An Initiative of the Federal Ministry of Education and Research

GRoW

WATER AS A GLOBAL RESOURCE

TECHNICAL BRIEF #4

The BMBF funding measure "Water as a Global Resource" (GRoW) has produced a number of governance tools which contribute to more efficient water management. This technical brief presents a selection of these products. Further GRoW products related to the topic can be found in the BMBF Atlas of Water Innovations (www.innovationsatlas-wasser.de). In-depth information is available in the final reports of the respective research projects, accessible via the GRoW-website (www.bmbf-grow.de), the individual project websites or the TIB (www.tib.eu).

ADDRESSING CONFLICTING GOALS IN WATER MANAGEMENT: NEW TOOLS FOR IMPROVED GOVERNANCE

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FONA Research for sustainability

NaWaM Sustainable Water Management

BACKGROUND

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.

GRoW projects investigated the causes for conflicting goals in water management and defined key factors for well-functioning water governance. In particular, they examined coordination processes and participation instruments to avoid conflicting uses of water resources. As a result, GRoW provides instruments to select and support suitable coordination processes in order to ensure efficient and sustainable water use by various actors. Results achieved in GRoW show that action must be taken to strengthen and consistently implement transparent, evidence-based water governance, as claimed in the **GRoW science-based call for action** (https://bmbf-grow.de/sites/bmbf-grow.de/files/documents/call_for_action_for_business_and_policy_leaders_web.pdf).

This Technical Brief presents selected products from the GRoW funding measure on the topic of water governance. Further innovative GRoW products on this topic can be found in the **BMBF Atlas of Water Innovations** (www.innovationsatlas-wasser.de) and include:

- Manual: Integrated water management concepts in arid regions
- Guideline: Pilot Plants for Drinking Water and Wastewater Treatment
- The spatially explicit water scarcity footprint
- Operational water demand of future global power generation
- Policy recommendations for improved cooperation in the IWRM
- Training material for non-specialist trainers in IWRM
- Water footprint calculator for the global cotton-textile industry
- WELLE regionalised water inventory database
- WELLE organizational water footprint tool

SYNERGETIC AND SUSTAINABLE POLICY MIXES IN WATER MANAGEMENT

The method is used to design and evaluate policy mixes to achieve different goals at the same time. It allows measuring the synergy and consistency of policy mixes, assessing sustainability effects as well as robustness, considering context uncertainty.

Water management is often faced with the challenge that different goals of various water users have to be achieved at the same time. Measures and instruments addressing these goals cannot be freely combined with one another. Instead, they mutually influence each other in terms of their effectiveness and can, for example, trigger conflicts in situations of water scarcity. This is where this method comes in.

With the help of the qualitative system analysis CIB (Cross-Impact Balances, Weimer-Jehle 2006), a conceptual model of interactions between measures to achieve different goals is created. Literature and knowledge from experts and/or stakeholders are used to assess the interactions. Hindering, fostering, neutral and mutually exclusive interactions are identified. The CIB balance algorithm in the freely available software SzenarioWizard then allows to measure the synergy and consistency of policy mixes. As a result, synergetic and internally consistent policy mixes can be identified. In addition, the sustainability performance of various mixes can be assessed if sustainability criteria (e.g. SDG targets or indicators) and their interactions are integrated into the system model. Finally, the robustness of policy mixes can be assessed, if context variants (e.g. governance, climate change) are integrated, too.

Overall, this is a qualitative but systematic approach to generate system-analytical knowledge about existing and possible alternative policy mixes. The method is a building block for coherent policy design processes for sustainable water management and planning.

