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Water in the World We Want

CATALYSING NATIONAL WATER-RELATED SUSTAINABLE DEVELOPMENT

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Citation: Schuster-Wallace C.J. and Sandford, R. 2015. *Water in the World We Want*. United Nations University Institute for Water, Environment and Health and United Nations Office for Sustainable Development.

Acknowledgements:
This report is based, in part, upon case studies provided by Hany Besada, Trong Tu Dao, Nilufa Islam, Jong Ho Ahn, Zhang Er Lee, Chimwang'a Maseka, Sutardi Sudirman, Sardar Muhammad Tariq, Callist Tindimugaya, and Claudia Vargas.

It would not have been possible without inputs from the following individuals: Zafar Adeel, Seleshi Bekele Awulachew, Jamie Bartram, Caridad Canales, Muhammad Aslam Chaudry, Thomas Chiramba, William Cosgrove, Dustin Garrick, Ania Grobicki, Fraser MacLoed, Dimple Roy, Jong Soo Yoon, and Susan Watt.

Special thanks go to Dr. Susan Watt for her exceptional editorial abilities and help.

Front Cover Photo: Adapted from: UN, 2014. *The Road to Dignity by 2030: Ending Poverty, Transforming All Lives and Protecting the Planet. https://sustainabledevelopment.un.org*

Layout Design: Carly Popenko (UNU-INWEH)

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Available for download at:
http://inweh.unu.edu

ISBN: 978-92-808-6051-1

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McMaster University

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The United Nations University Institute for Water, Environment and Health is a member of the United Nations University family of organisations. It is the UN Think Tank on Water created by the UNU Governing Council in 1996. The mission of the institute is to help resolve pressing water challenges that are of concern to the United Nations, its Member States, and their people, through knowledge-based synthesis of existing bodies of scientific discovery; through cutting edge targeted research that identifies emerging policy issues; through application of on-theground scalable solutions based on credible research; and, through relevant and targeted public outreach. It is hosted by the Government of Canada and McMaster University.

UNU-INWEH is supported by the government of Canada through the Department of Foreign Affairs, Trade and Development (DFATD).

Foreign Affairs, Trade and Development Canada
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PREFACE

The international community is at an important juncture, as it is engaged in an intense debate on the future of the development agenda at the conclusion of the Millennium Development Goals in 2015.

This worldwide dialogue takes place against a backdrop of poverty, increasing economic and social inequities, and global environmental changes. With failure no longer an option, we must build upon the lessons and successes of the Millennium Development Goals, recognise the importance of our environment for prosperity, and catalyse sustainable economic growth.

While the post-2015 agenda will be defined at the global level its success, however, will be realized at national and subnational scales. Thus, in deliberations, attention must be paid to potential disconnects between what we must achieve as a global society and how these goals can be implemented effectively, efficiently, and in a timely manner on the ground. While this implementation has to accommodate national development priorities, a coordinated and integrated response must guide evidence-informed decision-making, trans-sectoral planning and policies, full cost accounting and economies of scope and scale.

UNU-INWEH and UNOSD, together with our partners at the Global Water Partnership and McMaster University, have undertaken an analytical exercise to identify what implementation to achieve proposed Sustainable Development Goals (SDGs) will look like at the country level. This initiative directly builds upon a global assessment of the role of water in sustainable development that we concluded in 2013. Findings of this country-based study, combined with the underlying evidence are presented in this policy brief.

Through a series of country case studies, expert opinion, and evidence synthesis, the report explores the critical role that water plays (including sanitation and wastewater management) in sustainable development; current disconnects between some national development plans and the proposed SDGs; opportunities for achieving sustainable development through careful water management; and, implementation opportunities.

It is our anticipation that this report fills a critical gap in understanding the complexities associated with water resources and their management, and also provides substantive options that enable us to move forward within the global dialogue.

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UN Photo, Eskinder Debebe

Summary for Decision Makers

Effective management and provisioning of drinking water and sanitation are the most critical ingredients for sustainability and development. Water is necessary for human life and well-being and is a key element of all human industry. Changing circumstances with respect to water cascade through the environment, every sector of every economy, and all social and political systems around the world. The global water crisis is not that there isn't enough water on Earth to meet all needs; it is a crisis of there not being enough water where we want it, when we want it, of sufficient quality to meet these needs. As described here, sustained shortages will increase intra-community and inter-sector competition over water, which can lead to conflict

An in-depth analysis of ten countries shows that the implementation of water and sanitation-related SDGs is an expeditious and cost effective way to achieve sustainable development. Prosperous countries will be those with planned access to enough water for food, cities, industry and nature. This report highlights the growing global divide between those nations that have well-managed water supplies, sanitation facilities and wastewater and those that that are unable to manage their supply-demand equation. Improvements in water governance and management are essential to close this divide and offer a means to sustainably meet the growing societal and environmental demands within and between nations and across multiple economic sectors.

The increase in the global wealth gap has implications for sustainable water management and sustainable development more broadly. As long as there are governments, corporations, and individuals out to protect only their own interests, wealth will continue to be ill-distributed, financial resources will remain inadequate, and vulnerable populations will continue to bear inequitable costs and consequences. Large economic engines held to have the greatest development benefits, such as the extractive resources sector and prioritization of large scale dams, have proven over time to come at sometimes great expense to both environment and society. This is exacerbated by, and contributes to, social inequalities as, for example, when large numbers of people are relocated or exposed to health hazards.

Access to WaSH and the level of WaSH services has a significant impact on the health of individuals and therefore on the health care system and broader economy. It is ironic that the need to deal with the impacts of a lack of basic services actually increases expenditure in other sectors and categories; for example it usually costs more to get water from informal private providers, health costs increase because waterborne disease is more prevalent, and the potential for human productivity is compromised. While WaSH is critical for public health, it plays a contributing role in many development issues, as in the case of maternal and infant mortality, and infection control more broadly. Progress in WaSH is reflective of the relative investments which it attracts, with

sanitation and hygiene lagging drinking water investments. In the spirit of "leave no-one behind", it is acknowledged that inequities exist, with vulnerable groups including public schools, girls, Indigenous Peoples and specific geographic regions within countries, however currently there is a lack of quantitative targets to address equitable access to WaSH.

In many instances, water pollution leads to lack of sufficient-quality water. When finite water availability is reduced by the volume that is so polluted that it is unfit for other uses, the volume remaining may not be sufficient to meet domestic consumption needs, satisfy energy and food demands, and at the same time support industry and growth. A clear example of this is the more than one billion people who are estimated to have access to improved drinking water sources and yet not to drinking water of sufficient quality for consumption. Use of appropriate sanitation and wastewater management interventions is the first step to protecting source water quality and reducing water quality degradation. Another critical requirement is management of harmful agricultural runoff. Improvements can be achieved through education and outreach, enforced regulations and incentives. Valuing waste as a resource is one such mechanism for ensuring collection and offsetting capital and ongoing costs, but it must be undertaken in a manner that protects human health. Treating wastewater prior to discharge or for recycling purposes can decrease operating costs for water treatment.

Changes in the composition of the atmosphere resulting in climatic instability; deleterious land use and land cover change; and, changing demographics, especially in low and middle income countries, have led to changes in weather patterns and the distribution of water over space and time, inviting questions as to whether there will be sufficient water to support increases in demand. It has been argued that we are in a new geologic epoch called the 'Anthropocene'; an era of unprecedented human influence on Earth system function. The global population is expected to reach over 9 billion by 2050. In addition to expanding urbanization, demographics are shifting as the number of people impacted by environmental degradation, natural disasters, conflict, and diminished livelihood options grows. Ninety percent of the world's young people live in developing countries. In other regions a growing proportion of the population will be considered elderly. Both groups — youth and the elderly — will require special consideration to ensure that water-related targets are achieved equitably. This is in addition to other vulnerable groups such as women, Indigenous populations, and the physically disabled.

True sustainability may be forever beyond our grasp if we do not do the right thing now. If we want a sustainable world by 2030 we have to catch up with, and reverse, global poverty before population growth and Earth system changes further destabilise our already weakened global economic outlook and make implementation of sustainable development goals unaffordable yet even more imperative. Development will not have to be simply sustainable. It will have to be restorative. It must also be recognized that the manner and rate at which water moves through the global hydrologic cycle are changing. Current risk assessments were built on confidence in relative hydrologic stability that may no longer exist. For example, the warming of our climate has altered the fixed envelope of certainty within which we anticipated natural phenomena to fluctuate. The results are being experienced through increased droughts, floods and other extreme climatic events, which affect the ways in which we live.

Water-related disasters, climate change/disruption, and social and economic development are inextricably linked. Not only do floods and droughts disproportionately impact the poorest and the marginalised in any society, they also exacerbate vulnerabilities and widen social inequality while at the same time slowing or even reversing economic growth and development. An increase in the frequency, intensity, and duration of extreme weather events brought about by human-induced changes in climate increases the number of people and the value of the infrastructure and property in harm's way globally. Thus a target for reducing water-related disasters is critical not just for ending poverty by 2030 but for the achievement of all other post-2015 sustainable development goals.

More comprehensive evidence-based information on weather and climate and the larger relationship between water and people, coupled with enhanced data management can make sustainable and equitable universal

access to services and resources possible. In turn this will lead to greater inclusion in decision-making at the watershed level, which is the fundamental unit for good governance and management of water. More inclusive decision-making, with the right people at the table at the right time, will result in greater popular support for water policy reform, more effective policies and increased investment leading to greater private sector engagement with confidence in investment leading to further economic growth. More efficient public and private sector water use will lead to greater national and global water food and energy security, and measurable disaster risk reduction which will enhance national, regional and local adaptability and resilience in the face of climate disruption.

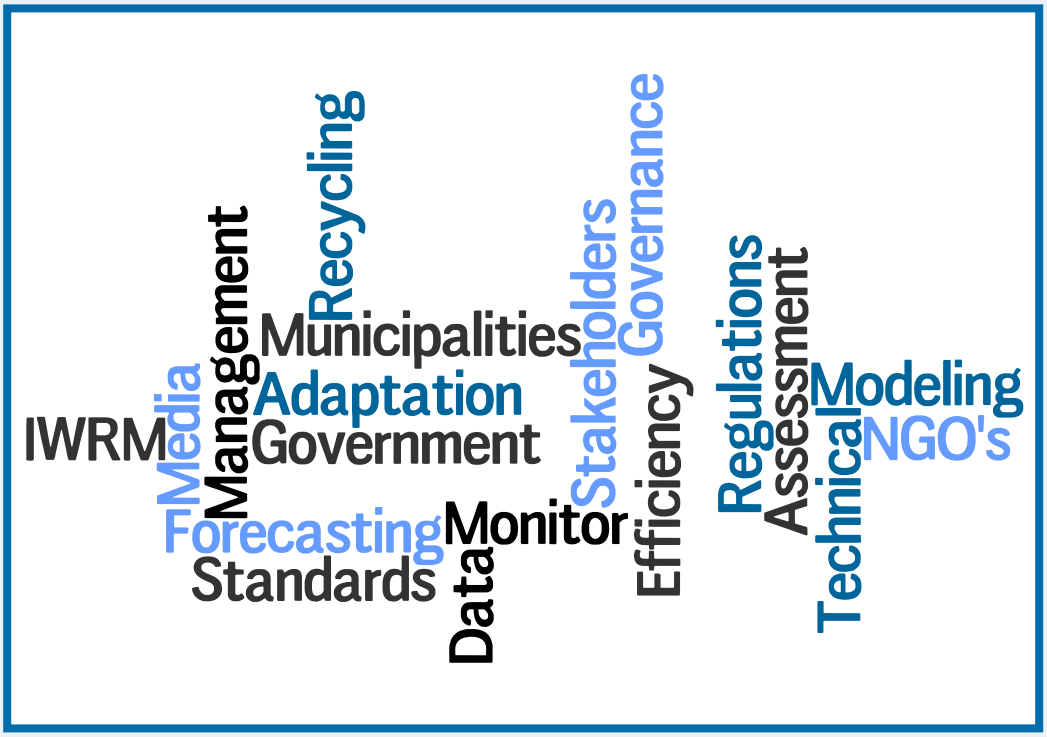
Every country must be willing to take sustainable development seriously by committing funds and supporting institutional resources and tools to the cause — including a major realignment of national economic priorities where needed. Now is the time to redress the imbalances that have perpetuated in the name of unsustainable economic growth. This will require that nations develop new mechanisms for transferring and sharing not only money, but also knowledge, data, technology, and "soft" solutions which have been proven in different contexts. Engagement of the private sector is critical in this transfer of technologies and know-how. Incubation hubs are needed to innovate and modify proof of concept responses so that they can be transferred into different contexts. Improved data collection and management systems are required that ensure availability of accurate, verifiable qualitative and quantitative data, when needed, to all bone fide partners at a level of detail required to be useful and used to inform water policy and practice. The improved data systems that are needed to achieve broader sustainability are now available.

The ten-country analysis in this report demonstrates that ambitious SDG targets being proposed must be matched by the requisite human, technological, institutional, and financial capacity. In the water sector in particular, individual and institutional capacity is not keeping pace with what is needed to meet and deliver these SDG targets, especially as it pertains to collection, management, and analysis of data. There is a significant mismatch between the investments that are needed to implement post-2015 sustainable development goals and the financial resources that are available to do so, demanding that existing available financial resources are used more efficiently and strategically. Waste and graft, which can be as high as 30 % of investments in the water sector, must be eliminated. Improving underlying pre-conditions for development and growth will make nations in need of sustainable development investments more attractive to existing and potential new donors and better qualify them to take advantage of innovative new financing mechanisms.

In many of the countries analysed in this report, comprehensive national water assessments have not been undertaken to date and, based on the expressed capacity gaps, cannot be undertaken until capacity improves. Ultimately, the pressing question to be answered is how nations can incorporate water into sustainable development frameworks in ways that remain achievable and which adhere to the principles of universality, equity, and sustainability. A lack of comprehensive national monitoring systems, analysis capacity, and capacity to develop reliable predictive models based on common principles all hinder this. As such, it is difficult to see how a global SDG structure can "take into account national realities, capacities and levels of development as well as respecting national policies and priorities" without outside assistance in improving capacity.

The balance between environment, human security, and economic viability will need to be articulated in a manner which holds all nations accountable for helping one another achieve the highest global standard for sustainable development, does not tolerate compromise, yet provides flexibility on the mechanisms by which to achieve those outcomes. The need for integration between water and other sectors emerged in this process as an essential pillar of sustainability, requiring complementary and/or interconnected targets. Divergences between individual country priorities and SDG targets on issues such as water quality and water-related hazards present an additional challenge for setting and meeting targets, but compromise could undermine the end goal of sustainable development.

GAPS AND OPPORTUNITIES IDENTIFIED THROUGH COUNTRY CASE STUDIES (APPENDIX III)



Ultimately, if multidimensionality of water is accepted and enabling environments are established to support financing and implementation of SDG solutions, it will be possible to close the gap between promise and practice in the management of global water resources. To optimise water and sanitation, a two prong approach to implementation is necessary. First we must catch up with existing problems and then get ahead of them. Even if money were no object, a critical barrier to implementation is identifying solutions to problems which are appropriate within physical, social, cultural and economic contexts, affordable and, sustainable in terms of operation, maintenance and replacement requirements. It is no longer acceptable to plan for, or finance, capital expenditures without due consideration of the full financial and social lifecycle costs and impacts associated with operation, management, maintenance, and replacement.

The cost of not leaving anyone behind is a critical consideration articulated through the country case studies to ensure necessary implementation mechanisms are in place. Facilitating dialogue that connects bottom-up country-level contributions to top-down global goal setting is critical for ensuring that the resources required exist and that implementation mechanisms are in place. Ultimately, everyone bears the burden of the moral and fiscal imperative to deliver on SDGs within a defined timeframe. If the development is to be sustained, serial market failures and economic collapses, Earth system change, and climate disruption must be recognised as a triple threat to human wellbeing and social and political stability. It is imperative that these goals be achieved during the prescribed timeframe.

RECOMMENDATIONS

- National governments must make sustainable advancements in **water, wastewater, and sanitation management**, supported by a dedicated and independent arm's length water agency, a high level policy **priority**.
- **Decisions for managing water at all scales must be evidence informed**, accounting for the multiple roles, uses, and demands on water and disposal of human waste and wastewater, as well as the way in which the distribution of water resources is changing, and expected to continue to change over time and space.
- Governments and all economic sectors must **eradicate corruption** through the establishment and implementation of clear and defined anti-corruption protocols, with meaningful consequences when the protocols are breached.
- **Capacity development** must be nested within, and form a pillar of, institutional reform at all scales within a country, with an emphasis on transferable skills that can be used for sustainable development across all areas and goals.
- **Governments, supported by relevant stakeholders, must commit to timely and transparent monitoring and reporting on SDG indicators** to monitor progress and hold the global community mutually accountable.
- There must be a national commitment to universal access to WaSH, linked to waste treatment and management, delivered through nationally coordinated and monitored multi-stakeholder response while recognizing and realizing the value in human and animal waste and wastewater wherever possible.
- The world must **identify, recognise, and account for water needs for planetary bio-diversity** based Earth system function and national governments must commit to ensuring continued viability and level of provisioning and regulating functions.
- National water governance and management must include a requirement to **balance supply and demand at the at the sub-basin level** for sustainability and disaster risk reduction, while recognising and protecting downstream users.
- Common **disaster risk reduction targets** need to be formally incorporated into post-2015 water- and sanitation-related sustainable development goals. These targets must permit the tailoring of actions to national realities.
- The **agriculture sector must be held accountable for water use efficiencies** and other system efficiencies which limit water demand while maintaining or increasing productivity, ensuring that women and small scale farm-holders are provided with the knowledge and technology to be able to play their part, thereby increasing income above poverty thresholds.
- The **energy sector must be held accountable for water efficiencies in energy** and a transition to clean energy, including hydropower, which does not compromise water quality, environmental integrity, community access, or disaster mitigation.
- **Water-dependent companies have a key role to play** in financing and implementing sound water, sanitation and wastewater management strategies and must step up to the plate or risk significant losses. This is no longer simply corporate social responsibility but sound economic strategy.
- **National governments, multi-national corporations, and international institutions must work together** to identify and implement strategies to equitably free up available existing resources.
- **Current expenditures must be more efficient**, freeing up and increasing returns on existing resources through integration of inter- and intra-sectoral activities that take advantage of economies of scope and scale.
- Subject to rigorous due diligence, national governments must **identify, explore, and utilise new and emerging financial sources**.

UN Photo, John Isaac

PART ONE

Sustainable Development, Water, and the Global Circumstance

The year 2015 will be critical for humanity. United Nations member states are set to agree on the Sustainable Development Goals (SDGs) that will guide social, environmental, and economic policy for decades to come. Of all our natural resources, water underpins sustainable development more than any other. Water is necessary for human life and well-being and is a key element of all human industry. The management of water is therefore the *sine qua non* of sustainability. Changing circumstances with respect to water cascade through every sector of every economy, and all social and political systems around the world.

Building upon "Catalysing Water for Sustainable Development and Growth"[1], which raised the question of "how we articulate water within sustainable development at the global level while remaining achievable at the national level", the purpose of this report is to examine the current and future narrative within the context of national priorities and development plans as they relate to water resources, WaSH (water, sanitation, and hygiene), wastewater, water for ecosystem services, water for economic activities, and water governance. Utilising information from ten countries around the world and expert consultations, the report examines i) potential disconnects between current national water status and planning and the proposed SDGs; and, ii) implementation needs and financing mechanisms currently anticipated at the national scale. These findings are used to articulate pathways forward towards implementation of SDGs at the national level by framing water as the entry and focal point for sustainable development. To this end, the report is intended as a resource for national SDG negotiators, implementers, and other sectors in order to aid understanding of the cross-cutting role and nature of water in social and economic development, and environmental management.

