Sustainable Development Goals: A water perspective

Content

GWSP Global Water System Project
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Summary Report and Extended Recommendations of the Bonn Conference 2015: Indicators, Interlinkages and Implementation:

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1. Executive Summary

Human activities play a dominating role compared to many other natural processes in changing the biosphere and affecting the functioning of the Earth system. Overstressing the earth and exhausting its resources are causing interrelated, complex and frequently unwanted outcomes. Changes of the water cycle have also impacted the global water system as part of the Earth system.

In September 2015 the UN General Assembly responded to these challenges by adopting the Sustainable Development Goals (SDGs). The importance of water as an integral part of all human development and ecosystem needs is emphasized through the dedicated Water Goal SDG 6. However, making sure that a Water SDG is "SMART (Specific, Measureable, Attainable, Realistic and Timebound)" requires a broad and in-depth knowledge of the global dynamics of water availability and use. Science is to play a strong role in facilitating the implementation of SDGs through assessments and engagement with policy at all levels - global to local.

While the goals and targets of sustainable development are now defined, there are still intensive discussions going on, concerning the definition and adoption of the official indicators to be used in monitoring and reporting the progress towards the achievement of the respective targets and ultimately all SDGs.

Recognizing that the formal involvement of the science community in indicator development so far was practically non-existent, the Global Water System Project (GWSP) sponsored by the German Ministry of Education and Research (BMBF) organized the conference "**Sustainable Development Goals : A water perspective"** in August 2015 in Bonn, Germany**.** With the focus on three essential aspects of SDGs- **indicators, interlinkages and implementation,** the conference played a key and timely role in helping the science community to interact with the international policy consultation process.

It is beyond doubt, that meaningful indicators are most needed to assess sustainable water use and protection for humans and natural systems considering both quantitative and qualitative aspects. In principle, indicators should be simple and SMART and able to inform policy makers on progress made towards sustainability. The number of variables for quantifying such indicators and indicator sets need

to be sufficient to capture complexity but it should also be small enough to be manageable in terms of monitoring and public communication.

At the global level, appropriate risk metrics are needed to assess whether humans are in a safe and sustainable operating space of the global water system and still can meet their essential needs. At regional and local levels, water risk assessment is needed to guide social, private and public decisions on investment and also in developing appropriate institutions and coordinating implementation plans. There is a need for development of scientifically-sound assessment and regulatory guidelines that can help to address the gaps in process understanding focusing on the interaction between stressors and their impacts on the ecosystem health of freshwater bodies.

The SDGs are formulated as individual goals but they are not independent of each other. Sustainable use of water, for instance, is the key to attain other goals as water is fundamentally linked to other SDGs. The SDG implementation process must thus support building of institutional capacity to achieve its goals. The SDGs will not be achieved without political will. Therefore the attendance of the conference by over 200 high level representatives of the policy making, intergovernmental (UN), civil society (NGO), professionally practicing and scientific communities was a promising sign of emerging partnerships and wide scale dedication.

It is crucial to recognize that implementing SDGs is a social process – it's a process of development. We need to link how SDGs relate to public benefits and communicate for the broader public. For instance, the question can be framed as 'how do we make the water drinkable', rather than an abstract question of water quality without considering the direct or indirect human dimension. In general, communication should target a common understanding of the essential role water plays for human life and existence to create a momentum where not only government bodies but societies are involved in implementing the SDGs. Solutions-oriented research can facilitate the emergence of innovative technologies and approaches towards the achievement of the water SDG and its inherent targets.

Obviously there are still serious unresolved scientific, professional, but also societal challenges involved. It is not perceivable that conclusive answers will be found to all of them before the implementation of SDGs starts and inherent monitoring and indicator related decisions have to be made. This implies that the scientific community must remain involved in the years to come and assist the implementation process. In many aspects it will be a "learning by doing" adaptive process.

This report summarizes the findings of the conference concerning research gaps in relation to the 8 targets of the Water SDG (SDG 6) and the currently proposed indicators in tabular form. Thus the conference "Sustainable Development Goals: A water perspective" can be seen as a starting point for a forthcoming fruitful partnership between scientists and other stakeholders of the SDG process.

The SDGs have set ambitious goals for sustainability which need equally bold and innovative approaches for financing the projects and programs that will turn the present goals to future reality. The financial

models have to account for the fact that environmental goals matter in the SDGs. Not only financial capital but also the natural capital should be built up, and not just for today but also for tomorrow.

Monitoring and evaluation have their own capacity needs both in terms of professional and financial resources. However the capacity needs of the SDGs go much beyond that of monitoring. Substantial capacity deficits, especially in developing countries must be addressed. Professional and vocational capacities, but also educators and media capacities are needed as the multi stakeholder implementation necessitates informed citizens, public and private engagement and mentality shift. Thus all levels of society - government, academia, NGOs, and others – should be involved in SDGs monitoring.
A key challenge will be to connect efforts of different actors into an effective systemic arrangement to deliver all goals of sustainable development and societal welfare.

Effective implementation of SDGs needs knowledge brokers to facilitate dialogue and communication between science, practitioners and policy makers. It is to enable scientific support in form of knowledge generated by global water science for decision makers from water policy, planning and management. It entails a robust science-based and internationally mandated process to regularly monitor, review and assess progress of the implementation of SDGs.

2. Kurzfassung

Im Vergleich zu natürlichen Prozessen hat das menschliche Handeln einen dominierenden Einfluss auf viele physikalische und biologische Prozesse im System Erde. Die Überbeanspruchung des Planeten und der Raubbau an den natürlichen Ressourcen haben komplex verknüpfte und größtenteils unbeabsichtigte Konsequenzen. Veränderungen auf allen Ebenen des Wasserkreislaufs, der wesentlicher Bestandteil des globalen Systems ist, beeinflussen auch das globale Wassersystem.

