

The BMBF Program "Decentralized (Alternative) Water Systems"

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FORSCHUNGSZENTRUM KARLSRUHE

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BACKGROUND:

The projects funded by the BMBF/PTWT+E concerning decentralized (alternative) water systems are based on an announcement in the "Bundesanzeiger" (Federal Gazette) of June 27, 2001.

All the drafts (112 in total) were surveyed on behalf of the BMBF by an external committee consisting of experts in water management, associations, universities, and members of industry. The announcement itself was made in accordance with the BMZ/GTZ project "ecosan". The levels of international development, technical feasibility, and administrative requirements were compiled from two studies carried out by the University of Witten-Herdecke and the University of Munich.

Especially with the international projects, we wish to contribute to a more conscious and sustainable use of water, a resource that cannot be replaced. Accordingly, these projects contribute to the ambitious aims of the Sustainability Summit of Johannesburg, which was to halve, by the year 2015, the proportion of people who are unable to reach or afford safe drinking water and do not have access to basic sanitation.

The BMBF research program is mainly designed to combine and to improve existing components. Apart from the reduction of the drinking water consumption key aspects are to decouple materials and water flows such that recovery of nutrients and energy will be possible and economically efficient.

Subjects of investigation are: Anaerobic waste water treatment, membrane filtration, processes close to nature, reuse of gray water and rainwater, separation vacuum and compost toilets, winning of biogas and decentralized power stations, production of compost and fertilizers, economic, socio-cultural, and legal aspects.

Concerning the implementation and dissemination of the research results an adequate contribution from German private companies as well as from the foreign partners is required. (The system of project funding does not allow a direct funding of foreign partners.)

CURRENT PROJECTS:

VIETNAM:

Topic:

Closing of agricultural nutrient cycles via hygienically harmless substrates from decentralized water systems in the Mekong delta

University of Bonn:

working group materials flows	Dr. J. Clemens
working group hygiene	Dr. Th. Kistemann
working group sociology	Prof. Dr. Th. Kutsch
working group agricultural ecology	Prof. Dr. M. Becker
working group agricultural water management	Prof. Dr. A. Rieser

University of Bochum:

working group drinking water	Prof. Dr. H. Stolpe
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Level of knowledge:

About 17 million people are living in the Mekong delta (40,000 km²). The population density is twice as high as in Germany. The delta is mainly used for the growing of rice, vegetables, and fish farming. Less than 50 % of the total population have access to fresh water, in rural areas less than 10 %. Instead of drinking water, people use collected rainwater (pathogenic germs) or water from uncontrolled wells (chemicals for use in agriculture, seawater intrusion)

Main activities:

In the first part of this project the soils, groundwater, water and materials flows, and the agricultural use of two different areas in the Mekong delta will be studied in detail.

The varying demands of soils for fertilizer/sludge or humus/compost will form the basis on which the most suitable waste water concept will be worked out.

Concerning drinking water, the disinfection with soil filtration, solar energy and the sustainable abstraction of groundwater will be examined.

Comment on project funding:

The Mekong delta is considered typical for many territories of South Asia:

alternation between flood and demand for irrigation

pollution of the raw waters (groundwater, surface water)

rural areas which are intensively used for agriculture

Construction and maintenance of drinking water treatment and waste water treatment plants are expensive, especially in areas with low average income. The idea of this project is to adapt the

waste water treatment system directly to the demands of agriculture. This will increase the consumer acceptance and decrease the costs of the maintenance.

EGYPT:

Topic:

Improvement of the effluent quality of aerated lagoons (ponds) by membrane filtration

Institute for Technical Pollution Control

Prof. W. Hegemann

National Research Center

Prof. Abdel Shafy

Level of knowledge:

Lagoons are widely spread because of the simple and cost-saving construction and maintenance. However, the rate of degradation and the retention of bacteria and germs is limited compared to activated sludge plants. Strictly speaking, direct use of the effluents for irrigation purposes is not possible.

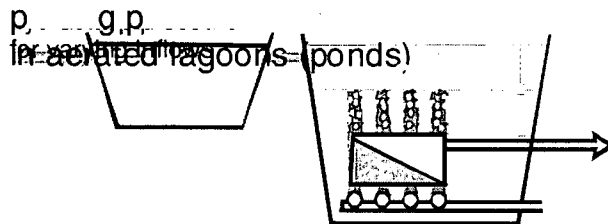


Figure 1: sketch of the pilot plant

Main activities:

A pilot plant will be constructed and transferred to an existing waste water treatment plant in a village near Cairo. The pilot plant will serve for about 500 population equivalents.

