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**United Nations University
Institute for Water,
Environment and Health**

**A Look Back at the First 25
Years: 1996-2021**

About UNU-INWEH

UNU-INWEH's mission is to help resolve pressing water challenges that are of concern to the United Nations, its Member States, and their people, through critical analysis and synthesis of existing bodies of scientific discovery; targeted research that identifies emerging policy issues; application of on-the-ground scalable science-based solutions to water issues; and global outreach. UNU-INWEH carries out its work in cooperation with the network of other research institutions, international organisations and individual scholars throughout the world.

UNU-INWEH is an integral part of the United Nations University (UNU) – an academic arm of the UN, which includes 13 institutes and programmes located in 12 countries around the world, and dealing with various issues of development. UNU-INWEH was established, as a public service agency and a subsidiary body of the UNU, in 1996. Its operations are secured through long-term host-country and core-funding agreements with the Government of Canada. The Institute is located in Hamilton, Canada, and its facilities are supported by McMaster University.



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Foreword

To help countries, primarily in the Global South, address water resource challenges is the fundamental mandate of UN University's Canadian-based Institute for Water, Environment and Health (UNU-INWEH), which is marking its 25th anniversary of service in 2021.

Hosted by McMaster University in Hamilton, Ontario, with long-term UN host-country and core-funding agreements with the Government of Canada, UNU-INWEH bridges the gap between research and the practical needs of political leaders and decision makers in low- and middle-income countries.

As a UNU research and training institute, one of 13 worldwide working on different development issues, UNU-INWEH draws on rich water management expertise in Canada and globally, and contributes to key UN system-wide processes, including UN-Water – a cross-agency network with international partners addressing global water and sanitation issues.

Over the years, UNU-INWEH has engaged scores of international experts, established hundreds of partnerships worldwide (many of them ongoing), trained hundreds of young water professionals, produced hundreds of research and policy publications, generated hundreds of articles featured on thousands of international news sites, and attracted tens of millions of funding dollars. With thanks to all collaborators and supporters, here are a few selected research highlights and other achievements during our first quarter century.



Helping countries achieve water development targets

Supporting water-related sustainable development has been central to UNU-INWEH's work since its inception. In 1999, a **UNU-INWEH-led World Water Day campaign** emphasised the critical importance of access to clean water and protection of water quality, illustrating with facts and numbers the consequences of water pollution. A decade later, UNU-INWEH offered **nine focused recommendations for achieving the Millennium Development Goal on sanitation** as a route to 100% access to adequate sanitation by 2015.

More recently, UNU-INWEH, with policy makers and researchers from the Republic of Korea, Pakistan, Tunisia, Costa-Rica, and Ghana, debuted in 2017 a tool to help countries set specific targets for all water-related Sustainable Development Goals (SDGs) — the **SDG 6 Policy Support System. Recommended for national use by UN-Water**, the SDG-PSS translates a broad range of data and information into an evidence-based framework for more effective national planning. It is freely available online in English, French, Spanish, and Korean, with versions in Portuguese and Arabic to be released soon. Countries can assess six critical components for achieving the SDG 6 targets: capacity, finance, policies and institutions, gender mainstreaming, risks/resilience and transparency. Once adopted in all 34 currently participating countries, it can improve the lives of around 100 million people trying to cope with inadequate water supplies and quality and 270 million people without improved sanitation facilities.

Meanwhile, UNU-INWEH has provided **critical analysis of the SDG framework**, identifying gaps between SDG 6 target aspirations and what is really measured by associated indicators. Also unpacked: the implicit **interlinkages between various SDG targets and groundwater**. As well, UNU-INWEH provided major input to the methodology for environmental flow assessment in the SGD6 monitoring indicator 6.4.2 (water stress). The results are summarised in **published guidelines** aimed at all UN Member States.