> *It is common to hear that water is essential for life on Earth. Without its meaningful and effective preservation, our ability to grow, advance and sustain ourselves, as a species, will grind to a halt. This project represents a conscientious attempt to bridge a critical knowledge gap, one which must be crossed if our broaching of sustainable water strategies and actions are to succeed, for without understanding how water is used, we may never fully comprehend how it can be saved.*
>
> *(Canada consultation, 2014)*

1.1. WATER AS A FOUNDATION FOR ECOLOGICAL STABILITY, DEVELOPMENT, HEALTH, AND HUMAN WELL-BEING

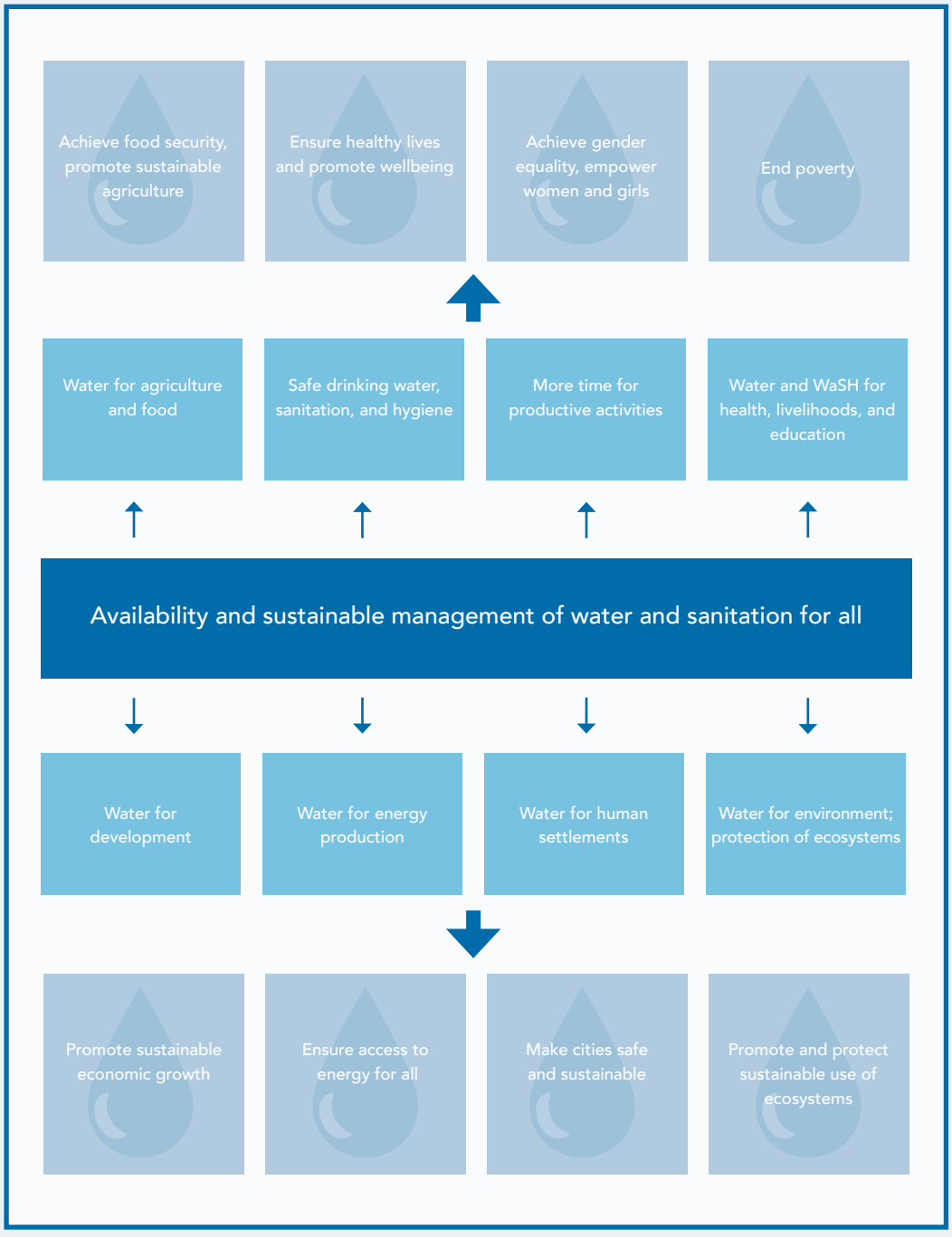
A strong link has been demonstrated between water resources development and economic development. Indeed, the Catalysing Water report highlights this dual role of water as a resource and a sector in its own right. As such, it is a right and a commodity, a necessity for human health and wellbeing and a key ingredient for economic productivity. Sensitivity to external pressures coupled with increasing scarcity and competition for its use puts water governance and management at a critical juncture as the world comes together to determine the post-2015 agenda (Figure 1).

The linkages between water, the environment, people, and the economy depend upon the level of national development and the water demands of priority sectors of the economy. As such, water management policies and strategies vary depending upon water supply, the degree to which social needs have been met, and the needs of individual economic sectors. Improvements in water governance and management can enable change, but only if a sustainable balance between the social and environmental demands on the resource and the needs of each economic sector is achieved. This is reflected in the recent report on the Role of Water in EU Development Policy[2] which called for the "mainstreaming of water into relevant policies and initiatives related to agriculture, energy, environment, health, education, gender, peace and security…". In this manner, raising the prominence of water in the development agenda can catalyse sustainable growth, thereby reducing poverty.

Historically, water development has consisted of large scale engineered solutions, such as large dams, reservoirs, canals, irrigation works, and water and wastewater treatment plants. Such infrastructure has improved lives and livelihoods through provision of electricity, secure drinking water supplies, and increased agricultural productivity, while at the same time reducing the effects of natural disasters such as floods and droughts. The benefits of industrial development and increased health and prosperity have, however, often been at the expense of the environment and individual communities. But there are also other infrastructure challenges. High cost, centralised water systems have proven to be a liability with vast amounts of buried infrastructure "hidden" out of sight and out of mind. These assets, and their degradation over time, constitute an infrastructure deficit that has not been taken into account when costing water. Consequently, unmet costs of infrastructure maintenance and replacement now pose a significant financial liability and burden on municipalities, state governments, and ultimately, end users. Getting the right balance between institutional capacity, infrastructure, and operation and maintenance is essential for sustainable development.

> *"Water is fundamental to all other development and has important explicit and implicit inter-linkages, making them mutually supportive."*
>
> *(Bangladesh consultation, 2014)*

FIGURE 1: TARGETS THAT RELY ON ACCESS TO WATER RESOURCES



Emerging and currently underdeveloped economies have an opportunity to leapfrog this traditional development trajectory by learning the lessons from previous development pathways and through an awareness of the benefits of combined soft- and hard-ware approaches to water governance and management practice. In this way, not only are economic advancements realised, but other benefits accrue through the protection and enhancement of economically valuable environmental services and optimised human productivity, which together constitute the true essence of sustainable development. With the world poised to adopt a new agenda of sustainable development, developing economies are afforded a comparative advantage in making the leap to a truly sustainable future, while, at the same time, developed economies have an opportunity to adopt leading edge approaches to sustainability.

Achieving water-related sustainable development will require broad partnerships, not only between all economic sectors, but also within the water sector itself. In addition to partnerships and alliances for financing, knowledge transfer and technological advancement, it should be emphasised that monitoring, and data collection and interpretation (including statistical analysis) form an essential foundation for implementing sustainable solutions and monitoring and evaluating meaningful change. This requires that policy, research, and practice are not seen as separate functions, but rather as integrated and coordinated so that they inform each other and the larger common good.

> *"Water has always played a key role in economic development, and economic development has always been accompanied by water development."*
>
> *(Pakistan consultation, 2014)*

1.2. FROM RIO TO NEW YORK: THE EVOLUTION OF THE SUSTAINABLE DEVELOPMENT IDEAL

In 1992, the world came together in Rio de Janeiro, Brazil, and committed to Agenda 21 (Appendix I) with the goal of addressing the interconnected environmental challenges of global warming, pollution and biodiversity and, social challenges of poverty, health, and population growth and mobility. For the turn of the millennium, a new set of goals were articulated that focused on poverty reduction. The eight goals, with associated targets, focused on education, malnutrition, gender equality, maternal health, child mortality, infectious diseases, the environment and global partnerships, and embodied basic human rights to health, education, shelter and security. Drinking water, sanitation, and water resources management fell under MDG 7 — the environment.

As the lifespan of the Millennium Development Goals (MDGs) approaches its end, the global community has begun its dialogues on how to build upon the achievements and momentum established by the original goals. The direction of this post-2015 agenda was catalysed by the United Nations Conference on Sustainable Development (Rio+20), which took place in 2012. The importance of expanding and refining global development goals to include not only poverty reduction, but also a sustainable balance between social development, economic growth, and environmental integrity was recognised by the UN General Assembly.

The outcome document from Rio+20, "The World We Want", prompted a series of parallel dialogues and processes including that of the Open Working Group and public consultations under "The World We Want 2015". These culminated in the UN Secretary General's report "The Road to Dignity by 2030"[3]. Attendant broad consultative processes led towards specific water-related dialogue, the outcomes of which included the Joint Monitoring Programme's WaSH goal and targets, which was rolled into the UN Water's recommendations on "Securing Sustainable Water for All"[4]. These processes and recommendations are detailed in the Catalysing Water report[5] and are underpinned by high level discussions in 2014 on the role and importance of data[6] and financing mechanisms[1].

1 The third Finance for Development Conference will be held in Addis Ababa, Ethiopia in July, 2015.

1.3. TAKING STOCK AND MOVING FORWARD

Since the start of the MDGs, over 2 billion people have gained access to improved drinking water sources[7]. However, this metric does not provide commentary on the quality of water accessed, or the continuity of access. If water quality is included as a metric, the real number of people without access to safe water would be almost 2 billion.[8] The metric also masks inequalities; geography, gender, and economic status, which all affect access. A similar pattern is seen in access to sanitation. However, in real numbers, access to improved sanitation lags that of drinking water, with 2.5 billion people living without access to improved sanitation. With a billion people still defecating in the open, the sanitation target is probably the most off track of all MDG targets. From a water management perspective, approximately 80% of countries are changing water management policies, but all are in various stages of planning versus implementation.[9]

Overall, progress in both WaSH and water management are reflective of the relative investments which they attracted. According to a 2014 report[10], two thirds of countries recognised the human right to drinking water and sanitation. While this improvement reflects strong political will, there is a general trend towards limited national capacity to define targets and to plan and implement water-related aspirations. This is coupled with insufficient national financing, particularly for operation and maintenance, even while overseas development aid to the water and sanitation sector has increased.

Despite the progress made under the MDGs, a number of short comings need to be addressed in moving into the post-2015 era. The first is the focus on developing economies. SDGs will clearly be global in scope, adhering to the principle of "common but differentiated responsibilities" as all countries have a role to play in reducing inequities and putting people and the environment at the centre of development. A second is the failure to deal with inequalities, which has led to the call for SDGs to "leave no-one behind". One legacy of the MDGs is that those left unserved tend to be marginalised individuals and / or populations for whom providing access may mean higher unit costs and a diminishing rate of return on investments. Even with an emphasis on prioritisation of the unserved, there is no guarantee that loss of those services and subsequent development reversal will not occur by way of natural disasters and subsequent water, energy, and food insecurities.

Finally, there is a need for co-emphasis on water management for social and economic development and for ecosystem function in order to overcome the mistaken prevailing view that development cannot occur except at the expense of the environment. While attempts were made to address the broader lack of integration across MDG goals, the absence of joint monitoring metrics and formal targets for meeting multiple MDGs prevented this from being realised. This gap can be addressed through "nexus" thinking and the inclusion of dimensions of economic growth, social development, and environmental management within and between goals and targets. More importantly, it emphasises the need for mutually reinforcing targets and compound indicators that demand the simultaneous achievement of more than one goal to achieve success. In this way, it is possible to catalyse action that appropriately reflects the "universal, integrated, and transformative nature of a sustainable development agenda" as called for by the UN Secretary General[11].

Moving forward, several sets of descriptive principles have been put forward to guide SDG development, articulation, and measurement. These principles have been characterised as follows:

- Global, universal, and sustainable;
- Context-specific and evidence-informed;
- National ownership, priority setting, and means of implementation within a framework of international solidarity;
- Action-orientated, measurable, achievable, and easy to communicate;
- Time-bound;
- Emphasising poverty reduction, inequalities, rights, demographic dynamics, governance, economic growth, conflict, and climate change and disruption; and,
- Multi-scale, multi-stakeholder partnerships.

With a view to achieving this end, the UN Secretary General has proposed six essential elements that need to be integrated into implementation of all sustainable development goals: people, dignity, prosperity, justice, partnership and planet.[12]

FIGURE 2: SIX TARGETS OF THE SDG WATER GOAL

Given the role of water as a key natural resource underpinning social wellbeing, economic prosperity, and environmental integrity, water is central to sustainable development and therefore must be placed at the centre of the post-2015 process (Figure 1). While the essential role of water in development is often recognised, its importance is not always measured, acknowledged, evaluated, and accounted for. While not always a central factor, aspects of water tend to have a contributing role in many development issues, as in the case of maternal and infant mortality, and other instances where WaSH access plays a critical role in public health and in disease and infection control. One of the criticisms of the MDGs is that they decoupled water and sanitation access from other targets and from health targets in particular. To be successful, SDGs must leverage the different roles of water into economies of both scope and scale, in areas as diverse as food and energy security, public health, and the growth of water-reliant economic sectors. That leverage must be applied in a manner that aids in management of trade-offs, risks, and uncertainties.

The adoption of a water SDG is an important first step to recognising the fundamental and implicit role of water in sustainable development, as articulated. The proposed water SDG comprises a diverse range of targets (Figure 2) and water is explicitly incorporated into a range of other goal targets, including management of waste, and health and well-being (Figure 3). Furthermore many more targets indirectly relate to achievement of the water goal, including ensuring efficiency of water use in industry and agriculture (Figure 4).

FIGURE 3: SDG GOAL TARGETS THAT EXPLICITLY INTEGRATE WATER

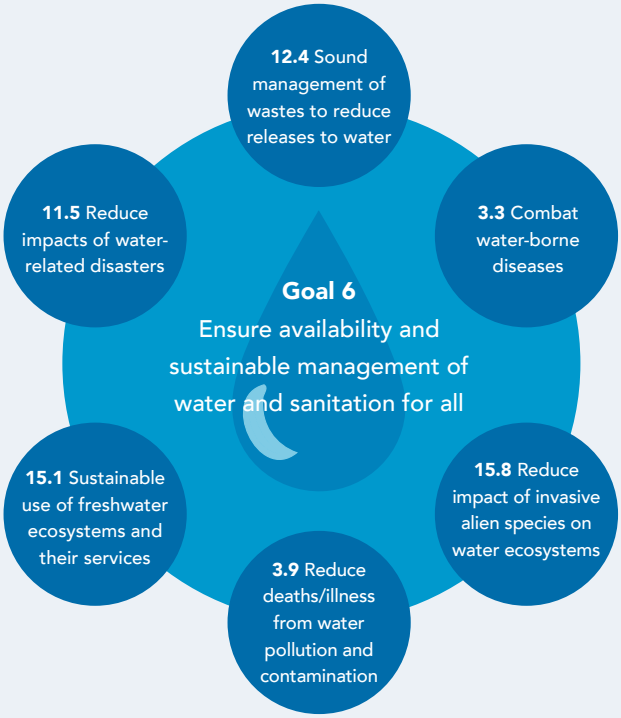
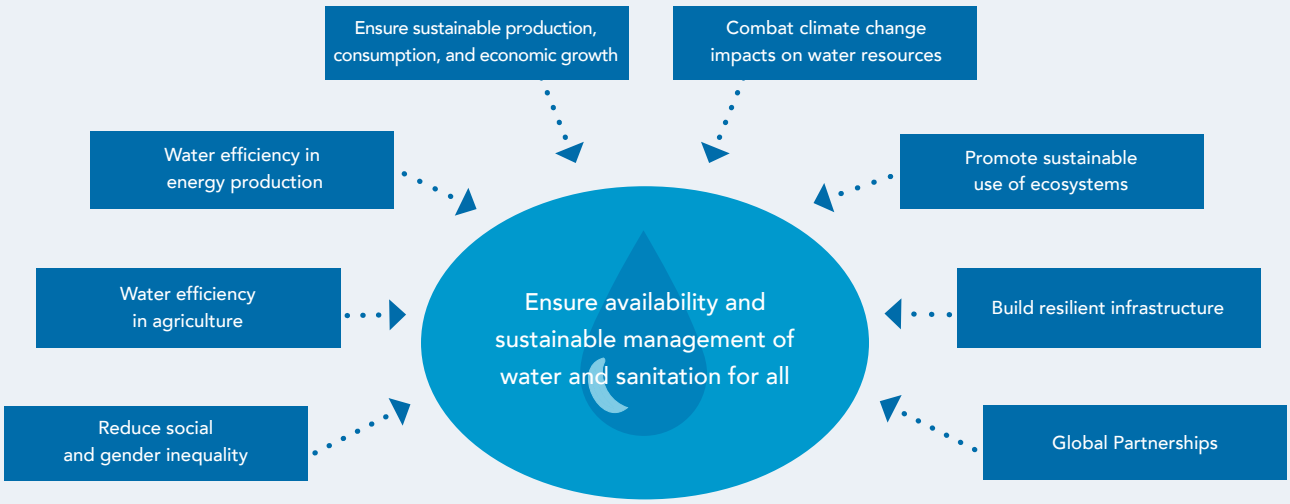


FIGURE 4: INDIRECT LINKS BETWEEN WATER AND OTHER SDGS



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PART TWO

The World We Have

Water cannot simply be defined discretely as a substance, resource, or sector, as it has often been described in the past, in attempts to simplify explanation of its uses and importance. While it appears to us as a substance, its substance is representative of the larger cycle through which it flows, lubricating all life processes, animating civilisations, and energising economies in ways that make life both possible and meaningful. Water comes to us simultaneously as both a substance and a system, a larger hydrologic circumstance that cannot be ignored by examining water in any of its singular forms.

The threat of a global water crisis is often mischaracterised as a lack of enough water to immediately meet all of humanity's diverse needs. The crisis is not that there is not enough water on Earth to meet all needs; it is a crisis of there not being enough water where we want it, when we want it, of sufficient quality to meet these needs. Five conditions of water scarcity have been identified: physical, economic, institutional, managerial, and political.[13] The fact that access to water can be impacted upon by so many external factors emphasises the vital interconnectedness to larger Earth system functions and societal wellbeing.

Systems theory, originating in biological sciences and analysis of ecosystem functions[14], has been applied to both physical (e.g. the Earth) and non-physical (e.g. urban) systems to explain inter-relationships, equilibrium, and function[15]. The

> *"Water connects several socio-ecological, economic, and geophysical systems at multiple scales and hence constitutes a "global water system".*[17]

Earth is a physical system in which everything, except energy, is contained within its boundaries. Solar energy drives the hydrological cycle which in turn determines where, when, and how much precipitation falls. In this manner fresh water should be viewed not just as a substance, but as a flow of mass, energy, and biochemical constituents through and between ecosystems and between the land surface and the atmosphere. Direct and indirect benefits of liquid water, water vapour, snow, and ice are realised across countries and across ecological and political boundaries, making productive and meaningful lives and livelihoods possible. Water is also both a mediator and transmitter of climate change and its impacts.[16]

However, the Earth is more than simply a physical system and more accurately described as a coupled socio-physical system[18]. Another characteristic of systems is that they scale, or nest, one within another. Thus our global system is made up of individual and overlapping ecosystems, large scale planetary cycles such as hydrologic and carbon cycles, and socio-political systems. Nested within these larger systems are river basins, the minimum unit at which water can be effectively and sustainably managed. As a result, the global water crisis spans multiple scales. With changes in planetary energy conditions affecting the global hydrologic cycle, weather and precipitation patterns are changing over space and time. These changes compound the cumulative impact of millions of local scale water issues which, in most cases, could be resolved through better water management. Instead, however, many of these local problems are being exacerbated by further climatic instability, land use and land cover change, and changing demographics. The global system is placed under greater and greater pressure as populations grow, migrate, urbanise, and becomes more prosperous. The need to grow more food, produce more energy, and increase luxury goods production will drive ever greater demand for water. The consequences of these trends include a need to grow 70% more food to meet population projections and changing diets as a result of increasing prosperity[19]. The ultimate consequence is that, by 2030, demand for water could be 40% greater than supply available[20].

