Sustainable Sanitation

Practice

EcoSan Club

Issue 4. 7/2010

- Introduction to the ROSA project
- From pilot units to large-scale implementation - Ethiopia
- Implementation of UDDTs in schools - Kenya
- Urban agriculture for sanitation promotion
- Operation and maintenance in practise
- Experiences from strategic sanitation planning
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rosa

Resource-Oriented Sanitation concepts for peri-urban areas in Africa

SIXTH FRAMEWORK PROGRAMME

The ROSA project

partner of

sustainable sanitation alliance

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Sustainable Sanitation Practice (SSP) aims to make available high quality information on practical experiences with sustainable sanitation systems. For SSP a sanitation system is sustainable when it is not only economically viable, socially acceptable and technically and institutionally appropriate, but it should also protect the environment and the natural resources. SSP is therefore fully in line with SuSanA, the Sustainable Sanitation Alliance (www.susana.org). • SSP targets people that are interested in sustainable sanitation systems and the practical approach to it. • Articles are published after blind review only. • Sustainable Sanitation Practice is published quarterly. It is available for free on www.ecosan.at/ssp.

Sustainable Sanitation Practice (SSP) hat zum Ziel praxisrelevante Information in hoher Qualität im Zusammenhang mit „sustainable sanitation" bereit zu stellen. „sustainable" also nachhaltig ist ein Sanitärsystem für SSP wenn es wirtschaftlich machbar, soziokulturell akzeptiert, technisch als auch institutionell angemessen ist und die Umwelt und deren Ressourcen schützt. Diese Ansicht harmoniert mit SuSanA, the Sustainable Sanitation Alliance (www.susana.org). • SSP richtet sich an Personen, die sich für die praktische Umsetzung von „sustainable sanitation" interessieren. • Artikel werden nur nach einer Begutachtung veröffentlicht. • Sustainable Sanitation Practice erschient vierteljährlich, kostenlos unter: www.ecosan.at/ssp.

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publisher: EcoSan Club, Schopenhauerstr. 15/8, A-1180 Vienna, Austria • chairperson: Günter Langergraber • website: http://www.ecosan.at/ • scope: EcoSan Club was funded as a non profit association in 2002 by a group of people active in research and development as well as planning and consultancy in the field of sanitation. The underlying aim is the realisation of ecological concepts to close material cycles in settlements.

Medieninhaber: EcoSan Club, Schopenhauerstr. 15/8, A-1180 Vienna, Austria • Obmann: Günter Langergraber • Gegenstand des Vereins: Der EcoSan Club wurde 2002 als gemeinnütziger Verein von einer Gruppe von Personen gegründet, die in Forschung, Entwicklung, Planung und Beratung in der Siedlungshygiene - Sammlung, Behandlung oder Beseitigung flüssiger und fester Abfälle aus Siedlungen - tätig waren und sind. Das Ziel des EcoSan Clubs ist die Umsetzung kreislauforientierter Siedlungshygienekonzepte (EcoSan Konzepte) zu fördern, um einen Beitrag zum Schutz der Umwelt zu leisten.

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Editorial

During the last years EcoSan Club was partner of the ROSA project. The ROSA (*Resource-Oriented Sanitation concepts for peri-urban areas in Africa*) project proposed resources-oriented sanitation concepts as a route to sustainable sanitation and was funded within the EU 6th Framework Programme, Sub-priority "Global Change and Ecosystems". The project had duration from October 2006 to March 2010 and was implemented in four pilot cities: Arba Minch in Ethiopia, Nakuru in Kenya, Arusha in Tanzania, and Kitgum in Uganda.

Issue 4 of ***Sustainable Sanitation Practice (SSP)*** is s special issue that presents the highlight s and main findings of the ROSA project. The 7 papers included in this special issue show specific aspects of the ROSA project as well as an outlook on future activities.

The thematic topic of the next issue (issue 5, October 2010) is "*Sanitation as a business*". Contributions are due to 1 August 2010. Information on future issues is available from the journal homepage (www.ecosan.at/SSP) and will be regularly updated. Please feel free to suggest further topics for issues of the journal to the SSP editorial office (ssp@ecosan.at). Also, we would like to invite you to contact the editorial office if you volunteer to act as a reviewer for the journal.

SSP is available online from the journal homepage at the EcoSan Club website (www.ecosan.at/SSP) for free. We do hope that SSP will be frequently downloaded and further distributed to interested people.

We thank Ms. Isabelle Pavese for her work in the SSP editorial office during the set-up of SSP and for the preparation of the first four issues. The SSP editors appreciate her work for SSP. Mr. Fritz Kleemann will continue the work as editorial officer. The email of the SSP editorial office will be the same: ssp@ecosan.at.

With best regards,
Günter Langergraber, Markus Lechner, Elke Müllegger
EcoSan Club Austria (www.ecosan.at/SSP)

Content:

Introduction to the ROSA project

The paper introduces the general concepts that form the basis for the ROSA project and briefly describes the ROSA pilot cities.

Authors: G. Langergraber, N. Weissenbacher

Abstract

The EU-funded ROSA project (*Resource-Oriented Sanitation concepts for peri-urban areas in Africa*) proposed resources-oriented sanitation concepts as a route to sustainable sanitation. Within ROSA these concepts have been applied in four pilot cities: Arba Minch in Ethiopia, Nakuru in Kenya, Arusha in Tanzania, and Kitgum in Uganda. These cities each have a population between 40'000 and 500'000 inhabitants and represent typical cities in Eastern Africa. The paper describes the general concepts that form the basis for the ROSA project, describes the ROSA pilot cities and gives an outlook on the SSP ROSA special issue

The general concept

"Sanitation" refers to the principles and practices relating to the collection, removal or disposal of human excreta, household wastewater and refuse as they impact on people and the environment. The main objective of a sanitation system is to protect and promote human health by providing a clean environment and breaking the cycle of disease. In order to be sustainable, a sanitation system has to be not only economically viable, socially acceptable and technically and institutionally appropriate, but should also protect the environment and the natural resources (SuSanA, 2008).

The EU-funded project ROSA (*Resource-Oriented Sanitation concepts for peri-urban areas in Africa*; duration 1.10.2006 - 31.03.2010) proposed resources-oriented sanitation concepts as a route to sustainable sanitation (Langergraber et al., 2008). These concepts have been developed and applied in the four ROSA pilot cities: Arba Minch in Ethiopia, Nakuru in Kenya, Arusha in Tanzania, and Kitgum in Uganda. These cities have a population between 40'000 and 500'000 inhabitants and represent typical cities in Eastern Africa. All pilot cities have common problems, e.g. the lack of sanitation and waste management for the poor in the peri-urban. Another common problem for all cities is the high growth rate of the population, hence adaptable, affordable and replicable solutions for sanitation of peri-urban areas in the pilot cities should be developed. For sustainability of the implemented solutions, integrated stakeholder based management concepts should be developed and tested including end-users, service providers and authorities.

The ROSA project consortium comprised 2 partners from each of the East African countries, a university and the respective municipality, and 5 European partners. The European partners were: University of Natural Resources and Applied Life Sciences, Vienna (BOKU University, co-ordinator), Hamburg University of Technology (Germany), EcoSan-Club Austria, WASTE (the Netherlands) and London School of Hygiene and Tropical Medicine (UK). The African partners were Arba Minch University and Arba Minch Water Supply and Sewerage Enterprise in Ethiopia, Egerton University and the Municipal Council of Nakuru in Kenya, the University of Dar es Salaam and Arusha City Council in Tanzania, and Makerere University

What is special about ROSA?

- Having the municipalities as consortium partners is an important step towards sustainable implementation of sanitation concepts.
- In all pilot cities, ROSA is the first project in this field where the municipalities work with their local universities
- About 8-10 local people worked for ROSA in each town – local teams are leading and defining the work, European partners are advisers
- The municipality and the university formed the core of a wider local network in which ROSA invited authorities, NGOs, CBOs, etc. working in the field sanitation to participate.
- Research in ROSA was demand driven and defined by the local African partners.

and Kitgum Town Council in Uganda. The location of the ROSA pilot cities is shown in Figure 1.

Figure 1: ROSA pilot cities

Resources-oriented sanitation systems

Resources-oriented or ecological sanitation systems are an approach to avoid the disadvantages of conventional wastewater systems which are based on (drinking) water as transport medium for collection and transport of human excreta via a sewer system. In resources-oriented sanitation systems, human excreta and water from households are recognized as a resource which should be made available for re-use. These systems are based on the closure of material flow cycles and on collecting and treating the different wastewater flows separate to optimise the potential for reuse (Figure 2). When implementing resources-oriented sanitation systems single technologies are only means to an end and are not resources-oriented per se but only in relation to implemented sanitation system. The applied technologies may range from natural wastewater treatment techniques to compost toilets, simple household installations to complex, mainly decentralized systems, but will include also low-cost sewerage and on-site sanitation systems.

Household wastewater consists of blackwater (wastewater from the toilets, a mixture of urine and faeces) and greywater (wastewater without excreta respectively from kitchen, bathroom and laundry). Separately collected urine is called yellowwater and separately collected faeces faecal sludge or faecal matter, respectively, depending on if flush water is used or not. The characteristics of the different streams of wastewater, the possibilities for reuse and the hygienic hazards can be summarised as follows (Langergraber and Müllegger, 2005):

- Most of the soluble nutrients are found in urine. If urine is separated and converted to liquid fertilizer for agricultural usage, the biggest step towards nutrient reuse and highly efficient water protection is taken.
- The hygienic hazards of wastewater originate mainly from faecal matter. Separation opens the way to hygenisation and finally to an excellent end-product for reuse as solid fertilizer and soil conditioner.
- Greywater, i.e. wastewater that is not mixed with faeces and urine, is a great resource for high quality reuse water.
- Source control should include evaluating all products that end up in the water. High quality reuse will be far easier when household chemicals are not only degradable but can be mineralised with the available technology.

Although there are a lot of advantages, the degree of risk to public health presented by reusing waste and excreta has to be taken into account. These include the consideration of national, socio-cultural, economic and environmental factors and goes beyond the bacteriological and chemical quality of the treated waste. In places where wastewater, excreta and greywater are used in agriculture and aquaculture, especially at the subsistence level, the health benefits from increased household food security and better nutrition may outweigh the potential negative health impacts.

The ROSA approach

The ROSA project aimed to develop and implement sustainable resources-oriented sanitation systems for four pilot-cities in Eastern Africa. In all these cities the local project consortium comprised the municipality administration and/or the entity responsible for sanitation issues and a local university. At the beginning of the project a wider local network was started in which ROSA invited all authorities, NGOs, community-based organisation (CBOs), etc. working in the field sanitation to participate. The inclusion of all stakeholders should help to create local project ownership.

