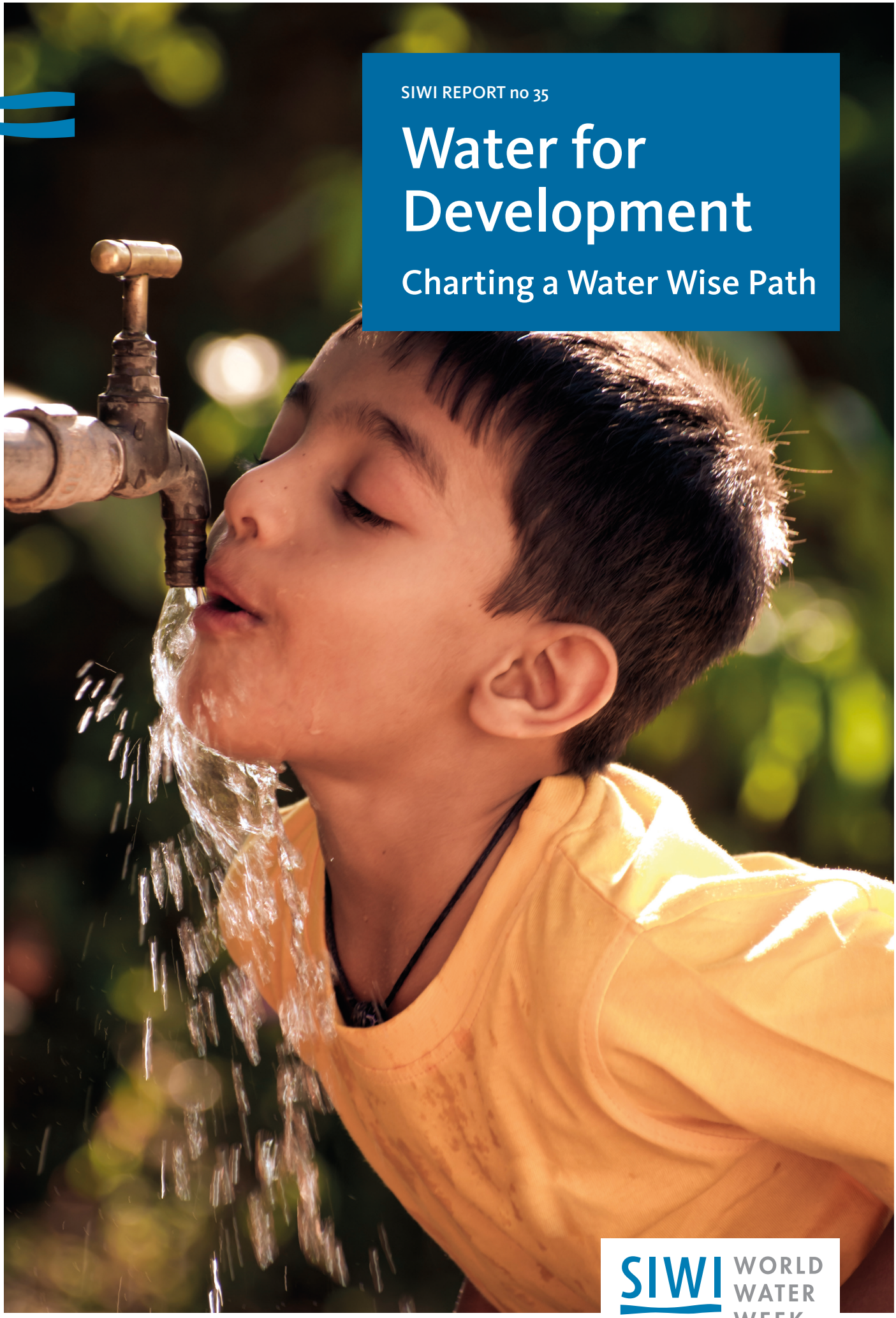

SIWI REPORT no 35

Water for Development

Charting a Water Wise Path

SIWI WORLD WATER WEEK

ISBN: 978-91-981860-4-8
ISSN: 1404-2134

How to Cite: Jägerskog, A., Clausen, T. J., Holmgren, T. and Lexén, K. (eds.) 2015. Water for Development – Charting a Water Wise Path. Report No 35. SIWI, Stockholm.

Cover photo: iStock.
Chief Editor: Anders Jägerskog.
Editors: Torkil Jønch Clausen, Torgny Holmgren and Karin Lexén.
Production editor: Victoria Engstrand-Neacsu, SIWI.
Language editing: Alex Kirby and Victoria Engstrand-Neacsu.
Design: Elin Ingblom, SIWI.

Disclaimer: The chapters in this report do not necessarily represent the views of SIWI but are contributions from individuals and organizations to the theme of 2015 World Water Week.

Printing by Molind, Stockholm, Sweden. The printing process has been certified according to the Nordic Swan label for environmental quality.

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Content

Charting a water wise path into the future

By Anders Jägerskog and Torkil Jønch Clausen

The topic for World Water Week 2015 is "Water for Development." This is an obvious theme as we take stock of the Millennium Development Goals (MDGs) and move towards the Sustainable Development Goals (SDGs) to be adopted by the UN General Assembly in September.It is also a logical continuation of the previous weeks with their focus on "Water and Food Security" (2012), "Water Cooperation" (2013) and "Energy and Water" (2014), and a pointer to the "Water and Sustainable Growth" theme in 2016. Water is critical for development. It is used to energize all sectors and levels of society. It is integral to the World Water Weeks to break out of the silo mentality that all too often characterize our ways of approaching the world.
We need to talk to the food, energy and development communities, as well as other key water-related communities, rather than talking about them.
The Week continues to make a strong effort to engage other communities in dialogue, knowledge exchange and joint learning on how to address the development challenges facing us.

Earlier in 2015, the Third UN World Conference on Disaster Risk Reduction (WCDRR) took place in Sendai. The year will end with the 21st Conference of the Parties (COP 21) in Paris, where the aim will be to arrive at a new global agreement on a common architecture for climate action. The vast majority of human and economic losses from disasters are water-related, and impacts of climate change hit us first and foremost through the land and water system. Hence, the processes and issues being addressed at these global events are critically important from a water perspective.
If we are to achieve a successful World Water Week that outlines how water can be a driver for sustainable development and green growth, it is imperative that we reach beyond the water constituency. In Stockholm, we provide an arena for the exchange of views between a range of stakeholders ranging from academia, policy makers, practitioners, private sector and civil society.

In its 2015 Global Risk Report, the World Economic Forum stated that a water crisis is the global risk with the most damaging potential impact on countries as well as industries within the next ten years.

In July 2014, the Open Working Group (OWG) on the Sustainable Development Goals (SDGs) presented its proposals, and in December 2014 the UN Secretary-General presented his report "The Road to Dignity by 2030" that included the OWG proposals. As this report was going to press, the proposed SDGs included a dedicated SDG on water with six targets to be reached, but water was hardly mentioned in targets to other SDGs, such as those adressing food, energy and climate change. Considering that actions in these and other areas depend on and affect our water resources, this presents a serious challenge for the final negotiations, and not least for the subsequent implementation of the SDGs. The proposed "marine SDG" makes reference to land-based sources of pollution of the sea, and hence to the important source –to- sea (or ridge-to-reef) linkage between freshwater and coastal/marine management.

The role of water in the proposed SDGs, and thoughts on how to approach and design implementation to reach the envisaged targets, will be an overriding issue in addressing water and sustainable development and the Post-2015 development agenda during the Week.

There is a great deal to be said about water for sustainable development. Water is crucial for human sustenance, health and dignity; as a driver for business; for food and energy security; and for the ecosystems upon which our societies and continued development depend. These issues are captured in the Thematic Scope of the Week (see page 72), as well as in the Week's eight core workshops, and they are reflected in the topics of the more than 140 events of the Week.

In this report, a range of aspects relating to water and development are covered. The perspectives brought forth are intended to be thought-provoking; provide examples of the latest thinking as well as propose new avenues for development.

The post-2015 development framework

The Sendai Disaster Risk Reduction Framework

A changing climate mainly manifests through water. The world experiences more frequent floods and other extreme, water-related weather events. These disasters account for approximately 95 percent of all people affected by disasters and have caused over 60 percent of all damage. The Third UN World Conference on Disaster Risk Reduction took place in Japan in March 2015. The agreement aims to reduce mortality and economic losses from disasters and guides actions by governments, organizations, and researchers to prevent and respond to disasters over the next 15 years. The Sendai outcome however falls short of reflecting the significant role water plays in DRR, and no specific reference is made to floods and droughts.

Sustainable Development Goals

The development of the SDGs originates in the Rio+20 Conference in 2012. It was decided that the process leading up to the adoption of the SGDs by the UN General Assembly would be "an inclusive and transparent process open to all stakeholders". The SDGs should be "action-oriented, concise, easy to communicate, limited in number, aspirational, global in nature, and universally applicable. The Millennium Development Goals (MDGs) did not include a goal on water. There were water-related targets included in Goal 7 on environmental sustainability, but the holistic approach was missing.

SDG 6

In the process leading up to the SDGs, the water community has advocated strongly for a dedicated water goal, to holistically address the world's water-related challenges, avoiding potentially fragmented and unsustainable solutions which can increase competition between different water users. It is also necessary for water targets to be included in other relevant SDGs, to secure strong interlinkages on food, energy, gender equality, health and climate.

When this report went to press, the proposed SDGs included a dedicated goal on water and sanitation. The text read as follows:

Goal 6. Ensure availability and sustainable management of water and sanitation for all

6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all

6.2 By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations

6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and increasing recycling and safe reuse by [x] per cent globally

6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity

6.5 By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate

6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes

6.a By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies

6.b Support and strengthen the participation of local communities in improving water and sanitation management

COP21

In December 2015, the French government will host the 21st Session of the Conference of the Parties (COP21) to the UN Framework Convention on Climate Change (UNFCCC). It is anticipated that the parties reach a new climate agreement for the period 2020-2030, aimed at keeping global warming below two degrees Celsius. Given its key role for climate change adaptation and mitigation efforts on the ground, water needs to be addressed in the future climate architecture and the Paris agreement should provide entry points for facilitating this.

Financing for Development

The issues related to financing for development will be central in the implemention of the post-2015 development agenda. In addition to the fundamental question about how to meet the huge demands for financial resources, ownership and enforcement of decisions are some of the issues that need to be addressed. How to build institutions and capacity in the poorest and most fragile states are also key issues to be addressed. The outcome of the Third Conference of Financing for Development, held in in Addis Ababa in July, provides a firm ground to build upon.

Source: UN Sustainable Development Knowledge Platform, www.cop21.gouv.fr

In their article on water and development at the international level Harlin and Kjellén take stock of the MDG progress as well as discuss the future SDGs and the role of water in (and for) them. They conclude that while water is essential for achieving the SDGs we need an adaptive and flexible approach as many of the key drivers – such as population growth, climate change and consumption patterns – are not static but moving targets. Schechtman complement the earlier chapter as she zooms in on the more Water, Sanitation and Hygiene (WaSH) related aspects of the MDGs and SDGs. The challenges in terms of definitions of access and the level to which it is being measured are critical questions analyzed in the chapter ten Brinke, van Zwol and Vlaanderen) discuss the need for more reduction of risks and disasters for improved water security. Tying in to the global discussion, they highlight the need for improved and more inclusive planning at all levels of society. They conclude that for societies to improve resilience to cope with disasters, they need to plan and build with instead of against natural processes. Berglöf and Devarajan highlight the imperative role that water plays for development with a particular focus on why water, in many aspects, have failed to serve as the catalyst for growth that it could be. The failure of public policy and the failure to adequately price and regulate water are identified as key stumbling blocks. Two contributions discuss the role of Information Communications Technology (ICT) for water and development. Van der Sommen and Sarni discuss accountability and the opportunities that the data revolution provides for citizens and communities while Lynggaard-Jensen, Mark and Gourbesville discuss the improvements that have been enabled through the use of ICT on urban water infrastructure through real-time control and modelling. Boltz, Martinez, Brown and Rockström highlight the ecosystem perspective (and the associated ecosystem services) in their contribution and conclude that the discussion about trade-offs may not necessarily be the only discussion to have; rather we need to recognize that in some locations there are indeed maximum thresholds of human use of available water resources. Swayze's article offers a slightly different viewpoint in that it discusses the corporate perspective on water and development from the view of H&M. Taking stock of the increasingly challenging global water situation she argues, based on the lessons learnt by H&M, for the need for a business perspective that not only talks about long-term perspectives but in fact does act on those same perspectives. Karar and Wilkinson discuss water, development and equity from a southern African perspective arguing that equity and social justice is imperative to development of the water sector in the development context.

Bergkamp, Diphoorn and Trommsdorff identify the complex challenges associated with water and development from an urban perspective. Promoting a new urban agenda they situate water in the midst of it and clearly show that progress towards more sustainable cities is inherently intertwined with a sound approach to water management. Dominique, Lexén, Matthews, Skyllerstedt and Widforss put the water and development question in the context of key international processes such as the climate change and disaster risk reduction agendas. Highlighting the need for a coherent approach to mitigation, adaptation and resilience building to climate change, they argue for the need for coherent approaches between the different agendas. Unver and Pluschke provide a different take on the Water-Energy-Food Security Nexus in that they analyze it from a human security and conflict perspective. Being a more people-centered approach, it offers to provide more coherence as well as a more long-term perspective. Falkenmark and Rockström discuss the important role of improved use of rainfall to provide for increased food security and poverty reduction in the African context and they highlight the need to further integrate policies on land, water and agriculture.

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Photos: iStock

Water and development: From MDGs towards SDGs

By Joakim Harlin and Marianne Kjellén

> *"Water holds the key to sustainable development, we must work together to protect and carefully manage this fragile, finite resource"*
>
> *UN Secretary-General Ban Ki-moon, World Water Day, 2013*

Introduction | Water, as a fundamental resource and necessary service, remains firmly on the international agenda. The urgency of addressing water issues is not only affirmed by the priority it receives in inter-governmental deliberations, but is also testified to by concerns expressed by the international business community: "water crises" took the top spot relating to "impact" in the World Economic Forum's 10th global risk report (World Economic Forum, 2015, page 9).

This article looks into the international water and development agenda through the lens of the Millennium Development Goals (MDGs) and the Sustainable Development Goals (SDGs) processes. These international processes have put the global spotlight on the importance of water, but have they helped to secure sustainable water for all? Will the focused effort achieved by the simplicity of the MDGs be lost through the increasing complexity of a broader SDG agenda?

Water and the Millennium Development Goals (MDGs) | In the year 2000, world leaders signed the Millennium Declaration (UN General Assembly, 2000) from which a set of eight Millennium Development Goals (MDGs) were carved out. For the first time, there was an agreed global compact in which rich and poor countries recognised that they share the responsibility of ending poverty and its root causes.

Although water underpins many of the MDGs, i.e. through its vital role in food production which constitutes one part of eradicating hunger, and its fundamental role in hygiene which is the main vehicle for reducing infections and child mortality, water is explicitly included only in the targets of Goal 7; see Chart 2.
It is widely recognised that the MDGs have been successful in rallying public, private and political support for global poverty reduction (see UN General Assembly, 2014c). A major strength of the MDG framework was its focus on a limited set of concrete development goals and targets, thus providing focus for priority setting in national and international development policies. While the MDGs created momentum and constituted a vital instrument for focusing global attention on the lack of access to safe drinking water and sanitation, consultative processes linked to the Post-2015 agenda highlighted the need to address the broader water agenda and the many institutional challenges such as lack of implementation capacity, weak stakeholder participation and unclear mandates within government structures (GWP, 2013; Technical Support Team, 2013).

Chart 1 – The eight Millennium Development Goals

Goal 7: Ensure environmental sustainability	
Goals and targets (from the Millenium Declaration)	**Indicators for monitoring progress**
Tagert 7.A: Integrate the principles of susianable development into country policies and programmes and reverse the loss of environmental resources	7.1: Proportion of land area covered by forest 7.2: CO_2 emissions, total, per capita and per $1 GDP (PPP) 7.3: Consumption of ozone-depleting substances 7.4: Proportion of fish stocks within safe biological limits 7.5: Proportion of total water resources used
Target 7.B: Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss	7.6: Proportion of terrestial and marine areas protected 7.7: Proportion of specles threathened with extinction
Target 7.C: Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation	7.8: Proportion of population using an improved drinking water source 7.9: Proportion of population using and improved sanitation facility
Tagret 7.D: By 2020, to have achieved a significant improvement in the lives of at least 100 million slum dwellers	7.10: Proportion of urban population living in slums

Chart 2 - MDG7 Targets and Indicators
(Source: United Nations Statistics Division, 2008)

Water and the Sustainable Development Goals (SDGs) | While the MDGs concentrated efforts on developing countries, the Post-2015 SDGs aim for a worldwide ambit. As proposed in the report of the Secretary-General on the Post-2015 sustainable development agenda, the road to dignity envisages "one universal and transformative agenda for sustainable development, underpinned by rights, and with people and the planet at the centre" (UN General Assembly, 2014c, page 1). Along with the broadening of the agenda, the number of proposed goals has increased significantly; from eight to seventeen (according to the final document of the Open Working Group to the UN General Assembly, 2014a); see Chart 3.

Water's fundamental importance for human development, the environment and the economy is manifest in its inclusion as proposed Goal 6. Although the sustainable development agenda is yet to be finalised, the proposal of the Open Working Group will remain the basis for the Post-2015 development agenda (UN General Assembly, 2014b). Many stakeholders, including UN-Water, the Global Water Partnership and Stockholm International Water Institute (see e.g. GWP, 2013, SIWI, 2014), have been advocating the importance of an SDG on water. It can be noted that all the elements of a possible water goal proposed by UN-Water in its technical advice paper (as reported in UN-Water, 2014) were incorporated into the final report of the OWG; see Chart 4.

The broader water goal and associated targets addresses some of the main criticism of how water was captured in the MDGs, i.e. being narrowly focused on water supply and sanitation, and within that realm not sufficiently taking water quality, inequalities and sustainability into account.

The broadened agenda is also relevant for richer countries: infrastructure has had a tendency to deteriorate and new infrastructure is still required (ASCE, 2011), and vulnerable populations in high-income

SUSTAINABLE DEVELOPMENT GOALS

GOAL 1	End poverty in all its forms everywhere
GOAL 2	End hunger, achieve food security and improved nutrition and promote sustainable agriculture
GOAL 3	Ensure healthy lives and promote well-being for all at all ages
GOAL 4	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
GOAL 5	Achieve gender equality and empower all women and girls
GOAL 6	Ensure availability and sustainable management of water and sanitation for all
GOAL 7	Ensure access to affordable, reliable, sustainable and modern energy for all
GOAL 8	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
GOAL 9	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
GOAL 10	Reduce inequality within and among countries
GOAL 11	Make cities and human settlements inclusive, safe, resilient and sustainable
GOAL 12	Ensure sustainable consumption and production patterns
GOAL 13	Take urgent action to combat climate change and its impacts
GOAL 14	Conserve and sustainably use the oceans, seas and marine resources for sustainable development
GOAL 15	Protect, restore and promote sustainable use of terrestial ecosystems, sustainably manage forests, combat destertification, and halt and reverse land degradation and halt biodiversity loss
GOAL 16	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountabe and inclusive institutions at all levels
GOAL 17	Strenghten the means of implementation and revitalize the global partnership for sustainable development

Chart 3 – Proposed SDGs
(Source: Open Working Group of the General Assembly, 2014, page 6)

countries may still lack access to WASH services (Prüss-Üstün et al., 2008). Water governance – the quality of the whole process of developing and managing water resources and services, and the related roles and institutional frameworks – is of great concern to countries of all income levels.

MDGs, SDGs and monitoring: towards increasing complexity | What we want and what counts – purpose and definitions.

The strength of the MDG monitoring, and particularly the water and sanitation targets, is the provision of simple numbers that can be easily understood and referred to; see Chart 5. Indeed, the WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation (JMP) updates have provided the world of water with a unique point of reference.

Yet there is relentless criticism of what is measured and what is not, and for what purpose.

GOAL 6: ENSURE AVAILABILITY AND SUSTAINABLE MANAGEMENT OF WATER AND SANITATION FOR ALL

6.1	By 2030, achieve universal and equitable access to safe and affordable drinking water for all
6.2	By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defeaction, paying special attention to the needs of women and girls and those in vunerable situation
6.3	By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and increasing recycling and safe reuse by [x] per cent globally
6.4	By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawls and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity
6.5	By 2030, implement integrated water resources management and att levels, including through transboundary cooperation as appropriate
6.6	By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes
6 A	By 203, expand international cooperation and capacity-building support to developing countries in water- and sanitation-realted activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies
6 B	Support and strenghten the participation of local communities in improving water and sanitation management

Chart 4 – Proposed water goal and targets (Source: UN General Assembly, 2014a, pages 14-15)

First, the purpose of monitoring and the different definitions and use of the data in different contexts: the JMP develops estimates to be comparable over time and between countries, based on a standard definition of "improved" water supply sources or sanitation facilities. The definitions and data sources used by the JMP, however, often differ from those used by national governments (WHO and UNICEF, 2014a, page 40). Hence the JMP estimates may differ from national estimates. With coverage data collected and used for different purposes (e.g. increased coverage to show goal achievement or low to argue for greater allocation of resources), there are conflicting incentives and tensions around the differences between national and international data (Kjellén and Cortobius, 2013, page 32).

The focus on the MDG targets as such, in contrast to the process for getting there, is also subject to criticism: Fukuda-Parr et al (2012) argue that it is most important to understand where and why there has been acceleration of progress, and that the focus on targets, or rather the shortfall between achievements and targets, is neither helping to encourage efforts, nor to monitor commitments and progress. Along these lines, Vandemoortele (2009) suggested that the MDGs should be treated as collective targets, meaning that they are to be achieved at the global level but not necessarily in all countries. The relative benchmarks (i.e. a halving of the proportion of people unserved) are highly unfair to the least developed countries, and they imply that few African countries have a chance of achieving the MDGs. Indeed, the feat of halving the proportion of people without access to water is entirely different if those without access are the majority of the population or a small minority. In this sense, the 'off-track'/'on-track' distinction between countries can possibly be counterproductive or discouraging to countries that are making significant progress towards an unachievable target.

Another early criticism of the water and sanitation MDG targets relates to the improved – non-improved dichotomy. Indeed, the access to services is certainly not one or the other. It is not always obvious what is a better service judging from a technology-based categorisation of the water sources. And poor households in particular tend to combine more than one source (see e.g. McGranahan et al., 2001).

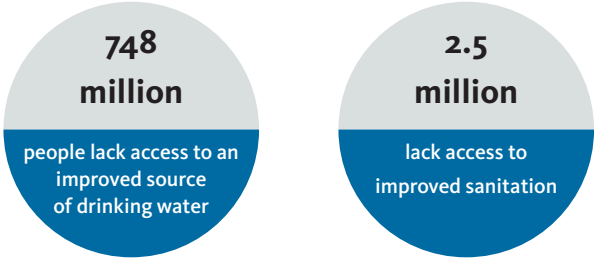

Chart 5 – MDG 7 water and sanitation target implementation status (Source: from 2014 Update WHO and UNICEF, 2014b, page 1)

The MDG drinking water target has already been surpassed

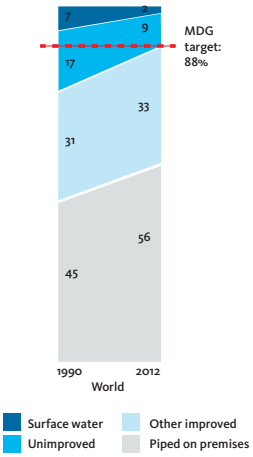

Fig 1. Trends in global drinking water coverage (%), 1990-2012

The world is unlikely to reach the MDG sanitation target of 75%

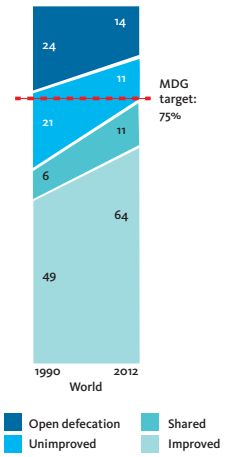

Fig 2. Trends in sanitation coverage (%), 1990-2012

Chart 6 – Trends in global drinking water and sanitation coverage (Source: from WHO and UNICEF, 2014a, Figures 1 and 2, page vi)

Taking this complexity on board, Bartram (2008) argued for a more fluid approach with multiple benchmarks to encourage efforts in service improvements for the poorest as well. Indeed, whatever improvements take place among the have-nots will constitute important steps towards improved health and well-being and must not be discouraged by not being sufficient for reaching the break-off point for "improved" solutions.