The device will be optimized to reduce water evaporation, to increase retention of pathogenic germs, the operation safety, and to reduce the costs of maintenance.

After membrane filtration, the treated waste water is intended to be reused for irrigation or as industrial process water.

For applications in Germany or Eastern Europe, where lagoons are frequently met, operation conditions for N- and P-removal will be studied. The treated waste waters should then be discharged into receiving water bodies or infiltrated into the ground.

Comment on project funding:

In the case of success, this project will contribute to the improvement of existing simple waste water treatment plants. It is designed to save rare drinking water resources and reduce the costs for fertilizers. Egypt was chosen as location as it is considered typical for all semi-arid climates.

The operation conditions with N- und P-removal will allow to optimize existing lagoons (ponds) in Germany and Eastern Europe, respectively.

TURKEY:

Topic:

MODULAARE - Integrated modules for high-efficient waste water treatment, waste treatment and recovery of energy in tourism resorts

partners:

AT association	Dr. U. Theilen
University of Stuttgart	
Department of Waste Water Technology	D. Steinbach
Department of Municipal Solid Waste Management	Mrs. A. Schultheis
Iberotel Sarigerme Park (TUI)	Heinz H. Fugger

Level of knowledge:

The materials flows in (tourist) hotels are extremely high::

waste/hotel	up to 2.5 kg/guest day
average/Germany:	about 0.5 kg/inhabitant day
drinking water consumption/Hotel	up to 1.200 L/guest day
average/Germany:	< 130 l/inhabitant day

Proper recycling management is generally not applied in hotels or tourist resorts.

Sarigerme Park Hotel situated on the Turkish Aegean coast about 372 beds and was selected for the following reasons:

there is sufficient place for pilot plants

the hotel provides the necessary technical equipment to support the research program.

the hotel is connected to a municipal waste water treatment plant. In the case of operation troubles or reconstruction measures there will not occur any problems.

the hotel has been granted different environmental awards and was certified according to DIN EN ISO 14001. This shows the commitment of the hotel management to a sustainable tourism.

Main activities:

A large closed-loop recycling waste water and solid waste is intended to be achieved by the activated membrane reactor the fermentation module.

The membrane module will produce industrial process water. Its suitability for irrigation, fertilization, and the hotel laundry will be investigated.

Cut grass, kitchen garbage and the surplus sludge will be treated in the fermentation reactor. This module will be optimized in terms of amount of produced biogas, quality of compost, and pre-treatment of the input materials.

A concept to make use of the biogas (i.e. decentralized power station) will not be realized at the moment.

Comment on project funding:

Since the tourism industry is an important economic factor in Germany, we are particularly responsible for supporting sustainable tourism. In a lot of touristic areas the situation is quite similar.

Due to the modular concept, an adaptation to various places and climatic zones seems to be easily realizable.

Brazil:

Topic:

Decentralized water supply and waste water treatment combined with recovery of nutrients and energy under consideration of hygienic aspects for Piracicaba

Partners

Fraunhofer Gesellschaft	Dr. Sternad
Universidade Metodista de Piracicaba	A. Nascimento

Level of knowledge:

Only 9.6 % of all South American bigger cities (> 50,000 inhabitants) treat their waste waters. In the city of Piracicaba (320,000 inhabitants) about 35 % of the waste waters are treated in 45 usually smaller treatment plants. The waste water is frequently treated in open ponds, so that the dengue fever and other tropical diseases have spread.

Solid waste is deposited on unsuitable dumps, no recycling has been applied up to now.

Main activities:

Waste Water:

Improvement of waste water treatment in Piracicaba.

- A study will be carried out regarding the optimization of existing treatment plants. They will be evaluated concerning the production of biogas, production of N-, P-fertilizers, disinfection of the effluents.

Most of the existing waste water treatment plants start with an anaerobic stage. (target: optimization of the anaerobic reactor.)

Most of the plants apply an aerobic reactor as second step. At the biggest waste water treatment plant (Piracicamirim) it is intended to install a closed pilot reactor developed in Germany.

Waste:

- A concept for the separation, recycling of waste, and production of biogas will be worked out. A pilot plant for the production of biogas will be constructed on the campus.

Comment on project funding:

The city of Piracicaba is considered a promising location in Latin America. The region has a good reputation regarding its commitment to environmental protection. The first environmental associations were founded in Piracicaba. So we are looking forward to finding highly motivated local authorities.

The concept developed by FhG strongly considers the local infrastructure which are characterized by a lot of small (decentralized!) plants, no space for enlargement, and frequently the above mentioned two-stage construction.