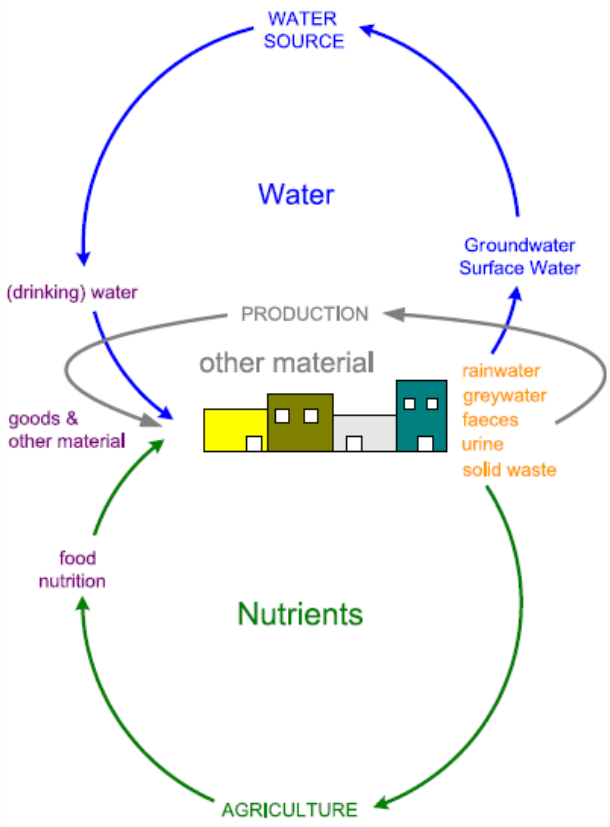

Figure 2: Resources-oriented or ecological sanitation system (Langergraber and Müllegger, 2005)

Within ROSA the focus of implementation was in the peri-urban areas away from the city centres. Peri-urban areas are a favourable scope and most pressing need for innovative sanitation based on livelihood improvement and low-cost, though sustainable concepts. For developing the resources-oriented sanitation concepts the main focus was on human excreta, greywater and solid waste management whereas storm water management and animal and industrial waste was given less priority.

Strategic Sanitation and Waste Plans (SSWPs) were developed in the ROSA pilot-cities. SSWPs are living documents and therefore have been updated on a regular basis throughout the project duration. The pilot units have been implemented in line with the SSWPs.

The research questions addressed in ROSA have been based on the needs for implementation of the chosen sanitation concepts within the following overall topics:

- an implementation study of the WHO-guidelines for use of waste and excreta in agriculture and aquaculture (WHO, 2006) in peri-urban areas,
- the development of decentralized solutions for greywater treatment,
- the development of operation and management strategies for peri-urban areas,
- the integration of resources-oriented sanitation into local settlement structures, and
- the development of local structures for financing of sanitation.

The ROSA pilot cities

Arba Minch, Ethiopia

Arba Minch, with a population of about 75'000, is administratively located in Gamo Gofa zone of the Southern Nations, Nationalities and Peoples Region at about 500 km south of Addis Ababa (capital of Ethiopia) and 275 km south of Awassa (capital of the region). Arba Minch consists of the upper town (Secha) and the lower town (Sikela) and is further subdivided into sixteen Kebeles.

The water supply system of the town has been drastically extended during the last years. At the moment about 5'300 households, i.e. about 40 %, have a private tap and 34 public taps are connected to the distribution system. There is a wide range of problems associated with sanitation in Arba Minch. As the city is one of the fastest growing cities in the country, the problem is expected to grow even bigger with time. Most households have a shallow pit dug for excreta disposal, with a temporary superstructure made of local material, a privacy cover of old clothes or pit without any privacy cover. Pits are often emptied manually and there are no official sites for sludge disposal available. Gorges and jungle sites are potential open defecation areas and solid waste disposal sites. Most household dispose grey water in their premises while others dispose outside of their premises with the intent of avoiding unsightly conditions within their own premises. Solid wastes are poorly managed and are either dumped in gorges and open places or collected and left at household premises and are in several cases also burnt.

Nakuru, Kenya

Nakuru is the fourth largest town in Kenya. It is located 160 km Northwest of Kenya's capital Nairobi. Nakuru lies at an altitude of 1859 m above sea level. The town covers an area of 290 km², Lake Nakuru National Park takes up 188 km² leaving 102 km² to the town. The current population is estimated to be close to 500'000 persons. The increase in population has led to an increase in demand for basic services and infrastructure such as housing, water, sanitation and road among others.

The Nakuru Water and Sanitation Services Company Ltd. (NAWASSCO) is responsible for water supply and sanitation in Nakuru. Up until 1985, Nakuru town was adequately served with water. In the recent past the supply of water has been characterised by chronic shortages. Disposal of domestic waste is done through a sewer network, septic tanks, cesspools and pit latrines. As of now, only one third of the town is covered with the sewer network, meaning less than 10 % of Nakuru's population is connected to the sewer. NAWASSCO currently operates two waste stabilization ponds with a loading capacity of 16'200 m^3/d. Only 50 % of the loading capacity is utilised. Greywater and storm water are poorly managed and locally discharged. The provision of solid waste management services rely on municipal waste collection and disposal services. These are inadequate and their provision is limited to activity areas within the town centre. In the newly developed areas, municipal waste collection services are seldom provided. These areas rely heavily on private initiatives.

Arusha, Tanzania

Arusha Municipality is one of the seven districts of Arusha Region in the north of Tanzania. It lies at an elevation ranging between 1'160 and 1'450 m above sea level. The population of Arusha Municipality is estimated to by around 450'000. Arusha Municipality consists of 17 wards whereas ROSA focussed on 3 wards (Lemara, Sokon I and Daraja Mbili) only.

The main sources of water in Arusha are deep boreholes, springs and river. The proportions of water supplied from boreholes, rivers and springs in the municipality are 27 %, 13 % and 60 %, respectively. Currently, about 90 % of the water demand is met. The majority of people in Arusha use pit latrines. There is a problem with emptying filled latrines and/or high water table and therefore local people are ready to cooperate in introducing new approaches to ease the problem. Only 12 % of the city is connected to the sewer system. Wastewater is treated in a waste stabilisation pond. Effluent from the pond is used for irrigating banana plantations. Therefore the issue of reusing sanitation products was not totally new in Arusha and there is high potential to promote and up-scale. Solid waste management in Arusha Municipality is unsatisfactory this is because collection and disposal of the waste generated is less than 50 %.

Kitgum, Uganda

Kitgum district is located in Northern Uganda, 450 km from Kampala. The district has an area of 9'774 km^2. Kitgum Town Council (KTC) is the district headquarter and commercial centre of Kitgum district. Kitgum has about 45'000 inhabitants, 7'300 households and is subdivided into in 7 parishes and 28 villages. The area includes typical urban, peri urban and rural settlement structures in terms of housing and population density. The indigenous people are from the Acholi ethnic group although there are a number of other tribes living there. Northern Uganda has experienced civil war for the last two decades. This resulted into abduction, rape, death, and destruction of social infrastructures and displacement of the people. As a result of this instability, poor sanitation and lack of safe water are the biggest problems encountered in the town.

The main water sources are boreholes serving 89 % of the population, with only 9 % of the people connected to the central water supply system and 2 % getting water from shallow wells. The main problems faced are water shortages, especially in cases when there is no electricity. Existing sanitation facilities are pit latrines, Ventilated Improved Pit (VIP) latrines, flush toilets, dry toilets, cat method, and open defecation. Of these systems, pit latrines are the most commonly used. 93 % of the population have access to a sanitation facility in their homes or neighbourhood, the other 7 % practice open defecation. In addition, there are two public sanitation facilities owned by the KTC. Solid waste management is one of the biggest problems. Solid waste generated in the town centre and slightly outside the town centre is managed by KTC. However, the collection frequency is low and can be up to monthly instead of daily. As a result, there is waste accumulation by the roadsides, in the homestead compounds and drainage channel banks waiting to be collected.

The SSP special issue

This special issue of SSP presents highlights and key findings of the ROSA project. The following contributions have been included in the special issue:

- From pilot units to large-scale implementation - the case of Arba Minch, Ethiopia (Ayele Shewa et al., 2010)
- Implementation of urine-diversion dry toilets in schools in Nakuru, Kenya (Gacheiya and Mutua, 2010)

- Urban agriculture as means to create demand for sanitation products (Tendwa and Kimaro, 2010)
- The importance of Operation & Maintenance – Lessons learnt from the ROSA project (Müllegger and Freiberger, 2010)
- Strategic Planning for Sanitation – A practical experience from the ROSA project (Schreiner et al., 2010)
- Summary of the main findings and main achievements of ROSA (Langergraber and Weissenbacher, 2010).

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From pilot units to large-scale implementation - the case of Arba Minch, Ethiopia

This paper describes the strategy followed in Arba Minch to promote and implement resources-oriented sanitation systems at a larger scale.

Authors: W. Ayele Shewa, K. Kassa Ayano, F. Meinzinger

Abstract

Within the framework of ROSA, in Arba Minch several pilot units have been constructed for the treatment and safe use of human excreta, greywater and solid waste. Different types of toilets have been constructed: 16 urine-diversion dry toilets (UDDTs), 30 fossa alternas and 9 arborloos. The initial units were built for demonstration purposes and therefore the construction costs have been fully covered by the ROSA project. The remaining units were built with shared costs. The community of Arba Minch liked the toilets and the demand was increasing. Construction of toilets started in large numbers without any subsidies. Up-scaling is supported by the Dutch funded SPA programme under which persons that are willing to build a toilet can get loans for this purpose.

Introduction

Within the ROSA project different technologies of resources-oriented sanitation systems have been demonstrated in Arba Minch. Among the different technologies constructed are: 3 different types of toilets, i.e. urine-diversion dry toilets (UDDTs), fossa alternas and arborloos, greywater towers, biogas units and several co-composting schemes. Research has been done to evaluate these units.

The initial toilets were built for demonstration purposes. These initial units were considered as testing units and therefore the construction cost was covered fully from ROSA project budget. The remaining toilets were built with shared costs, whereby 75 % of the construction cost had to come from the households whereas the remaining 25 % were contributed by ROSA. In total 16 UDDTs, 30 fossa alternas and 9 arborloos were constructed by ROSA.

Locally available material and basic craftsman skills were used for the construction of the toilets. Several trainings for micro and small enterprises on how to construct the three different types of toilets were carried out. Pilot trials to show how to use the products of the toilets have been carried out at the ROSA office compound as well as at Arba Minch University.

Within the duration of the ROSA project, the Dutch funded SPA project was begun. SPA (Sanitation for Peri-urban areas in Africa) is a project for further up-scaling of on-site sanitation that is besides Arba Minch also active in 4 other African countries. The lead in SPA is by Arba Minch Town Municipality whereas OMFI (Omo Micro Financing Institution) provides the local financial inputs. Based on the results of the ROSA project, i.e. the Strategic Sanitation and Waste Plan (SSWP), a business plan was derived for SPA.

