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GRoW

WATER AS A GLOBAL RESOURCE

MAY 2022

HIGHLIGHTS & RESULTS

New Tools and Analyses for the Management of Water as a Global Resource (GRoW)

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NaWaM Sustainable Water Management

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ViWA Efficient and sustainable global water use.
Coordination: Prof Wolfram Mauser, LMU Munich

SaWaM Seasonal water management in semi-arid regions.
Coordination: Prof Harald Kunstmann, Karlsruhe Institute of Technology, Institute for Meteorology and Climate Research (KIT/IMK-IFU)

MuDak-WRM Adapted approaches for monitoring and modelling water quality in reservoirs.
Coordination: PD Stephan Fuchs, Karlsruhe Institute of Technology (KIT), Institute of Water and River Basin Management, Department of Aquatic Environmental Engineering (IWG-SWW)

MedWater Sustainable use of politically and economically relevant water resources in hydraulically, climatically and ecologically highly dynamic hard-rock aquifers in the Mediterranean region.
Coordination: Prof Irina Engelhardt, TU Berlin

GlobeDrought Global information system on droughts and their impact.
Coordination: Prof Stefan Siebert, University of Göttingen

InoCottonGROW The global textile industry: Germany's water footprint in Pakistan.
Coordination: Dr Frank-Andreas Weber, Research Institute for Water and Waste Management at RWTH Aachen (FiW) e.V.

WELLE Determining the water footprint of companies.
Coordination: Prof Matthias Finkbeiner, TU Berlin

WANDEL The impact of water availability on a global energy transition.
Coordination: Prof Martina Flörke, Ruhr-University Bochum

TRUST Innovative planning tools for drinking water supply in water-scarce regions. *Coordination: Christian D. León, University of Stuttgart, Center for Interdisciplinary Risk and Innovation Studies (ZIRIUS)*

STEER Cross-sector coordination in water resources management.
Coordination: Prof Claudia Pahl-Wostl, Osnabrück University

iWaGSS Monitoring-based water governance system.
Coordination: Prof Karl-Ulrich Rudolph, IEEM gGmbH – Institute of Environmental Engineering and Management at the Witten / Herdecke University

go-CAM Implementation of strategic development goals in coastal zone management.
Coordination: Prof Hans Matthias Schöniger, Technische Universität Braunschweig, Leichtweiß Institute for Hydraulic Engineering and Water Resources, Division of Hydrology, Water Management and Water Protection

Contact details and links to project websites are available at *www.bmbf-grow.de*

EXECUTIVE SUMMARY

Sustainable Development Goal (SDG) number 6 commits the global community to 'ensuring the availability and sustainable management of water and sanitation for all'. In response, the Federal Ministry of Education and Research (BMBF) initiated the funding programme 'Water as a Global Resource' (GRoW), which attracted a great deal of interest. 12 joint research projects and one networking and transfer project were selected from a large number of applicants. These projects included 90 German partners from science, business and practice with a total of over 300 participants. They worked with research organisations and stakeholders from case-study areas around the world to help implementing the projects and transfer research results into policy and practice.

The guiding principle of the funding programme is to link global analyses with local solutions. To properly account for the complex reality of sustainable water management and its interlinkages with energy, food security, ecosystems and climate change, the programme employed an integrated perspective.

Under the topic of **'global water resources'**, innovative methods for the improved monitoring and forecasting of hydrological extremes, water availability and quality were developed. This enabled the improved prediction of drought and flood events over the next 7 months (SaWaM project) and the high-resolution analysis of global drought risks and vulnerabilities (GlobeDrought project). Drone technology was combined with multiple sensors in order to improve water quality, even in regions with little data (iWaGSS project), and enable predictions about the development of water quality in reservoirs (MuDak-WRM project). Groundwater modelling concepts were adapted to better map complex karst aquifers (MedWater project) and the risk of saltwater intrusion and nitrate pollution in coastal aquifers (go-CAM).

Methods for determining the water footprint and global models were used to analyse the development of **global water demand** and savings potential. A new method makes it possible to determine the water footprint of organisations and their value chains (WELLE project). The InoCottonGROW project developed a water footprint calculator for the cotton-textile value chain and quantified the local effects of optimisations on ecosystems. The WANDEL project estimated the direct and indirect effects of the energy transition on local water scarcity using the water footprint. To assess agricultural water use efficiency, the ViWA project developed a high-resolution global monitoring system based on satellite data and high-performance models.