Photo: Mo / Flickr

Defining and unpacking water security

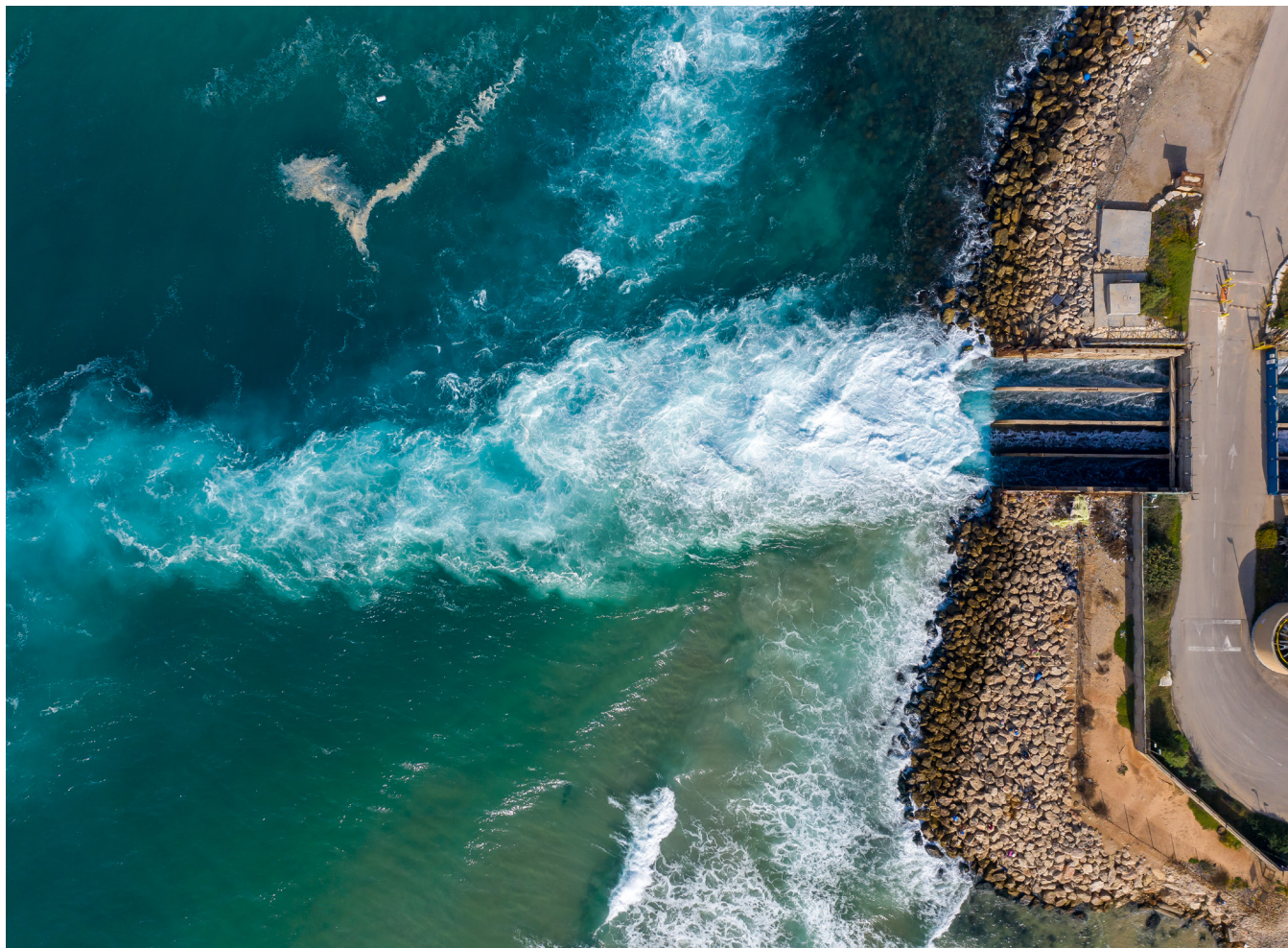
UNU-INWEH led the UN-Water Task Force in 2013 to develop a **UN-Water analytical brief on water security** to illustrate the concept and establish the common definition: “The capacity of a population to safeguard sustainable access to adequate quantities of and acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability.” The brief also called for: i) including water security in the formulation of the SDGs, ii) supportive environmental policies, including innovative financial mechanisms to achieve water security, and iii) increases in relevant capacity development. Despite concerns expressed by some Member States that water security may contravene national, human and environmental security, this UNU-INWEH-led UN-Water effort remains the major milestone in an ongoing global discourse on the topic. It contributed to conceptualisation of the SDGs and on-going attempts to quantify water security of countries and brought water security philosophy to the forefront of global development agenda overall.



Challenging the status-quo in the water sector

UNU-INWEH partnered in 2012 with the Global Environment Facility to examine the effectiveness of its roughly 200 major international water-related projects. The **analysis** revealed that world water sector decision making is too often poor and predicted potential ‘water bankruptcy’ in many regions, with implications for food and energy security, adaptation to climate variability and change, economic growth and human security. A principal lesson from this review was that science must play a more central role in determining the nature and priority of water sector investments.

