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MAXIMIZING THE BENEFITS FROM WATER AND ENVIRONMENTAL SANITATION

The UPA-Ecosan Concept in Uganda: Socio-acceptability and Hygiene Safety

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The interdisciplinary PhD research "Potentials and Constraints to the Link of Urban and Peri-Urban Agriculture and Ecological Sanitation" carried out at University of Technology Hamburg-Harburg, TUHH assesses the safe reuse of faeces and urine and the social acceptability of re-circulation of human-derived nutrients. Thus facilitating the interaction of ecosan and agriculture. The research complements already conducted and on-going work. Vital part of the studies is the continuous monitoring of temperature and humidity and the repeated analyses of bio-solids for pH and microbiological parameters over a period of twelve months. Furthermore a study on the survival of Ascaris suum eggs in the faecal matter is carried out while the assessment of the socio-cultural acceptance of human derived nutrients is conducted by interviews. Preliminary results from interviews and observations are presented.

Background

By 2020, the number of people living in developing countries will grow from 4.9 billion to 6.8 billion. Ninety percent of this increase will be in rapidly expanding cities and towns. More than half the population of Africa and Asia will live in urban areas by 2020 (Garret 2000). Growth in urban poverty, food insecurity, severe environmental degradation and hygienic problems caused by the lack of sanitation infrastructure will accompany urbanization.

The linking of urban and peri-urban agriculture (UPA) and ecological sanitation (ecosan), in short UPA-Ecosan concept could play an important role for the solution of some of these problems.

Agriculture within city limits, so-called urban agriculture, has increasingly become a survival strategy for many poor families in the last decade. These families would not be able to secure their nutrition without urban agriculture. This form of agriculture can be a vehicle to increase food security and health, to generate economic opportunities for people with low income, and to promote recycling of waste and wastewater. The philosophy of ecosan is based on the consistent implementation of the "closing the loop approach" (Nutrient Cycling), where urine and faeces are regarded as resources rather than waste. If collected separately they can be used as fertilizer or as soil conditioner. Ecosan approaches are mainly onsite or semi-central. They provide a viable alternative to cost extensive and unsustainable central waste water management solutions.

The UPA-Ecosan concept, see Figure 1, facilitates sustainable natural resource management and the improvement of urban sanitation and livelihoods. By sanitizing human excrements in an environmentally sustainable approach and providing organic fertilizer, which does not contaminate urban land and water resources, the UPA-Ecosan concept maximizes both, the benefits of environmental sanitation and agriculture.

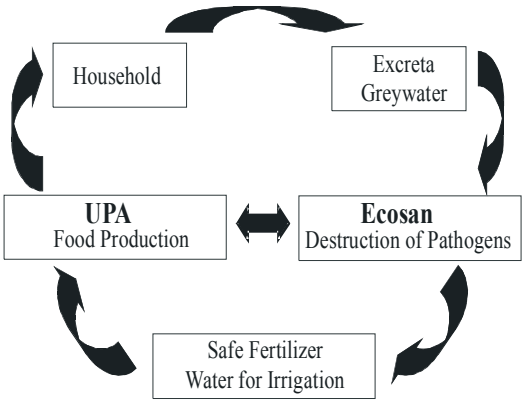


Figure 1. Improving Sanitation and Livelihoods through an UPA-Ecosan concept

The Research Project

The UPA-Ecosan concept could enable sustainable sanitation and hygiene, sustainable resource management, prevention of environmental degradation through urban agriculture, and an increase in soil fertility and, therefore, higher yields. The challenge is to prove this theoretical statement scientifically. It has to be evaluated, if an UPAEcosan concept fulfils the requirements of a system, which is feasible and appropriate, transferable to local conditions and easy to maintain, and effective with respect to public health, sanitation, and nutrient

recycling. The interdisciplinary PhD research "Potentials and Constraints to the Link of Urban and Peri-Urban Agriculture and Ecological Sanitation" addresses this challenge. A vital part of the studies is the investigation of the safe reuse of faeces and urine and the social acceptability of re-circulation of human-derived nutrients. The final results of the research complement already conducted (e.g., Moe, Izurieta 2004) and on-going research, and facilitate the often expressed but rarely established link to agricultural research and activities.

