Perspectives on water and climate change adaptation

Climate change and WASH services delivery – Is improved WASH governance the key to effective mitigation and adaptation?

This Perspective Document is part of a series of 16 papers on «Water and Climate Change Adaptation»

'Climate change and adaptation' is a central topic on the 5th World Water Forum. It is the lead theme for the political and thematic processes, the topic of a High Level Panel session, and a focus in several documents and sessions of the regional processes.

To provide background and depth to the political process, thematic sessions and the regions, and to ensure that viewpoints of a variety of stakeholders are shared, dozens of experts were invited on a voluntary basis to provide their perspective on critical issues relating to climate change and water in the form of a Perspective Document.

Led by a consortium comprising the Co-operative Programme on Water and Climate (CPWC), the International Water Association (IWA), IUCN and the World Water Council, the initiative resulted in this series comprising 16 perspectives on water, climate change and adaptation.

Participants were invited to contribute perspectives from three categories:

1 **Hot spots** – These papers are mainly concerned with specific locations where climate change effects are felt or will be felt within the next years and where urgent action is needed within the water sector. The hotspots selected are: Mountains (number 1), Small islands (3), Arid regions (9) and 'Deltas and coastal cities' (13).

2 **Sub-sectoral perspectives** – Specific papers were prepared from a water-user perspective taking into account the impacts on the sub-sector and describing how the sub-sector can deal with the issues. The sectors selected are: Environment (2), Food (5), 'Water supply and sanitation: the urban poor' (7), Business (8), Water industry (10), Energy (12) and 'Water supply and sanitation' (14).

3 **Enabling mechanisms** – These documents provide an overview of enabling mechanisms that make adaptation possible. The mechanisms selected are: Planning (4), Governance (6), Finance (11), Engineering (15) and 'Integrated Water Resources Management (IWRM) and Strategic Environmental Assessment (SEA)' (16).

The consortium has performed an interim analysis of all Perspective Documents and has synthesized the initial results in a working paper – presenting an introduction to and summaries of the Perspective Documents and key messages resembling each of the 16 perspectives – which will be presented and discussed during the 5th World Water Forum in Istanbul. The discussions in Istanbul are expected to provide feedback and come up with sug• gestions for further development of the working paper as well as the Perspective Documents. It is expected that after the Forum all docu• ments will be revised and peer-reviewed before being published.

14 Climate change and WASH services delivery – Is improved WASH governance the key to effective mitigation and adaptation?

Charles Batchelor, Ton Schouten, Stef Smits, Patrick Moriarty and John Butterworth

Climate change and WASH services delivery – Is improved WASH governance the key to effective mitigation and adaptation?

This paper attempts to identify and discuss the nature and scope of possible climate change impacts (negative and positive) on WASH services delivery. Rather than consider these impacts in isolation, the paper considers climate change as one of many important and uncertain external factors that can have a profound direct or indirect effect on WASH services delivery. Although the paper does not attempt to provide an exhaustive assessment of the state of climate change knowledge, recent literature is summarised and specific attention is given to the high levels of uncertainty in this knowledge and in recommendations resulting from it.

Taking a WASH practitioner's perspective, the paper discusses whether climate change is very different in nature from other challenges facing the WASH sector and, more specifically, whether a new set of interventions, methods, tools or approaches is needed to address climate change challenges. The paper notes that many of the solutions in the fast-developing climate change literature fall neatly under the heading: 'Business as usual – but better'. It is worrying that some solutions, that are being identified and strongly recommended in the literature, have been shown to have major limitations and/or negative tradeoffs when implemented at scale.

Similar to above, the paper discusses the scale and immediacy of climate change in relation to WASH services delivery in different regions of the world. It is argued that, even in the absence of climate change, the WASH sector is struggling to meet WASH-related MDGs. Of equal concern, is the widespread *slippage*[1] in WASH services levels in many parts of the world. When these are taken into account, immediate WASH challenges (regardless of a climate change overlay) become even more daunting.

Finally, the paper discusses the potential roles of improved WASH governance and *integrated water resources management (IWRM)* as a primary means for the WASH sector to mitigate and adapt to the potential impacts of climate change. This level of attention to WASH governance and IWRM is prompted in part by general agreement in the literature that improved governance and IWRM are needed to tackle immediate WASH challenges (e.g. Moriarty et al, 2007). Lessons are drawn from ongoing attempts to implement IWRM and improve WASH governance and specific practical recommendations are made for overcoming institutional obstacles that have been identified.