Um diesen Veränderungen und Herausforderungen zu begegnen, verabschiedete die Vollversammlung der Vereinten Nationen (UN) im September 2015 die Sustainable Development Goals (SDGs). Mit der Formulierung eines dezidiert wasserbezogenen Ziels (SDG 6) wurde die Bedeutung von Wasser für jedwede menschliche Entwicklung sowie für das gesamte Ökosystem unterstrichen. Um sicherzustellen, dass dieses Wasser-SDG „SMART“ (Specific-Measurable-Attainable-Reaslistic-Timebound) ist bedarf es umfassendem und tiefgreifendem Verständnis der globalen Dynamiken von Wasserverfügbarkeit und –bedarf. Durch entsprechende Analysen und Auswertungen sowie Einbringen von Expertise in die Entscheidungsgremien kann die Gemeinschaft der Wissenschaftler eine zentrale Rolle bei der Umsetzung der SDGs spielen – sowohl global als auch auf lokaler Ebene.

Während die Zielsetzungen (SDGs) und Zielvorgaben (targets) definiert und verabschiedet wurden, gibt es dennoch großen Diskussionsbedarf bezüglich der Indikatoren die im Rahmen des SDG Prozess zur Beobachtung der Umsetzung und Zielerreichung angewandt werden sollen. Mit Hinblick auf die

Tatsache, dass Wissenschaftler bislang in keinster Weise in die Entwicklung dieser Indikatoren eingebunden war, hat das Global Water System Project (GWSP) mit finanzieller Unterstützung des Bundesministeriums für Bildung und Forschung (BMBF) die internationale Konferenz **„Sustainable Development Goals: A water perspective“** im August 2015 in Bonn ausgerichtet. Der Fokus der Konferenz, die eine einmalige Plattform zur Interaktion zwischen Wissenschaft und dem internationalen SDG-Prozess bot, lag auf den drei „I“s der SDGs: Indikatoren, Interlinkages (Zusammenhänge) und Implementierung.

Es steht außer Frage, dass es aussagekräftiger Indikatoren bedarf um nachhaltige Wassernutzung zu messen, sowohl in quantitativer als auch in qualitativer Hinsicht. Prinzipiell sollten Indikatoren leicht anwendbar und „SMART“ sein um Entscheidungsträger einfach aber umfassend über den Fortschritt der Zielerreichung zu informieren. Die Anzahl der Variablen, die in solche Indikatoren einfließen, müssen ausreichend sein um die Komplexität des globalen Wassersystems zu erfassen jedoch gleichzeitig nicht zu umfangreich um noch realisierbar zu sein.

Auf globaler Ebene betrachtet ist die Entwicklung von Risiko-Messgrößen notwendig, um abzuschätzen inwieweit Gesellschaften im Rahmen des globalen Wassersystems nachhaltig mit Ihren Wasserressourcen umgehen. Auf regionaler und lokaler Ebene sind wasserbezogene Risikoabschätzungen eine Möglichkeit um SDG bezogene Investitionsentscheidungen sowie die Bildung entsprechender Institutionen unterstützend zu beraten. Von zentraler Bedeutung ist es, wissenschaftlich fundierte Auswertungsrichtlinien zu entwickeln, die die Lücken im Prozessverständnis der Wechselbeziehungen zwischen Stressfaktoren und Auswirkungen auf die Süßwasser Ökosysteme schließen.

Die SDGs sind als alleinstehende Ziele formuliert, sie sind jedoch nicht unabhängig voneinander zu betrachten. Die nachhaltige Nutzung der Ressource Wasser beispielsweise ist die Grundlage um verschiedene SDGs zu erreichen. Während des Umsetzungsprozesses der SDGs sollten die institutionellen Rahmenbedingungen geschaffen werden, um die entsprechenden Zielsetzungen zu erreichen. Ohne politischen Willen werden die SDGs nicht umzusetzen sein. Die Teilnahme von mehr als 200 hochrangigen Vertretern aus Politik, Wissenschaft, intergouvernementaler Behörden (UN), Zivilgesellschaft (u.a. NGOs) und Wirtschaft setzt hier ein vielversprechendes Zeichen und lässt auf zunehmende Zusammenarbeit und Engagement hoffen.

Die Umsetzung der SDGs ein sozialer Prozess ist – dies ist eine grundlegende Erkenntnis. Wir müssen die SDGs als positiv für die Gesamtwohlfahrt verstehen und dies entsprechend an die breite Öffentlichkeit kommunizieren. Ganz allgemein sollte die Außendarstellung und Bildung ein gesellschaftliches Verständnis der zentralen Rolle von Wasser für die menschliche Existenz zum Ziel haben. Aus einem solchen Momentum heraus wäre es möglich auch die Gesellschaft direkt in die Umsetzung der SDGs mit einzubeziehen. Lösungsorientierte Forschung kann die Entwicklung von technischen Innovationen stimulieren, die die Zielsetzung der SDGs unterstützen, sie kann jedoch nicht den politischen und

gesellschaftlichen Willen ersetzen. Offensichtlich ist noch eine Vielzahl von wissenschaftlichen, politischen und gesellschaftlichen Herausforderungen zu bewältigen. Es ist nicht absehbar, dass umfassende Antworten auf alle Fragen gefunden sind, bevor die Umsetzung der SDGs beginnt. Dies impliziert, dass die wissenschaftliche Community weiterhin und verstärkt in den SDG Prozess einbezogen werden sollte. In vielerlei Hinsicht kann dieser ein „learning by doing" Prozess sein.

Dieser Bericht trägt die Ergebnisse der Konferenz, im speziellen Forschungsdefizite bezüglich der 8 Zielformulierungen des SDG6 sowie der entsprechenden Indikatoren, tabellarisch zusammen. Die Konferenz „Sustainable Development Goals: A water perspective" kann entsprechend als Ausgangspunkt einer ergebnisversprechenden Partnerschaft zwischen Wissenschaftlern und den am SDG Prozess beteiligten anderen Akteuren gesehen werden.

