INCREASING RESILIENCE TO CLIMATE VARIABILITY AND CHANGE: THE ROLE OF INFRASTRUCTURE AND GOVERNANCE IN THE CONTEXT OF ADAPTATION

BACKGROUND

Freshwater systems and the way they will develop in the future depend on climatic-related factors such as precipitation, temperature and evaporative demands, as well as on non-climatic ones. Given the uncertainties related to climate change and variability and the lack of data to predict them with certainty within given time frames, non-climatic factors have become more relevant than ever. These include management, governance and policy issues; land use considerations; infrastructure (reservoirs, groundwater storage and/or recovery), technology and innovations as well as diversification of water resources through water reuse and desalination, for example.

Reservoirs have become an integral part of our basic infrastructure by offering indispensable benefits like irrigation, hydropower, domestic and industrial water supply, flood control, drought mitigation, navigation, fish farming and recreation. Construction of new reservoirs has often been controversial during the last decades due to the fact that social and environmental impacts have sometimes not had the due consideration. However, limited and skewed distribution of water over time and space to meet the increasing number of uses and users at the national, regional and global levels has made the world realize that more reservoirs are needed if development is to be promoted and if basic human needs are to be met. Global dynamics in terms of water, energy including electricity trade), food and climate securities have recasted the importance of the roles of reservoirs in national development. This has triggered massive investments on construction and modernization of multiple projects at the national and global levels, especially in countries like Turkey, China and India.

In order to improve the understanding of the role water storage plays in resilience, the World Water Council and the National Association of Water and Sanitation Utilities of Mexico (ANEAS) in collaboration with the National Water Commission of Mexico (CONAGUA) are supporting a series of case studies that will systematically and objectively analyze the roles storage and water management systems in the context of climate change and variability adaptation. The case studies focus on the Arid Americas (with emphasize on Unites States and Mexico), Australia, Brazil, China, Egypt, Himalayas, Mexico, Pakistan and Turkey. The studies will present policy and governance implications and decision-making alternatives for water storage and management practices. They will also identify activities that are able to increase water management flexibility and extend climate change adaptation efforts. These include, but are not limited, to increase flexibility in reservoir operations, water conservation and reuse to maximize the efficient use of available water supplies and existing water infrastructure; improvement of infrastructure resilience, reliability and safety to prepare for increased intensity and frequency of floods and droughts.

INITIAL FINDINGS

Initial findings in the Himalayan region indicate that improved understanding of predicted climate change impacts on water

infrastructure development provide ample opportunities for investment to promote climate change adaptation through producing hydropower, delivering more timely irrigation water, and regulating the extreme flows of the basin. Simultaneous investments is needed to develop and nurture governance and institutional systems for efficient, equitable, and sustainable governance and management of water-related services provided by water infrastructures.

In the case of the Arid Americas, preliminary conclusions suggest an emerging integrated view of water security resulting from infrastructure (especially that which is already built and in place) combined with more flexible and adaptive water management and policy. It appears evident, particularly with tight budgets and growing concern over social equity, that greater emphasis will be placed on soft-path measures in the future than on hard-path measures.

Regarding Australia and the Murray-Darling Basin, some of the key lessons of global relevance include, for example, that cap and trade water markets are a key complementary tool to storages as they ensure that available water resources are used to generate higher economic value and employment. In the basin, this significantly reduced the socio-economic impacts of climatic variability in the past two decades, and has decoupled growth in socio-economic benefits from water consumption.

In Brazil and Turkey, analysis focus on reservoir management under drought conditions. In Brazil, the main findings include the importance of communication and negotiations with users and uses affected due to reduction of minimum outflows in the Sobradinho reservoir such as water supply for cities, irrigated agriculture, hydropower generation, environmental flows and navigation.

In the case of Mexico, discussions focus on so-called high-risk dams in or near urban areas.

EMERGING MESSAGES

Water infrastructure, including reservoirs, have historically been designed on the basis of stationarity of stable climate. Nevertheless, climate change problems are surrounded by so deep uncertainties that the idea that natural systems fluctuate within an unchanging envelope of variability that we can estimate from the historical record, is long gone. A nonstationary and deeply uncertain world calls for new approaches to characterize key environmental variables and integrate them into future planning.

Management of water storage is complex and ideally is based on complementary governance at different scales, including establishing key parameters at the larger basin and national scales (such as capping water extraction) while offering stakeholders the opportunity and responsibility to apply local knowledge solutions at more local scales (subsidiarity).

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In closed or closing river basins additional surface water storage may detract from water security rather than enhancing adaptation. In such river basins, how the water storages are governed is equally or more important than the volume of water that they store, as suggested by the following lessons.

To effectively maximise the benefits of water storage, surface reservoirs and aquifers need to be managed conjunctively.

Rules that favour full-cost recovery are an important discipline to ensure that proposed new water infrastructure has strong socio-economic benefits while minimizing environmental impacts, or at least they put the ones on governments to be more transparent as to the justification for water infrastructure subsidies.

As the climate changes the benefits offered by some water storages will decrease, or their impacts may increase (for example, with greater evaporation) and may justify decommissioning. Further, the need to re-engineer surface water storages to meet new safety standards (e.g. with bigger spillways) provides cost-effective opportunities to add modern environmental mitigation technologies, including fish ladders, thermal pollution control devices and larger outlet valves. Periodic relicensing of infrastructure would provide more regular re-operation windows.

Good intentions for adaption are often derailed through a focus on climate change modelling, confusion as to how to manage uncertainty in the resulting projections, and political expediency. A better approach is the assessment of a full suite of adaptation options against a number of climate change scenarios to identify those interventions that may be effective (robust) under a range of future conditions.

In addition to direct impacts, climate change response policies will impact on and change the management of surface and groundwater storages requiring ongoing reform of water storage management. Some climate change mitigation measures threaten to significantly, negatively impact on water resources, for example, exploitation of unconventional gas and carbon sequestration plantations.

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