Climate change and water: current state of knowledge

The opening statement of the IPCC's Sixth Technical Report on Climate Change and Water (IPCC, 2008) asserts that: "Observational records and climate projections provide abundant evidence that freshwater resources are vulnerable and have the potential to be strongly impacted by climate change, with wide-ranging consequences for human societies and ecosystems". Specific findings and recommendations in this report, relevant to WASH services delivery, are summarised below. Please note that the text in brackets refers to the IPCC's system for classifying uncertainty[2]:

- **Climate model simulations for the 21st century are consistent in projecting precipitation increases in high latitudes (very likely) [3] and**

[1] *Slippage* refers to WASH services that have slipped back from being acceptable (e.g. in excess of government norms) to being unacceptable. The can be many different cause of slippage (e.g. poor O&M of WASH infrastructure, increases competition for limited water resources, insufficient finance for proper design of institutional capacity building etc).

[2] A detailed explanation of the IPCC uncertainty classification system can be found in IPCC (2008).

[3] Where uncertainty in specific outcomes is assessed using expert judgement and statistical analysis of a body of evidence (e.g., observations or model results),

parts of the tropics, and decreases in some sub-tropical and lower mid-latitude regions (likely). Outside these areas, the sign and magnitude of projected changes varies between models, leading to substantial uncertainty in precipitation projections. Thus projections of future precipitation changes are more robust for some regions than for others. Projections become less consistent between models as spatial scales decrease.

- **By the middle of the 21st century, annual average river runoff and water availability are projected to increase as a result of climate change at high latitudes and in some wet tropical areas, and decrease over some dry regions at mid-latitudes and in the dry tropics.** Many semi-arid and arid areas (e.g. the Mediterranean Basin, southern Africa) are particularly exposed to the impacts of climate change and are projected to suffer a decrease of water resources due to climate change (high confidence)[4].
- **Increased precipitation intensity and variability are projected to increase the risks of flooding and drought in many areas.** The frequency of heavy precipitation events (or proportion of total rainfall from heavy falls) will be very likely to increase over most areas during the 21st century, with consequences for the risk of rain-generated floods. At the same time, the proportion of land surface in extreme drought at any one time is projected to increase (likely), in addition to a tendency for drying in continental interiors during summer, especially in the sub-tropics, low and mid-latitudes.
- **Water supplies stored in glaciers and snow cover are projected to decline in the course of the century**, thus reducing water availability during warm and dry periods (through a seasonal shift in streamflow, an increase in the ratio of winter to annual flows, and reductions in low flows) in regions supplied by melt water from major mountain ranges, where more than one-sixth of the world's population currently live (high confidence).
- **Higher water temperatures and changes in extremes, including floods and droughts, are projected to affect water quality and exacerbate many forms of water pollution** – from sediments, nutrients, dissolved organic carbon, pathogens, pesticides and salt, as well as thermal pollution; with possible negative impacts on ecosystems, human health, and water system reliability and operating costs (high confidence). In addition, sea-level rise is projected to extend areas of salinisation of groundwater and estuaries, resulting in a decrease of freshwater availability for humans and ecosystems in coastal areas.
- **Globally, the negative impacts of future climate change on freshwater systems are expected to outweigh the benefits (high confidence).** By the 2050s, the area of land subject to increasing water stress due to climate change is projected to be more than double that with decreasing water stress. Areas in which runoff is projected to decline face a clear reduction in the value of the services provided by water resources. Increased annual runoff in some areas is projected to lead to increased total water supply. However, in many regions, this benefit is likely to be counterbalanced by the negative effects of increased precipitation variability and seasonal runoff shifts in water supply, water quality and flood risks (high confidence).
- **Climate change affects the function and operation of existing water infrastructure – including hydropower, structural flood defences, drainage and irrigation systems – as well as water management practices.** Adverse effects of climate change on freshwater systems aggravate the impacts of other stresses, such as population growth, changing economic activity, land-use change and urbanisation (very high confidence). Globally, water demand will grow in the coming decades, primarily due to population growth and

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then the following likelihood ranges are used to express the assessed probability of occurrence: virtually certain >99%; extremely likely >95%; very likely >90%; likely >66%; more likely than not >50%; about as likely as not 33% to 66%; unlikely <33%; very unlikely <10%; extremely unlikely <5%; exceptionally unlikely <1%.

