GYA connections

The magazine of the Global Young Academy

WATER

GLOBAL YOUNG ACADEMY

Issue 5 — May 2017

GYA Connections – Issue 5

01 Water

02 GYA Activities

03 Meet the New GYA Members 2017 40

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Editorial

by Orakanoke Phanraksa & Mari-Vaughn Johnston
(Co-Chairs of the Global Young Academy)

It has been a big year for the Global Young Academy. Together we have forged new alliances, expanded our activities, and propelled core projects to new heights – all while relocating to new offices in Halle, Germany, home of the illustrious Leopoldina. Our heartfelt thanks to all the GYA members, alumni, staff, and friends who contributed to these advances.

We chose water as the topic for this issue not only because it animates our blue planet, but also because it is symbolic of possibility and change.

Water is often used to illustrate the principle that the whole is greater than the sum of its parts. Its properties are not those of hydrogen or oxygen. Nor are they a compromise between the two. Rather, they are emergent properties that arise from the combination of its constituents.

The themed articles in this issue examine water from many different angles, encompassing the extremes of urban and rural, flood and drought, the lightning fast and the glacier slow. We hope you find them inspiring. The GYA activities pages include important updates on GloSYS ASEAN and the More Open Access pledge, as well as introductions of our new members. For those of you who are reading this at the AGM in Scotland, we wish you a very warm welcome, and we look forward to linking arms at the ceilidh.

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01

WATER

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Water in Megacities:

Risks and Research Gaps

by Shabana Khan

Nearly 55 percent of the world's population lives in urban areas, and over 500 million people live in just 31 megacities [1]. The UN defines a megacity as a city with over 20 million inhabitants [2]. Due to rapid urbanisation and pursuit of development and growth, many such cities have emerged in the global south without adequate infrastructure. Water is a lifeline for these cities, and is critical to their sustainability. However, without planned growth and without preparedness for climate change impacts, these cities face diminishing water security, and heightened risk of drought, flooding, groundwater depletion and chronic diseases due to poor water quality. It is estimated that most of these cities are exposed to at least one natural disaster [3]. The water-related threats confronting megacities are similar in all areas of the world. Yet efforts to manage the risk seem to be ineffective in the face of increasingly complex water governance systems.

The UN Sustainable Development Goals (2015–2030) specifically identify the vulnerability of cities to water disasters, and note the need to manage these risks in a holistic manner [1]. The global water policy based on Integrated Water Resource Management (IWRM) principles is a step towards integrating water management at a national scale (Fig 1). Megacities fall within a specific national boundary, but they tend to have very complex water management systems that defy the general principles of water use applied across the country. The gap between rising water demand and failing resources continues to grow, and urban water governance is increasingly occupied by the struggle to bridge this gap. As a result, responses to extreme events are frequently ad hoc and short-term, and they occur in the context of background hazards that reduce the city's resilience—unequal distribution of water, poor water quality, wastewater,

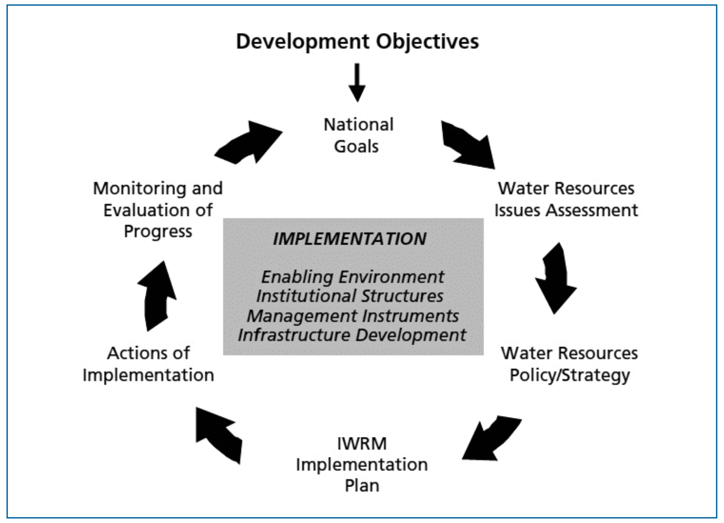

Figure 1: Stages in Integrated Water Resource Management (IWRM) Planning and Implementation.
Source: http://www.un.org/waterforlifedecade/iwrm.shtml

leakages, overflow, and over-dependence on external supply. Numerous studies have examined specific extreme events and specific cities. The challenge now is to develop holistic solutions at different scales, and to connect these to policy. Several knowledge gaps must be filled if this challenge is to be met.

Data Gaps: Data gaps have been identified in various areas of water research, from climatic and hydrological research to studies of water quality, water distribution and the socio-economic relationships built around water [4]. The need to understand complex water management systems in megacities is pressing, but in most cases, the necessary data are missing. Opryszko and colleagues [5] note that while small water enterprises are critical to managing the needs of megacities, data about their quality, effectiveness and health impacts are not available. Many studies base their conclusions on case studies rather than rigorous data collection [6], and this can limit their generalisability. City scale analyses of water risks are often based on data gathered at the municipal level, ignoring local variations. For example, Khan reported six different patterns of water supply and responses to water scarcity within Dwarka, a sub city of megacity Delhi, none of which feature in water management at the whole-city scale [7]. The lack of systematic data is a major challenge that limits detailed planning. Thus, research comprising comprehensive data collection for megacities needs to be supported and promoted for a greater understanding of water-related risks and responses.

Knowledge Integration: Megacities are served by multiple actors and their networks, including government bodies, non-governmental organisations, private industries, small water enterprises, and many other units from organised and unorganised sectors [8]. This variety is particularly characteristic of developing countries that have inadequate infrastructure and facilities. It is difficult to reconcile the interests, rights, and knowledge bases of diverse actors, stakeholders, and institutions operating at multiple scales [9]. This may be why so few studies have attempted a comprehensive analysis. Some of the broadest ranging studies in this field have been conducted by international organisations such as the World Bank, the Asian Development Bank, and other bodies with a focus on future investment. The academic contribution is fragmented depending on the availability and interests of the researchers involved. Although multiple national and international platforms offer support for information sharing and discussion, there has been no systematic approach to integrating knowledge from diverse, fragmented and incomplete sources. For a sustainable future, it is essential that megacities are not just understood as separate systems with multiple actors and stakeholders, but also studied and planned at a regional scale.

Image: © Indian Research Academy, 2017

Workshop on Community Managed Disaster Risk Reduction (CMDRR) with the Indian Research Academy. Author Shabana Khan is on the far right.

Gaps in practices and capacity building: The coping mechanisms of local communities often go unrecognised. In fact, they are rapidly disappearing as homogenising solutions to megacity water problems are phased in. This process disconnects communities from the local environment and water resources. Skewed perception of risks and responses can also create new threats to sustainability. A study conducted for the International START Secretariat (global change SysTem for Analysis, Research, and Training) shows that various actors engaged in water governance in Beijing, Mexico, Delhi and Lagos, had different notions of risks and different understandings of factors that influence responses, such as uncertainty, experiences, learning, trust, complexity, scale, and social contexts [10]. Officials have tended to follow guidelines rather than seeking to understand the risk context. Existing practices at the city scale will need to be rethought if more holistic water risk management practices are to be achieved.

To inform safe and sustainable development of megacities, we need to make sense of diverse risks, perceptions, capacities and responses. This requires interdisciplinary research to fulfill the critical need for data, knowledge integration, and bridge building between policy and practice.

References

[1] United Nations (2016). Department of Economic and Social Affairs, Population Division. The World's Cities in 2016 – Data Booklet (ST/ESA/ SER.A/392). Accessed on 15 January 2017 from http://www.un.org/en/development/desa/population/publications/pdf/urbanization/the_worlds_cities_in_2016_data_booklet.pdf

[2] UN-HABITAT (2011) State of the World's Cities 2010/2011 report. Accessed on 15th January 2017 from http://www.un.org/waterforlifedecade/water_cities.shtml

[3] United Nations (2016). Transforming Our World: The 2030 Agenda For Sustainability Development. A/Res/70/1. Accessed on 17 January 2017 from https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf

[4] Avellan, T. (2016). Closing Research Gaps in Water Science in Support of the SDGs. United Nations University. Accessed on 17th January 2017 from https://flores.unu.edu/closing-research-gaps-in-water-science-in-support-of-the-sdgs/

[5] Opryszko, M. C., Huang, H., Soderlund, K. & Schwab, K. J. (2009). Data gaps in evidence-based research on small water enterprises in developing countries. Journal of Water and Health. 7(4): 609–622. Accessed on 31 December 2016 from http://www.safewaternetwork.org/sites/default/files/Data%20Gaps%20in%20Small%20Water%20Ent%20-%20Journal%20of%20Water%20and%20Health%202009.pdf

[6] Kariuki, M. & Schwartz, J. (2005) Small-scale Private Service Providers of Water Supply and Electricity: A Review of Incidence, Structure, Pricing and Operating Characteristics. World Bank Report Number WPS3727, The World Bank, Washington, DC, USA.

[7] Khan, S. (2014). 'Towards Sustainability: Managing Integrated Issues of the Brown and the Green Agenda in Water Governance and Hazard Mitigation'. Policy Brief. http://chance2sustain.eu/67.0.html.

[8] McGranahan, G., Njiru, C., Albu, M., Smith, M. & Mitlin, D. 2006 How Small Water Enterprises can Contribute to the Millennium Development Goals: Evidence from Dar es Salaam, Nairobi, Khartoum and Accra. WEDC, Loughborough University. Accessed on 20th January 2017 from http://pubs.iied.org/pdfs/G00503.pdf

[9] Sansom, K. (2006) Government engagement with non-state providers of water and sanitation services. Public Admin. Develop. 26(3): 207–217

[10] Doyle, E. H., Kahn, S., Adler, C., Alaniz, R., Athayde, S., Lin, K. H., & Sword-Daniels, V. (2014). Risk Interpretation and Action (RIA): Decision Making Under Conditions of Uncertainty. Australasian Journal of Disaster and Trauma Studies, 16.

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DISSOLVABLE DEVICES

Gadgets that vanish without trace after function

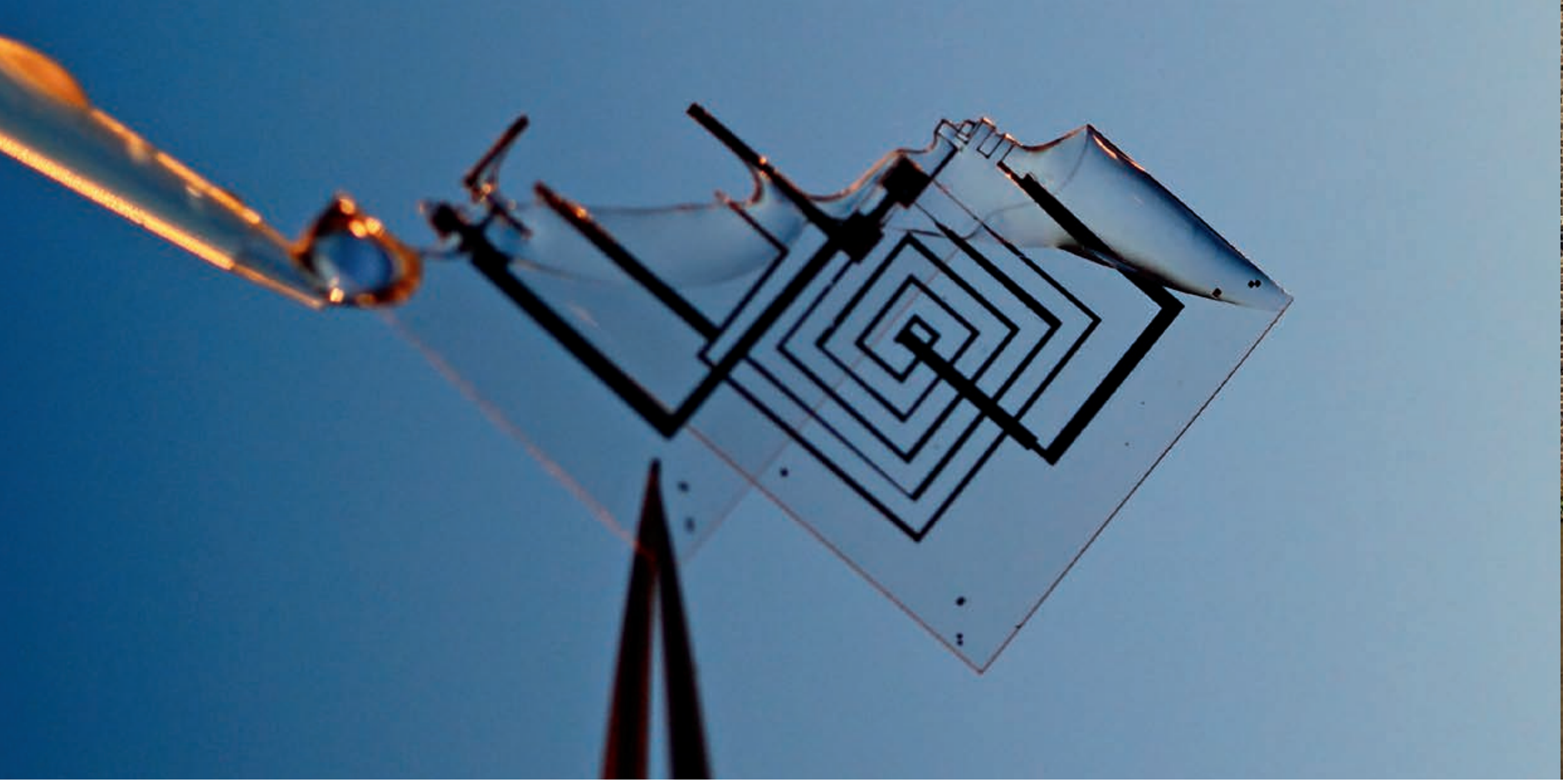
by Huanyu Cheng

The past decade has seen tremendous growth in the consumer electronics market. Electronic devices such as tablets and mobile phones contain non-renewable, non-biodegradable, and sometimes toxic materials, including heavy metals and organic compounds. The popularity of these devices has intensified environmental contamination, as ever larger quantities of electronic waste (e-waste) are discarded on a regular replacement cycle. In practice, disposal often begins with export from developed to developing countries, where contact with e-waste can expose workers and local residents to toxins.

