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Institute for Sanitary Engineering, Water Quality and Solid Wastemanagement | **ISWA**

Sustainable drinking water supply in prospering water scarcity regions - Development of decision support tools for the achievement of the sustainable development goals on the example of a water catchment area in Lima/Peru

Objective of the research project TRUST is to develop innovative tools, which combine methods of satellite-based remote sensing and water balance modelling with strategic decision support tools and concepts of integrated water supply and wastewater treatment for sustainable water supply. These not only allow the measurement of the condition of surface water but also the development of socially accepted concepts for the access to safe drinking water and a sustainable wastewater management adapted to local conditions. The method scope to be developed unites the expertise of research and practice in natural sciences, engineering and social science and is being tested exemplarily in the region of Lima/Peru. The focus is on the catchment of Río Lurín, one of three rivers of which Lima, the capital of Peru, can draw its water. Several pre-tests are being conducted in Germany, involving the Landestalsperrenverwaltung in Saxony. In this context, the aim is to verify regionally the correlation of remote sensing data to water quality issues and to ensure a methodical transferability.

Relevanz:

The achievement of the sustainable development goals (SDGs) of the UN represents a significant challenge for planning, governance and water management, particularly in prospering regions tackling water scarcity. Water shortages in regions that are already struggling with water scarcity are even more exacerbated by climate change. Regions where the rising demand for water is already well above the renewal rate of surface and ground water are especially affected, for instance fast-growing urban centers in arid regions. Simultaneously, the demand for clean drinking water, irrigation water and water for the industrial sector is increasing. The achievement of the SDGs in the water sector requires more interdisciplinary approaches to solving outstanding challenges. These include in particular the fragmentary monitoring of polluted and overused water resources, the competitive pressure for finite water resources and its resulting social conflicts, as well as the inflexibility of existing infrastructures and planning tools concerning the change of framework conditions for water supply and wastewater treatment systems.

Figure: A water reservoir in the upper Lurin valley for storing irrigation water for agriculture (C. D. León)

Tasks:

- Development of updated methods for status assessment, the prediction of variation in the qualitative and quantitative condition of surface water and the implementation of management instruments, considering the change of climatic and social conditions.
- Development and testing of strategies for the negotiation of interests and positions for a future-oriented strategic planning and conflict prevention having regard to ecological concerns.
- Planning of integrated concepts of network-bound and modular water supply and wastewater treatment systems, taking into account the seasonal fluctuation of the availability of water resources as well as social and economic framework conditions.
- Establishment of personnel and institutional skills in the project region by developing appropriate further education and training measures
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AP1: Monitoring and hydrological modelling

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Participating project partners: TZW: DVGW-Technologiezentrum Wasser, Karlsruher Institut für Technologie (KIT): Institut für Wasser und Gewässerentwicklung (IWG) und Institut für Photogrammetrie und Fernerkundung (IPF), Institut für Siedlungswasserbau, Wassergüte und Abfallwirtschaft der Universität Stuttgart (ISWA), Disy Informationssysteme GmbH, OTT Hydromet GmbH

Abstract: By combining remote sensing (KIT-IPF) and terrestrial sensors (OTT and KIT-IWG with Peruvian partners), water balance variables and regional characteristics can be monitored. These are combined with data on hygienic and physico-chemical water quality and risk factors in the catchment area (TZW). The sustainable usability is ensured by a central data and metadata management system (Disy).

To regionalise the data local observations are linked with remote sensing data and maps for hazard and vulnerability are developed. The hydrological modelling and simulation of outflow dynamics, water balance and water quality indicators on different scales will also be incorporated.

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AP2: Participative procedures for controlling conflicts of objectives

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Participating project partners: Zentrum für Interdisziplinäre Risiko- und Innovationsforschung der Universität Stuttgart (ZIRIUS), decon international GmbH

Abstract: Based on a detailed analysis of the engaged participants, the interactions between socio-cultural and other influencing factors are analysed and an analytical system model will be developed in order to obtain a comprehension of an integrated system of possible conflicts of objectives. In consideration of the identified conflicts, suitable dialogue formats are developed and exemplary tested in the project area. These support both the early communication of concepts developed in other work packages by the participants and the establishment of joint solution strategies for sustainable water management.