It is challenging to predict the ways in which widespread human pressures are changing natural systems due to complex interactions and feedback between many processes. However, some researchers have suggested these changes may lead to "tipping points," where the Earth will transition to a new state as a result of human disruptions of biological systems.[21] Humans have shaped the Earth's processes to such a degree that some have argued for a new geologic epoch called the "Anthropocene"[22]; the era unprecedented human influence on Earth system function. In response to these enormous changes, some researchers have worked to identify "planetary boundaries" that must be maintained in order to avoid negative outcomes.[23] These discussions highlight the importance of understanding the range of water and water-related challenges facing diverse human populations in order to ensure that actions to mitigate these changes, including the process of working towards ambitious SDG targets, is equitable for all.

2.1. POPULATION GROWTH AND MIGRATION

Most studies cite population growth as the principal driver of increases in the global demand for water. Although there are uncertainties surrounding future population projections, research shows that the world population is likely to grow by 30% between 2000 and 2025 and by as much as 50% between 2000 and 2050.[24] The Earth's population growth passed 7 billion in 2011[25] and is expected to reach over 9 billion by 2050[26]. This growth has occurred disproportionately in low and middle income countries, where birth and death rates are high, as well as in urban centres, as many people migrate to rapidly growing cities to seek economic opportunities.

At a minimum, the fact that the global population is expected to grow at such an exponential rate invites questions as to whether there will be sufficient water to support population increases of this magnitude. The concern becomes more urgent when it is recognised that nearly all of this growth will occur in developing countries, many of which had inadequate or barely adequate supplies to support population levels that existed in 2000. In 1995, 450 million people lived in countries that were either deemed water scarce, in that they did not have adequate water supplies to meet the basic needs of their population, or water stressed, in that they did not possess adequate water supplies to meet the needs of all of their people for at least part of the year.[27]

Even if populations do peak as some studies predict, many critical changes in the world's population are occurring that will impact the implementation of a water SDG goal. As countries experience rapid urbanisation and the attendant growth of urban slums, providing water and sanitation services to households will require greater infrastructure investments and greatly enhanced service capabilities. As population growth slows and regions experience improved economic circumstances, the size of households is expected to shrink while the number of households increases. Connections and service points for water and sanitation, whether centralised or decentralised, will need to keep up with this change in household structure. In addition, 90% of the world's young people live in developing countries[28], while in other regions a growing proportion of the population will be considered elderly. These groups will require special consideration to

> *"Population has increased about 3-fold between 1965 and 2013, putting enormous economic and environmental stress on the system… It is unlikely that Singapore's urbanisation trend will reverse; on the contrary, it is actually expected to continue."*
>
> *(Singapore consultation, 2014)*

ensure that water-related targets are achieved equitably. In addition to expanding urbanisation, demographics are shifting as the number of people impacted by environmental degradation, natural disasters, conflict, and diminished livelihood options (often as a result of increased water stress) grows. Many such environmental refugees are migrating to other countries and regions, placing burdens on infrastructure and water resources and health systems in the host areas. Piggy backing on the movement of people, water-related infectious diseases can migrate into new regions and find ecological niches which favour their spread and endemicity.

2.2. LAND USE AND LAND COVER CHANGE

The expansion of agriculture and food production to ensure food security for growing populations is significantly impacting terrestrial and aquatic ecosystems. Deforestation to create agricultural land degrades ecosystem services and contributes to greenhouse gas emissions. Intensive agricultural practices also lead to ongoing loss of soil quality and quantity, and cause changes in the physical properties of soils that can reduce water infiltration and increase runoff. Decreased water infiltration and groundwater over-extraction can deplete aquifers, upon which so much agriculture depends, to the point of exhaustion. Increased runoff brings about its own set of challenges, including soil erosion and loss of soil nutrients as well as contaminant and nutrient outflows from agricultural land, which is the basis of large scale eutrophication of lakes and watercourses worldwide. Eutrophication has recently been identified as one of the most pressing environmental issues facing humanity in the 21st Century.[29] Land use intensification is frequently linked to a loss of natural habitats including vital wetlands, while farming marginal lands can facilitate the emergence of infectious disease. These trends are expected to continue, as many regions face growing demands for food and others implement food security measures through policies of self-sufficiency.

In countries with relatively rapid economic growth, the need to develop water resources for irrigation, energy, urban areas, and industry is negatively affecting ecosystem services provided by rivers, lakes, wetlands, and aquifers. There is no standard prescription for achieving a balance between development and conservation of the natural environment, but understanding of the relationship between ecosystems and livelihoods and the likely consequences of change is critical.

2.3. HYDRO-CLIMATIC DISRUPTIONS

Our climate is changing as a result of changes in the composition of the Earth's atmosphere which is altering the energy balance of the planet. Rising mean land and sea surface temperatures are affecting established global oceanic and atmospheric circulation patterns which in turn determine weather. Perhaps the most immediately visible evidence of climate change, however, is its effect on water in its various forms.

These effects include:

- Changes in the extent, duration, and distribution of global snowpack and snow cover;
- Loss of glacial ice, sea, and lake ice and diminishment of ice caps and ice sheets;
- Changes in intensity, frequency, duration, and timing of precipitation and therefore wet and dry seasons;
- Increased evaporation rates;
- Increased frequency of deep and persistent drought; and,
- Increased capacity of the atmosphere to carry water vapour, resulting in heavier rainfalls and more frequent flooding.

As a result, all current water management challenges will be compounded in one way or another by climate change. It will be important for decision-makers to understand how context-specific climate change impacts will cascade through all water-dependent sectors, with ramifications for food and energy security, livelihoods, and human wellbeing, regardless of levels of current prosperity and political stability. However, the most vulnerable will continue to bear the greatest burden, given that they possess the fewest resources to personally mitigate the potential impacts associated with changes in the manner and intensity with which water moves through the hydrologic cycle.

Past and projected climate change means that we can no longer rely on predictable weather patterns.[30] This historical predictability, known as relative hydrological stationarity, is why we expect that winters will be cold and summers hot; that rainy seasons start in the same month every year; that melt from winter snow will always contribute roughly the same amount of water to rivers; and, that in temperate climates, rivers will rise so high in the spring and fall so low in autumn. Stationarity provides the certainty that is needed to build houses to withstand winds of a certain speed, snow of a certain weight, and rainfalls of certain intensity and duration, when to plant crops, and to what size to build storm sewers. The consequence is that the management of water in all its forms in the future will involve a great deal more uncertainty than it has in the past.[31]

The loss of relative hydro-climatic stationarity makes the established bell curve of climate risk meaningless. In a more or less stable hydro-climatic regime you are playing poker with a deck you know and can bet on risk accordingly. The loss of stationarity is playing poker with a deck in which new cards you have never seen before keep appearing more and more often, ultimately disrupting your hand to such an extent that the game no longer has coherence or meaning. Parallels are being seen as a result of the recent global economic collapse whereby traditional growth forecasting models are proving over simplistic and inadequate in today's far more unpredictable economic climate[32]. As of yet, there is no adequate replacement for stationarity statistics in models. Until a new way is found for substantiating appropriate action in the absence of stationarity, risks will become increasingly difficult to predict or to price and as a result, "fundamental uncertainty must be incorporated explicitly into the policy formulation process"[33].

UN Photo, Evan Schneider

> *"Picture the sailors of yore, accustomed to guidance from the stars in the northern hemisphere, enduring a three-day storm that takes them into the southern hemisphere, where the stars are all different."*
>
> *(Stephen Poloz, Governor of the Bank of Canada, 2014)*

2.4. EMERGENCIES AND PENDING URGENCIES

We have known for some time that hydro-climatic hazards such as floods and droughts have the potential to trigger or exacerbate social tensions that may lead to intra- and inter-state conflict.[34] While conventional wisdom in water policy circles today has it that growing populations and climate change do not necessarily translate into increased water wars, the same wisdom does not apply to temperature. Higher temperatures have already resulted in lower precipitation in North Africa, for example, and this has led to diminished agricultural production, greater unemployment, and growing unrest, especially among younger males. Scientists have modelled the connection between temperature and conflict to demonstrate that conflict increases in lockstep with temperature. When conflict analyses and climate model data were assimilated, they projected a roughly 50% increase in armed conflict by 2030, with almost 400,000 additional battle deaths in Africa alone[35].

Superimposed upon this, is a local competition for water resources. When finite water availability is reduced by the volume that is so polluted that it is unfit for other uses, the volume remaining may not be sufficient to meet human needs, satisfy energy and food demands, and at the same time support industry and growth. The outcome points unerringly in the direction of intra-community and inter-sector competition over water which could lead to conflict.

To date, most transboundary water issues have resulted in cooperation, rather than conflict.[36] However, as competition for scarce resources increase, this may change. People do not have the luxury of living without water and when faced with a life or death decision, people tend to do whatever they must to survive. This is why water collection from Lake Turkana (Kenya) is undertaken armed, not only with a jerry can, but with a sub machine gun.[37] In this manner, changes in fundamental hydrology are likely to cause new kinds of conflict, and it can be expected that both water scarcity and flooding will become major transboundary water issues.

At present, it is estimated that perhaps 25% of the world's major river basins run dry for part of each year[38]. New conflicts are likely to emerge as more of the world's rivers become further heavily abstracted so that they no longer make it to the sea. The prospect of the kinds of floods that were witnessed in Pakistan and Australia in 2010 and on the Great

Pixabay.com. Hans Braxmeier

Plains of North America in 2011 and 2014, suggests that the destruction of upstream flood protection and the failure to provide adequate downstream flood warning will enter into global conflict formulae in the future. But is it not just floods that are likely to cause conflict. Prolonged drought, as was experienced in the Horn of Africa in 2011, suggests that tensions will rise on both ends of the hydrological scale.

In addition to competition and conflict, flood and drought emergencies invoke catastrophic human suffering and economic hardship. While globally per capita loss of life appears to be decreasing over time, vulnerable countries are likely to continue to experience significant loss of life and cumulative economic impacts which could set back development[39]. Even in regions where loss of life is low, financial costs will continue to increase in direct relationship to the increasing frequency and intensity of extreme events and the value of the infrastructure and property that is damaged in those events, placing a greater burden on governments at all levels, the insurance sector, businesses, and individual property owners.

Because of the recent economic meltdown, some societies and governments maintain that economic recovery cannot be sustained if climate change mitigation is pursued too rapidly. However, this argument does not hold up in the face of rising costs and impacts of more frequent flooding and deeper and more persistent drought. Indeed, the costs of mitigation and adaptation are arguably far less onerous than persistently borrowing and accruing fiscal deficits in the wake of flood, drought, and fire disasters. As a case in point, in 2013 alone, global flood-associated damages were more than US$53 billion and total flood damage costs since 2004 exceed US$312 billion.[40]

2.5. WINNERS, LOSERS, AND TRADE-OFFS

It is projected that the number of water-scarce countries could grow to 29 and the number of water-stressed countries is anticipated to rise to 19 by 2025[41]. The combined population of these 48 countries is estimated to be 2.9 billion[42]. In addition, economic development is likely to fuel increased demands for water both directly, as in the growth in water-consuming industries, and indirectly, in the form of dietary and other lifestyle changes which tend to be more water consumptive. A study of 92 developing countries[43] shows that, as higher incomes drive improvements in diets around the world, as much as an additional 5,200 cubic kilometres of water may be needed annually for agriculture alone by 2050. Growth of agricultural water demand of this magnitude will put enormous pressure on existing water supplies in many parts of the world, leaving little left to support natural ecosystem functioning or other essential ecosystem services.

There is some urgency in responding to this important global trend. It is now recognised that in order to provide water and other benefits to people, nature needs water too. Water allocated to the environment is critical in supporting the production of ecosystem services and biodiversity. The failure to supply adequate water for environmental services could result in a decline in the capacity of the environment to provide food and to support modern agricultural practices. The continued reallocation of water away from environmental support towards agriculture and other consumptive uses may in fact threaten the carrying capacity of the Earth itself.

Unfortunately, however, a full 40% of humanity is already competing directly with nature for water.[44] As a result, we are beginning to see some frightening convergences. If nature is to have the adequate amount of water it needs in order to provide important basic ecological services, then less water will be available for agriculture, which means that there will not be enough food for people. If, on the other hand, priority for water allocation is given to agriculture in order to sustain growing populations, then there will not be enough water to allow nature to sustain its fundamental, long-term, planetary, life-supporting functions and self-regulation.

This explosive fault-line is likely to widen across the entire 21st Century political, social, and economic landscape. Without meaningful sustainable development goals, tensions will grow between those who control upstream water flows and downstream neighbours who do not receive all the water they need to sustain life, cities, and industry, and to ensure food and energy security. The only way to ensure the success of sustainable development is to invest in mechanisms of global compromise and wealth distribution through application of green economy strategies and the principles by which the sustainable development concept derives both its moral credibility and economic validity. Several multinational corporations have already seen the value in this approach to business through shared values[45]. Investments in local capacity, technological transfer, and economic growth has provided a win-win through local development, more secure market chains, and reduced transportation costs. Thus social development and environmental consideration are not divorced from, but embedded within, the broader business ecosystem.

George Hodan

PART THREE

Learning from National Priorities and Strategies

Given that efficient management of water, and related sanitation and wastewater, is central to sustainable development, and that successful implementation of the sustainable development agenda requires governments to play an important role, it is critical to understand how implementation of SDGs at the country level may occur. In order to advance understanding, information on current existing and future plans for various water purposes for ten countries was collected by local in-country water experts (Appendix II). The information was synthesised in order to bring the current context to bear on future setting of national SDG targets to meet global goals, identifying and addressing potential implementation challenges, and providing an enabling environment for advancing implementation under the post-2015 agenda.

The Catalysing Water report called for implementation of water-related SDGs to be linked to existing national development strategies and built upon comprehensive national water assessments. What is clear from this study is that very few countries, if any, include all aspects of water as expressed in the SDGs within current national plans. Critical missing elements tend to be water for ecosystem services, disaster risk reduction, and wastewater treatment. Moreover, comprehensive national water assessments have not been undertaken to date and, based on the expressed capacity deficits, cannot be undertaken within the current context. A lack of comprehensive national monitoring systems, analysis capacity, and capacity to develop predictive models, all hinder this. **As such, it is difficult to see how a global SDG structure can "take into account national realities, capacities, and levels of development as well as respecting national policies and priorities"[46].**

COUNTRIES STUDIED

Bangladesh
Bolivia
Canada
Indonesia
Korea, Republic of
Pakistan
Singapore
Uganda
Vietnam
Zambia

Pixabay.com, Frauke Feind

The countries included in this study experience diverse environmental and economic conditions that impact quality and quantity of water resources (Table 1). These include challenges associated with land-locked conditions, water scarcity, delta environments, and managing resources for small islands. Several countries experience specific challenges, for instance Bangladesh reports high arsenic levels in groundwater affecting 30-35 million people and there is an increasing trend in groundwater salinity observed in coastal districts. Pakistan experiences water scarce conditions, with over 75% of the land surface receiving less than 250 mm of rainfall annually and 20% of the country receiving less than 125 mm, with high variability. Thus, the population and economy heavily depend on the Indus basin, and the country reports high water stress indicators, high ecosystem deterioration, and extremely low water use efficiency. Indonesia's size and island structure makes water resources management uniquely complex, impacting water security and linked goals such as food and energy security. While groundwater resources are available in Uganda, water for food production is a priority because the majority of the population relies on agriculture for livelihoods, which is generally rain-fed. Similarly, other low income countries use large amounts of water for agriculture, with Zambia and Bangladesh consultants reporting agricultural use at 73% and 88% of all water withdrawals, respectively.

TABLE 1: PHYSICAL, GEOGRAPHIC AND ECONOMIC CHARACTERISTICS OF STUDIED COUNTRIES

COUNTRY	ECONOMIC CLASSIFICATION*	2013 GDP PER CAPITA (USD) *	2013 POPULATION (USD MILLIONS) *	2013 HDI RANKING	TOTAL AREA ('000 SQ KM) **	ARCHIPELAGO	LAND LOCKED	CLIMATE	TERRAIN
UGANDA	LOW	572	37.58	164	241		X	TROPICAL	PLATEAU WITH RIM OF MOUNTAINS
BANGLADESH	LOW	829	156.6	142	144			TROPICAL	FLAT ALLUVIAL PLAIN; HILLY IN SOUTHEAST
ZAMBIA	LOWER MIDDLE	1,540	14.54	141	753		X	TROPICAL	HIGH PLATEAU WITH SOME HILLS AND MOUNTAINS
PAKISTAN	LOWER MIDDLE	1,299	182.1	146	796			DESERT/ARCTIC	FLAT INDUS PLAIN IN EAST; MOUNTAINS IN NORTH AND NORTHWEST; BALUCHISTAN PLATEAU IN WEST
VIETNAM	LOWER MIDDLE	1,911	89.71	121	331			TROPICAL	LOW, FLAT DELTA IN SOUTH AND NORTH; CENTRAL HIGHLANDS; MOUNTAINS NORTH AND NORTHWEST
BOLIVIA	LOWER MIDDLE	2,868	10.67	113	1,099		X	TROPICAL/SEMIARID	RUGGED ANDES MOUNTAINS WITH A HIGHLAND PLATEAU (ALTIPLANO), VALLEYS, LOWLAND PLAINS OF THE AMAZON BASIN
INDONESIA	LOWER MIDDLE	3,475	249.9	108	1,905	X		TROPICAL	COASTAL LOWLANDS; SOME ISLANDS HAVE INTERIOR MOUNTAINS
KOREA	HIGH	25,977	50.22	15	100			TEMPERATE	HILLS AND MOUNTAINS; WIDE COASTAL PLAINS IN WEST AND SOUTH
CANADA	HIGH	51,958	35.16	8	9,985			TEMPERATE/ SUBARCTIC/ARCTIC	PLAINS WITH MOUNTAINS IN WEST AND LOWLANDS IN SOUTHEAST
SINGAPORE	HIGH	55,182	5.4	9	0.697	X		TROPICAL	LOWLAND; GENTLY UNDULATING CENTRAL PLATEAU CONTAINS WATER CATCHMENT AREA AND NATURAL PRESERVE

* World Bank. 2013. Country Classifications. *http://data.worldbank.org/news/new-country-classifications*

** UN Data (2014) World statistics pocketbook country profiles. Available online *https://data.un.org/CountryProfile.aspx*

Transboundary water resources are a challenge in several countries included in this study, including lake and river systems in Uganda and Vietnam. Vietnam has 13 major river basins with large catchment areas; however water resources in 10 of these rivers depend on water inflows from other countries. In particular, 18 million people live in the Mekong River basin, where almost 89% of the average yearly surface water flows are generated in upstream countries. In high income countries, more options are available for water resources. For instance, Singapore relies on water supplies from local catchments, imported water, reclaimed water, and desalinated water. The diverse water situations in each of the country case studies (Table 2) highlight the need for country involvement in setting relevant SDG targets.

Ultimately, the pressing question to be answered is how nations can articulate water within sustainable development in a way that remains achievable and which adheres to the principles of universality, equity, and sustainability.

3.1. DISCONNECTS

Differences exist between current country priorities for future development and the proposed Open Working Group goals. Divergences between individual country priorities on issues such as water quality and water-related hazards present an additional challenge for setting targets. However, setting targets that are not ambitious enough due to differences between country situations is a concern.

TABLE 2: WATER RESOURCES IN STUDIED COUNTRIES*

	SURFACE WATER PRODUCED INTERNALLY (10^9 M³/YR)	GROUNDWATER PRODUCED INTERNALLY (10^9 M³/YR)	LONG-TERM AVERAGE PRECIPITATION IN DEPTH (MM/YR)
BANGLADESH	536	135	2666
BOLIVIA	25996	12183	1146
CANADA	80723	10517	537
KOREA, DEM. REP.	2651	522	1054
INDONESIA	7896	1831	2702
PAKISTAN	260	302	494
SINGAPORE			2497
UGANDA	1038	772	1180
VIET NAM	3523	779	1821

*FAO. 2014. AQUASTAT database — Food and Agriculture Organization of the United Nations (FAO).