This environmental load could be reduced by electronic systems that degrade after their functional timeframe. In contrast to mainstream efforts that focus on high-performance operation over extended periods of time, there is growing interest in developing electronic systems that dissolve into environmentally benign end products at controlled rates when exposed to water. Early work has demonstrated partial dissolution of components composed of organic materials. For instance, organic thin-film transistors have been developed on soluble polymeric substrates.

Soluble transistors could already reduce the environmental impact of e-waste. But dissolvable electronics have other applications too, some of which present more complex challenges. Biomedical implants are expected to function and then dissolve within a small pH range around body temperature. Thus, the degradation kinetics of candidate materials must be examined in biologically relevant conditions. For a given device, its sensing components are interconnected by conducting traces, which are then encapsulated, and assembled on a supporting substrate. Review of the materials for each component reveals a selection of dissolvable semiconductors for active sensors, transient metals for conducting traces, and biodegradable polymers for substrates and encapsulations..

But a new discovery suggests that this is just the beginning. It has recently been shown that semiconductor grade single-crystal silicon can be broken down in bio-fluids and water—a process known as hydrolysis. This is significant because silicon has been the workhorse of the electronics revolution since its inception. Dissolvable silicon will allow the field to leverage the scientific knowledge and engineering capabilities that have emerged from decades of re-



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search in traditional electronics. Alongside other thin forms of inorganic materials, such as transient metals for conductors and silicon oxide for insulators, thin layers of silicon provide a new basis for integrated circuits. An ideal dissolvable sensor would function stably over a designed lifetime, and then degrade quickly. Two time metrics govern these types of devices. The first is the lifetime of stable operation, which is determined by passivation and encapsulation, and can be controlled by the thickness and material selection of the encapsulation layer. The second time period is how long the material takes to fully degrade, which is determined by the dissolvable materials.

Already, experimental devices can take power from a range of sources—batteries, thin film solar cells, RF power scavengers, mechanical energy harvesters—and use this power to monitor a range of physical signals—pressure, temperature, pH, hydration, and electrophysiological activity. This versatility opens up a wide range of potential applications. In environmental monitoring, an electronic component can be used to transmit data, and then disintegrate safely without the need for retrieval. In surgery, an implant can be resorbed by the body, obviating the need for a second operation. In neuroscience, applications range from deep brain monitoring of intracranial pressure, to bioresorbable silicon electronics for spatiotemporal mapping of electrical activity from the cerebral cortex.

These applications are exciting, and presage many new developments in electronics. Over the past few decades, important components of dissolvable tattoo sensors, initially conceived as science fiction, have been transformed into a promising and viable technology. Such progress would not be possible without the efforts of scientists from diverse backgrounds. However, some of the most thought-provoking implications of this technology are in the realm of privacy and security. A device that can vanish without trace creates new possibilities for destruction of stored data—along with the storage medium itself. These concerns go beyond electronics, and raise ethical issues that deserve a wider forum. GYA members and alumni are working together to examine dissolvable electronics in its broadest context. Our interests span not only physical impacts of the technology, such as environmental contamination, but also human impacts via political and economic systems. Pursuing these ideas requires close collaboration between scientists, social scientists, and clinicians. Expect some novel solutions.

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FLOODING and adaptation to climate change: A European perspective

by Carina Keskitalo

If we look at global adaptation to climate change, the water sector is arguably where most has happened. This may not be surprising. Floods are often destructive events, and tend to focus the minds of decision-makers and the general public alike. Of course, not all changes in climate cause flooding, and not all flooding is caused by climate change. Nevertheless, flood risk has been the leading issue for climate change adaptation strategies throughout Europe. Despite this push, progress has been slow. Adaptation to climate change is not well integrated into flood risk management policy or water policy, and policy development does not always lead to action.

Institutionalising climate change adaptation, by embedding it in a procedural and regulatory framework, ensures that it can have some impact on future decisions. However, achieving institutionalisation is rarely straightforward. As theorists of agenda-setting [1] have noted, whether the 'policy window' opens for a given issue depends on several factors, including the activities of its advocates, the political context, the framing of the issue in relation to recognised risks and needs, and external events that speak to its importance.

The extent to which flood and water management has been linked to climate change varies widely across Europe. For example, the Floods Directive, to be implemented in conjunction with the Water Framework Directive, addresses climate change explicitly. However implementation of this directive is uneven—both within countries and between countries. Large, well-resourced municipalities that recognise a connection between climate change and water policy have tended to act more strongly than small municipalities or local councils. Implementation at the sub-state level is often voluntary, and state policy can end up motivating individuals to act without actually supporting action with appropriate resourcing and authority.

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Even when a policy is successfully implemented, maintaining it requires work. Any given issue competes with all the others for political attention. Thus, interest in climate change may rise and fall as education, migration, or the economy jostle for centre stage. As part of this dynamic, the framing of a issue evolves over time. For example, flooding may be presented as a matter for mitigation in the present, or adaptation in the future. Keeping the issue in political view through such turmoil requires strong voices, visible links to established policies, supportive political context—sometimes even pressure from further flooding.

Comparisons across countries illustrate some of the complexities. England – a country with high flood risk – focused on adaptation early on, and included adaptation in its Climate Change Act. However, a change of government, and the introduction of economic austerity measures, have led to a shift in emphasis. Some issues that had been strongly connected to climate change adaptation are now more strongly connected to flood resilience. This reframing may seem innocuous, but it can result in short-term responses, such as dredging being favoured over long-term responses, such as climate change management.

In Sweden, a focus on adaptation was delayed, because climate change was seen as a 'developing country issue', and hopes were high for mitigation strategies. However, increasing realisation of the scope and severity of climate change, and limited progress on climate change mitigation, have spurred Sweden into developing adaptation strategies. Southern counties in Sweden argued that flooding is a security risk and therefore the responsibility of the state. Nevertheless, Sweden has been criticized for having an unclear authority structure for dealing with climate change, and for being reluctant to make state funding at the local level. While resources for adaptation may be available in a general sense, they are not always accessible to smaller municipalities with flood risk. The situation is unlikely to improve unless climate change adaptation climbs the national political agenda.

In the private sector, the picture is just as varied. Many private companies, particularly small ones, have yet to factor climate change into their business considerations. A notable exception is the insurance sector. Perhaps unsurprisingly, given the nature of their business, insurance companies have been among the very first to take climate change seriously. As an early indication of this, the private insurance sector in the UK has insisted that cover for flood damage in new policies will have to become more limited. Interestingly, actions such as this in the private sector have contributed to the urgency of the matter in the public sector.

So far, climate change adaptation has climbed the political agenda only where it has been seen as the most urgent issue. For example, outside of Europe, some small island states have recognised the urgency. However, adaptation is not on the agenda in all cases where it is urgent. As the Intergovernmental Panel on Climate Change (IPCC) notes, 'future proofing' decisions against climate change remains a goal rather than a reality. In the water sector, the transformation has begun, but it is far from over. In the next stages, it will be important to bear in mind the political context required for coherent decision making, the effort needed to keep an issue on the agenda, and the value of institutionalisation in shaping outcomes.

Reference

[1] Kingdon, J. W. (1984). Agendas, alternatives, and public policies (Vol. 45, pp. 165–169). Boston: Little, Brown.

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Fresh Water scarcity in the Middle East and North Africa:

The need for practical solutions

by Jauad El Kharraz

Summary

While water scarcity is a global problem, water issues are by their very nature deeply local. The challenge is, in fact, an array of local crises playing out around the world. According to the UN's Water Scarcity Report 2005–2015 [1], physical water scarcity already affects around 1.2 billion people, and 500 million more people are soon to be affected. Economic water shortages affect an additional 1.6 billion people in countries that lack the necessary infrastructure to transport water from rivers and aquifers.

The Middle East and North Africa (MENA) region is the most water scarce region of the world. It is home to 6.3 % of world's population, but has access to just 1.4 % of the world's renewable fresh water. Consider these numbers on a personal scale. In other geographical regions, the average water availability per person is about 7,000 m³ per year. In the MENA region, it is just 1,200 m³ per year. MENA has the highest per capita rates of freshwater extraction in the world (804 m³/year) and currently exploits over 75 % of its renewable water resources. However, water availability is expected to plummet in the coming decades as population and the economy grow. By the year 2050, two-thirds of MENA countries could have less than 200 m³ of renewable water resources per capita per year.

Given these projections, there is a pressing need for improved water security policy and for knowledge exchange between experts in this area. Policy makers should consider technology-based solutions including water recycling and reuse, desalination, and water resource optimisation. Meeting the water scarcity challenge will require technical innovation, holistic water resource management, and clear strategies for sustainably providing water.

The MENA Context

Located within a semi-arid to arid region, MENA has an extremely poor endowment of water resources. Regional rainfall is scarce and variable, and evaporation rates are high. The availability of water in the region is increasingly influenced by changes in global systems, in terms of both environmental conditions (e.g. climate, hydrology), and anthropogenic influences (e.g. water use, water pollution).

The MENA region contains just 0.3 % of the world's freshwater sources, making it the world's most water-scarce region in both absolute and relative terms (See Fig 1.). Over 50 % of MENA countries are already below the water stress level of 500 m³ per person per year, and water availability is expected to decrease by 50 % by 2050, as demand continues to grow.