The more nuanced or multiple benchmarking has been increasingly used, with different categories of improved (e.g. piped to premises along with other improved water sources) as well as unimproved (by including open defecation, [technically] unimproved and shared sanitation facilities). Yet the improved/unimproved dichotomy remains in relation to MDG target achievement; see Chart 6. It can be noted that the 2014 JMP update estimates that 1.8 billion people globally use a source of drinking water that is faecally contaminated, so factoring in water quality in future monitoring will be important.

From MDGs to SDGs: | To a great extent, the MDG7 water and sanitation targets live on through the new proposed SDG targets 6.1 (drinking water) and 6.2 (sanitation – now also including hygiene and open defecation) of OWG Goal 6. Yet, responding to parts of the criticism of what was not monitored in the MDG framework, the presently proposed water goal and its related targets go well beyond WASH (Water, Sanitation and Hygiene).

Targets 6.3 to 6.6 (see chart 4) expand the framework to cover the full water and sanitation chain. They underscore the importance of sanitation beyond the use of sanitation facilities, and consider the integrated water cycle, with the inclusion of issues such as ambient water quality, wastewater management, water-use efficiency, integrated water resources management and water for ecosystems. These proposed additional targets include improving water quality by reducing pollution, increasing water-use efficiency, implementing Integrated Water Resource Management (IWRM), and protecting water-related ecosystems. Water now also explicitly cuts across other SDGs, and water-related targets can be found under goals 3, 11, 12, 14 and 15. Target 11.5, for instance, captures water-related disasters. However, there is a noticeable absence of water in the proposed SDGs on energy, and partly also food.

Global monitoring of drinking water and sanitation has been done by the WHO/UNICEF JMP for the past 25 years. To respond to the emerging needs to routinely monitor global targets 6.3-6.6, a number of UN agencies (e.g. FAO, UNEP, UNESCO, UN-Habitat, UNICEF, WHO, WMO) with the support of the Swiss Agency for Development and Cooperation (SDC) are currently developing the Global Expanded Water Monitoring Initiative (GEMI) within the UN-Water umbrella (UN-Water, 2015). The expanded monitoring of the whole water cycle should be able to build on existing monitoring initiatives, e.g. AQUASTAT (FAO, 2015) and the Global Environment Monitoring System (GEMS) Water Programme (UNEP, 2015), to name a few. The GEMI initiative also explores what earth observations and other novel data collection methods have to offer in terms of data and data integration. These high temporal and spatial resolution data are routinely generated, frequently with public funding, and should be available for applications that create societal benefits and provide the foundation for a cost-effective monitoring framework.

Regarding governance-related targets mainly expressed through the means of implementation, the Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS) exercise can play an important role at national and global levels.

Water as Key to the Sustainable Development Agenda | The achievement of the MDG drinking water target, albeit measured through the proxy indicator of improved water supply, demonstrates that setting international goals and targets can drive change through sustained commitment, dedication of resources and effective implementation approaches. The inclusion of the sanitation target (shortly after the Millennium Declaration) has also effectively given focus, priority and resources to this field which is so vitally important for human health and dignity.

Yet the MDGs have been perceived to lack balance between the topics that were addressed. There was no reference to the full and complex role of water in sustainable development, as the MDG framework included only water supply and sanitation services, and within that realm did not sufficiently take water quality, rights, inequalities and sustainability into account. Beyond drinking water supply and sanitation, broader issues of water resources management, water-related disasters or the broader connection to ecosystems, was not captured in the MDG Framework. Many of these shortfalls have been addressed by the inclusion of an SDG relating to water, and the broadening of the contents of this goal. The consultative process of formulating "the future we want" and the SDGs extends far beyond the process of developing the MDGs. While the MDG process lacked wider consultation and has suffered from being perceived as donor-driven, the still ongoing process to arrive at the SDGs has provided solid ground and buy-in from many constituencies. At the same time, it has added layers of complexity. The number of proposed goals has not only increased from eight to 17; the number of targets has increased from 18 to 169. The possible sets of indicators, which might be several hundred, are poised to address processes and inequalities as well as complex economic, social and environmental processes. The broadening of the proposed water goal to include several dimensions of water addresses many of the limitations with the previous MDG environmental goal and related water and sanitation targets, but will a more complete and complex water SDG be able to attract the attention and resources needed for implementation?

The manner in which water, including sanitation, is captured in the proposed SDGs provides a good policy framework for addressing these aspects during the post-2015 period. Yet a policy framework in itself is not sufficient – we will need to build the governance framework and enabling environment, along with financial, human and not least environmental resources. Societal changes, such as population growth, urbanisation, increased income levels and changing patterns of consumption and production, and climate change continuously alter the circumstances for planning and action. While time is passing, the agenda must be kept to firmly in order to efficiently enhance equity: meeting the needs of the poor and enhancing rights, power and inclusion of currently marginalised groups – which is especially relevant for low-income countries.

Water may hold the key to sustainable development but it remains to be seen whether the suggested water SDG has struck the right balance between simplicity in application and capturing the inherent complexity of the Post-2015 development agenda. Only then can its full potential be unlocked.

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Chapter 2

Maximizing the benefits of water, sanitation and hygiene in the SDGs

By Lisa Schechtman

Introduction | The Millennium Development Goals (MDGs) are widely held to have successfully changed the global perspective on poverty, health and development. They created a clear story for advocates to tell, established clear goals for donors and governments, and influenced the structure of global development and financing mechanisms. However, for many sectors addressed by the MDGs, the framework itself created artificial divides between sectors and issues and did not create an incentive for governments to address implicit links or priorities. This has acted as a barrier to successfully achieving many MDG targets, as well as to achieving the MDGs' broad vision of reducing extreme poverty. The new Sustainable Development Goals (SDGs) framework provides a critical opportunity to apply lessons learned from the MDGs toward a renewed ambition for access to water, sanitation and hygiene (WASH) services. This requires the SDGs to recognize the importance of WASH as three discrete but interdependent services, increase the sophistication of their measurement, and intentionally apply them across the framework in order to best capture their many benefits.

The Challenge of Statistics | In the case of WASH, the lessons of the MDGs manifest themselves in two ways. First, the MDGs did not measure outcomes of water and sanitation access. Instead, the water and sanitation targets only focused on the presence of a latrine or water point, measuring success by user numbers and presuming the services are functional, accessible and acceptable. This focus only on the presence of a water point or latrine has stunted ambition. Second, because access to drinking water and sanitation were positioned as environmental issues through their inclusion in MDG Goal 7, WASH has not been appropriately tapped as a key health intervention. This is compounded by the fact that only household- and community-level access to water and sanitation is measured by the MDG indicators, despite evidence that institutions, such as health care facilities and schools, as well as hygiene supplies and ways of behaving, are of great importance to reaching the ultimate goal of universal access to water and sanitation and to maximizing their benefits across a health and development framework.

Goal 7 of the MDGs, to ensure environmental sustainability, includes target 7C, to "halve the proportion of the population without sustainable access to safe drinking water and basic sanitation (United Nations, 2008)." In 2010, five years ahead of the deadline, WHO and UNICEF reported that the goal of halving the proportion of the global population without safe drinking water had been met (UNICEF and WHO, 2012). Despite this apparent success, at least 748 million people (UNICEF and WHO, 2014) in the world remain without access to safe drinking water in their communities. For many, access to safe drinking water may be unreliable due to inconsistent or insufficient funding, poor management and maintenance, lack of government commitment or oversight, changing population patterns, and climate change. The need for access at the household level is much higher still and currently goes unmeasured.

Recent analysis has clarified the true number of people who are likely living without access to safe drinking water in 2015, by measuring at the household level – the benchmark used by the sanitation target in the MDGs – rather than at the community level as the MDGs demanded for access to water (Cumming et al, 2014). This methodology estimates that 2.35 billion people currently lack access to safe drinking water, as opposed to the widely accepted 748 million (Cumming et al, 2014). This analysis has enormous implications for the quantity and quality of water that must be available in order to reach universal access.

A full one-third of the global population, 2.5 billion people (Cumming et al, 2014), lives without access to improved sanitation, defined as something that "hygienically separates human excreta from human contact," at the

household level (WHO and UNICEF, 2008). One billion people defecate in the open (UNICEF and WHO, 2014). Faecal management is inadequately addressed and so the health benefits of sanitation may not be fully realized.

The proposal for the SDGs produced by the Secretary-General's Open Working Group (OWG) (Open Working Group of the General Assembly on Sustainable Development Goals, 2014) currently being used as the basis for UN Member State debate, calls for universal access to safe drinking water and adequate and equitable sanitation and hygiene for all by 2030. Yet the OWG document and an initial set of indicators from the UN Statistical Commission (UNSC, 2015) fall short of considering WASH in sufficient detail or building appropriately upon the MDGs. Taken together, these gaps demand new forms of measurement, and a more expansive definition of access that recognizes where people use WASH services and what needs remain.

Universal access demands sophisticated measurement | In order to achieve equity in access, monitor progress at all levels and in all contexts and locations, and ultimately achieve universal access to water and sanitation, sophisticated measures, which reflect a fuller understanding of access to water and sanitation, will be required. In finalizing the SDGs and their associated indicators, UN Member States should ensure attention to the indicators recommended by the Joint Monitoring Programme on Water Supply and Sanitation (JMP), in order to go beyond the baseline set by the MDGs.

The JMP calls for universal access to water, toilets and hygiene in homes, schools and health facilities (JMP, 2014), an important attempt to better understand the true extent of the challenges the SDGs seek to address and a notable contrast to the UNSC draft documents, which, to date, do not specify a location, such as homes or schools, for use in measuring progress toward universal access to safe water and sanitation. Additionally, the JMP recommends expanding the scope and ambition of monitoring to include safely managed water and sanitation services at the household level.

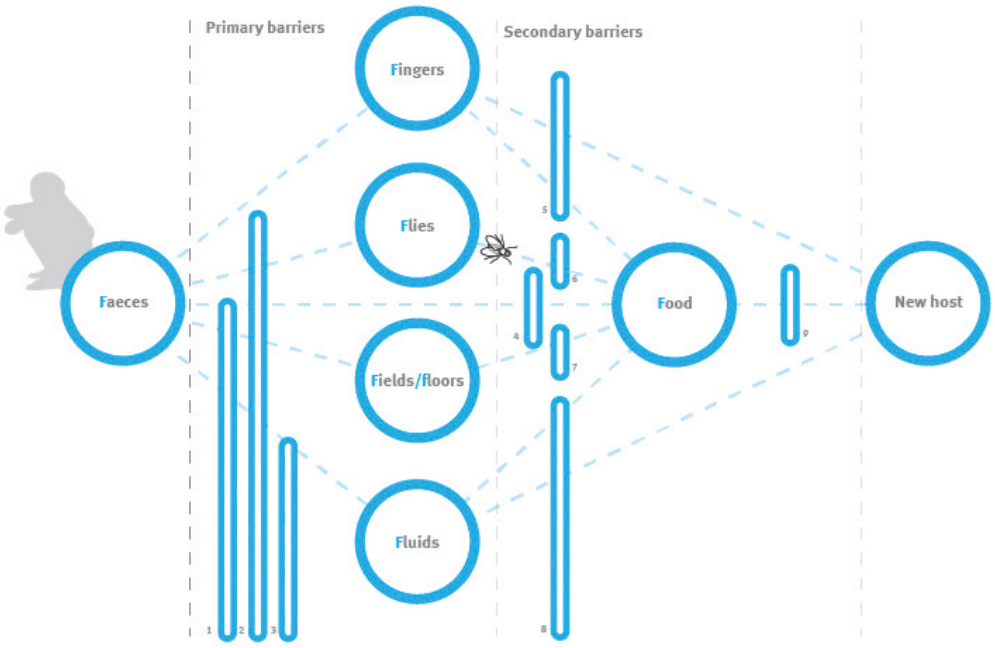
For water, this requires expansion of the definition of access to safe water from simply use of an improved source to a source that is in the household, tested for water quality and maintained to ensure that it is available when needed (JMP, 2014). For sanitation, the JMP definition of safely managed sanitation expands upon use of improved sanitation facility not shared with other households to stipulate that excreta are safely disposed in situ or transported to a designated place for safe disposal or treatment (JMP, 2014).

The official SDGs documents currently being debated by UN Member States lack a way to monitor progress in providing safely managed services – those that go beyond basic access – and access beyond the household and community. If the SDGs are to build upon the MDGs, the elimination of inequalities in WASH access over time, the presence and use of WASH services in institutions such as schools, health care facilities and households, and the quality of the services, particularly as we move from basic to safely managed water supply, must be measured at national and global levels.

Healthy lives depend upon WASH | A single Sustainable Development Goal focused on water and sanitation, with thoughtful indicators, is critical to achieving universal access in the next 15 years. However, only with a thorough consideration of what universal access means can WASH also enhance efforts to meet several priority areas currently under discussion as key to advancing health and well-being, such as the elimination of neglected infectious diseases and ending preventable under-five mortality. There is ample evidence of the benefits to health of safe drinking water, sanitation and hygiene. Diarrheal diseases are the most recognized WASH-related illness, causing the death of around half a million children under five in 2013, and ranking as the second largest cause of death for children aged from 28 days to five years worldwide (UNICEF, 2013). Beyond mortality, chronic diarrhoea in children and other infections spread through faecal-oral transmission such as soil-transmitted helminths (parasitic worms), which affect 1.5 billion people or around 20 per cent of the global population (WHO, 2014) contribute to physical stunting, cognitive delays, under-nutrition, anaemia, and reduced immunity to other infections. The reduction of open defecation alongside adequate faecal sludge management, improved hand and food hygiene and access to safe drinking water, can have enormous benefits for diarrhoea reduction efforts. Other infections, such as trachoma, the leading cause of preventable blindness from which 232 million people are at risk (WHO, 2014)

Fewer than half the health facilities in the developing world have safe drinking water, improved sanitation or water and soap for sanitizing hands.

F-diagram Fecal -oral disease transmission



Primary barriers: [1,2] Latrines and [3] protected water sources ⟶ Secondary barriers: [5] Handwashing after defecation and before eating Protection of food ([4] safe water reuse, [6] storage, [7] handling, preparation) [8] Protection of water in transit and in the home [9] Washing raw fruits and vegetables before eating them

and schistosomiasis, which can lead to permanent liver, intestinal, lung and bladder damage and from which around 240 million people were at risk in 2012 (WHO, 2014), would also be reduced by improved access to and use of sanitation. Addressing these issues requires a step change in household and community access to comprehensive WASH services that allow healthy behaviour and a faeces-free environment.

Ending these major water-borne and neglected tropical diseases by 2030 as suggested in the OWG's Sustainable Development Goal proposal for ensuring healthy lives for all would also have a major impact on the OWG target to end preventable under-five deaths by 2030. However, improvements to maternal health are also critical for improving child health, especially of newborns. Recent analysis (Velleman et al, 2014) suggests that here, too, access to WASH services is relevant to health outcomes.

Researchers recently explored evidence of impact of birthing environments without safe drinking water and improved sanitation, termed WatSan-unsafe by the investigators, on maternal and newborn morbidity and mortality (Benova et al, 2014). In a call to action on WASH and maternal health published last year, the authors recommended greater research into the links and for the Post-2015 framework to adequately embed WASH indicators in health targets to ensure no opportunities to improve maternal health are missed (Velleman et al, 2014). In seeking to identify the potential for improvements, the authors highlighted high rates of WatSan-unsafe births; for example in Bangladesh, 18.5 per cent of births in 2005 were found to be WatSan safe, while in Tanzania only 1.5 per cent of births in 2010 were (Velleman et al, 2014).

It is estimated that 80 to 90 per cent of women in the lowest two wealth quintiles in South Asia, Southeast Asia and sub-Saharan Africa gave birth at home between 2003 and 2011 (Montagu et al, 2011). Yet without a global benchmark that requires attention to household access to water, and without adequate progress on household latrines, these women are at risk of preventable illness and death. To illustrate the potential impact of giving birth in an environment without water or sanitation, sepsis, a consequence of poor hygiene, including lack of water for washing, often directly associated with giving birth, caused 16 per cent of all neonatal deaths in 2013,

the third leading cause of mortality during the neonatal period (Oza et al, 2015), while it accounted for 11 per cent of all maternal deaths in the same year (Say et al, 2014). This underscores the importance of working toward household-level access to water and sanitation as a condition of the SDGs' full success.

Finally, fewer than half of health facilities in the developing world have safe drinking water, improved sanitation or water and soap for handwashing (WHO and UNICEF, 2015). WASH is rarely defined in national plans as integral to basic healthcare. Should WASH in health facilities remain a low priority through 2030, it would be an enormous missed opportunity to improve health and well-being, as well as quality working conditions for health care workers. WASH in health facilities must be explicitly considered in the final SDGs framework and indicators in order to achieve the proposed SDG target for universal health coverage, address preventable infectious causes of mortality, protect health care workers, and even help to stop outbreaks such as the 2014 Ebola Virus Disease (EVD) outbreak in West Africa.

Recommendations | In September 2015, the world's governments will take an important step in efforts towards truly ending poverty and advancing health, development, and sustainable growth, through adoption of the Sustainable Development Goals. This represents an enormous opportunity to drive progress toward the realization of water and sanitation as human rights, to eliminate inequalities, and to capture the many benefits of access to WASH through careful construction of a water and sanitation goal as well as inclusion of WASH indicators across the framework.

A stand-alone goal on water and sanitation should be accompanied by thoughtfully constructed targets and indicators that address each intervention area of a WASH package – water, sanitation and hygiene – as discrete but related issues. Access to safe water, sanitation and hygiene cannot be considered universal if it is restricted to the community level alone; in fact, the health benefits of safe drinking water and sanitation are greatest when access is at the household – not community – level (Cumming et al, 2014). Yet access alone is not sufficient for the many benefits of WASH to be felt and for health and development outcomes to be accordingly improved; WASH services must also be high quality and the SDGs must account for this as well as, for WASH in public spaces such as schools, workplaces and health care facilities.

In order for the health benefits of universal access to water and sanitation to be fully realized, hygiene must be explicitly addressed in relevant SDG targets and indicators. Hygiene is often subsumed under sanitation programmes and measures for a range of reasons, including lack of investment in lasting behaviour change interventions, which require long-term relationships with communities rather than on-off programs, or assessments and lack of discrete budgeting. This trend of linking hygiene to sanitation is replicated in the Open Working Group's proposal for an SDG framework and presents yet another opportunity for UN Member States to endorse greater specificity by explicitly calling for water, sanitation and hygiene as three separate intervention areas so as to ensure the full benefits of each can be captured.
Despite the difficulties of defining and monitoring appropriate hygiene indicators, the JMP has proposed wording, with the support of a broad range of implementing organizations, and these indicators should be included in the SDGs framework so as to ensure that hygiene is increasingly prioritized, and related programs and statistical capacity are built at the country level.

Several of the proposed Sustainable Development Goals will require universal access to WASH as part of their pathways to success, and WASH-related indicators must therefore be embedded within them. This is especially true for achieving food security and nutrition, health and well-being, education, and gender equality. For example, household access to water is an important indicator for reducing unpaid labour within the proposed gender equality goal; hygiene and handwashing in homes would contribute to improved nutrition; and universal adequate menstrual hygiene management facilities in schools and health centres would contribute to gender equality, education, and health. WASH indicators must be reflected across the SDGs framework to ensure a focus on outcomes and to best leverage the cross-cutting benefits of these services.

Conclusions In replacing the MDGs, the Sustainable Development Goals must reflect the different context in which we are now living – from different forms of conflict, to new technologies, to climate change. They must also apply lessons learned from the MDGs. Chief among these is the importance of taking a sophisticated, ambitious and holistic approach, and creating incentives for maximizing the benefits of progress in one area on others. Water, sanitation and hygiene exemplify the necessity of this approach, in their evidence-based impact on health, well-being, and other areas. The global community of stakeholders focused on any or all of these three intervention areas must work diligently to ensure that the SDGs reflect the cross-cutting nature of WASH.

UN Member States should uphold the importance of safe drinking water, sanitation and hygiene through the progressive elimination of inequalities of access, focus attention not just on availability but also on quality, and recognize their importance to poverty reduction and sustainable development. Those institutions and organizations dedicated to WASH should demand a thoughtful and thorough approach to the next phase of health and development initiatives. Only then can we meet the human rights to water and sanitation, contribute to realizing the human right to health, and achieve the vision of a world of shared prosperity, environmental stability, and equal opportunity.

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Sustainable risk management for sustainable development

By Carien van Zwol, Niels Vlaanderen and Wilfried B.M. ten Brinke

Sustainable risk management (SRM) in relation to water management advocates a continuous process of adaptation that is distinct from the 'implement and maintain' philosophy of a traditional approach. Managing risks recognizes that not all problems are equally important and that the benefits of our investments can be maximized if we focus on our biggest and most urgent challenges. Doing this in a sustainable way means that it involves much more than simply maintaining the long-term integrity of flood control structures and a good water quality. It also includes taking care of the long-term health of the associated ecosystems.

In this way, SRM provides opportunities to advance the broader issues of sustainable development in alignment with its three pillars: environment, society and economy. The integration of disaster risk management and climate change adaptation on the one hand, and reaching the Sustainable Development Goals on the other, are closely linked.

In March 2015, a new UN Framework on Disaster Risk Reduction, including four Priorities for Action, were decided at a UN conference in Sendai, Japan. It is important to put those good intentions into practice as soon as possible, as the number and impact of water-related disasters is still increasing. This article aims to contribute to further action, in particular on the issues of strengthening resilience and preventive measures, by showing how these concepts can be implemented.

Global trends: more exposure, increasing vulnerability, more disasters | The risk of water-related disasters has increased greatly worldwide This is the result of the increase in flood events, as well as the fact that more and more people move to low-lying areas near rivers and in the costal zones. The latter means that not only more people are at risk during a period of flooding, but also that the economic value of these areas is greater than before with increasing economic activities. The Intergovernmental Panel on Climate Change (IPCC) has concluded that this is the major cause of long-term increases in economic losses from weather- and climate-related disasters (IPCC, 2012). In the Netherlands, socio-economic development during recent decades has increased the exposure of the population and their assets in flood-prone areas. This exposure will worsen, exacerbated by projected climate change. (De Moel et al., 2011).

Natural disaster risk reduction, therefore, should not focus just on reducing the likelihood of natural hazards, but on increasing resilience to cope with them as well.

River floods occur on a regular basis, causing ever more damage and affecting many people, including in Europe (IPCC, 2014; Visser et al., 2014). The low-lying areas along the world's coasts constitute only two per cent of the world's land area, but ten per cent of its population (and 15 per cent of its urban population) live there. Two thirds of the world's largest cities, each with a population of at least five million, are located in coastal zones (IPCC, 2014). The need to adapt is especially acute in developing countries in Asia, given that 14 of the top 20 urban agglomerations projected to have the greatest exposure of assets to flooding in 2070 are in developing countries in this region (IPCC, 2012).

Risk reduction: precondition for water security | The Sustainable Development Goals (SDGs) will cover a broad range of issues, including sustainable management of water.To ensure a prosperous and equitable future for humankind, water security is crucial. An important part of water security is that societies are resilient to natural disasters, and that disaster risk management focuses on reducing societies' vulnerability and exposure to these disasters. Sustainability and resilience are reciprocal concepts: more sustainability leads to more resilience, more resilience leads to more development and this development again leads to more sustainability. Economic and social development is the connection between the two: there can be no sustainability without development, no development without resilience. Disaster risk reduction

that focuses on strengthening resilience lays the foundation for reaching the SDGs.

The number and impact of flood disasters can be lessened by reducing the vulnerability and exposure of flood-prone societies. Thus, there is a strong link between disaster risk management and climate change adaptation on the one hand and reaching the Sustainable Development Goals on the other. As stated by the IPCC (2012), disasters can set back progress across many of the goals, and progress towards the SDGs can help to increase resilience to extreme weather events, and to climate change. Failure or delays in reaching the SDGs are likely to be both a cause and a consequence of vulnerability to extreme weather and climate change (UNISDR (2005b), in: IPCC (2012)).