AP3: Concept modules drinking water and wastewater

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Abstract: The first step is the definition of zones/clusters and analysis of water and material flow balances within and between them. The quality and quantity demand of all relevant users of water have to be balanced in and between the clusters and afterwards compared with the wastewater and industrial water flows in order to determine the interdependencies of local water cycles. According to the principle „best raw water for best drinking water“, solutions are derived for the ideal use of all available water flows. Hence, concepts of modular water supply and wastewater treatment are developed that contribute to a more resilient overall system, even under extreme climatic conditions. A planning and decision tool for risk management in water catchment areas is being developed in accordance with the concept “Water Safety Plan” of the World Health Organization (WHO).

ISWA work packages:

1) The evaluation of the interactions of local water cycles is based on the monitoring and balancing of the demands on quality and quantity of all relevant water users ((drinking) water suppliers, agriculture, industry, tourism, possibly others) in the areas of catchment, settlement and cultivation of the individual zones/clusters. To close local water cycles in the zones incorporating the existing treatment options according to the adapted PINCH-Technology the demands are compared with the qualities and quantities of the wastewater and industrial water flows. Following this step, water flows can also be exchanged and balanced between these zones. The aim is to devise solutions for the ideal use of all available water flows in the planning area with the priority on „best raw water for best drinking water“. In the second step, it will be investigated to what extent water can be reused. In the last phase, various reuse options will be optimized.

2) Concepts for modular water supply and wastewater treatment are developed to enhance the resilience of the overall system, particularly in increasingly extreme climatic situations (e.g. decrease in rainfall, El Niño, climate change). Therefore, the emphasis is on the following objectives and aspects:

- Assurance of a non-discriminatory drinking water supply for all inhabitants;
- Differentiation of water use according to the purpose;
- Multiple use and reuse of (waste) water and closure of the water cycle;
- Separate collection and treatment of partial wastewater flows (e.g. black water and grey water at household level);
- Linking water supply and wastewater treatment at decentralised and semi-centralised level (e.g. use of treated „grey water“ as industrial water = „supply by disposal“) in order to increase the flexibility, resilience and sustainability of the overall system;
- Recovery and recycling of nutrients contained in wastewater;
- Improving the energy balance of water use by the implementation of energy-efficient wastewater treatment processes.

3) Evaluation of integrated concept modules: Finally, the developed concepts for modular supply and treatment are evaluated on different levels on a multi-criteria basis:

1. Evaluation by local stakeholders in workshops (e.g. local feasibility, acceptance) (evaluation scenario „Lurín local“)
2. Evaluation of the technical feasibility, affordability, legal conditions, national immission and emission standards, national policy principles (evaluation scenario „Lurín national“)
3. Evaluation of the target achievement of the relevant UN Sustainable Development Goals, based on the United Nations indicator concept (UN 2016) (evaluation scenario „Sustainable Lurín“)

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AP4: Capacity Development

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Participating project partners: decon international GmbH, Universität Stuttgart (ISWA und ZIRIUS), Karlsruher Institut für Technologie (KIT-IWG und IPF), Disy Informationssysteme GmbH, OTT Hydromet GmbH

Abstract: In the first stage, the identification of training and advanced training demands takes place from the perspective of the operators and water users in close coordination with the local project partners. During the second phase, appropriate training modules according to the prioritized demands are derived and the planning of the implementation for the third phase is determined. Finally, the elaborated and coordinated training modules will be realised in the third phase in cooperation with local organisations (e.g. Engineering Chamber, Association of Water Companies, Universities).