Die SDGs haben ehrgeizige Ziele im Bereich der Nachhaltigkeit gesetzt. Sie verlangen nach innovativen und mutigen Ansätzen um Projekte zu finanzieren und durchzuführen die die gegenwärtig formulierten Ziele in zukünftige Realität umsetzen. Die Finanzierungsmodelle müssen dabei berücksichtigen, dass umweltpolitische Ziele im Rahmen der SDGs von großer Bedeutung sind. Nicht nur monetäres auch ökologisches Kapital ist zu bewahren, nicht nur für den Moment, sondern nachhaltig für die Zukunft der gesamten Menschheit.

Sowohl Monitoring- als auch Auswertungsvorhaben benötigen dabei spezifische Ressourcen – sowohl finanzielle Mittel als auch fachliche Expertise der durchführenden Personen. Die zur Umsetzung der SDGs benötigten Kapazitäten gehen jedoch weit über die des Monitoring hinaus. Grundlegende Defizite diesbezüglich müssen insbesondere in den Entwicklungsländern aufgearbeitet werden. Die Umsetzung der SDGs unter Einbindung verschiedenster Akteure verlangt sachkundige Bürger sowie hohes Engagement in den privaten sowie in den gesellschaftlichen Bereichen. Entsprechend sind fachliche Kompetenzen und Expertisen genauso notwendig wie hohes Niveau in den Bildungs- und Mediensektoren. Alle gesellschaftlichen Bereiche, Regierungsorganisationen, Wissenschaft, Nichtregierungsorganisationen und viele andere sollten in den Monitoring Prozess der SDGs mit einbezogen werden. Eine der grundlegendsten Herausforderungen dabei wird sein, die Anstrengungen der verschiedenen Akteure effektiv zu koordinieren um sicherzustellen, dass sowohl die SDGs erreicht werden als auch die gesellschaftliche Gesamtwohlfahrt aufrechterhalten bleibt.

Letztendlich bedarf es Vermittlern und „Übersetzern", nicht nur zwischen den unterschiedlichen Disziplinen, sondern auch zwischen Wissenschaft, Fachleuten der Praxis sowie der Politik. Für die wissenschaftliche Gemeinschaft geht es darum Entscheidungsträger durch wissenschaftliche Erkenntnisse aus dem Bereich der globalen Wasserforschung bei der Wasserbewirtschaftung und Planung sowie bei wasserbezogenen Entscheidungen in der Politik zu unterstützen. All dies sollte zu einem robust wissenschaftlich basierten und international legitimierten Prozess führen, der die Umsetzung der SDGs kontinuierlich überwacht, überprüft und bewertet.

3. Introduction

Today human activities play a dominating role compared to many other natural processes in changing the biosphere and affecting the functioning of the Earth system. Overstressing of the earth and exhausting its resources are causing interrelated, complex and frequently unwanted outcomes. They have also impacted the global water system as part of the Earth system and change the way water moves around the globe like never before. Today actions at the local scale to enhance human water securityi and well-being often trigger increased environmental stress at regional and local scales and thus create a trade-off between human water security and environmental sustainability. Thus, while the manifestations of human water security at the expense of freshwater ecosystem health or the occurrence of human water insecurity with the inherent political and ethical imperative to eliminate it may be at local and regional scales, the widespread occurrence of both cases magnify them to be of global concern. The governance systems in both industrialized and developing countries lack capacity to handle these challenges and uncertainties. Superimposed by other elements of global change like climate variability and change, population growth and displacement (migration, urbanization) , the relevant question arises how can we ensure human development (well-being and social equity) and sustainably that meets the needs of the present while safeguarding earth's vital life support system, on which the welfare of current and future generation relies?

Sustainable development, as seen in the context of this challenge, is strongly connected to the availability of sufficient quantity and quality of water for the preservation of healthy ecosystems and is critical for socio-economic and human development. In September 2015 the UN General Assembly, representing a vast majority of states of the world, responded by adopting a set of Sustainable Development Goals (SDGs), which emphasized the importance of water as an integral part of human development and ecosystem needs. However, making sure that an SDG in the area of water is "SMART (Specific, Measureable, Attainable, Realistic and Timely)" requires a broad and in-depth knowledge of the global dynamics of water availability and use. Thus science is to play a stronger role in facilitating the implementation of SDGs through assessments and policy engagement at all levels- global to local.

While the goals and targets of sustainable development are now defined, there are still intensive discussions (within and between the UN interagency Global Expanded Water Monitoring Initiative (GEMI) on Integrated monitoring of water and sanitation related SDG targets and the Inter Agency and Expert Group of the UN Statistical Commission UNSC) going on concerning the definition and adoption of the official indicators to be used in monitoring and reporting the progress towards the achievement of the respective targets and ultimately the sustainable development goals. In this process UN Water is proposing a total of 12 indicators to measure the progress of the achievement of the 8 targets of the dedicated water goal. Decision concerning the selection of indicators is expected in March 2016 during the 47th session of UNSC.

It is a paramount task to select "actionable" indicators measuring progress towards the achievement of 169 targets on local, national and global scales, and it is even more so as data in many parts of the world

are either non-existent or unavailable. Thus indicator based assessments will have to rely on intensified monitoring and sustained follow up according to the results of monitoring. Beyond measuring success (or the lack of it) on 169 accounts, the indicators have to capture the strong interlinkages and interdependencies among various goals and targets. This may imply the use of some common indicators which could measure simultaneously progress towards different targets. The implementation of the SDGs incorporates aspects of societal progress, development and deployment of capacities, change of mentality and human behaviour. Ultimately these changes should also be monitored to ensure successful and sustainable implementation of the SDGs. The SDG framework, not only from the water perspective, poses a number of conceptual as well as implementation challenges that requires enhancing the close collaboration between the policy and scientific communities and other stakeholders and sectors like industries, agriculture etc. from the very beginning. It is important to engage in partnerships between science, policy, industry, agriculture and civil society at large to implement and monitor the achievement of SDGs.

