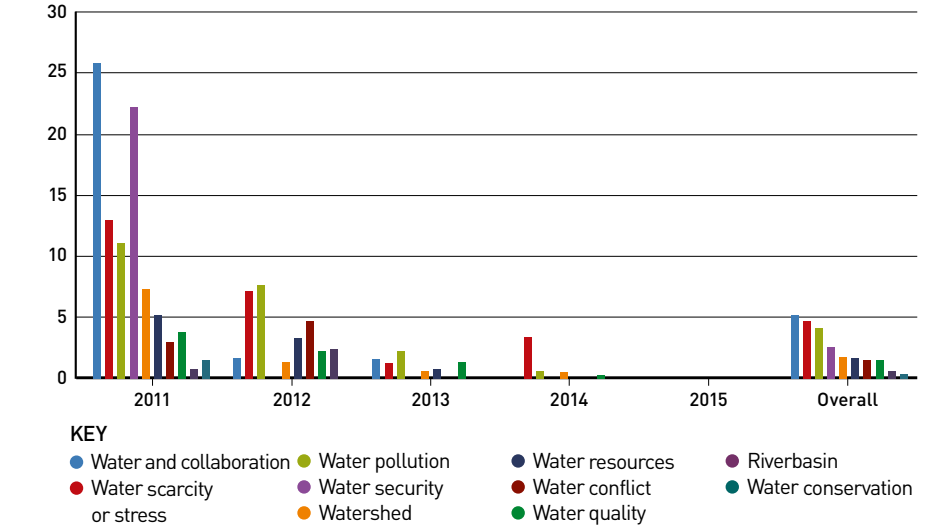
International collaboration and research impact



Patent applications and research impact



Patent citations per 1,000 publications



Other topics such as water conservation and water quality have a FWCI of below 1, indicating that the research is less impactful (as measured by citations) than the world average.

The majority of water-related research is highly collaborative, exceeding the 18% average for all scientific research. In 2015, water sanitation and hygiene was the most collaborative area with over 45% of publications involving international collaboration (with an average of 35% between 2011 and 2015). Water conservation exceeded the world average in 2015 for the first time, with international collaboration increasing by 8 percentage points between 2011 and 2015.

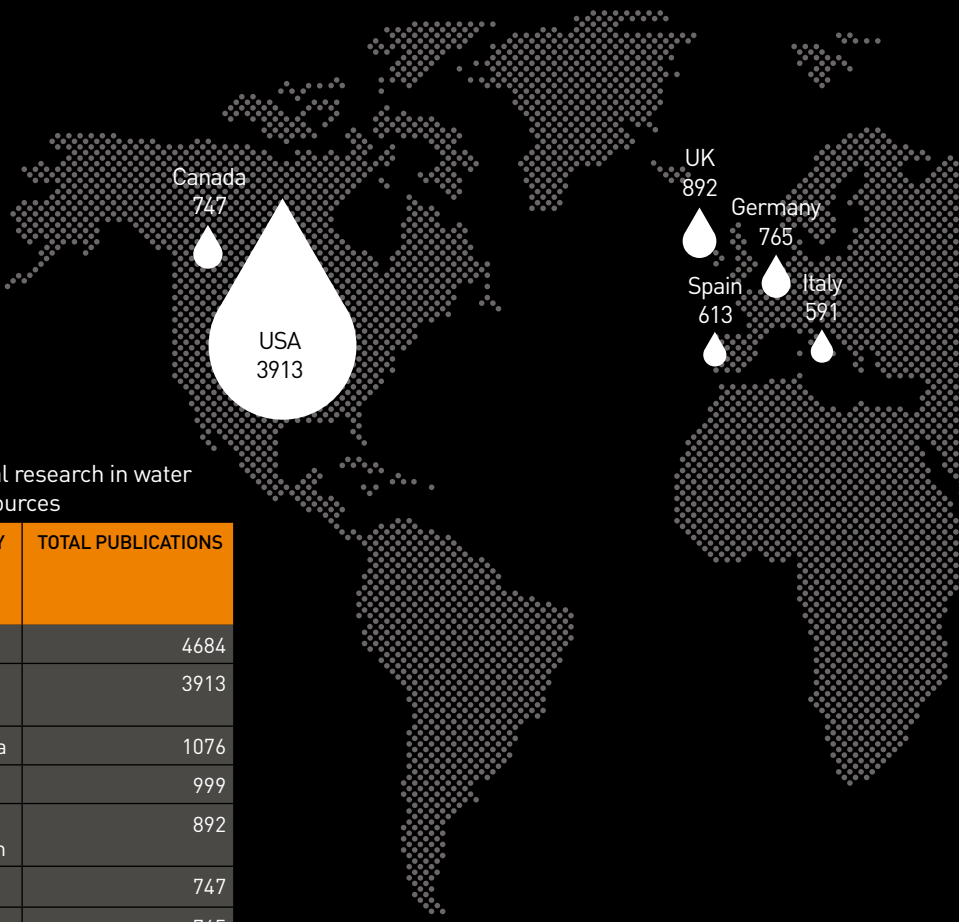
The higher the collaboration, the higher the impact: publications with more international collaboration correlated with higher citation impact.