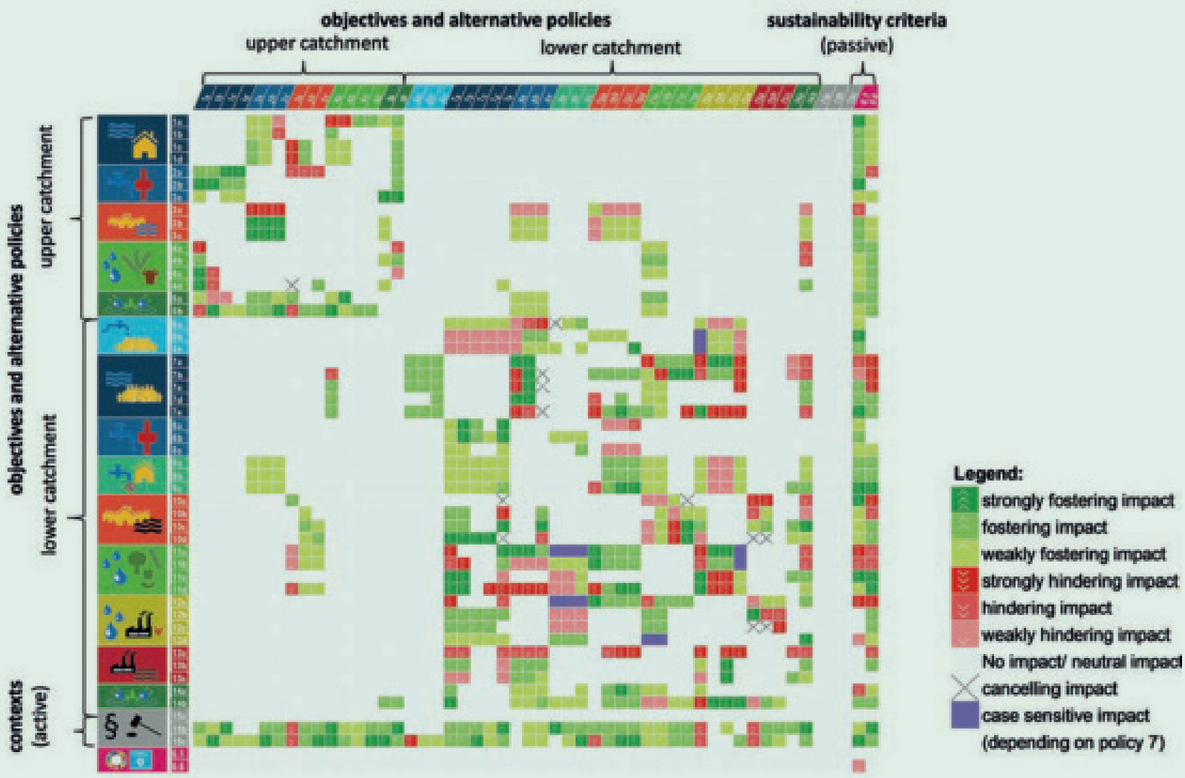

Figure 1: Matrix for qualitative system analysis of interactions between measures and instruments in water management, using the example of the Lurín river basin, Lima, Peru. © ZIRIUS.

INNOVATIVE ASPECTS

- New methodology to design and evaluate policy mixes (ex post and ex ante)
- Explicitly addresses synergies and trade-offs within and between policy sectors
- Simple operationalization of synergy and consistency of policy mixes
- Assessment of sustainability impacts and robustness of policy mixes

CASE STUDY: LURÍN RIVER BASIN, LIMA, PERU

For the catchment area of the Lurín, Peru, the analysis shows that the status quo policy mix is neither consistent nor optimal in maximizing synergies, nor sustainable. According to the model of policy interactions, the key to transformation lays in ameliorated forms of safe wastewater treatment and reuse. From there, various alternative policy mixes can be designed, which meet the different water users' objectives in more sustainable ways.

The GRoW project TRUST (Innovative planning tools for drinking water supply in water-scarce regions) provides an 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.

FURTHER INFORMATION

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Project website:
http://trust-grow.de/

Atlas of Innovations:
https://www.innovationsatlas-wasser.de/en/products/synergetic-and-sustainable-policy-mixes-in-water-management

ENVIRONMENTAL SUSTAINABILITY ASSESSMENT

To comprehensively assess the environmental impacts of the construction and operation of plants and anthropogenic processes – including prior to project start and remote impacts – the environmental impact assessment has been expanded into an environmental sustainability assessment.