Although this article focuses on the impact of floods, the effect of droughts and problems with water quality are just as important and should be part of sustainable water management.

Prevention: the cornerstone of disaster risk management | A focus of flood risk reduction on strengthening resilience is a focus on reducing societies' exposure and vulnerability to floods. This is not a focus on preventing a flood from happening per se, but on preventing large numbers of casualties, major economic damage, a relapse of society's sustainability and development, and therefore about preventing social disruption (Mennen and Van Tuyll, 2014). This may be reached by preventing a flood from happening or decreasing their frequency, by spatial planning to restrict the impact of flooding, by disaster preparation that effectively protects the population, or by a combination of these. This is an important notion from two perspectives. First, many countries cannot afford strong dikes and high-tech civil-engineering works, but generally they can afford flood-proof spatial planning and adequate contingencies planning (including early warning). Second, spatial planning as a means to reduce flood risk calls for a long-term approach and links disaster risk reduction to climate change adaptation.

A broader focus on disaster risk reduction | Disaster risk management used to focus on mitigating the (direct) impacts of disasters using stand-alone and ad hoc interventions. We need to
(i) broaden this focus to prevention, mitigation, preparedness, and vulnerability reduction,
(ii) recognise that disaster risk management is surrounded by many uncertainties and should therefore be a continuous, on-going effort requiring experimentation and learning, and
(iii) integrate and mainstream risk management into sustainable development policies, planning and programming at all levels: globally, nationally, locally and at community level.

Photo: SIWI

This especially holds for flood risk management where socio-economic and climate developments, and their impacts on society, are very uncertain. Globally, flood risk is becoming increasingly urbanised (IPCC, 2012). Population growth drives exposure, outpacing improvements in capacity to reduce vulnerability (such as through building standards and land-use planning). This rapid urbanisation calls for urgent action. A broad focus on flood risk management must be the start of spatial planning and not the final piece.

It is extremely difficult and costly to implement integrated flood risk management retroactively. In many cities around the world, the level of flood protection is lagging behind population and asset growth, both in the developed (e.g. New York) and developing (e.g. Jakarta) world. When cities are built up to the water's edge, finding space for dikes, dams and storm surge barriers becomes extremely complicated. On the other hand, countries that do have an adequately high level of flood protection have come to rely on their flood defences and have paid little attention to flood-proof spatial planning of the urbanising areas behind the dikes. When dikes fail, disaster strikes. This is the case in the Netherlands, where for centuries risk reduction has focused on preventing a flood from happening. Perspectives have changed, though: the focus is being broadened to integrated flood risk management where flood prevention is still the cornerstone (layer 1) but in addition vulnerability to the impact of floods is reduced by adequate spatial planning (layer 2), and more attention is paid to contingency planning and crisis management (layer 3).

Both developing countries with expanding cities and developed countries dealing with urban restoration, regeneration and modernisation can benefit from the lessons learnt from past mistakes.

Integrating disaster risk reduction and climate change adaptation | Disaster risk reduction and climate change adaptation, previously treated as separate topics, should be merged into an integrated approach. Spatial planning plays a central role in this. Flood- and climate-proof spatial planning restricts the exposure of people and their assets and allows for disaster preparedness to reduce their vulnerability. The close link between disaster risk reduction and climate change adaptation has already been stressed by the IPCC (2012): "Disaster risk management and adaptation to climate change can reduce exposure and vulnerability to weather and climate events and thus reduce disaster risk, as well as increase resilience to the risks that cannot be eliminated." This integrated approach can contribute to sustainable development and economic growth. All these elements should ideally be part of the countries' Integrated Water Resources Management programme, aimed at a co-ordinated development and management of water, land and related resources. The integration of disaster risk reduction and climate change adaptation translates into a shift from a reactive to a proactive disaster management approach. As the incidence and severity of extreme events are expected to continue to increase, investment in prevention is becoming more beneficial. For instance, major river floods in central Europe in 2002 resulted in tens of casualties and economic damage of up to EUR 20 billion. (Toothill (2002), Ulbrich et al. (2002)). By way of comparison: the costs of all the measures that have been taken in the Netherlands to enlarge the discharge capacity of the major rivers to avoid these kinds of floods add up to a little over EUR two billion.

Sustainable development calls for sustainable flood protection | Sustainable development of flood-prone regions can be achieved only when flood protection itself is sustainable. This calls for a flexible, adaptive approach and a strategy of building with rather than against natural processes.

Building with nature | Degradation of the environment is a major driver of increased risk. Along many parts of the world's coasts, mangrove forests provide a natural barrier against extreme weather and erosion. In addition, mangroves serve as feeding and nursery habitats for valuable fish species and sequester carbon more effectively than terrestrial forests (IPCC, 2012). However, fresh, brackish and coastal water systems suffer from human activities. Climate change may add to this. According to the IPCC (2014), climate change translates into a key risk of large-scale loss of ecosystem services, including water purification by wetlands, removal and sequestration of carbon dioxide by forests, crop pollination by insects, coastal protection by mangroves and coral reefs, regulation of pests and disease, and recycling of waste nutrients.

Degradation of the environment may also result from measures to reduce risk. An example can be found in the Netherlands where dams and storm surge barriers in tidal waters and river outlets have effectively improved the safety of the hinterland. However, they have also eliminated the fresh- to salt-water gradients that are zones of high biological productivity. Besides, the loss of a tidal range disturbed the natural sedimentary processes, resulting in erosion of tidal flats and salt marshes. The downside of flood protection was a loss of ecosystem services.

In the new Dutch flood risk reduction philosophy, sustainable flood protection calls for building with instead of against nature. A revolution is taking place in which building with concrete gives way to building with natural processes (Borsje et al., 2011). The forces of nature can be used to our advantage. The ecosystem-based approach leaves room for new solutions, such as the so-called sand engine in the Netherlands: an artificial "island" of sand near the Dutch coast, which will supply sand to most of the Dutch coast for years to come by the natural erosion processes. This is an innovative approach towards beach nourishment in order to maintain the beach at a width, which helps provide storm protection. The concept of building with nature can be applied worldwide. Restoration of salt marshes and swamps in Louisiana serves to reduce the impact of future hurricanes, and protects New Orleans. Permeable groynes on muddy coasts that trap fine sediments stop erosion, re-initiate sedimentation processes and help to restore the mangrove forests of currently eroding muddy coasts in, for instance, Asia (Dale et al., 2014).

Flexible, adaptive delta management | Uncertainties are no excuse for inaction: uncertainties are inherent in long-term planning and should be accounted for in a comprehensive, flexible and adaptive approach. In most countries, support for large-scale, long-term measures can be achieved only when these measures also offer benefits in the short term. Thus, in many cases, the most attractive adaptation actions are those that offer development benefits in the relatively short term, as well as reductions of vulnerabilities in the longer term (IPCC, 2012).

Combining measures for the short and long terms calls for a flexible, adaptive approach. Short term measures must be logical in the long term, must not obstruct long-term measures, or may even be necessary to keep long-term options open. It is complicated to take the right short term measures that also address long term issues while dealing with uncertainties in socio-economic developments and the impact of climate change. In the Netherlands, the Adaptive Delta Management (ADM) approach was set up to take into account uncertainties and links in decision-making on delta management, with a view to reducing the risk of overspending or underinvestment (Van Alphen, 2014). With this approach, short-term decisions on water management, land use and spatial planning are linked to long-term issues on flood

protection and freshwater supply, allowing switching between strategies through adaptation pathways.

Concluding remarks | Sustainable Risk Management in relation to water is strongly linked to achieving sustainable development. Globally, water-related disasters already account for 90 per cent of all natural disasters. Their frequency and intensity is generally rising due to climate change, causing enormous damage to life and property. In order to reach the SDGs, societies must become resilient to natural disasters in the long run. Sustainability and resilience are reciprocal concepts: more sustainability leads to more resilience, more resilience leads to more development and this development again leads to more sustainability. Risk analysis can be used as a basis to maximize the effect of your investment in preventive measures. It is important to realise that one cannot rely on a "one size fits all" approach for all developed and developing nations; solutions should be tailor-made and allow for an adaptive approach to be able to deal with the uncertainties of the future.

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Chapter 4

Water for development: fulfilling the promise

By Erik Berglöf and Shanta Devarajan

A baby splashing in his bathwater; a glass of cold water on a hot day; a farmer pumping water to irrigate her crop; a village lit by a run-of-the-river mini-hydro power plant; these are all images of the value of water for everyday life. When they are scaled up, the individual contributions of water can transform the developing world. Water is critical to agriculture, the source of livelihood for 70 percent of the world's poor people, and whose growth is four times as powerful in reducing poverty as growth in non-agriculture (World Bank, 2009). Clean drinking water helps prevent diarrhoea, increasing children's chances of surviving to adulthood, as observed in the United States and Europe (Scommegna, 2005) historically, and in Brazil (Gamper-Rabindran et al., 2010) and India, among other countries, today. Access to water promotes sanitation (Gunther and Fink, 2011), reducing open defecation, and saving the lives of even more children. When families get piped water in their homes, girls can spend the time saved from fetching water on education and other productive activities – or just enjoy more leisure and more satisfying lives (Devoto et al., 2012). And when water flows downhill, it generates electricity that can change the fortunes of billions of people. If fully utilized, Africa's hydropower alone can quadruple the continent's current power consumption (Appleyard, 2014).

Poor performance | Despite this potential, the actual performance of water has fallen short of its promise. In agriculture, water is frequently misallocated. One would expect that the productivity of water would be highest in water-scarce regions, to ensure that the limited water is being used most efficiently. The reality is the opposite. For instance, the Middle East and North Africa (MENA) is the most water-scarce region in the world. Whereas annual renewable water resources per capita are around 35,000 cubic meters per capita in Latin America and 8,000 in Africa, they are only 2,000 in MENA. Yet water productivity in MENA is about half the world's average (Figure 1).

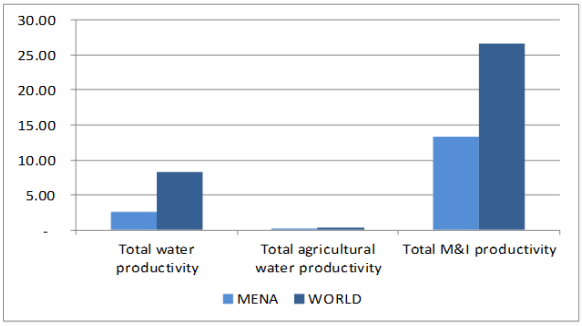

Figure 1: Water productivity in MENA and the world (Source: World Development Indicators, 2014)

Within countries, too, water-intensive crops are grown in water-scarce areas. Farmers in southern Indian states grow paddy and sugar-cane in some of the driest parts of the country. Furthermore, it is often not the volume of water but its variability that affects agriculture. Droughts and floods can ruin a farmer's harvest – and not just in dry countries. Throughout history, societies have solved this problem with irrigation – storing water when it is plentiful, and releasing it in the dry season[1]. Sub-Saharan Africa is the continent that today faces the greatest variability in rainfall – something that will grow with the effects of climate change (Figure 2). Yet Africa is the least irrigated continent in the world. A tripling of the irrigated area in the Zambezi basin would increase agricultural productivity five-fold. The dollar value of these benefits is twice the costs of the irrigation expansion (Bouzaher and Devarajan, 2012).

Similarly, although it can greatly reduce the number of child deaths, clean drinking water is still elusive in many developing countries (and the sanitation gap is even greater[2]). Few cities in South Asia or Africa have water 24

[1] More recently, hydro meteorological forecasts, sent to farmers over cell phones, have improved their ability to shift cropping patterns and adapt to variability.
[2] The MDG on water supply was reached globally, but not on sanitation.

hours a day, seven days a week. Yet this is what is needed to ensure that impurities do not enter the water system. Worse, the availability of water – measured in number of hours per day of service – is declining, even in cities with rapid economic growth such as Bangalore, Chennai and Hyderabad in India (World Bank, 2010), and Dar es Salaam in Tanzania (Ginneken et al., 2011).

Even more troubling is the fact that, within these and other cities, it is the poor (whose rates of child mortality are three or four times those of the rich)[3] who have the least access to clean drinking water. Moreover, the poor seem to benefit less than the rich when water supply or sanitation is increased. The uneven levels of service in different neighbourhoods of the same locality, or on different floors of a multi-story building, are further testimony to this pattern.

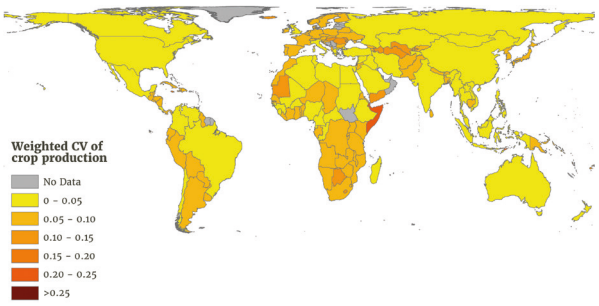

Figure 2: Variability in food crop production
(Source: Securing Water, Sustaining Growth, Report of the GWP/OECD Task Force on Water Security and Sustainable Growth, Figure 11)

Finally, in failing to harness water's potential as a source of energy, the world is missing a huge opportunity. Africa, where only a third of the population has access to electricity, has the highest untapped hydroelectric potential in the world. The three "water towers" of Guinea, Ethiopia and Democratic Republic of Congo could not just supply Africa with clean energy for years to come, but also be a source of export revenues. Nepal could significantly increase its per capita income by exploiting the Himalayan runoff and selling to its two energy-hungry neighbours, India and China (World Bank, 2014). To be sure, building large hydroelectric dams involves major safety issues and in some cases, concerns about resettlement of people living in the vicinity and the environment (ecosystems, biodiversity, etc.) And many rivers flow across national boundaries, raising questions of riparian rights to the water. But the need to find low-carbon sources of energy reinforces the point that these issues should be addressed sooner rather than later, so that water's ability to sustainably transform the world's energy consumption is fully realized.

Water is also often a source of conflict. In his seminal 2004 study, Edward Miguel found that water shortage predicted civil strife remarkably well. With climate change accelerating and intensifying competition between different uses, water conflicts are likely to escalate. More efficient management of water and better governance of water resources are paramount to reduce likelihood of future tensions.

What went wrong? | While there are different reasons why water has not lived up to its promise, the most important one is the failure of public policy to properly price and regulate water. Applying the textbook definition, water at its destination is a private rather than a public good[4]. First, it is rival: when I drink a glass of water, you cannot drink that glass of water. Second, with some exceptions, it is excludable: communities can (and do) stop outsiders from using their water source; you have to be connected to the grid to get piped water. As with other private goods, therefore, the price of water should equal the marginal cost of production for domestic, agricultural and industrial use alike. Furthermore, while water is technically renewable through the hydrological cycle (runoffs, evaporation, condensation, etc.), when it is overused, water comes closer to being an exhaustible resource: water overuse today means less water for future generations. Such a situation implies that prices should exceed production costs.

However, most governments have chosen to treat water at its destination as a public good and subsidize its use (Figure 3). In Africa, the average residential water tariff is about $0.67 per cubic meter while the production and distribution costs are about $1 per cubic meter (Banerjee et al., 2008). Another measure is the share of "non-revenue water," the share of water lost through leaky pipes and uncollected bills. In Africa it is 34 per cent on average, in India about 40 per cent. Nor are these subsidies unique to poor countries. In Saudi Arabia, water is sold at 8 cents per cubic meter, but costs about USD 1.09 per cubic meter to produce. Water subsidies, along with subsidies for energy and sometimes foodstuffs, are one of the major tools for leaders to maintain social stability and secure their hold on power.

Subsidizing water has at least three effects. First, it leads to excessive use of a possibly non-renewable resource. Cheap water is an incentive for farmers to use water-intensive crops which, in turn, depletes the available water resource faster. The MENA region, which is the most water-scarce region in the world, has some of the lowest water tariffs for agriculture. Not surprisingly, MENA has

[3] Wagstaff (2000).
[4] Water at its source exhibits many public-good characteristics, such as common-pool resources and the fact that the depletion of aquifers is a major threat to freshwater ecosystems. All of these point to the need for public intervention in managing water systems, which will be facilitated by rational pricing of water at the consumption stage.

low agricultural water productivity: due to the subsidies, the crop mix chosen is suitable for a region with much more water. The problem is exacerbated when, in addition to subsidizing water, governments subsidize fuels. In Yemen, diesel subsidies have led to severe water shortages – and a heavy dependence on qat, an addictive, water-intensive crop. Likewise, in southern Indian states, the policy of "free power" has contributed to the prevalence of water-intensive crops and the depletion of the water table. Farmers recognize the problem. After water subsidies were removed in Andhra Pradesh, India, one farmer said, "We will never again allow the government to give us free water."

The second consequence of subsidizing a private good like water is that it creates a "rent" – the difference between private willingness-to-pay for water, and the tariff. If, to avoid depletion, water is also rationed, the size of the rent is even greater. This rent is in principle available to everybody. In practice, those with political power are able to capture it first – and these are typically the non-poor. As a result, drinking water supply networks typically cover middle-class neighbourhoods (World Bank, 2003). This also explains why expanding water supply – without subsidy reform – does not necessarily increase poor people's access to water, as observed in Africa and South Asia.

Needing water to survive, poor people often resort to buying water from private vendors – at many times the meter rate. In other words, even if the tariff were doubled or tripled, and poor people got access to the water network, they would be better off. Some studies show that the coping costs that poor people bear because they do not have access to piped water – fetching water from remote sources, buying from private vendors, storing water – are multiples of the production costs (let alone the tariffs) of network water (World Bank, 1999; Devoto et al., 2011). Water illustrates the adage, "It's very expensive being poor."

Third, when water – or any other service for that matter – is subsidized, the service provider (in this case, the utility) is accountable to the politician, who provides the subsidy, and not to the consumer. Knowing this, politicians use the utility for their political purposes, rather than providing water to consumers. For instance, there is strong evidence that water utilities in India have many more employees than comparable private utilities – an example of "featherbedding" to curry favour with potential voters.

Politicians also ensure that the water network goes to where their political clients live – so the latter can earn the rents created by the subsidy – and this may not be where the poor live. The solvency of the utility depends on the subsidy, and is hence a political decision, creating uncertainty on the part of potential investors, especially if the subsidy scheme is not sustainable. As a result, there is limited investment, the grid deteriorates, and water quality suffers. This would also explain why there is so little irrigation in Africa: without proper pricing of water, there is little incentive for farmers to maintain the irrigation scheme, and for outsiders to contribute capital to irrigation infrastructure.

The under-exploitation of hydropower is not directly linked to the underpricing of water (although it is related to

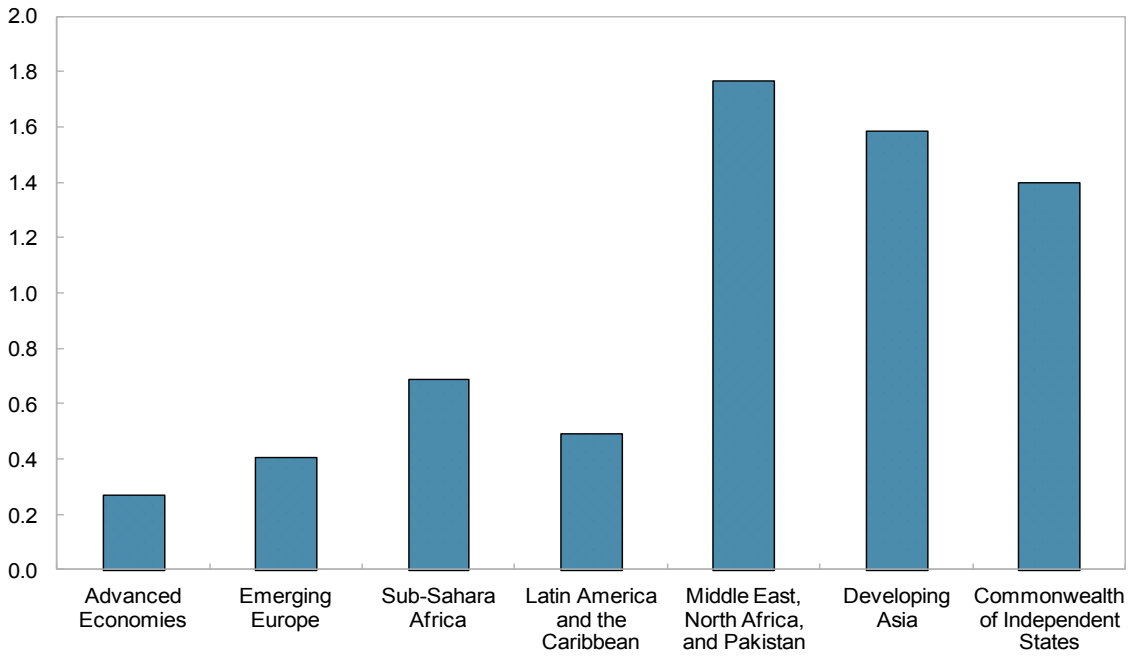

Figure 3: Water subsidies as a share of GDP Share of GDP
(Source: International Monetary Fund, 2015)

electricity pricing). Rather, the problem here is the lack of strong institutions to tackle the within-country issues of safety, environmental degradation and resettlements, and cross-border issues of shared river basins.

What can be done? | If water subsidies have such pernicious effects, why have they been so difficult to reform? From the discussion above, it is clear that various groups are benefiting from these subsidies – politicians and those fortunate enough to be connected to the grid or the irrigation system – even if the people whom they are supposed to benefit, the poor, are not among them. These groups are able to block efforts at reform. They sometimes do so by claiming that the reform "will hurt the poor," even if the evidence – as the farmer from Andhra Pradesh knows – is to the contrary.

In this setting, the only way to achieve reform, so that water can deliver on its promise, is to build political consensus for reform. A number of interventions can help in this regard. The first is to build the evidence base and make it accessible to the public, especially poor people. Information about who benefits from water subsidies – and how much governments spend on these subsidies compared with other pro-poor expenditures such as health and education – can be quite powerful. So too can information about water utilities and irrigation schemes. With this information, small incentives could generate major shifts in consumers' behaviour. Evidence from a controlled experiment in Morocco showed that only very small nudges (help in filling out forms) were needed to get customers to shift to piped water (Devoto et al., 2012).

Secondly, water users can be organized to demand better services from utilities. Experience from water cooperatives and users' associations can be relevant here. These associations can then force utilities to meet certain levels of customer satisfaction. Indeed, a coalition of users and utilities could diminish the power of politicians. Empowering end-users of water is reasonably straightforward as many aspects of quality of service delivery are relatively easily discernible.

Third, customers are often willing to pay more if they can be guaranteed better quality service. Reforms could be designed so that quality improves alongside price reforms. Citizens are more likely to accept tariff increases if they can see tangible improvements in water quality. The nascent movement of service delivery guarantees for utilities is a step in that direction--an opportunity to build grass-roots democracy even in societies with autocratic forms of government.

Fourth, whereas the thinking on managing water utilities in advanced economies has focused on how regulators can encourage privately-owned utilities to reveal information about their costs and revenues, the overwhelming challenge for developing economies is for the utilities themselves to find out what their actual costs and revenues are. Only once the budgets of the utilities have been separated from those of municipal authorities is it meaningful to discuss private-sector participation. Eventually, the insights from the economics of regulation literature, recognized in the 2014 Nobel Prize to Jean Tirole, can play an important role in improving water management in developing and emerging economies. Finally, inasmuch as there is a risk to outside investors, international organizations could help absorb some of that risk, including political risk. By supporting local authorities in negotiations, particularly in public-private partnerships when international operators are involved, these organizations can ensure that arrangements are more balanced, making them less likely to be renegotiated later, something that is disturbingly frequent. They could also play a role in helping countries manage the safety, environmental, and resettlement risks of hydropower, and possibly the cross-border issues associated with river basins.

If we are to achieve our dream of a world free of poverty, development in poor countries, and of poor people in middle-income countries, will have to accelerate. Water can and should play a leading role in that acceleration. So far, its role has not been commensurate with its potential. We now understand better why that is the case. The challenge is to use this knowledge to reform the water sector so that poor people can fully benefit from this precious resource.