4 Where uncertainty is assessed more quantitatively using expert judgement of the correctness of the underlying data, models or analyses, then the following scale of confidence levels is used to express the assessed chance of a finding being correct: very high confidence at least 9 out of 10; high confidence about 8 out of 10; medium confidence about 5 out of 10; low confidence about 2 out of 10; and very low confidence less than 1 out of 10.

increasing affluence; regionally, large changes in irrigation water demand as a result of climate change are expected (high confidence).

- **Current water management practices may not be robust enough to cope with the impacts of climate change** on water supply reliability, flood risk, health, agriculture, energy and aquatic ecosystems. In many locations, water management cannot satisfactorily cope even with current climate variability, so that large flood and drought damages occur. As a first step, improved incorporation of information about current climate variability into water-related management would assist adaptation to longer-term climate change impacts. Climatic and non-climatic factors, such as growth of population and damage potential, would exacerbate problems in the future (very high confidence).
- **Climate change challenges the traditional assumption that past hydrological experience provides a good guide to future conditions.** The consequences of climate change may alter the reliability of current water management systems and water-related infrastructure. While quantitative projections of changes in precipitation, river flows and water levels at the river-basin scale are uncertain; it is very likely that hydrological characteristics will change in the future. Adaptation procedures and risk management practices that incorporate projected hydrological changes with related uncertainties are being developed in some countries and regions.
- **Adaptation options designed to ensure water supply during average and drought conditions require integrated demand-side as well as supply-side strategies.** The former improve water-use efficiency, e.g., by recycling water. An expanded use of economic incentives, including metering and pricing, to encourage water conservation and development of water markets and implementation of virtual water trade, holds considerable promise for water savings and the reallocation of water to highly valued uses. Supply-side strategies generally involve increases in storage capacity, abstraction from water courses, and water transfers. Integrated water resources management provides an important framework to achieve adaptation measures across socio-economic, environmental and administrative systems. To be effective, integrated approaches must occur at the appropriate scales.
- **Mitigation measures can reduce the magnitude of impacts of global warming on water resources, in turn reducing adaptation needs.** However, they can have considerable negative side effects, such as increased water requirements for afforestation/reforestation activities or bioenergy crops, if projects are not sustainably located, designed and managed.
- **Water resources management clearly impacts on many other policy areas**, e.g., energy, health, food security and nature conservation. Thus, the appraisal of adaptation and mitigation options needs to be conducted across multiple water-dependent sectors. Low-income countries and regions are likely to remain vulnerable over the medium term, with fewer options than high-income countries for adapting to climate change. Therefore, adaptation strategies should be designed in the context of development, environment and health policies.
- **Several gaps in knowledge exist in terms of observations and research needs related to climate change and water.** Observational data and data access are prerequisites for adaptive management, yet many observational networks are shrinking. There is a need to improve understanding and modelling of climate changes related to the hydrological cycle at scales relevant to decision making. Information about the water related impacts of climate change is inadequate – especially with respect to water quality, aquatic ecosystems and groundwater – including their socio-economic dimensions. Finally, current tools to facilitate integrated appraisals of adaptation and mitigation options across multiple water-dependent sectors are inadequate.
- **Global mean sea level has been rising and there is *high confidence* that the rate of rise has increased between the mid-19th and the mid-20th centuries.** The average rate was 1.7 ± 0.5 mm/ yr for the 20th century, 1.8 ± 0.5 mm/yr for 1961–2003, and 3.1 ± 0.7 mm/yr for 1993–2003. It is not known whether the higher rate in 1993–2003 is due to decadal variability or to an increase in the longer-term trend. Spatially, the change is highly non-uniform; e.g., over the period 1993 to 2003, rates in some regions were up to several

times the global mean rise while, in other regions, sea levels fell.

Complexity aside, three important conclusions can be drawn from this summary: i) there are good reasons for the WASH sector to be concerned about the potential long-term impacts of climate change; ii) the WASH sector should become more actively involved in climate change research and debate; and iii) there is a great deal of uncertainty in the findings that increases as spatial scales decrease to those at which most WASH planning processes take place.