Projects related to '**good governance in the water sector'** examined coordination processes and participation instruments to avoid conflicting uses of water resources. In order to identify suitable coordination instruments, the STEER project developed tools for diagnosing water governance systems. The TRUST project developed a new methodology that enables the analysis of water management planning measures for synergies, consistency, sustainability performance and robustness.

Based on the experiences of GRoW, the experts make **three central recommendations to politics and industry:**

1. Make effective use of digitalisation
2. Consider the effects of global teleconnections at the local level
3. Promote functioning water governance.

This brochure presents selected highlights from the GRoW funding programme. Terms underlined in colour link to the presentation of the corresponding GRoW products in the BMBF Atlas of Water Innovations (*www.innovationsatlas-wasser.de/en/*). A more comprehensive presentation can be found on the website (*www.bmbf-grow.de/en*) and in the over 200 scientific publications of the projects.

HIGHLIGHTS FROM THE GRoW TOPIC 'GLOBAL WATER RESOURCES'

GRoW provides innovative methods for improved forecasts of the availability and quality of water resources

The overexploitation of global water resources is already having an impact on human health, ecosystems and economic development. It is expected that, by 2050, 52% of the world population will live in areas with water stress. The focus of the GRoW topic 'Global Water Resources' is the development of approaches for a consistent, up-to-date and comprehensive description of the state of global water resources and associated ecosystems.

One of the main challenges is the often low availability of locally collected meteorological and hydrological measurement data. In order to reduce this data gap, GRoW projects used **innovative methods for data collection**, including **new types of sensors and ground-level remote sensing**. They also developed methods to use **data from satellite-based remote sensing, international databases and global models**, which are often publicly available. GRoW projects developed new approaches to assessing the condition of surface water, reservoirs and aquifers, which allow predictions of changes in qualitative and quantitative terms.

IDENTIFYING DROUGHTS, WATER SCARCITY AND ASSOCIATED RISKS

If water scarcity and droughts are predicted in a timely manner, the responsible actors can take measures to avert greater damage as much as possible. This often requires the prediction of extreme weather events months in advance (seasonal forecasts). So far, however, this has only been possible to a limited extent.

With SaWaM's seasonal forecasting system, drought events can be better predicted up to 7 months in advance

Researchers of the **SaWaM project** provided evidence that in six drought-prone, semi-arid regions in South America, Africa and Asia, the relative frequency of drought months increased significantly from 10% to 30% between 1981 and 2018. This calls for consistent action to mitigate the impacts of climate change. Therefore, a *model system for regionalized improved seasonal forecasts* was developed to provide *information on water resources and long-term hydrometeorological extreme events* at a resolution of 10 km and up to seven months in advance. A model chain that includes hydrology and vegetation dynamics, combined with remote sensing-derived water-related data, provides additionally retrospective and near-real-time information. This system thereby supports critical drought management and reservoir management decisions. For the semi-arid study regions, it was shown that by basing water management decisions on the project's seasonal forecasts, potential economic savings of up to 70% of those with optimal early action can be achieved. Economic benefits from forecast-based action can even be achieved up to seven months ahead.

In addition to hydro-meteorological predictions of drought risks, the evaluation of the risks associated with droughts must consider the vulnerability of affected people and sectors. Similar drought risks can lead to very different effects depending on the economic conditions, for example. While conventional early warning systems are mostly limited to the (meteorological) drought risk, the **GlobeDrought project** has developed an innovative, international drought information system that takes into account not only hydrology but also the vulnerability to certain drought effects as well as drought exposure. To this end, the project identified suitable indicators for the assessment of vulnerability and integrated data from process-based models and remote sensing. The *drought information system* is internet-based and provides data on the various drought risks in irrigated agriculture, rain-fed agriculture and water supply. The project developed *12 online lectures and webinars* related to drought risk analysis.