In addition, it is important to consider that country priorities can, and often do, shift during the course of a long time period. For example, during the tenure of the MDGs, climate change became a greater issue of concern. Finally, it is not just government actors, but other stakeholders, who may have divergent priorities and, as such, a diverse range of actors must be accountable for achieving targets, including the voluntary and private sectors.

WaSH

Access to WaSH and the level of WaSH services has a significant impact on the health of individuals and therefore on the health care system and broader economy. It is ironic that the need to deal with the impacts of a lack of basic services actually increases expenditure in other sectors and categories; for example, it usually costs more to get water from informal private providers, health costs increase because waterborne disease is more prevalent, and the potential for human productivity is compromised. Countries have wide-ranging needs and very different starting points when it comes to WaSH. For example, Bolivia's aspirational goals of achieving 100% access to water and sanitation in urban areas, rural areas, and schools will require much greater effort focused on sanitation, with a starting point of 58% coverage. Moreover, significant disparities exist in service, even when considering improved versus unimproved access, which as previously stated, has little bearing upon water quality and continuous access. As can be seen from Table 3, universal access in households, schools, and health facilities is a current aspirational goal for both urban and rural contexts in several countries, and others aspire to achieving 90% coverage in both drinking water and sanitation. However, these aspirations do not specifically deal with open defecation, despite rates in some countries of up to 30%. In general, there is a lack of information on aspirational targets in many of the studied countries. In the spirit of "leave no-one behind", it is acknowledged that inequities exist, with vulnerable groups including public schools, girls, Indigenous Peoples, and specific geographic regions within countries. However, there is a lack of quantitative targets to address equitable access to WaSH.

WASTEWATER TREATMENT

The country data highlight several potential disconnects between country starting points, what they hope to achieve, and what they may be expected to achieve under the SDGs. The first disconnect is between the amount of wastewater collected versus treated. The proposed SDG target refers to "halving the proportion of untreated wastewater and increasing recycling and safe reuse"[47]. However, countries such as Uganda have development aspirations to expand sewerage to 30% of urban populations. Unless there is a commensurate target to treat all of this waste, environmental benefits will not accrue and human health benefits will be short lived, as watercourses continue to be contaminated with human and industrial waste. On the other hand, countries such as Singapore are already committing to expanding and sustaining wastewater treatment services at 100%. What does all of this mean for a specific target on wastewater? How can the simultaneous needs of the environment (i.e. reduction in eutrophication of waterways), people (i.e. reductions in waterborne diseases), and the economy (i.e. savings in water treatment costs for consumption and industrial use), be met when countries have such disparate starting points?

ECOSYSTEM SERVICES

It is clear from country responses that ecosystem services, and investment in maintaining and / or rehabilitating ecosystems such as wetlands and forests, are not a priority. It is equally clear that these services, while difficult to account for, provide significant economic benefit, from food stocks to water purification and flood mitigation. Indeed, the value of these services have been estimated to exceed $33 trillion per year[48], with wetlands, rivers, and lakes contributing services valued at between $1,500 and $3,000 per hectare annually[49]. This is an example of a target which, given current levels of investment and interest, could end up falling victim to the desire to streamline the number of goals and targets. However, from a sustainable development perspective, ecosystem services are the embodiment of a sustainable environment, not only accruing benefit, but as an indicator of environmental health.

TABLE 3: ACCESS TO WATER & SANITATION ASPIRATIONS A) RURAL AND B) URBAN*

A) RURAL						
	ACCESS TO IMPROVED DRINKING WATER (%)	ACCESS TO PIPED ON PREMISES WATER (%)	IMPROVED SANITATION (%)	PRACTICE OPEN DEFECATION (%)	TARGETS: ACCESS TO DRINKING WATER (%)	TARGETS: ACCESS TO SANITATION (%)
UGANDA	71	1	34	9	80	90
BANGLADESH	84	1	58	3	100	100
ZAMBIA	49	2	34	25	100	90
PAKISTAN	89	23	34	34	90	90
VIETNAM	94	9	67	26	100	100
BOLIVIA	72	57	24	49	100	100
INDONESIA	76	8	46	31	100	100
KOREA, REPUBLIC OF	88	64	100	0	90	-
CANADA	99	-	100	0	-	-
SINGAPORE	N/A	N/A	N/A	N/A	N/A	N/A

* The aspirational target data are reported by country consultants, originating from a range of publicly accessible sources. In some cases targets indicate that countries want to maintain 100% coverage with growing populations (e.g. drinking water and sanitation in Singapore). Additional aspirational country targets such as water and sanitation access in schools and healthcare facilities (e.g. Bangladesh), water quality (e.g. Vietnam), reducing open defecation (e.g. Indonesia) or increasing the percentage of the population with more advanced treatment of tap water (e.g Korea) are not shown in this table.

Source: Progress on sanitation and drinking-water — 2014 Update, World Health Organization and UNICEF, 2014.

B) URBAN						
	ACCESS TO IMPROVED DRINKING WATER (%)	ACCESS TO PIPED ON PREMISES WATER (%)	IMPROVED SANITATION (%)	PRACTICE OPEN DEFECATION (%)	TARGETS: ACCESS TO DRINKING WATER (%)	TARGETS: ACCESS TO SANITATION (%)
UGANDA	95	23	33	2	100	100
BANGLADESH	86	32	55	0	100	100
ZAMBIA	85	36	56	2	100	100
PAKISTAN	96	58	72	4	100	100
VIETNAM	98	61	93	0	100	100
BOLIVIA	96	95	57	5	100	100
INDONESIA	98	94	71	14	100	100
KOREA, REPUBLIC OF	100	99	100	0	-	-
CANADA	100	100	99	0	-	-
SINGAPORE	100	100	100	0	100	100

DISASTER RISK REDUCTION

There are direct links between water-related disasters and public health and economic prosperity. Given the increasing frequency and intensity of high impact and extreme weather events which result in floods and droughts and which can indirectly lead to other natural disasters such as landslides and storm surges, protection against losses in both economic and human terms becomes an imperative.[50]

Importantly, these kinds of events might reverse development even in the most highly developed countries, thereby reducing or threatening prosperity. The fact is that it is already happening sub-nationally in these countries, for example, flooding on the Canadian prairies is becoming a development issue. Following flooding in 2011, researchers were of the view that the region may have crossed an invisible threshold into a new hydro-climatic regime and that this new regime could, over time, bankrupt Canadian provinces such as Manitoba. For example, the total cost of flood damage in 2011 combined with disaster relief was $1billion dollars[2] which contributed significantly to the province's 2012 deficit. Only three years later, in 2014, the region suffered another major flood event. While it is still too early to calculate the full cost of flood damage in 2014, once again it is likely to reach $1 billion. These have directly impacted economic and political stability, through the implementation of an unpopular increase in the provincial sales tax deemed necessary to catch up with and great ahead of the infrastructure damage caused by recent flooding, and the consequent resignation of political leaders.

The 2010/11 floods in Pakistan resulted in damage to almost 4,000 km of roads and over 5,600 km of railway track, with repair costs for this transportation infrastructure alone estimated to be over $470 million.[51] In terms of human costs, more than 2,500 people died, 27 million people were displaced, and over 1 million homes were rendered uninhabitable. The agriculture sector was affected by the drowning of 200,000 livestock and the destruction of over 2 million hectares of crops. Moreover, almost 7 million hectares of fertile cropland went unseeded. Overall economic losses were estimated at $7.4 billion.[52] [53] The magnitude and frequency of these flood disasters have set back national development and undermined economic growth. In contrast, the Government of Pakistan plans to invest approximately $65 billion in disaster risk reduction to 2030.[54]

2 This excludes law suits totaling more than $1 billion, brought forward by rural households whose properties were flooded in order to protect and minimise damages in proximal high population centres.

The exposure of more assets to hazards means that economic losses from disasters are expected to increase rapidly.[55] Based on 2013 US dollar values adjusted for gross domestic product, it is projected that potential economic losses due to disasters by 2030 could be as high as 161% more than they were in 1980. Without meaningful global action on disaster risk reduction as many as 325 million already poor people living in 49 countries will be exposed to a full range of water-related disaster threats and climate extremes by 2030.[56]

The extent of the impact of water-related disasters on development varies depending upon whether disaster is brought about rapidly, as in the case flooding, or if its onset is gradual, as in the case drought. The extent of impact also depends upon the degree of readiness and resilience that exists at the household and community level in impacted areas. Much more needs to be known about the state of readiness and resilience at the country level. There is a need for countries to rank their own pre-existing state with respect to vulnerability to water and water-related social and economic shocks. It is estimated that there are recorded data on economic losses associated with only 49% of disasters that have taken place in high and middle income countries globally. The situation, however, is far worse in low income countries where data related to economic and other losses exists for only 15% of disasters.[3] In addition to self-assessment of vulnerability it is critical to improve forecasting particularly of events that threaten large scale loss of life such as droughts and large floods.

In cases where flooding as a result of extreme weather events is a major risk, improved flood management at the basin scale and investment in flood defenses can reduce impacts, provided that hydro-climatic change is taken into account. Full understanding of the larger risks, however, will require modelling. For instance, the insurance industry has developed significant capacity in probabilistic catastrophe modelling to calculate risks at the scale of individual cities. A far less expensive, and often more practical, way to model risk involves employing "proxies" such as hazard maps to model vulnerability and exposure. In the case of water-related disasters, however, there is no uniform agreement on which parameters should be employed for example in creation of


UN Photo, Evan Schneider

flood plain maps. Even the most sophisticated risk analysis, however, is by necessity based on the climatic conditions that have existed over the past century, not on the hydro-climatic circumstances that have begun to appear and are expected to come into existence in the coming decades. The risk assessment tools that exist today apply to climatic conditions that will not exist in the future. Until the composition of our planet's atmosphere is somehow stabilised, the calculation of disaster risk will remain a moving target.

FINANCING

Disconnects were also identified in financing, with many information gaps in both anticipated costs (Table 4) and financing mechanisms (Figure 5). From an equity perspective, the issue of whether the global community should contribute financially to countries that cannot meet globally agreed goals and targets must be considered. Financing the diverse range of proposed targets is likely to be a challenge due to interest in large-scale infrastructure projects over other less tangible investments. However, possible "win-win" solutions can be

3 Mitchell, T., Guha-Sapir, D., Hall, J., Lovell, E., Muir-Wood R., Norris, A., Scott, L. and Wallemacq, P. 2014. Setting, measuring and monitoring targets for reducing disaster risk. Recommendations for post-2015 international policy frameworks. ODI.

explored, such as investments in "ecological infrastructure" to address several targets concurrently. Alternative financing mechanisms should be considered in addition to traditional approaches. Mechanisms such as payment for ecosystem services and certifications for companies investing in green technology have already been successful.

Water and the financial resources to manage it sustainably share a common characteristic. There is likely enough of both in the world to sustainably meet humanity's needs but neither are reliably found when they are needed, where they are required, and in the amounts necessary to satisfy all the potential ends to which they could positively serve. There are two major funding problems that need to be overcome. The first is the existing global water and wastewater infrastructure maintenance and replacement deficit which has been estimated at $200 billion per year, with the US requiring $1 trillion alone.[57] The second is the financing of the implementation of the post-2015 sustainable development goals as they pertain to water. It has been estimated that global investments required to implement water system-related sustainable development will range from approximately US$1.25 to $2.25 trillion dollars per year for 20 years. This investment translates into between 1.8 and 2.5% of the global gross domestic product over the coming 20 years which is three times the current median annual investment in water, sanitation, and health of 0.73% of global GDP. The benefits that would be brought about by this level of investment, however, would be commensurately large. Based on available data related to immediate cost savings such as those generated through system efficiencies — and not counting health savings and added ecosystem service benefits — investment at this level would generate a minimum of $3.11 billion in additional benefits.[58]

TABLE 4. PLANNED PER CAPITA EXPENDITURES

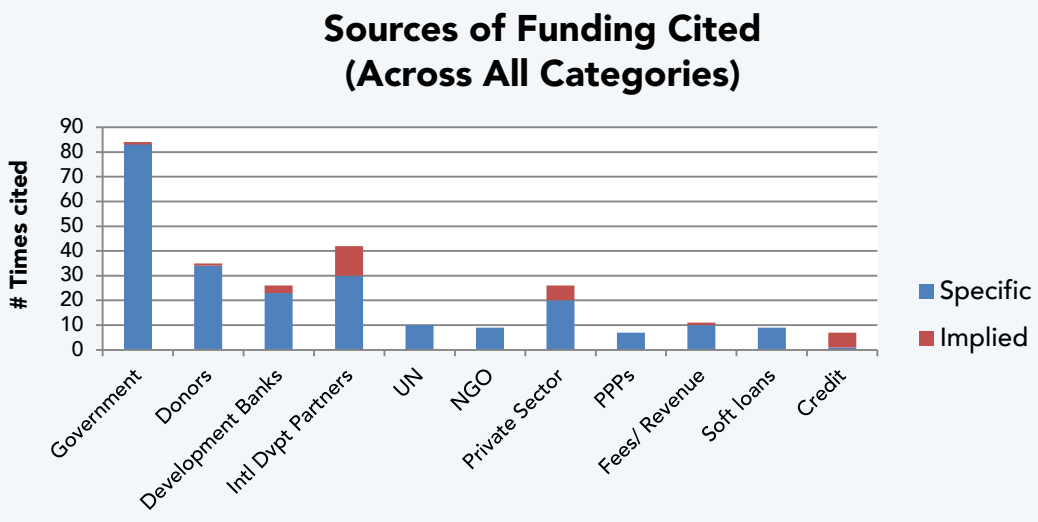
	PER CAPITA PLANNED EXPENDITURES (USD)									
	POPULATION (MILLIONS)	GDP / CAPITA	WATER RESOURCES	WASH	WATER MANAGEMENT	WATER QUALITY	DISASTER	WATER GOVERNANCE	TOTAL EXPENDITURE /CAPITA	TOTAL EXPENDITURE (MILLIONS)
UGANDA	37.58	572	6.5	20.9	8.5	0.4	1.3	1.5	38.9	1,460
BANGLADESH	156.6	829	333 TO 499	37.7	174.6				628.5	85,430 TO 111,420
ZAMBIA	14.54	1,540							-	-
PAKISTAN	182.1	1,299	557.4	93.9	203.7	22.0	65.9	0.2	943.1	171,738
VIETNAM	89.71	1,911		33.4					33.4	3,000
BOLIVIA	10.67	2,868	6.5	2.4					8.9	333
INDONESIA	249.9	3,475	100.0	210.0					310.0	77,479
KOREA	50.22	25,977		67.3	2,542.7	1,480.1			4,090.1	205,407
CANADA	35.16	51,958	11.8	3.5	33.1	6.3	22.3	8.6	85.6	3,010
SINGAPORE	5.4	55,182							-	-

*These data are reported by country consultants, originating from a range of publicly accessible sources

At present nearly one billion people in the world live in absolute poverty without formal access to water and sanitation. Even if current Official Development Assistance (ODA) pledges that constitute the bulk of traditional aid to developing countries were honoured, there would still be inadequate financial resources to achieve the post-2015 sustainable development goals. Moreover, the cost of climate disruption is rising so dramatically in some areas that it threatens to reverse hard won development gains. New funding streams are therefore required both to maintain and protect existing water infrastructure and to build sustainably on what already exists in the future. Financing post-2015 development goals will require a two-pronged approach — the first being the enhancement of the impact of already available resources and, the second, to find ways to add to these resources[59]. However, current national plans may hinder uptake of new funding streams. As can be seen from Figure 5 and Table 5, most countries currently rely on traditional funding sources for meeting planned aspirational targets. These typically include government funds, donors, development banks, and private sector. Interestingly different funding sources are prioritised for different water-related activities. For example, funding sources sought for water resources activities are predominantly government, donor, and development banks. Financing for WaSH and disaster mitigation activities favours government, donor, and international development partners, while financing wastewater activities is predominantly seen to be the responsibility of governments and the private sector.

Simply increasing public spending provides no guarantee that a given country will be able to meet its sustainable development goals if it suffers from poor or corrupt governance. Meeting post-2015 sustainable development goals relating to water and sanitation will demand that existing available financial resources are used more efficiently and strategically and that waste and graft, where they exist, are eliminated. Improving underlying pre-conditions for development and growth at the national level will make nations in need of sustainable development support more attractive to existing and potential new funding sources. A growing range of new sources and tools are now emerging.

FIGURE 5: CATEGORIES OF FUNDING SOURCES CITED



*These data are reported by country consultants, originating from a range of publicly accessible sources

TABLE 5: FINANCING SOURCES IDENTIFIED, BY COUNTRY (NUMBER OF REFERENCES)

	GOVERNMENT	DONORS	DEVELOPMENT BANKS	INTL DVT PARTNERS	UN	NGO	PRIVATE SECTOR	PPPS	FEES/ REVENUE	SOFT LOANS	CREDIT	TOTAL
UGANDA	8	8		3		6	5		2			32
BANGLADESH	25	1	8	27	4			1				66
ZAMBIA		2	15	2	6	3	6			6	6	46
PAKISTAN	9	23		8			4					44
VIETNAM	2	1	1	1			2	1			1	9
BOLIVIA	3	7	3		3	15					2	0
INDONESIA	5		2	1			1			3		12
KOREA	7						3	1	3			14
CANADA	22											22
SINGAPORE	6						5	4	6			21
TOTAL	**84**	**35**	**26**	**42**	**10**	**9**	**26**	**7**	**11**	**9**	**7**	**266**

*These data are reported by country consultants, originating from a range of publicly accessible sources

3.2. INTEGRATING WATER TARGETS WITH OTHER GOALS

The need for integration between water and other sectors emerged as an essential pillar of sustainability. There needs to be complementarity with targets used in other sectors, such as energy. This is critical as many of the SDGs are interconnected, and attaining many proposed targets will rely on access to water resources while success of the water targets will depend on water efficiencies under other goals. In addition to complementary targets, an integrative approach will allow more cohesive monitoring (including co-ordination between existing frameworks), maximise available resources for implementation, and ensure that certain goals are not achieved to the detriment of others. On a practical level, improved communication will be needed in order to integrate targets. To this end, it was suggested that water professionals, researchers, and practitioners need to harmonise key definitions so that each sector speaks the same language when it comes to implementing water targets and priorities.

3.3. A CRITICAL NEED FOR CAPACITY DEVELOPMENT

It will come as no surprise to many that a capacity deficit was identified in almost all country responses provided within this study. In the water sector in particular, capacity is not being developed in the ways needed to meet and deliver the ambitious SDG targets. Capacity can be broken

down into supporting (software capacity) and technical (hardware) expertise. One specific capacity gap identified is the collection, management, and analysis of data to monitor targets. Assessing existing capacity, defining the types of capacity that is needed, and approaches to develop this capacity were identified within the consultations as barriers to enhancing capacity. Gap analysis can be applied to each action area to identify what is needed for each country, ranging from institutional, financial, ecological, or human resources. Innovations in many of these areas, such as technology and financial mechanisms will be necessary to achieve targets. Furthermore, ensuring inclusiveness of all stakeholders in capacity development strategies is important. Key actors identified as requiring enhanced capacity included government employees at all scales, the general public (especially the youth), and media. Finally, the relevant scale for capacity development must be clearly defined, as requirements may be at the local or national level. A lack of capacity may represent a 'bottleneck' in some situations to even planning the achievement of targets.