With the help of two pilot plants it is intended to show an economically efficient way to improve existing plants.

GHANA:

Topic:

Ecological recycling management at the Valley View University in Accra

Partners:

Ingenieurökologische Vereinigung e.V.	Dr. Geller
Bauhaus University of Weimar/ecological engineering	Prof. Dr. D. Glücklich
University of Hohenheim/Tropics center	Prof. Dr. J. Sauerborn
Valley View University	Dr. S. Laryea

Level of knowledge:

The Valley View University is biggest private university of Ghana (about 710 students, 50 lecturers/administration), water supply is mainly managed by trucks because of the inefficient public supply, there's no utilization of rainwater or water-saving technologies, waste water is treated by old-fashioned methods, and the university will be enlarged (2005: about 1300 students)

Main activities:

The present concept for the enlargement of the university will be extended to an ecological master plan (subjects: urban development, transport; energy, water, and waste; social and cultural activities).

- Reconstruction of a building with water saving toilets, construction of a new building with water saving toilets, compost toilets, and utilization of gray water.
- Storage of rainwater in a cistern for irrigation
- Recycling of biowaste, compost, urine, ... in agriculture, production of biogas.

Comment on project funding:

This project addresses to a target group that is highly interested in new technologies. We expect this to be of great advantage to the implementation of the joint research results, because the graduates of the university will spread their acquired knowledge to their home countries.

It will be interesting to study the social acceptance and the technical advantages or disadvantages of different techniques (water-saving toilets, compost toilets...) applied at the same place.

The results of this cooperation will be incorporated into a new study course called "Community and International Development Studies" at the Valley View University.

CHINA:

Topic:

Semi-central Supply and Treatment Units for Urban Areas in China

Partners:

Technical University of Darmstadt

Prof. Dr. P.Cornel

Tongji University Shanghai

Prof. Gao

Level of knowledge:

In China 70-80% of the discharged wastewaters are untreated. 98% of the total amount of waste is disposed on the suburban areas or simply littered into the water bodies.

Especially in rapidly growing mega-cities these deficits lead to serious environmental problems like for example the overuse of water resources or the contamination of soil, ground-water and surface water.

Main activities:

Within this project new technical solutions (so-called semi central units) for an integrated supply and treatment system (water, wastewater and waste) will be developed. Semi central here means a dimension that exceeds single houses or buildings, but that clearly differs from a conventional central system. The best technical alternatives and unit sizes for different types of urban areas will be worked out and compared with existing systems.

Comment on project funding:

This project is the only one designed for rapidly growing urban areas. We think that the problem of the most effective size of waste and waste water treatment plants has not yet been satisfyingly resolved regarding the recovery of energy and raw materials.

LATIN AMERICA:

Topic:

Aqua Latina (www.aqua-latina.info)

Partners:

Fraunhofer Gesellschaft

Prof. Dr. R. Kümmel

ARÖW Ltd.

Dr. Hafkesbrink

Level of knowledge:

There's nearly no waste water treatment in rural areas of Latin America. In many places, the drinking water supply is considered as endangered or even critically endangered. 30 % of all cases of death of children and 95 % of all hospital stays of children are caused by unsafe drinking water.

Main activities:

In the first part of this project an internet based platform will be provided. More than 20 small or medium-sized companies will be involved in this project. These companies will provide technical

information, routines for the calculation and evaluation of different municipal water and waste water systems.

In the second part of the project, two concepts (water, waste water, recovery of nutrients and energy, reuse of sludge) will be implemented in two different cities. The results will also be spread via the internet based platform.

Comment on project funding:

We think that water and waste water technologies developed by high industrialized countries cannot be brought into developing or threshold countries without any adaptation to the local requirements, socio-cultural needs, and technical possibilities. Furthermore, we think that decentralized systems are more convenient for countries without a centralized water supply and sewer system. In Germany, it's rather the smaller companies which provide appropriate technologies for these purposes. These companies will be supported in their effort to go to foreign countries.

ALGERIA:

Topic:

Decentralized recycling of waste water from sewers for arid urban areas

Partners:

University of Witten-Herdecke

Prof. Dr. K-U. Rudolph

GTZ Gesellschaft für Technische Zusammenarbeit

Dr. D. Gomer

Level of knowledge:

In arid urban areas green belts can only exist if they are continuously irrigated. Especially in arid areas green belts are obligatory for the local climate. If they are missing, the resulting dust content of the air is intolerably high.

Main activities:

Within this project the controlled recovery of raw waste water or waste water after little pre-treatment will be studied from water technological, hygienic, geological, topographic and climatic points of view.