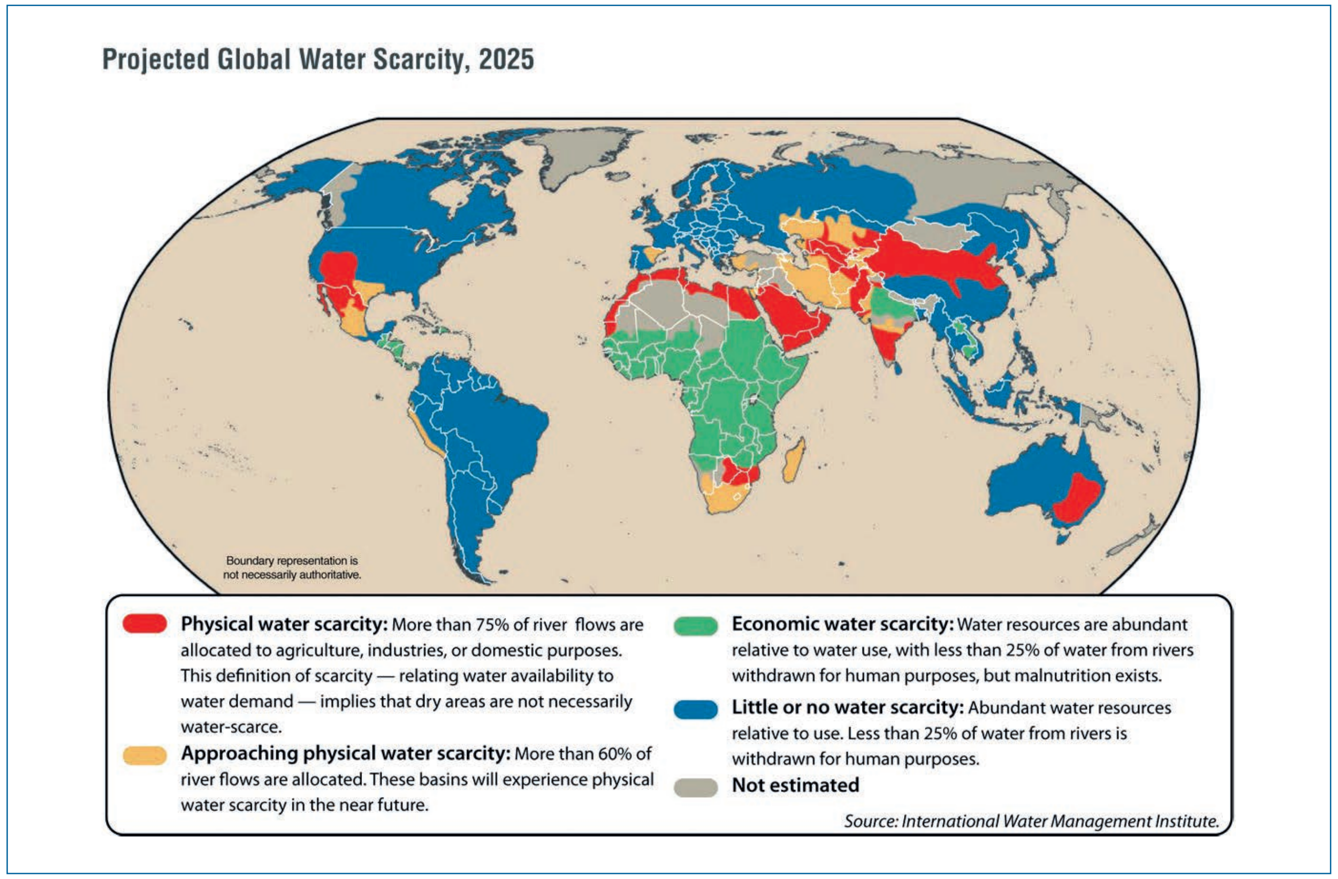

Figure 1: Water scarcity worldwide in 2025: imbalance between availability and demand

Unsustainable consumption and over-extraction of freshwater resources contribute to water shortages and threaten long-term sustainable development. On average, the agricultural sector continues to be the greatest consumer of water in the MENA region, although consumption levels vary significantly between countries. Around 85 % of the water in the MENA region is used for irrigation. This level of irrigation is not inherently sustainable and leads to overuse of scarce renewable water resources, which in turn results in increased salination. MENA's average water use efficiency in irrigation is only 50–60 %, compared to best-practice examples of above 80 % efficiency under similar climate conditions in Australia and the Southwestern United States. Similarly, physical water losses in municipal and industrial supplies in the MENA region are substantially above world averages. Non-revenue water is 30–50 % in some cities, compared to global best practice of approximately 10 % [2, 3].

Water utilities increasingly face freshwater shortages caused by drought, distribution losses, collateral damage to infrastructure, and energy costs associated with pumping water from more distant or deeper sources. These factors reduce their ability to provide regular and reliable services to domestic consumers.

The constraints associated with water management in the MENA region are well known, but subject to tremendous volatility as global climate changes. For example, a comparison of climate indices based on historical observations shows that there has been a consistent warming trend across the MENA region since the mid-twentieth century [1]. Increased volatility is expected to aggravate extreme phenomena such as floods and droughts, as well as regional variations such as population and tourism-related pressures in the coastal areas.. At the same time, demand for water will continue to rise with population and economic growth.

Current efforts to tackle water scarcity

For millennia, societies in the MENA region have innovated to improve water management and deliver water to where it is needed. And in modern times, the region is at the vanguard of some of the most advanced water management techniques. These include desalinating brackish and salt water (e. g. Algeria and Gulf countries), managing complex irrigation and drainage networks (Egypt), successfully privatizing urban water utilities (Morocco), managing efficient public sector water utilities (Tunisia), encouraging farmers to install water-saving irrigation technologies (Tunisia and Jordan), and using flash flood ('spate') flows to irrigate crops (Yemen).

Governments have sought to tackle water scarcity at three levels—physical resource, organisational capacity, and accountability. Most governments in the region have taken all affordable measures to capture, store, and augment supplies and have invested heavily in bringing water services to their populations. Recognising the need to manage the resource and supporting infrastructure carefully, the region has also begun making policy and institutional changes, including policies to promote end-use efficiency. Some countries, including Egypt, Jordan and Palestine, have approved national water resources plans, and awareness of the importance of an integrated approach to water management is growing. In addition, some countries have taken steps toward improving accountability in the sector. Overall, much has been done to tackle physical scarcity, and much remains to be done in addressing underlying challenges.

Figure 2: MEDRC RO Pilot Desalination Plant, MEDRC Headquarters at North Al-Hail Corniche, Oman

The MENA region is the world's largest importer of wheat, and recent economic instability has left its population even more vulnerable to food insecurity. There is an urgent need to ensure food security while avoiding negative impact on rural livelihoods. This has led MENA governments with agriculture-dependent sectors of society to pursue irrigation efficiency programmes, wastewater reuse, and water harvesting schemes as ways to conserve water resources. These measures were chosen over water pricing schemes that were thought to carry unacceptable socio-economic risks for vulnerable communities. Egypt, Jordan, Lebanon, Morocco, Oman and Tunisia have also sought to rehabilitate irrigation canals, terraces, and traditional water networks to improve the efficiency of agricultural water use, although flood irrigation remains dominant elsewhere in the region [5].

Some of the same countries have expanded water rationing and groundwater pumping to counter water shortages, while countries of the Gulf Cooperation Council (GCC) are looking at ways to increase water storage in aquifers to grow reserves and offset risks. Improvements in wastewater treatment for reuse and desalination have provided several new prospects for addressing water scarcity. Ultrafiltration (UF) and membrane bioreactor technologies are increasingly being used to remove fine particulates and macromolecules from wastewater. The use of reverse osmosis (RO) after filtration can achieve drinkable water quality, as is the case for the NEWater reclamation programme in Singapore, and Sulaibia—the largest wastewater treatment plant in Kuwait.

Despite these advances in technology, there are many gains still to be made in wastewater recovery. The total volume of wastewater generated by the domestic and industrial sectors in MENA region estimated at 13 billion m³ per year, of which only 6 billion m³ is treated for reuse [3]. In principle, treated wastewater is relatively reliable source, because the amount of wastewater produced is proportional to the amount consumed. In practice, however, its availability is limited by infrastructure capacity [6]. Across the MENA region as a whole, 57 % of wastewater is only partially treated or is not treated at all, although the recovery rate varies from country to country [7, 8].

Future practical solutions: Desalination and renewable energy

Desalination plants in MENA countries have a cumulative capacity of about 24 million m³ per day (see Fig 3.). The highest desalination capacity is in the Gulf Countries (GC) (81 %), with Saudi Arabia alone producing around 20 % of the world's desalinated water. Growth in this sector is expected to remain high for the next decade as domestic demand increases. Most of the anticipated increase in capacity will be concentrated in the region's high-income, energy-exporting countries. For example, more than 70 % of

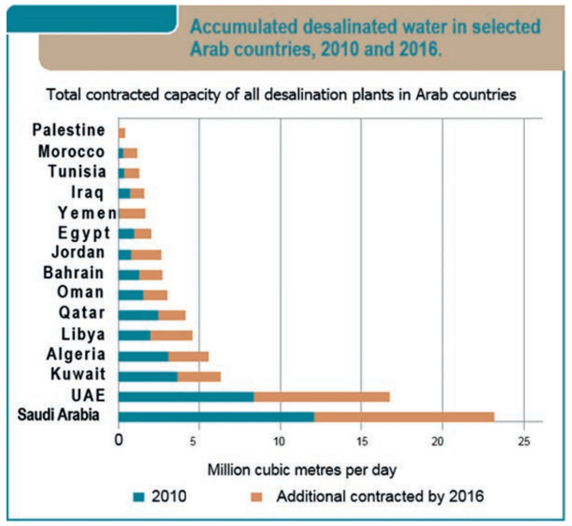

Figure 3: Accumulated desalinated water in selected Arab countries, 2010 and 2016. (Source: Arab League)

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the water supplied to cities in the GC already comes from desalinated water. This share is expected to rise as groundwater resources continue to deteriorate.

The GCC currently manufactures fresh water by using reverse osmosis (RO) to desalinate seawater. In Oman, agriculture is under pressure to improve water management and to explore available options to balance supply and demand. Desalination remains an excellent technical option to increase the availability of freshwater, both in coastal areas with limited resources and in areas where brackish waters – such as saline groundwater, drainage water and treated wastewater – are available. Greenhouse and hydroponic farmers are beginning to use RO to desalinate and purify irrigation water for greenhouse use (the RO product water tends to be lower in bacteria and nematodes, which also helps to control plant diseases). Small RO plants (See Fig 2.) have been built in rural areas where there is no other water supply option. Increasingly, Omani farmers are changing the irrigation water supply from a contaminated surface water canal source to an RO-desalinated brackish groundwater source. To take another example, a desalination plant in Gaza's Mediterranean shore was inaugurated in 2017 to serve Gaza's need for drinking water. This plant has the capacity to produce 6,000 m^3 of potable water per day, bringing safe drinking water to around 75,000 Palestinians in the southern Gaza Strip.

Water desalination is energy intensive, and currently relies mainly on fossil fuels. A transition to solar energy offers the prospect of increasing supplies of desalinated water while significantly reducing CO_2 emissions [9]. Deploying Concentrated Solar Power (CSP) for seawater desalination is one modern approach. Photovoltaic (PV) solar installations can also be used for brackish water treatment and for powering water pumping stations. However, the success of solar desalination technologies at commercial scales depends on the economic cost of converting solar energy into electricity. Current solar technology does not lend itself to large-scale desalination projects, but is useful at smaller scales, especially in remote areas where there is no grid electricity. In such areas, decentralised solar desalination plants offer independence and protection from price rises from utility or water companies, but the benefits of solar go far beyond desalination. Once installed, clean energy can also be used for soil fumigation and for drying animal feed for winter use. Thus deploying renewable solutions for the purpose of increasing water supply also creates opportunities in intersecting areas.

Very recent research has shown that graphene sieves can be used to remove salt from seawater [10]. This novel approach has the potential to make desalination much more efficient.

The bigger picture

The MENA region is responding to increased water scarcity, drought, climate variability and service deficiencies under changing and uncertain conditions. Technological options and improved water governance will continue to provide mechanisms for managing water scarcities. These measures should alleviate increasing tensions between water users in the short term. In the long term, a more integrated and inclusive approach to water management is needed if projected demand is to be met. Ensuring water security under conditions of increased water scarcity will require coordinated responses across sectors, and the recognition of water supply and sanitation as a human right is central to the achievement of sustainable development in the MENA region. When reconsidering development schemes at local and national level, due consideration must be given to societal and cultural context. For example, there is now an growing realisation of the need for cooperation in managing transboundary groundwater aquifers.

Tackling water scarcity means managing water demand and increasing water supply. The latter requires investment in wastewater reuse and desalination, and moving to renewable energy offers a sustainable and secure way to achieve desalination at scale. Until recently, solar desalination had been limited to small installations in remote areas, but with research and development efforts intensifying, large pilot desalination plants have operated successfully using solar energy. The MENA region has vast solar energy potential. Programmes to develop this potential are being supported by MENA governments including Algeria, Saudi Arabia, Bahrain, Oman, Morocco, Tunisia, Qatar, and the UAE. Among their highest priorities are developing solar-powered desalination technologies, producing energy from the brine water salinity, and reducing the energy required for desalination. If successful, these programmes will significantly improve water supply across MENA. More broadly, they also stand to improve the region's social, environmental, and economic conditions.

References

[1] Donat Castelló, L., Gil-González, D., Alvarez-Dardet Diaz, C. and Hernández-Aguado, I. 2010. The environmental millennium development goal: Progress and barriers to its achievement. Environmental Science and Policy, 13(2): 154–163.

[2] J. El Kharraz, El-Sadek A., Ghaffour N., Mino E., Water scarcity and drought in WANA countries, Procedia Engineering 33 (2012) 14–29, 2012.

[3] S. Zafar, Water Scarcity in MENA, 2014, Ecomena

[4] Jan Friesen, UFZ and Ralf Klingbeil, 'Water scarcity in Middle East North Africa: challenges and opportunities for water science cooperation', 2013. MENA NWC

[5] ICARDA/GEF/IFAD (International Center for Agricultural Research in the Dry Areas/Global Environment Facility/International Fund for Agricultural Development). 2013. Rehabilitating Irrigation canals and olive trees boosts farmer income in Jordan. MENARID Gateway, Knowledge Fact Sheet.