Key messages::

- For introducing new sanitation technologies demonstration units are important.
- Beneficiaries of demonstration units should contribute to the construction costs.
- Involvement of micro and small enterprises in the construction of infrastructure as well as in operation and maintenance of sanitation systems is required for large scale implementation and ensuring the sustainability of sanitation systems.
- Constructing sanitation systems at schools helps disseminating new sanitation concepts in the community and to create demand.
- Up-scaling of sanitation systems can be achieved when - once the demand for toilets is created - loans for persons that want to construct a toilet are locally available

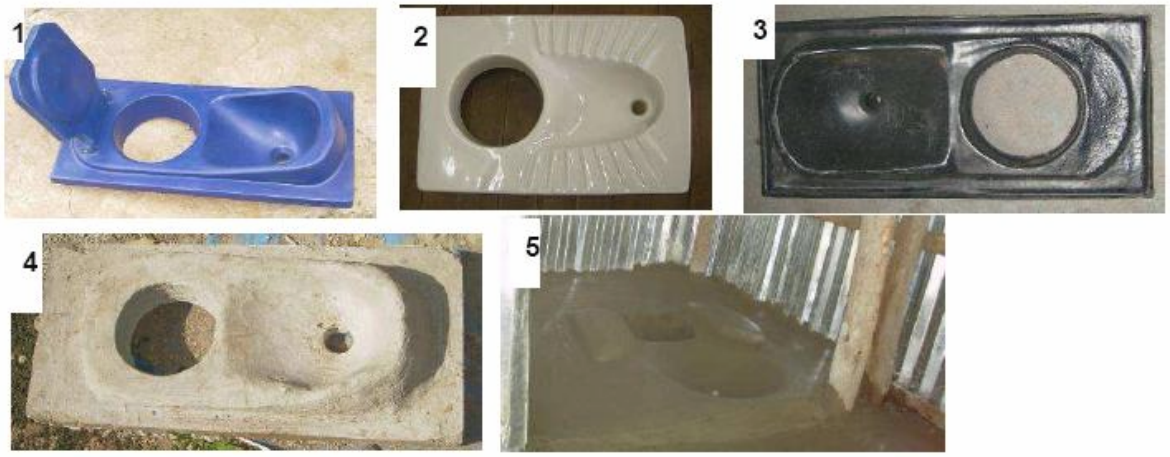

Figure 1: Locally produced squatting pans with urine-diversion.

A memorandum of Understanding (MoU) between the local ROSA project partners, i.e. Arba Minch University and Arba Minch Water Supply and Sewerage Enterprise, and the Arba Minch Town Municipality was prepared and signed before ROSA ended to ensure a proper handover. The SPA office will now be the resource centre of ROSA project works.

Types of toilets

Urine-diversion dry toilets

In UDDTs urine is separated from faeces. Urine is stored in a tank whereas the faeces are collected in a vault below the toilet interface. Two different types of UDDTs have been demonstrated: Single- and double-vault UDDTs. Different types of locally produced squatting pans have been installed. Currently there are five Ethiopian produced squatting pans with urine-diversion available (Figure 1): 1 = a fibreglass pan manufactured by Ethio-fibreglass Factory; 2 = a ceramic pan which is manufactured by Awassa Tabor Ceramic Factory; 3 =a plastic pan manufactured by AquaSan Manufacturing Ethiopia Plc; 4 = a reinforced concrete pan produced in ROSA project office compound; and 5 = a concrete pan cast on the toilet slab.

Two sizes of urine storage tanks have been used: 110 and 250 litre plastic barrels, respectively. In both cases when the urine gets filled a hose which is fixed at the bottom of the tanks is used to empty the urine from the tank to a jerry can put at lower position.

All the UDDTs have been constructed above ground. Four types of construction material were used for constructing the wall structure below the slab: 1) a hollow concrete wall, 2) a stone masonry wall, 3) a brick wall and 4) a mud wall. Figure 2 shows some of the UDDT structures constructed in Arba Minch showing the different types of construction materials used.

Besides households, 4 UDDT units have been constructed in schools. Table 1 shows the schools in which the UDDT units have been constructed, for use by either teachers or students. The construction of the UDDT units in the schools helped in disseminating the new technology in the town because the students spread the information. Their family members learn from the students about the advantages of the new type of toilet. Sanitation clubs were formed in these schools for taking care of the toilet units and sharing the lessons learnt with other institutions.

Figure 2: Some of the UDDTs constructed for single households.

Table 1 List of schools for which UDDT units have been constructed

Name of School	Users	Source of funding
Chamo Primary School	Teachers	100 % ROSA project
Nelson Mandela School	Students	25 % ROSA and 75 % School
Hibret Le Limat School	Students	25 % ROSA and 75 % School
Limat Primary School	Teachers	100 % School

Fossa alternas

A fossa alterna is a double pit compost toilet in which urine is not separated from faeces. Fossa alternas consist of two pits (depth of 1.5 - 1.8 m), two ring beams to protect the two pits (external and internal dimension 1.3 m times 1.3 m and 0.9 m times 0.9 m, respectively), a single concrete slab which sits on one of the ring beams, and the toilet house which provides privacy (Morgan, 2007). Figure 3 shows fossa alternas constructed in Arba Minch. In cases where digging pit is difficult Fossa alternas can be constructed above ground.

One pit is used first. During the first season the second pit remains empty. When the first pit is full, the toilet slab and structure are moved on to the second pit and top soil is placed over the contents of the first pit which is then left to compost. While the second pit is used the content of the first pit is composting. When the second pit is full, the first pit ideally contains mature compost. After emptying the first pit the toilet slab and structure are again moved to the first pit.

Arborloos

In Arborloos urine is also not separated from faeces. Soil and ash have to be added after every use. Arborloos consist of a pit (diameter 0.8 m; depth 1.2 m), a sheet metal or a half barrel to protect the pit, a concrete slab and a toilet house made of locally available materials (Morgan, 2007). Figure 4 shows a typical arborloo toilet house.

When the arborloo pit is full, the slab and the toilet house are moved to another pit and used in the same way again. A 0.4 m layer of soil is placed over the filled pit. A young tree is planted and utilizes the nutrient from the human excreta over time.

Operation and maintenance

In the following, the operation and maintenance (O&M) strategy developed for the three different toilet types implemented in Arba Minch is described.

For UDDTs, priority was given to the household/institution which utilizes urine and faeces in the compound or on their own fields. Urine and faeces which are not utilized are transported in light-weight donkey carts by solid waste collectors. In Arba Minch four micro and small enterprises (MSEs) are involved in collecting solid waste. The households/institutions pay for the solid waste collector services whereby the fee

Figure 4: Typical arborloo toilet house.

Figure 3: Fossa alternas constructed for single households.

Figure 5: Faeces are added for co-composting at the site of "Egnan New Mayet Compost Association".

for collecting human excreta is calculated in accordance with the fees for other domestic wastes. For the time being, one light-weight donkey cart is used for transporting urine and faeces.

Urine is stored in two places, one in the upper town (Secha) and the other in the lower town (Sikela), and is transported to organizations involved in urban agriculture, such as the state farm and other farms which are found inside and nearby the town. One has to pay for the urine to be used as liquid fertilizer. Faeces and some urine are transported to "Egnan New Mayet Compost Association" for co-composting (Figure 5). The compost association sells the final compost.

In fossa alternas the content of the filled pit can be emptied easily and applied in the compound of the household as compost. If there is no space for applying this compost in the household's compound it will be also collected by solid waste collectors. In this case the solid waste collectors buy the compost when awareness is raised among the community. After buying it, the solid waste collectors sell it to other persons who need compost. The feedback from the users indicates that using the compost in the own compound is the best option.

O&M of the arborloos is simple and can be carried out by the user. When the arborloo pit is full, the superstructure parts of the toilet are moved to another place, where a pit needs to be dug and used in the same way again. The household may only pay for a daily labourer to dig the new pit and move the slab and the shelter.

Focus group discussions among users of the different systems were organised to get the experiences from the users. These helped in identifying the problems encountered and the users learned from one another. Figure 6 shows users of fossa alternas who have participated in one of the group discussions.

Up-scaling activities

As described before, ROSA constructed pilot units to demonstrate technologies that can be part of resources-oriented sanitation systems. Members from three MSEs were given theoretical and practical training in the construction of arborloos, fossa alternas and UDDTs. The trained MSEs are now capable to construct these types of toilets and have built several units on their own.

To create awareness about resources-oriented sanitation applied research on the use of human urine as a fertilizer and faecal matter as soil conditioner was carried out. At the ROSA office compound and at Arba Minch University pilot trials were carried out. This helped to change the attitude of the community towards the use of sanitation products.

Following the construction of the demonstration units, the further toilets were built with shared costs only whereby the owners of the toilet had to contribute about 75 % of the total costs. Some households and institutions constructed the sanitation units by covering all costs. However, the absence of loans for households interested to construct a toilet has constrained efforts to further scale-up implementation.

Within the duration of the ROSA project, the Dutch funded SPA project began. The SPA (Sanitation for Peri-urban areas in Africa) project aims for further up-scale on-site sanitation based on a business

Figure 6: Participants of a focus group discussion for fossa alterna users.

Table 2: Stakeholders and their role and responsibilities in the SPA project

Stakeholder	Roles/responsibilities
Arba Minch Town Municipality	Leads SPA Project implementation
SPA project staff	Planning, appraisal and execution daily project activities, monitoring, evaluate and report activity and financial operations
Omo Micro Financing Institution (OMFI)	Accounting and operation of the credit services to the households and collection of repayment
Local MSEs	Construction, and operation and maintenance of sanitation units
WASTE Netherlands	Management and main execution of activities of the SPA project
Plan Netherlands	Funding

approach. SPA has duration from July 2009 until June 2014. The main objective of the SPA project is creating access to sustainable sanitation services for households in peri-urban areas. The role of the different partners/stakeholders in the SPA project in Arba Minch is shown in Table 2.

The total SPA project budget is about 1.25 million EUR whereby 55 % is a grant from the Netherlands, 37 % the contribution of OMFI and 8 % of the contribution of Arba Minch Town Municipality. The household's access to the sanitation loan finance is made through the provision of credit services by OMFI (Omo Micro Finanace Institution). The aim of SPA is to construct the following number of toilets during the project duration, i.e up to June 2014:

- 1000 UDDTs,
- 2200 fossa alternas, and
- 1000 arborloos.

The achievements of the ROSA project team in Arba Minch have been major driving factors for triggering the SPA project implementation. Based on the SSWP prepared in ROSA, the project team together with the Arba Minch Town Municipality and WASTE prepared the business plan required for the start-up of SPA. The ROSA project also trained members of MSEs on construction of UDDTs, fossa alternas and arborloos. These enterprises are the ones that are now involved in the implementation of the SPA project.

Before the ROSA project ended a Memorandum of Understanding (MoU) between the local ROSA project partners, i.e. Arba Minch University and Arba Minch Water Supply and Sewerage Enterprise, and the Arba Minch Town Municipality has been prepared and signed. The MoU has prepared the handing over between the ROSA and SPA project. In March 2010, the system descriptions, designs and bill of quantities of the pilot units were compiled and submitted to SPA project office. The documents were prepared in both Amharic and English. The SPA office will now be the resource centre of ROSA project works.

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overall project:
rosa
Resource-Oriented Sanitation concepts for peri-urban areas in Africa

Implementation of urine-diversion dry toilets in schools in Nakuru, Kenya

This paper describes the implementation of improved sanitation systems in two model schools in Nakuru, Kenya.