As will be discussed later in this paper, although raising awareness of climate change issues in the WASH sector will take time, it is a fairly straightforward task. Similarly, given sufficient resources, a more active involvement of the WASH sector in climate change can easily be achieved. Therefore, the fundamental challenge facing the WASH sector is to ensure that the uncertainty linked to climate change is effectively considered during WASH governance processes. This is in a situation where WASH governance systems are already struggling to take proper account of and adapt to societal, economic and environmental conditions that, in the absence of climate change, are already characterised by high levels of uncertainty, variability and change.

Finally, this paper assumes that there is considerable scope for improving WASH governance worldwide and, thereby, for taking better account uncertainty, variability and change regardless of the root causes. This requires development and/or strengthening of water governance capacity (e.g. in the use of: information systems, stakeholder platforms, legal and regulatory mechanisms, executive capabilities, conflict resolution systems and techniques such as scenario building) to enable society to respond and adapt to uncertainty, variability and change that could be local or regional, short or long term, political, economic, or environmental.

2 Potential impacts of climate change on WASH service delivery

According to the World Health Organization (WHO) and UNICEF Joint Monitoring Programme, the state of water-supply and sanitation services worldwide is a source of concern in several respects (WHO-UNICEF, 2009):

- Globally, 1 billion people are currently without access to improved water supply and 2.6 billion have no form of improved sanitation services. Most of these people live in Asia and Africa. In Africa, for example, 2 out of 5 people lack an improved water supply;
- Significant disparities exist between rural and urban services, which continue to contribute to the burden of life in rural areas. People who live in the informal, overcrowded peri-urban settlements spawned by urbanization, also have especially low coverage;
- Increasingly, surface and groundwater sources are being polluted by pesticides, and by industry and untreated household waste water;
- The over-extraction of water for agriculture and manufacturing, which causes the water table to decline, is another bad practice, which threatens the sustainability of these resources in many parts of the world.

Placing the potential impacts of climate change within this undeniable context supports the argument that climate change has not been a major contributory factor to the unacceptable WASH service levels that currently exist in many parts of the world. The fundamental causes of current WASH sector challenges are more closely linked to factors that include: poor governance, lack of capacity, urbanization, increasing population, increasing competition for limited safe water resources, lack of accountability and insufficient expenditure on, for example, O&M. As the recent GLAAS report (WHO 2008) indicates, the capacity of the WASH sector to even carry out its core mandate of service provision is very poor, particularly at the decentralised (local government) level. A similar view is expressed in the draft Climate and Water Report from the 2008 World Water Week. This report states: "The relative impact of climate change needs to be considered against the demands and threats to water resources from increasing wealth and consumption, and growing populations."

Figure 1 summarises potential direct and indirect impacts of climate change on the different components of water supply systems as represented by a Resources, Infrastructure, Demand and Access (RIDA) framework schematic. The RIDA framework has been used because it highlights the fact that water sources (i.e. resources) are linked to the demands of users