Sustainable technologies in electricity production often focus on reducing the carbon footprint, while other adverse effects on the environment are not always considered. It has been shown that a comprehensive assessment of environmental impacts in different categories is necessary in order to assess the sustainability of various technologies. The environmental impact assessment required in Germany for the evaluation of planned construction measures covers a wide range of environmental impacts, but also has weak points: the procedure can only be used meaningfully before the start of the project or measure, does not record any remote effects from upstream supply chains, and is purely verbal-argumentative. As a result, it does not establish comparability between different projects. It is possible to close this gap using selected life cycle assessment indicators – the material, water, land, climate and energy footprint, as well as indicators for the consideration of human health and ecosystem services. It can be used at every phase and include the entire supply chain of a plant. In the presented concept, these indicators are supplemented by descriptive elements so that experts in life cycle assessment analyses and users of the environmental impact assessment can achieve the most comprehensive possible assessment. In this way, the environmental sustainability assessment represents an interface between science-based sustainability indicators and practical applications.

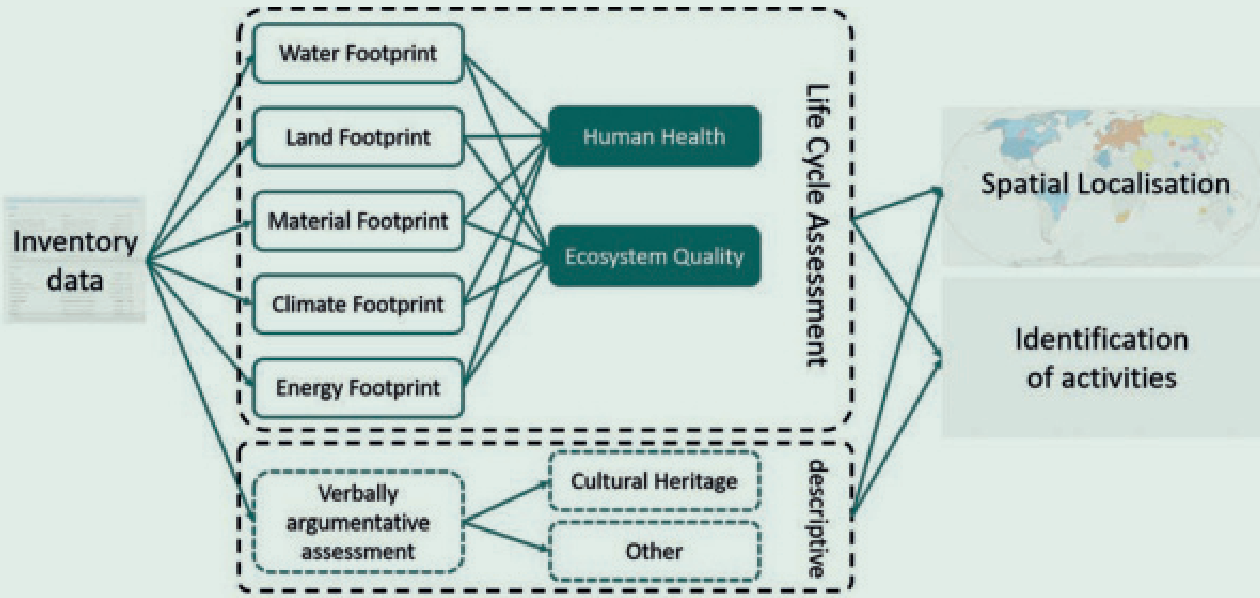

Figure 2: *Overview of selected indicators that can evaluate or describe short-term (middle) and long-term (right) environmental impacts in connection with anthropogenic processes. Based on an life cycle inventory analysis of these processes (left), at least 80% of all environmental impacts are covered. © Anna Schomberg.*

INNOVATIVE ASPECTS

- Expansion of the environmental impact assessment by a comprehensive assessment of environmental impacts, such as the material, water, land, climate and energy footprint
- Increased comparability between different projects
- Factoring of remote effects from upstream supply chains
- interface between science-based sustainability indicators and practical application

The environmental sustainability assessment and the global indication system for regional water and energy security were developed as part of the GRoW project WANDEL (The impact of water availability on a global energy transition), which examined the effects of the global energy transition on the availability of water. 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.