Authors: R. M. Gacheiya, B. M. Mutua

Abstract

Schools have been chosen as institutions for constructing ROSA pilot units. On the one hand, schools have been identified as good invention points for introducing sanitation systems. A huge number of persons can be reached as a big number of students are using the toilets in the school and further students bring the news about their new school sanitation system home to their families. On the other hand, there is a huge lack of sanitation facilities in schools and it has been reported that a lack of toilets disadvantage girls. In the case that the school has no toilets, girls do not attend during their menstruation periods resulting in a loss of weeks attending school and finally in less success in school. Against this background, this paper describes the implementation of improved and sustainable sanitation systems in two model schools in Kenya.

Introduction and background

Responsibility for sanitation provision in Kenya is currently at the Ministry of Public Health and Sanitation and the Ministry of Local Government. The latter is responsible for centralized systems while the Ministry of Public Health and Sanitation is in charge of on-site sanitation. Since the introduction of free primary education by the Kenyan government in 2003, national primary school enrolment has risen to about 7.3 million from 5.9 million pupils in 2002. In 2008, free secondary education was also introduced raising significantly enrolments in secondary schools. Despite government's initiative, expansion of physical infrastructure in schools has not been given much attention to match the increased number of students. Indeed school sanitation and hygiene have received the least attention in the allocations of free education monetary grants and other resources.

Within Nakuru the sanitation facilities found in the peri-urban areas are mainly pit latrines and cess pools/septic tanks (ROSA Nakuru, 2007). According to Kihumba (2007), the preferred method for a pit latrine is to abandon the old filled pit and moving to a new location within the plot. This situation is replicated in the learning institutions. It has been found that most schools in the peri-urban areas of Nakuru have a line of filled up and buried pit latrines. The schools lack space to construct any more pit latrines. Some pits have even collapsed leaving risky structures that pose eminent danger.

A brief overview of existing school sanitation systems in Nakuru

A study during which 120 students from 10 primary and secondary schools in and around Nakuru were interviewed was carried out by Gacheiya and Mutua (2009). At primary level the interviewed students were chosen from classes 7 and 8 while in the secondary schools, the students were from across the classes. The students were requested to provide basic background information about the status of the school sanitation facility. From this

Factors for successful implementation of UDDTs in schools

- Proper sensitization and awareness creation for students, teachers and the school management.
- Involvement of the students and the members of staff in the whole process from site selection, ground breaking, construction and commissioning.
- Hold informal discussions with the students for changing the attitude towards the systems and for developing proper mechanisms for operation well in advance.
- Clear responsibilities for operation and maintenance and availability of a caretaker.
- Organise scheduled feedback sessions with the students and teachers.

Figure 1: The Crater View Secondary School sanitation unit.

study it was deduced that 90 % of the interviewed students expressed dissatisfaction with the existent sanitation facilities and that the sanitation situation in their schools was deplorable and needed urgent attention.

Existing sanitation facilities

80 % of the sampled schools had pit latrines. 15 % had pit latrines and flush toilets while 5 % only had flush toilets. Most of the toilets, wholly or partially, had falling doors while others had no doors at all thus denying the students the privacy required. In the schools with pit latrines and flush toilets 90 % of the students preferred the pit latrines to the flush toilets. Reason behind this was that most of these schools lack adequate water supply hence the flush toilets are unhygienic. Toilets were not regularly cleaned, roofs were leaking and some had collapsing walls that posed risk to the students.

Number of toilets in comparison to the number of students

In one case a school with 800 students had only 8 toilets (4 for boys and 4 for girls), i.e. a ratio of toilets/students of 1:100. This is in contrast of the guidelines of by the Ministry of Public Health and Sanitation (2005) that requests a ratio of 1:25 for girls and 1:30 for boys, respectively. The lack of toilets results in students using a lot of time during their breaks for going to the toilet. As observed, most schools have only short breaks of 10 minutes which is basically insufficient for the students to relieve themselves. This may also explain the high incidences of improper use reported. 98 % of the students reported that they had to queue for at least 6 minutes. This is 60 % of the break time leaving the student with little time.

Hand washing facilities

Due to lack of hand washing facilities it is regrettable that 87 % of pupils/students do not wash their hands. On the other hand, from observation, 92 % of schools had no hand washing facilities put in place. The 8 % that had washing facilities, the facilities are a distance away from the toilets and most without running water thereby defeating the purpose of having the washing facility. 98 % of the students that wash their hands after using the toilet use plain water while only 2 % use soap.

Implementation of urine-diversion dry toilets in two model schools

Crater View Secondary School

"Crater View" is a two-stream mixed secondary school within the peri-urban areas of Nakuru municipality. The school has almost 400 students, with a ratio of boys to girls of almost 50:50. After carrying out a basic assessment between March and August 2008, it was found out that this school was in need of new improved sanitation facilities: The underground is characterised by a layer of rock just after 1 m depth. This inhibited the digging of pit latrines with a depth that would accommodate human waste for a considerable length of time. As a result the school have had shallow pit latrines (2 for ladies and 1 for boys with a poorly done urinal) that have been smelly and unhygienic, without any hand washing facility, attracted flies and were filling up quickly. Additionally, there was need to increase the school to three streams to accommodate the growing students' enrolments due to growing population.

The sanitation unit (Figure 1) constructed by ROSA in 2009 consists of eight single vaults UDDTs, 5 for girls and 3 for boys and a urinal with ten urinal bowls. Each vault holds three 50 litre containers for faecal matter. The girls section has 4 girl urinal chambers (Figure 2). The urine is collected and stored into a 2000 litre underground tank. Rainwater is collected for the hand washing facilities. More detailed information on technical

Figure 2: Urinals for girls

data can be obtained from the SuSanA fact sheet "*Pilot UDDTs and grey water treatment systems at Crater View Secondary School, Nakuru, Kenya*" that is available from http://www.susana.org.

Emptying of the faeces containers will be done once every three months during the school holidays. The containers with faeces are transported to a drying shade of 22 m² on the schools' ground where the faeces are further dried for a minimum of 6 months. As the school has a small farm for the school kitchen, the dried faeces will be used as soil conditioner for various crops. At the moment, the urine is already used to fertilize the tree plantation within the school; however, more experiments are planned.

The entire project is managed by the school after being handed over. As long as the ROSA project had been running (until March 2010) the ROSA team continued with back-stopping as and when need arises. To ensure sustainability, after mobilization and sensitization, the school nominated a care-taker who was actively involved during and after construction. The day to day cleaning of the toilet is done by an employee of the school who is paid a monthly salary of KES 4'500.

Egerton Primary School

Egerton Primary School is situated within Egerton University though it is a government funded school. The school has 900 students and 21 teachers. Within the school there has been a flush water system due to the water provision from the University. Despite this, it is notable that just as with other major institutions in the country, water is largely inadequate. Therefore the flush toilets are absolutely unhygienic and smelly despite the fact that the grounds man is cleaning them several times a day. The situation is even more worse when there are dry spells without adequate rainfall as well as power cuts (a normal occurrence in Kenya) at the University and the water supply system is interrupted.

In an effort to try and solve this challenge, the ROSA project together with Egerton University's Faculty of Engineering developed a UDDT facility for the school (Figure 3). This was made possible through a secured donation from the Clinton Foundation. The sanitation facility is for the upper class - 80 class eight students. The system is a 6 door UDDT with urinals for both girls and boys and in-built hand washing facility. A drying shed for the collected faeces is also provided.

The implementers organized several workshops with the teachers, students and with the school management board to create awareness. The final awareness and demonstration workshop was held during the official commissioning of the facility where the parents and also the District Education Quality Assurance Officer were present. During the construction process, informal small group discussions were held with the class eight pupils to train the basic principles of the UDDT. The students participated in small ways in the construction process such as ground breaking ceremony, digging of the foundation trenches and laying stones. By so doing, the students developed a sense of ownership and now look at the facility as their initiative that they are proud of. Further, the present grounds man was undertaken through a comprehensive training on the operation and maintenance of the facility. He prefers the UDDTs to the current system quoting the disgusting scenes of poorly used flush toilets that he has to contend with specifically wet faeces.

The school has agreed to a demonstration plot that will be under Egerton University where treated faecal matter will be used to grow crops and to carry out lab analysis. The Faculty of Engineering and the Department of Biological Sciences will carry out research and undertake analysis of the crops grown using the faecal matter and urine. The school on its part through the present grounds man will ensure proper use. The school has also appointed a student's representative who is in-charge of the UDDT facility as well as an in-charge teacher. It is agreed that the University through the Faculty will give any technical support that will be deemed necessary to ensure proper maintenance and operation to counter any unforeseen challenges.

Figure 3: UDDTs at Egerton Primary School.

Successes

- So far the students are happy with the piloted facilities as emerged in a survey done in the first weeks of March 2010.
- • More institutions interested in installing the UDDT systems. The Municipal Council of Nakuru has selected two schools (Kaptembwo and Kimathi primary schools, respectively) in which facilities or teachers have been constructed (completed in March 2010). Within Njoro District, Ndarugu primary school has benefited from donor money (from s::can company, Vienna, Austria) and is currently constructing a UDDT system for class eight pupils.
- Further institutions are putting financing structures in their school budgets for the construction of improved sanitation systems with emphasis on UDDTs.
- The Nakuru model where an upper class is trained to be the in-charge of the system to take the initiative of training new students is taking root and being adopted.

Challenges

- Financing the construction by interested institutions is a challenge due to the priorities and budgetary allocations within the schools.
- Some institutions that have been involved in piloting the systems are reluctant to take part in operation and maintenance activities but slowly this is being improved.
- Many schools still don't have a readily available grounds man/woman that could be the responsible person for cleaning and maintaining the sanitation facilities.
- Awareness creation and training for students has to be regularly as admission of new students is an ongoing process.

Recommendations

- It is recommended that providing adequate sanitation facilities shall become a priority issue in schools.
- There is an urgent need for the Ministry of Education and the Ministry of Public Health and Sanitation to work together to ensure a realistic sanitation and hygiene syllabus. The allocation of monetary resources to schools should reflect the need for adequate sanitation facilities to match the increased enrolments. These two Ministries need to deliberately increase monetary allocations for the provision of sanitation and hygiene both hardware and software with more emphasis on raising awareness.
- Increased collaborations between the learning institutions need to be encouraged. For schools in Nakuru the Engineering Department of Egerton University can be consulted on designs of improved sanitation facilities.
- Success will always be elusive unless and until those leading in the campaign understand and incorporate students in water and sanitation issues. There needs to be a pragmatic shift of focus to schools and students. Recognizably schools offer an important point of entry for raising the sanitation's profile of the current and future generations. The current pool of young men and women in learning institutions will be effective change agents for behavioural practices such as washing hands, using toilets and maintaining hygienic environments if they are properly integrated in the provision of improved sanitation.

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Urban agriculture as means to create demand for sanitation products

The paper illustrates how urban agriculture can be used as means to promote and create demand for resources-oriented sanitation concepts.