> *The UN-Water Global Analysis and Assessment of Sanitation and Drinking Water 2014 (GLAAS) results highlight that most sector decisions are not evidence-based due to the widespread lack of capacity for monitoring, inconsistent or fragmented gathering of data and limited use of information management systems and analysis.*
>
> *(GLAAS, 2014)*

3.4. DATA GAPS AND INNOVATIONS NEEDED IN THE COLLECTION OF BASELINE INFORMATION

The frequent absence of infrastructure to measure and monitor, gaps in on-going data collection, differences in the methods by which data are collected and interpreted, failures in the timeliness and effectiveness with which it is shared, and finally, limits in the degree to which data are understood by and influence decision-makers, continue to limit the way in which data inform water policy and practice in both developed and developing countries around the world. Fortunately, however, we are in the midst of revolution in the manner in which data are collected, interpreted, and shared. More data are available than ever before in human history. Data sets are also larger, gathered, retrieved, and interpreted faster, and more detailed than ever before.[60]

Baseline information was identified as a critical need in order for countries to set water-related targets that can be monitored and evaluated; countries do not have the information and capacity to be able to project needs out to 2030, especially under climate change impacts. However, obtaining data on current or projected water use is difficult in many contexts due to a range of barriers. This is especially important because many SDG targets for water "break new ground" and focus on areas that were not covered in the MDG process. Demonstrating and communicating the usefulness of thorough collection and sharing of data to relevant government ministries would contribute to prioritisation of obtaining baseline information. In some cases, new data collection technologies can be harnessed, such as remote sensing information collected by satellites. In the case of shared data, knowing who owns and uses the information is important. This has to be assessed against the backdrop of data versus information. Significant amounts of data exist, but the information required for decision-making is not available. Capacity to process and manage collected data is equally important to create useful and meaningful information outputs.

In order to ensure that data are collected effectively and efficiently and thus track change, establishing indicators and monitoring tools at the outset is important. The range of data gaps, including aspirational targets, highlights an opportunity to explore new mechanisms of monitoring and the use of novel indicators to measure achievement of SDG targets for water, particularly in new focus areas such as water quality, pollution, and wastewater treatment. This is relevant to water targets, as well as many other ambitious SDG goals that have not been the focus of global monitoring efforts, and could provide an important tool to making targets more tangible for decision-makers.

UN Photo,Patricia Esteve

PART FOUR

The World We Want

It is almost universally agreed that now is the time to redress the imbalances that have perpetuated in the name of sustainable economic growth. As such, there is tremendous pressure on the final formulation of the SDGs to deliver on a roadmap that leads us to both development and sustainability. For this to happen, every country must be willing to take sustainable development seriously, committing political will, funds, and supporting institutional resources and tools. This will require that nations develop new mechanisms for transferring and sharing not only money, but also knowledge, data, technology, and "soft" solutions which have been proven in different contexts. There is need for incubation hubs which can innovate and modify proof of concept responses so that they can be transferred into different contexts. More importantly, post-2015 SDGs must be set up for success and not failure. As discussed in Section 1, they must be global, universal, and sustainable; context-specific and evidence-informed; nationally owned, prioritised, and implemented within a framework of international solidarity; action-orientated, measurable, achievable, and easy to communicate; time-bound; focused on poverty reduction, inequalities, rights, demographic dynamics, governance, economic growth, conflict, and climate change and disruption; and, founded upon multi-scale, multi-stakeholder partnerships.

Doing so means that we have to come to grips with how to incorporate common but differentiated responsibility in the articulation of the SDGs with respect to national implementation at a global scale. It is critical that this be achieved without compromising the fundamental integrity of targets which are essential to the survival of the planet but are presently being ignored by national governments because they do not fit with current national economic agendas. These include, but are not limited to, issues such as disaster risk reduction and the formal valuing and protection of ecosystem services. It is this balance between environment, human security, and economic viability that will need to be articulated in a manner which does not tolerate compromise or abdicate responsibility for outcomes and yet provides flexibility on the mechanisms by which to achieve those outcomes.

A key mechanism by which success can be achieved is to ensure that the interlinked elements of each goal are made explicit. Compound indicators to ensure progress on ALL goals and not just some is one way in which this can be achieved. For example, reductions in maternal and newborn mortality require health system strengthening, improved access to healthcare, greater professional capacity, and adequate WaSH in health care facilities. This is why, no matter how much money is offered, a health care facility should not be built without inclusion of WaSH facilities. Again, success can only be achieved through multi-stakeholder, trans-sectoral collaboration, dialogues and partnerships that bridge research, policy, practice, and engage communities and the private sector.

Pixabay.com, David Mark

4.1 THE CRUCIAL ROLE OF MONITORING, DATA SYNTHESIS, AND SHARING

Sustainable development worldwide will not be possible without creating a data collection and management system that ensures that accurate, verifiable qualitative and quantitative data are made available, when needed, to all bone fide partners at a level of detail required to be useful and used. There is a maxim in the water sector that you cannot manage what you do not measure. Globally, reliable data are increasingly viewed as the foundation of sound decision-making and the raw material of meaningful accountability with respect to the management of water. Data must be disaggregated, documented, harmonised, managed, stored, interpreted, and disseminated in a timely manner to inform decisions. This means that core data required to manage water sustainably cannot be seen as secret or guarded as a matter of national or proprietary security. Neither can they simply be seen as data from physical variables; data on water, sanitation, and wastewater use, perceptions, desires, and needs are equally as important for comprehensive water management as data on precipitation, water quantity, and water quality. These data must be useful and relevant, and should not only inform matters related to water use at the community and national level but also inform discourse related to water's role in larger environmental, economic, and social issues that define sustainable development everywhere.

As member states of the United Nations embark on an historic initiative to affirm and refine the goals for sustainable development around the world, there remains an urgent need to mobilise new technologies and data collection protocols in order to accurately monitor changes in the Earth system; changes in human demographics, development, social structures, and function; changes in human and environmental wellbeing; to hold governments accountable; and, to advance sustainable development in service of the common good. As influences and impacts on water cascade through every sector of every economy and social and political system in the world, nowhere is there a greater need for a data revolution in sustainable development than in the management of the planet's limited and precious supplies of fresh water.

> *Never again should it be possible to say "we didn't know". No one should be invisible. This is the world we want — a world that counts.*[61]

In the world we have, we do not have an accurate understanding of how much fresh water we have at any given time in the atmosphere, flowing on the surface, or percolating slowly beneath our feet as soil moisture or groundwater. We have only limited knowledge about how much surface and groundwater we use and how much we waste or contaminate to the point that it is lost to any useful purpose within the hydrological cycle. We do not have enough high-quality data, data often arrive too late or are presented in a form that is not useful for decision-making and there are still many aspects of the water system for which there are no data at all, or if data exist they are not used or usable. Even in developed countries data often reside in ministries that that do not have the capacity, or sometimes the will or authority to share information with other government departments, researchers, or the public. Given that the water system falls under different levels of government or government jurisdictions, elements of data can be housed in different places, so that a complete picture of water never materialises. The picture of water becomes somewhat akin to the fable of the blind men describing an elephant.

To create the world we want, huge data and knowledge gaps exist that must be closed, and issues of access addressed, if the improved management of water is to fulfill its sustainable development promise. New technologies are making possible an exponential increase in the kinds and volume of data that can be captured, processed, and quickly translated into information of sufficient quality to inform decision-making processes. Moreover, community-based monitoring is an untapped potential in augmenting and expanding monitoring systems. With a vested interest in water, communities and local farmers are more than willing to participate in data collection as the data collected impact directly upon their day-to-day lives and empowers better local decision-making. Guided by standardised global data metrics, the current revolution in data collection, processing, and sharing presents an opportunity to enable data to play its full role in timely decision-making, accountability, and improved governance — critical elements of the post-2015 sustainable development agenda.

4.2. INDIVIDUAL, INSTITUTIONAL CAPACITY TO PLAN, DEVELOP, DELIVER, AND HOLD ACCOUNTABLE

All are well aware of the capacity deficits at various levels that will impede seamless delivery on sustainable development. What is less clear is where to start to redress these capacity deficits. Is it at the level of overall governance that trickles down to the different sectors that capacity building should be focussed? Or should capacity building be aimed at sector specific governance and management capacity that can be consolidated across sectors and form a strong foundation for overall national governance? Can and should capacity deficits be dealt with at all levels simultaneously? The latter is probably too complex to orchestrate as a starting point, but the reality is probably somewhere in between these options and will vary from context to context. Though the scope of the problem appears almost overwhelming, a myriad of entry points present themselves. What is important is not where we start, but that we realise the value shifts required for sustainable development and use evidence-informed decisions and planning to overcome inertia and start somewhere, sensitizing institutions to the need.

Once needs have been identified, the first step in enhancing capacity is to train educators and trainers who are capable of delivering on curricula. Another key consideration is that core capacities, such as technical expertise (e.g., engineering, statistics, economics) can be utilised in any one of multiple sectors. In this respect, some critical core capacities include the ability to analyse and utilise data, the capacity to make connections between economic, social and environmental elements, the capacity to undertake integrated impact assessments, the capacity for monitoring, regulation, and oversight, the capacity for fiscal management, and the capacity to value cost-benefits of action versus inaction. In addition to these individual capacities, institutional requirements include capacity to coordinate, plan, implement, manage, operate, maintain, monitor, and evaluate, capacity for research and development, and, capacity to develop, regulate, inspect, and enforce standards. These institutional capacities will reside not only within government agencies, but institutes of higher learning, non-government organisations, independent agencies, and private sector.

This serves to underscore the need for sustainable development goals and targets to be prescriptive in scope and timeframe but flexible with respect to specific timing, mechanisms and delivery within these constraints. Notwithstanding the need for flexibility, it must be realised that states do not necessarily currently possess required capacity and data to be able to undertake needs assessments, develop strategic plans and formulate national roll-out strategies to kick start implementation of sustainable development goals.

4.3. TECHNOLOGY TRANSFER

Even if money were no object, a critical barrier to implementation is identifying solutions to problems which are appropriate within physical, social, cultural, and economic contexts, affordable, and sustainable in terms of operation, maintenance, and replacement requirements. The only way in which countries will be able to determine which solutions are best for achieving sustainable development will be if knowledge, processes, and experiences are shared between stakeholders and, technologies are localised so that transfer can occur.

Engagement of the private sector is critical in this transfer of technologies and know-how. However, technology development and evolution requires large up-front financial investment. This cost to individual companies cannot be ignored. Sustainable and sustained technology transfer can only occur with the recognition and acceptance that profit is part of doing business and that some of these profits constitute funds that are re-invested in product development. On the other hand, current business models of making as much money as possible to appease investors is not sustainable and, with the exception of luxury items, comes at the expense of those who can least afford it. Mechanisms to overcome inertia in, and litigation over, technology transfer, while ensuring compensation for investments in development, have to be developed.

Local social and economic development, and the rationale for technology transfer, needs to be removed from the domain of corporate social responsibility — this is sound business sense. Some companies are already realising that this type of "shared values" approach benefits the private sector in the long term by "reconceiving the intersection between society and corporate performance", shoring up supply chains, reducing costs and catalysing local economies. This approach to "creating economic value in a way that also creates value for society by addressing its needs and challenges" has proven successful for several companies to date. Nestle reduced costs and improved supply chain reliability and quality by investing in farmer training (increasing yield and therefore incomes) and building local capacity to assess coffee bean quality (thereby reducing shipping costs for low grade beans and enabling payment of a premium to farmers). Other companies have realised benefits from wellness programmes, packaging reduction and, water and fuel efficiencies. Agrii is a UK company which offers support services for farmers, including weather stations which are used to monitor and predict pests and diseases.[4]

Other companies are realising that small profit margins but wide market opportunities can result in similar profit margins, particularly for turnkey solutions and low cost products. Moreover, the societal benefits, particularly for marginalised populations can be immeasurable.[62] Think of how quickly sanitation access can be scaled with free toilets contingent upon a term contract for emptying them. Not only does this result in affordable toilets, but it also deals with the issue of faecal sludge management for protection of human health and the environment.[63]

4.4. LIFECYCLE AND ASSET MANAGEMENT AND FULL COST ACCOUNTING FOR SOLUTIONS WHICH PROGRESSIVELY REALISE SDGs

It is no longer acceptable to plan for, or finance, capital expenditures without due consideration of the full financial and social lifecycle costs and impacts associated with operation, management, maintenance, and replacement. We need to move away from measuring success solely by the number of infrastructure projects constructed, towards an accounting system which ensures that appropriate, lasting, and sustained solutions are put in place to meet real, identified needs and anticipate climate and global environmental change impacts. Every dollar counts and cannot be wasted at any scale. This demands a commitment to integrated asset management with a transition to full cost accounting, including determination of revenue generation required to ensure adequate service, infrastructure maintenance, improvements, and replacement.

The alternative is what faces high income countries today — astronomical bills for deferred maintenance on existing water and wastewater infrastructure. Trillions of dollars will ultimately have to be paid if current levels of development and economic prosperity are to be sustained and ecological integrity protected. Moreover, substantial further investment is absolutely necessary if we are to sustain current levels of infrastructure function in the face of increasing climate disruption. Recent examples of cities in developed countries have been demonstrated to be vulnerable to increasingly frequent and more intense extreme weather events, such as Calgary, Copenhagen, New Orleans, and New York.

The way in which high income countries have achieved development is not, and should not, be seen as a blueprint for development post-2015, even as low and middle income countries are supported in their aspirations to realise comparable economic prosperity. Sustainable development is an alternative to the unfortunate development legacies and lessons to be learned from advanced economies, providing an opportunity to leapfrog into a more desirable future. Amortisation of true costs over time is a far better management strategy than ignoring environmental damage and postponing investment in deteriorating infrastructure, which in turn contributes to further environmental degradation and possible disasters. This is the only way forward for truly sustainable development. This does not mean that all costs are necessarily borne by the consumer, nor does it mean that those unable to pay are priced out of the market. Pro-poor strategies can be incorporated in many ways, including for example, increasing block pricing, where higher levels of water consumption come with greater price tags.

4 *http://www.agrii.co.uk*

Economies of scope and scale must be identified and acted upon to increase fiscal efficiencies. For example, the multiple benefits of dams for energy production, flood and drought alleviation, drinking water supply, agricultural irrigation, and recreation must be considered *a priori* and allocation mechanisms put in place. Economies must be realised in conjunction with environmental, social, and health impact assessments so that cost-benefit analyses are transitioned from solely economic to broader sustainable development metrics. In the same way, drinking water sources should not be developed without attention to sanitation and wastewater management and, health care facilities should not be allowed to be constructed without access to WaSH and electricity, essential components for delivering upon acceptable levels of care. While tools and models exist to support impact assessments, life cycle assessments, and asset management, human capacity needs to be enhanced if these tools are to be utilised effectively and purposefully.

4.5 INNOVATIVE FINANCING THAT BREAKS AWAY FROM TRADITIONAL MODELS AND EXPECTATIONS

Removing harmful and unproductive subsidies, including those granted to petroleum companies and natural gas and coal interests to the staggering value of $1.9 trillion[64], would free up public resources so that they can be directed towards the estimated $1.2 to $2.4 trillion[65] per year needed for investments in water and sanitation development, maintenance and replacement, water management and ecosystem services required to achieve post-2015 sustainable development. Additional public resources can be freed up by country efforts to eliminate illicit financial flows, estimated to be as much as 30% in the water sector[66]. Once these resources have been freed, a number of other tools are available for building greater financial capacity within the water sector to meet post-2015 sustainable development objectives. Improvement of procurement strategies for water-related projects, goods, and services does not just save money but can also help in the development of domestic industries and services. Cultivating existing private sector expertise and attracting private sector financing for water and sanitation related services is another way of freeing up and augmenting existing financial resources.

Since the financial collapse of 2008, bank lending for infrastructure has been curtailed. Therefore, it has become necessary to explore non-banking financing options. The most prominent of untapped capital pools are international financial markets. With assets under long-term management institutional investors such as pension funds, insurance companies, mutual funds, and sovereign wealth funds have become a source of capital for water and water-related infrastructure. Many of these sources now consider themselves Green Funds with a special interest in supporting sustainable development. As the World Bank has noted, institutional investors in OECD countries alone possessed over US$70 trillion as of the end of 2011[67].

While not a direct funding source, the technology needed to address water-related problems can come into existence through what are called pull mechanisms: incentives for innovation where the goal is to address a specific, clearly defined problem such as a specific kind of contamination. Such incentives can take the form of leveraging research and development through university partnerships and prizes for finding and applying solutions to specific problems or payments to competing interests that are conditional on their technological innovation's performance both in application and in target markets.[5]

One financing mechanism that has been employed can be characterised as resource-for-infrastructure trades whereby oil or mineral rights are exchanged for the construction of specific infrastructure projects which often include dams and other structures related to the control and management of water. Other trading commodities include carbon markets, which indirectly impact water through emissions allowances that limit changes in atmospheric composition that are the cause of the hydro-climatic change, and water quality trading, which has a direct impact through water pollution allowances. Such income sources are not likely to help achieve SDGs, however, if they are categorised as general revenues which go to national treasuries for redistribution and could be better

5 An excellent example of a pull mechanism in action would be a competition between farmers to produce soils that simultaneously hold and maintain water to make an agricultural region more resilient to flood and drought; reduce mobilisation of excess nutrients and contaminants in runoff; increase carbon storage while at the same time increasing yields.

Pixabay.com, Lynn Greyling

directed through, for example, the Green Climate Fund. If emerging financial sources are to aid the world in addressing sustainable development goals with respect to water, appropriations need to be reliably directed to specific water, sanitation, and water-related climate adaptation programs that are linked directly to post-2015 SDGs.

Another emerging source of potential financial support for implementing water and sanitation-related sustainable development goals is private philanthropy. As more and more of the world's wealth is concentrated in fewer hands, private fortunes have become so large that they rival that of many governments and far exceed the resources of official aid agencies. If, as Bill Gates has proposed, the world's richest people gave half of their wealth to philanthropic causes, much of the poverty in the world could be eliminated. If the world's wealthy deemed it important to do so, water and the financial resources to manage water could both end up where they are required, when they are needed, and in the amounts necessary to implement the sustainable development goals we need to achieve if we want to create a better, fairer, and most just world.

4.6 REALISING THE BENEFITS

Ultimately, if attention is paid to all aspects of the water system and enabling environments are established to support financing and implementation of sustainable solutions, it will be possible to close the gap between promise and practice in the management of global water (and sanitation and wastewater) resources. However, unlike current business as usual, these solutions must first be brought to bear on closing the equity gap; ensuring that no-one is invisible and that no-one is left behind.

UN Photo, Tobin Jones

PART FIVE

Pathways Forward: Options and Recommendations

According to country and expert consultations and the findings of the country case studies (Appendix III), clear implementation strategies are needed to provide concrete steps towards closing the gap between national and global development agendas relating to the SDGs. As articulated in the Catalysing Water report, several supporting conditions are required for implementation. These include vertical and horizontal linkages between stakeholders and governments; engagement and partnerships within and between sectors, stakeholders, and rights holders; feasibility assessment and prioritisation of actions; national and global support mechanisms; and, most importantly, persistent and uncompromising high-level political commitment to the complete achievement of the SDGs. In addition, governance support in the form of policies, national monitoring and reporting structures, financing frameworks, and institutionalised capacity development strategies are required. The final ingredients for successful implementation are the generation and sharing of solution options including software and hardware tools, models, appropriately evolving educational curricula, proven established and emerging technologies, and demonstrated deployment of innovative financing mechanisms. These options must include open articulation, evaluation, and unequivocal sharing of what works and what does not work in a range of physical, socio-economic and cultural contexts supported by a climate of political will in which there is a clear understanding that these are moral, political, and economic imperatives.

The sum total of all of these simultaneously directed actions — and the positive feedbacks that will allow each individual action to surface and advance each of the others — equals the way forward with respect to sustainable development. **To optimise water and sanitation related SDGs to create a stable, fairer, and more prosperous future, a two prong approach to implementation is necessary. First we have to catch up with existing problems and then we have to get ahead of them.**

It is not just corruption and poor governance that undermines national efforts to achieve sustainable development. Multinational corporate greed in tandem with weak or short-sighted government policy can erode gains in sustainability, bio-diversity conservation, and social justice, reversing earlier efforts to improve governance, transparency, ethics, and standards of business practice.

5.1. WATER GOVERNANCE, MANAGEMENT, AND CAPACITY

To undertake the policy, fiscal, educational, and structural interventions required for sustainable development, there must be a supportive framework in place. This framework provides coordination, oversight, and external accountability as well as incentives and regulation. While essential across all themes identified in the proposed SDGs, nowhere is it needed more than in the complex, yet essential sphere that is water.

National governments must make sustainable advancements in water, wastewater, and sanitation management a high level policy priority as essential prerequisites for sustainable development. This requires that governments transcend institutional fragmentation through the formulation of integrated national water policy with adequate financial commitment, which will empower ministries and institutions with responsibilities to manage, conserve, and protect water within the broader inter-related contexts of social development, food and energy security, environment, and economic growth.