Seven years later, UNU-INWEH carried out two global assessments focused on **water-related education and research**. These estimated that about 70% of academic journals that publish water research are located in just four countries – the USA, UK, Germany and the Netherlands – and that all 15 countries leading in publications per million population are among the world’s wealthiest. Wealthy nations are also home to highest-quality schools, with 38 of the top 50 post-secondary institutions for Excellence in Water Resources being in North America and Europe; the others are in Australia, China, and Taiwan. These assessments quantitatively illustrated that post-secondary education and research to tackle the global water crisis are neither located in, nor focus on the needs of, poorer developing countries where water-related problems are most acute. These assessments also pointed out that water research outputs will remain isolated in the field’s own “box” as long as impacts of the research are assessed by the numbers of papers published and cited by other researchers (e.g., H-index), rather than by the number of successful and practical applications of the research. Both assessments called this imbalance between resources and needs “alarming” as it impedes the search for solutions to crucial water challenges and slows global progress towards water-related SDGs.



Assessing the status and prospects of water desalination globally

Another groundbreaking UNU-INWEH analysis, published in 2019, examined **brine production** in the world's growing number of desalination plants. The study demonstrated that globally almost 16,000 desalination facilities produce much more water than previously thought — 35 billion cubic meters — equal to almost half the average annual flow over Niagara Falls. And they discharge more hyper-saline waste (brine) than useable water — close to 52 billion cubic meters, enough to cover an area the size of Florida, Tunisia, or Uruguay under roughly 30 cm (1 foot) of brine.

Desalination plant capacity is concentrated primarily in the Middle East and North Africa, expanding much-needed water supplies. The report concluded that innovative research and operational practices are needed to reduce brine volumes, and to use the salty waste in economically viable and environmentally friendly ways.

Again the world media helped relay the researchers' messages, highlighted by coverage by the **BBC**, **National Geographic**, **Reuters**, **Science News**, **Scientific American**, **The Guardian**, **Bloomberg News** and many others — in all, roughly 1,000 online news articles published in 82 countries and 21 languages. The work helped stimulate establishment of a Global Desalination and Brine Alliance engaging research organisations, relevant policy-setting agencies, other institutional partnerships and the private sector. Its aim: Promote efficient brine management technologies that offer additional water and revenue streams and roll out promising technologies for large-scale application.



Unpacking the global potential of wastewater

Wastewater has been a primary focus of UNU-INWEH. In a now widely-cited 2013 analysis of **global, regional and country level for data on wastewater generation**, treatment and use, UNU-INWEH showed that close to 60 countries had no such information and that the percentage of wastewater treated decreases with average national income per capita.

An analysis on **country-level estimates of wastewater**, published in 2021 with the University of Utrecht, revealed that about half of global wastewater undergoes treatment, with developing countries' rates lagging behind. Many such nations are also trapped in a “wastewater Catch-22,” whereby wastewater use benefits poor communities but comes with unacceptable health risks. Accordingly, UNU-INWEH has long advocated augmenting health and environment spending with preventative wastewater treatment.

With international and Canadian partners, UNU-INWEH examined the **potential of wastewater as a source of water, agricultural nutrients and energy**. This 2020 analysis found that annual wastewater production amounted to some 380 billion m³ worldwide — a volume rivalling the Nile River's annual discharge — and forecast a 25% rise in world wastewater production by 2030, and 50% or more by 2050. Meanwhile, full nutrient recovery from wastewater could offset 13% of global agricultural demand for nitrogen, phosphorus and potassium. And the energy production potential within wastewater could power the homes of about half a billion people (or help wastewater treatment plant meet their energy needs).

UNU-INWEH's wastewater work has been featured in the headlines of more than 650 different media outlets over the last decade, including **Reuters, Science, TIME, Washington Post, Guardian, The Water Network**, and **Climate News Network**, providing coverage in at least 16 languages across 75 countries, together creating roughly 2 billion potential public impressions worldwide.



Tapping unconventional water resources to alleviate global water scarcity

UNU-INWEH is unpacking the potential of unconventional and emerging new ways and technologies to collect water, including atmospheric (fog, cloud) harvesting, freshwater transport by sea, deep and offshore groundwater drilling, desalination, and others. Since 2017, UNU-INWEH has led 10 other UN agencies and international technical partners in a special UN-Water task force on unconventional water resources. The result, a [**UN-Water Analytical Brief on Unconventional Water Resources**](#), documented opportunities for international, regional, transboundary and country-level collaboration to tap these uncommon water sources to help achieve national and global water targets by 2030. UNU-INWEH has also formed a global community of leading scientists, experts and practitioners and facilitated production of a comprehensive book that makes a compelling case for exploiting various unconventional and underutilised waters for sustainable development.