Authors: O.M. Tendwa, T.A. Kimaro

Abstract

Using urban agriculture for creating demand for sanitation products (i.e. liquid and solid fertilizer produced from urine and faeces) is a promising way for up-scaling resources-oriented sanitation systems. In this respect, a demonstration urine-diversion dry toilet (UDDT) has been constructed by ROSA at the Nanenane Exhibition Park (NEP) in Arusha. Additionally, demonstration fields have been set-up to show the benefits of using sanitation products as fertilizers. Nanenane exhibition is an annual event that takes place during the first 10 days of August with the main events on 8 August. This is where the name originates from: 'Nanenane' in Kiswahili means "8-8". The exhibition has been held every year since 1996. The main focus is the agricultural sector but there is fair participation of business institutions and entrepreneurs. ROSA took part in the exhibitions in 2008 and 2009, respectively. The exhibition of the UDDT and demonstration of the fertilizing effect of sanitation products resulted in increasing interest and adoption of the system. Institutions and individuals in Arusha and as far away as 500 to 700 km from Arusha requested for technical assistance to construct UDDTs with their money.

Introduction

Urban agriculture is a growing practice in Arusha Town. However, growing food for immediate family use is limited by soil fertility and space. People need to add fertilizer to increase crop yield. Generally, the price of fertilizer is unaffordable to the majority of the poor who depend on agriculture for their livelihood. Resources-oriented sanitation technologies such as UDDTs can provide an alternative source for fertilizer from human urine and faeces. Results from a survey indicated not only low awareness on the fact that UDDTs exit but also a wrong perception on the use of urine for plant growth. Therefore the objectives have been 1) to create awareness on UDDTs in general and 2) to promote the use of UDDT products (liquid and solid fertilizer) in agriculture as fertilizer.

The demonstration facilities

As Nanenane is the farmers' exhibition, the agricultural department of Arusha Municipal Council has established an exhibition centre within the park. The centre covers about 200 m², part of it being a demonstration garden (150 m²). The UDDT constructed (Figure 1) is a double vault UDDT. The size of each vault is 1 m^3. The UDDT constructed by ROSA (Figure 1) is a double vault UDDT. The size of each vault is 1 m^3. For this UDDT, concrete blocks were used for sub- and superstructure. A locally available ceramic squatting pan was used for the toiltet interface. A demonstration garden was set-

Figure 1: Front view of the Nanenane UDDT: 20 litres urine tank adjacent to the door.

Key findings

- Urban agriculture can be used as means to create demand for liquid and solid fertilizer produced from toilets
- Cropping trails showing the fertilizing effect of sanitation products can convince farmers to use them as well
- To have a demonstration site at a agricultural exhibition has been proven to be very effective to reach a great number of people

Figure 2: Nanenane demonstration garden with crop fertilized by urine.

up at the exhibition site (Figure 2). More detailed information on technical data and costs of the system can be obtained from the SuSanA fact sheet "*UDDT for Nanenane Exhibition Park, Arusha, Tanzania*" that is available from http://www.susana.org.

The toilet is used by four to six people during day time and one person (security guide) at night. It is estimated that will take 3-5 years for one vault to get full whereas the urine tank (20 litres) has to be emptied every three to four weeks. During exhibition time the emptying of the the urine tank is done every 1-2 days. Urine is used in the demonstration gardens, especially as fertilizer for the banana trees. Faeces are not used to date since the vaults are not full. They are planned to be used in the same demonstrations garden to show the visitors the beneficial impact of faeces as fertilizer. This is another advantage of having the toilet at NEP as it provides a real life model which helps to sell the concept of resources-oriented sanitation.

Experiences during Nanenane exhibition

About 180 visitors daily visited the demonstration UDDT during the 2008 exhibition and more than 200 in 2009. Practical sessions on the proper use of UDDT were conducted with the visitors. Leaflets and brochures on ROSA general ideas and resources-oriented sanitation technologies were distributed (Figure 3). Face to face interviews were carried out using pre-tested questionnaires. People were asked whether they have ever used human urine as manure. 75 % out of 80 persons interviewed said, that human urine was harmful as it kills plants thus indicating that people do not know or followed the guidelines of urine application.

Farmers after seeing the results from using urine as fertilizer said:

> "*If urine contains essential element required by plants and if it is safe to apply in agriculture then train us on how to store and use it. It will help save money which we would otherwise use to buy fertilizers. Why should they buy fertilizers while urine is freely available*".

It is clear from the above statement that farmers are ready to use human excreta as fertilizer. What is lacking is additional education and practical training. This was also stated by agricultural extension officers.

Results from fertilizing experiments

Fertilizing experiments have been also carried out at the ROSA office demonstration garden (Figure 4). Crops grown at the ROSA office site are vegetables, banana, maize and trees. Urine is mixed with water 1:1 before applying to plants. The impact of urine as fertilizer could be easily observed by the appearance and the growth rate of the crops. Table 1 shows findings recorded from two different plots: Plot 1 was planted in dry season on August 2009 while Plot 2 was planted in

Figure 3: Stakeholders visited ROSA exhibition during Nanenane: distributing information brochures (left), demonstration of the UDDT (middle), and interaction session (right).

September 2009. Results show clearly the effect of nutrients on plant growth. Maize fertilized by urine and urea grows higher compared to non-fertilized maize. No difference could be found between maize fertilized with urine and urea since the amount of nitrogen applied was the same.

The effectiveness of urine as fertilizer could be demonstrated to farmers. When the farmers visited ROSA office and saw the maize grown using urine, for several farmers here was no more discussion on whether or not to use urine. They decided to build UDDTs in their premises (Iyulu and Tendwa, 2010). This shows that if more demonstration would be done the number of farmers that use urine as fertilizer is likely to increase.

Figure 4: ROSA office demonstration garden with urine-fertilized and non fertilized maize.

Lessons learnt

- The ROSA demonstration unit has become one of the most attractive sites of the Nanenane Exhibition Park. Many people could be interested in the UDDT technology and some have asked for technical advice and more information. The acceptability of the UDDTs to visitors of the exhibition seems to be get higher every year.
- Although urban residents seem to be very much interested in UDDTs, they are not ready to construct them in their town residents, but rather would like to implement the technology in their home villages.
- Trainings on the use of UDDTs are a vital tool to ensure the proper use of UDDTs. However, although people were trained to use them properly, there was still some that misused the toilet just few minutes after the training.
- The exhibition made exposure to institutions outside of Arusha possible. So far the ROSA team has been involved in the construction of UDDTs in Monduli District at Makuyuni village and in the Mswakini Juu area in collaboration with AWF (African Wildlife Foundation). AWF covered all the costs and ROSA provided technical skills.

Table 1 Average height (in cm) of fertilized and non fertilized maize after 7 weeks of growth

Fertilizer	Plot 1	Plot 2
Urine	112.3	87.8
Urea	113.7	88.1
No fertilizer	79.2	56.9

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Resource-Oriented Sanitation concepts for peri-urban areas in Africa

The importance of operation and maintenance – Lessons learnt from the ROSA project

This paper provides information on the importance of operation and maintenance for the sustainability of sanitation systems.

Authors: E. Müllegger, E. Freiberger

Abstract

Operation and maintenance (O&M) is the key for the sustainability of sanitation projects. Therefore, O&M of resources-oriented sanitation systems was one of the main research topics in the four ROSA pilot cities. The research focussed on the acceptance of urine-diverting dry toilets (UDDTs), the financial implications as well as the introduction of services chains, which include the collection, transport and treatment of UDDT products and its use in agriculture. Monitoring of the implemented pilot units took place to obtain more information of the O&M on household level and of the involvement of the private sector.

Introduction

In practise, operation and maintenance (O&M) of sanitation systems receives less attention compared to the design and construction or is sometimes even completely neglected. Especially in developing countries, O&M of decentralised sanitation systems is discounted to a great extend. Neglected O&M and non-functioning systems have consequences towards such as damage of the environment and compromising people's health.

Common operating problems for UDDTs have been the blockage of the urine pipes, the overflow of the urine tanks, and misuse by visitors and/or men, and odour if no ash was used are available on O&M of solid waste (e.g. Ahluwalia and Nema, 2006) as well as on water and sanitation service and urban services (e.g. Sohail et al., 2001). However, there is lack of adequate information on O&M requirements and data on costs for different resources-oriented sanitation systems regarding collection, transport, treatment and utilization of the sanitized products (Bräustetter, 2007). Furthermore, there is no evidence of community based approaches of O&M being rolled out in a city (Sohail et al., 2001). Therefore one of the main research fields addressed within the ROSA project was the development of O&M strategies for the implemented resources-oriented sanitation systems.

Why is operation and maintenance important?

The answer to this question seems to be very simple: Without a well designed O&M strategy the constructed infrastructure will sooner or later break down. But the identification of the reasons behind provide a wide range of answers and range from deficiency of training and awareness raising, a lack of skilled labour, high operating costs, excessive repair and replacement expenses, etc. Additionally, the technical options chosen are not always the best suited to the environment in which it shall be operated. Other reasons are closely related to donor financed projects, which often aim on construction of hardware, because it is

Key messages

- Generally, the implemented resources-orientated sanitation solutions are accepted and are working well.
- Private households prefer service providers and are willing to pay for the service.
- Institutions like schools have high interest in UDDTs and the use of the products in school gardens. A committed school administration and care-take is the key to success.
- The private sector shows interest in offering O&M services when it is profitable
- Common operating problems for UDDTs have been the blockage of the urine pipes, the overflow of the urine tanks, and misuse by visitors and/or men, and odour if no ash was used.

simpler and less time consuming. They end after a certain period, leaving behind constructed infrastructure, but rarely a strategy for O&M of the systems.
It is therefore obligatory that effective and efficient O&M of sanitation systems has to be seen in a holistic conceptual framework. The best way is to consider O&M already during the planning stage and not when it becomes apparent. Tasks and responsibilities have to be made abundantly clear and divided among the actors/stakeholders e.g. between the municipality, community based organisations (CBOs), users and the private sector.

What is operation and maintenance?

O&M refers to all activities needed to operate, maintain and manage a sanitation system, including the collection, transport, treatment and reuse and/or final disposal of the different sanitation products.

According to Sohail et al. (2001), operation refers to the daily activities of running and handling infrastructure that involves the major operations required to use the service and correct handling of the facilities by users to ensure the long life of the service.

Maintenance on the other hand involves the activities required to sustain existing assets in a serviceable condition (WHO, 2000) and includes preventive, corrective and crisis maintenance (Brikké, 2000). Basic maintenance activities consist of the inspection of the technical and operational function.

An effective and efficient O&M requires a clear organization and financial management with explicit responsibilities. Neglecting that can easily lead to dramatic results such as closing down of public toilets or the deterioration of treatment plants. Proper management of O&M needs further a budget to carry out the necessary tasks. However, municipality budgets often do not specify funds for O&M of sanitation systems (IRC, 1997). Funds are rather spent on activities which are more visible than on ones which are not recognised immediately. Thus it is recommended to allocate a separate budget for routine O&M including funds which allow major replacements, upgrading and extensions. This budget should to a large extend be generated from the users of unicipal infrastructure services.