> *"This (water) dominated every other policy. Every other policy had to bend at the knees for water survival."*
>
> *(Singapore's Minister Mentor Lee Kuan Yew at the inaugural Singapore International Water Week, 2008)*

To develop an integrated national water policy the following are essential first steps that will address disconnects between needs and plans, transition government priorities away from crisis management, and implement water-related sustainable development:

- Transparent, accountable, efficient fiscal decision-making[6];
- Creation of / strengthening of a joint sector national water commission which bridges research outcomes, policy-making, and implementation of solutions at the national and sub-national level;
- Long term national water policy that harmonises sub-national responsibilities and policies with national sustainable development objectives which bridge the terms of political office;
- National water act that builds upon the recently ratified International Water Convention, and that legislates legally binding standards to which regional and municipal governments, water jurisdictions, and water users and polluters are held accountable;
- A data revolution in support of sustainable development that underlines and supports evidence-informed decision-making;
- Joint institutional capacity that ensures trans-boundary harmonisation of national policies through regional compacts and international treaties, supported by dispute resolution mechanisms;
- Mechanism for equitable, ethical, gender sensitive water management and progressive realisation of human rights[7];
- Enhanced government capacity to understand complexities and their consequences, measure, monitor, analyse, synthesise, communicate, plan, regulate, oversee, and resolve conflict;
- Self-informing government supported by inter-departmental data sharing;
- Open registry of voluntary organisations with respect to coordination of activities and accountability to government policies, regulations, and benchmarks which include a moral accountability to the principles of sustainable development[8]; and,
- Implementation of national and sub-national processes for data sharing, active public outreach, stakeholder engagement, and participatory approaches to policy development and implementation.

These steps will require specific stakeholders to shoulder lead responsibility for implementation strategy recommendations. Specifically, the central government must vision and enact prioritisation of water, sanitation, and wastewater management through legislation and financial commitment, while government ministries must take on responsibility for implementing through regulation, management, and oversight. Institutions (government, non-government, academic) must implement responsible, effective, appropriate (financial,

6 For example the Water Integrity Network: *https://waterintegritynet.wordpress.com*

7 For example, the Water Ethics Charter: *http://www.waterculture.org/Water_Ethics_Charter.html*

8 For example, donors should not be able to finance a dam for enhancing domestic water supply without simultaneously paying attention to the increased volumes of wastewater produced.

capacity, environment, economic, and outcome) solutions that fit within government oversight. The help of international organisations may be needed in varying contexts to aid in forecasting and planning.

National governments should establish or strengthen existing arm's length water agency. This agency would be dedicated and independent and:

- Act as a repository for disaggregated social and physical data pertaining to the water system in the local, national, regional, and global context;
- Be responsible for synthesising, analysing, and disseminating information for informed decision-making to a broad variety of stakeholders;
- Provide oversight and independent validation of progress towards sustainable development as it pertains to water; and,
- Act as a bridge to and from the research community, the private sector, and policy and decision-makers, especially in Ministries of Finance.

These changes would result in more timely data and research breakthroughs and their dissemination to water-related professionals if all stakeholders commit to sharing information and data through the agency, creating a mutually accountable community of practice for water, sanitation and wastewater management research, policies, practices and financing. More important to success is a commitment at the level of Heads of State to support such an entity, both in terms of physical resources and legitimacy.

Capacity development must be nested within, and form a pillar of, institutional reform at all scales within a country, with an emphasis on transferable skills that can be used for sustainable development across all areas and goals. Capacity planning and realisation must be sufficient to fulfil the capacity deficits that exist in planning, design, implementation, and oversight of the water-related sustainable development targets. While human capacity is a priority, technical capacity to develop and shore up efficient, resilient, and sustainable supply and distribution chains is essential for realising water-related efficiencies in the manufacture of consumer goods and, to provide timely solutions to water-related sustainable development challenges. Capacity building must be phased, integrated into, and used to strengthen existing institutional education and training capacity. First, the physical capacity of institutions to deliver must be assessed and expanded if required. Then curricula must be developed or adopted from elsewhere. Local trainers and educators must be trained to deliver these curricula so that they can be embedded into broader national institutional training and education programmes.

While the demand for capacity is clear, education and training must be linked to job creation strategies. Governance and management framework must support job growth and staff retention, particularly in the early phase of transition to sustainable development. The near term shortfall in capacity could mean that people can be enticed away for better compensation packages and preferred locations.

Specific stakeholders and areas for capacity development include:

Government workers require broad capacity building to undertake their supportive governance and management roles (legislation, monitoring, oversight, conflict resolution); modeling and forecasting, data synthesis, analysis, and dissemination; stakeholder engagement; integrated impact assessments; trans-boundary negotiations; and, concept literacy in order to identify and act upon connections between water, other sectors, the economy, the environment, and social development.

Technicians require skills to support the demands of implementation, such as the design, construction, operation, maintenance, and replacement of physical infrastructure; design and programming of data management systems, knowledge portals, and virtual learning platforms; development and application of model simulations that can be used for prediction and forecasting; and, supporting legal expertise.

UN Photo, Ray Witlin

In 1999 the Government of Indonesia started water resources management policy reform, culminating in the enactment of the 2004 water resources law in which principles and process of IWRM were adopted. This was followed by formulation and establishment of government implementing regulations and institutions. New institutions include national and provincial Water Resources Councils for policy formulation and River Basin Cross — Sector Coordination Teams (approximately 35) for operational policy and implementation coordination that represent water resources stakeholders from non-government organizations and civil society. In addition, a coordination team was established to manage and share hydrological, geo-hydrological, and hydro-meteorological data and information among mandated institutions was established. Water resources regulations, standards and norms are still in development. Similarly, a new water is law under discussion in Bolivia that will reinforce principles of IWRM.

General public and community leaders require concept literacy, which is to say that they need to understand the importance of water, sanitation, and wastewater management as well as links between water, environment, health, and livelihoods and, the consequences of actions to which they may be subject. They also need to be data literate to be able to understand information disseminated by governments, non-governmental organisations, and the media. Ultimately, they need to know how to mobilise as agents of change, harness the power of social media, and possess the will and the capacity to participate meaningfully in stakeholder consultations.

Decisions for managing water at all scales must be evidence-informed, accounting for the multiple roles, uses, and demands on water and disposal of human waste and wastewater, as well as the way in which the distribution of water resources is changing, and expected to continue to change over time and space. This will require collection of and access to disaggregated, accurate, spatially and temporally consistent and comparable socio-physical data that are up to date, timely, and relevant, collected at appropriate intervals. These data have to be openly accessible, produced, and made available free of political interference. A systems approach has to be taken that will encourage the creation of a global "Network of Water Data Networks" similar to the larger network for global data on all aspects of sustainable development that was envisioned by the Expert Advisory Group on a Data Revolution for Sustainable Development[68]. In addition to strengthened coordination and data sharing among national and sub-national government data owners, new partnership arrangements and additional funding streams must be created and committed to integrate the data frameworks that currently exist and evolve them into the network of water data networks that will be needed to optimise the role of effective water management in making sustainable development possible (e.g. expanding the current groundwater observation monitoring network in Zambia to a minimum of 300 observation boreholes).

Specific needs include:

- Harmonisation of definitions, principles, and standards for monitoring;
- Development of common parameters and platforms for data collection, management, and sharing;
- Global commitment to augmenting existing data collection with that made possible by new technology such as satellite remote sensing and ground-truthing[9], and integrated SCADA[10] systems linked to low cost, hi-tech sensors;
- Expanded international cooperation on satellite based remote sensing and ground-truthing, data harmonisation, data sharing, privacy screening, and ethical use;
- (Virtual) centralisation of data sets nationally and globally;
- Trans-boundary knowledge, information, and data management and sharing;
- Enhance national statistical, modelling and forecasting capacity by improving capacity to collect, manage, interpret, utilise, and disseminate data (e.g. developing local capacity to monitor KKH glacier behaviour in Pakistan);
- More effective means to disseminate key findings of multi-disciplinary research outcomes in hydrology and the hydro-climatic sciences, especially to decision-makers and practitioners in planning, engineering, architecture and related fields;
- Encouragement of the private sector to share non-proprietary water-related information using common global standards and platforms so as to play its role in creating a network of water data networks open to all;
- Availability and transparency of open source data that permit civil society, non-government organisations, and members of the pubic to hold governments at all levels and the private sector accountable for water use and management decisions; and,
- An arms-length government institutional water hub that acts as a clearinghouse for information, a data repository, and a liaison between public policy and practice, research, and private sector interests.

Responsibility falls to governments and international water research institutions to work with one another, and with stakeholders, to define and implement common standards and infrastructure for water and water-related climate data collection, validation, management, storage, interpretation, and sharing. The UN should be responsible for leading the

9 This will be facilitated by the open access sentinel satellites to be launched in 2015: *http://www.un-spider.org/news-and-events/news/access-sentinel-satellite-data-will-be-free-and-open*

10 SCADA – Supervisory Control and Data Acquisition: *https://www.inductiveautomation.com/what-is-scada*

process to establish global consensus on data standards. National governments must empower water-related ministries and public institutions with capacities, financial support, and responsibilities to create a network of water data networks that keep data open and useable by all through investment in a water data revolution within the context of larger national data and information strategies. This objective requires investments in infrastructure and capacity (e.g. statistical capacity). Governments, the private sector, civil society, academia, and the philanthropic community must commit resources and expertise to share and visualise data in ways that raise public awareness of the importance of effective water management to our common future through constantly improving data literacy. This must be combined with media engagement and cultivation of media relations that ultimately foster the sharing of accurate and timely information that promotes evidence-based public discourse on water and water-related climate matters.

Governments, supported by relevant stakeholders, must commit to timely and transparent monitoring and reporting on SDG indicators to monitor progress and hold the global community mutually accountable. Rather than an additional burden, these requirements must be integrated into and emerge from national monitoring and data management, consolidated through linked sector data portals. This objective requires a balance between utilising variables that are currently monitored on a regular basis and variables which should have a strong expectation of being collected. For example, every country should be striving towards key essential monitoring and surveillance systems that provide socio-economic data, hydro-meteorological data, health data, and financial flows data, which are rolled up from local to national scales through established reporting mechanisms, ultimately feeding into the proposed SDGs analysis and visualisation platform. Compound indicators, with clear articulation of expected attribution from different sectors / goals, would go a long way to highlighting and mainstreaming water connectivity. Having said this, when formulating indicators for post-2015, we must ensure that we are not relying on variables whose collection will never be feasible at the global scale (e.g. because of prohibitive cost or the time required to collect the data).

Most importantly, these linked data portals and regular reporting strategies will facilitate identification of negative feedbacks between policies and / or solutions in different sectors and strengthen an overall systems approach to sustainable development. In this manner, it is possible to follow trade-offs and complexities to ensure mutually reinforcing and integrated responses. This is the only path by which people, the economy, and the environment are seen as agents acting upon and acted upon by each other. Sustainable development is the mechanism which maintains equilibrium as we work towards poverty eradication, social justice, and containment of climate change impacts, while ensuring supportive economic growth.

In an ideal world, the following indicators could be used to support monitoring and reporting. It is interesting to note that much of the data required are useful for reporting on multiple elements of a post-2015 water agenda. For example, monitoring water use and availability by sector and (sub) basin; accounting of water structures (location and status); and, expenditures and revenues by sector.

In Bolivia, community leaders have a key role in expansion of water and sanitation services. For example, a constructed wetlands wastewater treatment plant was built in Cochabamba to provide services for 250 families who had been living without safe water and sanitation. The project had a budget of $US 280,000 with financing from UN Habitat, the Municipality and the community. The plant is fully operational and community-administered with a self-sustainable monthly charge of 17 Bs ($US 2.50). This community-based, small scale approach is a solution that has begun to be replicated on larger scales in other cities.

TABLE 6: TRACKING PROGRESS AND CHARACTERISING RESEARCH NEEDS AND TOOLS

ELEMENT	INDICATORS BY WHICH TO MEASURE PROGRESS	RESEARCH NEEDS AND TOOLS
GOVERNANCE	Initial baseline (1990) versus current social and physical conditions	Prediction models; analysis of current and projected impacts associated with global environmental change and climate disruption; methods to provide economic justification of a moral imperative; quantification of multipliers
	Global environmental change projections (social and physical)	
	National risk assessment / risk management plans that account for baseline and projected conditions	
	Results-based management accounting against risk assessment / risk management plans, Growth and Poverty Reduction Plans and/or National Development Plans that are in line with global SDGs	
	Monitoring and reporting systems	
	Presence of internal, cross-ministerial and external coordination mechanisms	
	Presence and utilisation of data portal	
	Investment efficiency	
	Water efficiency	
	Cross sector flows (benefits; cross sector support)	
	Institutional capacity and training (positions available versus existing / trainee capacity to fill)	
ELEMENT	**INDICATORS BY WHICH TO MEASURE PROGRESS**	**RESEARCH NEEDS AND TOOLS**
WASH	Number of people served / unserved (against baseline conditions and future projections)	
	Level of service (including access, reliability, quality; percentage of unrealised losses and debts)	
	Number of people on centralised drinking water systems	
	Number of trained professionals and level of training in drinking water treatment plants	
	Date and synthesised results of most recent Water Safety Plan assessments	
	Number and frequency of water quality tests per 1000 population / source point	
	Number and type of institutions served	
	Level of service (including access, reliability, quality)	
	Ratio of domestic water use to industry extraction	
	Health improvements achieved (community and health care settings	
	Human productivity improvements (e.g. % time women engaged in productive labour; % living below poverty line)	
	Sustainability metrics (financial flows and capacity)	
	School absenteeism	
	Infant and child mortality reduced by 3 per 1000 live births, with a reduction of 1 per 1000 associated with access to drinking water and sanitation[11]	
	Diarrhoea rates reduced by 50%[12]	
	Wellbeing index changes over space and time	

11 This is based on Cheng et al. (2012), which found that for every quartile improvement in WSS, infant mortality rates were reduced by 1.4 per 1000 live births: Cheng, J.J., Schuster-Wallace, C.J., Watt, S., Newbold, K.B. and Mente, A. (2012). An Ecological Quantification of the Relationships Between Water, Sanitation and Infant, Child, and Maternal Mortality. Environmental Health 11:4. www.ehjournal.net/content/pdf/1476-069X-11-4.pdf

12 Links to WaSH as well as food safety, which will be increasingly important with climate change as well as to access to public health.

ELEMENT	INDICATORS BY WHICH TO MEASURE PROGRESS	RESEARCH NEEDS AND TOOLS
WASTEWATER	Percentage of wastewater treated / untreated (household understanding pollution sources and industry; centralised and decentralised) (against baseline conditions and future projections)	Understanding pollution sources and interactions
	Level of treatment	
	Water effluent quality exceedances against WHO water quality standards	
	Percentage of unrealised losses and debts	
	Percentage of wastewater for energy generation	
	Percentage of wastewater for food production (irrigation, fertilisers, soil amendment)	
	Sustainability metrics (financial flows and capacity)	
	Source water quality does not exceed selected (chemical and microbiological) WHO guidelines in 8/10 samples	
ELEMENT	**INDICATORS BY WHICH TO MEASURE PROGRESS**	**RESEARCH NEEDS AND TOOLS**
DISASTER MITIGATION	Reductions in water-disaster related deaths	
	Reductions in water-disaster related damages / ratio against DRR investments	
ELEMENT	**INDICATORS BY WHICH TO MEASURE PROGRESS**	**RESEARCH NEEDS AND TOOLS**
INFRASTRUCTURE	Shortfall against full cost accounting, including projected maintenance, replacement and improvement and accrued infrastructure deficits to date	Development of indices for natural infrastructure assessment; rehabilitation methods; technology development for environmentally-friendly infrastructure
	Storage volume for energy, irrigation, drought and flood mitigation	
	Per unit efficiency (productivity, energy use, investment)	
	Current and projected system losses	
	Percentage of use for different purposes	
	Economic contribution	
	Number of trained operators and level of training	
	Number of water quality tests undertaken per 1000 population	
	Date and findings of Water or Sanitation Safety Plans, or other Hazard and Critical Control Point (HACCP) Analyses	
	Number of inspectors and # of inspections per year	
	State and value and function of natural infrastructure	

ELEMENT	INDICATORS BY WHICH TO MEASURE PROGRESS	RESEARCH NEEDS AND TOOLS
AGRICULTURE	Crop productivity by crop per unit volume of water, water pollution and food waste (disaggregated by domestic / export volumes; women and small farm holders)	Trends in soil health and degradation; the development of efficient, inexpensive, farm level water and wastewater treatment; economic impact of agricultural impact on other sectors (drinking water, fisheries etc.); projected effects of hydroclimatic change on precipitation, crop typing, and agricultural practices.
	Percent GDP per drop	
	Income per drop, particularly for women and small farm holders	
	Wastewater reuse (treated / untreated)	
	Percentage of marginal land farmed versus water use / productivity	
	Water related drought mitigation (storage; sources)	
ELEMENT	**INDICATORS BY WHICH TO MEASURE PROGRESS**	**RESEARCH NEEDS AND TOOLS**
WATER RESOURCES	Groundwater extraction versus recharge	
	Every country incorporates integrated water resources management plans into their G&PRS that address universal access, economic growth, allocation (including transboundary) and climate change impacts	
ELEMENT	**INDICATORS BY WHICH TO MEASURE PROGRESS**	**RESEARCH NEEDS AND TOOLS**
ENERGY	Percentage of water used versus energy generation (by generation type)	
	HEP generation versus potential (incorporating CC projections) (large and small scale)	
	HEP co-benefits (flood alleviation, irrigation/drought mitigation)	
	Wastewater energy generation	

ELEMENT	INDICATORS BY WHICH TO MEASURE PROGRESS	RESEARCH NEEDS AND TOOLS
INDUSTRY	Percentage of treated / untreated effluent discharge (by type)	
	Level of treatment	
	Compliance	
	Energy (co)generation	
	Water quality	
	Efficiency – percentage of water use compared to economic productivity and employment (and effluent generated?) by type	

ELEMENT	INDICATORS BY WHICH TO MEASURE PROGRESS	RESEARCH NEEDS AND TOOLS
ECOSYSTEM SERVICES	Percentage of water for ecosystem services (supply – withdrawal) – sufficiency	Projected trends in ecosystem composition and function; Current and projected biodiversity changes; understand ecosystem function and its mechanisms; analysis and projection of invasive species distribution threats in all watersheds; what form do they take, what are implications of degradation, how can we move beyond economic valuation
	Current versus future predicted	
	Raw water quality	
	RBM against basin scale water resources management plans – economy, people, environment	
	Environmental improvement / changes in land degradation index over space and time	
	Changes in biodiversity index over space and time	
	Valuation/accounting of specific services	

5.2. WATER QUALITY AND QUANTITY

The main purpose for sustainable governance and management of water is to ensure necessary quantities of water of sufficient quality, to meet all current needs, including ecosystem services, while maintaining resources for future generations. Sanitation and wastewater management are critical as interventions which reduce water quality degradation, as is management of harmful agricultural runoff.

There must be a national commitment to universal access to WaSH, linked to waste treatment and management, delivered through nationally coordinated and monitored multi-stakeholder response. This commitment must include appropriate, affordable, equitable access in homes, schools, healthcare centres, and community centres and requires that:

- High impact, low cost solutions are identified and emphasised;
- Demonstration facilities are established and linked to training and capacity building programmes;
- Emphasis is placed on equitable (e.g. addressing water and sanitation in Aboriginal communities in Canada), full service, 24 hour access to supplies of adequate water quality; and,
- WaSH provisioning is prioritised, but considered within the context of multiple use, ecosystem services, and disaster risk reduction.

This responsibility must be shared by all government ministries responsible for WaSH, education and healthcare. NGOs have a responsibility to ensure activities are registered with national governments and are in line with national priorities and appropriate solutions. All must commit to the progressive realisation of the right to water and sanitation, including communities and individual families who are in a position to bridge government action through self-supply.