[6] C. Kfouri, P. Mantonvani and M. Jeuland, "Water Reuse in the MENA Region: Constraints, Experiences, and Pol-icy Recommendations," In: Jagannathan, et al., Eds., Wa-ter in the Arab World: Management Perspectives and In-novations, The World Bank, Washington DC, 2009, pp. 447–477.

[7] B. Ammary, "Wastewater Reuse in Jordan: Present Status and Future Plans," Desalination, Vol. 211, No. 1–3, 2007, pp. 164–176.

[8] A. Zyadin, "Water Shortage in MENA Region: An Interdisciplinary Overview and a Suite of Practical Solutions", Journal of Water Resource and Protection, 2013, 5, 49–58.

[9] J. El Kharraz, Solar desalination in the MENA region, Arab Water World (AWW) magazine, pp. 16–18, December 2015.

[10] Abraham, J., Vasu, K. S., Williams, C. D., Gopinadhan, K., Su, Y., Cherian, C. T., ... & Carbone, P. (2017). Tunable sieving of ions using graphene oxide membranes. Nature Nanotechnology.

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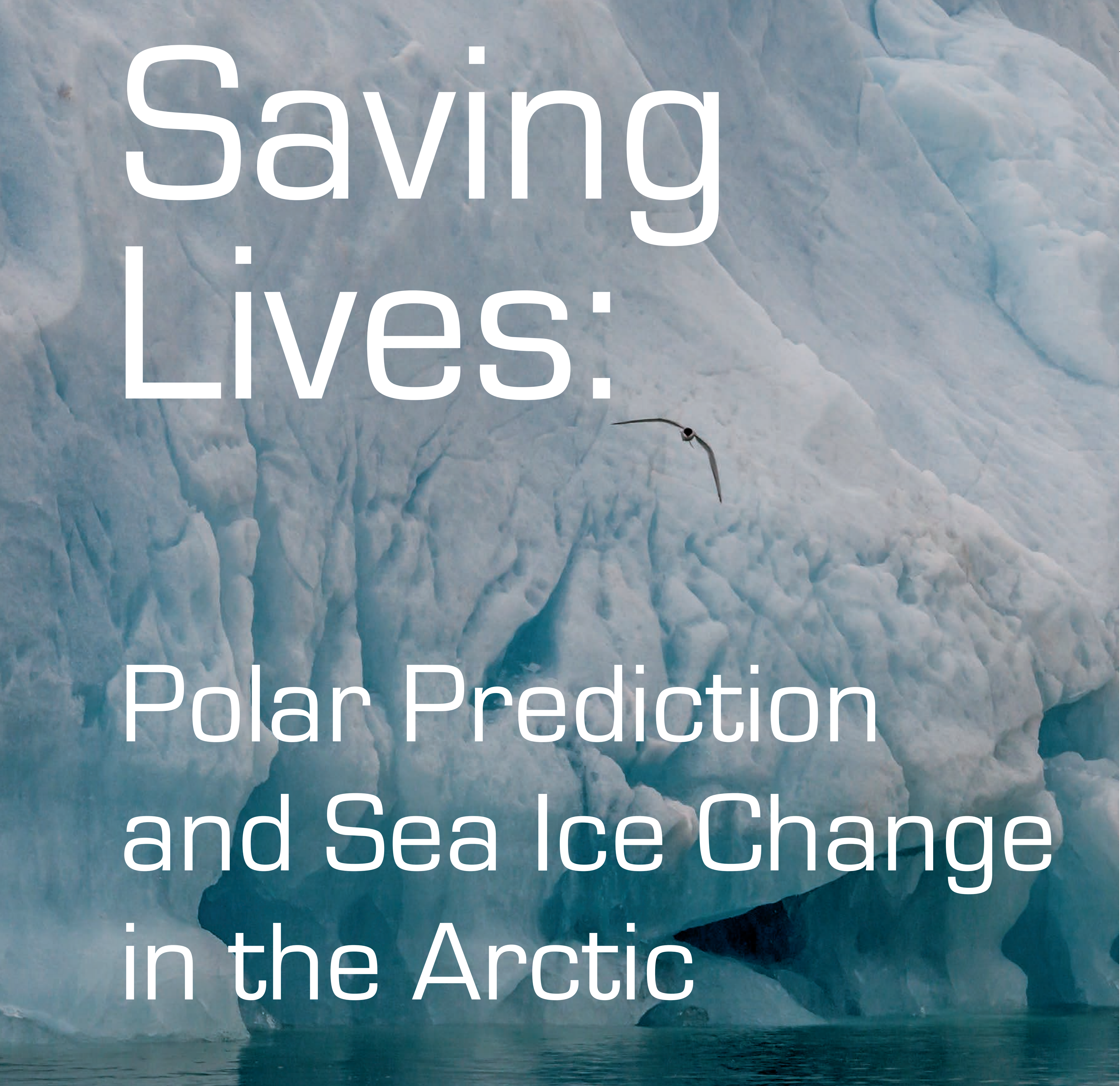


Saving Lives: Polar Prediction and Sea Ice Change in the Arctic

by Jackie Dawson

When we think about the importance of water we may not consider its significance in a frozen state. Yet, in the Arctic, sea ice moderates global climate, facilitates life preserving microbial environments, enables survival of iconic marine mammals such as walrus and polar bears, and supports fundamental human transportation routes among northern communities and to harvesting areas. Given the rapidly changing climate, it is increasingly important to understand how sea ice is changing, how these changes impact human systems, and what responses may be most appropriate in reducing risk and preserving favourable ecological, economic, and cultural conditions.

Average surface air temperature has increased faster in the Arctic than anywhere else in the world (AMAP, 2012; Serreze and Barry, 2011), and has influenced a decline in sea ice extent observable since the beginning of the satellite record in 1979 (Serreze and Stroeve, 2016; Serreze et al., 2009; Strove et al., 2011). The total extent of Arctic sea-ice (made up of thick multiyear ice) decreased from about 75 % in the mid-1980 s to 45 % in 2011 (Maslanik, 2011). These changes in climate and ice conditions have improved navigational opportunities along the major Arctic shipping routes—the Northern Sea Route, Transpolar Route, and the Northwest Passage—attracting cruise ships, cargo transport, fishing, research, and tanker activities related to resource extraction (AMAP, 2012; Pizzolato et al., 2014, 2016; Dawson et al. 2017). These trends are expected to continue as sea-ice recedes further (Smith and Stephenson, 2013; Pizzolato, 2014), garnering investments in the range of C$100bn (Lloyds, 2012) to €225bn (Synberg, 2013) over the next decade (also see Mikkola and Käpylä, 2013). This situation is both exciting and alarming for Arctic nations, industries, and local residents as they begin to navigate the opportunities and risks of a changing Arctic marine environment.

Changing ice conditions are becoming increasingly difficult to read and predict for Inuit harvesters and northerners who view sea ice as a vital extension of their traditional lands (ICC, 2008, 2015). A changing environment has led to an increase in accidents near Inuit communities including drownings, deaths, and vehicle losses. Variability in ice conditions has changed so quickly and so dramatically that Inuit elders who once had an intimate understanding of the ice are no longer able to distinguish between ice that is safe or unsafe for travel (Laidler et al. 2009, 2010). In-

Image: © CC BY 2.0 – NASA ICE, 2011

dustrial shipping accidents are also becoming more visible. These accidents include fuel leaks, groundings, ice strikes and, perhaps most concerning, sinkings—including loss of the MS Explorer, a cruise ship that struck an iceberg in the Antarctic (Stewart and Draper 2008).

Local residents, industries, and decision makers may not agree on how emerging biophysical and socioeconomic uncertainties should be handled. But all agree on the need for research and policy to address sea ice prediction and risk reduction. In direct response to this need, the World Meteorological Organization (WMO) is leading a major international initiative called the Polar Prediction Project (PPP). The goal of this project is to enable a significant improvement in prediction capabilities by coordinating a period of intensive observation, modelling, verification, user engagement, and education activities via the Year of Polar Prediction (YOPP) initiative. The core phase of this focused international effort begins this year and will continue until 2022.

The Polar Prediction Project will undoubtedly generate substantial new data sets, spur development of innovative technology, and lead to greater understanding of cryospheric dynamics. These outcomes are vital. However, the pursuit of scientific understanding must not overshadow the translation of new knowledge into risk reduction. Merely improving our ability to observe and predict sea ice conditions across Polar Regions will not prevent loss of life, environmental disasters, or other substantial impacts. What will make the real difference is translating observations and predictions into improved navigation and decision-making by Inuit hunters, international cargo shippers, and others in the region.

This relationship between science and end-users is the focus of the WMO's Societal and Economics Research Applications (SERA) working group. The Global Young Academy's Climate Change and Disaster Risk Reduction (CCDRR) working group has joined forces with SERA for the YOPP period (2017–2022). Together, they take on the challenge of combining highly technical scientific information with fundamental traditional knowledge (i.e. Inuit understanding and observations of changing sea ice), and ensuring that new knowledge is used to reduce risk and save lives.

References

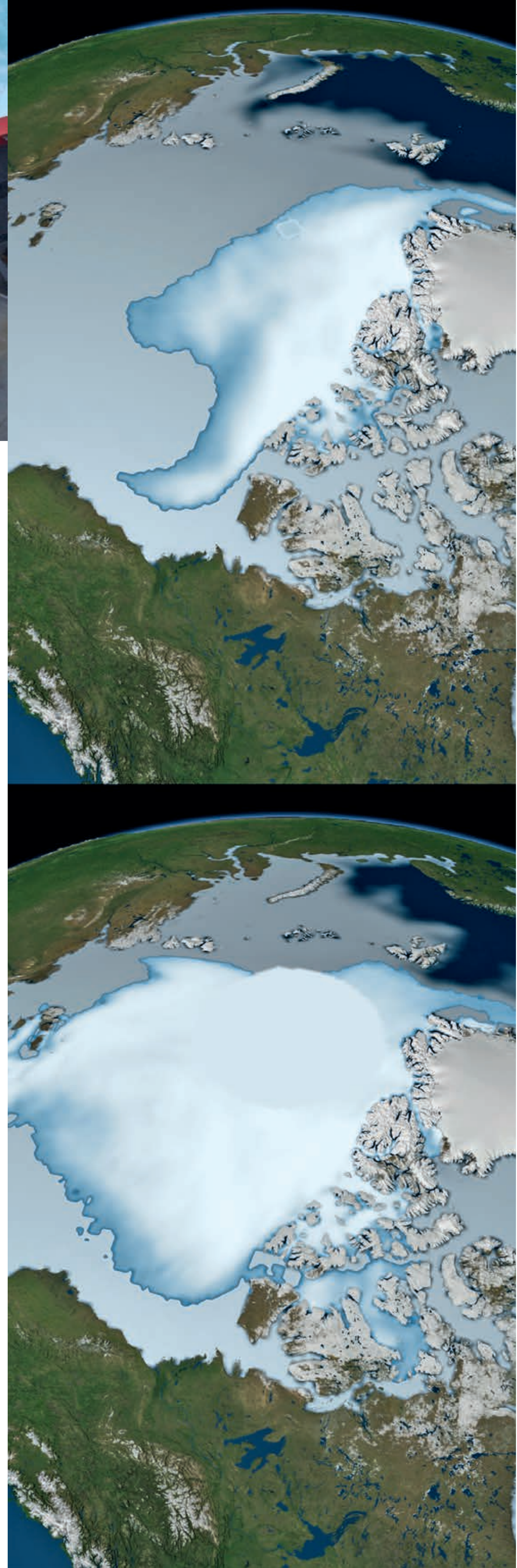
[1] AMAP, 2012. Arctic Climate Issues (2011). *Changes in Arctic Snow, Water, Ice and Permafrost.*

[2] *SWIPA 2011 Overview Report*. Arctic Monitoring and Assessment Programme (AMAP), Oslo. xi + 97 pp

[3] Dawson, J., Copland, L., Johnston, M.E., Pizzolato, L., Howell, S., Pelot, R., Etienne, L., Matthews, L., and Parsons, J. (2017). *Adaptation Strategies and Policy Options for Arctic Shipping in Canada.* Report prepared for Transport Canada. Ottawa.

[4] ICC (Inuit Circumpolar Council - Canada). (2014). *The Sea Ice Never Stops: Reflections on sea ice use and shipping in Inuit Nunaat.* ICC Canada: Ottawa, ON, Canada. Retrieved from: http://www.inuitcircumpolar.com/uploads/3/0/5/4/30542564/sea_ice_never_stops_-_final.pdf

[5] ICC (Inuit Circumpolar Council - Canada). (2008). *The Sea Ice Is Our Highway: An Inuit Perspective on Transportation in the Arctic*. ICC Canada: Ottawa, ON, Canada. Retrieved on February 11, 2014 from: http://inuitcircumpolar.com/files/uploads/icc-files/20080423_iccamsa_finalpdfprint.pdf



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[6] Lloyd's (2012). *Arctic Opening: Opportunity and Risk in the High North*. London: Chatham House. http://www.lloyds.com/~/media/Files/News%20and%20Insight/360%20Risk%20Insight/Arctic_Risk_Report_20120412.pdf

[7] Laidler, G. J., Ford, J., Gough, W. A., Ikummaq, I., Gagnon, A., Kowal, S., Qrunnut, K., and Irngaut, C. (2009). Travelling and hunting in a changing arctic: Assessing Inuit vulnerability to sea ice change in Igloolik, Nunavut. *Climatic Change,* 94: 363–397.