O&M in practise – research results

Materials and methods

In all four ROSA pilot cities research on O&M has been performed using similar methods including baseline studies, a two-day workshop on O&M research focusing on methods and research question and hypothesis development, and conducting on-site research using (semi-)structured interviews, focus group discussions, telephone and internet surveys.

According to the local situation, the focus of research varied but the thematic priorities were on UDDTs and the development of service chains, i.e. transportation, treatment and use of faeces/urine, by including the private sector. Additionally, financial implications and the acceptance of reuse–oriented sanitation systems were investigated.

The implemented systems have been monitored over the last few months of the project duration and operation, maintenance and monitoring reports have been drawn. These reports provide information on O&M in practice including successes and problems.

Development of service chains

Closing the loop on household / institutional level

Based on the HCES approach (Household centred environmental sanitation; EAWAG, 2005), resources-oriented sanitation focuses on the point of origin. That implies ideally stakeholders who are willing to use human excreta on-site, agricultural activities and users who are positive about the impact.

In Arba Minch 50 % of the urine from UDDTs is used as fertiliser in the owners' gardens, also faecal compost production started in a school and a few households. In Kitgum 114 users of UDDTs have been interviewed. All responded that urine is directed to soak pits, no use at all and less than half of the users make use of composted human excreta, the majority is employing somebody to empty the faults. In Nakuru the situation for private UDDTs is similar: households have very little interest to use urine/faeces and are willing to pay a service provider. For school facilities the picture is different. At Crater View Secondary School and Egerton Primary School for instance, faeces are transported to a drying shade, further treated (Figure 1) and used in the school gardens. The collected urine is then used for flowers and

Figure 1: Drying shade for faeces from UDDTs at Crater View Secondary School, Nakuru.

Figure 2: Grounds man at Egerton Primary School, responsible for O&M of the UDDTs.

tree fertilisation. However, to ensure sustainability, a committed care-taker (Figure 2) took over O&M responsibilities. The care-taker shall ideally already be actively involved during planning and construction. In both mentioned institution the sanitation systems are working to everyone's satisfaction.

Involvement of the private sector

Sanitation systems where UDDT products can be treated and reused on-site are the easiest possibility for a closed-loop system. But in many cases, like in densely populated areas, storage and reuse on site is not possible so collection and transportation systems have to be implemented.

Kenyan and Ethiopian ROSA teams were mainly focusing on the involvement of the private sector as O&M service providers. In Nakuru the ROSA team figured out that 86% (out of 215) are interested to use an UDDT if they are not responsible for O&M. This figure has been confirmed later on as further results showed that owners of UDDTs preferred to use a private operator and were willing to pay for the service. The established service providers, on the other hand, are willing to take up this task as a business. MEWAREMA, a local CBO engaged in solid waste collection and composting, is willing to offer services for collection, transportation and composting of faeces and urine in a fee ranging from 100 - 300 KES (100 KES = ca. 1 EUR), depending on the amount and distance. Also other solid waste collection service providers are interested to get involved. Nevertheless, one of the biggest challenges is the development of a market for faecal compost. Still more awareness creation and marketing is required to raise demand.

In Arba Minch solid waste collectors are engaged in transporting human faeces and urine (using donkey carts, Figure 3) whereas youth groups are active co-composting human excreta. The main problem is transportation of urine because of the big amounts produced. The compost shall be used by local farmers, thus demonstration plots were installed to convince farmers on the advantages of using compost as a fertiliser. At the beginning the compost was given to them for free. The latest success in the project was that could already be sold, which is a clear sign that compost is appreciated by the farmers.

Financial considerations

In Arusha the transportation costs of UDDT products using different means of transport were analyzed. The costs for the urine transport were determined to be 0.018 - 0.021 EUR per household and km when a septic emptier truck is used. The precondition is that the truck is filled on the trip, which means that the urine produced by 300 to 700 households within 2 weeks has to be collected on one trip. The collection with push carts or pickups is more expensive (0.25 - 0.31 EUR per

Figure 3: Donkey cart for faeces and urine transportation in Arba Minch

household and km). The transportation costs of faeces for one household using a single vault UDDT have been estimated to be about between 0.015 EUR per month.

The average monthly costs for the O&M of one household have been calculated to be between 1.2 and 2.2 EUR. This includes urine emptying, transportation of urine and faeces, soap for mopping as well as the cleaning of the toilets. More than 70 % of the people have indicated that they are willing to pay for this service. Private operators, who are currently carrying out sludge emptying and solid waste collection in the city, are interested in transporting the sanitation products within and outside the municipality. Their pre-condition is that a sufficient number of UDDTs exists, so that they can make profit, which is currently not the case.

In Arba Minch urine from UDDTs is collected in 20 litre jerry cans. About 50 % of households make use of solid waste collectors. The users are paying between 0.3 - 2.0 EUR, depending on the amount of urine produced and distance to composting site. Compost producers use urine and dried faeces for compost production and sell the compost.

Use of human excreta in agriculture

To introduce a sustainable sanitation system, awareness creation and marketing is needed to motivate service providers to collect and transport of the sanitation products, on the one hand, and the farmers to use them for fertilising their crops, on the other hand. The demand shall convince private businesses that provide collection and transportation services that these services can be profitable. Private companies showed interest in providing this service; however, regulations and policies for the transport of faeces and urine are unclear and still have to be developed.

In Arusha and in Arba Minch the gardens in front of the ROSA offices were used to demonstrate the impact of using sanitation products to fertilise various crops. In Arba Minch additionally four organised groups of farmers have been involved in crop trials. The farmers received the co-compost and urine for free to show the positive effect of the use in agriculture and therefore to create a demand for these products. In the first month of 2010, 5'400 kg of compost has been sold for 0.01 EUR/kg for a market centre.

In Arusha, Arba Minch and Kitgum greywater towers (Figure 4) were introduced on a household level to allow the safe use of greywater for

Figure 4: Greywater tower planted with spinach and onions in Arba Minch.

irrigation of crops even when space for agriculture is limited.

In Nakuru the local CBOs involved in composting are organised under an umbrella organisation called NAWACOM. NAWACOM buys the compost from local producers, further processes the raw compost, pack it and sell “Mazingira organic fertilizer” to farmers. The organization has agreed to buy also faecal compost. Trials to increase the nitrogen content by adding urine during the composting process are on-going at Egerton University.

In Kitgum composting was started in nine household accompanied by workshops and sensitization. Until the end of the project the number of households carrying out composting has risen to 120.

Monitoring the use of toilets

The implemented pilot toilets were monitored during the last period of the project duration. Except of Arba Minch, where also the use of Fossa alterna was monitored, the main focus was on the use and acceptance of UDDTs. The main findings can be summaries as follows:

- *Acceptance and problems*: The toilets were generally well accepted in all project areas. The users appreciate the absence of odour and flies when the toilets are well operated and managed. Main problems for users were the blocking of urine pipes with pieces of paper or charcoal and the absence of anal washing draining line in some users house UDDT. In some cases the filled faeces container was too heavy to be carried by one person or ash and hand washing water was missing. Also in some cases

misuse by visitors was reported like men urinating into the faeces whole.

- *Design:* Kitgum reported that the UDDT design where the toilet has to be entered by using stairs is a big problem for children, sick or old people. Therefore toilets at ground level with underground faecal chambers were introduced (Figure 5).
- *Cultural implications:* In case of Arusha municipality it was found out that cultural aspects didn't affect the introduction of UDDTs. The people have to face a big sanitation problem within many parts of the municipality so cultural issues seem to be of minor importance. However, in Kitgum cultural aspects influenced the acceptance of UDDTs since the Luo culture doesn't allow to put ash on the faeces.
- In Arba Minch more than 30 Fossa alterna toilets have been constructed by ROSA. These toilets are popular because transport of urine is not required.

Conclusions

- Generally, the resources-orientated sanitation solutions were accepted and are working well. In each ROSA pilot city toilets were built on private initiative which can be seen as proof of acceptance of the implemented technologies within the population.
- Common problems with UDDTs include the blockage of the urine pipes, the overflow of the urine tanks, misuse by visitors or men, who urinate into the faecal hole and smell if no ash was used.
- On household level in urban areas it was observed that there is in most cases no space for use of the faecal matter, also urine is normally just soaked away. This shows that there is a clear need for O&M of the toilets. The owners of the toilets are in most cases willing to pay for the service of collection and transport of faecal matter and urine.
- The private sector in the four ROSA pilot cities showed interest in the sanitation business. A big problem of starting the business is the amount of toilets needed in order to make the business profitable.
- It is important to note that availability of the market and demand for the product is likely to motivate the service provider to be very efficient in collection and treatment of human excreta due to the monetary gains involved.

Figure 5: UDDT toilet with underground faecal chambers in Kitgum.

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Strategic Planning for Sanitation – A practical experience from the ROSA project

The article describes and evaluates the approach of establishing Strategic Sanitation and Waste Plans (SSWPs) in the four ROSA pilot cities in order to initiate a process of integration of strategic infrastructure planning in the towns' agendas.

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Abstract

The development of Strategic Sanitation and Waste Plans (SSWPs) for the four pilot cities was one of the main objectives of ROSA. Through this planning process, main pre-conditions and difficulties for strategic planning in the pilot cities were identified. The paper shows, why the chosen approach for strategic sanitation and waste planning in the ROSA project has appeared as instructive. ROSA initiated a strategic planning process and laid the ground for further developments. It was intended, that municipalities are taking over the responsibility to institutionalise the process as such. If this is not happening, the SSWPs developed in ROSA will remain a project document only and will not favour an integrated strategic planning process considering all relevant needs of such. So far, the respective municipal bodies of Arba Minch and Nakuru integrated the strategic plan in their agendas.

The approach of strategic planning in ROSA

The objective of this part of the ROSA project was to develop a generally applicable and adaptable framework for the development of participatory Strategic Sanitation and Waste Plans (SSWPs). These locally designed plans should get incorporated in future decisions of the municipalities for improvements regarding their urban sanitation infrastructure. The development of the SSWPs has been based on existing general guidelines for strategic sanitation and waste planning, such as Household Centred Environmental Sanitation (HCES; EAWAG, 2005) and Strategic Sanitation Planning (Tayler et al. 2003). These general guidelines have been used to set up more specific guidelines for the development of the SSWPs.

A lot of experience exists within organisations working in the field of sanitation and waste management in developing countries. However, up to now only few general applicable frameworks for the development of a SSWP including all key stakeholders, taking into account the different local needs, have been applied. Based on the

The main pre-conditions and challenges for strategic planning are:

- Municipalities should initiate and incorporate strategic planning as a tool.
- The needs of the civil society must be key for any strategic planning.
- Politicians are neither in a position to lead the analysis nor to plan strategies. Rather, interdisciplinary teams of engineers, researchers and social scientist with a participatory approach and strategic planning expertise can do so.

Lessons learnt and recommendations from ROSA:

- Integration of the principles of strategic planning is needed in the entire system of education, legislation and regulation.
- Theoretical knowledge about planning in general and practical knowledge on strategic planning is lacking, particular in the ROSA pilot cities.
- Qualitative planning education and experiences need to exist in form of experts who then need to get responsibly involved in a strategic planning process aside technicians and social scientists.

experiences in developing the SSWPs for the ROSA pilot cities recommendations for practical implementation of a sanitation planning process should be drawn.

