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WATER SECURITY – CHALLENGES AND NEEDS

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ABSTRACT

Our fate is intrinsically bound to the fate of our water resources. To build the future we want, we need to harness the contributions of science and innovation for water security. An interdisciplinary and integrated approach is needed for watershed and aquifer management, which incorporates the social dimension of water resources, and promotes and develops international research in hydrological and freshwater sciences. This article presents the challenges and needs pertaining to water security.

Keywords: Groundwater, Floods, Droughts, Water Quality, Urban Water, Ecohydrology.

Introduction

Freshwater is a key resource for human health, prosperity and security. It is essential for poverty eradication, gender equality, food security, and preservation of ecosystems. Yet billions of people worldwide are confronted with serious freshwater challenges, from water scarcity, poor quality, lack of sanitation facilities, to water-related disasters such as floods and droughts. Lack of access to drinking water of adequate quality and quantity remains one of the largest human health problems globally. Almost half of the world's population will be living in areas with high water stress by 2030.

Water resources are under increasingly severe pressure from climate change and other global drivers. Climate change alters rainfall patterns, soil moisture, humidity, glacier-mass balance and river flow, and also causes changes to underground water sources. At the same time, floods or droughts are rising in frequency and intensity. Population growth and rapid urbanization will create further pressures on water resources and will have a tremendous impact on the natural environment. Given these challenges, the need to manage freshwater properly is essential.

The role of human behaviour, cultural beliefs and attitudes to water, and socio-economic research to better understand and develop tools to adapt to changing water availability are some of the issues to be addressed. We need to bring multidisciplinary, environmentally-sound, innovative methods, tools and approaches into play by capitalizing on advances in water sciences, as well as build competences to meet today's global water challenges (IHP-VIII).

Water-related Hazards

Water-related hazards or hydro-hazards are the results of complex interactions in the ocean-atmosphere-land process cascade. Floods and droughts are expected to increase due to global warming. The challenge is to identify appropriate and timely adaptation measures in a continuously changing environment.

Major research gaps include incomplete understanding of hydrological processes and links with atmosphere/biosphere/human society; appropriate techniques for data integration and/or assimilation; scaling and heterogeneity issues; capabilities to predict hydrological processes and their interactions and feedbacks with socio-ecological systems; and uncertainty estimation, communication, and incorporation into adaptive resource management decision-making. Knowledge needs to be transferred more actively to policy makers to ensure that decisions take into account the best available information. We need furthering research and developing early warning systems, supporting cooperation to advance vulnerability studies and adaptation actions related to climate change, and promoting innovative approaches to education and capacity building.

Groundwater Systems

Groundwater represents 98% of the world's unfrozen freshwater. It drives many geological and geochemical processes and sustains various ecological functions and services. The use of groundwater has increased significantly over the past 50 years due to its high reliability during drought seasons, good quality and generally modest development costs. We know about groundwater and aquifers, but we need to learn more about the complexity of aquifer systems, increasing global risk to groundwater depletion, quality deterioration and pollution, and resilience of communities and populations dependent on groundwater sources.

We need promoting measures addressing the principles of sustainable management of groundwater resources, addressing methods for the sound development, exploitation and protection of groundwater resources, developing new groundwater resource maps, and strengthening groundwater governance policy and water user rights in emergency situations. These challenges call for comprehensive research, implementation of new science-based methodologies and endorsement of

principles of integrated management, and environmentally-sound protection of groundwater resources.

Water Scarcity and Quality

For many countries, water scarcity represents the most pressing challenge to socio-economic and human development at large. Water scarcity can be exacerbated by climate change, especially in arid and semi-arid zones, which are already water-stressed. Protection of the world's freshwater resources requires that the human impact on the earth's environment and climate be addressed in an integrated manner. Investment in programs that protect the natural environment, conserve water and use water efficiently is critical.

We need to promote catchment based water resources planning and decision making, and good water governance practices, as well as supporting a policy shift towards water demand management and good water governance practices.