FURTHER INFORMATION

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Project website:
https://wandel.cesr.de/en/

BMBF Atlas of Water Innovations:
https://www.innovationsatlas-wasser.de/de/produkte/umweltnachhaltigkeitspruefung-unp

GLOBAL INDICATION SYSTEM FOR REGIONAL WATER AND ENERGY SECURITY

Electric power generation is highly dependent on water. However, there is currently no set of criteria for the assessment of the stability of energy generation in a region. This set of indicators changes that.

This product offers the first integrated set of indicators for the synergies and trade-offs between the generation of electrical energy and the required water supply. No other available tool deals with the energy-water relationship in an integrated manner – in this way, the set of indicators is a novelty.

Based on the SDG principles, the product uses the concept of security according to Grey and Sadoff (2007) as a foundation, and is geared towards the numerous technical dependencies of energy and water.

The set attempts to reflect the diverse ways in which electrical energy is dependent on the water supply in a dynamic ecological, economic and social environment. Since the interactions between energy and water mainly take place on a regional level, the set is designed in such a way that it can be applied to any administrative area or river basin. The product requires only moderate data availability, which means it can be used for both industrialised and non-industrialised countries.

The set is based on six indicators and sixteen sub-indicators that encompass ecological, social, physical, technical, administrative and economic perspectives on the energy-water relationship.

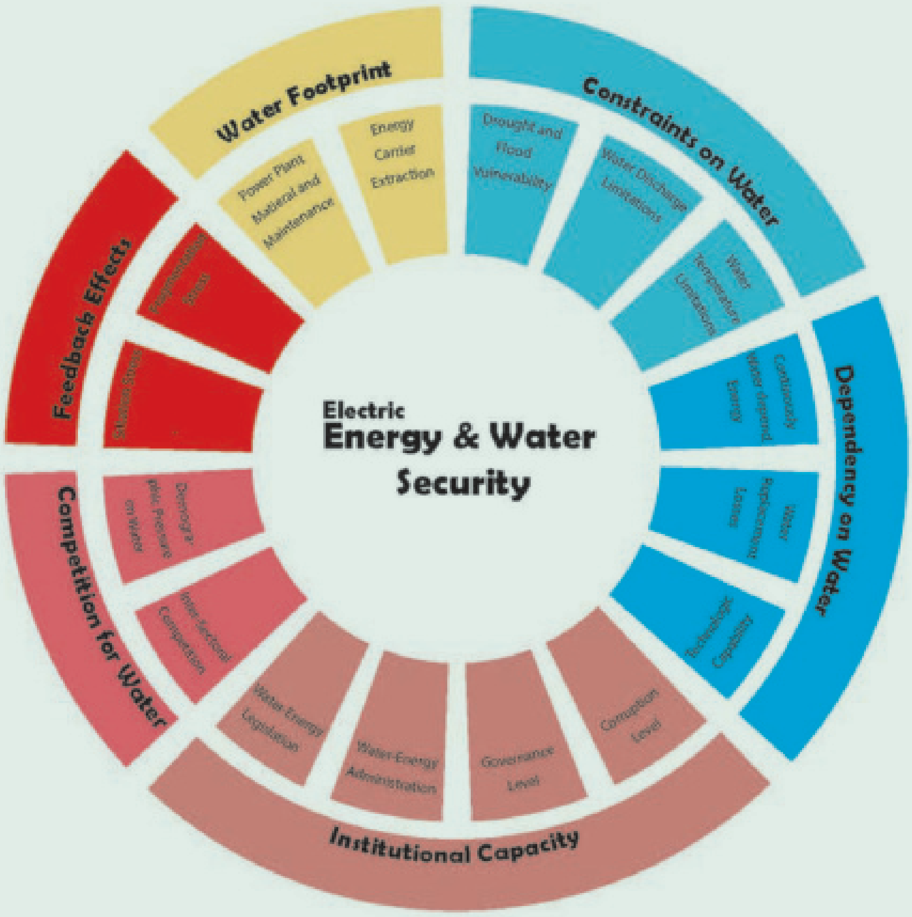

Figure 3: *The "Water & Energy Security" indicator set: Six main indicators and 16 sub-indicators for water and energy security. © Tobias Landwehr, IUSF.*