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Chapter 5

ICT for urban water infrastructure

By Anders Lynggaard-Jensen, Ole Mark and Philippe Gourbesville

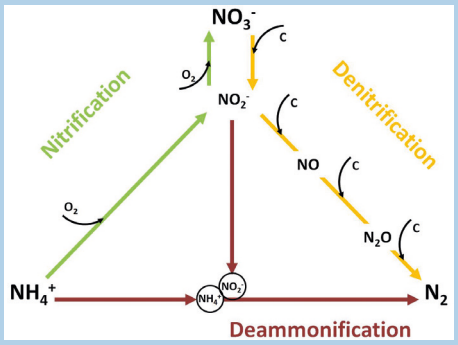
Introduction | Water is a driver for development – not least in fast-growing cities, where it is a challenge to secure a safe drinking water supply, as well as efficient collection, sustainable treatment, and possible reuse of the water. At the same time water is a barrier to sustainable development, as flooding and the damage it causes can seriously affect a country's GNP. This happened in Thailand, where flood damage in 2011 is estimated at USD 45.7 billion, and GNP fell from approximately 3 per cent in 2010 to 0.1 per cent in 2011 (http://en.wikipedia.org/wiki/2011_Thailand_floods). ICT is a key to meet these challenges as it enables – and even in some cases is a prerequisite – for planning, implementation, and operation of an efficient and sustainable water-related infrastructure. The present paper outlines cases from the urban water sector where ICT is a necessity. With several developing countries, water-related infrastructure is very limited and inadequate. However, the use of innovative ICT for real-time control and modelling of water infrastructure makes it possible for some countries to leapfrog and directly use cheaper and more efficient solutions, notably by the use of mobile devices and networks.

Energy and resources | The vocabulary of water-related infrastructure is changing. For example, wastewater treatment plants are today called water reclamation plants (WRPs), waste and wastewater are now seen as resources, and treated wastewater is referred to as recycled water.

The use of ICT for better monitoring and control at WRPs has been a prerequisite for changing the plants from being the most energy consuming components within the water related infrastructure to be energy neutral. However, the development does not stop here, as the use of ICT has also made possible the introduction of new energy-saving processes (Box 1), which requires carefully, controlled process conditions (Wett et al. 2013). Together with optimised operation of anaerobic digesters, these turn the WRPs into net energy-producing units. In warmer climates, a realistic target of the energy produced is 50 per cent more than the energy consumed. The biogas produced by the anaerobic digesters is used as fuel in very efficient CHP units (combined heat and power) consisting of a biogas-powered engine and a generator. Again, the very high efficiencies of these units could not be reached without the use of ICT for monitoring and control. Amongst other functions, this automatically takes care of the varying composition of the biogas – an important parameter for optimal operation of the engine.

WRPs can also be seen as "bio-refineries" in relation to recovery of resources. Phosphorus is the most striking example, as it will be a limited resource in the future, and we cannot live without it. Here ICT is a prerequisite for the re-introduction of a well-known process producing struvite (Box 2), which is easy to handle - and for crops a directly accessible fertilizer.

Box 1



Traditional nitrogen removal uses nitrification/denitrification to remove ammonium, whereas the de-ammonification process needs only a part of the ammonium to be oxidised to nitrite, in order to allow Anammox bacteria to produce free nitrogen from ammonium and nitrite. De-ammonification therefore saves almost 2/3rds of the aeration, and it uses no carbon source. As much of the carbon in the influent to the WRP as possible can therefore be fed to the anaerobic digesters in order to increase biogas production.

The reclaimed water – now released for its energy content and other resources (formerly known as pollutants) can be used for irrigation or even as drinking water. However, the use of the reclaimed water may introduce the need for some further treatment – disinfection, for example. Direct recycling as drinking water is possible after a carefully monitored and controlled membrane filtration – the barrier for this is not technical but psychological.

The target is now to turn the whole water-related infrastructure into a sustainable energy-neutral structure delivering water to the cities and producing nutrients (fertiliser) for the food consumed by their citizens.

Flood control planning and extreme events | Traditional urban water management has offered classical structural solutions, with a lot of expensive construction works. Integrated modelling med ITC provide opportunities for smarter integrated solutions than the traditional civil engineering only relying on structural solutions to water management. Existing water-related infrastructure can be utilised and optimised, and new infrastructure can be planned and implemented – both at significantly reduced costs compared to classical structural solutions.

An example is how the implementation of real-time flood forecasting for cities, based on ICT solutions, can help to reduce urban flood damage and be a driver for more resilient and sustainable water-related infrastructure. Extreme events will always occur with a force which exceeds the design, even when design standards have been updated on the basis of the latest climate change projections.

Forecasting and coping with extreme events requires an analysis of the risk that they will happen, the damage they can cause, and the costs of managing them. The results of such analyses provide valuable information for long-term social planning, for example when planning where new infrastructure can be built, and where existing infrastructure and buildings have to be moved from vulnerable areas.

Box 2

A magnesium salt is added to a phosphate and ammonium rich side stream (reject water from dewatering of sludge from anaerobic digesters or from surplus sludge taken from anaerobic hydrolysis of return sludge), which is flowing upwards in a reactor with recirculation.

$$2Mg^{2+} + 2NH_4^+ + H_2PO_4^- + HPO_4^{2-} + 3OH^- + 10H_2O \Rightarrow 2MgNH_4PO_4 \cdot 6H_2O\,(s) + H_2O$$

The size of the precipitated struvite crystals is carefully controlled by pH (adding sodium hydroxide) and retention time.

In addition to these primary economic analyses, there is also a need for outlining the general ethical and social consequences which society can accept. It is never possible to avoid flooding and the consequent damage completely, but it is possible to reduce flooding to a level where human lives are not at risk and where the most vital infrastructure (power supply, hospitals, etc.) can still work during extreme flood events. Finally, there is a need for emergency plans for handling extreme weather situations as they arise, both today and in the future. When flood hazards have been mapped, and emergency responses outlined, it is time for the design of the real-time flood forecast system.

Research by Renee et al. 2012 have shown that basically every city in the world can get access to real-time rainfall forecasts and topography so that the basic data requirements are covered for real-time flood modelling. The level and sophistication of the flood forecast system may be a simple empirical system or a model predictive system working with probabilistic flood forecasts as outlined by Hénonin et al. 2012. Examples of a real-time flood forecast system can be seen in Table 1.

A final point where ICT can apply to flood forecasting is in reducing the requirement for local human capacity to run and maintain a real-time system (Hénonin et al.

Table 1

	Rainfall–runoff model	1D model	2D model	1D–1D model	1D–2D model
Main data requirement	Catchment parameters	Network data	Topographic data (DEM) and/or DTM	Network data. Surface data (streets, topography)	Network data. Topographic data (DEM and/or DTM)
Drainage network representation	None	Yes	None	Yes	Yes
Surface flood representation	None	None	Yes	Yes, to some extent	Yes
Computation time scale	1 min	1 min. to 1 h	1 h to several hours	5 min to 1 h	1 h to several hours
Real-time application	Yes	Yes	On-going research	Yes	On-going research
Flood map and analysis accuracy	None	None to low	Moderate to high	Moderate	High

2012). Such a system was established for Dhaka during the CORFU project (Hénonin et al. 2014). With the implementation of stable data communication lines over the internet, the real-time system can in practice be located anywhere where human resources and a stable power supply are available. The benefits of such a system design are that dependence on local power supplies and ICT resources can be reduced to a minimum, for example with a battery back-up and satellite communication. This will ensure that the real-time system still works during local power failures.

Summary | As demonstrated, the implementation of ICT solutions in the water sector represents a way to improve the efficiency of services and the management of resources (also referenced by Ross and Luu, 2012; Finlay and Adera, 2012). But this also requires adapting the available ICT solutions and developing specific methods that may address some key issues, like the cities of tomorrow, asset management, the water energy nexus, and real-time management. Identifying relevant ICT solutions requires a formal and standardised approach to ensure that solutions implemented are compatible with one another. At the same time, the development of common standards endorsed by the ICT and water sectors must ensure sustainability.

So the need for a safe water supply, reduced urban flooding, reduced pollution and a cleaner environment for a growing population concentrating in fast-growing cities requires changes in how we handle the complete water cycle and adapt to climate changes. This challenge can only be met if we exploit the new processes and knowledge gained from the use of ICT to change the design, construction and operation of the water-related infrastructure. ICT will thus be the driver that changes traditional urban water management.

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Chapter 6

The power of Information Communications Technology (ICT) in water for development

By Jeroen van der Sommen and Will Sarni

Why ICT and water? | Advances in information and communication technology (ICT) have made huge strides in the 25 years since the first Stockholm World Water Week. And while ICT has achieved many positive effects for water development, the Sustainable Development Goals (SDGs) offer an opportunity to drive demand through greater global footprint and impact of measurement and monitoring. As the global "digital divide" narrows, the WASH divide (access to safe water, sanitation and hygiene) will become more apparent, and WASH data will need to become downwardly accountable to citizens and communities. This will provide the opportunity for the WASH "ecosystem" (Deloitte University Press, 2015). WASH ecosystems of stakeholders are forming to ensure access to safe water, sanitation and hygiene. An example is the World Council for Sustainable Development (WBCSD) WASH Pledge and guidelines which is mobilizing over 20 multinational companies to commit to providing WASH to their employees.

In the 25 years since Stockholm World Water Week was first convened, ICT, the convergence of telecommunications, computing networks and software infrastructure, has developed at breathtaking pace. In 1990, ICT was a tool for the few – for the professionals, for "the west", for institutions, for industries. And then in 1991, the world's first mobile call based on the GSM standard was made from Finland, the same year Tim Berners-Lee published a short summary of his idea of a "world-wide web". By the end of 2014, almost three billion people will be using the Internet, up from 2.7 billion at the end of 2013 (ITU, 2014).

ICT underpins virtually all global supply chains and has played a central role in addressing many environmental issues such as energy and greenhouse gas emissions. Note the success of the Global e-Sustainability Initiative (GeSI) in harnessing ICT to improve energy efficiency and reduce greenhouse gas emissions (http://gesi.org/SMARTer2020). There is considerable momentum to go further, specifically in the context of how businesses and governments commit to addressing social issues such as increasing access to safe water, sanitation and hygiene (WASH) and fundamental issues such as increased supply chain traceability and transparency. The World Business Council for Sustainable Development (WBCSD) WASH Pledge and Guidelines are a good example, as is the use of ICT to tackle food and material traceability, such as palm oil and conflict minerals. ICT has also dramatically improved communications and the development of understanding, through the sharing of knowledge and the ease of information exchange.

But somehow ICT itself has soared ahead of key environmental and social challenges, leaving a huge gap between potential and reality on the ground. For some years now it has been commonplace for the world's poorest people to have a mobile phone long before they have safe drinking water or a toilet. And a typical upscale apartment complex on the edge of Bangalore, India's most advanced information technology city, trucks all its water in. That is up to 40 trucks per day, each carrying 6,000 litres. Meanwhile residents enjoy high-speed broadband. Welcome to the paradox of global development in 2015.

Open Data, Big Change | For the world's poorest people, establishing the UN Millennium Development Goals in 2000 shaped the spending of billions of dollars of investment in WASH. Yet when the 15-year water-related MDG targets were set, just 400 million people were using the internet (www.statista.com, 2015), Google as a company was less than two years old and Wikipedia was still a year away from launch. It was not well understood how ICT would penetrate and transform sectors and societies, how knowledge networks and search tools would evolve. A 2014 ITU report found that many indicators of the MDGs showed significant correlation with ICT improvements, notably those related to poverty reduc-

tion and health improvement. And as the focus shifts to setting the SDGs many, including the United Nations, state that in 2015, we're standing on the precipice of a "data revolution". In November 2014, the UN Secretary-General's "Independent Expert Advisory Group" report, "A World That Counts" (www.undatarevolution.org), made concrete recommendations on bringing about a data revolution for sustainable development.

It is worth reading the WASH SDGs for 2030 and thinking about the key phrases, and the role ICT will be expected to play in the journey to them. Goal 6 proposes to "ensure availability and sustainable management of water and sanitation for all". And goal 6.1 mentions terms like "universal", "equitable access", "safe", "affordable", "an end to open defecation", "reducing pollution", "eliminating dumping". ICT will be expected to mobilize, measure and monitor each of these. And that's before we account for goals around water-use efficiency, water scarcity, integrated water resources management, transboundary cooperation, and more.

A "World That Counts" also emphasises that data should be open whenever possible, published in machine-readable forms that allow others to use and build on insights. This shift amongst all global actors towards greater transparency on spending and results is leading to the implementation of data standards that will make it easier to exchange and share data about water-related investments, programmes and interventions. An example is the International Aid Transparency Initiative, where aid donor countries such as the UK and the Netherlands now stipulate that all organisations they fund must publish core data to common standards. A water point data exchange standard is also being explored in the United States. So the SDGs are a key opportunity to herald dramatic leaps in what is counted, what we monitor, and how people have more voice in decisions around WASH investments. But things aren't likely to stay still, either. The same ITU study found that 4.3 billion people are still not online, and 90 per cent of them live in the developing world. Bridging this digital divide will be a major focus for many over the next few years, and the implications for WASH of this transition will be dramatic.

New technology, new skills, new dynamics | ICT's rapid surge in the world's poorest countries to close this "digital divide" means baseline surveys and the monitoring of infrastructure projects are going from paper to smart-phone, fast. And the scale and immediacy of this roll-out brings into focus the skills of existing institutions to make rapid, informed decisions. It puts the ability to design and manage better surveys into the hands of people on the ground. Supporting the development of data literacy skills in low-income countries, for public servants, "infomediaries" and citizens was a key need highlighted in the "World That Counts" report. A real challenge lies in what we do with the collected data in terms of processing, analysing, and visualising the outcomes in multiple report forms to support better decision-making and resources.

Photo: Teresa Howes, SXC

Another factor is the need for downward accountability of WASH data. As databases become decentralised and open, rather than centralised and inaccessible, the politics change too, as in theory there is greater empowerment of civil society organisations from the bottom up as they become agents of change.

A good example of collaboration between public and private sectors, facilitated by ICT, is Ghana's Community and Water Sanitation Agency (CWSA), which is engaged in a programme called SMARTerWASH (http://nepadwatercoe.org/smarterwash-a-new-model-for-rural-water-service-monitoring-in-ghana/). This enables a shift from counting facilities to monitoring the services actually provided. Services are measured against indicators for functionality, service level, service provider performance and service authority. The goal is rapid improvements to water and sanitation coverage in rural and small town areas. Local citizens, repair and maintenance businesses and local and regional government staff are linked through ICT. Intensive smart phone point monitoring is combined with improvements and incentives to the local and regional repair networks, with the goal of building a sustainable network of repair businesses. This is closely integrated by a commercial partner to make smart use of communication technologies – Short Message Service (SMS) or Unstructured Supplementary Service Data (USSD) and a call centre – to organise mobile payments, spare parts ordering, book mechanics and manage deliveries. The results have triggered repairs and other remedial actions that benefit over 11 million water users (IRC, 2015), leading to a scaling-up supported with additional funding of around USD 3.9 million from the Government of Ghana, the Netherlands Government, World Bank,

UNICEF and the Conrad N. Hilton Foundation.
The low cost, power and portability of smart phones means they can now become mobile laboratories. In Bangalore, India, Ternup Research Labs is developing and testing Caddisfly, an Android phone-based drinking water testing system, backed by Akvo. The design goal is to achieve a simple, fast, portable and low-cost testing kit, built around the power of the smart phone and its camera, that can be used anywhere to quickly analyse the level of fluoride in drinking water. Caddisfly allows water quality data to be mapped and shared online, at scale. It automates a colorimetric field test using the camera and flash of the phone. The colour change is recorded and compared against a calibrated range, resulting in a fluoride value in milligrams per litre that is displayed to the tester. The approach aims to generate reliable field results to support action and investment, and provide communities with better information on the quality of their water. Further validation and analysis is being executed in cooperation with India's Fluoride Knowledge Action Network (FKAN) and the UNESCO-IHE lab in Delft.
An interesting aspect of ICT in 2015 is how low cost smart phones and data networks now empower both professionals and non-professionals alike. As more and more devices go into the hands of citizens, their voice can grow quickly, and they can evolve ways to campaign for better infrastructure or services, and highlight where services fall down. Those working in governments or other organisations who are not prepared for this, will find the future very uncomfortable. As citizens gain a voice, it is important that local, regional and national governments use their ears.

Companies, governments NGOs and a range of other stakeholders and civil society now have unprecedented opportunities to use ICT to achieve a range of sustainable development goals. ICT gives them the ability to engage, organize, measure, photograph, track and publish data and information and, equally important, share this quickly and transparently. ICT's role in sustainable WASH has never been more compelling or dynamic, nor its ability to redraw the dynamics of power and representation in relation to the use and access to water, that most important of resources.

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Chapter 7

Healthy freshwater ecosystems: an imperative for human development and resilience

Frederick Boltz, Alex Martinez, Casey Brown and Johan Rockström

Introduction | Fresh water is vital to human life and wellbeing. Along with food and shelter, it forms our most basic need. So vital, in fact, that access to drinking water is commonly considered a fundamental right for all humanity. Healthy, functioning freshwater ecosystems provide reliable and quality water flows upon which these basic human needs depend. Energy, food and health – all indispensable to human development – rely on the water services provided by natural ecosystems. Freshwater ecosystems, such as wetlands and rivers, also provide crucial regulating services, such as water purification, flood mitigation and the treatment of human and industrial wastes. Now, more than ever, we must incorporate the value of water-related environmental services in our water management decisions. Eradicating poverty and hunger among the billions living in deprivation today and those in the future will depend fundamentally on water security – for both people and ecosystems.

Water is central to the functioning and resilience of the biosphere. Its availability and variability strongly influences the diversity and distribution of biomes and habitats that harbour the wealth of plant and animal life on Earth. Water of specific quantity and quality is required to preserve the state and stability of ecosystems and build their resilience to localised disturbance and to global change. It mediates the persistence of ecosystem types, their composition and function, and facilitates the migration of species and habitats as key environmental conditions such as temperature, rainfall, and soil moisture change.

Water's central role in the biosphere has long implied that several of the most important challenges confronting human development are related to fresh water (e.g., Falkenmark, 1990). This has been true for decades and will only intensify without a change in the course of human water use. For too long, conventional approaches to water planning have focused narrowly on economic productivity, largely ignoring the costs of overdrawing water from ecosystems or disrupting natural flow regimes with hard infrastructure. If we are serious about meeting human development objectives for the coming century, the way we plan and manage water resources must change.

Humanity's freshwater footprint | Water provision for economic growth provides unquestioned benefits that too often come at significant but unquantified costs to ecosystems and biodiversity (Vörösmarty et al., 2010). Humans change the dynamics of the water cycle through damming and diversions, through water withdrawals for energy, agriculture, industry, and domestic use, and through return flows of altered quality, quantity and variability. Reservoirs intercept more than 40 per cent of global river discharge (Vörösmarty et al., 2003, Lehner et al., 2011) and more than 50 per cent of large river systems are affected by dams (Nilsson et al., 2005, Lehner et al., 2011). Fragmenting and degrading freshwater ecosystems results in a reinforcing cycle of decline, as ecosystem damage in turn reduces the quantity, reliability, and quality of water flows, weakens storm and flooding protection, wastewater treatment, fish production, and other ecosystem services. In several regions of the planet, direct human impacts on the water cycle are of the same order of magnitude or even exceed the impacts expected for moderate levels of climate change (+2°C) (Haddeland et al., 2014).

Freshwater species and ecosystems are disproportionately threatened by human activities due to both the magnitude of disturbance and their exceptional richness as a

Photo: Fred Boltz

habitat for plants and animals. Over 10,000 fish species live in fresh water, approximately 45 per cent of global fish diversity (IUCN, 2014). Together, freshwater endemic fish, amphibians, reptiles and mammals constitute as much as one third of all vertebrate species (Dudgeon et al., 2006). Yet surface freshwater habitats contain only around 0.01 per cent of the world's water and cover only about 0.8 per cent of the Earth's surface (Gleick, 1996). Of some 25,000 freshwater plant and animal species assessed for the IUCN Red List, almost one third are threatened with extinction, over 200 are already extinct, and their rate of loss is higher than either marine or terrestrial species (IUCN, 2014). Extinction rates rival those of previous transitions between geological epochs like the Pleistocene-to-Holocene (Meybeck, 2003); suggesting, based on a similar exponential rise in human pressures on other key parameters that regulate the stability of the Earth system (e.g., nutrient loading and climate change), that humanity has entered a new geological epoch: the Anthropocene (Crutzen 2002, Steffen et al., 2007, Zalasiewicz et al., 2008)

Freshwater ecosystem resilience | While improved water management is needed to meet human development goals, it is also required to provide protection from the uncertainties of a changing planet. Both people and ecosystems are vulnerable to environmental changes or shocks, like floods and droughts. Floods displace people from their homes and livelihoods. Droughts damage both natural wetlands and human agriculture. Wetlands can provide natural buffers to flood waters, but only if they are allowed to thrive, which requires that some water be allocated to sustain their function. Similarly, it is easier to withstand droughts if a system is not already stressed. Allocating adequate water flows to ecosystems during periods of stasis adds stability and adaptability during times of stress. This concept is known as water resilience (Rockström et al., 2014). Resilient ecosystems handle shocks without being damaged beyond repair. Excessive changes to ecosystem structure and function, stress, and simplification of natural complexity has the potential to push functionally intact freshwater ecosystems beyond the bounds of resilience (Baron et al., 2002).

Freshwater systems are directly threatened by human activities and stand to be further impacted by climate change. Climate change will not only exacerbate water scarcity in many parts of the world, it will also increase the variability of rainfall patterns (IPCC, 2014). This makes the availability of fresh water even more unpredictable, further complicating its allocation between increasingly stressed, competing sectors such as agriculture, energy and domestic use.

As more and more water is allocated to human use, less becomes available for ecosystems. In the increasingly unpredictable planetary conditions of the Anthropocene, it is more important than ever to ensure that human activities operate within safe boundaries of Earth system change (Rockström et al., 2009). Human development within the safe operating space of these boundaries offers a better chance of preserving a desired stable environmental state of the Earth system, thus providing resilience – the ability to absorb and respond to shocks without fundamentally altering biophysical, social, and economic systems. Building resilience is an urgent social and economic issue, one that communities across the globe must focus on as shocks and stresses become more frequent (Rodin, 2014). Exceeding these boundaries risks pushing the Earth into an even more volatile and unpredictable state (Steffen et al., 2015) and humans to ever more dire conditions.

This concept is equally applicable for natural systems such as a water basin: freshwater systems are defined by key attributes that also constitute a "boundary" (Rockström et al., 2014). Flow regime, sediment and organic matter inputs, thermal and light characteristics, chemical and nutrient characteristics, and biotic assemblages are defining attributes of freshwater ecosystems (Poff et al., 1997, Baron et al., 2002). Their natural ranges of variation are critical to maintaining the integrity and dynamic potential of aquatic ecosystems (Baron et al., 2002).

When water use drives river basins below minimum thresholds for these attributes, freshwater ecosystems become more unstable and unpredictable, and less resilient to change. Once a boundary is transgressed, freshwater ecosystems may change rapidly to a new stable condition that is very difficult to restore to previous natural conditions (Holling, 1973, Scheffer et al., 1993). Fisheries collapse and eutrophication from nutrient inputs are two examples of potentially irreversible freshwater ecosystem change.

The ecological consequences that result from depriving freshwater aquatic ecosystems of adequate water quantity, timing, and quality often become apparent only after they begin to interfere with societal uses of freshwater (Baron et al., 2002). Without reliable water supplies, freshwater ecosystems are prone to damage from shocks, with potentially grave consequences for the communities and industries that depend on them.

Human development and water Management decision-making | Water and human development are inseparable. People need water for sustenance and for basic sanitation and hygiene. Water is a key input to both food and energy production, and waterways provide a means of transferring people, food and energy from place to place. The amount and variability of water availability affects economic growth (Brown et al., 2014, Hall et al., 2014). As such, water management to preserve freshwater ecosystem productivity and resilience as well as ecosystems is a prerequisite for human development, and fundamental to attaining the Sustainable Development Goals. However, improving water management requires a substantial shift in how decisions are currently made in the water sector.

Photo: iStock

Currently, some 1.6 billion people live in river basins with severe water stress. Under business as usual, that number is expected to increase to 3.9 billion by 2050, or over 40 per cent of the world's projected population (OECD, 2012). Under current population and economic growth trends, by 2030 global water demand will exceed available supply by 40 percent (The 2030 Water Resources Group, 2009).