[8] Laidler, G. J., Elee, P., Ikummaq, T., Joamie, E., and Aporta, C. (2010). "Mapping Sea-Ice Knowledge, Use, and Change in Nunavut, Canada" (Cape Dorset, Igloolik, Pangnirtung). In: Krupnik, I., Aporta, C., Gearheard, S., Laidler, G. J., and Kielsen-Holm, L. (eds.). *SIKU: Knowing Our Ice, Documenting Inuit Sea-Ice Knowledge and Use.* Dordrecht: Springer. pp. 45–80.

[9] Maslanik, J., Stroeve, J., Fowler, C., & Emery, W. (2011). Distribution and trends in Arctic sea ice age through spring 2011. *Geophysical Research Letters*, 38(13), 1–6.

[10] Mikkola, H. & Käpylä, J (2013). *Arctic Economic Potential: the need for a comprehensive risk-aware understanding of Arctic dynamics*. FIIA Briefing Paper. Helsinki: FIIA. Retrieved from, file:///Users/jdawso5/Downloads/bp127.pdf

[11] Pizzolato, L., Howell, S., Dawson, J., Laliberte, F., and Copland, L. (2016). The influence of declining sea ice on shipping activity in the Canadian Arctic. *Geophysical Research Letters,* 43(23), 12146–12154. doi: 10.1002/2016GL071489

[12] Pizzolato, L., Howell, S. E. L., Derksen, C., Dawson, J., & Copland, L. (2014). Changing sea ice conditions and marine transportation activity in Canadian Arctic waters between 1990 and 2012. *Climatic Change, 123*(2), 161–173. doi: 10.1007/s10584–013–1038–3

[13] Serreze, M.C., and Barry, R.G., (2011). Processes and Impacts of Arctic amplification: A research Synthesis, *Global and Planetary Change*, 77, 85–96.

[14] Serreze, M.C., Stroeve, J., Barrett, A.P., (2016). Summer Atmospheric Circulation Anomalies over the Arctic Ocean and their Influences on September Sea Ice Extent: A Cautionary Tale, *Journal of Geophysical Research*, 121 : 19, 11, 463–11,485.

[15] Serreze, M.C., et al, (2009). The Emergence of Surface-based Arctic Amplification, *The Cryosphere*, 3, 11–19.

[16] Smith, L. C. and Stephenson, S. R. (2013). New Trans-Arctic shipping routes navigable by mid century, *Proceedings of the National Academy of Sciences,* 110, E1191–E1195.

[17] Stewart, E.J., and Draper, D. (2008). The sinking of the MS Explorer: implications for cruise tourism in Arctic Canada. *Arctic*, 61 (2), 224–228.

[18] Stroeve. J.C., Maslanik, J., Serreze, M.C., Rigor, I., Meier, W. (2011). Sea ice response to an extreme negative phase of the Arctic Oscillation during winter 2009/2010. *Geophysical Research Letters*, 38, L02502.

[19] Synberg, K. (2013). Russia and the Arctic. *Baltic Rim Economies Review*, 2, 53.

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Anticipatory Governance:

Engaging Citizens in Shaping the Future

by Lekelia D. Jenkins and Lauren E. Oakes

The problem was clear and not uncommon. Too many boats, too much fishing, too few fish. The West Coast trawl fishery in the United States stood on the edge of collapsing populations. Seven fish populations were in dire straits. But this familiar problem had a new solution. Allowing fishermen to use different, more ecologically-friendly fishing gear could protect troubled fish populations and their habitat. If policy-makers could allow fishermen to switch from trawling gear to pots or longlines, would fishermen take the leap? During the summer of 2007, Dr. Kiki Jenkins, now Assistant Professor at Arizona State University, decided to find out. Loading up her biodiesel powered 1984 Peugeot, she scoured the fishing docks from Fort Bragg, California to Neah Bay, Washington. She wasn't imposing solutions. She wasn't soliciting feedback. She wasn't checking off boxes for public participation in policy-making. Beyond researching the feasibility of a policy solution, she was testing foresight and engagement—fundamental elements of anticipatory governance.

Anticipatory governance is a process in which stakeholders and the public can prepare for the impact of a technological innovation while the innovation is still a nascent idea. Jenkins' explorations of the West Coast fishing community showed that these same principles apply to policy innovation as well.

Proactive engagement and integration, now fundamental elements of anticipatory governance, emerged in part from a white-walled laboratory in stark contrast to the weathered docks of the Western coastline. In 2003, the U.S. National Nanotechnology Initiative became a legal mandate requiring the inclusion of social concerns into the Nanotech Research & Development (R&D). Yet the law didn't describe how to achieve this integration. The research community did not even know whether observing this law was possible in practice.

Erik Fisher, a doctoral student at the time, had a hunch. Having spent years in experimental research, Fisher wondered whether decision-making in the lab could guide implementation of this new policy. To find out, he embedded himself in a nanotube research lab, holed up with scientists working amidst stacks of cartridges and a furnace filtering gases. Carbon nanotubes, also known as buckytubes, are sheets of carbon rolled into a cylindrical structure. Advances in nanotube technology have improved the performance of lithium batteries in smart phones, tracking of threatened fish and wildlife species in ecological research, and x-ray technology in hospitals. There is no doubt that these man-made molecules are useful. Yet, no one knows what unintended consequences could follow their deployment.

In his time at the nanotech lab, Fisher made a habit of four simple questions: What are you doing? Why are you doing it? Where might this go? And who cares? By probing researchers about the possibilities of their research and reflecting their own understandings back, Fisher made an important discovery. When study participants began thinking about different ways they could do things, they began to examine the values behind their own choices. They were able to imagine and then pursue alternatives that they had never considered, such as replacing a readily available but potentially harmful chemical with one that is harder to find, but safe.

Taking anticipatory governance out of the lab and into the policy domain involves three steps: anticipation and assessment of an emerging situation; engagement of stakeholders who have not been involved; and integration of broader considerations into early-stage development of technologies. Ideally, anticipatory governance allows people who stand be affected by an innovation to learn about that innovation years or even decades in advance, and to guide its development in an effort to minimise negative impacts and maximise positive ones.

In her months of talking with fishermen and resource managers, Jenkins discovered that people who knew very little about fishing gear could engage in an imaginative exercise and develop their own future scenarios of the policy and its practical implications. "Initially, I didn't realise that my research had anything to do with anticipatory governance; it wasn't intentional at first," she recalls.

Image: © CC BY 4.0 – Hans Hillewaert, 2010

Then there came an opportunity to shift a fishery towards a more sustainable system. “I needed to sketch just enough of this new idea that my interviewees could spin it forward, but without presenting any kind of a full picture. I wanted their own vision of what this could mean in the future.”

While Jenkins crunched the data from the fishing docks, Karen Garrison, Co-Director of the Oceans Program for the Natural Resources Defense Council, took up the dialogue. Garrison favoured conversion from trawl fishing gear to lower-impact gear as a management option. Her task was to introduce this idea to stakeholders—to engage them on policies that were under consideration. “I was surprised that there was so much openness to the idea from quarters where I didn’t expect it,” she recalls. “People were more able to express their ideas in interviews than I have witnessed before. I don’t think that would have been the case with the usual public comment process.” Garrison saw the process of anticipatory governance in the trawl fishery as similar to a technology assessment. “We looked at a future technology and tried to understand the impacts it might have, instead of just allowing it to happen. I think that’s a very useful approach.”

The future scenarios they imagined came to the fore three years later and facilitated implementation of new policy that was authorized by the U.S. Government in August 2010. Jenkins’ work evolved into a natural experiment for anticipatory governance, and showed that it is possible to envision as-yet-undefined futures in a way that will hold meaning, relevance, and value for future policy-making processes.

Fisher too sees enormous potential for anticipatory governance in the policy arena. He believes that the foresight, engagement, and integration he fostered in the lab occurs constantly in our actions and our decision-making processes. Fisher’s process involved observing scientists, describing their own actions back to them, seeking feedback on why they chose those actions, and then eliciting alternative actions that are more mindful of other perspectives. Conflict mediation, for example, draws upon this technique. He says, “The methods aren’t new. It’s putting them together for new purposes that’s new.”

Critics often claim that the traditional public participation process is an ineffective method of going through the motions—thirty-day comment periods or input solicited merely to fulfill regulatory obligations. The practice of anticipatory governance in policy development and implementation could make public participation more meaningful for all concerned. Realising the potential of anticipatory governance requires answering two key questions: Will people find enough merit in the process to actually engage in it? And will the discussion be truly relevant to distant future issues that anticipatory governance is trying to manage?

The work of Fisher and Jenkins represents incremental but significant progress towards answering these unknowns. The researchers Fisher observed became increasingly enthusiastic about the project and his methods. Several expressed gratitude for what they had learned in answering his four simple questions. Jenkins engaged people who had not given much thought to changing fishing gear, and moved them to a place where they could reach a view on the proposal and its implications. When it came to the public comment process, the fishermen and others held true to the futures they had envisioned during interviews with Jenkins.

These efforts in nanotube labs and trawling waters are experiments in anticipatory governance. Both provide models for engaging citizens in shaping technological and policy futures, and both identify key questions. What will be the scope of applications for anticipatory governance? How can we engage stakeholders that are indirectly affected by a policy? What is the optimal delay between the envisioning and realization of potential futures? Answering these questions will deepen our understanding of anticipatory governance, to the benefit of communities, stakeholders, and society at large.

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Wastewater treatment

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Adsorption advanced

by Felycia Edi Soetaredjo

Water is critical to life on Earth, and water degradation is one of the biggest environmental problems facing us today. Although water covers around 70% of Earth’s surface, almost all of this is salt water that can not be used directly for drinking or agriculture. Only 2.5% of water on Earth is fresh water, and less than half of that is accessible. In many areas of the world, clean water is already in short supply, and demand will only continue to grow as the human population increases.

The imbalance between supply and demand is exacerbated by industrialisation. In recent decades, contamination of clean water by industrial effluents and wastewater has intensified. Many manufacturing processes use a significant amount of water in some production steps, for example washing of raw materials, dilution, cooling, and sanitation. Particulates and chemical compounds in wastewater from those processes are often toxic, and their entry into waterways can have adverse effects on the environment and human health.

Industrial activities release a wide variety of pollutants via wastewater, including heavy metals, organic compounds, and inorganic compounds. The range of heavy metals commonly found in wastewater includes lead, arsenic, chromium, mercury, copper, cadmium, and zinc. Each of these has known toxic effects. Unfortunately, heavy metals are highly persistent, which makes them very difficult to eliminate from the environment. Organic pollutants in wastewater range from biocides and antibiotics to aromatic organic solvents—even synthetic dyes. Like heavy metals, biocides and antibiotics are resistant to biological degradation, and tend to accumulate in the food chain. An added complication is that microorganisms may develop resistance to biocides or antibiotics as a result of long-term exposure. Not only does resistance jeopardise the utility of these treatments, it can also disrupt the balance of ecologies where it is introduced. Aromatic organic solvents pose a more direct challenge. Many of these substances are carcinogenic or mutagenic, and their presence in water—even at low concentrations—represents a significant health risk.

A number of techniques have been developed for removing hazardous substances from water and wastewater. Different techniques are suited to different applications. However, some are much more costly to set up and run than others. Adsorption, in which unwanted molecules stick to the exposed surface of a solid, is a cost-effective method of removing low to medium concentrations of a wide range of pollutants, including heavy metals, antibiotics, and dyes.