Recognizing that the formal involvement of the science community in the development of the indicator development so far was practically non-existent, the Global Water System Project (GWSP) sponsored by the German Ministry of Education and Research BMBF) organized the conference "**Sustainable Development Goals: A water perspective"** in August 2015 in Bonn, Germany, to advance the science-based monitoring and implementation of the Water SDG (SDG 6)**.** With the focus on three essential aspects of SDGs- **indicators, interlinkages and implementation,** the conference played a key and timely role in helping the science community to interact with the international policy consultation process to inform, and catalyse action by key actors—including policymakers, intergovernmental (UN), non-governmental organizations, the private sector, educators, and researchers as agents of change.

While the conference adopted a "water perspective" the focus was not only on the six "what to achieve" type and two "how to do" type targets of the dedicated water goal (SDG 6) but also on the potential interlinkages with other goals and targets, among them "genuine" water targets like 11.5 (resilience to water-related disasters) or 15.1 (improve status of freshwater ecosystems), which were defined and adopted as part of other SDGs.

Different aspects of indicators, interlinkages and implementation, the three "I"s were discussed in 10 panel/dialogue sessions. While all sessions addressed all three "I"s, the associated challenges and recommended solutions the perspectives were different.

Theme: Indicators

Thoughts about indicators, assessment and reporting

This theme covered the discussion how to develop appropriate indicators, and indices across several disciplines for water, wastewater and water resources management & governance, water quality and water related disasters. It explored monitoring frameworks and data integration for a comprehensive

picture of the global water system. The sessions under this theme also discussed the strategic and detailed elements of the scientific assessment process, and how to create a practical set of steps leading to a reporting mechanism to deliver knowledge and insights generated by global water science e.g. periodical assessment reports on water to be provided to water-related policy makers and the applications community.

Theme: Interlinkages

Identifying key trade-offs and complementarities

Under this theme, trade-offs and complementarities were determined to distinguish between "What" and "How" type of SDGs and targets; and how SDGs can be more effectively implemented and monitored by the use of integrated information, and principles of good governance and management through strengthening cross-level interactions in water , food, energy , health interfaces. This theme also covered tools to support the implementation of innovative and integrated risk governance and management approaches under uncertainty, and explored how risk governance can minimize the negative impacts of existing and emerging risks in relation to the SDGs.

Theme: Implementation

Advancing Practice, Science and Policy Links, Partnerships and Innovative Solutions

This theme focussed on the practice, science & policy (P-S-P) link, and how it can be strengthened through co-design of research and solutions in the perspective of SDGs. The sessions under this theme addressed on how sharing available information, knowledge and action gaps, as well as viable instruments and approaches can contribute to implementation of SDGs. This theme discussed integration of scientific research with industrial solutions towards identifying a feasible set of sustainable water solutions with an overall objective of sustaining environmental services, reducing threats to ecosystems while ensuring human water security.

4. Specific Comments on Research Gaps Related to the Water SDG (Goal 6) its Targets, the Proposed Indicators, Interlinkages and Implementation

This section summarizes the challenges related to implementation and monitoring the targets of SDG 6. It lists some key recommendations formulated by the science community, and other stakeholders during the conference. The targets are classified into "how's" and "what's" targets.

INDICATORS proposed by UN WATER	**RESEARCH GAPS** as identified during preconference consultations and the conference
TARGET 6-1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all ("WHAT" TARGET)	
• Percentage of population using safely managed drinking water services	• Assess risks to human health from unsafe water sources • Explore how such risk can be mitigated in a cost efficient and sustainable way • How could investment in natural infrastructure help securing the sustainable provision of drinking water • Measure and address affordability of drinking water supply
TARGET 6-2 By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations ("WHAT" target)	
• Percentage of population using safely managed sanitation services • Percentage of population with a hand washing facility with soap and water in the household	• Understand the interlinkages between agriculture, health and sanitation • Understand and explore ways to change the perception of households towards hygiene and sanitation practices (using soaps) • Design solutions that reduce negative environmental impacts of hard path engineering in providing improved hygiene and stable water supply and protect environmental resources and services • Stimulate technical, institutional, social innovation increase the access to affordable sanitation and hygiene
TARGET 6-3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally ("WHAT"/"HOW" target)	
• Percentage of wastewater safely treated • Percentage of receiving water bodies with ambient water quality not presenting risk to the environment or human health	• Focus on research and technological advancement that can help in better monitoring of waste water from production perspective • Need to distinguish point and non-point source pollution in indicator development • Develop and implement innovative solutions (also recognizing intuitional and institutional barriers) that can reduce the untreated waste water discharges into

	water source instead of following the hitherto prevailing "impair and then repair" approach • Improve the quality and reliability of water supply in cities that seeks to make greater use of "local" resources in a sustainable way • Understand the links between the water, phosphorous, nitrogen and carbon cycles and other pollutants such as heavy metals, pathogens, and pharmaceutical residues • Assess the magnitude and the impact of these pollutants on water quality and how could these impacts be reduced and controlled • Develop an appropriate indicator that links water quality to environmental flow requirements for maintenance of aquatic ecosystem (% of aquatic life lost)
TARGET 6-4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity ("HOW" target)	
• Level of water stress: freshwater withdrawal in percentage of available freshwater resources • Percentage of change in water use efficiency over time	• How can we use the "saved" water equitably, sustainably and efficiently which is key to understand the benefits of water use efficiency • National statistics often fail to assess water stress and fail to capture the full dimensionality of water problems. Alternative geospatial analysis could give better insights over populations at risk • Develop Indicators on economic water scarcity that can give insights of lack of investment in water or insufficient human capacity to satisfy the demand • Measure the footprints of scarce water • Measurement of water efficiency should take into account relative water scarcity to assess the benefits of water saved from efficient usage
TARGET 6-5 by 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate ("HOW" target)	
• Degree of integrated water resources management	• IWRM is a process rather than a target. It can help to achieve targets 6-4 and 6-6 • The indicator requires comparable water governance data bases collected nationally