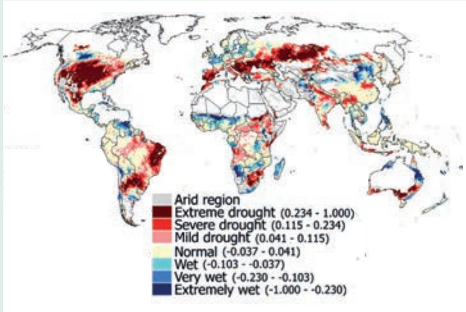


Figure: *Drought hazard for rainfed agricultural systems in year 2012 (top) and in period 1981-2018 for South Africa, Germany, Australia and at global scale (bottom). (Source: Eyshi Rezaei et al., unpublished)*

An innovative drought information system enables the analysis of global drought risks in high resolution

WATER QUALITY IN SURFACE WATERS

Although we often focus on the amount of water resources available, it is the quality that determines whether or not that water is useful. Close monitoring of the water quality in surface waters is often associated with considerable costs and challenging maintenance.

Drones and online sensors enable the collection of high-resolution data for water modelling – even in remote areas

Drones can help collect data on the state of water, even in remote areas. The **iWaGSS project** capitalised on this, equipping *drones with an innovative combination of sensors*: multispectral sensors for monitoring quality parameters, sonar sensors for recording water profiles, and techniques for taking water samples and measuring sediment transport. This enabled the collection of high-resolution data for water modelling, which was fed into a newly developed data management and early warning system to protect Kruger National Park in South Africa.

The **MuDak-WRM project** developed ways to more easily and quickly assess the future development of water quality in rivers and reservoirs. This allows, for example, the reliable assessment of the eutrophication potential in reservoirs and the selection of appropriate countermeasures. The project coupled data from in-situ measurements and near-ground water remote sensing by hyperspectral sensors (which are attached to drones, for example) with globally available remote sensing data. It fed this information into a *tool for regionalised sediment input modelling*. To reduce the effort needed for in-situ monitoring and enable statements even in regions with limited data, the project determined the minimum data requirement and designed an efficient minimum monitoring concept. The water quality data is integrated in real time in a *sensor web*. It is available online and can be used to support decision-making.

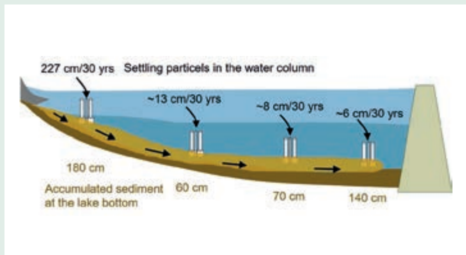


Figure: *Siltation inside the reservoir shows importance of density currents by the difference of settling and accumulated sediment. (Source: S. Hilgert, MuDak-WRM).*

An adapted tool for regionalised entry modelling enables predictions of water quality development even in regions with little data

AVAILABILITY AND QUALITY OF GROUNDWATER

The management of large underground reservoir systems is key to securing adequate water resources for consumption and industrial use in the long term. However, groundwater resources are often managed unsustainably and without the necessary data.

Groundwater recharge of the Western Mountain Aquifer in Israel predicted to decrease by 18%

In the Mediterranean region, which has been severely affected by climate change and water scarcity, groundwater is often found in karst aquifers. Given their complex geological structures, they represent a particular challenge for predicting groundwater availability. The **MedWater project** developed generalised models for different types of Mediterranean karst aquifers and calculating the associated groundwater stress index (GSI). Based on this, the project enabled the estimation of the *vulnerability of 365 Mediterranean karst aquifers with regard to climate change*. For the *Western Mountain Aquifer in Israel, MedWater predicts* that the average annual groundwater recharge rate will decrease by 18% by 2070, with the groundwater level falling by another 5m in the long term.

Improved modelling of the risk of saltwater intrusion and the development of nitrate pollution in coastal aquifers

Salinization is often a key challenge for the use of coastal aquifers. With the improved construction and calibration of hydrological, hydrogeological and geological models, the **go-CAM project** can estimate the risk of saltwater intrusion and the development of nitrate pollution in the context of climate change and socio-economic change. The project defined eight parameters and corresponding indicators to enable the assessment of the status of groundwater resources. This information was fed into a software-based coastal zone management system, *CAM (Coastal Aquifer Management)*, which combines decision support methods, hydro system models and monitoring data.
Eight water indicators were identified according to UN-SDG requirements that allow assessing the state of groundwater resources. The concept underlying the CAM online platform enables several user groups to communicate, evaluate and develop solutions together.