Supporting sustainable land management

UNU-INWEH's decade-long work on **sustainable management of drylands and land degradation** through 2015 included collaborations with UNESCO and ICARDA and the rehabilitation of degraded drylands through training, capacity building, and interaction with landowners and farmers in Bolivia, Burkina Faso, China, Egypt, India, Iran, Jordan, Pakistan, and Tunisia. This initiative triggered multi-million-dollar investments in dryland management from national sources in participating countries.

UNU-INWEH was also the key partner in the international initiative "**The Economics of Land Degradation**" (ELD), which documented the chronic undervaluation of land because it is commonly quantified only by immediate agricultural or forestry markets. ELD offered a universal way to quantify the costs of land degradation and the economic benefits of sustainable land management, which could **raise world crop supplies by an estimated 2.3 billion tons, worth \$1.4 trillion**. Some 2 billion people live on drylands and annual global losses of arable land can amount to 8 to 10 million hectares — an area roughly the size of Austria. Media coverage by such major outlets as the **Washington Post**, **Reuters**, **The Guardian**, and **Newsweek** led to the ELD coverage in at least 13 languages and 32 countries.

A related global analysis of soil salination indicated that such degraded soils cover 62 million hectares (20%) of the world's irrigated lands, up from 45 million hectares in the early 1990s. Global economic losses due to **salt impacts on crop yields were assessed at \$27 billion per year**. It too was well publicised by world media, led by a full page in **National Geographic magazine** and coverage by the **BBC**, **New Scientist**, the **Daily Mail**, Canada's **The Weather Network**, and many others reaching the public in 34 countries.



Promoting sustainable coastal zone management and biodiversity conservation

UNU-INWEH has consistently emphasised the ineffectiveness of existing coastal management practices, and that continuing the status quo endangers ecosystems on which over half the world's population depends for tourism, fisheries, and other economic activities. In 2008, the Institute warned that **coastal marine ecosystems have declined** in recent decades due to population growth and human demands on the ocean resources, and because of the climate crisis. The Institute has strongly advocated for integrated coastal zone management worldwide, scaled appropriately to regional ecology, and for eliminating political jurisdictions as management borders. In 2014, in a coordinated statement supported by over 20 scientists from seven countries, UNU-INWEH advanced a transformative proposal **to introduce and enforce the use of zoning of Earth's coastal ocean waters**, mirroring approaches commonly used to manage and protect land resources.

UNU-INWEH joined forestry and conservation sectors and agencies across the United Nations in an unprecedented partnership in 2012, led by The Nature Conservancy, that formulated **policy recommendations for mangroves' conservation** based on the **World Atlas of Mangroves**. These "forests of the tide" provide enormous benefits as biodiversity harbors, as wave buffers, as CO₂ storage sinks, and as nurseries for coastal and offshore fisheries worldwide. Since 1980 the world has lost about 20% of mangrove forests to coastal aquaculture and to infrastructure for tourism, and many of the dwindling number remaining are degraded. The partnership called for genuine government commitment to reverse mangrove loss in order to stem the growing vulnerability of coastal peoples.

UNU-INWEH also warned that, despite impressively rapid growth in the areas of protected lands and marine ecosystems worldwide, totaling over 100,000 in number and covering 17 million km² of land and 2 million km² of oceans, biodiversity is in steep decline. Continued reliance on a strategy of setting aside land and marine "protected areas" is insufficient to **arrest global biodiversity loss** and additional solutions are needed, particularly those that stabilise world population and our ecological demands.



Identifying the emerging risks of large water storage dams

In 2021, UNU-INWEH published the first global **synthesis of knowledge on the state of large water storage infrastructure**. It indicated that by 2050 most people on Earth will live downstream of tens of thousands of large dams built primarily between the 1930s and 1970s with a design life of 50 to 100 years. Many of these dams, therefore, are already operating at or beyond their design life span and can show signs of ageing, thereby increasing potential dam failure cases, repair and maintenance costs, reservoir sedimentation, and the loss of dam functionality and effectiveness.

The report said that dam decommissioning — an already growing practice — may further increase as the option of choice where economic and practical limitations prevent upgrading a dam or if its original uses have become obsolete, and noted that dam removal may be 10 or more times less costly than repairs.