Resources /Natural environment		**Infrastructure**		**Demand**		**Access**	
Direct	Indirect	Direct	Indirect	Direct	Indirect	Direct	Indirect
* Rainfall increases in high latitudes and parts of the tropics, and decreases in some sub-tropical and lower mid-latitude regions. * Increased precipitation intensity and variability increases the risks of flooding and drought in many areas. * Water supplies stored in glaciers and snow cover are reduced. * Higher water temperatures affect water quality and exacerbate many forms of water pollution. * Global mean sea level rises and contributes to saline intrusion in to coastal aquifers. * Frequency of extreme temperatures (hot and cold) increases.	* Land use change and agricultural intensification lead to changes in hydrology at local and basin scales. *In areas of lower rainfall, water quality of rivers and groundwater decreases as a result of reduced dilution of pollutants. * Risk increases unsustainable use of surface and groundwater resources. *In areas of groundwater-level decline, increase in groundwater pollution from natural contaminants (e.g. fluoride, arsenic) *Warmer and damper conditions increase the incidence of many water-borne diseases.	*Major investments are needed in flood protection and re-engineering of dam spillways. *Major investments are needed to increase the capacity of storage, supply and treatment systems. *Major investments are needed to supply WASH services to people migrating from flooded coastal areas or areas of absolute water scarcity. *Destruction of WASH infrastructure and contamination of groundwater occur as a result of localized flooding. *Increased energy costs and a shift to low-carbon policies lead to major increases in the operating costs of WASH systems.	*Anarchy leads to water theft and major damage to reticulation systems. *Break down in law and order occurs at water supply points as a result of conflict between migrants and existing users. *Major increases in investment in irrigation infrastructure to increase food supplies leads to less water for urban use. *High levels of expenditure on WASH infrastructure to meet WASH crises are accompanied by low levels of financial accountability.	*Contribution to increased demand for safe water results from prolonged drought, increasing temperatures etc. *Demand increases for MUS activities using water from WASH infrastructure e.g. for livestock as a result of failure of traditional water sources. *Increased demand for irrigation and for rainfed farming (including demand for irrigated biofuels) increases competition between WASH and agricultural sectors.	*Reallocation of water from agricultural to urban use leads to social unrest in rural areas and to decreased food production. * Interest increases in all types of demand management, regulatory instruments etc. *Increased demand leads to increased concerns over maintenance of ecological flows and protection of rare habitats. *Increased demand leads to increased challenges of water treatment and sewage sludge disposal.	*Increasing challenge of ensuring access to WASH services is consistent with established norms during periods of drought. *WASH service provision to poorer social groups, especially in areas affected by flooding or sea-level rise, is a major. *The poor increasingly rely on unregulated provision of water by private vendors. *Allocation of water for aquatic ecosystems and maintenance of rare habits is less than required.	*Many kinds of livelihood problems result from rapid climatic change to which adaptation may be difficult or even impossible * Possible increased risk of capture of water resources by elite social groups * There is a possibility failure on the part of regulatory systems and/or legislation aimed at protecting rights of individuals or community to access water for different uses.

Figure 1: Potential direct and indirect impacts of climate change.

by supply (and water treatment) infrastructure. The access component is used to emphasise the fact that user access to water services is often less than the demand quantified in terms of politically-acceptable norms. Figure 1 draws attention to several important points:

- Climate change has the potential to impact on all the components of a water supply system (i.e., not just the sources of water) and that these potential impacts can be varied in nature;
- Some potential impacts are likely to be direct and very obvious (e.g. increased incidence of extreme floods that damage WASH infrastructure), whereas others are likely to be indirect and more uncertain in nature and severity (e.g. sea level rise leading to migration away from coastal areas);
- Given the range and uncertainty of climate impacts, there will not be unique strategies for mitigating or adapting to climate change. The challenge will be development of water governance systems, which ensure that strategies are based on a solid understanding of the impacts of climate change on the different components of individual WASH services delivery systems.

How should the WASH sector prepare for potential climate change impacts?

Clearly, a first step is for the WASH sector to engage more effectively with climate change researchers and in relevant research programmes. The benefits of this approach are twofold. First, this will ensure that discussions on the potential impacts of climate change on the WASH sector avoid the shortcoming of considering these impacts in isolation of all the other challenges currently facing the sector. Second, this will also ensure that development of new recommendations draws upon lessons (both positive and negative) learnt through past and ongoing attempts to meet existing WASH challenges. This will increase the likelihood of new initiatives being successful and reduce the risk of mistakes being repeated.

The next step should be to decide whether there are specific actions, changes of practice or interventions that are required to mitigate and adapt to potential climate change impacts. Review of climate change literature (e.g. IPCC, 2008) suggests that most of the proposed solutions to climate change fall neatly under the heading of 'Business as usual – but better' (e.g. increase storage, manage demand, improve governance, adopt principles of IWRM etc). Obviously, potential impacts of climate change might require an increased emphasis on certain actions or interventions (for example, recognition of potential impacts of climate change could add weight to arguments for increased funding for drought preparedness or for enforcing stricter planning regulations against siting WASH infrastructure in areas prone to flooding). Nonetheless, it is clear that rather than try to develop innovative technologies or quick fixes for tackling climate change impacts, the WASH sector should put the bulk of its long-term effort into:

- **Improving WASH governance systems** so that they are better able to take account of the increased uncertainty that can be attributed to climate change. Also governance systems are required that explicitly match actions and interventions to specific contexts and take explicit account of potential externalities;
- **Adopting and implementing IWRM** so that there is better alignment of plans across the whole water sector and other sectors that have an influence on water supply (e.g. the power sector) and demand for WASH services (e.g. planning departments);
- **Adopting principles of adaptive management**. Adaptive management is based on the recognition that in a complex and rapidly changing situation there can never be sufficient information to reach a settled 'optimum' decision. Hence, the WASH sector should put effort into planning approaches that are and supported by strong monitoring and information management systems, which allow for constant adaptation and the upgrading of plans and activities;
- **Strengthening capacity** within the WASH sector, particularly at the intermediate and local levels.