INNOVATIVE ASPECTS

- First integrated set of indicators for synergies and trade-offs between energy generation and required water supply, reflecting the diverse ways in which electrical energy is dependent on water supply
- Tool is applicable to any administrative area or river basin and requires only a moderate level of data

FURTHER INFORMATION

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Project website:
https://wandel.cesr.de/en/

BMBF Atlas of Water Innovations:
https://www.innovationsatlas-wasser.de/en/products/global-indication-system-for-regional-water-and-energy-security

DIAGNOSTIC WATER GOVERNANCE TOOL

The Diagnostic Water Governance Tool is a comprehensive instrument to support integrated management in water catchment areas. Based on the data entered, the tool provides both a diagnosis of the governance system and recommendations for instruments to improve coordination in water management.

In the past few years, a number of online tools have been developed that provide helpful information for solving water management problems. However, they do not offer any case-specific recommendations for dealing with coordination and cooperation deficits. The Diagnostic Water Governance Tool provides comprehensive support for the implementation of integrated, adaptive water management on a case-by-case basis.

Based on the data that users enter for their respective situation (e.g. a river catchment area), they not only receive a diagnosis, but also specific recommendations for instruments to improve coordination and cooperation in water management. The algorithm for recommending certain instruments is based on the empirical results of the STEER research project.

The tool is divided into three consecutive sections. Based on the information provided by the user on water governance in the respective area, deficient governance variables are identified in a "Diagnosis" step. Then, in the "Therapy" step, instruments are suggested to improve these variables. These can help to strengthen integrated and adaptive water management in a specific case. In addition, the tool enables the results to be further narrowed down based on the context of a specific water catchment area. The tool also includes a database of real-life examples where these tools have been successfully put to use.

The target audience for the tool includes practitioners in water administration and management as well as development cooperation and consulting, but also researchers.

INNOVATIVE ASPECTS

- Diagnosis of deficient water governance variables.
- Case-specific recommendations for the implementation of integrated, adaptive water management.
- Growing data base of real-life case studies integrated in the tool.

THE CASE STUDIES OF THE WATER GOVERNANCE TOOL

The Water Governance Tool includes a catalogue of 27 case studies that were assessed in the STEER research project. The case studies are located at the basin or sub-basin level and cover diverse water governance challenges in more than 20 countries. For each of these case studies, a short description is provided. The Tool allows to compare the results of the tool assessment of the case study entered by the user with each of the case studies in the database

„The tool gave a quick, focused, and pointed diagnosis of the water management situation in my case area and provided some key tools that can be used to plan actions"

Test user of the Tool (anonymous)

The diagnostic water governance tool was developed as part of the GRoW project STEER (Cross-sector coordination in water resources management). The project's diagnostic approach 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. Following this approach, the STEER water governance tool suggests targeted instruments to address existing coordination deficits and resolve existing water use conflicts.

FURTHER INFORMATION

Contact:
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Project website:
https://www.steer.uni-osnabrueck.de/

BMBF Atlas of Water Innovations:
https://www.innovationsatlas-wasser.de/en/products/diagnostic-water-governance-tool

Online tool:
https://watergovernancetool.eu/

WATER FOOTPRINT GUIDE FOR ORGANIZATIONS

The organizational water footprint determines the water consumption of an organization and the resulting local impacts along value chains. This guide provides guidance for practitioners who want to analyse water use and the resulting local consequences along the supply chains of their organization

So far, most organizations only measure water use of their own facilities by means of environmental management systems or other internal accounting methods. These approaches, though giving an overview concerning on-site water demand and potential action measures at the facility's location, do not account for the whole sphere of influence of an organization on the world's freshwater resources. Water footprint studies of industrial products have revealed that water use at production sites is usually the tip of the iceberg only. The largest part of a product's water use and resulting impacts often occur in supply chains, e.g. in the production of agricultural goods, the mining of mineral resources, or the generation of fossil-based electricity.