A national commitment to universal wastewater treatment and management, including industries and farms, in line with a polluter pays strategy and minimum effluent / source water quality standards, while recognising and realising the value in human and animal waste and wastewater wherever possible. This will require:

- Global consensus on minimum water quality targets;
- Targeted, ongoing investment in domestic and industrial wastewater collection, treatment, and management;
- Progressive and adaptive asset management including full-cost accounting;
- Regulation of harmful contaminants, including persistent organic pollutants;
- Regulation and enforcement of national polluter pays principles;
- Safe use of resources from human and animal waste and wastewater; and,
- Regulations to protect workers, consumers, and the environment when recycling wastewater, whether for agriculture or groundwater recharge.

Commitment is necessary not only from the global community, coordinated by UNEP, for global minimum standards, but also from strengthened prioritisation of both wastewater and the environment at the national level. This includes capacity and resources to provide regulatory oversight and accountability, the establishment or strengthening of national environmental monitoring entities, and recognition of

UN Photo, UNICEF/ZAK

Pakistan's National Water Vision 2025 aims to reduce the amount of untreated water released into water bodies to 70% by 2030. Punitive measures are being proposed to be implemented through Pakistan Environmental Protection Agency (PEPA).

traditional practices (e.g. traditional and cultural wastewater practices in agriculture are recognised in the Constitution in Bolivia). Research is required to help understand ecosystem function and its mechanisms in order to be able to better manage threats and to be able to clearly define the impact of pollution in order to hold polluters accountable.

It is critical that the world identify, recognise, and account for water needs for planetary bio-diversity based Earth system function and that national governments commit to ensuring continued viability and level of provisioning and regulating functions. This includes:

- Consensus on accounting conventions for ecological and ecosystem services;
- Accounting for ecological and ecosystem services;
- Incorporating water requirements for ecological and ecosystem services into integrated impact assessments;
- Strategically protect and rehabilitate wetlands, forests and other hydrologically important eco-zones for enhanced delivery of ecosystem services; and,
- Proactively implementing approaches to prevent and manage invasive species and diseases.

Given the many questions that still exist concerning ecosystem form and function and the impacts of Earth system change, responsibility falls initially upon the research community to provide a strong evidence base and recommendations upon which decisions can be made. Once the evidence exists, it falls to governments and all economic sectors to ensure that degradation is halted and reversed in accordance with the principles, policies, and practices associated with sustainable development. Media and civil society have a role to play in ensuring that accurate information becomes mainstreamed into society, and local challenges and opportunities highlighted in a timely way. Communities can be involved in remediation efforts through reforestation, wetland rehabilitation, and soil restoration initiatives. Businesses can employ green infrastructure solutions and minimise context-based water footprints.

Between 2010 and 2013, Vietnam made considerable progress in comprehensively integrating principles of sustainable development into national policies and programmes. The strong commitment of the Government towards sustainable environment has been demonstrated in such policies as the National Green Growth Strategy for 2011-2020 and the National Strategy on Climate Change. Indicators of natural resources, environment, and biodiversity have remained stable and protected terrestrial and marine area increased by 4.7 percent compared between 2010 and 2012. Between 2011 and 2013 Vietnam had two Biosphere Reserves, two Ramsar sites and one ASEAN Heritage Park recognized by international environmental organizations.

Pixabay.com, David Mark

National water governance and management must include a requirement to balance supply and demand at the at the sub-b¬asin level for sustainability and disaster risk reduction (e.g. monsoon seasons in Pakistan), while recognising and protecting downstream users. This must include:

- » Moving beyond traditional IWRM, building upon progress to date and transitioning into an IWRM that emphasises sustainable management for people, economies, and ecosystems;
- » Simultaneously investing in supply augmentation and amelioration as well as demand regulation;
- » Implementing multi-use and multi-purpose solutions for efficiencies of scope and scale;
- » Making a serious commitment to green infrastructure solutions based on utilising and mimicking natural ecosystem processes;
- » Shifting to integrated impact assessments (environmental, economic, health, cultural);
- » Measuring, monitoring, and managing withdrawals against supply;
- » Investing in existing and advancing technologies for forecast and prediction models for proactive planning that supports the precautionary principle in policy choices; and,
- » Reducing reliance on inter-basin water transfers as they are unsustainable and ignore long term

Solutions include:

- » Supply regulation and augmentation approaches (e.g. rain water harvesting; groundwater recharge; wastewater reuse and recycling; new sources of water including desalination and fog harvesting; in line storage; enhancement of natural ecosystem services and green infrastructure such as terracing);
- » Recognising and harnessing the value of natural infrastructure including snow pack and aquifer water storage;
- » Demand regulation approaches (e.g. pricing; education and outreach; smart meters; incentivising water efficient technologies including low flush toilets and low flow showers);
- » Framing demand within the context of supply;
- » Integrated large scale infrastructure solutions that respond to a broad range of human and ecosystem needs including risk reduction predicated by strong positive integrated impact assessments;
- » Forecasting and prediction models (e.g. long range precipitation and drought prediction models; integration of prediction of extreme weather events; early warning systems; agent based modeling of social systems);
- » Global repository system(s); and,
- » Source water protection to reduce water treatment costs and environmental impacts, protect public health, and increase resilience to climate effects.

For a water-dependent country like Bangladesh, many adverse and counter-productive outcomes have been created due to lack of coordination in development programs and use of water resources. The National Water Policy (1999) and the Bangladesh Water Act (2013) have made provisions for integrated development, management, abstractions, distributions, use, protection and conservation of water resources.

Common disaster risk reduction targets need to be incorporated into post-2015 water and sanitation–related sustainable development goals. These targets must permit the tailoring of actions to national realities. Each country needs to know the hazards to which it is exposed and in which regions and then develop a disaster risk reduction strategy to each hazard. As noted by the Hyogo Framework for Action, which in tandem with the MDGs established a global agreement on disaster risk reduction, there is an on-going need to shift from crisis management to proactive approaches to risk reduction and ensuring public safety.

In poorer countries, in particular, there is an urgent need to improve forecasting for early warning and disaster risk reduction activities — particularly of events that threaten large scale loss of life such as droughts and large floods. Earth system satellite remote sensing offers enormous promise in terms of improvements in water-related disaster forecasting. However, to fulfill that promise in ways that will simultaneously diminish disaster risk, reduce poverty, and advance sustainable development, much more needs to be done to collect, process, interpret, and share existing satellite data and to link those data to country level needs.

Effective targets for reducing disaster mortality, physical, social, and economic impacts and development setbacks demand the establishment of a common baseline against which progress can be measured. That baseline must include precise quantitative indicators that permit the reporting of real change.

Standardised assessment methods need to be developed to provide more accurate data on direct and indirect economic impacts of water-related disasters in order to be able to justify investments in disaster risk reduction and understand the broad impact that different types of disasters can have on various sectors for better disaster planning and risk reduction. These methods must not only provide a record of economic impacts adjusted for inflation and country GDP, but must also account for disaster loss in terms of mortality and its consequences with respect to human suffering, public health, education, and loss of productivity as well as the effects on those already in or driven into poverty by any given disaster.

Common definitions and processes need to be established for calculating flood plain risk probabilities. Uniform parameters need to be established globally to determine what constitutes, for example, the probability of a 1 in 100 year, 200 year, or 500 year likelihood of return events. These calculations must take the loss of relative hydrologic stationarity into account, moving beyond typical stochastic modelling that depends on the (now invalid) assumption that the past can be used to predict the future.

In Singapore PUB collects 100% of used water (or wastewater) enabling large-scale water recycling to produce NEWater (high-grade recycled used water). Currently, NEWater and desalinated water — supply up to 30% and 25% of total demand for the city-state respectively.

Measurement tools need to be developed to identify and reform policies at the country level that generate great disaster risk or encourage development that undermines resilience. Globally, there is a need to stop creating or exacerbating obvious water-related climate disaster risks such as extensive development in known and projected flood plains, clear-cutting in headwaters, and channelisation of streams in places vulnerable to extreme weather events.

As has been noted elsewhere in this report, as part of a larger movement to improve the quality and availability of data generally, a data revolution is critically needed in water and water-related disaster risk reduction. In order to ensure the transparency and accuracy called for by the data revolution, it is vital that independent evaluation of water and water-related disaster data accompanies self-reporting at the country level.

The successful implementation and on-going evolution of meaningful water-related disaster risk reduction actions associated with post-2015 SDGs will benefit greatly from the active involvement of national and regional scientific institutions and expert multi-disciplinary support from a wide-range of disciplines. This must be achieved in parallel with already well established climate change mitigation targets and strategies.


UN Photo, Pernaca Sudhakaran

Targets include:

- Halving the number of water and water-related climate disaster deaths globally by 2030;[69]
- Reducing economic losses from water and water-related climate disaster by 20% per GDP unit by 2030;[70] and,
- Ensuring that 100% of national post-disaster recovery plans take into account the impacts of water-related disaster both on poverty and on sustainable development.

5.3. ECONOMIC SECTORS

Water-Energy Nexus, Water-Food-Energy Nexus, and the Water-Health Nexus; all are used frequently in workshops and publications and all indicate the critical role of water in productive sectors of the economy. Whether for agriculture, mining, manufacturing, processing, energy generation, or a healthy workforce, water is a non-negotiable ingredient (e.g. in Canada water used in oil sands operations is equivalent to the residential water use of 1.7 million Canadians[71]). It follows that the proposed SDG targets for health, energy and agriculture must incorporate a specific focus on water, sanitation and wastewater. More specifically, to achieve water sustainability, there needs to be significant reductions in water use across all sectors. A 30% reduction across the board must be achieved through a combination of technological advances, best practices, improved system efficiencies, water efficiency credits and tax incentives.

The Government of Indonesia is committed to construction of flood control and drainage measures that will protect human settlements, productive areas, and nationally strategic transportation corridors.

The agriculture sector must be held accountable for water use efficiencies and other system efficiencies which limit water demand while maintaining or increasing productivity, and ensuring that women and small scale farm-holders are provided with the knowledge and technology to be able to play their part, thereby increasing income above poverty thresholds. This can only be achieved through:

- A new global focus on soil health and restoration;
- Efficiencies that transcend crop per drop measures through the addition of other relevant parameters including simultaneous reductions in food waste and harmful agricultural runoff;
- Crop choice, mixing and patterns based on best local traditional, environmental, economic, and nutritional evidence, particularly for local food sufficiency and improved nutrition;
- Irrigation, pesticide, and herbicide solutions based on traditional knowledge and working in tandem with natural systems in order to reduce impact on both water quantity and quality;
- Elimination of barriers to access to efficient and advanced practices, especially as they pertain to the agricultural gender gap;
- Increasing the value of marginalised agricultural land, for example through use for biofuel production;
- Food and worker safety when implementing wastewater reuse;
- Sustainable livelihood transitioning to augment incomes from agriculture;
- Prioritising efficient food security over short-term, unsustainable, water dependent biofuel production;
- International oversight of food prices and development of a supportive environment for elimination of the unachievable goal of national self-sufficiency in food;
- Incorporation of multiple uses of water into irrigation and other large scale water systems[13]; and,
- Incorporation of drainage management and sustainable land management in order to increase water demand efficiencies.

Pakistan plans to utilise multiple channels — including provincial "agriculture extension services", electronic media and expert advisory services through help-lines to educate and incentivise farmers to make efficient use of inputs.

This will require investments in technology, practices, and infrastructure including:

- Increasingly efficient irrigation technologies (e.g. drip systems linked to soil moisture sensors; crop lifecycle irrigation);
- Change in tillage considerations, cropping, and other context-relevant agricultural practices;
- Brackish water aquaculture and saline-tolerant crops for marginalised agricultural land, such as biofuel crops;
- Green infrastructure (e.g. riparian zone management and rehabilitation) for agricultural runoff treatment;
- Affordable, more efficient, targeted, and time released fertiliser and pesticide delivery systems;
- Technology advances in affordable, small scale, on-farm agricultural runoff collection and treatment;
- Protection, management, and rehabilitation of wetlands as productive agricultural systems;
- Improved national integrated flood and drought prediction accessible to even the smallest subsistence farm-holder;
- Green infrastructure amelioration of hydrologic extremes through soil and aquifer storage (e.g. using sand dams and terraces);
- Drought resilience strategies that augment sound agricultural practices and improvements in seed stocks;
- Flood resilience strategies that simultaneously address eutrophication challenges and are part of defined broader basin-wide, multi-use sustainable water management objectives; and,
- Low cost, low energy wastewater treatment to quality sufficient for crop irrigation.

13 Examples include terraces and water channels in the vadose zones of reservoirs and use of wetlands for aquaculture.

UN Photo, L. Groseclose

The new Government of Indonesia plans to achieve self-sufficiency in food production within the next 3 years (2015-2018) through construction of an additional 1.5 million Ha of irrigation schemes, rehabilitation of 3.0 million Ha of existing irrigation schemes, and construction of 49 new reservoirs.

The Energy sector must be held accountable for water efficiencies in energy and a transition to clean energy, including hydropower which does not compromise water quality, environmental integrity, community access, or disaster mitigation. Solutions include:

- Energy efficiencies in water and wastewater transport, treatment;
- Use of wastewater to generate energy (close the loop);
- Water extraction (groundwater);
- Water efficiencies for energy efficiencies, including water leakage reduction, use of water that is fit for purpose (i.e. not over treated for specified purpose) because waste of water is a waste of energy;
- Better shared understanding of impacts of non-conventional oil and gas exploration on water and common agreement on how to manage risks;
- Water as energy storage (e.g. urban heat island effect; HEP recirculation);
- Closing the urban water loop through innovative urban planning; and,
- Realise untapped hydropower potential with due consideration of multi-use principles, integrated impact assessments, and new technologies (e.g. low head turbines).

> *"Not all profit is equal. Profits involving a social purpose represent a higher form of capitalism, one that creates a positive cycle of company and community prosperity."*[72]

Water-dependent companies have a key role to play in financing and implementing sound water, sanitation, and wastewater management strategies and must step up to the plate or risk significant losses. This is no longer simply corporate social responsibility but sound economic strategy. Relatively small investments can avoid certain huge losses as climate disruptions threaten supply chains. Companies must assess their exposure both to current conditions and future projections of water and water-related events. Governments and research institutions must make data freely available to the private sector for this purpose to ensure consistent application of projections, particularly smaller local companies who may lack the resources to undertake their own projections. Tools must be modified so that strategic planning and operational strategies of companies incorporate water security and supply and distribution chains impacts / threats within context of climate change and disruption. Transitioning in the private sector to sustainable development provides an opportunity for low and middle income countriesto leapfrog other states and implement new technologies in increasing efficiencies and becoming more competitive faster. The following changes must occur:

- Companies must fast track water efficiencies and energy efficiencies, recognising the interdependencies;
- Water footprints must be embedded within the local water context (i.e. framework needed for variable benchmarking);
- Shared values preferred over corporate social responsibility (i.e., social contracts and partnerships and development of local economies and markets);
- Incentivise bottom of the pyramid investments that are characterised by low per unit profit margins and high sales volumes;
- Drive market demand and link supply chains with demand;
- Move beyond environmental, social, and sustainable certifications to social and environmental credit trading to support climate change mitigation (e.g. the Social Venture Connexion (SVX) platform[14]); and,
- Expansion of resource trading to include water quality and other ecosystem services trading (e.g. phosphorous and nitrogen) in order to empower communities and mitigate power differentials that have plagued more conventional public-private partnerships.

14 *http://svx.ca*

Ultimately, the private sector has to start being accountable to the triple bottom line. It can no longer be driven by regulatory decree and loopholes. This is an abdication of responsibility. Social corporate conscience is far more imperative than responsibility if we are to be successful in sustainable development.

5.4. FINANCING

Given that current aid funding is far from adequate to finance the required level of investment, new funding streams are needed both to maintain and protect existing water infrastructure and to build sustainably on what already exists into the future. As has already been noted in this report, financing post-2015 development goals will require a two-pronged approach — the first being the enhancement of the impact of already available resources and, the second, to find ways to add to these resources. Regarding the former, mechanisms need to be developed for targeting philanthropic and Official Development Aid investment directly to water-related sustainable development goals through a global revolving fund.

Governments and all economic sectors must eradicate corruption through the establishment and implementation of clear and defined anti-corruption protocols, with meaningful consequences when the protocols are breached. The enhancement of the impact of already available resources cannot be accomplished without the eradication of corruption. In many places in the world, corruption is resulting in the hemorrhaging of precious financial resources that could and should be made available to eliminate poverty and support SDGs particularly as they relate to water. Corruption at any level is not just a criminal act in its own right. In the context of sustainable development it could be viewed as a crime against all of humanity. Corruption simultaneously undermines both the potential of individual nations to achieve stability and progress toward sustainable development on a regional basis. In the context of the urgency created by global economic uncertainty, accelerating Earth system changes and the growing threat of hydro-climatic disruption, corruption threatens the stability and very existence of some nation states. In the context of a global society, the instability and failure of individual nations affects everyone, diminishing the potential of future sustainability for all.

The eradication of corruption can be achieved through:

- Strong adherence to already existing clear and comprehensive UN Agency policies with respect to financial accounting and transparency;
- The setting at the country level of codes of conduct that include background checks and clear accountability standards that define values, clarify matters related to conflict of interest, and create a culture of zero-tolerance for corruption at all stages and levels related to the management of water and the implementation of SDGs with respect to water and water-related climate issues;
- Full, active, and continuous engagement of civil society as participants, observers, and consulted stakeholders at Policy Board meetings at the project level;
- Formal development of national programs that monitor and evaluate anti-corruption rules and safeguards on an on-going basis and that provide vital safeguards to whistle-blowers; and,
- The development of clear and comprehensive sanctioning procedures by UN Agencies that establish what sanctions may be applied where corruption is proven and how such sanctions will applied and enforced.

Government funding capacity for water resources infrastructure in Indonesia has improved significantly over the past 10 years, with approximately US$31 billion is secured for the next 5 years. Another source expected to contribute more than US$4 billion per year is a government policy to re-allocate the energy subsidy budget to more productive activities including water resources and agriculture.

In Singapore, PUB has leveraged private financing options for recent water supply infrastructure projects, e.g. the first Public-Private Partnership (PPP) plant — SingSpring Desalination Plant.

National governments, multi-national corporations, and international institutions must work together to identify and implement strategies to equitably free up available existing resources. While eradicating corruption is critical, meeting post-2015 SDGs relating to water and sanitation will demand that all existing available financial resources are used more efficiently and strategically.

The freeing up of available existing resources can be achieved through:

- The creation of more equitable tax structures (such as the elimination of safe havens) that ensure that wealth generated within a given nation remains there to support sustainable development investment;
- Ending of unproductive subsidies as a first step to redistribution of available financial resources, increased global competitiveness, and the closing of the equity gap;[15]
- Improvements in determining what constitutes true water use efficiency founded in more complete data, greater multi-disciplinary collaboration and cooperation, and broader, accurate, more universally meaningful methods of assessing water productivity are necessary not just in agriculture but all sectors to ensure limited financial resources are not being wasted by simply concentrating on more water saving technology at the expense of broader sustainability targets;
- Finding cheaper, more efficient ways to procure goods and services related to the operation, maintenance, and replacement of water-related infrastructure and delivery of water services and emergency services related to disaster relief;
- Finding greater value in waste streams;
- Cultivating existing private sector expertise and attracting private sector financing for water and sanitation related services (e.g., SingSpring desalination plant, Singapore);
- Negotiating full cost accounting contracts with extractive industries, foreign agricultural land-buyers, and water bottlers which ensure that the full price for water is realised; and,
- Exploring resource-for-infrastructure trades whereby oil or mineral rights are exchanged for the turn-key construction of specific infrastructure projects which often include dams and other structures related to the control and management of water.