CONCLUSIONS FOR WATER RESOURCES MANAGEMENT

- Publicly accessible information from satellites and global models can make a major contribution to improved water management. This is especially the case in regions with limited data or in transboundary river basins where data is usually not shared and an independent data source is needed. Bias correction and regionalisation make publicly available global seasonal forecasts more accurate and allow forecast periods of up to seven months.
- Remote sensing methods can provide support in determining the conditions, but (complex) on-site measurement methods are still required for differentiated situation and risk assessment. Quality-checked local observation data are still only sparsely available in climate-sensitive regions with weak infrastructure. Minimum monitoring and consistent data management as the foundation of water management remain long-term tasks.
- In the future, satellite information and high-resolution meteorological data could be used by an independent body to monitor the achievement of the SDG indicators (e.g. on water availability, yield and agricultural water use efficiency).

HIGHLIGHTS FROM THE GRoW TOPIC 'GLOBAL WATER DEMAND'

GRoW provides new ways to predict water use in different sectors and assess associated effects and conflicts

Global water demand is expected to increase by 55% by 2050. This exacerbates the conflicts associated with scarce water resources. The focus of the 'Global Water Demand' topic in the GRoW funding programme is research on using the available resources more effectively. Evidence-based and comprehensible forecasts of the development of water demand are an important tool for decision-makers in companies and administration. In addition to water use in the manufacturing industry, future water demand in the water-energy-food nexus (WEF Nexus) must be taken into account.

GRoW projects improved and applied various **methods for determining and predicting water use in different sectors**. The water footprint and related approaches played an important role, in particular. Remote sensing data and global data sets were often used as sources of information. In addition to water demand, this also enabled the identification of conflicts of use and water risks.

INNOVATIVE METHODS FOR THE WATER FOOTPRINT

Up to this point, the water footprint was essentially known as a concept for determining the direct and indirect water consumption related to the production of individual goods. In GRoW, methods and approaches were developed to understand and determine the water footprint in a broader sense.

Companies often measure and manage their water consumption at their main production sites – although the consumption there is usually very low compared to the total water consumption along the globally distributed value chains (<5%). The **WELLE project** developed a method for analysing an organisation-related water footprint to determine the water consumption and the resulting local effects along value chains. With the help of a *database*, a *guide* and an *online tool*, companies can determine their entire water footprint and identify where local water hotspots are located in their supply chains and take action accordingly.

Determine the water consumption of an organisation and the resulting local effects along its value chain

The InoCottonGRoW water footprint calculator quantifies water use and impacts on human health and ecosystems along the cotton-textile value chain

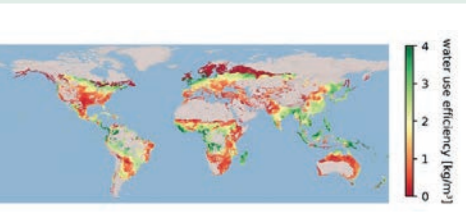
The **InoCottonGROW** project examined the water footprint of the global cotton textile industry along the entire value chain, from the cotton field to the textile industry and wastewater treatment. This included not only direct water consumption, but also water pollution. The resulting ***water footprint calculator*** allows decision-makers to quantify the associated effects on human health and ecosystems and compare various ways of reducing the water footprint. It is important to evaluate the local effects through monitoring, model calculations and analyses of agricultural systems and dyeing technologies. The ***case study in the Lower Chenab Canal (LCC), Pakistan*** showed the contribution that better irrigation technologies, more heat-resistant seeds in cotton production and functioning wastewater treatment plants could make.

METHODS FOR THE EVALUATION OF WATER RISKS AND CONFLICTS OF USE IN THE WATER-ENERGY-FOOD NEXUS

The increase in global water demand is mainly driven by population growth and economic development, which in turn causes an increase in the production of food and energy. GRoW examined global interactions in the WEF nexus and assessed the associated water risks and conflicts of use.

The environmental impact of energy systems must be determined comprehensively and along their entire supply chain

The **WANDEL project** examined the effects of the global energy transition on the availability of water. To this end, it analysed how different decarbonisation strategies affect the direct ***water demand for electricity generation on a global and regional level***. Through a combination of global modelling and case study analyses, the project determined the direct and indirect ***effects of various energy systems*** (coal, biomass, solar thermal and hydropower) on water scarcity at the local and regional levels. The analysis demonstrated that the ***environmental impacts of energy systems must be determined comprehensively along their entire supply chain*** to avoid the displacement of problems. With regard to an energy transition, it shows that a reduction in greenhouse gas emissions through the use of renewable energy sources does not necessarily lead to a reduction in water consumption. The majority of the globally available water resources are used in agriculture. In order to guarantee water supply and food security in the future, water use in agriculture must become more efficient and sustainable.



