DUPC2 themes addressing key water and development challenges

Efficient water management, particularly in the agricultural sector

The main goal of the theme '*Efficient water management, particularly in the agricultural sector*' is reducing the knowledge gap to management of land and water resources for food and energy security in a sustainable and equitable way. This requires synergies with natural ecosystems, compatible with the respective socio-economic context. Challenges relate to amongst others improving water productivity taking into account values beyond crop production, best ways to revitalize large-scale irrigation systems as well as support small-scale farmer-led irrigation development, and water storage that are at the same time affordable and accessible and environmentally friendly. The challenges strongly link to understanding and analyzing the complexities of the inter-relations among agricultural water management technologies, the management and governance mechanisms and the ecosystem to develop a sustainable and profitable agricultural sector. Also, information and the generation of knowledge related to the dynamics of water in the real world, through the integration of information and communication technologies for data acquisition, modeling, forecasting, optimization and decision support are challenges to be addressed.

Improved catchment area management and safe deltas

Central to the *'Improved catchment area management and safe deltas'* theme is the evolution of both the social and natural dimensions of socio-ecological systems in deltas with a long history of civilization and socio-economic development, and that are currently densely populated. Water availability and equitable allocation between users is one of the challenges, and the promoting of cooperation to prevent conflict over shared waters. Environmental concerns are part of this, and the interaction with the social and economic systems. Water-related hazards like floods, droughts, pollution and related issues, are expected to increase in frequency and intensity almost everywhere around the globe due to economic development, population growth and effects of climate variability and change and sea level rise. Drought forms the other extreme of managing water resources, and although less clear to identify than flood hazard has widespread social, economic and environmental impacts to communities across the world. New approaches in the analysis and assessment of flood management, water resources availability and exploitation, river structure planning, hydropower potential are asked for. For instance, more holistic flood risk management that considers not only the hazard posed, but also the consequence of floods. Like the first theme, this theme requires a good understanding of the management and governance dimensions, as well as the support from information and communication technologies for data acquisition, modeling, forecasting, optimization and decision support.

Access to clean drinking water and basic sanitation

The theme '*Access to clean drinking water and basic sanitation*' aims at increasing access to safe, sufficient and affordable water for people to meet needs for drinking, sanitation and hygiene. Research in this theme addresses the entire water supply and sanitation chain, mainly within an urban and peri-urban context, including centralized and decentralized approaches, advanced and low-cost technologies, and engineered and natural systems. It focuses on knowledge and innovation to both help *meet basic needs* and support the development of water supply, wastewater treatment, and resource recovery systems that *enable economic development*. It includes experimental work at laboratory, pilot, and field scales as well as mathematical models and decision support systems in both conventional and irregular (emergency) applications. Besides technical, technological and engineering aspects of water supply, sanitation, and hygiene (WASH), the theme also addresses societal, economic and institutional aspects in cooperation with the researchers in the theme of water management and governance (described below), recognizing that technical solutions alone do not guarantee sustainable provision of WASH services.

Water diplomacy

Water diplomacy goes beyond cooperation over water, as it is more broadly concerned with improved regional security and stability, improved trade relations and regional integration. Water diplomacy thus has the potential to promote geopolitical relations between countries sharing a water resource. Water diplomacy can be successful in situations where it is recognized that despite competing and conflicting interests in water, non-collaboration results in a worse outcome for all. Water diplomacy is associated with water governance that seeks to analyze and improve institutional arrangements and decision making processes that govern access, use and disposal of water and the interaction between competing and collaborating users and sectors at local, watershed and basin levels. For water diplomacy and water governance spatially explicit information about current and future availability and use of water resources can be important, as well as the linkages with related sectors, such as food, energy, transport and trade. The recognition of spatial heterogeneity and resulting interdependencies between parties can give leads towards stable agreements.

Cross-cutting themes

Water scarcity and water problems related to the refugee crises with a specific focus on the Middle East

The theme '*Water scarcity and water problems related to the refugee crises with a specific focus on the Middle East*' aims to address the following three research areas.

1. *Addressing water scarcity by improved planning and management, including governance*
   What are the current levels of water scarcity? What are differences supply and demand? Is water reaching the users? What are future levels of water scarcity? What are implications for social stability? How to address water scarcity in regular planning and management? How to deal with different perspectives of water users? How to improve governance structures?

2. *Reducing water scarcity by efficient water use, re-use of wastewater and desalinisation of brackish and sea water*
   What are options for improving agricultural crop productivity? What are options for better waste waste treatment? What are options to reuse water for agriculture and other uses? What are experiences with desalinisation, also for agricultural use? Can we learn from past projects, and use in other regions? What is needed in terms of capacity and institutions?

3. *Improving WASH for urban settings under stress of migrants*
   How to ensure a sustainable use of water available? How to reduce pollution also from human excreta? How to minimise social and environmental impacts? Can technological innovations help? What is needed in terms of capacity and institutions?

Water Governance

Water governance is a key entry-point in solving water issues. Research in this theme investigates how water management decisions are made, which influence where water flows, for what purpose, and at what cost (ecological, social, economic). This cross-cutting theme spans all of the elements of sustainability but is distinct in its focus on knowledge to *ensure equity and reduce conflict.* It centres on the conviction that in order to fully understand how management decisions are made, it is necessary to study the intrinsic linkages between the social, biophysical and technological processes of water systems. Two broad methodological approaches are distinguished. The first is characterised by an instruments-oriented approach targeting management arrangements, including laws, regulations, incentive structures and planning tools that seek to enhance efficiency, equity and effectiveness of water management and to achieve good governance. The second employs a critical analytical approach in analyzing contested

decision-making processes, the ensuing allocation of resources and services and the impacts of such decisions on access to resources and services of different actors; it thus understands water management and governance to be emergent phenomena.

Gender/inclusiveness

Gender/inclusiveness hierarchies deeply shape processes of water governance, and co-determine the allocation of water and water services, the distribution of the risks of climate hazards and floods, as well as the distribution of the benefits of water interventions. This cross-cutting theme sets out to make these linkages visible. Gender and diversity (inclusiveness) are an integral part of the broader water governance agendas. The theme forms an explicit part of broader attempts to better understand the social impacts of water interventions or water-related disasters, as part of the development of strategic knowledge about what works for whom. It includes efforts to improve the inclusiveness of water decision making processes and water education, as well as the development of strategies to empower those with least voice in water and strengthen the water security of those with least rights and powers.

Climate change

Climate change is one of the main drivers of change in the above-described DUPC2 themes. Reducing the vulnerability of stakeholder groups, particularly the poor, to climate change is a main challenge. To reduce vulnerability from droughts and floods appropriate local adaptation measures will need to be understood and their application assessed in different contexts. Solutions often are of a nontechnical nature or have an international dimension. The theme therefore also strongly relates to governance. The development and application of innovative tools and models is needed to better understand climate change and to support the identification of adequate measures.