Agriculture is currently by far the largest user of water, responsible for nearly 70 per cent of fresh water withdrawals from rivers, lakes and water tables globally (FAO, 2014). However, the majority of additional water withdrawals by 2050 are expected to come primarily from manufacturing, electricity, and domestic use (OECD, 2012). A 2014 survey of 302 companies in the Global 500 index found that 82 per cent of the energy sector is exposed to water risk while 77 per cent of consumer industries that include food and beverage companies are affected (CDP, 2014).

Growing recognition of the vital threats to water for economic growth and development and the increasing costs of water-related hazards will drive major new initiatives and investments to mitigate these concerns. As a result there is an important opportunity to rethink current approaches to decision-making for fresh water use. Most industrialised settings utilise constructed infrastructure and policy approaches that rest primarily on traditional cost-benefit analyses. These conventional paradigms for water management, enshrined in institutional planning guidance and engineering education, have delivered water benefits and protection from hydrological hazards to human society for centuries, but they are no longer suitable to chart the future of fresh water management. New approaches are needed that build on sound traditional engineering planning but redirect the objectives to a focus on building resilience to changing conditions for both services and ecosystems (Brown, 2010). The transition to adaptive approaches to sustainability embedded in dynamic, variable ecosystems will prove to be a critical intellectual shift for humans this century (Matthews and Boltz, 2012).

Redirecting the efforts to provide water benefits to society beyond traditional approaches will not be easy. Yet there is a strong case for doing so. As illustrated in the previous section, withdrawing more water from ecosystems to meet human demand can actually make water availability more unpredictable and exacerbate water

scarcity, undermining water resilience. Unless the water needs of freshwater ecosystems are incorporated into decision-making, it is difficult to envision how human development will be anything but negative for ecosystems. Economic-based decision-making could help spur greater efficiency in water use, but will not necessarily lead to benefits for ecosystems. One can envision a scenario where water savings from the agricultural sector flow to the energy sector or urban centres, with none of the saved water returning to ecosystems. Without due consideration for ecosystems, the human development-led agenda will lead to greater use of water, with negative consequences for freshwater ecosystems and, ultimately, for all humanity.

A path forward: freshwater ecosystem management for resilience | Sustaining and restoring ecosystems will require reducing or limiting water withdrawals in many river basins, preventing the ill-conceived construction of new dams that cause fragmentation and are not suited for adaptation to future climate and water regimes (e.g., Ansar et al., 2014, Poff and Matthews, 2013), and treating polluted water from cities and agriculture. The establishment of measurable thresholds in freshwater use and ecosystem change is vital to changing the contemporary decision-making processes that continue to lead to ecological degradation. The challenge is how to integrate the threshold concept in the context of disaggregated, local and largely political decision-making processes. Current approaches to water planning do not adequately account for the costs of overdrawing water from river basins or of disrupting natural flow regimes with hard infrastructure. These costs can be significant, particularly to the extent that they undermine a water basin's ability to adapt and respond to changing environmental conditions (Meng et al., 2014). In the long run, degrading freshwater ecosystems could actually prove more costly than implementing policies to protect them.

Recognising environmental objectives in their own right was promoted in perhaps the most influential water planning initiative in academia, the Harvard Water Program (Reuss, 2003). This program was initiated in response to the recognition that economic planning approaches used for US water projects did not reflect the national interest, which was broader than simple economic efficiency and must fundamentally include protecting the environment (Maass, 1962). The Harvard Water Program launched the field of water resources systems analysis and created multi-objective water planning which explicitly formalised the equal standing of economic and environmental objectives. Under current and future conditions of increasing freshwater stress, competing demand and ecological uncertainty, such principles of multi-objective, integrated planning are now an imperative (Brown et al., 2015).

Conclusion | Sound freshwater ecosystem management is central to human wellbeing. Water resilience is a prerequisite for human development, helping to protect and maintain the resilient ecosystems that people rely on for our most basic needs and for the success of our economies and society. Fresh water must now also be recognized as a key factor safeguarding natural capital and ecosystem services by providing water resilience. Moreover, global sustainability is now a prerequisite to achieve stable water supply at the local and regional scales. This means that investing in sustainable water use at the community, city or river basin scale cannot be done in isolation from a deeper understanding of global changes. Likewise, successful water management at the local level now depends on our ability to safeguard water resilience at the Earth system scale, i.e., ensuring that human development must take place within the safe operating space of a stable planet. This fundamentally changes the water resource management agenda – every scale of operation must relate to global dynamics. The time has come to stop framing issues of water security in terms of tradeoffs between human benefit and environmental benefit – they are interdependent. This requires a significant shift in the conventional paradigms of water management. Decision makers can no longer ignore the costs of overdrawing water from ecosystems or disrupting natural flow regimes with hard infrastructure. Rather, these costs must be internalised by promoting safe thresholds on water use and ecosystem alteration. Doing so will make freshwater ecosystems more resilient, giving us the best chance of meeting human development objectives.

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Chapter 8

Driving water stewardship in the textile sector

By Elisabeth Swayze

Introduction | Access to freshwater is increasingly identified as one of the most important issues at the global level. This year, the World Economic Forum identified global water crises as the top threat worldwide to business and society (WEF, 2015). For apparel companies, water is a vital resource for business continuation. The textile industry relies on water for raw material manufacturing and for clothing production. Having stable and long-term water sources reduces business risk while continued production with reliable suppliers reduces cost. This article will address the nexus between sustainable development and corporate water stewardship through presenting H&M's strategy and experiences.

Water is essential for society. And the role of water in development is clear; the United Nations sees water as "fundamental to the three dimensions of sustainable development, including social needs, economic development and environmental limits, and a cross-cutting driver" (www.un.org, 2015). The United Nations is finalizing the Sustainable Development Goals in 2015; a set of international goals addressing a wide range of global challenges, including water availability and sanitation; and businesses have a responsibility to help governments meet these goals. H&M has worked for over a decade on water issues and has built up a water strategy with the aim to be the leader in water stewardship. H&M will play a role in meeting the Sustainable Development Goals through water stewardship.

The link between private companies and economic development is straight-forward. H&M has a growing business and many of the workers that its suppliers employ live in developing countries. Private sector enterprises bring gainful employment opportunities to communities and thus economic security to the women and men who are employed. For the industry to be sustainable, the local water supply must be secured.

Water is directly linked to social development. The human right to water and sanitation entitles everyone to accessible, affordable, acceptable and safe water and sanitation (CESCR, 2002). One person in three – an estimated 2.5 billion – lacks access to adequate sanitation. H&M recognizes the responsibility private sector actors have, to use water responsibly in production. About two-thirds of the 500 factories that produce clothing for H&M have wet processes and are located in areas that experience water stress. As water is a shared resource, yet vital for production, companies must work together with suppliers to improve water management and reduce the water use and consumption of the industry.

H&M has been addressing water issues for over a decade as part of the extensive sustainability work, which also includes a main focus on labour, anti-corruption and human rights issues. Together with the World Wide fund for Nature (WWF), H&M developed a water strategy, targeting four key themes: improving the use of water; building water awareness; collective action; and measuring water impact and risk. Including various strategic partners, H&M is able to systematically address the complexity of water issues.

Improve the use of water | The textile value chain has a significant footprint on freshwater resources; from the cotton field, through the dyeing processes to the laundering done by end users. Many of the river basins where the textile value chain operates and supports the local economy suffer poor water management, which imposes significant risks to the industry and the economic development of these regions. H&M considers water challenges in the value chain to pose strategic company risks. Hence, sustainable water management in important river basins is a requisite for continued long-term growth. Our water risk assessment informs which suppliers we focus our water management efforts on.

Improved water management is equally significant for sustainable environmental development. By participating in the Sweden Textile Water Initiative (STWI) this dimension is methodically addressed. Collectively, the Swedish brands that make up this network alongside SIWI developed guidelines for sustainable water use in textile and leather manufacturing. Beginning in 2015, H&M is participating in STWI projects in Ethiopia,

Turkey and India with the support of the Swedish International Development Cooperation Agency (Sida). The programme focuses on achieving measurable results at the factory level, addressing resource efficiency and building the capacity for workers and managers alike to continue the work towards sustainable production.

Another initiative that supports H&M's goals addressing improved water management is the Better Mill Initiative (BMI) in China. Together with implementing partner Solidaridad, the aim is to improve the production efficiency of more than 30 printing and dyeing mills in China over a three-year period. The programme evaluates the mills on-site, enables action plans, runs workshops and provides opportunities to share best practices.

Cotton requires significant amounts of water which is why there is focus on this raw material, and H&M is committed to sourcing all cotton from more sustainable sources by 2020 at the latest. To this end, H&M collaborates with the Better Cotton Initiative (BCI) addressing both the social and environmental sustainability pillars of development. Reduced water and pesticide use will positively contribute to both the agricultural community and the surrounding community dependent on the same water sources for drinking and sanitation. Additionally, in terms of water use in the production of denim, collaboration with Jeanologia, and the Environmental Impact Measurement tool (EIM) makes it possible to rate impacts from washing and apply the highest standards in production. The water reduction alone for the washes used is 56 per cent compared to other conventional denim collections. By 2015, all H&M denim production will be scored accordingly.

The dependence on raw material can also be reduced through fiber recycling. Through the Garment Collection initiative, customers are able to contribute to reducing the dependence on water-intensive materials like cotton by handing in old garments to be recycled into new ones. Close loop recycling is the quickest and easiest way for our industry to dramatically reduce our resource use and dependency as well and to make the transformation from a linear to a more circular system of operating. So far, over 14,000 tonnes of textiles have been collected through this program worldwide.

Building water awareness | In order to elevate water as an issue that requires serious and immediate attention, actors at all levels need to be informed and inspired to engage. As a global apparel company, we have the opportunity to reach a broad range of actors including employees, suppliers, factory workers, communities and customers worldwide.

Water training is deemed important for H&M employees so that they can be inspired to implement our water savings efforts. So far, over 43,000 employees (33 per cent) have completed the sustainability introduction e-learning programme and more than 5,800 have completed the advanced learning programme, where water is addressed in-depth.

Photo: Shahid Siddique, SXC

To reach suppliers with wet processes (where yarn and textile is bleaching, dyed and washed, for example), H&M has implemented a technical water training programme. The suppliers are trained in three different areas – general water awareness and H&M's water requirements; technical water testing; and technical training on ETP functionality. The training has an attendance rate of 89 per cent. An additional component has been a water awareness film. Together with WWF, a film was produced in early 2015 on water in Bangladesh, which addresses the connection between water and economic development. The aim was to increase awareness of how supplier use of water affects the local environment as well as the importance of water for the textile industry in Bangladesh, including job creation and the national economy. The film shows that if sustainable solutions are not applied, the industry cannot be sustained long-term.

Building water awareness among workers in the supply chain is also an opportunity for companies to get direct feedback about what obstacles they face with regard to water availability. Access to water and sanitation leads to healthier factory employees, which in turn leads to better performance and less absenteeism. Since 2002, H&M has partnered with WaterAid and water is one of the identified priorities in the company's Human Rights Polices. More recently, the collaboration with WaterAid included developing a programme addressing access to water and sanitation in cotton growing areas of Ethiopia.

Moreover, a supplier employee survey in India was conducted in 2014, which indicated that access to safe water and sanitation at home arose as an identified need. Together with the suppliers, this issue will be addressed to ascertain if this might be a productivity enhancing activity for the supplier.

Building water awareness and providing water access to the larger community also fall under being a responsible company and sharing water resources. To address this, H&M has initiated the H&M Conscious Foundation driving projects together with WaterAid to impact access to clean water and toilets in schools as well as improve hygiene education.

In addition to initiatives in production and supply chain, it is important to engage customers as there are water and climate impacts occurring once the garment comes into the customer's home. Initiatives such as linking the Clevercare label to the company's website enable customers to find practical suggestions about how and why to reduce the frequency of washing, for example.

Collective action | Solving global water challenges is not something a single company or organization can do alone. Collaboration is vital to tackle shared water risks through collective action as well as promoting better practices throughout the industry. WWF and H&M are working on supporting stronger water governance in Bangladesh, through collaboration with other organizations and analysis of governance challenges and have published "Water Governance in Bangladesh - challenges and opportunities around policy, institutional function and implementation for a sustainable water future." The aim is to raise awareness with public and private actors on the importance of strong water governance and create a roadmap for all actors to contribute towards strengthened governance and a sustainable, shared water future. An additional report recently completed is an economic risk analysis of future water management and governance scenarios, to understand the impact of water on growth and development in Bangladesh.

In China, H&M and WWF have recruited an Industrial Park (IP) for the implementation of a Water Stewardship project in the Taihu area. The aim is that factories will improve internal practices as well as share resources and expertise regarding water management and engage in collective action with other factories, as well as local communities and NGOs. This is according to a methodology developed with input from local experts, and tested with relevant industry and political stakeholders.

Measure water impact and risk | Measuring water impact and risk is vital to ensuring that production activities are in line with the sustainability strategy. This involves yearly water risk assessments of all 500 supplier factories with wet processing. The assessment focuses on water use, water discharge and geographical location.

By using the WWF Water risk filter combined with water data and production volume from our suppliers, a comprehensive water risk analysis at a global level is made. The analysis provides information which makes it possible to track the hotspots of water risks in the supply chain and find a way to mitigate them.

From years of experience, it is apparent that supplier transparency is an integral part of work with accountability and advancing sustainability in our industry. To this end, the current compliance-based supplier assessments will be replaced by a new assessment method that is better adapted to both encourage transparency and drive lasting positive change. Since compliance models are based primarily on a binary "pass/fail" grading against a code of conduct or legal regulation, the non-compliant have an incentive towards non-transparency, and at the same time this lack of gradation in evaluation offers no incentive to a compliant supplier to improve performance beyond compliance. H&M's new Sustainable Impact Partnership Program (SIPP) combines the management system evaluation focus of the Sustainable Apparel Coalition's Higg Index, with complementary performance indicators that can be tracked over time and have targets set against them. The indicator "withdrawal of groundwater," for example, will allow suppliers to benchmark their water use against peers and help promote finding water saving strategies specific to each supplier's scenario. SIPP will include self-reporting, coupled with validation, to promote supplier ownership and inform capacity building programs.

Looking ahead | Water stress will increasingly become a challenge. By 2050, more than 40 per cent of the world's population will live in areas experiencing water stress. Investing in water is not something that can be approached with short-term goals and activities – it requires long-term thinking and investment and is vital for business in the future.

Furthermore, companies need to engage with water issues, not only for economic development, but because strategic water use is vital to ensure the strength of all three integrated pillars of sustainability - economic, environmental and social. Through water stewardship, H&M aims to transform the textile industry and drive sustainable development.

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Chapter 9

Water equity dimensions in a developmental state

By Eiman Karar and Melanie Wilkinson

A 'developmental state' is the model followed by many East Asian nations after the Second World War to rapidly modernize their economies (Gumede, 2009). In this context, a development state was one that set specific development goals and then single-mindedly mobilized society to achieve them. A developmental state, according to UNCTAD (2007) was one which had a major preoccupation to ensure 'sustained economic growth and development on the back of high rates of accumulation, industrialization and structural change'.

The Africa region is considering mirroring the East Asian developmental state example to hasten development in the continent (Routley, 2014). The developmental state has also been called for by the Economic Commission on Africa, making the recommendation that based on the failure of earlier approaches to development in Africa – state-led and market-driven – the Report recommends that African countries adopt a developmental state approach that uses the market as an instrument rather than a sole mechanism for fostering long-term investment, rapid and sustained economic growth, equity and social development (ECA, 2011). The African National Congress (ANC) of South Africa also introduced the developmental state in its Strategy and Tactic Policy of 2007 (ANC, 2007).

If such a developmental state is desirable to promote economic transformation in the African region, what kind of developmental states are being promoted? The ECA and South Africa defined the development state as.

One of the pre-conditions for a developmental state is economic growth and transformation, without sacrificing equity.

What is Water Equity? | To achieve broader water equity in South Africa and probably other countries, both distributive and procedural justice are crucial. This implies that water decision-making is fair, transparent and consistent and the manner in which water is allocated and utilised clearly demonstrates justness and objectivity between water users and uses. Water equity could widely be defined as the absence of socially unjust or unfair water disparities in a country (Crafford and Wilkinson, 2015).

Water equity is often determined by the history or social values and conditioning of a country, stemming from 'generally accepted' human values of fair play and justice at that time. South Africa strove towards achieving the Millennium Development Goals (MDGs), and hence extended significant resources and achieved equity in access to improved water supply and sanitation (Republic of South Africa, 2013). South Africa is only one of sixteen African countries that, in 2012, had met the water MDG, with another six on track (United Nations Economic Commission for Africa, 2014). The sanitation progress in South Africa is similar to other countries on the continent with only four African countries having met the sanitation target in 2012 and another six countries on track, including South Africa (United Nations Economic Commission for Africa, 2014).

Attributes and definitions of a development state	
ECA	**South Africa**
A developmental state is one that has the capacity to deploy its authority, credibility and legitimacy in a binding manner to design and implement development policies and programmes for promoting transformation and growth, as well as for expanding human capabilities. Such a state takes as its overall socio-economic goals the long-term growth and structural transformation of the economy, with equity (ECA, 2011).	A developmental state is defined as an activist state that intervenes decisively in the economy with a generally progressive agenda (ANC, 2007).

Photo: Eiman Karar

Apart from addressing the MDGs, achieving equity in access to water services affirms the water right enshrined in the South African Bill of Rights. This water and sanitation right is legitimized in the Water Services Act (South Africa, 1997) which articulates that all South Africans have the right of access to basic water supply and basic sanitation necessary to ensure sufficient water and an environment not harmful to health or well-being. This enabling legal framework potentially facilitated the achievements of the MDGs.

This right is also a progressive one, with the legislation indicating that the water sector should work progressively or incrementally towards providing higher levels of water supply to all households, including in rural areas. The Strategic Framework for Water Services (SFWS) (DWAF, 2003) mandates moving up the water ladder when providing water supply, which requires the planning of water services to consider both the supply required to meet current domestic needs and possibly future productive use requirements, as well as future growth in these requirements. A household, according to the SFWS, does need to pay for this higher level of service.

Countries, globally, are at the point of shifting from MDGs to the Sustainable Development (SDG) Targets by 2030. This will require African countries, including South Africa, to shift their monitoring focus from one of 'access' to one of 'sustainable provision of the services'; an aspect that might have been neglected in the reported MDG achievements.

Water equity and poverty eradication | The perceived dichotomy between equity, including water equity, and a developmental state centres on the perception that economic transformation is achieved largely at the expense of equity. The World Development Report of 2006 addressed the issue of equity and development by emphasizing that "equity is complementary, in some fundamental respects, to the pursuit of long-term prosperity." The key message is that equity, including water equity, is crucial to address the developmental state agenda in a country (World Bank, 2006). However, one can argue that in the current water distribution landscape in developing regions water flows towards money and power (WRC, 2013a). Access to water requires: water! physical infrastructure to transfer the water, legal and administrative rules that allow for it, institutional rigour to deal with it, access to information and access to justice to provide recourse. Thus to eradicate poverty and fulfil equity targets in access, there is a need to follow clear requirements that go beyond political statements.

There still seems to be a focus on the political economy of water allocation in South Africa, namely the interplay of political and economic structures and processes, with the central state and markets being the most important actors in the water allocation process. This conception is despite the recognition that state institutions need to be strengthened and decentralized to enter into genuine development-promoting partnership with the citizens and their organizations.

However, the whole issue of local self-government is extremely complex (Movick, 2012). In the last twenty years, locally elected bodies and local level administration have not always been successful in carrying out their tasks. Often, local elites have been able to invade and take over local authorities and force on them a mode of functioning which is in their own narrow interests. These interests can be at the expense of poverty eradication and national water equity imperatives. There is a need to formulate more complex decentralization strategies in the allocation of water. Of particular interest are notions about pluralism, power, wealth, competition, education, and choice in the whole setting for water management and allocation. Constitutional democracy is about providing public order and the public good, taking efficiency

and the ability of sustaining the economy to produce the wealth necessary to sustain the public good, economic growth and social justice (Tapela, 2015).

Water equity mechanisms in a water-scarce developmental state | In water-scarce situations, the developmental state needs to ensure efficient use of water by those 'who have' whilst 'freeing' up water for those who do not. Although this comes at a cost, this cost should arguably be borne by the beneficiaries as well as by the central state as a 'developmental' contribution for example to 'redress legacies of the past' in the South African context. Whilst the legal frameworks recognize past water entitlements, social requirements specially in the public interest can define sectoral priorities in sustaining developmental goals and hence reallocate accordingly (South Africa, 1998). Four types of water use entitlements are defined by the National Water Act (NWA):

1. Schedule 1 water use which includes a small amount of water abstracted directly from a water resource on land owned or occupied by a person for reasonable domestic use, domestic gardening (not for commercial purposes), animal watering, water harvesting, and fire-fighting, including recreational use.
2. General authorization which specifically aims to meet the water needs of historically disadvantaged individuals and the poor; to ensure participation by these groups in water resource management; to promote the sustainable use of water resources; and to promote the beneficial and efficient use of water in the public interest.
3. Water licensing which allows a person to use water in terms of a license granted under the NWA.
4. Existing Lawful Use (ELU), which provides for the continuation of water use which was in place prior to the date of commencement of the NWA. The idea is that the ELUs be transformed to water use licenses over time.

Photo: iStock

Despite these legislative mechanisms to facilitate social and distributive justice in the water sector, the country still experiences difficulty in ensuring equity in the allocation of this scarce resource. This could be due to the lack of adequate management instruments that are enforced at the right level and with the right capabilities to monitor and measure water use. Arguably, when the locally based water resource management organizations become fully operational as responsible authorities and take control of issuing general authorizations and licenses in the country, they will be able to establish, as required by the National Water Act, "redress the results of past racial and gender discrimination" (South Africa, 1998). Crucial to achieving water equity in a developmental state is the need to also ensure equity in the pricing of water. Although water is becoming scarcer (Tapela, 2012), it currently remains relatively inexpensive. Economic charges are based on market instruments and would likely favour users with the highest willingness and ability to pay for water. Thus, although a potential social cost emerges with respect to water equity, it also points to an opportunity of incentivizing water equity measures among wealthier users. In such an approach, the cost of domestic water supply may be ring-fenced within a water supply jurisdiction.

Water equity and the water institution | A pre-condition for a developmental state is an appropriate development policy and plan which promotes equity in access to resources, users and uses and to the benefits of natural resources in a country. Integrated Water Resource Management (IWRM) principles of decentralization and managing demand seem to have influenced the water policies and legislative institutions in many countries in the region (CEEPA, 2013).

Despite this, in South Africa, the sector continues to be largely state-centric, top-down, target-driven, supply-led, generously funded, and often fully subsidized (World Bank, 2011). This has led to investment decisions biased toward highly capital- and skills-intensive solutions, aggravating the pre-existing skills shortage.

The state as the custodian of the water has effectively acquired the sole responsibility for achieving water equity, potentially usurping this power from citizens. As the institutional reform is being rolled out, one continues to observe some weakness in procedural justice, particularly regulation and decision-making processes. This is particularly significant to addressing water equity in the country as citizens who perceive inequity in the system currently feel powerless and ignored, leading to the citizenry resorting to social protests to have their grievances heard. The most frequently cited grievances of these social protests have related to lack of municipal services mainly in small municipalities, including lack of electricity, water, sanitation or roads (WRC, 2013b). Despite these institutional challenges, there are institutional success stories in the country. Larger Metropolitan

Areas such as eThekwini (Durban's Water and Sanitation) have been the recipient of the Stockholm Industry Water Award "for its transformative and inclusive approach," the metro being called "one of the most progressive utilities in the world." So, 'size does matter'. The city has connected 1.3 million additional people to piped water and provided 700,000 with access to toilets in 14 years. It also was South Africa's first municipality to put the provision of free basic water for the poor into practice.

Water equity: research, technology and innovation | Research, technology and innovative means of access, allocation, decision-making and procedures in the water sector can all contribute significantly to achieving water equity imperatives. Water resources are limited and face mounting pressures from climate change, pollution, population growth, and aging water infrastructure. Research and innovation can help address these challenges in a more sustainable and equitable path while also supporting economic growth. New information technologies offer a good basis for achieving equitable access to information and devolved decision-making to address many of the challenges faced, for example, in quantifying water use, connecting citizens remotely and sharing information faster for more swift responses in an increasingly variable biophysical and political environment. Examples include the use of remotely-sensed data for volumetric use assessments, and the miniSASS (South African Scoring System) national citizens' bio-monitoring tool . Systems thinking embracing complexity offers considerable scope for defining research and organizing knowledge boundaries in pragmatic ways that can enhance social interactions, sharing, learning and better collective responsiveness.