The ViWA 'water-food-energy nexus' tool enables the analysis of interactions and potential conflicts of use in the WEF nexus

The **ViWA project** succeeded in developing a high-resolution global monitoring system for agricultural water use efficiency (AWUE) using remote sensing data and global weather data. This enables the identification of ***areas with low (or high) agricultural water use efficiency*** and the estimation of possible increases in yield. A newly developed ***'water-food-energy nexus' tool*** enables the analysis of the conflicts of use between agricultural production, water demand, electricity production by hydropower and the preservation of aquatic ecosystems. It also allows the evaluation of different measures to increase agricultural intensification. For the catchment area of the Danube, the analysis shows that exploiting the irrigation potential for corn leads to a significant increase in water use efficiency and a doubling of the corn harvest (approx. € 4.7 billion more in revenue), but at the same time results in serious effects on the water ecology and in reduction in the hydropower production by 2.7% (about € 156 million less revenue).

Figure: *Global Water Use Efficiency of Maize (2015-2017) (Source: ViWA).*

CONCLUSIONS ON THE ASSESSMENT OF CONFLICTS OF USE AND WATER RISKS

- The water footprint is an important tool for making politicians, industry and consumers aware of the effects of their decisions. It also makes it possible to identify starting points for more sustainable water management and can in this way provide valuable insights for achieving the SDG goals.
- In many industries – e.g. cotton textile production, agriculture or the energy sector – the implementation of technical solutions, management options and development strategies towards more sustainability requires coherent policies across sector boundaries.
- Integrated tools for the local-to-global analysis of water conflicts in the water-food-energy-ecology-nexus are available and should also be used in decision-making towards cross-border, sustainable water management and more sustainable world trade.
- Given the extreme importance of water consumption in supply chains, reducing the water footprint requires cooperation among suppliers (water stewardship), consideration of the water footprint in product development (ecodesign) and sustainable procurement (water-efficient materials, certified suppliers, etc.).

HIGHLIGHTS FROM THE GRoW TOPIC 'GOOD GOVERNANCE IN THE WATER SECTOR'

▶ *GRoW provides instruments to select and support suitable coordination processes in order to ensure efficient and sustainable water use by various actors*

In many countries, major changes in administrative practice are required to achieve ambitious goals like the SDGs. **Coordination processes between actors in different sectors and on different levels** are crucial to the effective coordination of sectoral policies and strategies as well as addressing the causes of resource problems and conflicts of interest. Societal, social and cultural factors often determine the acceptance and effectiveness of solutions in water resource management. The involvement of stakeholders is also an important step in increasing **acceptance and implementation**.