Contrary to common practice, the organizational water footprint (OWF) not only considers the direct water consumption at an organization's location, but also the indirect water consumption due to, for example, energy generation and raw material production (upstream), the use and end-of-life phases (downstream). The process also takes the organization's direct water consumption into account, i.e. that related to its production processes, watering green spaces, supplying employees, etc.

The starting point for the development of the OWF was an analysis of existing approaches to water consumption for products and organizations. The OWF method was developed from this analysis based on two existing standards, the water footprint (ISO 14046) and the Organizational Life Cycle Assessment (UNEP 2015). A scientific comparison identified the complementary and contradicting methodological aspects of both standards. On the basis of this analysis, methodological requirements were drawn up for the OWF, which include the definition of the objective and the research framework, the inventory analysis, the impact assessment and the evaluation. The water footprint guide for organizations presents the OWF method clearly and concisely and illustrates each step with a case study to make the OWF method accessible to stakeholders.

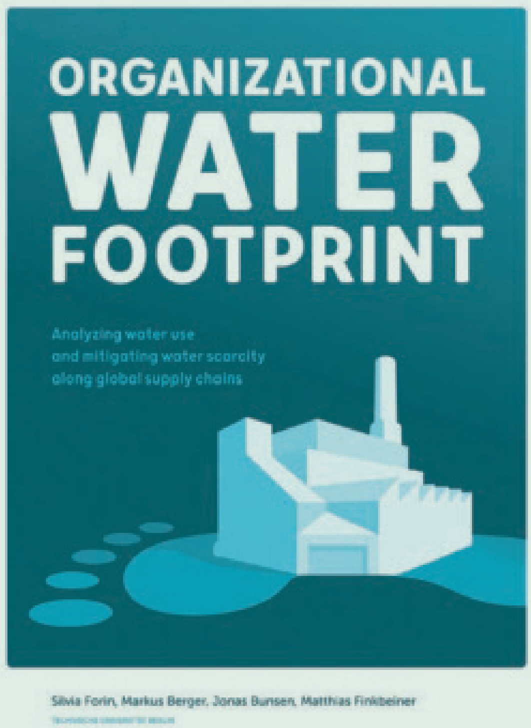

***Figure 5:** The WELLE water footprint guide for organizations: Analyzing water use and mitigating water scarcity along global supply chains © TU Berlin.*

INNOVATIVE ASPECTS

- In addition to the direct water consumption, the indirect water consumption through energy generation and raw material production, the use and end-of-life phases is considered
- Increased accessibility of the OWF to stakeholders due to a clear and concise description and illustrations of each step as well as a case study

The water footprint guide for organizations was developed as within the GRoW project WELLE (Determining the water footprint of companies). The 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 in order to take action accordingly.

FURTHER INFORMATION

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BMBF Atlas of Water Innovations:
https://www.innovationsatlas-wasser.de/de/produkte/leitfaden-wasserfussabdruck-fuer-unternehmen

Download Water Footprint Guide:
https://www.innovationsatlas-wasser.de/fileadmin/2021-03-16T14_27_40_01_00-Organizational_Water_Footprint__OWF__Practitioners_Guidance.pdf

WELLE inventory database with regionalised water footprint data:
https://welle.see.tu-berlin.de/#database

WELLE OWF tool:
https://wf-tools.see.tu-berlin.de/wf-tools/owf/#/calculation

WATER-FOOD-ENERGY-NEXUS TOOL

The "Water-Food-Energy Nexus" tool is used to determine the trade-offs between agricultural production, irrigation requirements and electricity production by hydropower under scenarios of agricultural intensification in river basins.