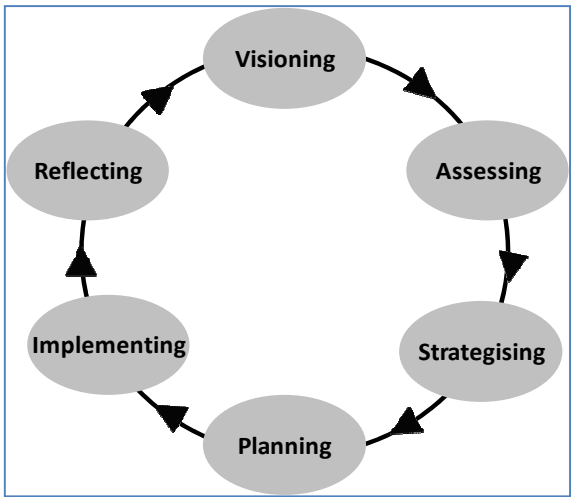
Improved WASH governance

Improving WASH governance is not a trivial matter as indicated by the fact that ongoing attempts to improve WASH governance are having very mixed results. What is clear is that achieving good WASH governance cannot be undertaken hastily using blueprints from outside any given county or region. Good governance needs to be developed to suit local con-

ditions. Incremental improvement and flexibility is key. WASH sector reforms do not have to be implemented in a comprehensive or fully integrated way. However, they do have to workable and doing a few things well to demonstrate that new approaches work. This approach is both pragmatic and likely to generate public and political support.

A practical generic means of improving WASH governance is to adopt project cycle management (PCM) as a framework for stakeholder dialogue, decision making and adapting to change. PCM emphasises the need to put decision making within a clearly defined set of iterative steps that ensure that the decisions reached are based on evidence and a clear and logical flow of thought.

PCM acknowledges that there will always be multiple paths to resolving problems and achieving visions[5]. In other words, there is no 'objectively' 'best' or 'optimum' strategy for achieving a vision. Deciding between different strategies is always a political issue. Such decisions should, nonetheless, be based on a reasonably thorough identification of externalities and sources of uncertainty; which in turn should, as much as possible, be based on a clear and logically consistent interpretation of existing and likely future conditions.



Although many versions exist, a typical project cycle[6] is made up of the following phases:

Visioning – Initial problem identification, visioning, and scenario building

Assessing – Targeted data collection and analysis; creation of a shared information base

Strategising – Development of strategies to meet the vision under different scenarios

Planning – Detailed planning based on most likely scenarios and related strategies

Implementing – Execution of plans

Reflecting – Analysis of monitoring information and process documentation to inform further cycles to promote institutional learning

The PCM approach ensures that explicit account is taken of risk and uncertainty, and that decisions are based on a cycle of continuous adaptation or learning. Another generic means of handling risk and uncertainty is using scenario building as an integral part of planning processes. In the context of WASH governance, the main purpose of scenario building is to identify, evaluate and take explicit account of a whole range of uncertain factors that might either support or derail strategies aimed at improving WASH service provision. Equally important, the approach helps stakeholders think creatively about important and uncertain factors over which they have no or very limited control (e.g. climate change). The net result should be that stakeholders are less likely to fear or ignore these factors and are more likely to consider how they could thrive in a range of future settings. Some of these future settings may be strikingly different to anything that they have ever experienced.

Integrated water resources management (IWRM)

IWRM is being promoted by many organisations, implemented in some areas and piloted in others. A huge effort involving the reform of water laws, institutions and capacity building is underway based upon the IWRM 'recipe'. However, in much of the world, it remains business as usual (Moriarty et al, 2004).

A definition of IWRM, that is in common usage, is as follows: "IWRM is a process which promotes the co-ordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an

[5] In this context, a *vision* is a concise description of a desired future state.