The following three figures are examples for the ideas that will be followed within this project.

Protection of erosion-endangered slopes by irrigation with raw waste water

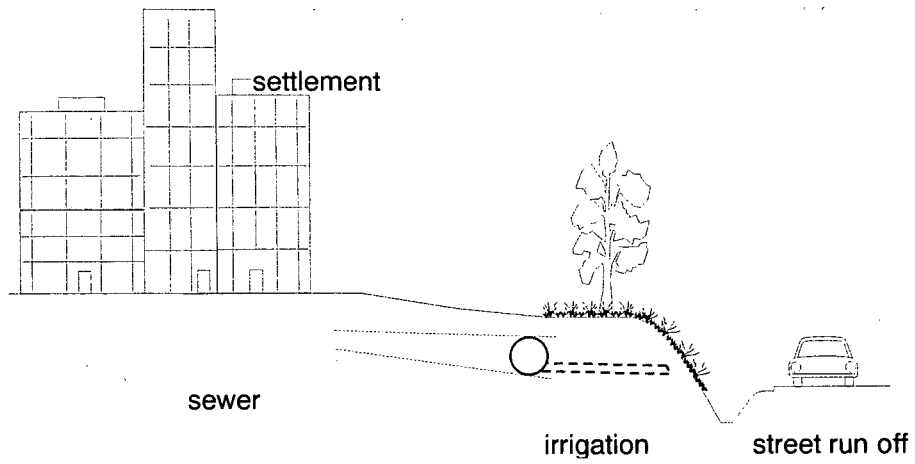


Figure 1: Irrigation of raw waste water from higher situated sewer systems (erosion-endangered areas)

- Creation of new green belts between lanes of roads by filtrated waste water

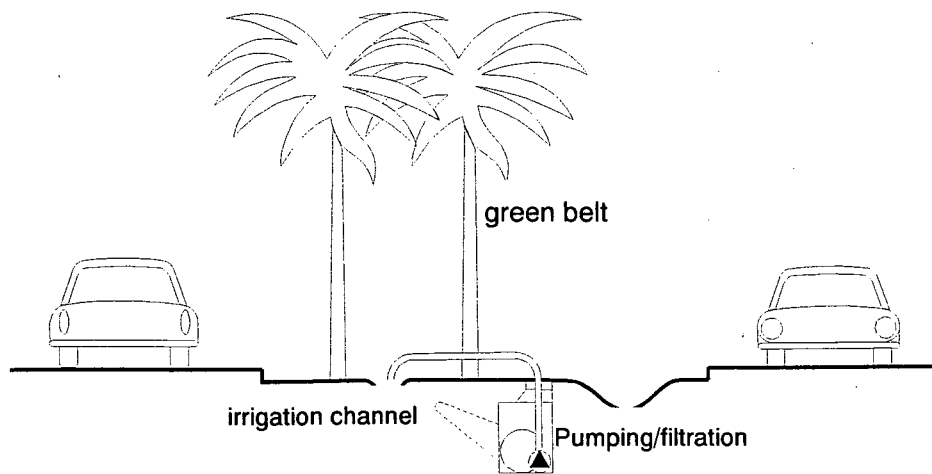


Figure 2: Irrigation of green belts between lanes by filtrated waste water

- Irrigation of green areas by waste water after sedimentation

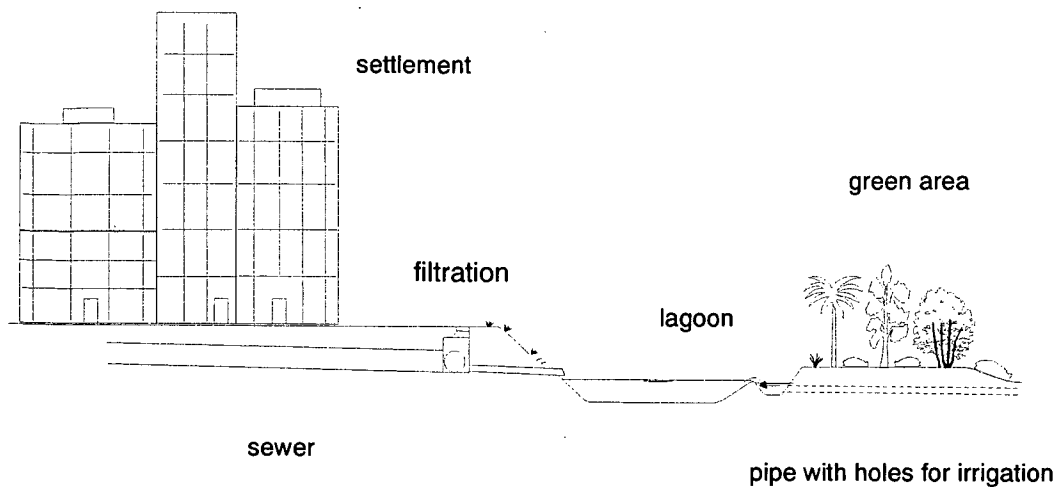


Figure 3: Irrigation of green areas after sedimentation in lagoons.