Methods

Hygienic safety of the material and the social acceptability of the human derived nutrients as fertilizer or soil conditioner are the two main aspects of the successful link of ecosan and agriculture. The research project aims at assessing both aspects.

Socio-economic and socio-cultural parameters

Socio-economic and socio-cultural parameters are investigated to assess the social acceptability and the potential of re-circulation of human-derived nutrients. The quantitative and qualitative research comprises reactive and non-reactive methods.

During the quantitative research, statistical data regarding economy, education, sanitation coverage, health status, environment and agriculture is collected. Information about habits and attitudes of the target groups are collected during the qualitative research by household interviews. The respondents are selected from three target groups: I. Ecosan-User, II. Farmer, and III. Farmer are using ecosan material as fertilizer or soil conditioner. Table 1 illustrates the different sampling parameters for each target group.

The household interviews were developed using a gender analytical framework. Each interview covers three areas of interest, general information about the household, hygiene and sanitation, and agriculture. In addition to household interviews, expert interviews with key persons at the municipal level are conducted. All interviews are semi-structured while observations complement the findings.

Table 1 Target groups and parameter for theoretical sampling

Target Group	Parameter
I Ecosan user	Technology[1] Demographic[2]
II Farmer (non-ecosan user)	Agricultural Practice[3] Organisation[4] Reason[5] Demographic
III Farmer-Ecosan user	Technology Agricultural Practice Organisation Reason Demographic
[1] Technology [2] Demographic [3] Agricultural Practice [4] Organisation [5] Reason	- Dehydration - composting, basket - single - double vault, solar - non solar - Location – income - Organic - "conventional" - Community, school, backyard, park, enterprise, informal – organised - Market orientated - subsistence

Hygienic safety

The rate of pathogen destruction in a dry sanitation system is dependent on temperature, moisture content and pH (Hoglund 2001, Winblad 2004). The monitoring of these parameters will allow conclusions on functionality, maintenance, and hygienic safety. Therefore, the storage conditions of the faeces are monitored in about forty toilets. In order to guarantee the significance of the gathered data the monitoring period is twelve months. The analysis of the data retrieved from the monitoring facilitates the assessment of the pathogen destruction (indirect analysis). The continuous monitoring of temperature and humidity is assured by the use of programmed data loggers. Measurements are taken three times a day and stored at the loggers memory.

Faecal samples are periodically taken from the study toilets and tested for hygienic indicator micro-organisms (direct analysis, see Table 2) to double-check the conclusions drawn from the monitoring of the ambient conditions. Total coliforms (including e-coli) have a very short survival rate in the environment and are capable of regrowth in the environment (Hoglund, 2001). Therefore, they are not suitable as an indicator and are not used in this research. Parallel to the monitoring a study on the survival of *Ascaris suum* eggs in the faecal matter is carried out using the method of Phi et al. (2004).

Table 2 lists the parameters for a direct and an indirect analysis of pathogen destruction.

Table 2 Analyses of hygienic parameters

Pathogen Destruction	
Direct Analysis	**Indirect Analysis**
Hygienic indicator micro-organism • Salmonella • Fecal Streptococcus • Ascaris eggs • Cryptosporidia	Ambient conditions • pH • Water content (moisture) • Temperature

Site selection

The research is carried out in various settings in Uganda. The site selection had to facilitate the evaluation of the influence and importance of the socio-economic, sociocultural, technical, and climatic conditions on the physical and microbial safety of human derived nutrients from ecosan toilets for use in agriculture.

For the selection of the project sites the following criteria were mandatory:

- A functioning ecosan system already exists
- Partnerships with other key institutions (e.g. NGO's, International Organisations)

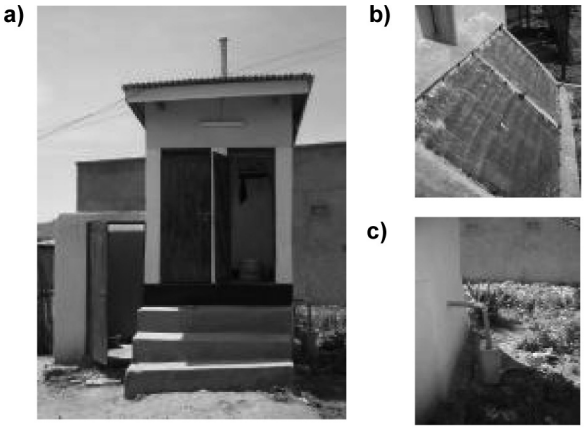
The following criteria were optional:
- The ecosan material is/or has been used or
- An interest in the reuse exists or/and
- There are considerable activities in urban agriculture.