AP5: Project Management and Coordination

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Case studies:

The solution and planning tools for drinking water supply and wastewater treatment developed in the project are being tested on the example of the region Lima/Peru. The research area represents typical aspects of prospering global regions characterised by water scarcity and complex governance structures on one hand and marginal data and partly extreme climatic conditions on the other. Key partner for the planning and implementation of utilisation and transfer measures in the region is Centro de Competencias del Agua (CCA). Close cooperation is also established with the water company SEDAPAL, the National Water Authority (ANA) and other scientific and governmental institutions of Peru. For comparative investigations and considerations of the transferability of project results, the catchment area of a reservoir in Saxony is additionally used. The Landestalsperrenverwaltung des Freistaates Sachsen (LTV) supports the TRUST project as a practice partner.

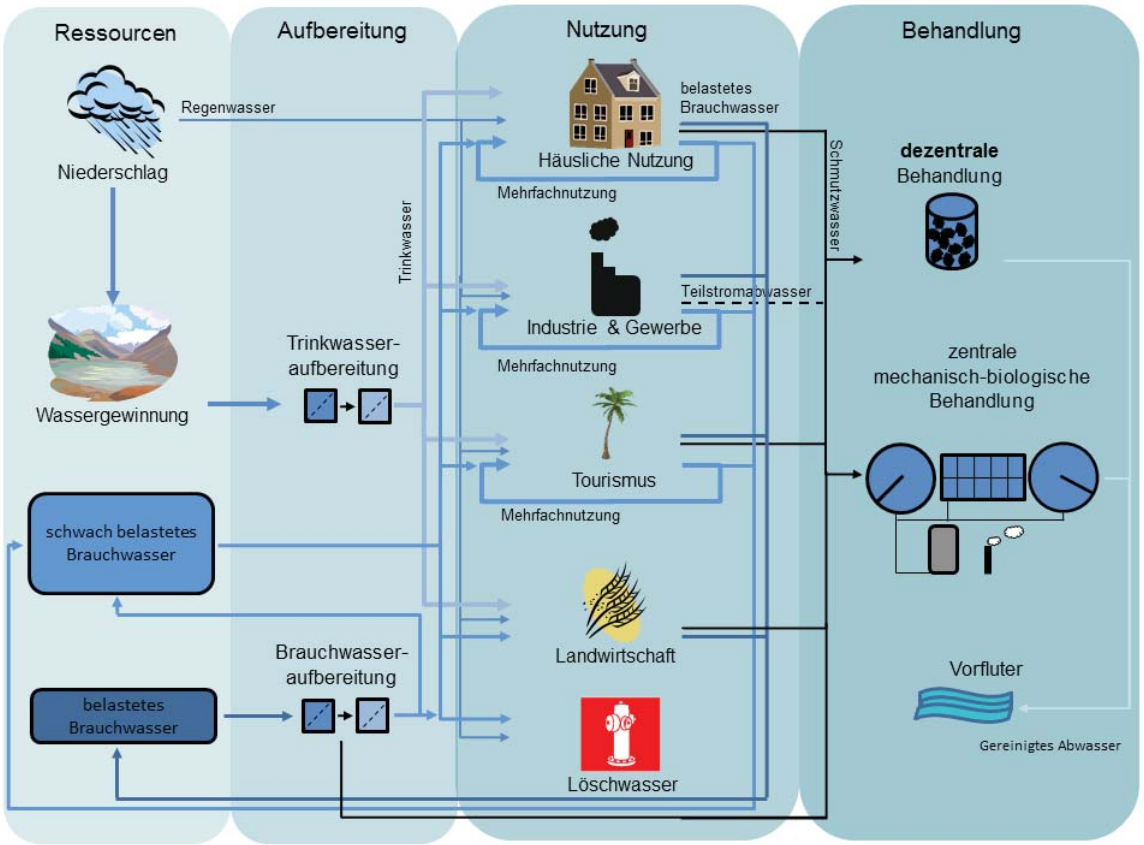

Figure 1: Exemplary representation of the interconnection of the identified water flows in the catchment area of the Rio Lurín (ISWA)

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