(IWRM) implementation (0-100 %) • Percentage of transboundary basin area with an operational arrangement for water cooperation	• Develop an indicator that focuses on implementation of solutions and contribute to effective flood and drought prevention, and integrated land and water management • Develop an indicator that focuses on benefit sharing principle in transboundary water sharing
TARGET 6-6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes ("WHAT"/"HOW" target)	
• Percentage of change in wetlands extent over time	• Target 6-6 is connected to achieving Targets 6-1 to 6-4. It is important to make the connection explicit • Develop an indicator to measure the loss of aquatic species • Develop an indicator that maps the capacity of upstream source areas to provide water for human populations downstream • Develop an indicator that compares the river discharge at sea as percentage of annual flow • Develop an indicators that ensures that sediment budgets in major river deltas remain balanced
TARGET 6-A By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies ("HOW" target)	
• Amount of water and sanitation related Official Development Assistance that is part of a government coordinated spending plan	• Need for engaging policy, business, science and civil society at large in developing innovation in water engineering technology, institutions, and new instruments of governance • Political will is needed to ensure local level solutions emerge and achieve simultaneously the twin goals of environmental conservation and economic development over a broader domain and over a time span of generations • Free data sharing and transparent public reporting against quality and quantity objectives in place
TARGET 6-B Support and strengthen the participation of local communities in improving water and sanitation management ("HOW" target)	

• Percentage of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management	• Local communities and stakeholder groups need to be involved in the process of implementation and assessing progress of SDG implementation

5. Meaningful Indicators for Assessment in Informed Decision Making at Different Levels

"Not everything that can be counted counts, and not everything that counts can be counted"

– Albert Einstein

It is beyond doubt that meaningful indicators are most needed to assess sustainable water use for humans and natural systems considering both quantitative and qualitative aspects. Current set of indicators developed to track water related SDGs, however, lack clear-cut definitions including minimum standards/guidance and suffers ambiguity (e.g. what is "improved sanitation" or "appropriate transboundary cooperation") and may fail to provide a clear understanding on the progress that will be made on SDGs. For example definitional uncertainties and misinterpretation can even discredit acclaimed target achievements. The shift of semantics to "improved" water supply in Millennium Development Goal MDG 7 drinking water target created sizable uncertainty whether the target of providing "safe drinking water" was achieved at all.

In principle, indicators should be easy to apply, SMART and able to measure how far political aspirations were achieved, inform policy makers on progress made towards sustainability, and not to give implementation rules for countries since every country should translate those targets and how to achieve them into their own realities. On the other hand, indicators shall not be too simple but ultimately deliver sustainability measures so that we will be able to understand the trajectories that ensure resource efficiency, sustainability and well-being. For instance an ideal indicator may reflect on how sustainable is a water management measure and not only counting of installed latrines per capita or other simply quantifiable achievements.

The number of variables for quantifying such indicators and indicator sets need to be sufficient to capture complexity but it should also be small enough to be manageable in terms of monitoring. Scenarios are useful tools to determine water futures and can be used to see if potential indicators can characterize the outcomes of complex scenarios. For scenario development, time series data are needed which are spatially scalable, consistent and harmonized. Such kind of information backed by scientific

evidence can allow distinguishing between “what can be done" and what can’t be done, and what are the costs of inaction to implement water related goals including social implications.

There is a risk of overlooking and neglecting global dynamics with large and possibly irreversible impacts on humans and nature if the focus is only on local processes. Also, there is a particular concern that an approach which attempts to assess water situations only at a global scale may mask critically important and unique local contexts that influence water risk. Given the reciprocal benefits of considering local to global scales, a continuum approach from local to global and assess systemic risk at different levels and for different sectors is needed so that it can inform policy makers on progress made, and provide a reality based global vision on sustainability.

Indicators need to be inspirational, i.e. we should not stick to what we know and should not be afraid to innovate.

At the global level, appropriate risk metrics are needed to assess whether humans are in a safe and sustainable operating space of the global water system and still can meet their essential needs. At a regional and local level, water risk assessment is needed to guide social, private and public decisions on investment under risk and uncertainty, and also in developing appropriate institutions and coordinating implementation plans.

Water quality is strongly linked to SDGs, focusing on sustainability of water use for future generations. Declining water quality, for instance with harmful implications in the long run for socio-ecological

Local indicators for global SDG efforts?

In order to gain more information on wastewater treatment which is a crucial part of sanitation, the Yale Environmental Performance Index (EPI) has developed the national wastewater treatment indicator. An interactive map of percentage of wastewater treated per country performance is established using crowdsource data to overcome data scarcity in this field.

Even more “on the ground” approaches are taken up for example by the Swachh Bharat Mission (SBM) in India. Their sanitation campaign aims at promoting the use and construction of latrines in rural areas. The previous monitoring system was based on expenditure for sanitation, thus not directly observing de facto toilet construction leading to significant over-reporting: 80% of the toilets being recorded could not be verified as existing by the Census 2011. In order to improve the monitoring system the SBM is setting up a smartphone based observation system. Using geo-tagged pictures of latrines are a simple and efficient method to report toilet construction and existence household specific. Both cases could be used as baseline examples for SDG monitoring. However, neither of the procedures bridges the gap between local and global scale monitoring.

systems as a whole, has become a global issue of concern. Today we recognize that water scarcity is gradually even more a quality than a quantity problem. Currently there exists a very wide range of possible water quality indicators, and yet it remains a formidable challenge to adequately address the quality status of freshwater bodies in most parts of the world.

There is a need for development of scientifically-sound assessment and regulatory guidelines that can help to address the gaps in process understanding focusing on the interaction between stressors and their impacts on the ecosystem health of freshwater bodies.