This represented the first attempt to explore comprehensively and to focus global attention on the creeping issue of ageing water storage infrastructure and the emerging risk it presents. International media, including **The Guardian, Times Of India, Italy's Corriere Della Sera, Canada's CTV News** and many others helped deliver the message: Articles at over 225 news sites spanning 40 countries and in 14 languages together generated 1.3 billion potential reader impressions online alone. UNU-INWEH continues to explore various aspects of ageing water storage by analyzing reasons and cases for dam failure, and the risks for individual countries.



Understanding the triggers of environmental migration

A 2007 UNU-INWEH report was among the first to warn that environmental degradation, and desertification in particular, was rising to a place among the world's greatest environmental challenges. The loss of nature's life-support services threatens international stability and without an overhaul of government policy approaches, the report said, **mass migrations of people driven from degraded homelands** could take place within a single generation. An estimated 50 million people were at risk of displacement over the coming decade, the researchers warned, outlining a multi-point prescription for reform at every government level.

UNU-INWEH subsequently offered a comprehensive global analysis of **water-related causes and effects of human migration**, and a framework to both aggregate and interpret them in various social, economic and political contexts. That research showed that global agreements, institutions, and policies on migration often missed the impacts of water and climate crises as direct or indirect triggers. Since then, **environmental migration has proven to be a major global development issue**.



Harnessing the value of human waste

Through a novel economic analysis, UNU-INWEH showed that the methane in biogas potentially generated from **human waste produced worldwide** would have a value of up to US\$ 9.5 billion in natural gas equivalents. And the treated residue, dried and charred, could produce 2 million tonnes of charcoal-equivalent fuel, curbing the destruction of forests in many areas of the world where trees are cut down to produce charcoal. Concerns about the safety of generating such fuels were noted, as were high initial capital investment in biogas production. Yet, the challenges associated with utilizing “waste to wealth” approaches are small relative to the global health and environmental benefits of safely treating human waste in low-resource settings. These strategies would advance progress towards better sanitation, reduced mortality from the diseases, meeting energy and agricultural needs, and mitigating the climate crisis. The 2015 **news release** generated 1.6 billion potential public impressions via **TIME**, the **Washington Post**, **Science Magazine**, **Global News Canada**, and almost 400 other online news sites with a combined potential reach of roughly 1.3 billion.



Photo: Marisol Grandon/Department for International Development

Assessing vulnerability to water-related health risks and diseases

UNU-INWEH developed an index-based **tool for assessing vulnerability to water-related diseases** over different spatial and time scales using publicly-available data. The tool uniquely quantified vulnerability by integrating data for diverse environmental parameters that influence exposure to water-related diseases (e.g. temperature, precipitation, land cover), social conditions (e.g. life expectancy, income), and indexes of adaptive capacity (e.g., female literacy, access to healthcare). This provides a new way of conceptualizing and communicating vulnerability to water-related diseases and was used to develop **global** and **country-specific maps of vulnerability to dengue**, and to assess **health impacts of climate change on parasitic diseases (i.e., leishmaniasis and schistosomiasis) in the Arab region**. UNU-INWEH is working to evaluate vulnerability to cholera, diarrhea and other water-associated diseases to inform local, regional and national policies and resource allocations.

UNU-INWEH also assessed the effectiveness of technologies to remove natural arsenic from groundwater and developed **global standards for measuring the effectiveness of such technologies**. With nearly 140 million people worldwide consuming groundwater contaminated by natural arsenic, UNU-INWEH proposed a **roadmap to eradicate exposure to the problem** in affected countries.



Mainstreaming gender equality into water management

With the Women for Water partnership (WfWP) network, UNU-INWEH collected information on the **importance of women and women's groups for successful drinking water, sanitation and hygiene (WaSH) projects**, especially in low and middle income countries. It was clearly shown that female leadership in this field is uncommon, while the importance of the WaSH sector for strategic empowerment of women and achievement of the SDGs is critical.

UNU-INWEH has also consistently pointed up a lack of sex-disaggregated data, which means that gender policy-oriented information cannot be assessed or corroborated. To change this, UNU-INWEH included gender mainstreaming as part of its **SDG 6 Policy Support System**. This component of the PSS helps users understand gender-specific objectives and commitments within national water policies; the frequency of gender specialists being included in decision-making; funding levels for gender mainstreaming activities in water sector; evidence of institutional commitment to gender parity and promotion of gender equality in water-related ministries and institutions; and the status and implementation of training to raise awareness on gender equality in water related institutions.