Comment on project funding:

Many people in developing countries even use raw waste water for agricultural purposes. This causes enormous hygienic and ecological problems. Within this project we try to develop a simple method to create green areas in arid cities in order to improve the local climate without causing hygienic problems for the population.

CHINA/TANZANIA:

Topic:

Obtaining of water by exchange of radiation

Märkische Fachhochschule Iserlohn

Koch Anhängerwerke Ltd.

Prof. Dr. D. Ihrig

Christian Koch

Level of knowledge:

A method to obtain drinking water independent from the ground-water table is to use the humidity of the air. Most devices which have been developed so far are inefficient, very expensive, and difficult to control, respectively.

Main activities:

A new concept to obtain drinking water from the humidity of the air will be studied. The problem of the energy need will be solved by the exchange of radiation with the atmosphere. The control of the device will be managed without any difficult electronic control units.

Comment on project funding:

One big task for the future will be to develop alternative methods to gain and store freshwater for drinking water supply. This project will be one part of Germany's contribution to fulfil the contracts

of Rio and Johannesburg. The aim is to reduce by half the amount of people without access to safe drinking water until 2015.

At the moment the obtaining of water from the humidity of the air is quite expensive. Numbers raise from 10 to 60 €/m³. On the other side, the costs for sea water desalting are more and more decreasing (1 - 2 €/m³). However, sea water desalting is only useful in costal areas and is managed by fossil energy. It seems to be feasible to reduce the costs of the new method effectively.

SOUTH AFRICA:

Topic:

“Water House” Makuleke, near to the Krueger National Park

University of Potsdam

Dr. K. Soyez

University of Venda, South Africa

EBT Ltd.

AHK Deutsch-Südafrikanische Außenhandelskammer

Level of knowledge:

The supply with fresh water, mainly managed by trucks, in the village of Makuleke is completely insufficient, and furthermore the water delivered is of bad quality. The abstraction of raw water by wells cannot be managed continuously due to the changing ground-water table. There is no distribution system.

Main activities:

A so-called “water house” designed for all water-related activities will be constructed

This includes a survey on the current status of the drinking water supply, climatic conditions, the hygienic conditions, socio-cultural aspects. Currently it is planned to include compost toilets, rain-water storages, constructed wetlands, and reuse of the sludge from waste water treatment in the agriculture.

Comment on project funding:

This project has been designed to improve the hygienic situation of rural areas in the third world. We support this project because a funding system has been worked out to operate the water house after finishing the research project. Receipts from the Krueger National Park will be used for this purpose. And furthermore, only appropriate technologies will be used, which can be handled by local people. Within a socio-cultural study it will be worked out, how the local population can contribute to the operation of the water house.

GERMANY - HEIDELBERG:

Topic:

DEUS 21 - Decentralized Urban Infrastructure System

Partners:

Fraunhofer Institute

Dr. Harald Hiessl

Institute of Urban Water Management, RWTH Aachen,

Dr. Th. Buer

Level of knowledge:

In Germany centralized water supply and waste water treatment on a high technological standard predominate.

For some years alternative concepts on a smaller scale have been implemented at some locations (e.g. Luebeck, Freiburg).

Single components (bio-membrane reactor, nutrient recycling, ...) have to be optimized before they can be applied in new residential areas.

Main activities:

Implementation of an integrated decentralized concept of

water supply (drinking water quality)

waste water reuse

recycling of organic waste for energy recovery and recovery of nutrients (P, N)

cost-saving infrastructure (e.g. pipe-laying)

in a new residential area (about 600 residents).

Optimization of technologies, particularly waste water processing by bio-membrane technology

Modeling and sustainability assessment.

Comment on project funding:

The proposed combination of decentralized technologies meets several important aspects in protecting natural resources:

- Emissions into surface waters will be drastically reduced
- A significant reduction of drinking water consumption is expected by the use of rain water
- The need for energy and resources for fertilizer production can be reduced by the recycling of nutrients and closing of material cycles.
- This residential area will serve as a model for establishing and demonstrating a new standard of integrated alternative water management.