The strategic planning process

Tayler et al. (2003) define principles of a strategic sanitation planning approach.

1. First of all: strategic planning is a process. This process shall be demand driven and consider a whole city. Roles of stakeholders as well as various sanitation options shall be divided according to different responsibilities and areas of a city.
2. A strategic plan is a written document which defines a certain demand, goals and a strategy. A "strategy" is defined here as a group of activities that contribute to specific targets. According to Tayler et al. (2003) a "strategic plan" is a flexible document. Based on experiences, modifications of planned actions might be needed.
3. Strategic planning approaches shall be based on existing services and framing conditions. It is a process of rather incremental advancement than on implementing ample projects. To prepare a strategic plan is a starting point to develop and document sets of activities as parts of a strategy towards the overall goal. Therefore, the strategic planning process requires time and bravery to evaluate the aims, activities and knowledge available from time to time and modify where necessary.

Also Breckner et al. (2005) proposes to use a certain framework, similar to the one of Tayler et al. (2003), for urban planning projects of infrastructure as well as environmental and social urban planning tasks.

The step-wise approach to strategic planning developed for the ROSA pilot cities is visualised in Figure 1 and should contain the following:

- The strategic planning process starts with the problem definition (step 1) which includes the supporting and restricting boundary conditions. After evaluating the boundary conditions the demand for improved living conditions has to be examined.
- Overall goals that shall be reached are defined. Sub-goals shall allow a step-wise achievement of the overall goals. It does not make sense to set unrealistic goals. Rather, realistic and practical small steps to the goals make sense which can get implemented within an existing system. Afterwards, research questions are developed and an analysis of existing situation is conducted (steps 2-4). The research objectives need to be reviewed and revised from time to time according to changing conditions and insights.
- Based on the results from the previous steps the planning team generates options and concepts to reach the goals. These concepts need to consider restrictions of time, legislative, financial and also human resources. The decision on the implementation of solutions must be made by the group of stakeholders, planners and other involved persons who are responsible or important for the integration of a strategy in a city (steps 5-6).

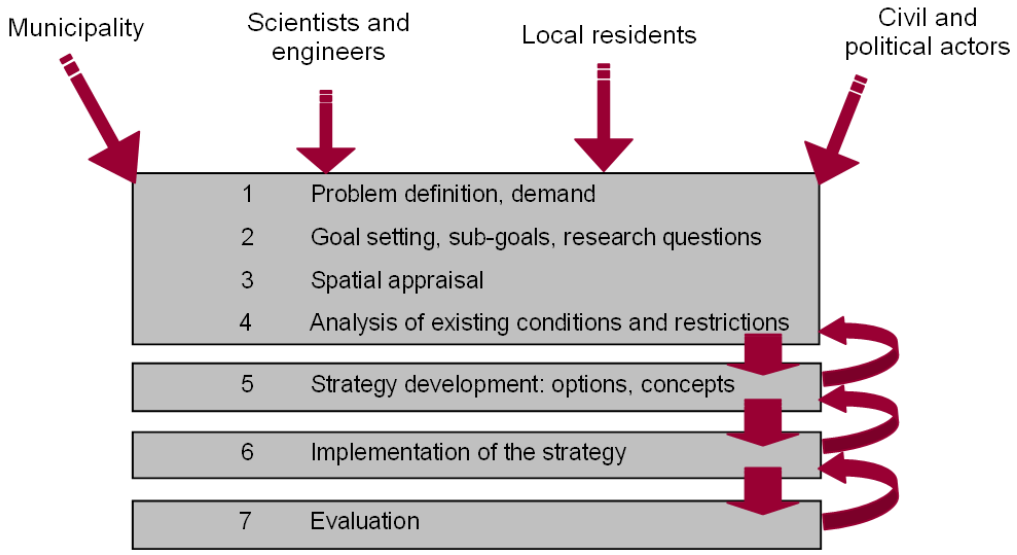

Figure 1: The single steps of and the feedback loops in a strategic planning process.

- An evaluation of the content as well as the whole process should be done after the first tasks of the strategy were implemented (step 7), e.g. about one year after the planning process shifted towards a rather implementation-oriented process. Such evaluation would best be conducted by somebody who was not directly involved in the strategic planning process but has experience and knowledge about the content, the area and interdisciplinary project management. If necessary, the evaluation results will lead to 1) the inclusion of missing or neglected aspects and/or 2) an adaptation of the implementation strategy.

For the realisation of a strategy it is important to integrate all necessary stakeholders, e.g. as civil and political actors (like union or association leaders, spokespersons of civil groups and relevant contact points) in central positions in the strategic planning process from the beginning. The integration shall provide the stakeholders with the possibility to have influence on the progress and the decisions of the strategic planning process (e.g. Healy, 2006; Rothman et al., 2009). Important findings should be discussed during the problem analysis with the determined stakeholders to get a detailed view on the different civil and spatial areas. This helps in developing realistic aims and assures the project team that necessary knowledge for the strategic planning process exists. Such process is not only linear, but also contains feedback loops for re-thinking analysis results, developed strategies and decisions critically among all who are part of this planning team (Breckner et al., 2005).

Strategic Sanitation and Waste Planning in ROSA

Main content of the SSWPs

The aim of the development of the SSWPs was to establish an overall and long-term framework for the improvement and implementation of sustainable sanitation and waste management in the four ROSA pilot cities. The relevant data for developing the SSWPs have been collected by using results of an initial city assessment, based on observation walks, interviews, mappings, stakeholder meetings and literature reviews. The main content of the SSWP documents are:

- Description of the existing sanitary conditions including problems with open defecation, collapsing pit latrines, shallow pits due to high water table and rocky terrain, flying toilets, lack of de-sludging facilities, lack of space for construction of new pits, poor solid waste management, etc.
- Future objectives including the elimination of open defecation and flying toilets, improvement of the construction and maintenance of sanitary facilities, establishing sanitary disposal systems in municipalities and town councils where there is none, the construction of improved resources-oriented sanitation systems, etc.
- Proposals for achieving the objectives focusing on capacity building and awareness creation, training of trainers, holding workshops, seminars and demonstrations to train local communities on the importance of safe hygiene and improved sanitation, and training of masons in the construction of toilets.
- Creation of demand for liquid and solid fertilizer from sanitation facilities by establishing pilot trials.
- Identification of stakeholders and their roles in improving of sanitation including the municipalities, water supply companies, households, CBOs, private entrepreneurs, farmers, micro and small enterprises (MSEs) and local government offices such as the agricultural and health offices.
- The development of operation and maintenance strategies to ensure sustainability of the sanitation interventions according to the local conditions.
- Time frames for the different implementation steps.

In Nakuru and Arba Minch the SSWPs have been adopted by the municipalities and converted into official documents. The Municipal Council of Nakuru developed a "*Strategic environmental sanitation plan*" under the umbrella of the Nakuru Environmental Consortium in 2009 that was based on the ROSA SSWP. In Arba Minch the SSWP has been incorporated in the business plan that was required for the start-up of SPA programme (see Ayele Shewa et al., 2010). However, development of the SSWPs in Arusha and Kitgum was rather seen as fulfilment of a deliverable for the project only. Incorporation of strategic planning into the municipalities could not be achieved.

Lessons learnt from the ROSA SSWPs

The decision makers and stakeholders in the municipalities were inadequately involved in the SSWP development process. This is one of the major challenges in the institutionalization of the SSWPs as active participation is needed for the success of the process. This was noticed by the fact

that stakeholders were only integrated in this process in Arba Minch and Nakuru, not in all four cities. However, in all cities the stakeholder meetings had no character of community planning workshops. Rather stakeholders got informed about municipal future plans that would affect the community. There was no possibility of active decision-making on the same level of power among stakeholders, ROSA staff and municipal leaders.

Politics plays an important role in decision making in municipalities. This factor has not been thoroughly examined to bring out the pros and cons of the impact of politics on implementation of sanitation projects and programmes. During ROSA, not all relevant politicians for a strategic planning process were involved from the beginning. Partly, the responsible persons changed during the project duration and thus new arrangements and relations needed to get strengthened.

However, the limitation in this is that some ROSA SSWPs are not such binding documents that ensure the carrying out of these activities. The SSWPs have been handled more as a project deliverable and not as a strategic tool for the municipalities. The exceptions are Arba Minch and Nakuru where the SSWPs have been used as basis for developing municipality-owned plans.

Also, an in-depth breakdown is needed for the different chosen areas for improvement of sanitation since different areas require site-specific solutions to their sanitation problems. Within the ROSA project, the spatial appraisal and the analysis of existing sanitation, social and environmental characteristics were too broad to come to site-specific strategies.

Recommendations

General recommendations for strategic planning

A strategic planning process shall remain within the municipality:

A project is by definition a temporary organisation. On the other hand, the strategic planning process is characterised by its continuous nature, although a number of specific activities will and should have the character of a project (e.g. various assessments, detailed design activities, etc.). For this reason the strategic planning process as such should not be outsourced but remain within the permanent organisation which is the municipality. Very likely a strategic planning process, if implemented within the frame of a project, will not be incorporated into the permanent structure of the municipalities and therefore not be sustained beyond the project period. It is recommended to clearly separate those activities with a permanent character which should be implemented by the municipality from activities with a temporary nature which may need the support of an external, temporary project organisation.

A successful implementation depends on demand expression by the municipality:

Understanding that a strategic planning process as such will be the responsibility of the permanent organisation, i.e. the municipalities, leads to the conclusion that a successful implementation strongly depends on the expression of the need for such a process from within the municipalities. Strategic planning has to be understood as a valuable tool for urban development. If a demand is not expressed by the permanent organisation (e.g. municipality) the planning process may not be incorporated into the regular agenda of the municipalities.

Strategic planning covers all relevant aspects of municipal development:

Strategic planning is necessarily not limited to a single aspect of municipal development like sanitation. For this reason strategic planning has to cover all relevant aspects of municipal development and consider the interrelationships among these various aspects. The internal division of responsibilities may be an obstacle for this process and can be overcome by the establishment of an interdepartmental strategic planning working group.

Municipalities have to initiate a strategic planning process:

In summary, the initiative for strategic planning has to come from the municipalities and the municipality has to take lead. A necessary precondition is adequate understanding of the principles and benefits of strategic planning. Therefore a strategic planning process will only be implemented successfully if Key personnel at municipalities

1. understands the purpose of the process,
2. knows an appropriate methodology for implementation,
3. takes the initiative for its implementation, and
4. has the required resources within the organisation or sufficient resources for outsourcing of temporary activities.

Specific recommendations for the planning process – How to do strategic planning?

