Title	**Enhancing reuse options in DEWATS-projects in Sichuan Province of PR China through ecosan approaches**
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Short CV for Introduction Purposes (100 words max)	Thilo Panzerbieter, civil engineer. Currently working as a junior ecosan-expert with GTZ-ecosan in Chengdu, China. Prior ecosan experience: pilot project at a peri-urban school in Lusaka, Zambia; three months of ecosan-training with the GTZ-ecosan-programme in Eschborn, Germany. Ina Jurga, graduated as a civil engineer, supported since 2002 GTZ ecosan activities as a young professional in China. Since April 2005 she works as CIM-junior expert at the Chinese Academy of Agricultural Engineering. Tong Boitin, biogas expert. Currently working as project team leader at BRTC as a CIM-integrated expert.
Photograph attached (jpg)	Picture1-Panzerbieter-Village.jpg; picture2-Panzerbieter-fertiliser.jpg

INTRODUCTION

The following paper presents the findings of a six-month-long project carried out at the Asia-Pacific Biogas Research and Training Center in Chengdu, PR China, in collaboration with the Deutsche Gesellschaft fuer Technische Zusammenarbeit (GTZ) GmbH and the Bremen Overseas Research and Development Association (BORDA). The team consisted of German team leader Tong Boitin (integrated CIM-expert at BRTC), Chinese team leader Deng Liangwei (BRTC), Thilo Panzerbieter (junior ecosan-expert, GTZ) and Shi Guozhong, Li Fuquan and Wu Libin (all from BRTC). The goal of the project was to increase environmental soundness and economic efficiency of the Decentralised Wastewater Treatment Systems (DEWATS) typically built in Sichuan Province, PR China. This was to be achieved by closing material flows and increasing recycling rates through the integration of ecological sanitation (ecosan) elements into the local systems. An ecosan inception phase was carried out to prepare a pilot project for disseminating the results of the study.

BACKGROUND OF ECOSAN IN CHINA

The reuse of human excreta, urine and faecal sludge from latrines, septic tanks and biogas digesters on fields has a long history in China. The famous writer and philosopher Han Feizi (280-221 B.C.) wrote: “in order to increase fertility of soil, human excreta must be used.” Well into the last century, night soil was a marketable product being sold to farmers. In its traditional use, which is still widely practiced today, the excrements are mainly used untreated or only partially treated, leading to major health risks.

Due to these already common practices, the introduction of ecological sanitation concepts, which stress the hygienic treatment and safe handling conditions in the process of reuse, were not faced with the same faecophobic barriers in China that similar projects encounter in other countries. This led to a large success of ecosan projects implementing dry urine diverting toilets in rural areas. The trend began in the southern province of Guanxi, and has since spread to 17 provinces with a total of over 685,000 toilets. However, still half of the rural population still has no access to any sanitation (Mi Hua, 2004).

In the urban and peri-urban regions, the wastewater scenario is still lacking and a large amount of wastewater is collected, but then discharged into the nearest surface water bodies. The urban municipal wastewater treatment rate in 2002 was about 39.9%. In counties, towns and extensive rural areas the percentage is significantly lower, so that the actual treatment rate lies below 20% (US Department of Commerce, 2005: 4). Furthermore, the existing plants have economical and operational problems. Nevertheless, the state has the ambitious goals to treat about 45% of China's urban wastewater by 2005; by 2010 the ratio should reach 50%. This corresponds to building 10,000 new sewage treatment plants, representing a market investment of US$48.4 billion (Water China, 2003). The gigantic necessary investment and operation costs cannot be afforded by the country, which causes a great push towards choosing decentralised rather than centralised solutions.