WATER RESEARCH AND PATENTS

According to information from the world's five largest patent offices, covering approximately 50% of global patents, patent citations in water research have been declining. In every category they are below the world average of 14.1 between 2011-2015. Water and collaboration generates the most patents per 1,000 publications – an average of 5.2 between 2011-2015. Patents matter because they are indicative of technological advancement and the application of water research.

Research with the greatest impact leads to more patent applications

The global landscape

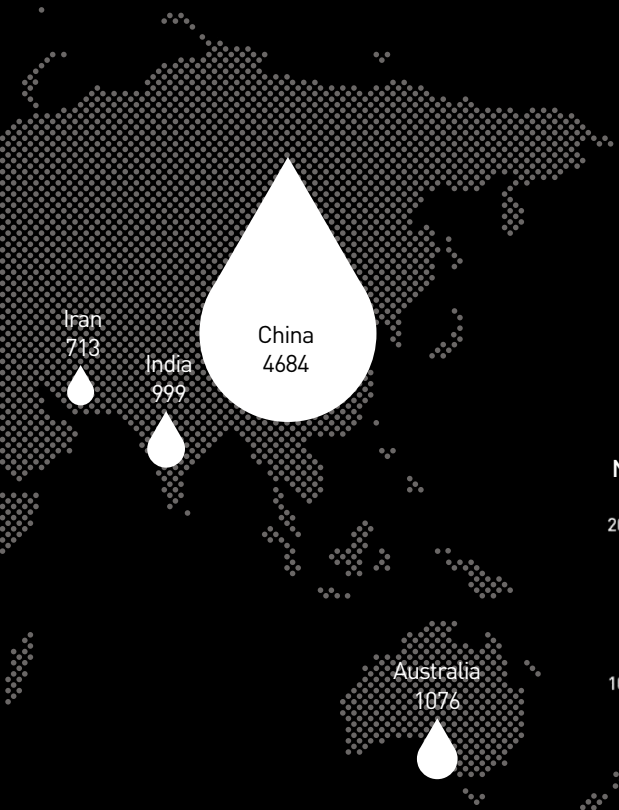


Total research in water resources

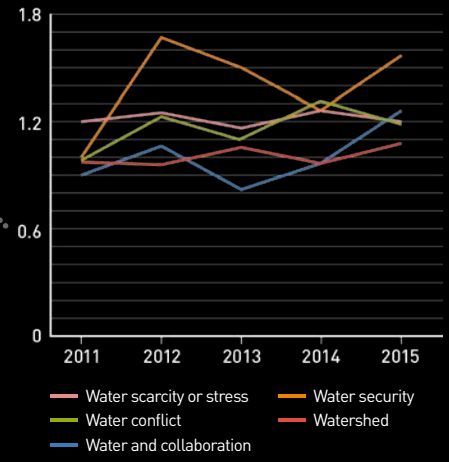
COUNTRY	TOTAL PUBLICATIONS
China	4684
United States	3913
Australia	1076
India	999
United Kingdom	892
Canada	747
Germany	765
Italy	591
Spain	613
Iran	713

Total Research in water resources 2011-2015

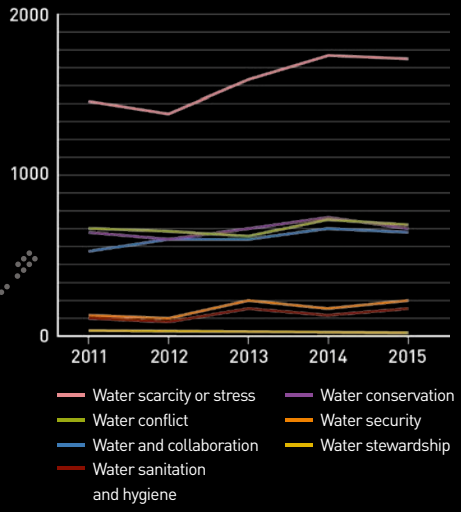
Topics with a FWCI below 1 represent below average impact