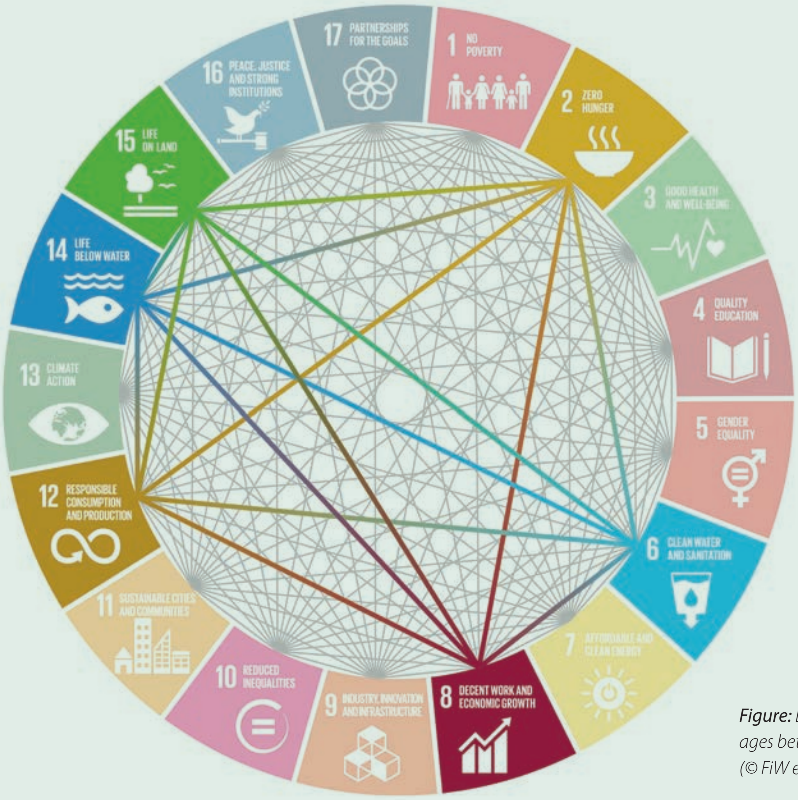


Figure: *Example for selected interlinkages between SDG 6 and other SDGs (© FiW e.V., Aachen).*

COORDINATING AND INTEGRATING DIFFERENT ACTORS AND STAKEHOLDERS

The **STEER project** has developed a diagnostic approach that enables a deeper understanding of the influence of different factors in the water management and governance system. This includes a detailed analysis of the water-related challenges in a particular region, the actors involved and their decision-making structures. Taking into account the natural and social framework, it is possible to derive *recommendations for improving coordination in water management*. The *STEER water governance tool* enables the simplified diagnosis of water governance and management systems and suggests targeted instruments to address existing coordination deficits and resolve existing water use conflicts.

The STEER water governance tool enables the selection of targeted coordination instruments based on a diagnosis of the existing water governance system

The **TRUST project** provides another approach to preventing conflicting goals between different water users when planning water management. The newly developed *methodology* examines so-called 'policy mixes' for water management planning to evaluate how coherent they are in terms of synergies and consistency. In addition, the method evaluates their sustainability performance and robustness. This provides a strategic decision-making tool that enables the design of conflict-free and sustainable water use concepts.

TRUST: evaluation of policy mixes in water management planning for coherence

In order to create a basis for transparent assessment, analysis and discussion between different actors in coastal water management, the **go-CAM** project developed a tool that offers a bundled representation of the state of coastal hydrology and water management. The *software-based coastal zone management* system CAM (coastal aquifer management) combines hydro(geo)logical models with the analysis of the governance framework and socio-economic factors. The system is accessible to various users, including water agencies, specialist authorities, water suppliers and soil and water associations. In addition to the representation of the current and future conditions, it enables the visualisation and evaluation of the future effects of climate change on coastal areas. The tool can be used to evaluate the effect of coastal water management measures. This increases transparency, objectivity and acceptance in coastal management decision-making processes.

CAM combines hydro(geo) logical models with the analysis of governance frameworks and socio-economic factors to create a common basis for dialogue between actors

CONCLUSIONS FOR IMPROVED COORDINATION IN WATER RESOURCES MANAGEMENT

- Coordinated water resources planning is essential to avoid conflicts between usage goals and measures taken by the various users. To this end, coordination platforms must be established that bring together actors from the relevant sectors and spatial levels in a representative manner.
- Polycentric governance and management systems that combine decentralisation with coordination mechanisms are particularly effective in aligning sectoral policies and strategies.
- Such processes require a good legal foundation, but also the ability of state actors to actually implement regulations. Especially in the absence or failure of responsible state water management institutions, transparent monitoring and data availability are essential prerequisites for the self-organisation of affected stakeholders and civil society actors and an important decision-making basis for (informal) resource management.
- A combined scientific and social-science approach to data collection has proven to be particularly helpful in regions where there is little or no reliable data. This means that, in addition to collecting in-situ measurement data and using innovative techniques like remote sensing (cf. topic 'Global Water Resources'), local stakeholders should also be included in the data collection and analysis.

OVERARCHING POLICY RECOMMENDATIONS FROM GRoW

Safeguarding water resources in a globalised world: A science-based call for action

In the recommendations paper '*Safeguarding water resources in a globalized world: A science-based call for action*' the GRoW community calls on decision-makers from policy, business and society to take action. To this end, it suggests the following:

Action I: Leverage digitalisation.
The new potential of the digital era should be used consistently and systematically in order to achieve and improve sustainable water management everywhere.

Action II: Consider global teleconnections at the local level.
Sustainability of local water resources needs to be considered in global supply chains and international trade.