Water quality degradation is becoming one of the greatest threats to freshwater sustainability and availability, in addition to its negative health and environmental impacts. This is a serious and neglected aspect of water resources management. Poor water quality negatively affects human health and ecosystems in multiple ways. It reduces water availability, making the water unfit for different uses. Rapid urbanization, high population densities, intensive use of fertilizers and pesticides in agriculture, land degradation, and inadequate wastewater and waste management are the primary causes of water pollution. Water and wastewater treatment is expensive and a challenge to developing countries. Action is needed to improve water quality and wastewater management.

We must strengthen the knowledge base on the quality of the world's freshwater resources, integrating quality-quantity management and science-based decision-making, enhancing legal, policy and institutional frameworks for improved water quality management, and promoting new innovative tools for water quality management and pollution control.

Urban Water Management

Cities around the world are facing a range of pressures resulting from population growth, climate change and deterioration of urban infrastructure systems. As water demand continues to increase in the future, an increasing number of cities will face challenges of managing scarcer and less reliable water resources in an efficient way. Realities on the ground and the challenges of future pressures have made it obvious that business as usual is not the way forward.

Therefore, we need to explore new approaches, technologies and system-wide changes towards integrated urban water management such as flexible and adaptive urban water systems, water sensitive urban design, and water (beneficiation) in urban areas; promoting effective governance and institutional structures of urban water management; and identifying and disseminating best practices for different economic and geographic settings in developed and developing countries.

Water issues in emerging cities and rural settlements in developing countries merit a special emphasis, including the special needs and problems in slums or peri-urban areas that are often the most deprived. New approaches for water management in the city of the future have to be developed. Strategies to build resilient urban water systems must adopt a broader perspective that recognizes the interdependence of the different water systems. Game-changing approaches and technologies that allow optimization of water quality, quantity, and the water and energy footprint in cities need to be explored.

The traditional model of water management in most cities around the world is compartmentalized into three highly centralized, yet separately managed and financed, systems: (1) drinking water supply, (2) wastewater treatment and (3) urban drainage and flood control. Although this traditional urban water management approach has endured for nearly a century in developed countries, it remains inadequate to address the challenges of sustainability in the face of rapid urbanization and population growth, especially in emerging cities in developing countries where most population growth will occur. These traditional models of urban water systems rely on large imports of water and energy and are inadequate on technical, environmental, economic, and social levels to keep pace with the current rate of population growth and urbanization.

There is a need for a paradigm shift in how water resources are used and managed in urban areas towards a holistic approach to managing all components of the urban water cycle in an integrated, participatory, and forward-looking manner. Based on viewing water sources,

wastewater and stormwater, and their interactions with the natural environment with its diverse aquatic habitats, land use and energy as integral elements of a single water cycle, but within a wider basin context, the concept of the urban water cycle has emerged as a sustainable alternative to traditional urban water management. Therefore, transitioning to sustainable urban water management requires integrated, participatory approaches throughout the entire urban water cycle.

Ecohydrology

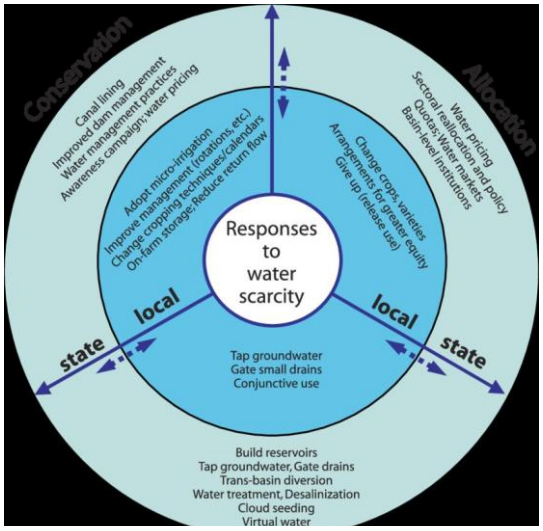
In the face of increasing climate instability, demographic growth and human migration, there is an urgent need to reverse the degradation of water resources and stop further decline in biodiversity. Ecohydrology uses the understanding of relationships between hydrological and biological processes at different scales to improve water security, enhance biodiversity and further opportunities for sustainable development by lessening ecological threats and maximizing greater harmony within catchment processes.