Impact by research area



Number of publications by research area



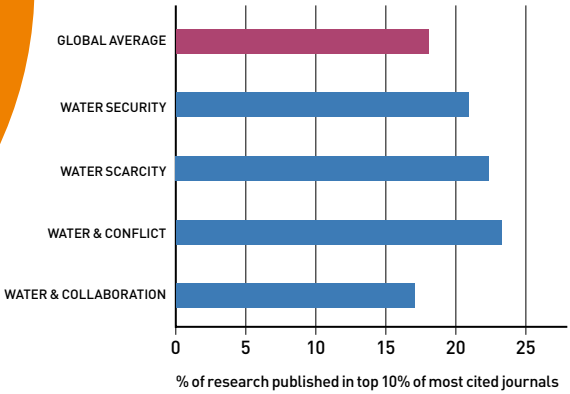
The challenge

The challenge is ensuring that a predicted global population of 9 billion by 2050 has access to a safe water supply.

The findings indicate that water research is highly collaborative and impactful in a number of areas. Output is increasing, however it is not yet leading to an increase in applied innovation as indicated by patent citations data.

Over the last five years, China has overtaken the US in research on water resources; availability and quality of water is a key issue for the country.

Research published in top journals 2011-15



Research on water and conflict is most likely to appear in a top journal

Water research in the developing world

Output in scientific research is led by developed countries which have advanced research capability. Yet the need to improve water resources to achieve SDG 6 is most pressing in developing nations. It is important for researchers there to contribute to understanding of and practical solutions for regional water challenges.

Between 2011 and 2015, Africa produced 5% of the world's water research, with nearly half emanating from three countries: Egypt, Nigeria and South Africa. However, African researchers published 13% of all research in the sub-field of 'water and sanitation', with Nigerian research here averaging a FWCI of nearly 7 times the global average.

Research in water and sanitation is also strong in South America which produced 10% of the world's related research papers, although the region produces just 4% of water research overall. Chilean papers are particularly cited with an average FWCI of 29.53 between 2011 and 2015.

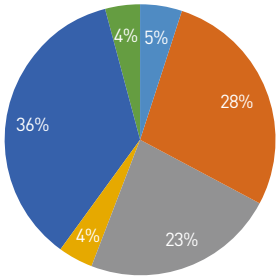
Between 2001 and 2015, Asia Pacific produced 50% of all water conservation research, with China representing 72% of the total. Cambodia published 44 papers across water research fields, but had the highest FWCI (3.25) for water conservation in APAC.

China was responsible for 57% of water pollution research in the period of 2011 and 2015; India 15%. New Zealand produced less than 1% of water pollution research but had the highest FWCI of 4.06.

Water research in the Middle East represents 4% of the total. The majority of papers concentrated on water pollution (31%) and Qatar achieved the highest FWCI for this sub-theme (2.63 between 2011-2015). Iran produced 51% of the total of all water research in the region.

As a group, BRIC nations (Brazil, Russia, India and China) contributed 27% of water research papers published between 2011 and 2015.

Water Research Output by Region



Where do we go from here?

In addressing SDG 6 to ensure water and sanitation for all, there is good news: water research is highly collaborative, which is positively correlated with its impact. However, patent citations have fallen below the average in all water research areas since 2011, suggesting that more focus is needed on translating water science into practical and scalable innovation.

RELX ENVIRONMENTAL CHALLENGE

The RELX Group Environmental Challenge is a competition to advance access to safe water and sanitation. It prioritises projects that are innovative, scalable, involve local communities and address issues such as health, education and non-discrimination.

There is a $50,000 prize for the first place entry and a $25,000 prize for the second place entry. Winners receive access to Science Direct.

For more information visit:
relx.com/corporateresponsibility

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To read **Sustainability Science in a Global Landscape**, the basis for Waterscape visit:

www.elsevier.com/research-intelligence/research-initiatives/sustainability-2015

The supplement is part of a multiyear project to provide insight into sustainability science. If you would like to suggest areas for further research or find out more about the RELX Environmental Challenge, please email corporateresponsibility@relx.com

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