BACKGROUND OF EXISTING DEWATS SYSTEMS IN CHINA

DEWATS stands for decentralised wastewater treatment systems. It is an approach based on a set of treatment principles, which ensure treatment reliability, longevity, and tolerance towards inflow fluctuations. Most important factors is, that it only includes systems which can be maintained and operated under local conditions. DEWATS work without energy input, so that the systems cannot be shut down accidentally and most of the materials/inputs are available locally; it therefore presents an affordable solution guaranteeing long-term, reliable operation. It is based on four treatment systems:

1. sedimentation and primary treatment
2. secondary anaerobic treatment in fixed bed filters or baffled septic tanks
3. secondary and tertiary aerobic/anaerobic treatment in constructed wetlands (subsurface)
4. secondary and tertiary aerobic/anaerobic treatment in ponds

The four above-mentioned systems are combined in accordance with the wastewater influent and the required effluent quality.
Starting in 1994, DEWATS have been developed by contributing organisations from China India, France and under coordination of BORDA. In China, until 2003 approximately 120,000 units with totally 4,5 million m^3 digester volume have been built, corresponding to 38,8 million tons wastewater treated (Ministry of Agriculture, 2003). Sichuan Province took the leading role in the implementation of DEWATS by the promulgation of a provincial policy: outside of the city boundaries, new housing complexes and special objects require decentralised wastewater treatment systems within the building concept. As a result, alone in Sichuan 40,400 DEWATS with 2,18 million m^3 digester volume have been built so far, and 540,000 m^3 domestic wastewater are treated daily. Until 2010, wastewater being treated by DEWATS should reach 40% of the total wastewater in areas not attached to centralised sewer systems. So each year, 250,000 to 300,000 m^3 digester volume will be constructed, bringing the total digester volume in Sichuan up to 4,5 to 5 million m^3. Under the anaerobic treatment approx. 47 million m^3 biogas is produced per year, which is often not utilised, because of the low yield in each plant. The construction costs are 600-800 RMB/m^3 digester volume (Sichuan Rural Energy Office, personal communication).

Although these systems present reliable solutions if designed properly, the money saving principle is leading to under-dimensioning and not adhering to the standards. Until now reuse options of the different wastewater streams are not being realised in China. Wastewater resources are still being wasted, totally forgetting the local historical understanding of the agricultural significance of wastewater products.

ENHANCING REUSE OPTIONS IN DEWATS PROJECTS THROUGH ECOSAN APPROACHES

Our project aspires to optimise the existing state of the art designs of DEWATS, reducing the cost of the treatment facilities, through closed loop approaches, which make better use of the resources in wastewater and increase recycling rates. For the study, several design options were chosen and compared with one another as well as with existing DEWATS designs using technical, economic, environmental and social criteria. It is interesting to note that the existing designs in Sichuan Province already make use of two pipes within the household: one for the kitchen wastewater and the other one combining toilet, shower and wash water.
All new designs were designed in accordance with the local effluent standards. The existing DEWATS in the pilot area - which is currently not fulfilling these standards - underwent a theoretical up-grading with according cost estimate, to ensure comparability. The study analysed the reuse of separated faeces, urine, greywater, as well as the possible reuse of DEWATS effluent or digester sludge.

CHARACTERISTICS OF PILOT AREA

Changshi Village in Wanchun Township, Wenjiang District is a 3-story-high housing settlement, which is typical for peri-urban residential areas newly constructed in Sichuan Province. In the course of its urbanisation programme of moving farmers into urban settings, the district's government has chosen Changshi Village as a demonstration model for future similar settlements. This fact insures political and public interest in the new sanitation concept being developed here. Since DEWATS must be built in accordance to the local Rural Energy Office's requirements, and the plans for the in-house components of the sanitation concept must be approved by the local Construction Bureau, this project site is ideal to ensure that the recommended designs will be accepted by the authorities.

The pilot area is being constructed in three phases. Phase one – with 106 households and approximately 400 residents – has already been completed, according to conventional local planning practices. Phases two and three – with another 100 and 200 households – will be

planned and constructed in 2005 and 2006 respectively. This constellation allows the sanitation concept and existing DEWATS in area one to act as a reference model against which alternative, theoretical ecosan-DEWATS concepts and designs can be compared, in regard to cost, public acceptance, and performance. The later construction phases present potential pilot project sites.

