THE CONTRIBUTION OF IAHR'S COMMUNITIES OF WATER MANAGEMENT AND CLIMATE CHANGE TOWARDS THE SDGs

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Integrated and adaptive management can foster more equitable, efficient and sustainable access and use of water resources, and in this way address the specific needs of the SDGs. These principles must be the core concept of societal and human development.The perception of endless resources exploitation should be replaced by resource efficiency. End of poverty, suffering, hunger, inequalities and injustice must be considered as core objectives of water management. IAHR is committed to create interest for all communities and stakeholders involved in development of sustainable and climate-change sensitive and risk-informed water resources management, thus contributing to the achievement of the SDGs.

IAHR's communities of water resources management and climate change

IAHR's Committee on Water Resources Management, and Working Group on Climate Change have promoted the discussion of sustainability. Recent activities of these communities are the publication of a book on "Sustainable Water Resources Planning and Management under Climate Change" published in 2017 and a Hydrolink article on "Summary of recommendations for policymakers on adaptation to climate change in water engineering" (Issue 2015/3) Among IAHR's journals, the Journal of River Basin Management, the Journal of Applied Water Engineering and Research and the Revista Iberoamericana del Agua (RIBAGUA) include the topic of Water Management in their scope. 37th IAHR World Congress' sessions on Water Resources Management hosted some 98 papers, most of them related to the SDGs. Among these, 55 addressed Integrated Water Management, including reservoir, drought, flood, groundwater and demand management; 15 presentations addressed climate change impacts on water and 15 wastewater treatment and pollution control. These numbers show the strong commitment of the members of these IAHR communities to ground-based research aimed at sustained and inclusive global and regional development. In the next paragraphs, we show some examples on how IAHR is developing state-of-the-art knowledge and methods for policy-makers to achieve the SDGs considering water as main resource under threat.

Figure 1. Kamafusa Reservoir, a multi-purpose reservoir operated for flood control, water supply and power generation in the Natori River basin in Japan. The reservoir provided enhanced capability for flood protection by introducing prior release operation considering real-time hydrological predictions while river levees in the downstream were damaged by the great earthquake and tsunami in 2011

Green economy and water resources management

A holistic approach to water resources management needs to incorporate all drivers of change. Integrated and adaptive management, where decisions are made taking into account space and time variations and where adjustments are to be made according to specific needs can foster more efficient and sustainable use of water resources. SDGs mainly consider the use of resources and the way human activities affect the natural and built environment. The sustainable use of natural resources and the environment has to be the core concept of economic growth while the perception of endless resource exploitation should be replaced by resource efficiency. The use of improved technology lowers inputs of material and energy, which in turn reduces pollutants, resulting in this way to higher environmental protection. In this sense, green economy and green development provide a core concept for sustainable water management.

Water needs to be seen as an integral part of the ecosystem and as such, solutions should revolve around maintenance of ecosystem services, reallocation among sectors, true cost pricing and public engagement in all stages of decision-making. Using water efficiently, making it available to all at a reasonable cost and ensuring environmental sustainability of ecosystems constitutes the "puzzle" of sustainable water management. Water and water management is essential in combating poverty, enhancing economic development, ensuring food security and sustainable agriculture, allowing for sustainable production and consumption. Water management is also essential in promoting sustainable cities and securing peace.

Water management under climate change

Decision makers need to recognize that new types of decisions are needed under climate change. Modelling and analysis needs to take these, often unclear, factors into account including making allowances for greater fluctuations in available water resources. The problems of climate change are global and where water sources overlap national boundaries, water managers should transcend those boundaries.

Traditional estimates of hydrologic risk and infrastructure design principles are based on the notion of stationarity that can be challenged by global warming and associated changes in the coupled natural and human systems. Comprehensive methods have been developed for investigating climate-change-induced non-stationarity in hydrologic extremes and how it can affect hydrologic risk estimation for infrastructure design and hazard mitigation. New approaches and principles address the effect of non-stationarity and also the associated uncertainties, with the aim to aid practitioners and policy makers in developing water infrastructure to ensure equitable and universal distribution of water resources. These principles are generic and apply to all environmental systems undergoing change, thereby aligning to achieve the SDGs.

Adaptive reservoir management

Novel and holistic approaches for the adaptive operation of reservoirs considering real-time hydro-meteorological predictions can enhance the significance of reservoirs by integrating operations for achieving different objectives related to the SDGs, such as flood and drought management, municipal and agricultural water supply, and power generation.

Reservoirs play a significant role in mitigating water-related disasters such as floods or droughts, which may become more severe under a changing climate. Development and implementation of the integrated operation of reservoirs are therefore important to reduce