Conclusion | The question remains, why do we place the equity and economic development parameters at different ends of the spectrum, when they should actually be part of the same development state vector? In a situation of scarce water resources, decision-making should not be a trade-off between equity imperatives and the economic transformation of the state. As the custodian of water resources, the state needs to ensure that water decisions are just and fair. One cannot study the history of water allocations without giving close attention to the role of power and wealth. It is power that determines the relationship between the state, the market and society. Whilst there could be resistance in changing the current status quo in terms of water allocation in the country, there is also a disproportionate focus on the technical aspects of water allocation reform. This perpetuates the prevailing belief that equity is converse to economic growth, with water scarcity used to justify inability to attain equity in access to water as well as justice in allocations. It is telling how Dr Movick framed the Existing Lawful water users as 'downplaying the history of acquisition' in the South African context. There is thus a need to rethink what is 'just' and what is 'sustainable'.

On the other extreme, as a public property, local self-organizing in sharing water equitably is complex. Traditional leadership, locally elected bodies and local-level administration: often, local elites can focus on their own narrow interests which can be at the expense of poverty eradication and national water equity imperatives. There is a need to formulate robust constitutional democracy through more complex decentralization/representation strategies in the allocation of water, better understanding of pluralism, power, wealth, competition, education, and choice in the whole setting for water management and allocation.

The question should be "what is the most efficient and sustainable way of enhancing access to water, equitably?" Market-driven politics and economics in the water sector are about the use of scarce resources and unlimited wants. The state-driven decentralized model is about power and wealth. How best to use these scarce resources fundamentally remains a question of efficiency. But efficiency in itself is not necessarily distributive; in fact, it tends to reinforce inequalities. South Africa falls into this trap, with water services models largely focussed on state-driven interventions, without consideration of community or private delivery models. Although private sector delivery of water services may not seem to lend itself to addressing water equity imperatives; the 'developmental state', with adequate capacity, is probably best suited to regulate the whole value chain of water, ensuring equity in access to water and its resources rather than trying to separate politics and economics.

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Water and development in the urban setting

By Ger Bergkamp, Bert Diphoorn and Corinne Trommsdorff

Introduction: water and cities | Water is the lifeline of human civilization. Since time immemorial, access to water has been a key defining factor in the location and prosperity of cities. Rivers like the Nile, Euphrates, Tigris and Indus enabled agricultural activities and trade to thrive ensuring the development of some of humanity's most recognised civilizations. Great civilizations such as the Roman Empire, Egyptian civilization, the Venetian Empire and the Omayyad Dynasty, among others, were founded on riverbanks. The Romans, for example, were the first to pipe water into their growing cities, especially with their aqueducts. And today, modern cities like London, Paris, Moscow, Cairo, New Delhi and Stockholm are likewise built on the banks of rivers and lakes.

The central role of water in the development of cities can, therefore, hardly be overstated. Water for drinking and for sanitation sustains the health, livelihood and the general living environment of city residents. A sustainable urban economy is also dependent on the quality, reliability and cost of water supply. Providing sufficient water for drinking and adequate sanitation is one of a city's key responsibilities. Water and sanitation services are the cornerstone of a local government's contact with its residents, and are one of the most tangible results for which communities hold their elected officials accountable.

Rapid urbanization: implications for water | The current pace of urban growth is unprecedented in human history. At the beginning of the 19th century, only 2 per cent of the world's population was urban. By the beginning of the 20th century, the percentage had increased to 10. During the first decade of the 21st century, a historic milestone was reached when the population living in cities and towns exceeded 50 per cent of the global population, thus making urban centres the dominant habitat of humankind. And rapid urbanization continues, with 60 per cent of the world's population expected to live in cities by 2030 and nearly 70 per cent by 2050. This equates to the world's cities adding up to three billion people to their ranks in the next 35 years, nearly doubling the existing urban population. Most of this growth, at least 90 per cent, will take place in low-income countries, some of which are fragile states plagued with recurrent conflicts (UN-Habitat, 2013).

In general, and particularly where urbanization is fastest, cities are failing to sufficiently prepare themselves for urbanization with advance planning and services. In many countries, urban expansion has often been characterised by informality, illegality and unplanned settlements, especially in developing countries. Above all, urban growth has been strongly associated with slum growth, which is primarily due to a lack of appropriate planning and affordable housing as well as low incomes. The number of people living in urban slums since 1990 has increased by 33 per cent. If current trends continue, between 75 and 90 per cent of future urban growth will take place in peri-urban settlements comprising the inner-city slums and squatter settlements. Currently, these settlements accommodate between 30 and 60 per cent of urban populations in developing country cities and towns (UN-Habitat, 2013).

As cities grow and their populations increase, so does demand for water, and the generation of wastewater, much of which, in developing countries, is discharged untreated into the environment. By 2025, annual demand for municipal water in the world's large cities is expected to have increased by nearly 80 billion cubic meters, from around 190 billion cubic meters per year in 2012 to about 270 billion cubic meter per year. Building or expanding the municipal water supply infrastructure will require cumulative investment of about USD 480 billion by 2025, including investment to increase supply and to expand the distribution and treatment of wastewater (McKinsey Global Institute, 2012). This rate of withdrawal increase is unsustainable for many metropolitan areas, without looking to mining water resources in adjacent basins, building extensive conveyance infrastructures or desalination for coastal cities.

In the developing world, the supply of water has not kept pace with the high demand created by continued and rapid urban population growth combined with rising consumption patterns. Furthermore, the lack of adequate institutional arrangements and infrastructure to manage increasing volumes of wastewater and faecal sludge continue to pose major public health and environmental hazards. Internally, cities' capacity to deliver adequate and affordable water and sanitation is hampered by many factors such as poor planning, weak governance and legal frameworks, fragile institutions, or low capacity of local authorities to finance, build and operate essential infrastructure.

A key issue is that urban planning today is highly undervalued in developing countries and its practice outdated. By the time a plan is finalised the conditions on which it was based are no longer valid. There is a need for a different type of planning, more proactive, flexible, and reactive that can anticipate urban growth and prevent slum formation and its related water challenges. Furthermore, there is a need for more holistic approaches that integrate water and sanitation planning into the urban planning process, as well as an adaptive capacity and resilience to respond to rapid change, including disruptive events such as flooding and droughts expected to be more frequent with climate change, or a slow changing context.

With large sections of the urban population living in informal settlements where water and basic sanitation are severely deficient, cities will increasingly have to face the challenge of how to expand and upgrade these services to keep pace with urban growth, while ensuring access to an adequate level of services for the poor. This has implications for the planning process, as optimal solutions must be found to achieve the right balance between investments in bulk centralised and decentralised infrastructure to accommodate urban growth, as well as service extensions to the informal settlements.

Embracing urban growth for sustainable water management in cities, beyond basic service provision | We can observe a historical continuum on water in cities, which does not need to be followed for future expansions of our growing cities.

Cities have focused on developing water and sanitation services that ensure public health of their citizens: safe water and sanitation for all. However, in most cases the development of these services has been done in a subsystems approach – water first, then sanitation, and disconnected from the natural water cycle principles. The protection of the environment by ensuring safe withdrawals and waste discharges adequate for the natural treatment capacity of ecosystems has been the next focus of many stakeholders, e.g. utilities in the developed world, and will be a focus for the world cities driven by the newly defined SDGs. Beyond the healthy city, there are the healthy ecosystems for the City.

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The concern for healthy ecosystems in and around the city being addressed, the development of water for comfort and well-being, water as a driver for attracting businesses, and for giving citizens a sense of belonging is more and more a focus. Water in Cities has increased its scope from contributing to a healthy city to fostering a liveable city.

Climate change awareness has brought Cities to face the reality of water-related disasters and chronic stress. Climate change adaptation has come up on Cities' agenda with water being a major focus point. Cities are now working on reducing their water-related risk to move towards the risk-resilient city. The realisation that the urban water cycle needs to reconnect to the natural water cycle is central to this transition. New urban areas and infills will embrace principles such as increasing the buffer capacity to cope with natural rainfall, shaping the urban landscape to allow for non-destructive flooding, reconnecting to the upstream watersheds to restore healthy hydraulic regimes of rivers. The notion of safe withdrawal in an uncertain climatic future and population growth requires many cities to plan for potential future water scarcity, which can be dealt with by implementing two different approaches: 1/ look for more water in adjacent basins and build major infrastructure to convey it, or 2/ reduce the needs within the City through usage reduction and fit-for-purpose re-use and recycling. For the long-term sustainability of our cities within their ecosystems, the second option -reducing, re-using, and recycling – allows reducing dependency on uncertain future resources, and fosters much stronger risk resilience. Coincidentally, if all energy and materials fluxes are considered using an "urban metabolism" approach, this second option is likely to be more energy-efficient, as well as resources-efficient through the recovery of

nutrients in wastewater treated to be reused as irrigation water.

Water security for cities can be achieved by realising that the water cycle is a natural system that is severely impacted by urbanization. Many stakeholders impact this water cycle upstream, within and downstream of a city and the governance across the water cycle has evolved as our cities grew and now often provides an impediment to integrated water management.

The historical development of urban water, sanitation and storm water management in Europe or North America, for example, has been sequential in time and has produced an infrastructure often not flexible enough, that does not easily adapt to changing dimensioning criteria (flood level, reduced water supply, etc.). It has also resulted in an urban water cycle disconnected from the natural water cycle – where forests and soils provide a buffer to floods, where water is reused by different ecosystems. This disconnection results in an infrastructure that is insufficiently risk-resilient and resource-consumptive.

Embracing the concepts of "re-duce", "re-use", "re-cover", "re-cycle" and "re-plenish" for a Regenerative City allows increased risk-resiliency, both in regards to acute risk and chronic stress or slow changes, as well as increasing the sustainability of our cities by only using resources that can be regenerated.

The goal is to provide water security for cities by embracing a city planning agenda for a "regenerative city" which enables better planning for the healthy, liveable, risk-resilient city. This agenda goes beyond water and addresses all urban disciplines, it recognises how water actually shapes urban landscapes both because of natural waterways, storm and flood management, and also because regenerative urban water services are only fully implementable if integrated in urban landscapes at the building, district and metro scales. For example, the City of Sydney is re-developing the Barangaroo area into a carbon-neutral, water-positive, zero waste precinct that enhances the wellbeing of the community. This development integrates energy production, district cooling and water treatment into an urban landscape with plenty of public and green spaces to enable this "regenerative" city planning. Another example of a city embracing the "regenerative" approach is the city of Rotterdam with its stormwater management that includes filtration and storage for reuse as well as green roofs to limit rainwater surges. In addition, the Rotterdam Innovative Nutrients, Energy and Water management (RINEW) project investigates the possibilities of recovering and reusing water, nutrients and energy locally, regenerating the resources' uses.

Rapid urbanization is a challenge, but it also opens up an opportunity to embrace the constraints of uncertain future climatic conditions and limited water supply in a given geographical area, to plan our cities' growth along the "5 Rs" principles of Reduce, Reuse, Recycle, Recover, and Replenish, finding inspiration in the way the natural water cycle works. This requires water-related planning to be more integrated with urban landscapes and other urban services, as well as to be connected to its basin and associated ecosystems services. It is an opportunity to adopt flexible and reactive integrated planning, with a cluster approach, where trans-disciplinary teams work together at the building and district scale, while maintaining the coordination with the metro and the catchment (IWA, 2012, TNC, 2014). The Semizentral concept developed by TU-Darmstadt and implemented in Quingdao, China, is a successful example of this decentralized cluster approach, allowing water reuse and energy production locally in a compact urban plant, with a replicable design of a precinct that is implementing all 5Rs principles.

The need for integrated planning: "A new urban agenda" | It is estimated that urban areas account for about 70 per cent of the world's gross domestic product: some 55 per cent of GDP in low-income countries, 73 per cent in middle-income countries, and 85 per cent in high-income countries. In spite of the relatively weak global economic growth since the beginning of the financial crisis in 2008, many developing countries have witnessed high economic growth rates of over 7 per cent per year since 2010, and most of this growth is concentrated around industrial activities of towns and cities, often enhanced by increasing inputs from rural areas.

Cities offer benefits of agglomeration, the potential for greater productivity gains where specialised or complementary activities cluster together. Agglomeration brings the factors of production into proximity, optimises specialisation and increases the relative size of urban markets. Because productive activities in industry and services cluster in cities it is estimated that almost 80 per cent of the world's gross domestic product is generated by cities. Cities offer opportunities, with their higher density, to cost effectively provide water and sanitation, as well as provide resource recovery and synergies with other sectors. However, the higher density is also a threat to the preservation of waterways, to sustainable water withdrawals, to the population settling on high-risk land. In order to seize these opportunities and best mitigate the threat, cities need to be planned with buildings and urban landscapes that reconnect the City to its natural water cycle, with water flows shaping the city, waste being recovered as a resource, and water reused as necessary to ensure withdrawals that match the natural capacity of the catchment. This type of planning requires a change of paradigm from the way we have often planned water and sanitation in the past, in a sequential pluri-disciplinary approach. The outdated approach by sub-systems leads to sub-optimal solutions, missing opportunities for synergies between sectors: water services, waste, energy, food, transport, spatial planning, etc…

Urban planning is moving from being multidisciplinary sequential to transdisciplinary holistic, where different disciplines inspire each other to identify synergies and mutually beneficial solutions. The Cities of Sydney and Rotterdam are good examples of this transition. The trans-disciplinary team includes engineers and architects but also social scientists that can place the right priorities on how to best address the needs of people and their roles in the cities. This integrated planning of basic services and infrastructure strategies, including water and sanitation, green infrastructure, transport and mobility, is therefore people-centred. With a cluster approach integrated at the metro scale it can work on housing programmes and land-use plans, which address the needs of city residents, of new urban dwellers arriving in the cities, as well as the needs of the vulnerable and marginalised groups.

Integrated planning however is often impeded by institutional constraints rather than technical. To achieve integrated planning, change is needed at several levels: institutional, regulatory, city planning departments, and urban planning professionals, including water professionals. In order to initiate this transition, political, technical and societal leadership is essential, as it will inspire professionals and citizens to drive the necessary change. The City of New York illustrates how political leadership associated with participative processes results in a resilient and regenerative reconstruction. Capacity development is also critical to bring city planners, institutions and all urban professionals to work in the same direction. Cities sharing their experiences and inspiring each other highly contributes to this capacity building.

The challenges are numerous, with a major one being the financing of this integrated infrastructure for all. It requires a shift in financing models where shared public benefits, such as increased resilience, or the ability to react a changing context, can be accounted for. New businesses in the city around the green economy can highly contribute to this shift in business model, through partnerships for reuse, resources recovery, or energy efficiency.

The third United Nations Conference on Housing and Sustainable Urban Development (Habitat III), planned in October 2016 in Quito, offers an excellent opportunity for the UN system organisations to reflect on the role of urbanization in sustainable development and to come up with a system-wide approach that is guided by the content and spirit of international human rights instruments, including on women's rights and gender equality. Similarly, the discussions on the Post-2015 development agenda are crucial to developing a shared perspective on sustainable cities and human settlements, and for discussing the challenges and opportunities that urbanization offers for the future implementation of the Sustainable Development Goals (SDGs).

Conclusion | The proposed "new urban agenda" represents a paradigm shift towards a new model of urbanization that can better respond to the challenges of our age, optimising resources to harness potential. The "new urban agenda" should promote sustainable cities and other human settlements that are environmentally sustainable and resilient; socially inclusive, safe and violence-free; economically productive; and better connected to and contributing towards sustained rural transformation. Such a vision should be fully in line with all of the evolving Post-2015 sustainable development goals, most particularly the proposed goal on sustainable cities and human settlements.

Water is a central element to cities. It can be a great entry point to this transition to a new urban agenda by engaging leaders and citizens in reconnecting with the natural water cycle and embracing the 5Rs principles: Reduce the amount of water used, Reuse the water, Recycle the materials and nutrients, Recover the energy, Replenish the surrounding environment.

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Chapter 11

Integrating water in future climate policy architecture

By Karin Lexén, Kathleen Dominique, John Matthews, Sofia Widforss, Sonja Koeppel and Susanne Skyllerstedt

Introduction | The year 2015 is one of high-level decisions on sustainable development that will steer our future. Just a few weeks after the 2015 World Water Week, the UN General Assembly member states will decide on a set of sustainable development goals (SDGs). Another milestone for 2015 is the anticipated climate agreement of the 21st Conference of the Parties (COP 21) to the UN Framework Convention on Climate Change (UNFCCC) in Paris in December. In March, a Post-2015 framework for Disaster Risk Reduction was agreed in Sendai. These meetings provide the international community with a unique opportunity to enhance coherence across national and global policies and institutions. Integrating effective and sustainable water resources management will be key for successful implementation of this agenda. Water also has the potential to serve as a connector, not only between different policy areas and economic sectors, but between nations aswell.

This chapter explores the links between water resources management, climate policy and disaster risk reduction and suggests how water could be better addressed in the future global climate architecture.

Robust water resources management builds resilient economies | Climate change is already altering the global water cycle, a process that is projected to accelerate for many decades. Direct impacts include likely changes in the frequency and magnitude of floods and droughts, the absolute amount of water available in many regions, and the seasonality, intensity and form of precipitation, in addition to sea-level rise and coastal inundation (IPCC, 2014). All this is generating a greater degree of uncertainty than water managers and users and societies have traditionally had to cope with.

Impacts due to climate change will compound the challenge arising from the projected increase by 55 per cent in global demand for fresh water between 2000 and 2050 (OECD, 2012). A recent survey of 34 OECD countries reveals that governments have multiple concerns relating to impacts from climate change on water resources (OECD, 2013). This is the case not only for the OECD countries covered in this survey, but for emerging economies and developing countries as well. The World Economic Forum stated in its 2015 Global Risk Report that a water crisis is the global risk with the most damaging potential impact on countries as well as industries over the next ten years. It also concluded that water is closely linked to several other risks: food crises, interstate conflict, profound social instability, extreme weather events, and the failure of climate-change adaptation as well as of urban planning.

Hydro-climate disasters similarly have implications for poverty reduction as they exacerbate inequalities and their burdens are disproportionately borne by poor and vulnerable communities (IPCC, 2014). These disasters account for approximately 95 percent of all people affected by disasters and have caused over 60 per cent of all damage (UNISDR, 2012).

In Brazil, the current drought has meant water rationing in cities, rolling power cuts, and strains on agricultural production that can ripple through global commodity markets. With nearly 80 per cent of Brazil's electricity derived from hydroelectric power, water shortages also have driven up electricity prices and prompted electric companies to burn fossil fuels, adding both costs and greenhouse gas emissions (Watts, 2015). In California, the unprecedented drought led to an estimated economic cost of USD 2.2 billion in 2014, with a loss of over 17,000 seasonal and part-time jobs (Howitt et al., 2014).

Climate variability is projected to increase in a changing climate, imposing significant economic costs in particularly vulnerable countries. In Nepal, for example, extreme weather events impose direct economic costs equivalent to an annual cost of 1.5 to 2 per cent of current GDP/year, but this can rise to 5 per cent or more in especially severe years (IDS-Nepal, 2014). An estimate of the direct annual economic costs related to the impact of climate change on water-induced disasters at a national level puts the additional expense at USD 100–200 million/year (or

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equivalent to 0.6–1.1 per cent of current GDP/year) by mid-century in current prices (IDS-Nepal, 2014).

These estimates exemplify the economic impacts of water-related risks and highlight the extent to which water management is not just an "environmental" issue, but also an economic and social one. It underscores the fundamental importance of integrating and mainstreaming water resource management into climate adaptation and mitigation measures as well as into disaster risk reduction.

While abundant examples exist of countries struggling to adjust to new challenges related to water resources and climate change, evidence also exists for coherent, programmatic approaches to address these challenges. Organisations such as the Global Water Partnership have been working with national-level decision-makers in Africa, Europe, Asia, Latin America and the Caribbean to identify institutional gaps around water management and resilience building across and between ministries (GWP, 2015), while the UN Economic Commission for Europe (UNECE) has been promoting transboundary cooperation in climate change adaptation as well as the exchange of experience about such efforts in Europe, Asia, Africa, and Latin America. Networks such as the Alliance for Global Water Adaptation have been catalysing new technical expertise to promote innovative approaches such as decision-scaling and adaptation pathways that can make robust water management a systematic, consistent outcome at local, basin, and national scales for operational and planning processes.

Water resources – a connecting force for coherence and coordination | While the importance of coherence is generally recognised, it has proven difficult to overcome divisions between different policy areas and economic sectors in the policy processes. One example is mitigation and adaptation to climate change, which are dealt with in separate tracks in the climate negotiations. The division has historical reasons and may also make sense from a technical perspective to facilitate negotiations. However, in practice, mitigation and adaptation measures are strongly interconnected in important ways. Recent research and experience on the ground show that implementing appropriate water resources management is essential for reliable energy production (Rodriguez et al., 2014) and for sustainable forest and land use and is thus a very important factor for successful mitigation, while energy is important for many adaptation measures (Lexen et al., 2012). Mitigation and adaptation efforts must therefore be dealt with in a way that reflects these important interconnections. The terms of this dialogue converge over water and energy.

Reducing greenhouse gas emissions means investing in solar and wind, hydropower, biofuels, and other non-fossil energy sources, most of them highly dependent on reliable access to sufficient water resources, (Ebinger & Vergara, 2011). Most energy investments are long-lived infrastructure, with an operational lifetime spanning many decades. Thus those that require reliable access to water resources and changes in design floods must factor in potential future changes in water availability, including those arising from climate change. In a similar vein, water infrastructure's longevity can engender conflict if not designed for flexible operations; this can limit adaptation options (Matthews et al., 2011). For example, more than 300 hydropower facilities are now under development in the Himalayan region alone (Qui, 2012: see comment). While the shift to non-fossil energy sources is critical, the financing and planning for these systems must recognize the need to integrate climate adaptation into their design, operations, and governance. We must assume a coherent approach to how we manage economies and ecosystems through infrastructure in developing robust approaches that can guide us through effective decision pathways.

Further, disaster risk reduction (DRR), climate mitigation and adaptation as well as water resources management must be well coordinated. Risk assessments, focusing on preventing water-related risks and planning, should include an emphasis on rapid and comprehensive

responses when disasters inevitably occur. However, in many nations and institutions, climate adaptation and disaster risk reduction function as separate, disconnected areas. The outcome document "Sendai Disaster Risk Reduction Framework", agreed in March 2015 (UNISDR, 2015), for instance, falls short of reflecting the significant role water plays in DRR, even if water resources are briefly mentioned in relation to three of the four priority areas and no specific reference is made to floods and droughts. However, in the next steps for defining mechanisms under the UNFCCC and implementing the SDGs, there will be new possibilities to improve coherence between water resources management, DRR and climate measures.

Addressing the gap between water resources management and global climate policy | The role of water in sustainability generally and the link between water management and climate specifically seem well understood by many local and national stakeholders.

One example is the National Adaptation Programmes of Action (NAPAs), a process under the UNFCCC for Least Developed Countries (LDCs) to identify priority activities that respond to immediate needs to adapt to climate change. Many LDCs, especially Small Island Developing States (SIDS), have identified water resources as their top priority.

Further, an analysis of UNFCCC Adaptation Fund expenditures between 2012 and spring 2015 suggests that roughly 90 per cent of the funded projects are water-related projects, spanning topics such as ecological conservation, urban resilience, agriculture, coastal defense, and DRR (UNFCCC, 2015). Water resources management is also one of the priority sectors for the Least Developed Countries Fund (LDCF) and the Special Climate Change Fund (UNFCCC, 2014).

This recognition needs to be better articulated in global policy making and much better integrated into the UNFCCC programmes and its mechanisms. Water resources are addressed as one of the focus areas of the UNFCCC Nairobi Work Programme (UNFCCC, 2013). Also, GWP has developed a water supplement to the NAP (National Adaptation Plans) technical guidelines emphasizing the importance of mainstreaming water and resilience into adaptation planning (GWP, 2014). However, the overall picture is that water, so far, plays a minor role in the UNFCCC negotiations. Currently there is no reference to water, not even in the context of food production, vulnerability to climate-induced risks or adaptation activities in the negotiating text for the Paris agreement.