Water and wastewater treatment methods

Physical processes	Screening	Removal of gross pollutants such as rags and debris to protect downstream equipment.
	Comminution	Pulverisation of large floating materials to reduce unsightliness, flies, and odour.
	Flow equalisation	Leveling out flow, pollutant levels, and temperature to minimise effects downstream.
	Sedimentation	Removal of heavy particles suspended in a mixture, such as grit, particulate matter, and biological floc.
	Flotation	Removal of light, tiny by gas bubbles. Mainly used to remove suspended matter and concentrate biological sludge.
	Filtration	Removal of unwanted substances using a filter. Widely used to remove suspended solids from effluents of biological and chemical treatment processes. Membrane filtration is used to treat drinking water and for desalination.
Chemical processes	Chemical precipitation	Used to promote flocculation of fine solids into settleable flocs. Enhances the efficiency of subsequent processing steps.
	Adsorption	Removal of molecules by adhesion to the exposed surfaces of solid bodies with which they are in contact. Effective in removing dissolved matter even in very low concentration. Applied in water treatment to remove heavy metals, other fine contaminants, and odour.
	Disinfection	Destruction of microorganisms that may cause waterborne diseases.
	Dechlorination	Removal of chlorine from chlorinated wastewater effluent using adsorption by activated carbon or addition of reducing agents.
Biological processes	Activated sludge process	A method for stabilising organic matter. An active mass of microorganisms aerobically degrades organic matter into carbon dioxide, water, new cells, and other end products.
	Aerated lagoon	Similar to activated sludge process. The large surface area of a lagoon may cause more temperature effects. Aeration is used to oxygenate wastewater and to create turbulence to keep the basin contents in suspension.
	Trickling filter	A biological filter used for the removal of organic matter. Organisms are attached to a fixed bed of highly permeable medium. Percolation of wastewater causes a biological slime layer to form.
	Rotating biological contactors	Similar to a trickling filter, but using large discs that slowly rotate through the wastewater.
	Pond stabilisation	A natural process for primary treatment of organic waste and effluents, which includes aerobic, anaerobic or aerobic-anaerobic biological activities.
	Anaerobic digestion	Treatment of sludge and wastewater with high organic content in the absence of molecular oxygen.
	Biological nutrient removal	Removal of excess nitrogen and phosphorus from wastewater using microorganisms to avoid eutrophication of lakes and reservoirs.

Source: Adapted from Metcalf and Eddy, Inc., Wastewater Engineering, 3rd Edition.

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Adsorption is a simple technique in principle. The challenge is identifying suitable adsorbents for the targeted pollutants. Currently, the leading commercial adsorbent for water purification and wastewater treatment is activated carbon—an extremely porous substance with a high surface area. Activated carbon is a very effective adsorbent, but it is too expensive for wastewater treatment on any large scale. Our research group, at the Department of Chemical Engineering, Widya Mandala Catholic University Surabaya, Indonesia, has been developing more affordable alternatives. We have pioneered the use of biomass and clay materials in producing high-capacity adsorbents that can remove hazardous compounds such as antibiotics, heavy metals and dyes from water. These new adsorbents have already been implemented by an electronics company in Central Java, Indonesia, to treat wastewater from painting processes. They have also been used on our University campus to reduce the ammonia content of Koi fish ponds.

These successes bode well for the application of low-cost adsorption technologies in other treatment settings. Industrial wastewater tends to draw attention, especially when it contains high levels of toxins. Municipal, domestic, and agricultural wastewater often contains lower levels of toxins, but its overall volume is high. Cheaper methods for treating wastewater of all types will need to be developed, if the quality of surface water and ground water is to be maintained. As different types of wastewater contain different impurities, a range of low-cost adsorbents with distinct performance profiles will be an asset.

One-third of people in the world are already living in fresh water scarcity. Without access to adequate sanitation, many are vulnerable to cholera, typhoid fever and other potentially fatal water-borne diseases. Water conservation is urgently needed to ease this crisis, but technical advances alone will not solve it. To be effective, water conservation requires a social, economic, and political framework based on a rigourous understanding of the geography and demography of each affected region. In bringing together young researchers from different disciplines and different parts of the world, the Global Young Academy provides an important opportunity to make progress at that level.

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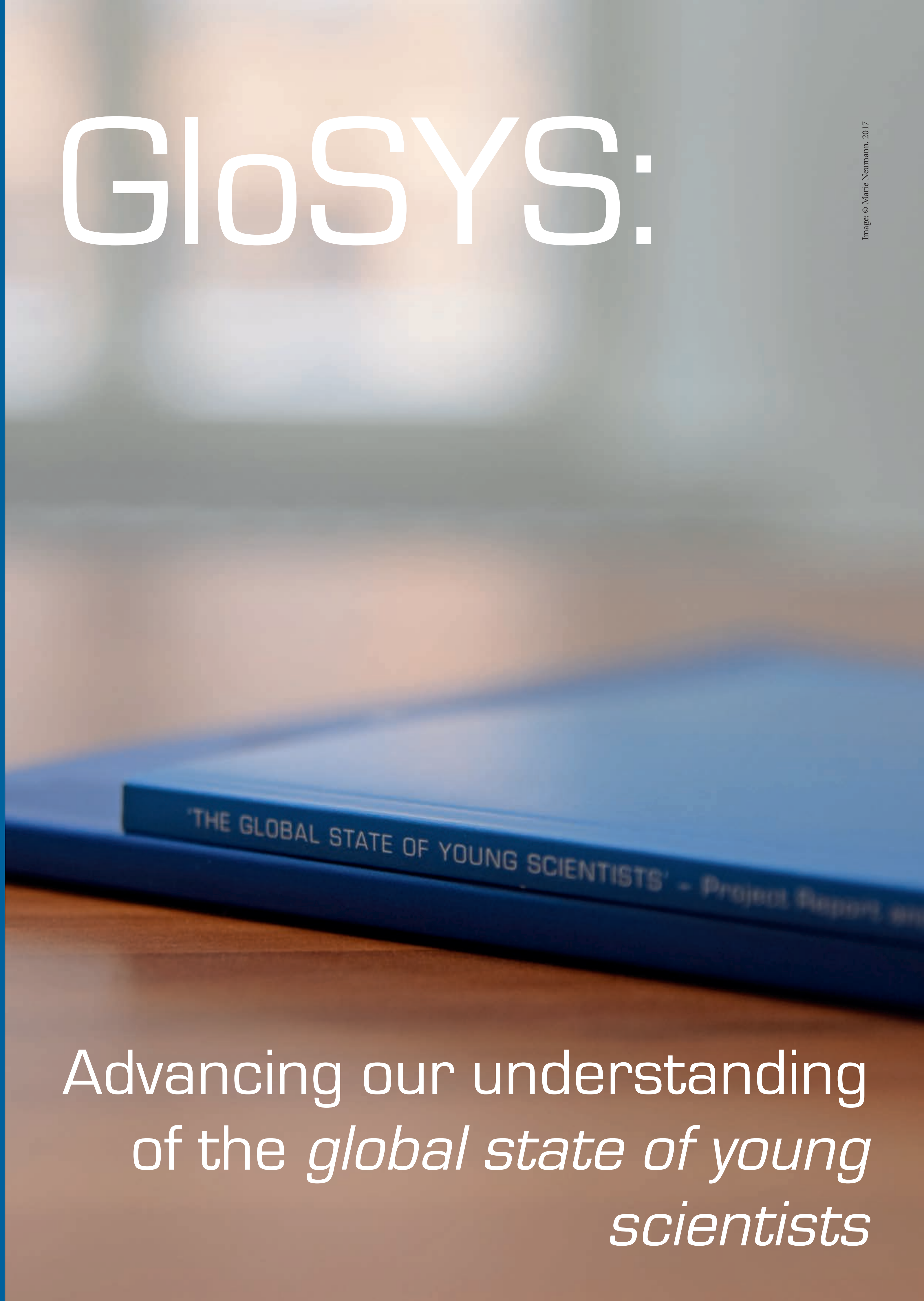
02

GLOBAL
YOUNG
ACADEMY

ACTIVITIES



GloSYS:

Advancing our understanding of the *global state of young scientists*

Image: © Marie Neumann, 2017

GYA Activities

by Marie Neumann

In many regions of the world, public trust in science and scientific authority has been waning. Conversations within the scientific community about the place of science in society have been reinvigorated as a consequence of this trend. Many are asking with renewed energy: To what extent should science shape policy? How can we teach and communicate science most effectively? And, more broadly, *what is the appropriate role of science in society*?

Discussed and acknowledged much less often is *the role that society plays in science*.

Late last year, Nature magazine dedicated a special issue to the challenges faced by early-career researchers. Featured articles describe a research environment characterized by a lack of available funding and the resulting intense competition for grants, an evaluation process connected disproportionately to the quantity rather than the quality of scientific publications, and a lack of support for researchers who try new paths. This, some of the authors argue, is bad not only for young scientists, but for science itself [1].

While discussions about the role of science in society are of utmost relevance and importance, it is perhaps equally critical to step back and evaluate the social and structural context in which research today is conducted. This is what the GYA's *Global State of Young Scientists (GloSYS)* project aims to do. Our study of the motivations that drive young scientists and the challenges they face in their careers provides us with evidence we can use to develop policy recommendations aimed at ensuring that young scientists receive the support they need to be successful.

"Scientific research is as much the product of the society that enables it, as of the individuals who author it."

David Dorling, Professor of Geography, Oxford University, 2006

Why *young* scientists?

The idea that scientists are often their most innovative toward the beginning of their careers is not new and was, for example, endorsed by Charles Darwin (in 1859) and Max Planck (in 1936). It was Planck who famously quipped that *science advances one funeral at a time*. Of course, Planck's statement is hyperbole, but some recent studies seem to suggest that young researchers are, in fact, especially open to investigating new ideas.

The authors of one study developed software that analyzed the titles and abstracts of all papers published in the field of biomedicine since 1946 – more than 20 million of them – to assess at which point in their career a scientist is most likely to cite new ideas. They find that papers authored by scientists with a lower "career age" are more likely to build on new ideas than those published by researchers further along on their career paths. Perhaps more interestingly, the same study found the most innovative author pairing to be an early-career researcher as the first author with a mid-career researcher as the last author.

Findings like these suggest that young scientists may be especially open to new ideas, particularly in a context where they receive mentorship from more experienced researchers. They also underscore the importance of understanding the structural and cultural environment in which young scientists are establishing their careers, and the kinds of resources and support they receive.

The GloSYS Studies

Two completed GloSYS studies have helped increase our knowledge of these contextual factors and how they may shape the trajectories of young scientists. These studies utilize a mixed-methods approach: we 1) gather pre-existing statistical data and conduct literature and policy analyses, 2) collect survey data, and 3) conduct one-on-one interviews with young scientists. When integrated and analyzed together, these different types of information help paint a detailed picture of how young scientists today are faring, and how they can best be supported in their careers and research efforts.

The initial GloSYS study was a first attempt to assess the state of young scientists globally. We found that many young scientists take on extreme workloads in order to progress in their careers. Unfortunately, this leaves relatively little time for inspiration and creativity – important ingredients in the recipe for innovative research – and makes it difficult to lead a satisfying personal life. Study findings also point to a need for more systematic and constructive support, mentoring, and training. Perhaps one of the most important conclusions of this preliminary study is that current knowledge on the state of young scientists is geographically biased, originating almost exclusively from research based in OECD countries, particularly in the US and Europe. We simply don't know very much about how young scientists are faring in other regions of the world. At the same time, it may be precisely in developing regions where a well-trained, well-supported, and well-funded research community can be most impactful. For that reason alone, expanding our knowledge about the state of young scientists to include the developing world is of critical importance.

Subsequent GloSYS studies aim to do just that. Our second study, GloSYS ASEAN, investigated the state of young scientists in Southeast Asia, and was the first in what we envision to be a collection of regional GloSYS studies. Young scientists from Indonesia, Malaysia, Singapore, and Thailand participated in the study and reported a number of structural and institutional barriers to conducting high-quality, meaningful research. One such barrier relates to the way that funding for research is structured. For example, young scientists indicated that funding cycles are too short to produce meaningful findings. Many study participants also discussed a lack of continuity in funding streams, forcing researchers to shift between research topics if funding dries up, which can prevent early-career scientists from developing a high level of expertise in one area. Young scientists also reported, both in the questionnaire and the interviews, that they often don't have sufficient time to do what they are trained to do: conduct research. Instead, many of their responsibilities revolve around administrative duties, which don't produce much value in and of themselves.

These barriers are not specific to Southeast Asia, and have been reported by young scientists across the world and across disciplines. What is perhaps a more regionally-specific phenomenon relates to research collaboration and mobility. The GloSYS ASEAN study participants indicated that they collaborate more with researchers from other continents than within the region and are more interested in travelling to Europe or North America for their career advancement than staying in Southeast Asia. Such findings are interesting on their own. More importantly, however, they involve policy implications that may be highly impactful: perhaps if research infrastructure and funding can be strengthened regionally, more young talent can be incentivized to stay and collaborate within the region.

The GYA is now in the process of conducting the second regional study on the global state of young scientists: GloSYS Africa. The study will utilize the same three-pronged mixed methods approach and collect data in fourteen African countries. In addition to the core themes that are explored in each GloSYS study, this research will also touch on themes of particular regional relevance, including gender in academic- and research-careers and the diaspora. The project is set to be completed by September 2018. Additional regional studies are currently being considered.