Further, many global measures or indicators do not reflect the household or community level action towards or away from sustainability. The sustainability conditions which hold at the macro level may not be the same at the household (micro) level. There is a strong need to include household and community level water quality and sanitation assessments to account for the multiple scale nature of the respective target achievement.

6. Understanding the SDG Interlinkages

The SDGs are currently formulated as individual goals but they are not independent. Sustainable use of water, for instance, is key to attain other goals as water is fundamentally linked to other SDGs and remains a crucial factor of adaptation to the intertwined challenges that humankind faces in the light of global change, including climate change, environmental hazards, population growth, health risks, food insecurity and pollution, while aiming to achieve social objectives like poverty alleviation, economic development, technological innovations, land use change, ecosystem protection and restoration including the inherent ethical issues and socio –political implications. This is why the targets relating to fresh water systems are to be found not only in the dedicated water goal (goal 6) but also in other goals. A risk in the failure to achieve water related goals can propagate and make also the achievement of other goals doubtful, while prioritizing the water targets could be one of the smartest ways to maximize the potential stimulus of other SDGs. Partial approaches neglecting the cross effects may underestimate or overestimate the consequences of uncoordinated actions and lead to biased policy implications. There is growing evidence that the areas with the largest rural poverty, malnutrition and food insecurity are also those with the greatest water and land degradation. This requires integrated management approaches like IWRM, in the context of agro-ecological systems to preserve ecosystem services for humans and nature, and higher investment in integrated land and water resource improvements in these areas.

The SDGs are individual goals but they are not independent.

Indicators that are multipurpose such as those related to nexus issues should be cautiously used and not seen as a panacea to reduce the number of indicators. This requires a rigorous evaluation and

assessment on the linkages of water and other goals. Water quality, for instance, is influenced by many factors (e.g. land degradation, health, sanitation etc), however, in the dedicated health and food security goals there is no water related indicator that addresses this interlinkage. Further as water quantity and quality are highly interlinked, there is also a need to address linkages between water supply and wastewater treatment.

In this context the problems related to surface water bodies are more obvious. Their deterioration takes place precipitously; it is visible and often detectable to the human nose. However unsustainable practices influence the entire hydrological cycle.

Groundwater systems (local, regional and continental aquifers) are strategically significant, constituting the planet's major storage reserve of freshwater and representing a critical buffer for socioeconomic adaptation to climate and environmental change. Threats to their sustainability, associated with both excessive exploitation and quality degradation over the past 30-50 years, represent a potential impediment to achieving the SDGs – and this applies not only to the SDG-6 for water, but also to SDG-2 on food security, SDG-3 on human health, SDG-11 on resilient cities and SDG-15 on protecting ecosystems and conserving biodiversity. In many senses the proposed SDGs tend to 'skate around' the critical consideration of absolute physical constraints on natural resources such as groundwater, and how these have been significantly reduced as a result of inadequate custodianship historically. The SDGs relating to food production, resilient cities and aquatic ecosystems can only be achieved in the long term if underlying groundwater systems are conserved in 'good status' and not subject to continued depletion and/or quality degradation.

7. Supporting the SDG Implementation Process

The implementation of the ambitious SDGs poses considerable challenges to water governance. Many water related problems arise from inadequate and dis-functional governance settings, irrespectively whether the physical scarcity is prevalent or not. A lack of institutional capacity is the central factor to explain poor performance of water governance in many countries. Effective implementation of the SDGs requires adaptive and effective governance and the respect of good governance principles in water-related sectors and elsewhere to prevent adverse implications. The SDG implementation process must thus support building of institutional capacity to achieve its goals. The SDGs will not be achieved without political will. Water governance should be participatory, accountable, transparent, responsive, consensus orientated, effective and efficient, equitable and inclusive, and should respect the rule of law. This raises the question: How can political will, institutional capacity and good governance be fostered so that SDG process could become a global process driving transformative change towards sustainability? It requires engaging policy, business, science and civil society at large, and formulating incentives that

Integrated water resources management will be a key element to achieve the SDGs.

foster harmonised interlinked regulations and policies. It is key to recognize that implementing SDGs is a social process – it's a process of development. We need to link how SDGs relate to public benefits and communicate for the broader public. For instance, the question can be framed as 'how do we make the water drinkable', rather than an abstract question of water quality without considering the direct or indirect human dimension.

Innovations for Sustainable Development

Many water initiatives and solutions exist, all around the globe, and indeed address these challenges, but frequently from single, constrained perspectives. Scientists are concerned with understanding the nature and impact of global change, businesses implement new strategies and products, policy makers on all different levels attempt to mitigate and adapt to environmental impacts and non-governmental organizations raise awareness and actively protect and support impacted humans and nature. Despite these various efforts it is beyond any doubt that sustainable development requires accelerated technological, social and institutional innovation. The increasing demand for drastic reductions of environmental burdens and footprints of human consumption e.g. of water pollution and excessive withdrawals, implies that adaptation within existing technologies is not sufficient. Instead, radical and systematic innovations - we urgently need a paradigm change in approach and a framework that strongly connects problem identifiers with solutions identifiers, knowledge generators and knowledge implementers while focusing on integrated solutions. Such a solutions-oriented integrated approach can act as an antidote to the otherwise sluggish flow of evidence-based knowledge from the water sciences to policy formulation to applications. It can help to develop knowledge-to-concrete actions, and find solutions through the co-production of knowledge involving scientists and other stakeholders. This may be done by facilitating dialogues between different stakeholders (science, industry, policy makers, and civil society), which will help to stimulate the diffusion process of innovations by identifying "demand pulls" instead of creating a "supply push". There is a need to bring forward best practices of technological, institutional and social innovation that will help in designing co-evolutionary policies and ensure the twin goals of environmental conservation and economic development are not conflicting but producing mutual benefits (or synergies).

