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EDITORIAL

Integrated Water Resources Management under different hydrological, climatic and socio-economic conditions

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Introduction

Around 900 million people currently have no access to safe drinking water and around 2.6 billion people live without adequate sanitation (WHO/UNICEF 2010). This situation has serious impacts on the health of these people, but also on the economy of the concerned countries and regions. Following the Millenium Summit in 2000, the United Nations agreed upon the Millennium Development Goals (MDG). One of these goals is to reduce the number of people without access to safe drinking water and without sanitation by half by the year 2015. Water resources management is a prerequisite for all the water- and health-related MDG (World Water Assessment Programme 2009).

The appropriate management of water resources is essential for achieving sustainable development including social and economic development, poverty reduction and equity, and sustainable environmental services (World Water Assessment Programme 2009; Teutsch and Krüger 2010). The fact that water is a natural resource, an integral part of the ecosystem and a social and economic good is recognized in the concept of Integrated Water Resources Management (IWRM), which has been defined by the Technical Committee of the Global Water Partnership (GWP) as "a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems" (GWP 2000).

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The International Water Research Alliance Saxony (IWAS) aims to contribute to an IWRM in hydrologically sensitive regions by developing specific system solutions as a response to water-related problems worldwide. Overarching objectives are (1) to generate interdisciplinary system understanding for a sustainable management of water resources in response to natural and social changes, (2) to develop and implement site-specific methods, models and technologies for water management, (3) to develop and apply site-specific management concepts and implementation strategies involving local governance structures and participatory processes, and (4) to contribute to the transfer of existing and newly acquired knowledge into the model regions (capacity development). Research questions concerning worldwide water problems in the context of global change are tackled in the project. Specific aspects of representative priority problems of water management are examined in selected regions (Fig. 1), where a pronounced sensitivity with regard to the investigated aspects is identified. All relevant water compartments, the managed systems (drinking water, wastewater, irrigation), the status and function of natural ecosystems, as well as anthropogenic influences (climate, land use, etc.) are investigated, where they appear most sensitive. In order to link the regions and form the potential to later on integrate the findings to a holistic IWRM concept, certain aspects relevant to all model regions are treated in cross-cutting sub-projects. These aspects include

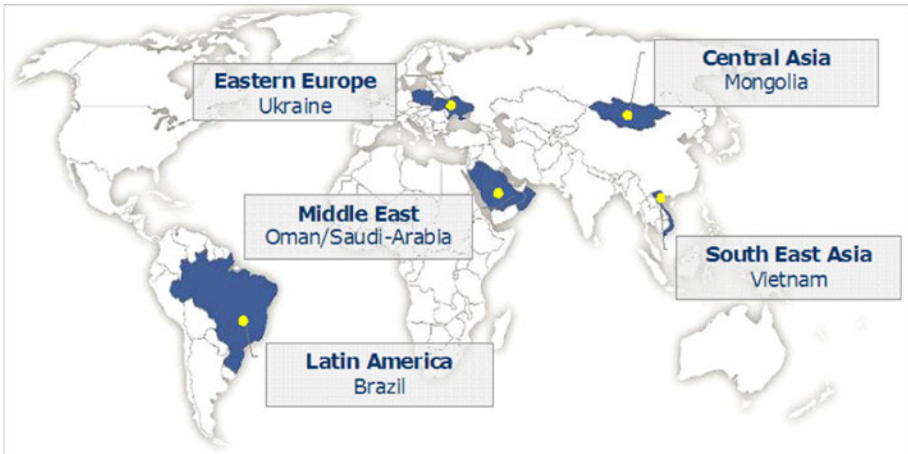

Fig. 1 The model regions of the IWAS project

systems analysis, scenario development and modeling, institutional prerequisites for water resources management, capacity development, and technology development and implementation.

In order to help the reader to assign the papers of this issue to the structure of IWAS, a brief overview is given of the contents and the main emphasis of the IWAS subprojects.