The "Water-Food-Energy Nexus" tool is an integrative tool for determining trade-offs that result from potential scenarios of agricultural intensification in river basins. Using scenarios for increased fertiliser application, more productive variety selection and irrigation of crops (e.g. maize), the tool enables the calculation of the irrigation water demand and the expected increase in yield in the river basin (production volume in tons and sales volume in € according to the world market price). The tool determines the reduction in discharge in the channel due to the abstraction of surface water for irrigation. The losses in hydroelectric power production resulting from the reduction in discharge are quantified (amount of energy in kWh and sales volume in € according to the price of electricity) and compared to the increases in agricultural yield. In addition, river sections are identified which, under the given scenarios, fall below the threshold value of the minimum ecological flow due to the abstraction of irrigation water.

The tool was developed using the Danube river basin as a case study and, thanks to its transferable methodology, can be applied to any river basin of any scale (a few km² to > 100,000 km²) and with any spatial resolution (10m² to > 100km²).

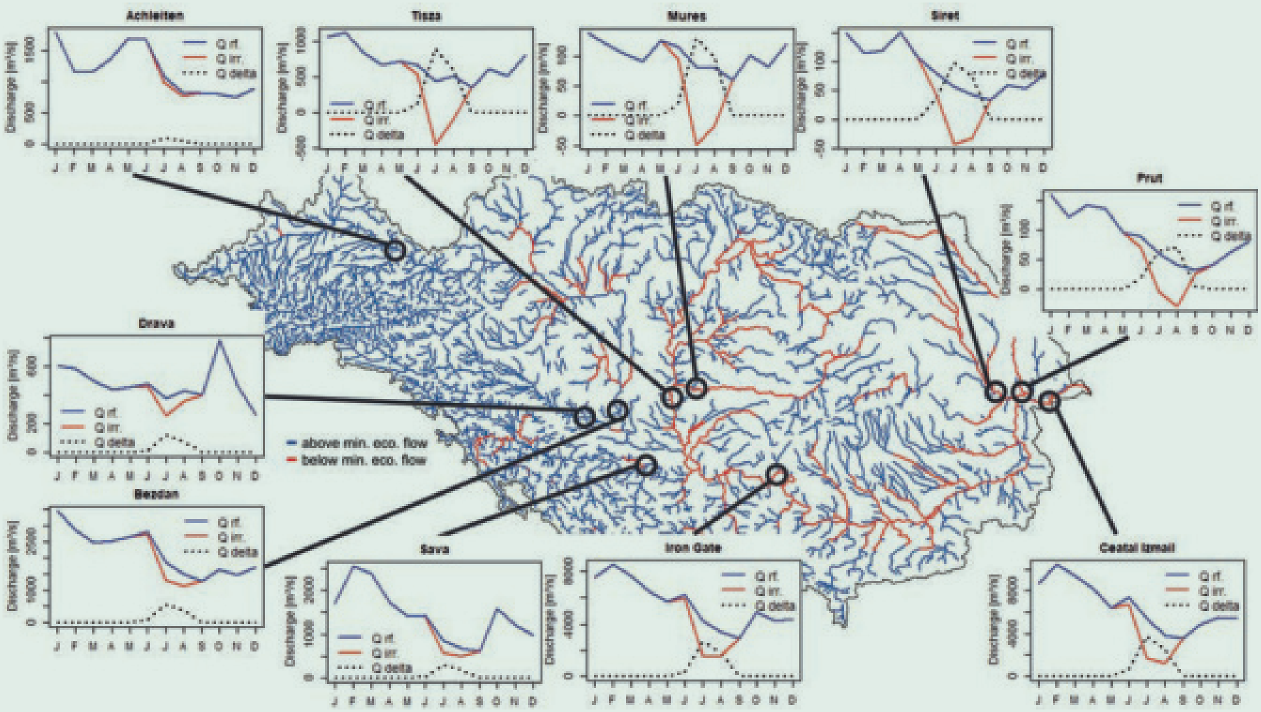

Figure 6: Change in discharge [m³/s] in the Danube river basin due to the large-scale intensification and irrigation of maize in 2017 (Q rf: rainfed discharge, i.e. without intensification or irrigation, Q irr: irrigated discharge, i.e. with intensification and irrigation, Q delta: absolute reduction in discharge). Red sections in the river network indicate a drop below the minimum ecological flow in at least one month for the year 2017. © Elisabeth Probst, Christine Werner, Tobias Hank, Wolfram Mauser, Ludwig-Maximilians-Universität München, 2020.