The way forward: suggestions on how to integrate water in the future climate architecture Translating knowledge and practical experiences from water resources management and research into recommendations relevant to the UNFCCC process leads to the following considerations:

The Paris agreement
At the UNFCCC COP 21 in December 2015, the negotiations under the Ad hoc group on the Durban Platform (ADP) towards a new global climate agreement are expected to be finalised. The outcome of COP 20 in Lima calls for "a protocol, another legal instrument or an agreed outcome". A possible outcome is an agreement that would create an architecture requiring the parties to continuously revise and increase their contributions to climate mitigation and adaptation over the period 2020-2030. This approach offers an opportunity to reflect an evolved understanding of the role of water for action on both mitigation and adaptation. Given its key role for climate efforts in practice, water needs to be addressed in the future climate architecture and the Paris agreement should provide entry points for facilitating this.

Intended Nationally Determined Contributions
Following the Lima call for action, the parties of the UNFCCC are encouraged to submit their Intended Nationally Determined Contributions (INDCs), stating their domestic plans and priorities from 2020 onwards (UNFCCC, 2015). Despite some uncertainties, for example related to baselines, the INDCs are believed to constitute an important element of the Paris outcome. INDCs thus provide an opportunity to highlight the role of water in country actions for both mitigation and adaptation. However, including adaptation in the INDCs is optional and in those INDCs already submitted, mitigation is the dominant focus. Since recognition of the increasing need for resources for adaptation is an important trust broker, it will be important to encourage the adaptation component of the INDCs.

National Adaptation Plans
The NAP process, initiated at UNFCCC COP 16, was established to facilitate the integration of climate change adaptation into relevant policies, programmes and development planning processes and strategies (UNFCCC, 2010). Given the high priority vulnerable countries give to water-related challenges, it is evident that the NAP processes would need to address water resources management. In addition to already existing sectorial guidelines and technical guidelines, further guidance could be developed on how to promote integrated approaches for the NAPs, building on integrated water resources management experiences and acknowledging the cross-sectoral nature of water resources. As the NAP process was established to identify medium- and long-term adaptation needs and implement strategies to meet these, there are evident synergies with the INDCs process. Whether the progress in developing NAPs will encourage parties to include an adaptation component in their INDC is yet to be seen. Further, since including adaptation in INDCs is optional, it remains unclear by which mechanisms Parties will communicate their actions on adaptation.

Loss and Damage
The concept of "Loss and damage" has emerged in the climate change negotiations during recent years to

address consequences of climate change that cannot be managed by mitigation or adaptation measures. UNFCCC COP 19 established the "Warsaw International Mechanism for Loss and Damage associated with Climate Change Impacts" and COP 20 agreed on a two year work plan (UNFCCC, 2013, 2014). Given the severity of water-related disasters such as floods and droughts, it is relevant to identify ways to integrate water resources in this work plan.

Funding
Implementing the Paris agenda will mean investments, technology transfer and capacity building. The Green Climate Fund is an important instrument for addressing climate change. Many questions remain over how existing funds and mechanisms like the Adaptation Fund, the Least Developed Countries Fund and the Clean Development Mechanism will function following the Paris COP. A coherent approach is needed in order to ensure that funding channels are complementary, to ensure that the greatest benefits are reaped in terms of climate mitigation and adaptation, and that the role of water resources management's role in supporting these aims.

Opportunities in addition to the UNFCCC programmes and mechanisms
In addition to the formal COP 21 decisions, countries and different actors may need to put forward initiatives about how to integrate water and climate in policy, practice and funding at all levels.

The French solutions agenda initiative "Solutionscop21" (www.solutionscop21.org) offers one possibility for the water community to engage and showcase the relevance of water solutions to the challenges of climate change. Further, the role of non-state actors (http://climateaction.unfccc.int/) provides a venue for companies and other stakeholders to contribute to innovative solutions to our common challenges.

Above all, the task of contributing to better water and climate coherence is a challenge to us all, practitioners, policy makers and technical specialists, in public and private institutions. Existing good examples need to be expanded and complemented. If we are able to mainstream water resources management, climate measures and disaster risk reduction in our efforts to achieve sustainable development, we will not only reduce risks for communities, economies and nature but we will also gain economic benefits and contribute constructively to achieving sustainable growth.

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Can saving lives save livelihoods? The water-energy-food nexus and human security

By Olcay Ünver and Lucie Pluschke

Introduction | The year 2014 marked a gloomy record as more than 108 million people needed humanitarian assistance, with more displaced by violence worldwide than ever before (United Nations News Centre, 2014). Today crises are frequent and often persist for years, becoming the "new normal" for many people and changing the nature of humanitarian aid. Humanitarian aid and development work can no longer be seen in isolation from one another and should go hand-in-hand. This article looks at how a cross-cutting Nexus perspective can help to promote human security in crisis situations, and to align the work of different sectors to find synergies and to manage trade-offs effectively. Humanitarian situations are complex and each one deserves comprehensive, context-specific and prevention-oriented planning and action. Without intending to present Nexus as the solution, the article highlights some examples, where a cross-cutting approach to water, energy and food can positively impact on human security.

What is human security? | The concept of and the debate on human security have been, particularly following the milestone 1994 Human Development Report of the United Nations Development Programme. Heads of State and Government declared at the 2005 World Summit Outcome on Human Security (A/RES/60/1/ paragraph 143) "the right of all people to live in freedom and dignity, free from poverty and despair", and recognised that "all individuals, in particular vulnerable people, are entitled to freedom from fear and freedom from want, with an equal opportunity to enjoy all their rights and fully develop their human potential" (United Nations General Assembly, 2005). This indicates a shift in our understanding of insecurities. Threats to human security are cross-cutting, encompassing everything from international war and internal conflicts to chronic and persistent poverty, climate-related and other natural disasters; and from organised crime, human trafficking and health pandemics to sudden economic and financial downturns. Moreover, this definition of human security helps to frame the discussion and sets its scope in a way that we can more readily relate to by putting our rights under the spotlight. It helps to make the link between "the right to live free from poverty and despair" and the provision of and access to water, energy, food, and other resources. Conversation along these lines can potentially inform humanitarian interventions, and their coordination with more long-term development plans.

What is the Water-Energy-Food Nexus and why does it matter? | The concept of security has repeatedly come up in debates about the Water-Energy-Food Nexus. Following the World Economic Forum 2008 annual meeting in Davos, the WEF Water Initiative looked at water security in relation to energy and food systems as well as climate, economic growth and human security (WEF, 2011). The WEF and other actors, too, have since drawn attention to the global risks related to water security (WEF, 2015). The concern is not about water resources in isolation, but about the role they play for economic development and for people. In Asia, for example, rapid industrialisation and urbanisation push the demand for energy and food. Increasingly more water is required to meet these growing demands, putting additional pressure on natural resources and the environment, which is anyway strained by climate change and population growth (ADB, 2013). Similarly, the Bonn Nexus Conference in 2011 has placed emphasis on the water-energy-food security Nexus, drawing attention to the development opportunities that arise through a Nexus approach, but also the need for mechanisms to minimise negative trade-offs (Hoff, 2011).

Photo: iStock

FAO's framing of the Nexus approach is within its vision of sustainable food and agriculture: "Agriculture must meet the needs of present and future generations for its products and services, while ensuring profitability, environmental health, and social and economic equity" (FAO, 2013). FAO's Nexus approach distinguishes between the resource base – water, energy, land, soil, and associated ecosystem services – and the goals and interests that are to be achieved with major implications on the resource base and the environment (FAO, 2014a). It explicitly recognises that there is a range of actors with divergent, often competing goals. A mining company has very different stakes from a small-scale farmer and yet there needs to be a solution for both of them. The challenge is to find a balance between different resource user goals and interests – while maintaining the integrity of ecosystems. The approach, therefore, suggests a framework for managing the Water-Energy-Food Nexus, by 1) providing evidence, 2) developing scenarios about the future, and 3) designing and appraising response options across sectors and scales. This cannot be done in isolation, but only in dialogue with stakeholders. It is a process-based approach that extends beyond resource use, also considering the broader development implications.

The Water-Energy-Food Nexus in insecure settings

Human security aims at ensuring the survival, livelihood and dignity of people in response to current and emerging threats –threats that are widespread and cross-cutting. In the context of immediate or protracted crisis and post-conflict settings, the sustainable provision of water, energy and food is particularly urgent. A lack of basic resources and services can destabilise societies. Unresolved issues around tenure and user rights can reignite conflicts, some of which are fuelled by access, or a lack thereof, to natural resources or control over them. In the summer of 2014, for example, there were multiple reports of the extremist group Islamic State of Iraq and al-Sham (ISIS) seeking control of key water infrastructure in the upper reaches of the Tigris and Euphrates, two rivers on which Iraq and Syria depend for water, food and energy (Gleick, 2014). Under the stranglehold of ISIS, this caused water levels in Lake Assad, the reservoir of Syria's largest hydroelectric dam, to drop by six metres, disrupting energy production while causing severe water shortages in nearby cities (Chudacoff, 2014). Control over a resource turned into a weapon against a population. Finally, the environment and disasters are inherently interlinked. Deforestation, degradation of watersheds, land degradation and desertification, depletion of reefs and coastal ecosystems, among other factors, all reduce resilience and aggravate the impacts of natural disasters, typically harming the poor, the disadvantaged and the vulnerable more than others. Nevertheless, such crisis situations can also offer opportunities for trust-building and for improving the initial situation by "building back better".

A cross-cutting Nexus approach can therefore provide a useful framework to find synergies and to manage trade-offs between resource uses and needs in different insecure settings. It must be underlined, however, that within the context of human security, the tools and approaches used in identifying and quantifying trade-offs and co-benefits may be significantly different from the same in other contexts, where market concepts and tools are more readily applicable. In an insecure setting, the conditions for recovery and development are fundamentally different, but a small intervention can have significant impacts on people's livelihoods and the surrounding environment. The bottom one billion, for example, to be

provided with minimum levels of water, food, energy and shelter, can substantially benefit from coherent planning of responses, considering their impacts across sectors and scales, and improved resource allocation and sharing, with proper attention paid to the associated environmental issues.

Development partners and donors can play a key role here, by, on the one hand, increasing the overall effectiveness of their interventions, and, on the other hand, contributing to the longer-term livelihood of the communities. The remainder of the text contains examples of Nexus-type approaches applied to diverse human security situations.

Basic access to resources: the Syria crisis | By every measure, the security situation of people in Syria is critical and its impacts for the region are substantial with little positive improvement, if any, since the beginning of the conflict. In Syria, food supplies are limited, difficult to access and costly. Fields and farming assets have been left idle or destroyed due to violence, displacement, increased production costs and a lack of basic farming supplies. The wheat harvest in 2013 fell 40 per cent short of an average year (FAO, 2013a). Syria's essential services are on the brink of collapse under the burden of continuous assault on critical water and energy infrastructure (UNICEF, 2013). This situation has been further aggravated by the eighth consecutive summer of drought that could escalate into a full-blown water, energy and food crisis. Compiled UNHCR figures report 3, 977,211 Syrians registered as refugees in four neighbouring countries and in Egypt (UNHCR, 2015), a large majority arriving at the twenty-one refugee camps in Turkey (eight camps), Jordan (three camps), Iraq (eight camps) and Lebanon (two camps) with a substantial number of refugees living outside the camps, too. Host communities in these countries face a huge demand and intense competition for resources such as land and water, and for income opportunities, while costs for housing, food and other basic commodities soar.

As the crisis shows no signs of abating, the response is now shifting from humanitarian relief to longer-term, development-focused response. In Jordan, the shift has taken place in the form of the 2015 Jordan Response Plan for the Syria Crisis (2014) and the 2014-2016 National Resilience Plan (2014). These plans encompass a great number of sectors in an attempt to mitigate the impacts of the crisis as well as to build back more resilient livelihood systems. They mark a shift in the way we deal with resources. While basic access to water, energy and food supply still has priority, the focus is now on the development of sound supply and management structures, taking into account different levels of interventions from the al Za'atari and al Azraq camps, located 20 km apart, to the national and regional level. Nexus thinking can thereby help to identify synergies as, for example, in the Zaatari camp, where basic water and energy resources are needed on a continuing basis by tens of thousands of refugees living in the camp. Renewable energy capacities are being developed to power two planned wells to access the groundwater resources on which the camp is situated. Al Azraq camp was built with the primary objective of relieving the excess population in Zaatari, when the population in Zaatari exceeded 84,000, way over its capacity of 60,000 people, in 2014 (UNHCR, 2015). As the crisis is seemingly protracted, this is a cross-point for humanitarian and development communities to work together more constructively to ensure that their programmes are reinforcing and not conflicting with or disrupting each other. What are the implications of the crisis for the already limited water and land resources, for energy security, and for the environment in Jordan and the region overall? To what extent do national development strategies need to be adjusted to deal with the extra strains the Syria crisis has put on resources, and more importantly, how can the needs of the increasing number of refugees be met in the long-term?

Safe access to fuel and energy in humanitarian settings | In times of conflict, natural disasters and complex emergencies, something as simple as providing cooking fuels can have a wide rippling effect. The collection and use of biomass cooking fuel in emergencies creates a myriad of risks, including rape or assault during firewood collection, skin burns, respiratory illnesses due to indoor air pollution, and environmental degradation (WFP, 2012). In South Sudan, access to firewood to cook food remains a challenge as firewood collection outside camp limits is too risky. Subsequently, people have resorted to burning plastic materials for cooking, which is an environmental and health hazard (Ndawula-Kampala, 2015). In Darfur, people – often women and girls – must venture out into unsafe areas to collect firewood, putting themselves at risk of harassment and gender-based violence. As environmental degradation and deforestation continue, the distance they have to walk to find firewood increases and the availability of firewood becomes prohibitively difficult, leaving people with little choice but to exchange food rations for cooking fuels, or to change their cooking and eating habits altogether (FAO, 2013b). The dwindling resources have also been a source of tension between the displaced and the host communities.

The SAFE initiative aims to support displaced people not only with cooking fuels, but with a longer-term perspective to rebuilding their lives. Clearly, the entry-point is the provision of energy, though it has broader, cross-cutting implications for people's livelihoods. One example of a SAFE-related intervention is the promotion of integrated food-energy systems that simultaneously address food and energy needs as well as generating income opportunities (FAO, 2010). In Darfur, for example, farmers use crop residues as well as by-products from livestock for biogas and compost production (WFP, 2012). With these integrated systems farmers can save money, because they do not have to buy costly fossil fuels as well as the

integrated system improves the personal safety and health particularly of women and girls (FAO, 2010). Several community tree nurseries and forests were established as sources of firewood, nutritious fruits and for income generation. With energy as entry-point, the SAFE initiative is a good example of the Nexus in practice. It is not prescriptively about water, energy and food, but about finding solutions to ensure "the right of all people to live in freedom and dignity, free from poverty and despair" (United Nations General Assembly, 2015).

Current drought emergency situation in Central America | In El Salvador, Guatemala, Honduras and Nicaragua, the drought has resulted in severe crop losses, resulting in an exceptional shortfall in aggregate food production, particularly of maize, rice and cereal production in 2015 (FAO, 2015). In Honduras, the 2014 maize production reached a 10-year low and import requirements are forecast at record level (FAO, 2015). The situation is similar in other parts of the region. A subsequent reduction of coffee sector income for day labourers and a rapid increase in staple food prices are likely to lead to a deterioration of food security of extremely poor households in early 2015 (FAO, 2014b). With no rain falling, crops are failing in places where there is no irrigation or where irrigation water is in short supply. As water levels drop, so do capacities for generating hydroelectricity. A human security analysis can provide useful information for developing evidenced-based protection and empowerment strategies (UNOCHA, 2009).With basic human security at risk, the situation calls for more systematic thinking about how to ensure food security, while providing water and energy without degrading the ecosystems on which we rely to do exactly that. This requires more systematic planning at basin, national and regional level, integrating disaster risk reduction into the ongoing processes of sustainable development policies.

Conclusion | Use of a water-food-energy Nexus approach to human security is not only relevant and possible but also potentially preferable to the more traditional approaches that more than often lack longer or broader vision in one or more of the following three dimensions:

(i) planning horizons, by putting more emphasis on the provision of immediate needs at the expense of longer-term sustainability;

(ii) cross-sectoral linkages, by focusing primarily on one sector a time, and hence missing the opportunities as well as negative impacts emanating from these, albeit with varying significance depending on the situation; and

(iii) inclusive governance, by not systematically incorporating non-governmental actors or informal elements, on the one hand, that may enhance societal impact and equity, including gender equity, and by not creating conducive frames, on the other hand, that can link multiple, parallel interventions.

Nexus thinking about water, energy and food can be broadened to incorporate human security with people at the center of efforts to prevent disasters, build resilience and promote human development. While the international community is moving into an era where sustainability, human welfare and effectiveness of implementation are key considerations, for instance through the Sustainable Development Goals for which an interconnected approach and broad coherence is essential, there is more reason to believe that both the approach and the analytical tools that the Water-Energy-Food Nexus offers can be more widely put to the service of human security. Current efforts to bridge the existing science-policy-practice gaps are encouraging and can certainly benefit from more focused and heightened interest from the donor community.

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Double water blindness delaying sub-Saharan green revolution

By Malin Falkenmark and Johan Rockström

Hunger and poverty culminate in sub-Saharan Africa | Twenty five years ago, the question "The massive water scarcity now threatening Africa, why isn't it being addressed?" was already being raised (Falkenmark, 1989). Now it has reappeared in the ongoing intergovernmental discussions around the Sustainable Development Goals (SDG) of eliminating poverty and hunger in the world within 15 years, i.e., by 2030 (UN, 2014). It was recently brought to the fore by a Concerned Scientist Statement (2014) launched at the 2014 World Water Week in Stockholm, which highlights the failure to recognise the ominous congruence between, on the one hand, poverty, malnutrition, rapid population growth (Figure 1) and economic reliance on agriculture, and on the other the rising water challenges and inherently harsh predicament in semi-arid tropical climates. The experts stressed that these drylands are the most water-vulnerable inhabited regions of the world, hosting the world's poorest countries.

At the global scale, sub-Saharan Africa is a region characterised by the dominance of a highly variable and water-scarce hydro-climate, with a disproportionately large part of the population caught in a stubbornly resilient social trap of poverty, hunger and social unrest (Gray et al., 2013). Almost half of the sub-Saharan African population is stuck in absolute poverty, and the number has unfortunately risen over the past 30 years from approximately 250 million, to approximately 500 million today (FAO et al., 2012, Rockström and Falkenmark, 2015).

Interestingly, livelihood discussions on strategies to alleviate poverty and hunger have in the past tended to have very little focus on the role of natural resources, and in particular of water and ecosystems, which together form the basis for all food production. Moreover, when attention has been given to water, the discourse has been dominated by a focus on the amount of "blue water", i.e., runoff available in different regions for irrigation purposes. Unfortunately, as will be developed in the following pages, semi-arid and dry sub-humid regions in sub-Saharan Africa have very limited blue water resources. Moreover, the "water discourse" has tended to focus on droughts and desertification, i.e., the absence of water. This has led to an unconstructive double water blindness: first, the mistake of emphasising so strongly just runoff – blue water – as the sole source of development, and secondly proclaiming essentially all years of crop failure as "drought years". In fact these drylands are not so dry, which becomes apparent by shifting focus. Rather than focusing on these water-blind ends, a redirection of emphasis is needed towards the water that actually exists, and which we call "green water". This is the water upon which development has to build, i.e., water which infiltrates into soils from highly variable rainfall, which never reaches the river or groundwater table, but which is available for rainfed food production (Falkenmark and Rockström, 2008).

This means that managing rainwater will be a key to eradicating poverty and hunger in large parts of sub-Saharan Africa. Eliminating hunger in Africa requires a paradigm shift away from the central role of irrigation, which has and continues to dominate the water-for-food discourse, influenced by the Asian Green Revolution. In S Asia, rich and stable supplies of blue water have been delivered from the Himalayan mountains. In the poor and hungry so-called "drylands" in Africa and elsewhere, much more focus has to be directed to the dominating water resource, i.e. the rainwater infiltrating into the soil (green water).

Sub-Saharan Achilles heel | The semi-arid and dry sub-humid regions of sub-Saharan Africa (shown in Figure 2 a) remain an area with extremely variable rainfall – ranging from low rainfall of < 200 mm in the semi-arid driest end to < 1,500 mm in the wetter dry sub-humid end (Figure 2 b blue curve) – combined with high evapotranspiration that consumes much of that

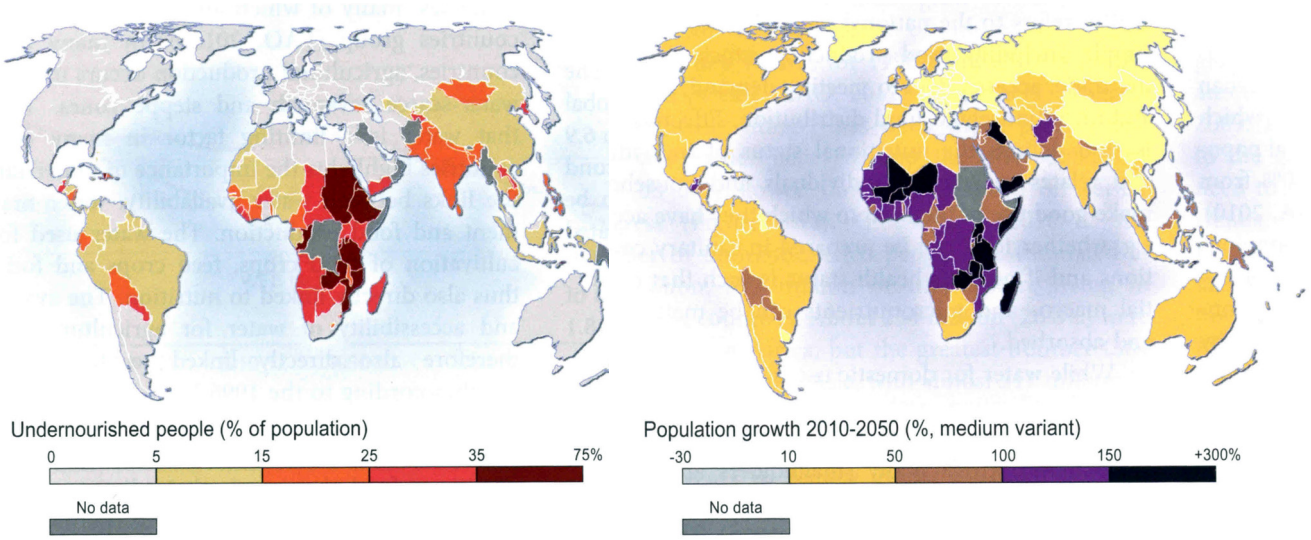
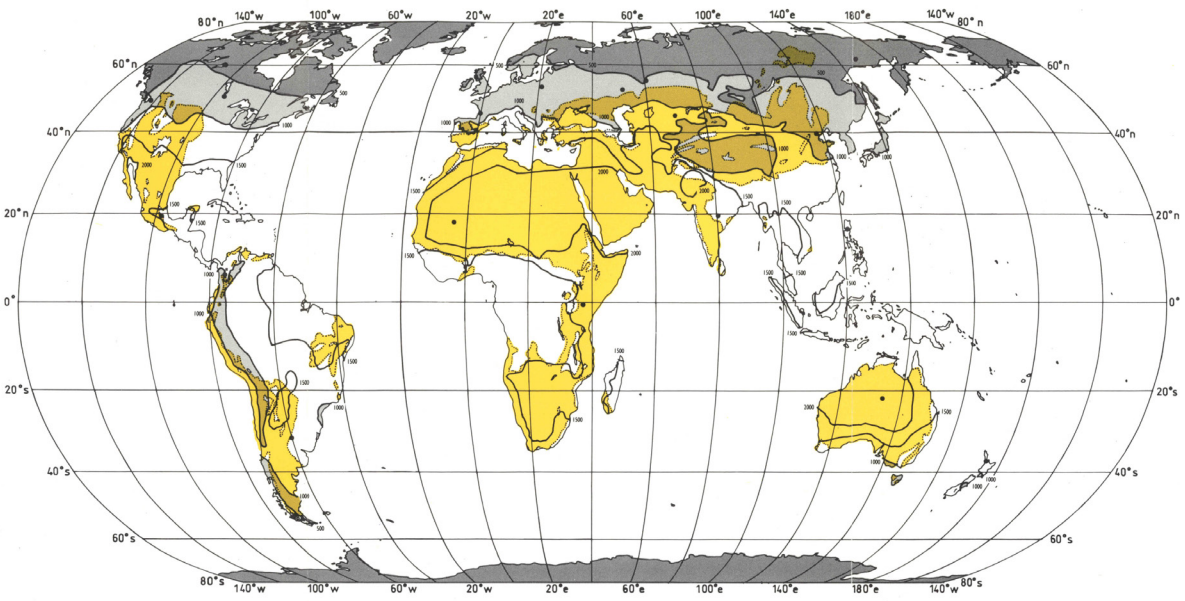


Figure 1 Undernourishment and population growth are largest where climate is driest. Modified from Falkenmark & Chapman 1989 and Rockström et al 2014.