Freeing up and increasing returns on existing resources through integration of inter- and intra-sectoral activities that take advantage of economies of scope and scale and result in greater spending efficiencies. Managing water in the post-2015 agenda must be underpinned by financial transfer mechanisms designed in such a way that a significant portion of funds are sourced within the water agenda itself. There will be no single source of such funds. Additional financing can be made available through a number of innovative inter- and intra-sector mechanisms which include:

- Developing durable public, private, and civic partnerships to bridge the gap in government capacity to deliver needed services;
- Realising and expanding markets that trade in the integrity of natural resources and the value of ecosystem services;
- Realising savings, redistribution of wealth, and enhancement of environmental, health, and economic benefits that can accrue through cross investments and/or revenue sharing between water, health, agriculture and energy sectors in the combined management of urban and rural water supply, sanitation, and wastewater systems;
- Re-valuing the role of virtual water export in agriculture when supported by global food pricing stability mechanisms;

15 Removing harmful and unproductive subsidies such as those granted to petroleum companies and natural gas and coal interests can advance post-2015 SDGs with respect to water but only if savings are directed towards investments in water and sanitation development, maintenance and replacement.

- Establishing and expanding carbon markets which either tax greenhouse emissions directly or employ cap-and-trade mechanisms to create carbon credits or emissions allowances as a direct source of potential funding for post-2015 water and sanitation-related SDGs;
- Expanding and harnessing certification and equity and credit trading of environmental, social, and equity values;
- Reallocation of sector subsidies to sustainable development and poverty eradication; and,
- Executing water projects in conjunction with other planned infrastructure development in order to realise cross-benefits and cost-efficiencies (e.g., simultaneously rehabilitating all buried infrastructure on a city street in the event of an emergency water pipe break repair rather than re-excavating roads a short time later for planned repairs required for other infrastructure elements.)

Subject to rigorous due diligence, national governments must identify, explore and utilise new and emerging financial sources. If emerging financial sources are to aid the world in addressing sustainable development goals with respect to water, appropriations need to be reliably directed to specific water, sanitation, and water-related climate adaptation programs that are linked directly to post-2015 SDG targets. Fortunately a number of novel financing options have emerged since in the interim. These include:

- Crowd source funding for badly needed small local WaSH projects;
- Small scale financing for self-supply to bridge gap in government capacity to deliver;
- The cultivation of hitherto untapped capital pools such as pension funds, insurance companies, mutual funds and sovereign wealth funds as a source of capital for water and water-related infrastructure;
- The growth of private philanthropy as a consequence of more and more of the world's wealth being concentrated in fewer hands[16]; and,
- Incentives for innovation where the technology needed to address water system-related problems can come into existence through funding that is applied to addressing specific, clearly defined problems.

The global community has a responsibility to support due diligence in assessing new financing mechanisms and developing templates for engagement, while research institutions need to explore and identify modifications and new opportunities, and evaluate transferability. National governments, after undertaking due diligence, must implement new mechanisms as a way to diversify and expand financing. Further, they must take ownership of investment, reducing dependency over time on external financial support through strategies to transition into sustainable financial self-sufficiency, requiring local economies to strengthen tax bases, collect taxes and user fees, and access historically accumulated pools of capital etc. A caveat to this is the allocation of money for fragile and conflicted states, where investments in creating readiness for change as opposed to catalysing change are required. The global community has an overall responsibility to ensure that resources are made available to countries that are unable to meet minimum targets within the prescribed timeframe.

16 As has been noted, some private fortunes have become so large that they rival that of many governments and far exceed the resources of official aid agencies. If the world's wealthy deemed it important to do so, water and the financial resources to manage water could both end up when they are needed, where they are required, and in the amounts necessary to implement the sustainable development goals we need to achieve if we want to create a better, fairer and most just world.

5.5. A WAY FORWARD

The crux of success in implementation of the eventual SDGs will lie in the balance between urgency, ability to succeed, and common but differentiated responsibility. It will further depend on how countries split up different sectors and how these link-up to the economic sector and Ministry of Finance. In the case of water, it is clear from current country-level aspirations that some water-related targets may be selected because they are easily actionable, while overlooking longer-term steps that are also important and perhaps deserve higher priority from a sustainable development perspective. Some of the questions that are likely to be raised over the coming months include how much can really be achieved in the next 15 years? How much can we afford not to achieve? In response to the latter, an analysis of hazards and critical control points for most economic sectors, for environmental integrity, and for human health and wellbeing are linked to the water system.

There is a clear precedent by which external circumstance can force and sustain change. In the current global situation, the external pressure is, and must be recognised as, a combination of Earth system change and associated climate disruption. We have created a circumstance in which existing inequities are exacerbated by these accelerating effects. In the context of global environmental change, a "no regrets" approach ensures that investments and implementation provide multiple dividends.

As such, the specific approach taken in articulating progress towards achievement of SDG targets will set sustainable development up for success or failure (Table 7). Unfortunately, we are at a point where we cannot afford to fail. Failure will reverse hard won gains and may make ultimate achievement of sustainable development impossible.

The standards that sustainable development demands is a commitment to very well established principles. As can be seen from Table 8, deviation from these principles may result in failure. Given that starting from different points can make problems look very different, perhaps the most equitable approach is one that is based upon phased and staged, time-bound commitments. As such, we propose the following:

- *Phase 1*: in 3 years (all achieve) specific progress towards each target — may mean that states with shortest pathways achieve target;
- *Phase 2*: in 3 years those who haven't achieved goal achieve specific progress towards each target — more states will achieve target;
- *Phase 3*: in 3 years those who haven't achieved goal achieve specific progress towards each target — more states will achieve target;
- *Phase 4*: in 3 years those who haven't achieved goal achieve specific progress towards each target — more states will achieve target; and,
- *Phase 5*: in 3 years those who haven't achieved goal achieve specific progress towards each target — more states will achieve target.

States must articulate a staged sustainable development plan in year 1 that indicates how many of the phases it will require for each target and implementation plan for Phases 1 and 2. In year 5, states report on progress to date and implementation plans for phases 3 and 4. In year 10, states report on progress to date and implementation plan for phase 5 which closes any gaps in achievement over the previous phases to ensure all targets achieved by end of phase 5. Finally, in year 13, states report on progress and ability to achieve targets by end of Phase 5. If unable to deliver, countries must clearly outline i) resources and implementation strategy required to accelerate achievement and, ii) an alternative plan with revised timeline for delivery to be implemented if option 1 is unfeasible.

TABLE 7: IMPLEMENTATION ALTERNATIVES AND THEIR CONSEQUENCES

APPROACH	TIME	FINANCING	URGENCY	CAPACITY TO DELIVER	ACHIEVEMENT OF SUSTAINABLE DEVELOPMENT	RISK	PROS/CONS
All specific targets addressed	Likely require more than 15 years	High potential burden, but likely to be spread over longer time frame than initially anticipated	If well-articulated targets are achieved within the timeframe, will respond to urgency	More difficult for those with distal starting points;	As long as targets are well articulated, SD will occur, but the question is when	Those who cannot afford have the most to achieve	Formalises priorities and focuses commitment; requires full, timely financing
Proportional improvement targets	More feasible to achieve within 15 year framework	Less immediate financial burden	May not respond to urgency	Allows implementation at the country level for all member states	SD not guaranteed to occur, especially in those countries with the furthest to go; on the other hand, it relieves developed nations with the least left to achieve of the responsibility of full implementation	Will not achieve globally acceptable benchmarks in many countries which lag far behind others	Additional costs to achieve sustainable development beyond proportional advances; longer time until benefits are achieved

APPROACH	TIME	FINANCING	URGENCY	CAPACITY TO DELIVER	ACHIEVEMENT OF SUSTAINABLE DEVELOPMENT	RISK	PROS/CONS
Tiered / staged specific targets (low, medium, high benchmarks)	Possible that states will try to argue that they only meet the lowest target in the given time frame	Less immediate financial need but costs increase with respect to unmet goals	Broader priorities beyond national interests will be ignored despite their centrality to the full achievement of sustainable development	Increases apparent capacity to deliver	Will not be achieved except by those in the high benchmark category, who arguably have the least to change in the first place	Extends risk, which grows beyond fixed time frame; greater vulnerability to economic uncertainty, ecosystem change and climate disruption	Con: additional costs of monitoring and oversight; Pro: continued oversight and demonstration of progress to facilitate iterative course corrections
Phased approach (globally defined)	Likely that only first stage will be achieved in 15 year framework, depending on number of stages	Permits phased funding, but with no assurances for subsequent phases	Doesn't respond to urgency	Capacity to deliver cannot be enhanced unless governance improvements are a priority	Partial achievement of SD only		
Hierarchy of needs (nationally defined)	Least prioritised not likely to be achieved in timeframe	Financing can be targeted at high priority actions	Only responds to local (national) urgencies	Focuses limited capacity on fewer goals	SD unlikely to occur	Could end up being continuation of business as usual	Takes simultaneous pressure off achievement of all that needs to be done to ensure SD

APPROACH	TIME	FINANCING	URGENCY	CAPACITY TO DELIVER	ACHIEVEMENT OF SUSTAINABLE DEVELOPMENT	RISK	PROS/CONS
Pathways from different starting points	Those with longer pathways may not meet time commitment; those with shorter pathways able to spread over longer time period	The costs continue to grow on unaddressed	Responds to urgency as long as all pathways are pursued within the timeframe prescribed; given unlikelihood that longest pathways will meet this timeline, will not respond sufficiently to urgency	Capacity to deliver can grow as country moves along pathway; requires improvements in governance	May permit some SDGs to be achieved	Greater vulnerability to longer term economic uncertainty, Earth system impacts and climatic disruption	May be all that is possible at the country level but puts full SD beyond reach
Phased and staged time-bound commitments	Commits all to rigid timeframe	Costs likely to over-run as commitments accelerated to meet deadlines; conversely, as states move through phases they will realise economic growth and social development as returns on investment in sustainable development, freeing up capital for investment in future Phases	Will respond to urgency as long as targets well-articulated	Will require clear, early focus on governance targets to fuel and create capacity	Can make all SD goals achievable	Reducing vulnerability to uncertainty through time bound approach	Puts full SD within reach within a clear timeframe but requires goals to be a national priority for the span of several elected governments at the national level

UN Photo, Kibae Park

PART SIX

Concluding Remarks

The gaps identified in the country-level consultations highlight the need to bridge disconnects between country-level target setting and global processes. The cost of not leaving anyone behind is a critical consideration to ensure necessary implementation mechanisms are in place. Facilitating dialogue that connects bottom-up country-level contributions to top-down goal setting occurring at a global level is critical for ensuring that the resources required exist and necessary implementation mechanisms are in place to achieve ambitious water system-related sustainable development targets.

Earth system and hydroclimatic circumstances are changing and resulting impacts are exacerbated by poverty, environmental degradation, and low social development. Our response must be immediate and must include:

1. Better monitoring and research leading to enhanced data management and therefore greater inclusion of evidence in decision-making, better policies and increased investment, resulting in: more private sector engagement, investment and growth, better water management and universal access to services, greater national and global water, food and energy security, better disaster risk reduction, and enhanced climate change adaptation, all of which creates sustainable development;
2. Positive feedback loops which must cascade through all aspects of the water system to ultimately achieve sustainable development;
3. Widely transferable processes and solution repositories within the context of common but differentiated responsibilities — processes that include data management, education, ownership and responsibility, and demonstration projects;
4. Building upon existing governance structures and strengths, transforming rather than tearing down;
5. Aspiring towards a less consumptive life while maintaining standards of living, understanding and advancing solutions which prove these are not mutually exclusive;
6. Scoring successes while learning from failure;
7. Shifting the focus from short-term private sector accounting metrics to progress towards longer-term outcome-based targets; and,
8. Global conscience that transcends environmentalism, does not unduly defer to economic growth, and appeals to shared fundamental values and personal principles.

There is enough money in the world to finance the implementation of water-related SDGs if these resources can be freed up and appropriately and efficiently directed. Ultimately, everyone has a responsibility to balance conservation and development within the context of how ecosystem services contribute to human wellbeing and economic development. However, we must recognise that throwing money at a problem will not solve it. Sustainable solutions must be supported by governance and management structures, capacity, and behaviour change i.e. many different resources need to be realised, released, and re-invested based on

UN Photo, Sophia Paris

evidence of their efficacy. Progress further demands that governments revisit and transition water rights that are unsustainable, inequitable, and prevent realisation of water requirements for ecosystem services and essential domestic use. Unenlightened self-interest has the power to completely destroy progress towards sustainable development and sustainable societies. We no longer have the luxury to simplify; everyone needs to understand the linkages as well as the cause-consequence relationships between water and a viable, vibrant, equitable global society. We will not see immediate results; results occur beyond typical political terms, necessitating visionary leaders who invest because it is the right thing to do and not the vote-getting thing to do.

Ultimately, everyone bears the burden of the moral and fiscal imperative to deliver on SDGs within a defined timeframe. If the development we have worked so hard to possess and advance is to be sustained, serial market failures and economic collapses, Earth system change, and climate disruption, must be recognised for the triple threat they pose to human wellbeing and social and political stability. If we want a future of promise there can be no compromise in the implementation of post-2015 SDGs related to water, sanitation, wastewater, and aquatic ecosystem services. It is imperative that, at the country level, these goals be achieved during the prescribed timeframe. Strategies need to be laid out to demonstrate how and when water and sanitation-related objectives will ultimately be realised. Without this level of real commitment the world we want will forever be beyond our grasp.

APPENDIX I: METHODS

This report is based on ten country case studies, expert consultations and pertinent literature. Starting from the global needs assessment framework articulated in the Catalysing Water report[73], an Excel-based data collection tool was sent out to consultants in ten countries selected to represent varying regions, socioeconomic status, governance structures, patterns of resource use, and other characteristics. The countries were selected to provide important insights into developing an aggregated and integrated response to water-related global challenges and needs.

The framework represented six major themes: water resources; water governance; access to WaSH; water management and sustainable use/reuse; water quality; and disaster mitigation. These were assessed in terms of current status and targets, country implementation, and finance:

Status – current and aspirational status (2030) and the progress required to achieve the aspirational status, thereby providing an idea of the needs assessed and progression required for each theme;

Implementation – the needs and solutions that have been identified with respect to achieving aspirational targets as they pertain to capacity (national and private), technology, and infrastructure; and,

Finance – anticipated expenses, revenue/benefit, and funding sources based on best possible available estimates were identified for each component.

The framework was augmented by:

- A written report that provided additional context for the country frameworks;
- Virtual country consultations to validate findings and assess similarities and differences across countries; and,
- High level consultations to link national findings to larger scale SDG processes.

APPENDIX II: RIO DECLARATION PRINCIPLES (AGENDA 21)

Principle 1:	The centrality of people in development.
Principle 2:	The right to exploit national resources and the responsibility to ensure no damage beyond national boundaries.
Principle 3:	The need to meet environmental and developmental requirements equitably and sustainably.
Principle 4:	Environmental protection as integral to development.
Principle 5:	Eradication of poverty as indispensable to sustainable development.
Principle 6:	Prioritisation of least developed and environmentally vulnerable countries.
Principle 7:	Cooperation to conserve, protect and restore the health and integrity of the global ecosystem through "common but differentiated responsibilities".
Principle 8:	Elimination of unsustainable production and consumption.
Principle 9:	Strengthening of capacity for sustainable development through knowledge exchange and technological development and transfer.
Principle 10:	Promotion and facilitation of stakeholder engagement and participation.
Principle 11:	Enactment of effective environmental legislation.
Principle 12:	Growth of a global economic system that supports both economic growth and sustainable development.
Principle 13:	Mechanisms for redressing environmental damage, including pollution.
Principle 14:	Prevent movement of activities and substances that cause harm to humans and/or the environment.
Principle 15:	Invoke the precautionary principle.
Principle 16:	Principle of polluter pays.
Principle 17:	Use of environmental impact assessments.
Principle 18:	Global notification, and support of, natural disasters and emergencies.
Principle 19:	Transboundary notification of environmental issues.
Principle 20:	Harness the essential role of women in sustainable development.
Principle 21:	Mobilise the youth.
Principle 22:	Support participation of Indigenous people in sustainable development.
Principle 23:	Protect natural resources on behalf of those who are unable to do so themselves.
Principle 24:	Protect the environment during periods of conflict.
Principle 25:	"Peace, development and environmental protection are interdependent and indivisible."
Principle 26:	Resolve environmental disputes.
Principle 27:	Cooperate in the fulfilment of these principles and the furthering of sustainable development law.

Source: http://sustainabledevelopment.un.org/index.php?page=view&nr=23&type=400

APPENDIX III: CASE STUDY NEEDS AND OPPORTUNITIES

National case studies identified actors requiring capacity development (Table AIII.1), the types of capacity needs that exist (Table AIII.2) and the solutions that have been identified to support achievement of current national development plan aspirations (Table AIII.3).

TABLE AIII.1: WHO HAS BEEN IDENTIFIED AS REQUIRING CAPACITY DEVELOPMENT?

	WATER RESOURCES	WASH	WATER MANAGEMENT	WATER QUALITY	DISASTER	WATER GOVERNANCE	TOTAL COUNTRY REFS
COMMUNITY		1			1		2
SCHOOLS		2				1	3
MEDIA	1	1	1				3
CIVIL SOCIETY	1		1	1		1	4
MUNICIPALITIES		2	1			1	4
NGO'S	1	1	2	2	1	1	8
STAKEHOLDERS	2	2	2	2	1	3	12
GOVERNMENT MINISTRIES	4	2	3	4	1	2	16

TABLE AIII.2: WHAT CAPACITY NEEDS HAVE BEEN IDENTIFIED?

	WATER RESOURCES	WASH	WATER MANAGEMENT	WATER QUALITY	DISASTER	WATER GOVERNANCE	TOTAL COUNTRY REFS
WATER RECYCLING				1			1
ADVOCACY		1	1				2
ENERGY EFFICIENCY	1		1				2
DESALINATION	2		1				3
FLOOD MANAGEMENT	1				2		3
RESOURCES ASSESSMENT	1		1	1			3
WATER CONSERVATION		1	2				3
MODELING / FORECASTING / EARLY WARNING	2				2		4
DATA/MONITOR/ ANALYSIS	1	1				2	4
PARTICIPATORY					1	3	4
TECHNICAL	2	1		2			5
LAWS / REGULATIONS / STANDARDS / GUIDELINES		1	3		1		5
CC ADAPTATION / MITIGATION	4				2		6
RESEARCH & DEVELOPMENT	3			1	1	1	6
COLLABORATION		1	2	1		4	8
DEVELOPMENT / MANAGEMENT (INCLG FINANCIAL, RISK, CONFLICT)	1	2	1	2	1	2	9
WATERSHED MANAGEMENT INCLG WETLAND, FOREST, IWRM			3	1	1	4	9
EDUCATION/ COMMUNICATION	2	5	1	3	1		12

TABLE AII.3: IDENTIFIED SOLUTIONS

	WATER RESOURCES	WASH	WATER MANAGEMENT	WATER QUALITY	DISASTER	WATER GOVERNANCE	TOTAL COUNTRY REFS
LABORATORY FACILITIES				1			1
COLLABORATION						1	1
ASSET MANAGEMENT		1					1
OPERATION & MANAGEMENT		1					1
CC ADAPTATION / MITIGATION	1						1
EDUCATION / INFORMATION			1				1
CONTRACT MANAGEMENT		1					1
STORAGE			1				1
NON-REVENUE WATER		1					1
RESEARCH & DEVELOPMENT			1	1			2
WEB / PORTAL		1			1		2
FLOOD MANAGEMENT			1	1			2
POLLUTION CONTROL				3		1	4
RESOURCES ASSESSMENT	4		1				5
INTEGRATED PLANNING / IWRM	1		2		1	1	5
GOVERNANCE	2		1		1	1	5
MODELING /FORECASTING / EARLY WARNING	2			1	4		7
WATER/WASTEWATER/SANITATION INFRASTRUCTURE (INCL. BIOGAS)	1	4		2	1		8
WATERSHED MANAGEMENT (INCL. WETLAND, FOREST, IWRM, WATER SUPPLY)	2		2	1	1	2	8
INNOVATIVE TECHNOLOGIES	1	2	2	4			9
POLICY	4	1	2	1	1	1	10
WATER SUPPLY AUGMENTATION (RWH, GR WAT RECHARGE, RAIN SEEDING, WATER RECYCLING, DESALINATION)	4	2	1	3	1		11
DATA/MONITOR/ANALYSIS	3	2		3	3	2	13
LAWS / REGULATIONS / STANDARDS / GUIDELINES	1	3	3	6	2	3	18

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ISBN: 978-92-808-6051-1