Project sites should be located in different ecological zones and the comparison of different dry sanitation technologies should be possible. On this basis Ishasha, Rwemshama, Kabale, Kitgum, and Kampala were chosen as project sites.

In order to ascertain and analyse information through a participatory process in collaboration with ecosan users and UPA farmers, the research is conducted in co-operation with relevant institutions in the urban areas selected (municipality, farmers associations, NGOs, academic institutions). The focus is on low-income and middleincome ecosan users and small-scale UPA farmers whose livelihoods depend largely on UPA-related activities.

For the socio-economic and socio-cultural assessment the differentiation between subsidised and self-financed installation is of interest For example, in Ishasha, Rwemshama and Kisoro 90% of the construction of the ecosan toilet is subsidised. The owner has to pay 100.000 USH (equivalent to approximately 58,-$). Whereas the ecosan toilets at the other project sites are built on own expenses and initiative.

Photographs 1a-c depict an ecosan toilet in Kabale town. The owner does reuse the faecal material and the urine for the homestead garden. The pictured ecosan toilet is a double-vault, urine diverting, solar heated technology with a double stance, one for each chamber. The design was done by the owner and masons trained by the South Western Towns Water Sanitation (swTws) project. The latter ones also constructed the toilets.



Photograph 1. Toilet of Amos Bitwire in Kabale
a) Front view with attached bathroom
b) Back: solar collectors
c) Urine collection

Status of the research

Currently, the field work has started in Uganda in cooperation with swTws-Project, Uganda, the Austrian Development Agency (ADA), and Makerere University, Uganda. Project sites were identified, approximately 100 ecosan toilets inspected and 30 interviews were conducted. Samples of solid materials were taken. Laboratory results are not available yet.

Preliminary findings of the conducted interviews and site inspections

Attitude towards ecosan and reuse:
- Ecosan toilets in the project areas are seen as a modern and desirable but expensive technology.
- The majority of the respondents stated the production of manure as one of the three main reasons for their decision for adopting ecosan technology.
- The knowledge about the agricultural use of the faecal material is more wide spread than the knowledge about the use of urine as fertilizer. Often urine of animal and human origin is used as insecticide.
- None of the interview partners at household level stated any doubts eating food which is fertilized by human derived nutrients. However, expert interviews suggest that there is a considerable resistance towards food fertilized with ecosanmaterial.
- The dissemination of information by swTws using the mass media, like radio and newspaper is crucial to the success of ecosan in the area.
- Farmers without ecosan showed interest in the faecal material as manure.

Washing communities:
- Washing communities did use the urinal part for anal cleaning, or did included a separate washing section in the design.

Stated and observed challenges:
- The main challenges stated are the high installation cost, misuse by visitors, and the shortage of ash.
- It was evident that there is not enough knowledge of indoor solutions.
- Another challenge in the design is the low durability of the urine pipes. They get broken easily and the caps get stolen. The metal sheets for solar heating are subject to heavy corroding in certain areas and therefore are not watertight.
- The chambers should be easy to open and not sealed by plastering. The most convenient design was using fitted metal sheets in a frame which could be locked and therefore not get stolen.

Agriculture:
- Organic agriculture is wide spread in Uganda. Fertilizer is used very rarely and depends on the training of the

farmer. Organic fertilizers are preferred to chemical fertilizers due to cost and health concerns.
- According to the respondents, the main problem in agriculture is the scattered land, which does also limit the use of the ecosan material due to difficulties in transport.
- The majority of subsistence farmers do sell surplus on the local market.

Box 1. Ecosan – Organic Agriculture

To make ecosan a viable option for (urban) organic farmers and before promoting the use of the human derived nutrients the European guidelines on organic agriculture have to be discussed!

Next steps

The socio-economic and socio-cultural survey will be extended to project areas in the north of Uganda, outside the swTws project area. The north of Uganda is characterized by different cultural beliefs and different agricultural practices. The monitoring, sampling and the study on the survival of *Ascaris suum* eggs will start in July 2005.

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