Increasing our understanding of the complex social, institutional, political, and cultural landscape in which young scientists today are doing their work is of critical importance. After all, if young researchers are so burdened with administrative tasks and applying for highly-competitive funding that little time remains for actually conducting research or being creative, science suffers. If scientists are entering a research environment that in many ways rewards quantity over quality of publications, science suffers. And if underrepresented groups such as women and ethnic minorities are met with resistance or even hostility in their scientific careers, science suffers.

The *Global State of Young Scientists* project is our contribution to better understanding how young scientists, particularly in developing regions, are faring and how they can be provided with an environment that supports them in their research efforts and career development. And that's good for scientists- and for science.

Reference

[1] Nature 538, 427 (27 October 2016) doi:10.1038/538427a

Towards universally accessible research findings

Image: © CC0 https://static.pexels.com/photos/245618/pexels-photo-245618.jpeg

by Eva Alisic

Despite substantial movement towards Open Science, we're not there yet. Many research publications are still behind paywalls. And even those that are shared in repositories are often not indexed in Google Scholar, a frequent starting point for literature searches.

This is a serious problem for several reasons. For example, we expect practitioners in medicine, psychology, education and other fields to conduct 'evidence-based practice'. How is that possible if they do not have access to the evidence base? The same applies to policy advisors. How can they develop evidence-based policies if the evidence is inaccessible?

More and more citizen scientists are carrying out excellent, applicable research. They could do even better given access to previous studies. And with much academic research being publicly funded, there is a moral imperative for the outcomes to be publicly available.

Even academic researchers do not have unfettered access. This is a genuine impediment, especially in low-resource settings. There have been several great initiatives to improve access for researchers in low- and middle-income countries, from the Egyptian Knowledge Bank to Sci-Hub. However, these are not always well known, and 'pirate' sites such as Sci-Hub or the hashtag #ICanHazPDF occupy a legal grey area. Arguably, these pirate sites only exist because the publishing system has failed. So what should we do about it?

With members of the Global Young Academy, we set up the More Open Access pledge. The goal was to help make research findings widely available in a way that is feasible for as many researchers as possible, irrespective of discipline, level of seniority, or resources. Of course, we wanted to increase awareness of the issue, but even more, we wanted to spur people to action. Pledging meant committing to submit at least one manuscript to a quality open access journal or a widely used pre-print server by the end of 2016.

The pledge began as an internal affair, but it quickly gained traction outside the GYA too, with over 300 researchers signing up ahead of the deadline. Not only has this initiative boosted submissions to open access outlets, it has also generated new conversations and unexpected positive side effects. For example, GYA member Anna Coussens negotiated free access to an entire special issue of a journal. More action is needed to truly change the system. But the More Open Access pledge has raised the profile of open science, and encouraged some researchers to make a stand.

This article is an adaptation of a Research Whisperer blogpost.

First Asian National Young Academies Meeting

Bangkok, Thailand, 15 – 16 December 2016

Image: © NSTDA Media Team, 2016

by Ali Douraghy, S. Karly Kehoe, Numpon Mahayotsanun, Orakanoke Phanraksa and Samuel Sojinu

Despite where you are, "connections" are a key component to having a greater impact in the science community. Asia is no exception. The 1st Asian National Young Academy (NYA) Meeting, entitled "Advancing Synergies in Asian NYAs", took place from 15 – 16 December in Bangkok, Thailand. The meeting was the first of its kind to connect the majority of Asian NYAs with the Global Young Academy (GYA). It brought together representatives from 10 established NYAs from India, Indonesia, Israel, Japan, Malaysia, Pakistan, Philippines, Thailand, Turkey, and Vietnam as well as an NYA Initiative from Korea. The meeting was co-organised by the GYA, the National Science and Technology Development Agency (NSTDA), and the National Science Museum (NSM).

Key objectives of the 1st Asian NYA meeting were to create a platform where young scientists from Asia could establish their regional networks, to allow the young scientists to exchange and share their experience with NYAs, and to further plan for the future of the young scientist network within the region and beyond. Since this Asian NYA meeting was held back-to-back with an in-person meeting of the GYA Executive Committee (EC), it allowed the representatives from Asian NYAs to get *connected* with the GYA EC as well.

Highlights from invited prominent speakers

The first day's session was inspired by three prominent speakers. H.E. Dr. Pichet Durongkaveroj, Minister of the Minister of Science and Technology of Thailand, addressed the importance of motivating the young generation to get involved in science. Most top talent goes into medicine, rather than science and engineering. It is also essential to create places for them to pursue their research and career opportunities. His speech was confirmed by Yuko Harayama, GYA Advisory Board Member. "Our future is in your hands!" was her starting point. Young scientists are encouraged to pursue the science which they enjoy. It is possible to be a scientist and do research and also be "on-the ground" to change society. Next, Kanchana Wanichkorn, National Science Technology and Innovation Policy Office (STI), shared her view regarding ASEAN Talent Mobility and the STI Collaboration platform. ASEAN is an attractive region with many ongoing activities. It is the 3rd largest market with 633 Million people, 7th largest economy in the world, and with 6 – 7 % growth, it is the fastest growing in the world over the last 5 years. With this in mind, strengthening the existing network of young scientists is the key to the rise of Asia in the future.

Talking about an overall picture of the NYAs in Asia, most of the NYAs are within the first three years of formation with two of them older than five years. The recruitment procedures of all the NYAs are similar and centred on academic excellence and coordinated by the NYAs themselves, with the exception of two NYAs

Image: © NSTDA Media Team, 2016

whose recruitment is directly linked to their senior academies. Structurally, different patterns can be seen in the various NYAs, ranging from 6–10 Executive Committee members with some having specific portfolios for their EC members. The NYAs operate through different organs with some having working groups, research groups and others apportioning tasks through ECs. The membership cap likewise varies, with the minimum being 100 members while there are varying ratios of female to male memberships. The NYAs have a five-year maximum term limit, with some having 2–3 year initial limits with one renewable term. All the NYAs have a membership age limit of 45 with the exception of the Philippine Academy of Young Scientists with life membership. Many of the NYAs are independent of their senior academies in the administration of the academy but still financially dependent on them. The majority of the NYAs have functional websites and social media pages through which they engage their members and the public.

The majority of the NYAs are active with diverse engagement activities, including but not limited to capacity building through workshops, conferences, reports, newsletters, national science challenge, outreach programmes, colloquia, science policy initiatives, promoting relationships between academia, policy makers and society, and promoting that status of young scientists.

Strengthening the linkage and promoting collaboration of the NYAs in Asia

Starting with West Asia, South Asia, and Central Asia, there is a need to increase the visibility of existing NYAs, to offer a network between these NYAs and then to explore how they can work together to deal with challenges affecting this region.

The focus will also need to be on promoting active membership beyond expanding numbers. There will be a need to use the GYA members in the countries of each region to drive activities and to ensure representation at meetings as a way of bringing everyone together. There is a need to ensure inclusiveness and better communication, and it is critical that ways are found to enable representation from every country at the meeting.

Proposed action:
- A contact list will be created for each of the NYAs. If a country does not have a young academy (YA), then a GYA member will be identified, or someone from The World Academy of Sciences (TWAS).
- A communication network will be established using the contact list as a basis.
- Aim to increase number of attendees and representation within the regional group.

Moving from West Asia to East Asia and Southeast Asia, the group felt that the NYAs should concentrate on increasing impact, on improving credibility, on enhancing visibility of the NYAs and increasing inclusivity. They also agreed that while there is a definite need to target policy makers and politicians, more must be done to connect with citizens. Building a collaborative network will be useful in sharing more information, in enhancing engagement and in fostering more outreach. Beyond that, however, is the desire to leverage and share resources, to have a collective voice and to learn about each other's research ecosystems. These features are all critical to science diplomacy because they will help to create opportunities for greater influence. Power in numbers!

This group had a desire to establish a network with meetings (regional and national) and to support the establishment of NYAs in countries that do not yet have them.

Proposed action:
- Focused discussions about shared concerns in small regional meetings are important for enabling the less confident members to speak up and be heard.
- Establish a network with meetings to enable interaction. With this in mind, six ASEAN nations – namely Indonesia, Philippines, Laos, Malaysia, Thailand, and Vietnam – agreed to nominate GYA Co-Chair Orakanoke Phanraksa (Thailand) to serve as the pro tem Chair to drive the network of young scientists in ASEAN.
- Support the establishment of NYAs in countries where they do not yet exist (e. g. Cambodia, Singapore, Myanmar)

Bridging Africa to Asia

To promote a linkage between the NYAs in Asia and Africa, two outstanding young scientists were invited to share their experiences at national and international levels. Vidushi Shradha Neergheen (Mauritius) was invited to share her experiences gained from the GYA. Vidushi was one of the outstanding GYA members who was selected as a fellow of the Africa Science Leadership Program (ASLP), Next Einstein Forum, and to participate in the World Economic Forum as well as the Lindau Nobel Laureate meeting. In her view, regional meetings provide the opportunity to learn about what the shared challenges are, and this is critical if we are to begin to tackle them. Most importantly, meeting in person connects people.

Abhi Veerakumarasivam (GYA member, Malaysia) discussed a learning curve of the Young Scientists Network- Academy of Sciences Malaysia (YSN-ASM). Key highlights included a discussion about the key question: "Why is it that no one wants to hear us?" A series of other interesting questions were pointed out, including but not limited to: "What motivates us?", "What is our role OR what do we want our role to be?" His additional point further confirmed that inclusivity is essential. It is important for young scientists to work with people outside of their own research areas (contact with the arts, humanities, and social sciences is a must for those in the natural and technical sciences).

Finally, the meeting concluded with an interesting discussion about science engagement and science communication. A number of common points were addressed, including using a multidisciplinary approach to develop a healthier research ecosystem, the constant effort by scientists to communicate research to non-experts, teachers' need for support in learning about new research and approaches, and finally the need for a range of support networks behind the scenes to make innovation possible. At the end of the day, participants agreed that we need to cultivate "volunteer spirits" in our research communities. The GYA could be a starting point to engage more volunteer spirits worldwide

About Global and Regional Networks of NYAs

To facilitate exchange between young scholars, as well as established and upcoming national young academies, regional and global meetings have become a regular occurrence, often in cooperation with the GYA. In 2012, the GYA co-organised the first world-wide meeting of Young Academies "Shaping the Future of Young Academies" in Amsterdam, The Netherlands, together with the Dutch Young Academy. A second world-wide meeting of Young Academies took place in November 2015, in Stockholm, Sweden, co-organised by the GYA and the Young Academy of Sweden. This year, the GYA is working together with the South African Young Academy of Science (SAYAS) to hold the third world-wide meeting of Young Academies, scheduled to take place in July 2017, in Johannesburg, South Africa.

Regional meetings can address more regionally specific problems. In 2014, an African Young Academies Regional Conference focused on "Accelerating science for development in Africa by increasing the momentum and impact of National Young Academies". The meeting, organised by the GYA in cooperation with the Network of African Science Academies (NASAC), aimed to engage and empower excellent young researchers from across Africa to address the challenges that impede scientific development towards a sustainable future for the region. The second Africa Young Academies Regional Conference entitled "Empowering the Next Generation of Scientists in Africa" took place from in October 2016, in Mauritius. The first regional meeting of Asian young academies was held in December 2016, in Bangkok, Thailand and the second is already in planning, to be held in February 2018, in Jerusalem, Israel, organised by the Israel Young Academy.

https://globalyoungacademy.net/regional-networks/

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MEET THE NEW MEMBERS

2017

Bahaa El-Dien M. El-Gendy (Egypt)

Medicinal chemist

Associate Professor of Bio-Organic Chemistry at Benha University, Egypt, his training as a synthetic chemist, both in Egypt and USA, prepared him for a career in drug discovery. With his research group, he designs and synthesizes novel small organic molecules as modulators of nuclear hormone receptors and kinases for the therapeutic treatment of cancer and fatty liver diseases.

Mary Donnabelle L. Balela (Philippines)

Nanotechnologist + mother

Creates and designs various organic nanomaterials, particularly metal and oxides, for various applications in electronics and photocatalysis. She believes that nanomaterials can be used as building blocks to fabricate products and/or devices that will greatly benefit mankind and the environment. She is a mother of 2 beautiful daughters.

Benedetta Berti (Israel)

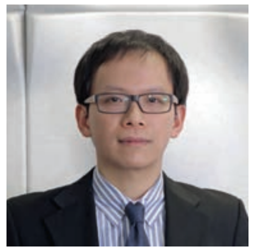
Foreign policy researcher + author

Senior Fellow (TED and Foreign Policy Research Institute) and Fellow (Institute for National Security Studies. She is a foreign policy and security researcher, analyst, consultant, author and lecturer. Her work focuses on armed groups and internal wars, analyzing the impact of insecurity on civilians and studying how to build more peaceful and resilient communities.