INNOVATIVE ASPECTS

- Determination of trade-offs between agricultural production, irrigation requirements and electricity production by hydropower under scenarios of agricultural intensification in river basins
- The transferable methodology allows the tool to be applied to any river basin of any scale and with any spatial resolution

CASE STUDY: THE DANUBE RIVER BASIN

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). At the same time, this results in serious effects on the water ecology and in reduction in the hydropower production by 2.7% (about € 156 million less revenue).

The water-food-energy nexus tool was developed as part of the GRoW project ViWA (Efficient and sustainable global water use), enabling the analysis of the conflicts of use between agricultural production, water demand, electricity production by hydropower and the preservation of aquatic ecosystems. The project succeeded in developing a high-resolution global monitoring system for agricultural water use efficiency using remote sensing data and global weather data.

FURTHER INFORMATION

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BMBF Atlas of Water Innovations:
https://www.innovationsatlas-wasser.de/de/produkte/water-food-energy-nexus-tool

SEVEN SINS AGAINST LOCAL WATER MANAGEMENT

The list of "seven sins" offers a clear set of criteria for investors, regulatory authorities, water utilities and water service providers. It formulates recommendations for improved local water management practice that has added social, environmental and economic value.

In view of the slow progress towards Sustainable Development Goal 6 (clean water and sanitation), in-depth research on the functional deficits of local water management took place. It included an analysis of case studies and publications, interviews with water supply practitioners, as well as a complimentary consultation of a wide range of experts from academia, practice and donor institutions. As a result, seven core topics were found to be particularly relevant for successful local water management.

These criteria are listed with brief comments on WHY each topic needs to be addressed and recommendations on HOW this can be done in practical terms. If not addressed (too common worldwide, unfortunately), the seven topics must be named as what they are: seven serious, typically fatal sins against local water management. However, if properly managed and mitigated, they can be considered as seven success factors; they can serve as starting points to strengthen the performance of local water and wastewater management and prevent sunk investments that would otherwise be a burden on local, national and multinational taxpayers, or water consumers and their environment.

INNOVATIVE ASPECTS

- Depiction of seven core topics, particularly relevant for successful local water management
- Starting points to strengthen the performance of local water and wastewater management and prevent sunk investments
- Based on an in-depth analysis of case studies and publications, interviews with water supply practitioners, as well as a consultation of experts from academia, practice and donor institutions

The "Seven Sins Against Local Water Management" were put together by members of the GRoW group "Incentives Mechanisms in the Context of Governance" and the GRoW project iWaGSS (Monitoring-based water governance system). The idea was based on experience in iWaGSS, which developed a data management and early warning system to protect Kruger National Park in South Africa.

FURTHER INFORMATION

Contact:
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Project website:
http://www.iwagss.com

BMBF Atlas of Innovations:
https://www.innovationsatlas-wasser.de/de/produkte/sieben-suenden-gegen-die-lokale-wasserwirtschaft

7 Sins Paper: https://bmbf-grow.de/sites/bmbf-grow.de/files/documents/_grow_7_water_sins.pdf

THE GRoW FUNDING MEASURE

With the funding measure "Water as a Global Resource (GRoW)" as part of the framework programme "Research for Sustainable Development (FONA)", the Federal Ministry of Education and Research (BMBF) is contributing to the achievement of SDG 6. GRoW comprises 12 international cooperation projects with 90 partner institutions from Germany and more than 40 case studies worldwide, involving approximately 300 experts from research, policy and practice over more than 3 years.

GRoW is characterised by a close link between local and global action. On the one hand, the projects develop new methods for the improved monitoring and forecasting of global water resources and global water demand. On the other hand, they develop decision support systems and practical solutions for sustainable water resource management at local and regional levels. In order to ensure the long-term implementation of project results, particular attention is paid to social framework conditions and relevant actors are involved in the development at an early stage.

IMPRINT

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