[6] For a detailed discussion of PCM please see the EMPOWERS Water Governance Guidelines: www.empowers.info.

equitable manner without compromising the sustainability of vital ecosystems (GWP, 2000)". In one form or another, the three concepts of equity, efficiency and sustainability are present in almost all definitions of IWRM. IWRM aims to:

- Promote more equitable access to water resources and WASH services;
- Ensure that scarce water is used efficiently with priority going to meeting basic human needs;
- Achieve more sustainable utilisation of water including for a better environment.

A fourth key concept is that of process. IWRM is a process of getting from some existing state to some envisaged and preferred future state, by achieving commonly agreed principles or best practice in managing water through the involvement of all relevant stakeholders.

The political naivety of IWRM has been denounced by Biswas (2004) because of discrepancy between the concept of integrated management and actual political institutions and property rights. The Global Water Partnership toolbox on IWRM (GWP, 2003) also states that when social actors try to put IWRM into practice, "they are faced with the apparently insurmountable difficulty of bringing together a very intricate socioeconomic reality, the legacy of the past and its ingrained practices and beliefs, and the apparently non-reconcilable conflicting demands". Yet the vagueness of the means by which IWRM might be achieved does not remove all utility from the IWRM concept nor should it be used as an excuse to regress into out-dated technocratic governance. IWRM continues to inspire many adherents amongst international agencies and, like the equally elusive concept of 'sustainability', it has inspirational value as an ideal goal or direction for improvement of water governance.

Strengthening WASH sector capacity

Capacity, or rather lack of capacity in the WASH sector, is a key issue and often a limitation to tackling both immediate and longer-term challenges. Any attempt to improve WASH governance must grapple with operational realities of capacity and other resource constraints, particularly at the intermediate and local levels, and with reluctance or resistance to change. In some cases, unwillingness to change may be for valid reasons, in others the reasons may be linked to issues of integrity and accountability. It is clear, however, that significant improvements in the WASH sector worldwide will not be achieved without strengthening capacity. Clearly, in the context of climate change, a carefully-targeted awareness campaign is needed. This should to be informative and recognise that climate change is just one of many important and uncertain challenges faced by WASH professionals working in the public and private sectors. Similarly, carefully-targeted capacity strengthening programmes that are appropriate to WASH professionals working in different roles and at different institutional levels need to be developed and implemented.

Those involved in climate change research have a very important role to play in capacity strengthening. This includes presenting information in forms and formats that can be easily understood by non-specialists. It is also important that information be provided at scales relevant to typical decisions made in the WASH sector, so that information can be used, for example, in scenario building at the local and intermediate institutional levels.

Conclusions and recommendations

The current state of 'climate change and water' knowledge can be summarised simplistically as follows:

- Precipitation will increase in high latitudes and parts of the tropics, and decrease in some subtropical and lower mid-latitude regions;
- Annual average river runoff and water availability are projected to increase in high latitudes and in some wet tropical areas, and decrease over some dry regions at mid-latitudes and in the dry tropics;
- Increased precipitation and variability intensity will increase the risks of flooding and drought in many areas;
- Water supplies stored in glaciers and snow cover are projected to decline as will dry-season river flows based on snow melt;
- Higher water temperatures and changes in extremes, including floods and droughts, are projected to affect water quality and exacerbate many forms of water pollution;
- Global mean sea level has been rising;

- Climate change challenges the traditional assumption that past hydrological experience provides a good guide to future conditions

There is a high-level of uncertainty in climate change predictions that increases at the scales at which WASH decisions are generally made. It is recommended, therefore that the WASH sector focuses its attention on improving WASH governance and, more specifically, on methods, approaches and tools that support and improve decision-making processes by enabling groups of stakeholders to take explicit account of risk and uncertainty.

Solutions to climate change tend to be the same as those advocated for tackling more immediate WASH challenges. However, solutions being advocated with particular evangelical vigour in the climate change literature have already been shown to have limited scope for tackling WASH challenges, and/or to have significant negative tradeoffs when implemented at scale. It is recommended that WASH professionals become more involved in climate change research so that a more rigorous vetting of 'solutions' takes place.

Finally, it is recommended that a climate change thematic network be established within the WASH sector for better exchange of views on climate change and to promote a more active engagement of the sector in climate change research programmes, workshops and policy fora.

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