Map showing on the one hand the water attraction capacity of the atmosphere (expressed as potential evaporation in mm/year), on the other regions with dry climate (hyper-arid, arid, semi-arid, sub-humid)

Potential evaporation

0-500 mm/yr

500-1000 mm/yr

> 1000 mm/yr

Hydroclimate

dry climate

rain. Since a mature food crop yield typically requires a minimum of 500 mm of rainfall through the growth season (grey curve), crop failure is frequent in the semi-arid region where the two curves meet (a high probability of seasonal rainfall < 500 mm]). In the dry sub-humid region (fig 2 a green area), most rain evaporates and a high frequency of dry spells makes agriculture vulnerable (2-4 weeks of intermittent "drought" during the growing season, i.e., there is enough cumulative rainfall over the season, but poor distribution causes water scarcity). When it rains, it often pours in intense convective storms that generate flash floods with eroding surface runoff, making both fruitful rainfed agriculture and traditional irrigation extremely challenging. In the wet sub-humid region (greyish green) runoff generation increases with rainfall (fig 2 b red curve), but – due to large evaporation

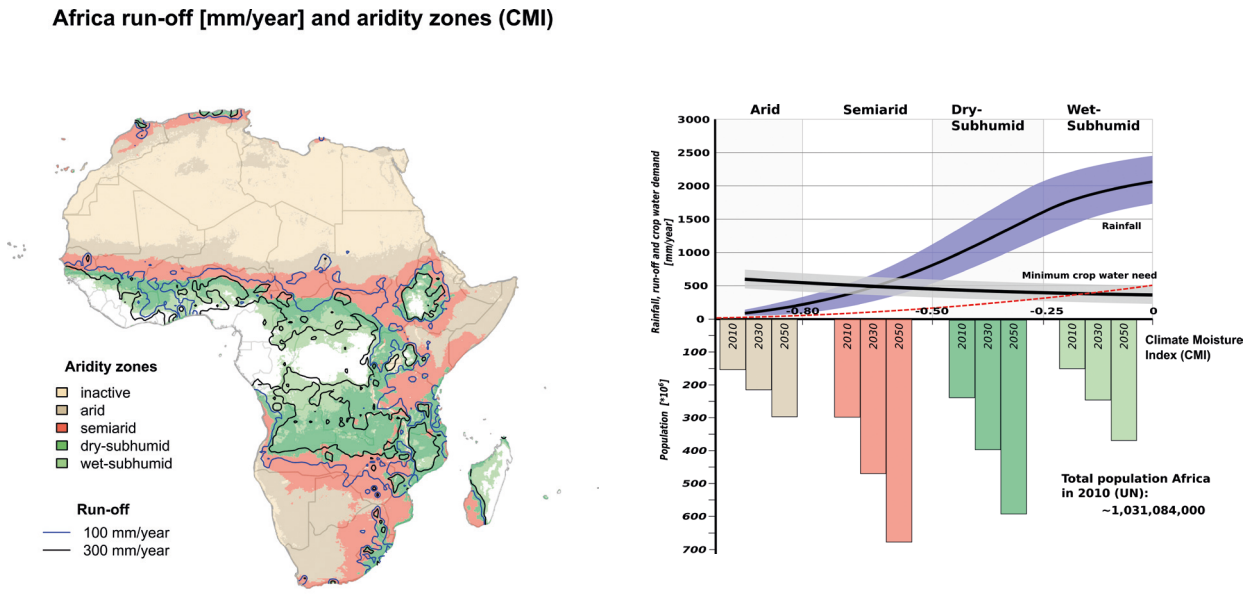


Figure 2. Volatility of sub-Saharan drylands: Left: geographic distribution of semi-arid, dry sub-humid and wet sub-humid zones, and of runoff generation. Right: annual precipitation (blue) in relation to water requirement for crop production (grey), both plus/minus one standard deviation; runoff generation (dotted red line); and population in the different zones 2010, 2030 and 2050. Source: the authors. Credit: Ingo Fetzer

– remains small and geographically dispersed. This makes an irrigation-based agricultural strategy difficult.

Due to limited runoff, more than 95 per cent of African food production is rainfed (Vörösmarty et al., 2005). In 2010, altogether some 0.5 bn lived in either the arid or semi-arid regions where irrigation-based (blue water) strategy is not an option, and 0.25 bn in the dry sub-humid zone where runoff generation is limited and needed for socioeconomic development support. By 2050, the former total is expected to have grown to almost 1 bn and the latter to close to 0.6 bn. It is only the population in the wet sub-humid zone that can benefit from conventional irrigation.

In the semi-arid zone it is not only that river flow for irrigation is scarce. The limited runoff is confined to sparse river corridors, often far away from the majority of rural farming communities (Vörösmarty et al., 2005). To this inherently challenging water predicament has to be added (i) the unsettling new projections that suggest a dramatic underestimate of the future African population size, which is more likely to reach 3-4 billion rather than 2-3 billion by 2100 (Gerland et al., 2014), and (ii) the latest IPCC AR5 (Intergovernmental Panel on Climate Change, Fifth Assessment Report) climate assessments, showing over 25 per cent decline in rainfall totals for certain parts of semi-arid and dry sub-humid African regions, with significant shifts in rainfall totals both downwards and upwards, and with a warming of 2°C (IPCC, 2014). To neglect the water-related Achilles heel in sub-Saharan Africa when defining pathways to sustainable development would, against this background, be a historic mistake (Rockström and Falkenmark, 2015).

In the near future, moreover, economic growth, necessary to alleviate poverty, can be expected to remain largely reliant on agricultural development (Kemp-Benedict et al., 2011). Production of food in savannah drylands needs to cope with the inherent frequency of inter-annual droughts, dry spells during the growing season, and extreme rainfall events, which due to climate change are likely to grow in frequency, making extreme variability – and not necessarily lack of rainfall – part of normality (Rockström et al., 2014).

Towards an African green revolution | Thus, since there is limited runoff accessible to support irrigated agriculture in these regions, an African Green Revolution will have to rely on rainfed production (green water). Semi-arid and dry sub-humid tropical regions may be dry in terms of runoff generation, but they are not dry in terms of rainfall (Fig 2 b). The challenge will be to radically increase today's low crop yields and get out of poverty traps (Rockström et al., 2014), and to find ways of overcoming drought problems.

A better mental model for a strategy to upgrade rainfed agriculture, rather than the Asian Green Revolution, is a Triple Green Revolution. An African Green Revolution would involve three parallel green dimensions:
a) maximised use of green water, to reach a Green Revolution in terms of radically increased production,
b) adequate attention to protection of critical ecosystem services, and thereby sustainability
c) in the long term the ability of landscapes to safeguard water resilience, i.e., the capacity to regenerate rainfall by moisture feedback, and wetness in landscapes for ecological functions.

Triple green, thus, means a green water, green production, and green sustainable revolution.

In terms of a green water-based revolution, there is evidence of a large untapped water potential, also in the apparently water-scarce drylands. Field observations from rainfed agriculture, even in the drier semi-arid regions of Africa, show that 50-70 per cent of the available rainfall does not infiltrate or go to productive crop water use, i.e. transpiration, but is instead "lost" as surface runoff (generally causing local land degradation – gully erosion) and evaporation. This indicates a large untapped potential to drastically improve rainfed food production, if only more of the water can be guided to the root zone, in particular during dry spells, for beneficial, productive uses by water harvesting or other means (Rockström et al., 2014, Falkenmark, 2013).

Furthermore, coping with droughts will benefit from understanding their actual cause. The fact is that even in years with crop failure, the reason is often intermittent dry spells, rather than inter-annual meteorological droughts involving overall water deficiency. In fact, years with poor distribution of rainfall, causing disastrous loss of yields, are often misleadingly denoted "droughts" when they in fact are not meteorological droughts but instead seasons hit by severe dry spells.

Consequently, upgraded low-loss rainfed agriculture will contain, as essential strategic components, the following three practices:

- best use of actual rain by focus on infiltration, maximising root water uptake and minimising water loss
- efforts to master increasingly frequent and severe water shocks: inter-annual drought years, intra-annual drought periods, and intra-seasonal drought episodes (dry spells)
- harvest surface runoff flows, which normally generate soil erosion and land degradation, in storage systems, where the water can be made available for supplementary irrigation.

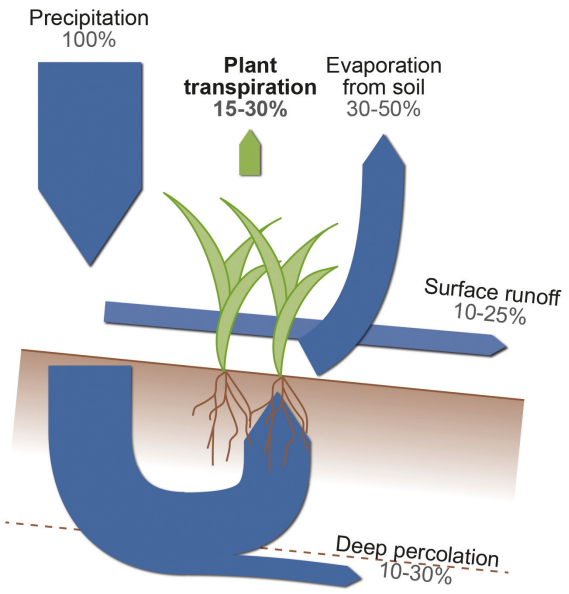


Figure 3. Observed rainwater partitioning in sub-Saharan rainfed agriculture in Africa. Modified from Rockström et al 2014

Evidence-based management of rain | There is today ample evidence of the opportunities for building resilience and enhancing food production in semi-arid farming systems through water harvesting and other agricultural water management interventions (Rockström et al., 2014). Such interventions are often developed from indigenous knowledge. Most make use of green water, but some technologies combine green and blue water sources. Management practices and techniques, such as rainwater storage, supplementary irrigation, and integrated management of water, land, crops and nutrients, can provide significant productivity gains and sustainable intensification of smallholder agriculture for livelihood improvements, community development and food security. This could also offer a possibility for investments, stimulating further agricultural development.

Water harvesting systems involve a wide array of small-scale strategies to supplement supplies with small volumes of water to bridge dry spells during the rainy season. They include in situ conservation of moisture in the soil, runoff concentration in crop fields, and various forms of micro-scale storage systems (e.g., ponds and micro-dams, sand dams and sub-surface storage in shallow water tables). Ex situ systems use runoff farming technologies such as gully harvesting to divert runoff from extended areas.

Large-scale application of water harvesting has been demonstrated by China (Zhu and Yanhong, 2006). Starting around 1990 in the Gansu area, managing rain was developed as a key measure to change a water scarcity situation, help the population to get out of poverty, and promote socio-economic development in remote mountain areas through an efficient rainwater harvesting technique. It was first developed on the household level through the so-called 1.2.1 rainwater catchment project in a region with about 350 mm of annual rainfall. It was later followed by a project for supplementary irrigation to improve the basic agricultural conditions of the area. This approach turned out to be an effective means to alleviate poverty and allow a breakthrough for small-scale rainfed dryland farming.

In India, a revival of water harvesting systems, an old traditional practice that was largely phased out during the irrigation- and groundwater-based Green Revolution in the 1960s and 1970s, has proven a key strategy to enhance food production in rainfed semi-arid farming systems (CA, 2007). Large-scale experiments have taken place among smallholders, and improved water, nutrient

and crop management have increased yields from current levels of ca.1 ton/ha to 5 ton/ha (Wani et al., 2003).

In Africa, similar experience has been shown in semi-arid farming systems where the current rainfed agricultural systems for staple food crops of maize, millet and sorghum, hovering for 20 years at approximately 1 ton/ha, can be tripled or even quadrupled by combining green water management with nutrients and crop improvements (Rockström et al., 2007). For instance, farm experiments with improved agricultural water management practices in Burkina Faso led to dramatic yield responses with sorghum harvests increasing by 300 percent (Rockström et al., 2014).

Conclusion | Without a major step-change in rainfed agricultural productivity, it is difficult to see how sub-Saharan Africa could continue the road out of poverty and hunger, as stipulated in the SDG goals. Since only 15 years remain to 2030, it is extremely urgent to address sub-Saharan Africa's critical predicament: a highly variable dryland hydro-climate with rainfall as the main resource accessible for agricultural production. However, the unexpectedly rapid population growth (Gerland et al., 2014) calls for adequate attention also to a long-term risk for food deficits, and resulting needs for food import. Food trade – on regional as well as intercontinental scales – will be necessary for at least 30 African nations (Rockström et al., 2014), even after considering moderate population growth and the opportunities of water productivity and yield enhancement. This will not be possible without large investments in transport and markets.

Shifts in mental images of agricultural and economic development will be essential, adapted to sub-Saharan hydrological realities. Given the serious water shortage in most of this region, and with a 1 bn population now struggling with undernutrition and poverty, doubling by 2050, and then again doubling to 4 bn by 2100, it is evident that fundamental efforts and long-term solutions are urgent to secure a resilient future for Africa's inhabitants. Without taking integrated approaches and making adequate connections between water, food, growth and poverty, we fear that the Sustainable Development Goal framework is bound to fail in delivering on its basic promises, in particular for sub-Saharan Africa.
A sustainable development of sub-Saharan Africa will have to be based on a skilfully balanced use of both blue and green water: blue water for urbanisation, industrialisation and energy development, and green water for food and biomass production. The key will be to integrate blue supplementary irrigation thinking into upgrading green-based rainfed agriculture, based on various strategies of harvesting local runoff. This would not only raise productivity, but also build water resilience to high and rising water shocks under a changing climate.

The sustainable development agenda for Africa should therefore raise its attention to two critical questions: 1) how can rainwater management contribute to unlocking poverty traps in smallholder farming systems and to social and economic development? And 2) what will be the crucial policies and strategies to make such innovations successful and possible to scale up?

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Acknowledgement:
This article is an extended version of Rockström and Falkenmark, 2015

From talk to action

2015 is a year of far-reaching global decisions on sustainable development. The preparatory work for a new development agenda that has kept water and development professionals busy for the past few years, will intensify as we enter into the important implementation phase. The Sustainable Development Goals (SDGs) will have to be translated into global programmes and mechanisms, as well as national and local implementation strategies and action plans.

This report has addressed the necessity to integrate water in disaster risk reduction, in the SDG framework and in efforts to adapt to and mitigate climate change. In the implementation, coherence between different policy areas and between economic sectors remains a challenge. It is not only important to mainstream water in the sustainability efforts to increase the opportunities for prosperity, environmental quality, equity and dignity; water resources management is also a means for coherence and collaboration across borders, sectors and stakeholder groups.

Issues related to financing for development will be central in the implementation of the post-2015 agenda. In addition to the fundamental question on how to meet the huge demands for financial resources, ownership and enforcement of decisions are key issues that need to be addressed. How to build institutions and capacity in the poorest and most fragile states are also key challenges to be tackled. Actors engaged in water-related issues can and should contribute to forward-looking and innovative solutions, turning challenges into opportunities. The outcome of the UN Financing for Development conference in Addis Ababa in July 2015 provides a firm ground to build upon. The engagement by the business sector is especially encouraging.

Financing for development is also closely linked to the World Water Week theme in 2016, "Water for Sustainable Growth." As stated throughout this report, robust water resources management helps build resilient and sustainable economies. Water scarcity, variability and unreliability pose significant risks to all economic activities in a society. Poorly managed water resources cause serious social, environmental and economic challenges – but if managed well, they are a source of prosperity. This calls for investments in water security, in risk management, and in knowledge, people and partnerships.

It is paramount to build resilient societies and to secure functioning ecosystems while developing our economies. In increasingly unpredictable conditions, we must ensure that human activities operate within safe limits of the planetary boundaries. This includes recognizing and addressing competing demands and tradeoffs between different water uses and users. Securing ecosystem services is an important building block in addressing the challenges ahead.

Identifying innovative incentives schemes for more efficient water use, and reuse – like different forms of water pricing – would not only contribute to raising financial means for investments in necessary infrastructure, it would also secure universal access to safe and affordable drinking water and appropriate sanitation for all.

The real challenge starts in 2016 when, building on the global decisions to be taken in 2015, we should move forward – going from talk to action – in establishing a water-wise world for all.

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Water for development

Water and the development challenge | 2015 is the target year for achieving the Millennium Development Goals (MDGs). Although considerable progress has been made in halving poverty, the targets to achieve improved access to key basic services during the first 15 years of this century will not be fully reached. Almost two billion people will still lack access to safe water and about 2.5 billion people lack access to basic sanitation. More than one billion people will still be without electricity and almost one billion people will go to bed hungry. They are largely the same underprivileged poor. The challenge remains for the world community in 2015 to formulate, commit to and urgently pursue a new set of Sustainable Development Goals (SDGs).

Water is central to this challenge. Our lives and livelihoods, along with all other living creatures, depend on water. Without it we cannot sustain a productive economy to live healthy lives, produce our food, energy and other basic necessities and commodities. This is why World Water Week in Stockholm focuses on these issues, and the vital role of water in addressing them, from "Water and Food Security" in 2012, through "Water Cooperation" in 2013 and "Energy and Water" in 2014 to "Water for Development" in 2015.

2015 – The year for renewed global commitments | Irrespective of how water will be captured in the future SDGs, the understanding that smart water management underpins success across sustainable development is most important. Without improved development and management of this finite and vulnerable resource we cannot achieve better livelihoods for all, and particularly for the poor, regardless of where they live. Poverty is appearing not just in the least developed countries but also to a large extent in middle income countries and growing economies. Poverty, lack of dignity, as well as (lack of) access to basic services, is a daily challenge for the underprivileged in every part of the world. Therefore, the SDGs will need to apply to all.

2015 is also the year in which a new global climate agreement will be arrived at during COP 21 in Paris in December. The recent 5th Assessment by the Intergovernmental Panel on Climate Change (IPCC) has clearly shown the need for urgent action on reducing greenhouse gas emissions and scaling up of investment and action in climate change adaptation. A review of the Hyogo Framework for Disaster Risk Reduction will take place in Sendai, Japan in March 2015. Both of these processes have strong links to water and its role in the three key dimensions of sustainable development: economic development, social progress and equity, and the maintenance of a healthy and rich environment.

The Post-2015 agenda and Sustainable Development Goals | In debating the water dimension of the SDGs, with a strong call for a dedicated water goal, a broad approach has been advocated that recognises the following key aspects: drinking water, sanitation and hygiene (WASH), water resources, water productivity, water governance, water quality, improved resilience, healthy ecosystems, mitigating water related disasters, managing wastewater and reducing pollution. The need to highlight the role of water in other SDGs, such as those addressing food, energy, climate, health etc., and preferably including some specific targets, has also been raised. During World Water Week in Stockholm in August 2015, the negotiation of the Post-2015 development agenda and the SDGs are entering a final phase, therefore the main contribution of the Week will be to discuss how the water-related goals and targets can be most effectively implemented, measured and monitored.

New development pathways | In addressing the role of "Water for Development" in Stockholm in 2015 it will be important to bring into focus how we go beyond the discussions about global goals and targets to address the actual implementation of the new Post-2015 development agenda in the local context. If we are to progress beyond 'business-as-usual' that did not fully deliver on the MDGs, we need to think innovatively – together – about new development pathways. Our various communities, too often separated in silos, need to form new alliances, innovative public-private partnerships and social entrepreneurships for an effective and socially accepted development agenda. This involves building bridges between traditional sectors and communities, such as water, food, energy, health, and environment, as well as across public, private and civil society stakeholder groups. This may be a tall order, but the last few years in Stockholm have shown that it is possible to build and expand such new bridges and alliances.

The global to local change perspective | The Post-2015 development agenda will be shaped by key drivers such as continued population growth, increased income levels in many countries, increased urbanisation, growth in the emerging economies with a fast growing middle class, conflict and post-conflict challenges, continued

rapid move from agriculture-based economies to industry and services-production, and accelerating impacts of climate change. These drivers will pose serious challenges to our water, food and energy security. Water will be affected both in terms of availability and quality. Building resilience to climate change, whether in the form of long term temperature and hydrologic change, sea-level rise, or more frequent and severe floods and droughts and water-related disasters, calls for new approaches to mitigate risk and manage uncertainties. Such approaches must also consider how to best promote coherence and synergy between climate change adaptation and mitigation. While these challenges are universal, they obviously manifest themselves differently in different countries, contexts and hot spots, with regions and countries characterised by poverty and a fast growing population calling for a special focus. However, while many global drivers may be seen as challenges, there are also important positive aspects to consider, such as the information revolution with new and powerful tools and ways of communicating, as well as technological development to increase water and energy efficiency.

The human and social perspective | A growing disparity in access to water, food and energy, from the affluent top billion to the poor, hungry and disadvantaged bottom billion, and an increasing demand from a rapidly growing global middle class calls for new ways to manage water and improve service delivery. Awareness about losses and waste in the value chain, as well as recognition of the value of the water and energy we consume, need to translate into changes in human behaviour and lifestyles in high-income countries. Respecting that there are critical limits to human transformation of the biosphere and natural resource use, i.e. that there are planetary boundaries, a more efficient use of scarce natural resources to tackle the increasing global demand calls for an increasing shift from supply to demand management. The human dimension of land and water resources allocation, as exemplified in the increased demand for arable land, and the social distribution of water and goods and services produced from water, needs more attention. More focus is also required on water equity and the concept of equality/justice in access to resources, be it between people in the local setting, or between countries and regions. The basis is the human right to access to safe drinking water and sanitation. We also need to see, in a broader perspective, how smallholder farmers and other relevant and disadvantaged social groups can get secured access to water.

The political economy of growth and development
In addressing growth, a quality perspective is needed: emphasising growth that is environmentally sustainable and socially equitable. In the face of rapid per capita income increase globally and growing urbanisation, this perspective must also be fundamental to long term water security. The growth agenda poses several challenges: we need to properly understand who pays and who benefits, how water related trade-offs are dealt with, and how we share, re-distribute and trade water and water related benefits within and between countries. It also calls for improved governance across scales and societal sectors. For these issues special focus on arid-climate growth countries, particularly low income countries and post-conflict countries is required, including a special consideration of how to optimise subsidies for water services for the poor.

The ecosystem and pollution perspective | A sustainable Post-2015 development agenda needs to put the human development in relation to the ecosystems and the planetary boundaries, taking a holistic perspective. Development decisions must more accurately reflect the full value of ecosystems services to enhance livelihoods, reduce poverty, and maintain critical resource stocks and flows – from land and fish to water and climate regulation – and to conserve biodiversity. The environmental dimension of the water, energy and food security nexus, and the green growth concepts, need to become explicit. In a changing and uncertain world we need to increasingly learn to build resilience by living with nature, and make optimal use of natural storage before and when engaging in infrastructure development. Considering the high proportion of untreated wastewater in many countries today, we need to increasingly base growth on accelerated pollution prevention and abatement efforts. Changing from 'business-as-usual' to a much more ecosystem conscious development path requires a paradigm shift and recognition of the need to build public awareness and political will to make such a transition.

Photos: iStock

About SIWI Report no 35: Water for Development – Charting a Water Wise Path

Water is crucial for human sustenance, health and dignity; as a driver for business; for food and energy security; and for the ecosystems upon which our societies and continued development depend. For this report, prepared as input to 2015 World Water Week – themed *Water for Development* – we have invited a wide range of experts with different perspectives on water and development to share their thinking and propose new avenues for development.

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