PROJECT DESCRIPTION

The pilot project *awaregio* aims at the development of innovative, modular wastewater treatment methods fostering

- **the reuse of water,**
- **the reuse of nutrients contained in the wastewater and**
- **the exploitation of energetic potentials**

in plant production, aquaponics and substitution of potable water in certain applications. This could facilitate market opportunities for small and medium-sized enterprises, especially in regions affected by water scarcity.

The approach enhances regional development in the following ways:

1. **development of modular wastewater treatment technologies, adapted to sparsely populated regions,**
2. **enabling of new business opportunities in aquaponics/hydroponics-based production,**
3. **employment effects in enterprises in the water treatment sector and**
4. **strengthening of resilience against water scarcity and water resource depletion in the light of overuse and climate change**

awaregio

www.awaregio.net

PARTNERS

FiW | Coordinator

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awaregio – Modular wastewater treatment processes for the reuse of wastewater, nutrients and energy as an opportunity for small and medium-sized enterprises (SME)

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ON THE ROAD TO SUSTAINABLE WATER USE

Water is a scarce resource in many countries. Extended dry periods can lead to water use conflicts. Global trends such as climate change, population growth and the rising living standards exacerbate the conflict potential.

Wherever human settlements exist, an alternative water source is ubiquitous: wastewater. The challenge lies in developing flexible, adaptable solutions for the synchronization of treatment systems and reuse options.

The pilot project *awaregio* is funded by the German Federal Ministry of Education and Research (BMBF). In the joint effort of German research institutes, SMEs and a regional water entity, a modular pilot plant with downstream aquaponic system is being developed and implemented. Different reuse-specific process schemes and applicable monitoring procedures and analytics are being evaluated as part of the project.

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THE PILOT PLANT

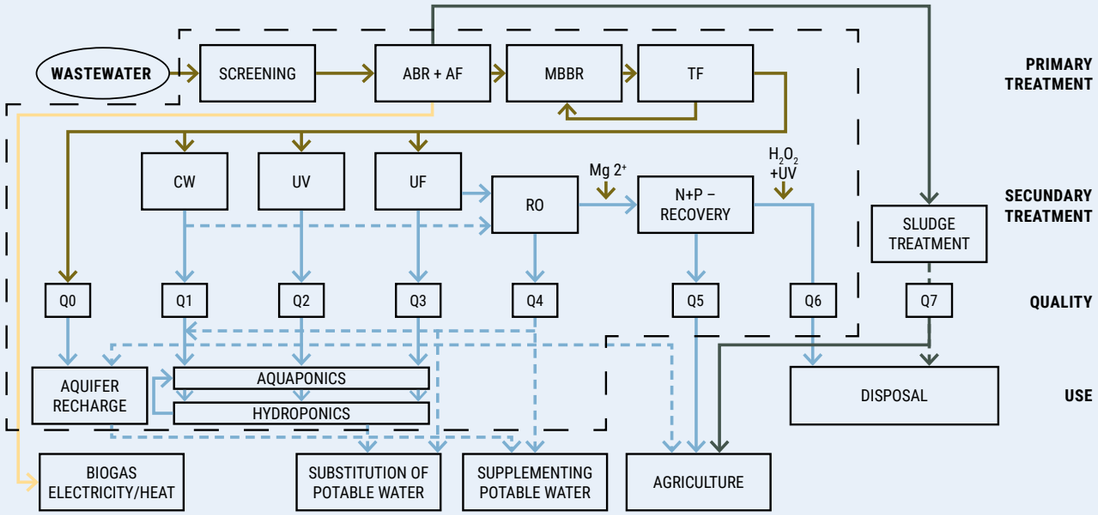
The multi-stage treatment scheme consists of a primary treatment followed by a number of secondary treatment approaches evaluated in parallel. The aim is to reuse 90% of the treated wastewater. Additionally, the reuse of nutrients and (partial) desalination are focal points of the research effort.

Primary treatment
The combination of an Anaerobic Baffled Reactor (ABR) and Anaerobic Filter (AF) with an anoxic Moving Bed Biofilm Reactor (MBBR) and a Trickling Filter (TF) ensures an energy and cost-efficient as well as low-maintenance primary treatment of the pilot plant. The municipal wastewater of a local wastewater treatment plant's grit chamber serves as an input to the pilot plant.

Secondary Treatment
A range of secondary treatment modules producing different effluent qualities (Q) are being evaluated. An operationally simple approach (Q1) is a Constructed Wetland (CW). As an alternative approach (Q2), the operability of an UV disinfection unit is being assessed. More sophisticated secondary treatment options producing higher effluent qualities (Q3 and Q4, respectively) are an Ultrafiltration (UF) and a downstream Low Pressure Reverse Osmosis (RO) module. Additionally, nitrogen- and phosphorous-recovery for agricultural fertilizer application is obtained in a physico-chemical post-treatment of the RO-concentrate.

Greenhouse with Aquaponics
In aquaponic systems, nutrient-rich water from pisciculture (fish) is used to fertilize plants in a hydroponics system (plant production). After this biological treatment (nutrient removal) the nutrient poor water is recirculated.

In the greenhouse of the *awaregio* pilot plant site four separate aquaponic systems are operated utilizing the process water Q1, Q2, Q3 and well water as a reference. The piscicultural tanks are used to breed African catfish, while the hydroponic system is used to test different combinations of vegetables, herbs and flowers.



EVALUATION OF APPLICABLE ANALYTICS

To monitor the efficiency of the treatment steps, applicable methods for water quality analytics are being tested. The parameters in focus are pesticides, biocides, pharmaceutical compounds and industrial chemicals frequently found in wastewater.

For the testing of the particular treatment step's in- and outflow diffuse samplers and bioanalytical methods are used. Acute toxicity (algae, daphnia, fish) and mechanism-specific toxicity effects (mutagenicity/genotoxicity, dioxin-like modes of action and estrogenicity) of the samples are determined.

SUSTAINABILITY AND ECONOMIC EFFICIENCY

Based on the operational experiences with the pilot plant, appropriate fields of application are identified. Specifically adapted process schemes for selected applications in Germany and global target regions are defined.

The assessment of sustainability and profitability is conducted in consideration of the specific boundary conditions of the respective scheme and context using a set of selected methods and tools (e.g. Water footprint, ecological efficiency).

Cost efficient treatment solutions, the economic benefit from water savings by water reutilization and business and innovation potentials for SMEs strengthen the regional development.

▲ *Ultrafiltration (left); automatic feeding system of the aquaponics (right)*

▲ *Constructed wetland*
◀ *Hydroponics*
▼ *Trickling Filter*

Wastewater from primory treatment
Treated water from secondary treatment
Biogas
Sludge
System boundary of pilot plant

Qx	Quality of partial flow x
ABR	Anaerobic Baffled Reactor
AF	Anaerobic Filter
MBBR	Moving Bed Biofilm Reactor
TF	Trickling Filter