Solutions-oriented research can facilitate technologies and approaches towards the achievement of the water SDG and its different targets.

Obviously there are still serious unresolved scientific, professional, but also societal challenges involved. It is not perceivable that conclusive answers will be found before the implementation of SDGs starts and inherent monitoring and

Strong "political will" is required to make SDGs a reality.

indicator related decisions have to be made. This implies that the scientific community must remain involved and assist the implementation process. No doubt in many aspects it will have to be a “learning by doing” adaptive process.

The Role of Water Infrastructures

Water storage plays a key role to mitigate the effects of scarce and unreliable water supply and yet no other engineering intervention is as controversial as dams and reservoirs. Thus the potentially controversial debates over technical solutions can be well illustrated in the case of dams. There are no doubt serious consequences for freshwater but also for terrestrial ecosystems and human society. Not only the displacement of people due to the impoundment of water but the differences between the (new, mainly downstream) beneficiaries and the affected (local) population are serious issues both within a country and even more in transboundary context.

In spite of this conflict prone background the question, whether the SDGs can be achieved and whether the adaptation to climate change can be implemented without providing substantial additional storage facilities and capacities is exemplary for this type of dilemmas. There is historical evidence that human water security, but also other dimensions of human well-being are positively correlated with the availability and size of water storage space per capita in the respective countries. At the present level of professional wisdom it cannot be perceived that the relevant SDGs could be achieved without increasing water storage capacities worldwide. A massive dam development, propelled predominantly by funding from private sources is already under way to respond to increasing energy needs. Potential co-benefits for agriculture are unlikely to be considered. There is much to be learned how to establish consensus to build those dams which are most needed and save as many rivers and valleys as possible from being turned into an engineered system. Reservoirs which are well designed and operated as multipurpose facilities can contribute to the achievement of several SDGs, including even ecosystem oriented ones. Improved energy, food and water security, but also disaster risk mitigation and securing environmental flows downstream can be attributed to dams and reservoirs.

Groundwater reserves constitute the other major form of freshwater storage, and also have specific (but very different) ‘infrastructure requirements’ if they are to be used sustainably. Foremost amongst these is an adequate monitoring network to keep under long-term review whether they are being excessively depleted or progressively salinized by current regimes of withdrawal for irrigated agriculture and/or urban water-supply. In most cases their sustainable utilisation to improve water-supply security and ensure ecosystem conservation will require conjunctive management with surface water resources to take advantage of complementary hydrologic characteristics. This in turn often initially requires larger up-front capital investment and always needs strengthening of the ‘resource governance regime’.

Financing the Water SDG

The SDGs have set ambitious goals for sustainability which need equally bold and innovative approaches for financing the projects and programs that will turn the present goals to future reality.

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We will need to depart from Business-As-Usual, fully embrace a new and comprehensive view of social, economic and environmental development, and encourage and enable countries to take ownership of the SDGs. We should actively seek new models of financing, and should recognize that there are significant opportunities to mobilize public and private capital if investment risks are adequately reduced. With competitive returns, or at least reduced risks than what has traditionally been the case for water sector projects, we will find that there is willingness to invest and previously untapped resources can become accessible.

We need to depart from Business-As-Usual Models.

Finance for Development: Alternatives needed!

The Bolsa Familia social protection system is a good practice example from Brazil. It provides cash transfers to households which fall below a certain income level. It accounts for extreme low income as well as for families with a newborn and after 3 years in place the programme reached more than 11 million families in 2006. Besides such domestic monetary sources which are needed the Finance for Development Conference (FFD) also proposed innovative private solutions. For water specific projects, new financing schemes like crowd funding might be a promising approach, not only providing benefit but also ownership to the society.

The financial models have to account for the fact that environmental goals matter in the SDGs. Not only financial capital but also the natural capital should be built up, and not just for today but also for tomorrow. The real value and costs of ecosystem services should be accounted for rather than ignoring them and paying later for the repair of damages. The accounting needs to be different and the time evaluation horizon is long – this changes the equation for finance in fundamental ways. Furthermore, it is needed to move beyond financial evaluation and broadly think of the economic impacts with a comprehensive consideration of social and environmental aspects. In order to achieve the SDGs, a mix of hard and soft systems will be needed – therefore a combination of financial models and approaches should be considered. We will also have to be astute in ensuring that not a cannibalistic economy would be created where net impacts of development don't add up to costs that cities and municipalities are unable to afford.

Municipal water resources and services are currently under-resourced, undervalued, and underpriced. There is a strong need to consider financial instruments which are user paid like tariffs and taxes. Those can help to achieving a sustainable financial system in the long term. However, if the investments of many large water projects are financed through transfers through external aid and philanthropy, then it may lead to a less sustainable outcome in the long run. Concessional funding, bonds or loans could be viable alternatives.

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Capitalizing on the Willingness to Invest in Risk Reduction and Willingness to Pay

A key element in attracting investments will be risk reduction – and that goes hand in hand with governance. New and effective financial models will be necessary but not sufficient for mobilizing monetary resources – good governance models will also be needed. The drain of corruption has been a major barrier that has stalled development also in the water sector. Investors do not want to commit resources where corruption losses do not only loom large but also certain to occur. Another key element in attracting investment (public or private) is to present substantive evidence of success. New models that demonstrate economic and service delivery sustainability will increase confidence and initiate a virtuous cycle of further investments.

Additionally, pragmatic narratives and presentation of the issues are needed that draw in private sector support. We need to leverage the recognition that already exists in the private sector about sustainable development and the negative consequences of environmental degradation. For continued prosperity, we want to have places where people want to live not leave. Corporate social responsibility offices and recognition alone will not be sufficient in the future – real action will be needed.
In conjunction to willingness to invest on part of public and private sector, there is also a willingness to pay if the benefits can be perceived and received by the users of water. Research shows in a number of cases that users are prepared to pay more for water services if they benefit from the improved service.