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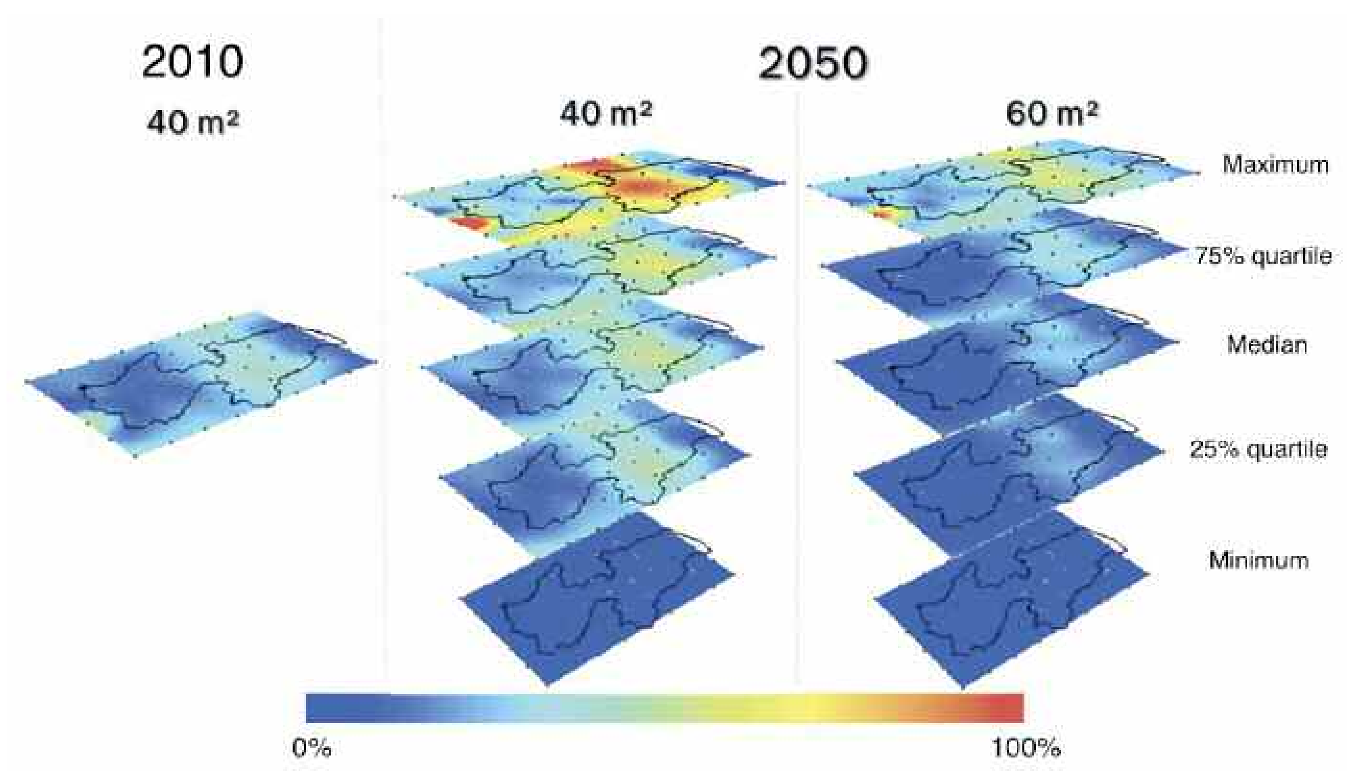

Figure 2. Current (2010) and future (2050) values of water scarcity (expressed as the water supply deficit as % of annual domestic water demand) of rainwater systems for water harvesting surfaces of $40m^2$ and $60m^2$ in the Brazilian rural semi-arid in the State of Paraíba derived from projections by 19 climate models. The quantiles refer to simulations of water scarcity from model projections of rainfall. For example, the second plane from the bottom, labelled 25% quartile, represents predictions of 25% of the models showing the smallest deficit, i.e. the lowest water scarcity. Risk of future scarcity can be minimized through larger water harvesting areas. Approximately one million of such small rainwater systems supply safe water for small communities in the whole Brazilian semi-arid region (courtesy of Marilia Dantas, of the University of Campina Grande, Brazil)

vulnerability and exposure of people to those disasters, which can contribute to building the resilience of the poor for sustainable development. The methods of adaptive reservoir operation provide an effective approach to increase the ability of reservoirs to control those water-related disasters in an integrated manner utilizing advanced real-time hydrological forecasts for more adaptive and resilient water resources management under climate change. An example of this approach is the operation of the Kamafusa Reservoir in Japan (Figure 1) following the Tohoku earthquake of 2011, when real-time predictions of hydrologic conditions were used to adjust water releases from the reservoir in order to provide adequate flood protection downstream where the river levees had been damaged by the tsunami that was caused by the earthquake.

Many reservoirs supply water for irrigation, contributing to enhanced food production. Introducing a sophisticated operation of reservoirs is therefore important for more sustainable food production systems under changing climate. One of the common purposes of reservoirs is hydropower, which is considered as renewable energy. It is therefore important to optimize reservoir operations for power generation in order to increase the amount of renewable energy generation.

Water governance for the SDGs

SDGs-related challenges are so great that they may require substantial adaptations and even transformations in social organizations and the use of their resources. In the context of climate change, uncertainties associated with climate variability in the future are even more striking and complex towards this end. An example, of the magnitude of such uncertainties is shown in Figure 2 which shows the range of predictions of future water scarcity in a semi-arid rural part of Brazil.

To know more

From the perspective of the integrated and adaptive management of water resources, it is important to understand its aspects relevant to water governance, considering the adaptation measures that promote the SDGs. In this sense, new approaches have focused on the following questions:

- in what aspects will water governance, through its policies, plans and management systems, need to adapt to better cope with the new development goals?
- how to generate strategies to meet the requirements of this adaptive governance?

It is essential that no group of people, independent of race, ethnicity or socio-economic class, should suffer alone the negative impacts resulting from industrial, agricultural, commercial and infrastructure activities or government programs and policies. The concept of equity should, therefore, be a key criterion of sustainable water management. As an example, inefficient water resource management has caused unequal access to water by different social groups or unequal exposure to water-related disasters in many regions of the world. ■