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Experience with the introduction of dry, urine-diverting sanitation systems in Ethiopia

M. Oldenburg, F. Meinzinger, A. A. Lisanework, K. Gutema, P. Krusche, O. Jebens, Ethiopia

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To overcome the drawbacks of conventional sanitation systems, new approaches to sanitation are necessary. Human faeces and urine as well as greywater represent potential resources requiring efficient management. Thus, source-separating systems, which safe water and allow the recycling of nutrients to agriculture, can provide an alternative. These systems can even be integrated into multi-storey houses, therefore addressing the need for resource-efficient sanitation in condominium housing programmes. Several urine-separating facilities are implemented in Ethiopia showing a high acceptance by their users. The cost comparison between source-separating systems and the conventional system for condominium houses shows an advantage for the new approach due to savings of water for toilet flushing as well as reduced costs for the treatment of the wastewater in septic tanks. The use of human urine as fertiliser in several trials resulted in significant benefits in terms of improved crop growth.

Introduction

According to the WHO and UNICEF [UN, 2006] Ethiopia is one of the countries in the world with the lowest sanitation coverage. Less than 15 % of the population have access to improved sanitation. Although the percentage is higher in urban areas than in rural areas, it is the fast growing cities where the most pressing problems with regard to sustainable sanitation exist. Like in the majority of countries in Africa urbanisation is increasing, thus, appropriate provision of infrastructure in the urban agglomerations becomes more and more urgent.. Ethiopia currently sees the implementation of a large housing programme with about 400,000 so-called condominium houses being constructed in 55 cities across the country [Hayal, 2008]. These condominium housing programmes differ from conventional housing areas due to increased population density and the implementation of multi-storey apartment houses. This paper introduces a project which links the idea of sanitation technologies that allow an efficient management of natural resources in the Ethiopian context with its implementation in condominium housing.

The majority of existing toilets in urban areas of Ethiopia are simple pit latrines which face a variety of problems like pit collapsing and flooding. Also the need for digging of new pits once the old one is filled is considered a drawback of this conventional technique. The use of septic tanks is impeded by factors like the lack of desludging facilities (e.g. vacuum trucks) and missing sludge management concepts. Centralised sewerage systems are usually not within reach of the municipalities due to the high costs for sewers and treatment facilities.

All of these conventional technologies have in common that they are not providing for a safe and non-polluting final disposal of the sewage. Moreover, they neglect the need for hygienic recycling of plant nutrients to agriculture. Due to rising energy prices for the production of fertiliser as well as the fact that phosphorus is a limited resource, the retail price of inorganic fertiliser in Ethiopia is seeing yearly increases of up to 20%. This is highlighted by the fact that in many places raw or insufficiently treated wastewater from pond systems as well as septage from septic tanks is used for the supply of nutrients to agriculture.

Thus, new sanitation approaches and concepts are required, taking into account not only hygienic excreta management but also the value that human excreta represent in terms of plant nutrients and organic matter.

Objectives of the project

The Ecological Sanitation in Ethiopia (ESE) project is a private public private partnership (PPP-)project funded by the GTZ has been working on urine-diverting dry toilets and the management on the residues in Ethiopia since beginning of 2006. It is implemented by different partners from Germany in cooperation with Ethiopian organisations. The project develops new technologies in sanitation based on the idea of natural cycles. Main objective of the project is a proper sanitation technology with a significant reduction of the water consumption and the possibility to produce natural fertilisers. This will be achieved by the separate collection of urine, faeces and the residual wastewater from the houses.

Activities

Production of urine separation sanitary devices in Ethiopia

For the separation of urine and faeces at source, special kinds of toilets providing for two outlets are required. Several types with different materials and costs are available on the international market. In Ethiopia, squatting toilets ("Turkish toilets") as well sitting toilets are used.

To facilitate the introduction of urine separating toilets in Ethiopia and to create value within the country the production of urine separating toilets has been initiated and realised with local companies. Currently, a squatting type as well as a sitting type out of fibre-glass reinforced plastic is available. Fibre glass plastic has the advantage of being easily adjustable if the need for alterations is arising. In addition, the products can be fabricated on request and in a small number. However, since the costs for this type of production are relatively expensive when it comes to mass production, the cooperation with an Ethiopian ceramics factory brought forth the production of a squatting type of toilet out of ceramics.

Photograph 1. Squatting type toilet made of fibre glass

Photograph 2. Squatting type toilet made of ceramics

Demonstration toilets

Several toilets were built in the project areas in private households as well as in institutions like an agricultural college for demonstration purposes. For the demonstration of this technology within the large scale housing programmes one toilet block with urine separation was built on a construction site for use by the workers on the site. Users realised the advantages of the new technology. The project also saw a private household adapting this idea by themselves and constructing a urine separating toilets on their own. In general, users of the toilets show a great acceptance and satisfaction with regard to the new technology. Reasons for this are manifold, like:

- Lack of hygienic awareness and thus little incentive for toilet construction and modernisation,
- Low income and therefore little economic possibilities,
- Lack of know-how of construction and O&M of sanitation facilities,
- Lack of hardware, e.g. urine separating toilet seats not widely available on the market, and
- Non-existing links to other actors like service providers (e.g. MSEs) and no established reuse strategies outside the households.

These aspects emphasise the importance of setting up holistic projects that restrict sanitation not only to toilet construction, but set up marketing strategies and establish the links to public institutions, service providers and end users in agriculture.

Agricultural use

Two academic institutions, i.e. Arba Minch University and Sodo Agricultural College, as well as private farmers supported by the Sodo Agricultural Department are investigating the use of human urine as fertiliser for different crops. First experiences with the reuse of human excreta products in agriculture were gained during two growing seasons. These tests showed very good results in terms of crop yield and acceptance.