Action III: Promote functioning water governance.
In the future, water must become an integral and decisive part of all decisions about natural resources. To this end, action must be taken to strengthen and consistently implement transparent, evidence-based water governance.

Seven sins against local water management

In the thesis paper '*Seven sins against local water management*', GRoW experts[1] address grievances in local water management and identify which points are decisive for the success of local water governance. The list of the 'seven sins' provides a specific catalogue of criteria for investors and banks, regulatory authorities and companies that are active in the water sector. It formulates recommendations for success in local water practice with social, ecological and economic added value. The 'seven sins' can also be seen as starting points to strengthen the efficiency of water supply and wastewater management on site and to prevent sunk investments.

1 The authors are the GRoW project iWaGSS and members of the GRoW group '*Incentive Mechanisms in the Context of Governance*'.

Water footprint policy brief

Water footprint has become a widely used concept to study water use and the resulting local impacts of agricultural and industrial production. With their *policy brief on the water footprint*, GRoW experts[2] intend to raise awareness of the great potential of the water footprint, e.g. for decision-making in the public and private sector with regard to improved water management and the achievement of the SDGs.

SDG6 position paper

In advance of the UN High Level Political Forum (HLPF) in 2018, the GRoW community published a *position paper* that identifies the key challenges to achieving the UN SDGs, in particular SDG 6. The paper names the areas in which GRoW projects develop concrete solutions and closes with the claim for evidence-based decision-making processes in water resources management. The GRoW projects support the suggestion of the 'United Nations Secretary General's Advisory Board on Water & Sanitation' of the Secretary General of the United Nations to set up a scientific platform on the subject of water for SDG implementation.

2 The authors are members of the GRoW cross-sectional topic group '*Water footprint*'

GRoW PRODUCTS IN THE BMBF ATLAS OF WATER INNOVATIONS

Analysis tool and training simulator for cascade reservoirs (WANDEL)

Automated satellite data integration for water management (MuDak-WRM)

Automatic model chain for forecasting seasonal hydrology (SaWaM)

Calculating groundwater recharge in karst aquifers (MedWater)

CAM online dialogue platform (Coastal Aquifer Management) (go-CAM)

Classification scheme for carbonate aquifers (MedWater)

Components for integrating sensor data into the data infrastructure (MuDak-WRM)

CSV template for structuring water management measurement data (MuDak-WRM)

Decision support tool (viewer) for seasonal water management (SaWaM)

Diagnostic water governance tool (STEER)

Documentary: the water footprint of the cotton-textile industry (InoCottonGROW)

Environmental sustainability assessment (WANDEL)

Global indication system for regional energy-water security (WANDEL)

Global maps for the characterization of Mediterranean karst aquifers (MedWater)

Global maps of agricultural water use efficiency (ViWA)

Guideline Pilot Plants for Drinking Water and Wastewater Treatment (TRUST)

High-resolution satellite-based precipitation information in near real-time (SaWaM)

HIPPO - in-situ device to monitor fine sediment remobilisation (iWaGSS)

Hydrometeorological seasonal forecast in semi-arid regions (SaWaM)

Inland water level time series from satellite altimetry (SaWaM)

Manual: Integrated water management concepts in arid regions (TRUST)

Model system for water and sediment transport (SaWaM)

Mooflow - optimization of groundwater management with MODLOW (MedWater)

MoRE - tool for regionalised emission modelling (MuDak-WRM)

Multiparameter drone for high-precision water data collection (iWaGSS)

Numerical groundwater model to predict water availability (MedWater)

Operational water demand for future global electricity generation (WANDEL)

Policy recommendations for improved cooperation in the IWRM (STEER)

Seven sins against local water management (iWaGSS)

Synergetic and sustainable policy mixes in water management (Trust)

The spatially explicit water scarcity footprint (WANDEL)

Tool for simulation-based, optimised dam control (WANDEL)

Training material for non-specialist instructors on the IWRM (STEER)

Water-food-energy-nexus tool (ViWA)

Water footprint calculator for the global cotton textile industry (InoCottonGROW)

Water footprint guide for companies (WELLE)

Water safety plan tool for risk management in drinking water supply (Trust)

Web-based satellite image analysis and geodata management – WEOMerge (WANDEL)

WELLE corporate water footprint tool (WELLE)

WELLE regionalised water inventory database (WELLE)

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