Scenario and system analysis

The focus of the cross-cutting topic "Scenario and system analysis" lies on the development and provision of applicable tools to analyze aspects of water resources management issues. The idea of developing a ToolBox was to provide interfaces for combining existing simulation tools to answer specific questions related to coupled hydrosystems (Kolditz et al. 2008; Kalbacher et al. 2011a). Examples are (1) investigating the interaction of roots and soil to better understand the mechanisms of water uptake (Kalbacher et al. 2011b), (2) studying the interaction between surface and subsurface water in the River Bug model area in particular to better understand the mechanisms of hydrograph separation and mass exchange between different hydro-compartments (Delfs et al. 2009, 2011), (3) setting up models of the wastewater systems based on little information (Blumensaat et al. 2011) and linking them with a river model, (4) climate projections (Pavlik et al. 2011), (5) future scenarios development (Schanze et al. 2011). The development of concepts and tools for data integration and visualization (Rink et al. 2011) became an important prerequisite for hydrological process analysis. Several web applications have been developed and implemented for the model regions in Vietnam and Brazil in order to handle the amount and heterogeneity of data in an adequate way.

Eastern Europe

In this region the focus lies on the improvement of surface water quality within the Western Bug River which rises in the Ukraine, then partly borders the Ukraine and Poland. While showing a good morphological quality (Scheifhacken et al. 2011), the river is strongly polluted with inputs from agriculture, industry, urban areas and mining activities (Blumensaat et al. 2011; Delfs et al. 2011; Ertel et al. 2011; Tavares Wahren et al. 2011). Two general research questions are (1) can the lessons learned from the newly formed German states be useful for improving the water quality in the Bug Area and (2) what are the consequences for the implementation of the EU Water Framework Directive as the Bug River crosses the EU border.

Central Asia

Research in Central Asia/Mongolia in the pilot catchment of the Kharaa River focuses on key elements of IWRM strategies in a semi-arid continental climate setting under dynamic global change processes (especially climate, land use, and demographic changes). The foci are (1) regional hydrological processes (Vetter et al. 2011), (2) land use impacts on the ecological quality of surface waters (Hartwig et al. 2011), (3) innovative decentralized wastewater management strategies backed with an integrated analysis (Sigel et al. 2011) and (4) institutional settings as a prerequisite for effective implementation (Horlemann and Dombrowsky 2011).

South East Asia

In many areas of Hanoi, Vietnam, problems of flooding and water pollution occur frequently. The general objective of this sub-project is the development of a sustainable drainage concept based on the existing master plan for the Long Bien district, Hanoi, and its integration into existing local and regional water cycles with the following aims: (1) supporting further urban development by using systems which are adaptive to fast growth, (2) protection and recharge of groundwater resources, (3) flood protection and (4) improvement of the quality of surface and groundwater.

Middle East

New solutions for a sustainable management of the scarce water resources in (semi-) arid regions are explored in Oman (Grundmann et al. 2011) and Saudi Arabia (Pfletschinger et al. 2011). Research topics are (1) the large-scale, highly precise determination of groundwater recharge, (2) saltwater intrusion (Kalbacher et al. 2011a), (3) the storage and use of ephemeral streams (artificial groundwater recharge), and (4) the optimization of water use in agriculture (Schütze et al. 2011). Modern hydrogeologic tracer and isotopic methods are used and innovative regional models are developed as a basis for a sustainable management.

Latin America

Accelerated non-planned urbanization and changes in land use have caused a strong impact on the water resources of Brazil's capital Brasília. According to the local water supplier, already in 2010 water demand has exceeded the system's supply capabilities. Here, the main objective is to develop an IWRM covering (1) the general natural framework (climate, hydrological cycle, land use, etc.) (Lorz et al. 2011), (2) the drinking water supply systems (Vasyukova et al. 2011), (3) wastewater treatment and sewer systems and management, and (4) sediment characteristics (Franz et al. 2011).

Transfer and application

Developing adequate concepts of knowledge transfer and capacity development (CD) is an essential component of the IWAS initiative. CD concepts are developed which are tailored to the regional conditions to improve local capacity. Such measures include the vocational training of people working in the field of water resources management, support of scientific education and curricula development, knowledge exchange, and the exchange of scientific staff. It is crucial for the success of such measures to elaborate functioning networks in both the academic and the practice arena in order to ensure the mutual exchange of experiences (Leidel et al. 2011).

This special issue presents selected aspects of the IWAS project. However, it provides a first insight into the achievements and ongoing research activities. At the same time it indicates the wide horizon of aspects related to IWRM and the need to later on integrate these aspects. More information can be found at http://www.iwas-initiative.de.

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