In Sodo, three farmers fertilised 100 m² of their wheat fields with urine at an application rate of about 50 kg N/ha and applied mineral fertiliser as usual on the remaining of their fields (100 kg DAP/ha). Even though the DAP-fertilised fields were supplied with nitrogen and phosphorus, the urine-fertilised plots had yields that were 1.4 times higher than the DAP-fertilised plots. Due to these convincing results the farmers, who have also used sludge from septic tanks on their fields in the past, expressed a demand for urine for the fertilisation of their fields and suggested the construction of more urine separating toilets. All in all, farmers as well as consumers have not raised any objections, but appreciated the value of the fertiliser in the form of urine and composted excreta.

Photograph 3. Application of urine as fertiliser

Photograph 4. Comparison of yields (left hand: conventional fertiliser, right hand: urine fertilising)

Integration of dry urine-diverting toilets into multi storey-buildings

The system that is implemented in the condominium houses is based on the so-called double-vault system. The toilet is produced in the form of a larger box produced out of fibreglass and two such toilets are installed in every bathroom. The urine is separated via the urine outlet of the sitting toilets and collected in large containers outside the houses. In order to prevent smell from the urine containers entering into the bathrooms, a smell trap (e.g. made by rubber) is integrated into the urine pipe. The faeces are collected in the rear of the box. Households are advised to use ash, which is widely available as a result if Ethiopian cooking habits, or other dry material like dry soil for covering the faeces after every use and improving the drying process. The toilet boxes are designed in such a way that an average Ethiopian family can use one box for about six months. After this period, the adjacent toilet (i.e. the second vault) will be used (see Figure 1 for a schematic view of the toilet boxes). This allows the first faeces pile to dry and, thus, reduces the pathogen content for subsequent safe handling. During this time the first toilet may be used as a urinal by addition of a urinal bowl. After the second six-months-period the first toilet box needs to be emptied so that the cycle can start once again. The emptying takes place by pushing the faeces pile down the shaft at the rear of the toilet box and collecting the faeces in a container at the bottom of the shaft. From there, the containers with the dry faeces are collected and transported e.g. by donkey carts to post-composting sites. The shaft additionally serves as vent duct. Due to it relatively low nutrient content the greywater can be treated easily in decentralised constructed wetlands, which are foreseen in the immediate surrounding of the houses.

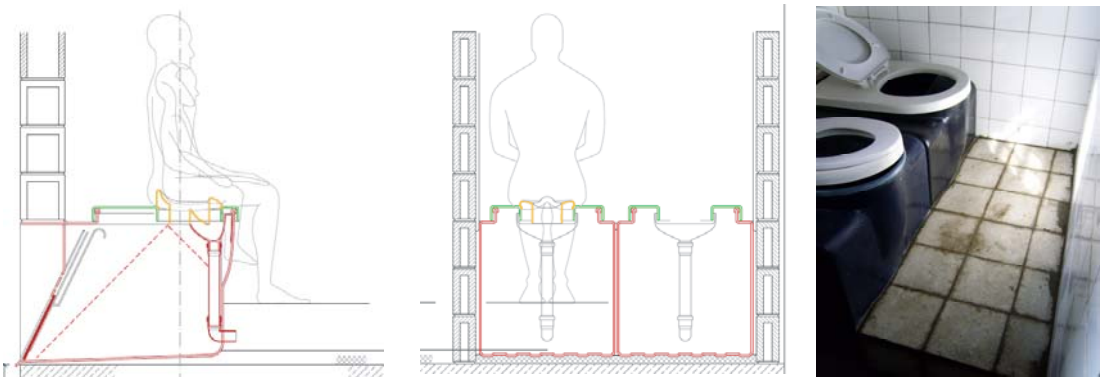

Figure 1. Schematic view of a urine separating toilet and implemention in multi-storey buildings

To check the economic viability of the source-separating sanitation system, a cost comparison is carried out for seven blocks of houses with six flats each, which is equal to about 210 inhabitants in total. The dry sanitation system using urine separating toilets is compared to the conventional water-based system with septic tank. The lifetime of all investments is assumed to be 10 years and the interest rate is assumed to be 10%. Costs for further processing of urine and faeces as well as treatment of septage from septic tank are not included in the analysis. However, the investment costs for on-site storage and treatment (e.g. greywater treatment in constructed wetlands) as well as emptying costs are considered. The analysis shows that the costs of sanitary installations inside the houses are more expensive for the source-separating system compared to the conventional system. Yet, the costs for construction of septic tanks are saved. In addition, operational costs of the ecological sanitation system are lower due to savings in water for toilet flushing and reduced collection costs of urine and faeces compared to the expensive hiring of vacuum trucks for emptying the septic tanks. All in all, the urine separating system shows cost advantages against the conventional system. Even assuming that the septic tank is not going to be emptied by vacuum trucks, the conventional system is slightly more expensive than the source separating system. Taking into account the expensive hiring costs for a vacuum truck service as operational costs the total costs of the source separating system (investment and operation) are only about 85% of the costs of the conventional system. A sensitivity analysis with varying interest rates shows that the source-separating system is always favourable compared to the conventional system. Even the neglect of emptying costs for the septic tank does still result in slightly lower costs for the source-separating system.

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Contact details

Martin Oldenburg
Ecological Sanitation Ethiopia
22182 / Code 100
Addis Ababa, Ethiopia.
Tel: +251 – 115 544 913
Email: oldenburg@otterwasser.de
www.otterwasser.de

Franziska Meinzinger
Institute of Wastewater Management
and Water Protection
Hamburg University of Technology (TUHH)
Eissendorfer Str. 42, 21073 Hamburg, Germany.
Email: f.meinzinger@tuhh.de
www: www.tuhh.de/aww