Cristina Blanco Sío-López (Spain)

Contemporary global historian + digital humanist

Interdisciplinary scholar fascinated with mapping factors of positive change in history through the critical discourse analysis of: the social, intellectual and myth-making dimensions of time perceptions' instilment in political communication; comparative regional integration as a driver of democratic sustainability and global governance innovation and citizens' empowerment through free movement of persons.



Zhiming Cheng (Australia)

Economist

His research interests are in the interdisciplinary areas of labour economics, employment relations, working life, inequality and their relationships with health and subjective wellbeing.

Matthew Cole (United Kingdom)

Nanotechnologist + materials engineer

Following research at the Universities of Oxford and Cambridge, his research focuses on the integration of aligned nanomaterials in atomic-scale devices towards realising the electronics of tomorrow.

Maral Dadvar (Germany)

Computer scientist

Being an expert in semantic web and natural language processing, she aims to continue her research and efforts in making the cyber society a safer environment by prevention and detection of crimes and online misconducts. She believes that better solutions derive from multidisciplinary approaches rather than sheer technical ones.

M. Bilge Demirköz (Turkey)

Astroparticle physicist

She studies the composition of cosmic rays in Low Earth Orbit with the Alpha Magnetic Spectrometer (AMS-02) experiment on the International Space Station. She is also leading the METU-DBL (Defocusing Beam Line) project in Turkey to perform radiation tests on electronics and materials intended for space and high radiation environment such as the Hi-Lumi LHC (Large Hadron Collider).

Meghnath Dhimal (Nepal)

Environmental health scientist + public health expert

Chief Research Officer since 2010 at the Nepal Health Research Council (NHRC), Government of Nepal. Achieving practical and theoretical advances in environmental and public health research, he has been leading research projects on environmental and climate change, non-communicable diseases, neglected tropical diseases and health systems research in Nepal.

Lahcen El Youssfi (Morocco)

Agronomy engineer + agro-environment researcher

Focusing on the development of application of bio-ecological, technical and economic principles for sustainable agro-ecosystems management (Soil, Water and Plant continuum), he is responsible for training and research activities within the agro-biology and rural development program and member of the steering committee of Aromatic and Medicinal Plants research Cluster.

Aysha Fleming (Australia)

Research social scientist

With a background in education and rural sociology, Aysha specialises in applying educational theories to climate change in agriculture, fisheries and forestry. She is especially interested in language and engaging with communities and stakeholders. She focuses on qualitative research methodologies, including interviews and discourse analysis and aims to understand and influence stakeholder perceptions and behaviour.

Aminata A. Garba (Rwanda)

Computer engineer + telecommunications expert

Assistant Professor at the Department of Electrical and Computer Engineering at Carnegie Mellon University and internationally active with particular focus in Africa, Aminata's interests include ICT infrastructure, technologies and policies, Internet of things, emergeny communications, cybersecurity, ICT4D, capacity building and higher education.

Meet the New Members of 2017

Syed Ghulam Musharraf (Pakistan)

Bioanalytical Chemist

Dr. Musharraf has extensive experience in the field of mass spectrometry and its utilization mainly in two areas: 1) Metabolomic and proteomic biomarker search in cancer. 2) Analysis of natural products and chemical fingerprinting of medicinally important plants.

Anna Harris (USA)

Social scientist

Social scientist first trained in medicine who tries to make sense of the extraordinary and ordinary worlds of medical practice through comparative and collaborative ethnographic projects.

Lisa Herzog (Germany)

Philosopher + economist

Lisa is a philosopher and economist working on social and economic justice and teaching political theory at the Technical University Munich. Recent research topics include the global financial system and ethics and democracy in the workplace. She also writes for non-academic audiences and has not (yet?) given up the hope that philosophy can contribute to social progress.

Wataru Iwasaki (Japan)

Computational biologist

Associate professor at the University of Tokyo, who carries out research at the intersection of biological and information sciences. As technological innovations in the life science domain have enabled us to obtain and analyze massive amount of data, he aims at uncovering new concepts, insights, and laws behind life systems and ecosystems by utilizing those datasets.

Jacobus FA Jansen (Netherlands)

Neuroscientist + biomedical engineer

His aim is to answer clinically relevant neurological questions using advanced imaging techniques, in order to obtain a better understanding of the underlying mechanisms and to improve treatment and care for patients with neurological and neuropsychiatric disorders.

Akihiro Kishimura (Japan)

Material chemist + nano-medical engineer

Based on basic knowledge of material synthesis (organic and inorganic nanomaterials), his recent research focuses on development of biomedical nanosystem. He has developed therapeutic nanosystems to overcome the present limitations of drug therapy, and pioneered the material-based physiology to reveal how to deal with intractable diseases.

Mahesh Kumar (India)

Material scientist + device engineer

Concerns about the changing environment and fossil fuel depletion, it is prompted, not only use the renewable resources but also reduce the power consumption. His scientific focus is on design and fabrication of energy efficient devices such as GaN LEDs, nanosensors and 2D transistors. He also promotes awareness in the society about child education, climate changes and utilization of energy efficient systems.

Matthew C. Levy (UK)

Computational scientist

Working at the intersection of physics and artificial intelligence (AI). Previously he studied the interaction between the most powerful lasers in the world and dense matter, for fundamental high-field physics and applications in energy generation. Increasingly he is interested in AI and holds two patents pending covering physics-inspired approaches.

John Henri Malone (USA)

Evolutionary biologist

A genome and organismal biologist interested in how different copies of genes influence organisms and evolution. By using state-of-the art genome sequencing technology and studying variation among animal genomes, his research will provide a deeper understanding for how genomes work when copies of genes are altered.

Nonglak Meethong (Thailand)

Materials scientist

Dr. Meethong's research work is mainly related to developing electrode materials for Li-ion batteries for use in portable electronic devices and electric vehicles. Her aim is to develop nano-materials from natural and industrial wastes to make high performance Li-ion batteries with affordable cost and low environmental impacts.

Binyam Sisay Mendisu (Ethiopia)

Linguist + education specialist

With a track record of numerous field-specific and multidisciplinary publications, his research interests lie in the study of African languages, education and the humanities. He is a founding member of the Ethiopian Young Academy of Science (EtYAS) and founding fellow of African Science Leadership Program (ASLP).

Maha Nasr (Egypt)

Pharmaceutical scientist + educator

An academic pharmacist interested in the science of drug delivery and formulation design. Her research work mainly focuses on advanced technologies such as nanotechnology based drug carriers and composite delivery systems. She currently investigates the creation of novel carriers for treatment of diseases, mainly cancer and Alzheimer's.

Marian Asantewah Nkansah (Ghana)

Environmental chemist + humanitarian

Due to her passion for the environment and the desire to help preserve it, she is dedicated to finding solutions to environmental problems associated with levels of toxic substances such as heavy/trace metals and polycyclic aromatic hydrocarbons (PAHs) in food, water, soil, rocks, sediments and other matrices; and the interaction of these pollutants with each other in the environment as well as remediation strategies.

Daniel Ochieng Orwenjo (Kenya)

Applied linguist, literacy expert + consultant

As an applied linguist, his main research interests revolve around the nexus between linguistics and other disciplines by focusing on the application of linguistic knowledge in solving real life problems in other disciplines such as education, law, anthropology, sociology and psychology on one hand; and using knowledge in these disciplines to solve linguistic problems on the other hand.

Mohd Hafiz D. Othman (Malaysia)

Chemical enigneer

Associate Professor and Deputy Director of Advanced Membrane Technology Research Centre, Universiti Teknologi Malaysia. He is highly published in Scopus-indexed journals, in the field of sustainable membranes for energy & environmental application and involved in 68 research projects, some receiving international awards.

Naim Rashid (Pakistan)

Environmental engineer

A dedicated environmental scientist instilled with a passion to work on green economy and to promote environmental sustainability. His particular interest is in carbon bio-sequestration, bio-remediation, wastewater ecology, and algal biotechnology to reinforce waste-to-energy concept. He received the Green Talent Award-2015, Germany, for his outstanding contribution to advocate sustainable development.

Ibrahim Sidi Zakari (Niger)

Statistician + data scientist

He was a former data scientist at CAPED Niger (Prime Minister's Office) and is currently serving at Abdou Moumouni University. His research area includes statistical modeling of genomic diseases, household energy transition, air pollution, quality of public expenditure and Open Data.

Teresa Stoepler (USA)

Ecologist

Her research has focused on the role of environmental factors in shaping plant-insect interactions, including pollination, parasitism, and disease transmission. Passionate about the power of science to bridge nations, she now works with two bilateral programs aimed at strengthening U.S. – Egypt and U.S. – Pakistan scientific collaboration.

Egle Sumskiene (Lithuania)

Sociologist + expert on disability and human rights

Associated Professor at Vilnius University Social Work department. She works actively in the Lithuanian NGO sector, focusing on mental health and human rights, and has been involved in various international and national projects focusing on human rights and disability, discrimination, mental health care, policy, social integration of people with psychosocial disabilities.

Shuhui Sun (Canada)

Chemist + materials scientist

He leads the Laboratory of Sustainable Nanotechnology (SUN), developing nanomaterials for energy and environmental applications. His current research focuses on the fabrication and characterization of multi-functional nanomaterials (e.g., graphene, CNTs) and their applications in energy conversion and storage, and wastewater treatment.

Erick Gankam Tambo (Cameroon)

Computer scientist + educational technologist

With research interests in the design and development of socio-technical systems, he is currently interested in the linkage/integration of ecosystems for innovation and entrepreneurship (tech innovation hub) into universities in Africa, and investigating which role local and international actors (donors, research stakeholders, policy makers, etc.) could play in supporting this process.

Tran Quang Huy (Vietnam)

Nano-biomedical scientist + electron microscopist

Witnessing an increasing number of infectious diseases as well as the evrironmental pollution endangering public health in developing countries, he wonders if nanotechnology can minimize their impact. His research has focused on nanotechnology to develop innovative biosensors/biochips, and nanomaterials applied for rapid detection of infectious pathogens, disinfection and environmental monitoring.

Bernardo Urbani (Venezuela)

Anthropologist

An anthropologist dedicated to researching in primatology in the Neotropics. He examines primate cognitive ecology as well as the history of primatology, primate conservation, and ethnoprimatology. His goals are to understand how primates behave, to explore how they are perceived by humans, and finally to propose ways to protect them.

Hakan Usta (Turkey)

Molecular engineer + materials scientist

As the head of his own research group, he focuses on the design, development, and engineering of nanostructured functional organic materials for use in high performance optoelectronic applications. He has a strong desire to develop novel materials for a better technological future.

Fernando Valiente-Echeverria (Chile)

Molecular virologist + science diplomat

His work is focused on evasion of the host response against HIV infection as well as on the characterization of zoonotic emerging pathogens. He co-founded and participated in organizations in Latin America and Canada to protect young researchers' rights and increase awareness about the importance of Science, Technology and Innovation.

Abhi Veerakumarasivam (Malaysia)

Geneticist + science communicator

His research focus is in developing new strategies for bladder cancer diagnosis and therapy by dissecting the molecular basis of cancer recurrence and invasion. He currently chairs the Young Scientists Network-Academy of Sciences Malaysia. He believes that effective science communication is key in the successful delivery of scientific solutions and creation of sustainable innovative ecosystems.

André Xuereb (Malta)

Quantum physicist

Senior lecturer in atomic and quantum physics at the University of Malta, he is also Science Policy Officer of the Malta Chamber of Scientists, acts as the Government of Malta expert on quantum technologies, and represents Malta on several European research networks. André established and leads the quantum research group at the University of Malta, and co-owns an educational software company.

Imprint

GYA Connections is published annually. Suggestions for content should be sent to the editor.

Publishing Date: May 2017
Publisher: Global Young Academy
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About the Global Young Academy

The Global Young Academy (GYA) was founded in 2010 with the vision to be the voice of young scientists around the world. The GYA empowers early-career researchers to lead international, interdisciplinary and intergenerational dialogue by developing and mobilising talent from six continents. Its purpose is to promote reason and inclusiveness in global decision-making. Members are chosen for their demonstrated excellence in scientific achievement and commitment to service. Currently there are 200 members and 134 alumni from 70 countries.

The academy is hosted at the German National Academy of Sciences Leopoldina. The GYA received its seed funding from the Volkswagen Foundation and has, since 2014, been funded by the German Federal Ministry of Education and Research (BMBF). It has been supported by the IAP: the Global Network of Science Academies. The GYA has also benefitted from project funding from a variety of donors and partners.

Co-Chairs: Orakanoke Phanraksa (Thailand),
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Find out more at: www.globalyoungacademy.net

GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung

The Global Young Academy gratefuly acknowledges funding by the Federal Ministry of Education and Research in Germany.

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