8. Capacity Development and Monitoring of the SDGs

With the adoption of the SDGs the world obliged itself to abandon the clearly unsustainable business as usual trajectory and to engage itself in finding the sustainable path towards the achievement of its cherished societal and environmental goals. The set of 17 goals and 169 targets are conceived as benchmarks to be achieved by 2030 (some of them by 2020 or preferably even earlier). Progress towards the achievements of the SDGs (and inherent targets) can be measured by comparing any intermediate state of matters with the benchmark values. In many cases surrogate values (indicators) will have to be used to measure progress (or the lack of it). Thus implementation of the SDGs implies continuous monitoring and recurring evaluations to check whether the direction and pace of development are right. This implies collection, archiving and processing of massive amount of data to be evaluated at different scales. Monitoring and evaluation have their own capacity needs both in terms of professional and financial resources. However the capacity needs of the SDGs go much beyond that of monitoring. Substantial capacity deficits, especially in developing countries must be addressed. Professional and vocational capacities, but also educators and media capacities are needed as the multi stakeholder implementation necessitates informed citizens, public and private engagement and mentality shift. It is obvious that as the SDG implementation commences neither the monitoring capabilities nor the capacities are at an ideal level. Thus implementing the SDGs implies also to develop simultaneously the very basis of its targeted success. The “ladder approach” epitomizing the process of

gradual improvement of monitoring can also be applied to many other facets of the SGD implementation process.

Role of Earth Observation

Remote sensing and Earth Observation Technologies can play a key role in supporting the monitoring of water targets, and identify emerging risks of underachievement, and help to understand changes when shifts between (economic) activities take place. These technologies could lead to a cost-effective, high-quality monitoring program for the Water SDG in providing a global date to complement *in situ* national data. By combining Earth observations with hydrologic and biophysical models, and socioeconomic data, water indicators can be monitored at high data resolutions and enable effective computation of complex water indices.

Past lessons include governance issues, technical training, and social incentives

Building constituencies in countries is important for monitoring SDGs. Previously; there were individuals within countries who provided data for GEMS (Global Environmental Monitoring System). Now, the process needs to improve so that countries data can be reported and more readily accessible. The increased visibility of global data platforms (like UNEP live) can motivate countries to contribute data to do so – since most senior government officials do not wish to see their countries as the white spot on the global map. The "tragedy of the averages" however needs to be avoided for countries that have diversity in natural geography, while the concepts such as monitoring ladders or monitoring tiers (with various levels of complexity) can be a useful and a feasible trajectory for poorer countries.

Still, sustainable operation of water infrastructure is insufficiently valued and life cycle costs assessments are lacking too often in major investment decisions, leading to lack of maintenance and long term failure. Enhanced capacity building could help decision makers to identify the long term superior solutions in systemic approaches.

Multi-lateral efforts from all societal levels are needed

All levels of society - government, academia, NGOs, and others – should be involved in SDGs monitoring. An important question is how can this be made to work in practice, and what are the challenges in terms of capacity in these sectors to contribute meaningfully. One approach is to recognize that each sector should do what it can do best. For instance, the role of the public should be to push policy makers and government to provide services at affordable rates and sustainable practices (such as good quality drinking water, clean environment etc.); politicians need to implement policies for societal benefits and institute rewards and penalties for enforcing policies; academics need to engage in data collection, knowledge creation, and mediation of societal aspirations with sustainable development goals; administrators need to devise effective mechanisms to implement policies and meet national development aspirations etc.

The role of modern digital technologies, ubiquitous devices ranging from smart phones to hand-held computers etc. can bring a sea change to data acquisition and monitoring realms. Citizen science holds a lot of promise in certain areas. However, it has its limits and will not work where data quality, calibration, standardization are of concern. Nonetheless it has an important role to play in raising awareness and in contributing towards efforts for monitoring as well as implementation.

9. Conclusion

The decision to incorporate a dedicated water goal (SDG 6) among the 17 SDGs is a clear recognition that water is not only part of many other SDGs but in many aspects their precondition. There is a well perceived need to institutionalize an intergovernmental framework which accounts for this importance and cross cutting features of water and the solution of water related problems. Similar to the already existing intergovernmental panels like the Intergovernmental Panel on Climate Change (IPCC) and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services(IPBES) several member states (first among those are Mexico and Hungary) advocate the establishment of the Intergovernmental Panel on Water. During the conference, it was raised that this intergovernmental mechanism could serve as an excellent "docking station" for the scientific community to remain involved in the development and implementation of the SDG process.

A key challenge will be to connect efforts of different actors into an effective systemic arrangement to deliver all goals of sustainable development and societal welfare.

The expected set of (probably quite simple and much too few) official indicators to be decided in 2016 for use in the intergovernmental progress reporting won't be able to adequately capture the progress of the SDGs and the cross cutting role of water in them. Hence the scientific challenge to develop actionable and scientifically sound (secondary) indicators still exists. Close exchange between research and policymaking within the proposed Intergovernmental Panel on Water will increase the robustness of knowledge to be produced.

Effective implementation of SDGs needs knowledge brokers to facilitate dialogues and communication from science to practitioners and policy makers to enable scientific support in form of knowledge generated by global water science for decision makers from water policy, planning and management. It entails a robust science-based and internationally mandated process to regularly monitor, review and assess progress of the implementation of SDGs. The end users of such science based knowledge can be represented by the Intergovernmental Panel on Water which may include multiple stakeholders (not only policy makers) to create political space for member states to discuss more formally, regularly and proactively the water issues, to facilitate partnerships between nations but also between water use

sectors and custodians of freshwater ecosystems. An Intergovernmental Panel on Water can be conceived also as a funding facilitator mechanism and supervisory body assessing the performance of SDG (in particularly SDG 6) implementation.

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[i] Throughout this report "human water security" is interpreted as achieving a high degree of service reliability both quantitatively and qualitatively, as well as providing reasonable safety against the impacts of water (related) hazards.