Pilot Site: Changshi Village, Sichuan Province

In the next 5 to 7 years, Wenjiang District intends to construct 57 more urbanisation complexes, similar to Changshi Village. The Construction Bureau of Wenjiang has expressed interest in implementing and testing different design options in these future projects, and to let these serve as models for later dissemination to private investors building housing.

The current living conditions and user acceptance have been assessed through resident surveys. These display that the population is very poor, mostly preferring to pump smelly and polluted groundwater, in order to save water costs by minimising the use of piped water supplies. Over 50% of the population wants to try dry toilet models to save water / money, while another 30% would be willing to use them if the study shows the clear economic benefit for them. Research has been done on water saving technologies and the possibility of greywater reuse.
Particular to the Chinese situation and mentality is that without being asked about this over 30% of the population stressed that they would try new toilet models if “everybody uses them”, “if the government tells them to use them” or “if there is a law concerning the matter”. Since the residents do not own agricultural areas, an infrastructure will have to be developed for the transport of the wastewater products. Research of reuse possibilities led to the discovery of a recently founded organic fertiliser factory, a key player in our project concept.

INCORPORATING WASTEWATER RESOURCES INTO THE ORGANIC FERTILIZER TRENDS IN CHINA

In China, there is a great demand for organic fertilisers. Especially producers of fruit aimed at export are in the need to fulfil ecological-label requirements. This demand has led to a recent rapid increase in the number of organic fertiliser companies, growing almost tenfold in the past year to over 100 in Sichuan Province and aver 1000 in China. The government is supporting this trend with start-up subsidies, in an attempt to solve the pollution problem cause by animal wastes.
With the growing number of fertiliser producers, there is also an increase in the demand for organic wastewater products, as a resource. Most of the these companies use pig manure, chicken manure and digester sludge, treating and hygienising is done with a wide variety of

processes ranging from composting to heat treatment. The Lusheng Ecological Organic Fertiliser Factory, which is located also in Wenjiang district, wants to incorporate domestic household wastes into their existing concepts. They see the advantages in the possible source separation of faeces and urine. The high levels of nitrogen and other nutrients and their availability to plants promises high quality fertilisers. The Lusheng Fertiliser Factory is therefore willing to pick up faeces and urine free of charge, thereby – in the ideal scenario – reducing necessary treatment investments to greywater treatment. A reuse of the greywater is still being discussed.

Lusheng Organic Fertiliser Factory, Wenjiang

Wenjiang District is known for its agricultural production and will host a large international Flower Fair in October of 2005. The local authorities seem motivated to build up upon this.

MAIN FINDINGS OF THE STUDY

The study shows that ecological sanitation concepts have a future in peri-urban settings in China. Public acceptance of dry separation toilets is high amongst the users and there is a market for fertiliser products made from human urine and faeces. Water quality test show that due to oily cooking habits, kitchen wastewater in China has extremely high organic content. Further research will be necessary to see whether extra investments for additional pipelines and separate treatment of kitchen wastewater can reduce total investment costs.
Finally, although the process took some time, the local authorities are becoming increasingly interested in our results. The partners also realise that officials from the animal husbandry need to work together with the Rural Energy Office and the Construction Bureau to coordinate their common interests in the project.

OUTLOOK

The driving force behind our concept is the financial initiative created by the market value of the fertiliser products. Before more exact planning is possible, nutrient requirements of local plants should be considered to create the best fertiliser products possible and a market survey is needed to determine their market value. An improved cooperation between the fertiliser company, the Construction Bureau and the Rural Energy Office are necessary to optimise collection methods, infrastructure services and to maximise the profit margin for the fertiliser company.
In the mid to long-term, several pilot projects testing different technical options, should be created in Wenjiang. The final project results will be presented at the International Flower Expo held in Wenjiang in October of 2005. To reduce the risk that is associated with relying on a company for collection and treating the domestic wastewater, more fertiliser companies must be incorporated into the concept. Investors should be included to add scale to the project and to increase efficiency.

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