Our aim should be advancing the integration of social, ecological and hydrological research, and to generate outcomes that enable the development of effective policies and practices for integrated water resources management. We need to improve the understanding of the role of different types of terrestrial and wetland ecosystems, sharing knowledge on the integration of ecohydrological technologies with good agricultural and environmental practices, promoting model development to reduce adverse impacts on ecosystems by integrating specific environmental science knowledge, and developing catchment scale ecohydrological early warning systems.

Guidelines should be developed for the integration of various types of biological and hydrological regulations to improve water quality, biodiversity and freshwater systems. Regional ecohydrological solutions on the impact of global changes on hydrologic cycles and coastal ecosystems to address the increasing vulnerability of aquatic resources should be shared and improved.

Responses to Water Scarcity

Responses to water scarcity are extremely varied but can be classified under three different categories: (a) augmentation of supply, (b) conservation of water, and (c) reallocation of water. The following figure (Molle, 2003) synthesizes some of the main strategies for dealing with water scarcity and distinguishes between those that are implemented locally and those that are implemented primarily by government agencies or donor-assisted projects.



[Source: Molle, 2003]

There is normally little if any coordination or communication between farmers and government agencies. That is to say, the decisions of both entities are often made quite independently, although they are often interlinked (e.g., a farmer's decision to adopt micro-irrigation may be influenced by economic incentives). Most government irrigation agencies are involved in the operation of canal systems but they do not have information on the number of privately operated wells and pumps even within their own command areas. However, the need to respond to water scarcity (whether drought or chronic shortage) tends to increase the interaction between parties and the potential benefits from collaboration.

Water Education for Water Security

Water education at all levels needs to be improved if the challenges identified in the previous paragraphs are to be met. Water education must go beyond the teaching of hydrological sciences, and be both multidisciplinary and interdisciplinary. This approach would include advancing scientific knowledge through the training of scientists as well as increasing knowledge on water issues through courses aimed at water professionals and decision makers. Water education should also reach out to media professionals so that they can communicate water issues accurately and effectively. The work will include community education strategies to promote communitywide water conservation, as well as enhance skills in local co-management of water resources. Efforts should be made to make water a significant component of the Secondary School curriculum.

Human capacities and expertise of the water sector and related areas must be ensured to guarantee universal access to freshwater and address complex challenges linked to social, economic, climatic, and other factors at local, regional and global levels. We must support the enhancement of tertiary water education capacities, particularly in developing countries, promoting the continuous professional development of water scientists,

engineers, managers and policy makers in the water sectors, as well as developing guidelines, briefing papers, prototype professional development programs and case studies connected with water education for water security.

Water Cooperation

More than 90% of the world's population live in countries which share their water resources with neighbouring countries. Competition over water becomes even more acute considering the extent to which some countries are dependent on others for their water. These challenges have become increasingly important as water availability is further threatened by global changes. There is an urgent need to develop sustainable and equitable ways of managing water cooperatively.

Water cooperation can be promoted by facilitating multi-level and interdisciplinary dialogues, which in turn foster peace and development. We can enhance water security by strengthening the capacity of stakeholders in anticipating, preventing and managing water conflicts.

A range of region-specific as well as global educational materials can be developed and multidisciplinary training courses can be organized for the benefit of several hundred water professionals and decision-makers from around the world. Research can be focused on examples of cooperation over transboundary waters, the causes of water conflicts, best practices, and innovative management techniques. Support can be provided in cooperation processes to the parties facing difficulty in the joint management of their transboundary water resources with forum in which to establish dialogue and exchange knowledge, as well as experiences related to water management and security.

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