A recent analysis further examined **gendered WASH inequities, related disease burden among women and girls**, and the effectiveness of interventions in alleviating inequalities related to SDGs 3 (health), 5 (gender), and 6 (water). The Institute also helped demonstrate how fog water systems – because they are implemented within or near communities – help **decrease the physical and social burden of water collection on women and girls**. UNU-INWEH also contributed to UNU's "Gender Atlas" – a collaborative summary of gender-focused work by the university's 13 sister centers from 2015 to 2020, launched in June 2021 at the **Generation Equality Forum**, Paris.



Promoting water as a means of collaboration and peace

UNU-INWEH is an avid supporter of water as a vehicle for collaboration, peace, and prosperity, particularly across countries that share water resources of large river basins like the Indus, shared by Afghanistan, China, India, and Pakistan. The basin's significance stems from the importance of these countries (three being among the planet's most populous; one boasting the world's second largest economy, and three being members of the exclusive nuclear weapons club), and from the region's massive dependence on irrigated agriculture amid climate change and water scarcity challenges. UNU-INWEH led the analysis that called for **urgent transboundary cooperation over Indus water resources** to overcome insecurity arising from water dependence and scarcity in what many water experts believe is developing into one of the planet's most gravely threatened river basins. Similarly, in recent years UNU-INWEH has coordinated the **Large River Basins book series**, which brings together experts from riparian states to comprehensively examine basin water challenges and inform a common vision for Basin development and transboundary collaboration.

Earlier, UNU-INWEH and the InterAction Council – an independent organisation of former world leaders led at the time by former Canadian Prime Minister Jean Chretien – carried out a **comprehensive analysis of the global water crisis**, including energy, food, environmental and water supply security; climate change; human development; sanitation and hygiene; women's participation; and the human right to water. UNU-INWEH also summarised key **facts and numbers of the global water crisis**. UNU-INWEH has always underscored the need for strong political will and effective global coordination to alleviate and eventually eradicate the water crisis. And, conversely, **pursuing water security within a framework of peace** carries the unexploited potential for political stability and sustainability.



Influencing Canadian water policies

UNU-INWEH has actively promoted **Canadian visibility about water on the global stage**. A decade ago, the Institute underlined that Canada is well-positioned to mobilise and share worldwide its extensive experience gained as stewards of 9% of the world's freshwater resources. A few years later, UNU-INWEH led more than 20 experts from 12 Canadian organisations in the first critical **analysis of the capacity of Canada's water sector** to meet water-related Sustainable Development Goals, and to help other countries to meet these targets too. The analysis examined Canadian water education and research, investments overseas, water technology and governance. UNU-INWEH also worked closely with Canada's largest water research program, Global Water Futures, to identify challenges and opportunities **and promote management of the country's water resources through coordination at the federal level**. The Federal Government recently committed to "create a new Canada Water Agency to keep our water safe, clean, and well-managed," and to "identify opportunities to build more resilient water and irrigation infrastructure." Beyond improving management of the country's water resources, realisation of the new Agency will also inevitably strengthen Canada's stance on the global water stage.



Photo: Krupesh Patel

Photo: Sarah Dickson

Developing capacity of the future global water leaders

For over 10 years, in collaboration with McMaster University, UNU-INWEH has run a **Water Without Borders (WWB) program** that provides a certification for students in graduate programs from any faculty. The two-semester program enhances professional and academic development by addressing water issues across geopolitical or disciplinary boundaries and includes an international field trip for “experiential learning” in a developing country. Some 120 students have graduated since the program's inception.

UNU-INWEH has helped develop young water professionals in other ways too. **Internships** are open to recent graduates or students in the final stages of a graduate program. In the last five years alone, UNU-INWEH has hosted around 80 in-house trainees, with numbers increasing, with interns recently allowed to work remotely, creating much more flexibility to collaborate from anywhere worldwide.

And in the past decade UNU-INWEH has hosted the **on-line Water Learning Centre (WLC)**, offering courses in integrated water resources management. The WLC follows a partnership approach with regional training centers in South East Asia, Latin America and the Caribbean, the Middle East, and Sub-Saharan Africa. The recently redesigned WLC now also offers focused courses on global water security, “big data” analysis for water-related applications, water and migration, water and health, mangroves biodiversity and ecosystems, and unconventional water resources. Course duration varies from several hours to weeks with primarily self-paced learning in focused areas. Some courses target practicing water professionals, others are designed for university students. WLC now enrolls at least 200 students per year. In addition, UNU-INWEH experts engage in various focused training events worldwide in partnerships with other organisations.