- **A strategy must build on local specific frame conditions:** Development of a strategy is core of a strategic planning process to reach the specific goals. This strategy must be considering local restrictions according to time limitations and/or budget and human resources. It is then result and part of a strategic planning process which measures are evaluated and adapted within the timeframe of its realisation.
- **Goals are reached by defining a number of steps:** Goals must be structured in main and sub-goals. Sub-goals should be realistic and practical small steps to the goals and should be achievable within an existing system.
- **Working steps need a regular review:**Reviews of work steps need to be integrated in the strategic planning process. Different views on the content and the emotional parts (e.g. decision making) should be discussed and evaluated to get a more or less "real" picture on the situation.
- **Plans need to be adapted in the light of changing circumstances:** Restricting conditions (e.g. knowledge, budgets) have to be considered realistically. Otherwise, no realistic and implemental realisation of the strategy and its actions is possible.
- **The role of key persons for strategic planning shall be institutionalised in municipalities:** The role of experts in strategic planning should be institutionalised in the municipality. This allows that these experts can support various departments in carrying out their planning processes.
- **Stakeholders must be integrated in all important steps:**As mentioned before all necessary stakeholders need to be actively integrated in all important steps of the planning procedure, also in terms of responsibilities and decision making. That can produce acceptance and an easy integration in the districts of a city.
- **Each planning setting and process is different: Therefore, the existence and planning of relevant resources in terms of knowledge, political power, methodological certainty, technical understanding and cognition of the social-urban space is base for the team carrying out the strategic planning process.**

Conclusions

The approach in ROSA for strategic sanitation and waste planning has appeared to be instructive. The project has partly initiated a strategic planning process in the different ROSA pilot cities which in the best case laid the ground for further development. But as long as all the municipalities are not taking over the responsibility to institutionalise the process as such, the SSWPs developed in ROSA will remain a project document only and will not favour an integrated strategic planning process considering all relevant needs of such.

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overall project:

Summary of the main findings and main achievements of ROSA

The paper summarises the main findings and main achievements of ROSA and gives an outlook on future activities

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Abstract

During the last 3.5 years (1.10.2006 - 31.3.2010) the ROSA project promoted resources-oriented sanitation concepts as a route to sustainable sanitation. To make it a success the project team aimed at the start of ROSA that the following points should be reached at the end of the project: 1) people like the systems implemented and use it, 2) the systems continue to run after project funding ends and 3) the work ROSA started continues in the involved pilot cities. In general, the achievement of these goals would reflect that the sanitation systems have been implemented in a sustainable way. In this paper the main findings and main achievements of ROSA that have not been presented in the previous contributions are summarised and an outlook on future activities is given.

Towards large-scale implementation

A crucial part of the work in ROSA was that the consortium explored possibilities for further financing the implementation of the whole Strategic Sanitation and Waste Plan (SSWP) developed. ROSA has been successful to launch large-scale implementation projects that are funded through the Dutch SPA programme (Sanitation for Peri-urban areas in Africa) in two cities, Arba Minch and Nakuru. For Arusha the Dutch ISSUE-2 programme (Integrated Support for Sustainable Urban Environment, phase 2) is continuing the work and the Arusha Municipal Council has allocated money to continue with the ROSA office activities for at least 12 months after the project ended. The ISSUE-2 programme is also going on in Nakuru parallel to the SPA programme. For Kitgum, due to internal problems in and non-activity of the Town Council, activities regarding continuation of ROSA have not been succesful.

ISSUE-2 started in 2007 and lasts until the end of 2010. It is a Netherlands Government (DGIS) funded subsidy program. In ISSUE-2 local sustainable finance takes centre stage. A Waste Venture scheme was set up between the implementers (private investors in sanitation construction and/or operation and maintenance) and a commercial bank. A modest donor-supplied guarantee is supposed to entice the banks to regard poor communities, households, and entrepreneurs as "bankable propositions", while applying usual lending conditions. In Nakuru, the Waste Ventures scheme with Family Bank was quite successful. ISSUE-2 supported landlords that wanted to install toilets after the ROSA pilot units have created the demand. About 20 toilets have

Main achievements of ROSA

- Pilots are in operation, people like them and are using them in all pilot cities.
- Private persons as well as organisation got interested and built toilets with their own resources (ROSA provided technical support only)
- Awareness regarding the need of operation and maintenance was created in all pilot cities.
- Large-scale implementation of on-site sanitation was launched in Arba Minch and Nakuru.
- Arusha Municipal Council allocated money for continuation of ROSA office activities for 12 more months after the end of ROSA.
- ASKNet, the African Sanitation Knowledge Network, was launched at the AfricaSan+5 conference in February 2008 in Durban, South Africa.
- ROSA could significantly contribute to the work of SuSanA, the Sustainable Sanitation Alliance (http://www.susana.org)

been constructed on initiative of the landlords until the end of ROSA. In Arusha some pilot toilets have been constructed in cooperation with ISSUE-2. The CRDB Bank is involved in the Tanzanian Waste Venture scheme under the leadership of the Arusha Municipal Council.

SPA is a programme for further up-scaling of on-site sanitation that started in 2009. One of the basic conditions is that the municipal institutions have to take lead. SPA has a strong focus on a business approach which is assumed to be required to reach numbers of installations that really matter in the peri-urban context. In Arba Minch SPA started in July 2009 (see also Ayela Shewa et al., 2010). In Nakuru the whole process of starting up the project was delayed by the Post-Election-Violence in early 2008 and by Kenyan macro-politics. Finally, toward the end of ROSA the Municipal Council of Nakuru took the lead, though the business focus has shifted towards direct relationships between private actors, households, and the finance institutions, with the municipality only providing 'light guidance'. Besides the ROSA pilot cities Arba Minch and Nakuru, SPA is also active in Parakou in Benin, Kabwe in Zambia, and Blantyre in Malawi.

The experience has shown that the shift of mindset from the old "input based" traditional donor project to a "business mode" is challenging. Nevertheless the results show that the introduction of a more business approach to sanitation implementation is possible and a promising way towards large-scale implementation of sanitation.

Main research results regarding reuse and greywater research

The main findings of the research on the WHO Guidelines for a safe use of wastewater and excreta in agriculture and aquaculture (WHO, 2006) and on greywater can be summarized as follows:

WHO guideline research:

- In Arusha the effluents of the existing waste stabilization ponds (WSPs) were used for uncontrolled irrigation.
- Increased inflow beyond the design capacity of the WSP resulted in final effluent faecal coliforms and helminth eggs concentrations that exceeded standards set by the WHO guidelines.
- The surveys conducted at all ROSA pilot cities further indicated considerable post-harvest contamination.
- Taking the multiple barrier approach advocated by the WHO in consideration the improvement of market hygiene is strongly recommended.

Greywater research:

- Not surprisingly, there was a huge variability in quantities and quality of greywater produced by the households sampled.
- The faecal coliform concentrations in greywater were very high thus indicating a considerable contamination of greywater by human faeces.

Dissemination of knowledge

A strong focus in the ROSA work was on disseminating the results and experiences gained in the project. The main activities and results in this respect are summarised below.

The ROSA website http://rosa.boku.ac.at

The ROSA website has been online since ROSA started. From the public area a number of resource material produced by ROSA can be downloaded, e.g. posters and flyers produced for awareness raising campaigns in the pilot cities, leaflets with more specific content such as descriptions how to use a UDDT or how to use urine as a fertiliser, papers presented at conferences, etc. This resource material is also made available via the SuSanA homepage.

ASKNet - the African Sanitation Knowledge Network

ROSA was co-initiator of the African Sanitation Knowledge Network (ASKNet, http://www.asknet-office.net/), a network aimed to strengthen African universities. ASKNet is a joint initiative of ROSA together with SEI (EcoSanRes2 programme), UNESCO-IHE and WASTE (ISSUE-2 programme). ASKNet was officially launched at the AfricaSan+5 conference in Durban, South Africa, in February

Figure 1: ASKNet logo.

2008. 2 member meetings have been organised so far, from 10-13 December 2008 in Vilanculos, Mozambique, and from 13-14 November 2009 in Nakuru, Kenya.

SuSanA - the Sustainable Sanitation Alliance

The Sustainable Sanitation Alliance (SuSanA, http://www.susana.org) is a loose network of organisations working along the same lines and be active in the promotion of sustainable sanitation systems. ROSA partners have been actively involved in SuSanA by leading the working group on "Operation and maintenance of sustainable sanitation", translating the SuSanA vision document in Amharic and Kiswahili languages, and sharing information with SuSanA, e.g. the descriptions of the pilots implemented in ROSA have been published as SuSanA case studies and the resource material.

Presentation and publication of ROSA results at conferences

ROSA research results have been presented at various conferences. The main event for ROSA in this respect was the 34th WEDC conference that was held in Addis Ababa in May 2009. The African ROSA partners presented 12 papers which have been published in the proceedings and are available from the ROSA website. Additionally, a joint ASKNet/ROSA side event was organised at the 34th WEDC conference.

Lessons learnt from project design and implementation

The lessons learnt from project design and implementation have been drawn from an internal project evaluation (carried out in September/October 2009) and can be summarized as follows:

- Not enough time and resources have been foreseen for "family building" at the start of the project. However, to allocate more time to get to know each other is difficult as these kind of projects are normally very limited in time which is needed for the "actual work" in the project.
- Some of the problems that have been arising in Uganda and Tanzania have been caused from the distance between the country partners. Work generally has more smooth in the pilot cites where the partners where the partners were close, i.e. in Arba Minch and Nakuru.
- It was not very surprising that problems with massive bureaucracy in the municipalities occurred, especially in procurement and processing financial requests to run routine ROSA activities.
- Regular communication between the African partners has not been as strong as anticipated, e.g. for exchanging findings during the research process. Unfortunately the information exchange between the African partners actually only happened during personal meetings at the ROSA consortium meetings every 6 months.
- Some of the problems in some pilot cities at the beginning of the project have been caused due to the fact that staffs left on short notice. Amended working contracts ensured that there is a guaranteed handing over phase between leaving and incoming staffs.

Main achievements

The main achievents of the ROSA project can be summarized as follows:

- In all pilot cities the pilot installations constructed by ROSA are in operation; people like them and using them. This was one of the main objectives the project consortium set for it self to reach at the beginning of the project.
- Due to the ROSA demonstration units demand for toilets was created. Private persons as well as organisation got interested and built toilets with their own resources for which the ROSA teams provided technical support only.
- Awareness regarding the need of operation and maintenance was created in all pilot cities (see also Müllegger and Freiberger, 2010). This is of utmost importance for a sustainable implementation of sanitation systems.
- The SPA programme for large-scale implementation of on-site sanitation was launched in Arba Minch and Nakuru, whereas the ISSUE-2 could be brought to Arusha and Nakuru.
- Arusha Municipal Council, on its own activity, allocated money for continuation of ROSA office activities for 12 more months after the end of ROSA.
- ASKNet, the African Sanitation Knowledge Network, was co-founded by ROSA and launched at the AfricaSan+5 conference in February 2008 in Durban, South Africa.
- ROSA could significantly contribute to the work of SuSanA, the Sustainable Sanitation Alliance, by leading working groups, translating documents and sharing results by making them available via the SuSanA homepage for download.

Outlook

A consortium including key partners ROSA and from the FP6 "sister" project NETSSAF (http://www.netssaf.net/) successfully applied for a follow-up project that builds on the findings and experiences from both ROSA and NETSSAF. The CLARA project (Capacity-Linked water supply and sanitation improvement for Africa's peri-urban and Rural Areas) will be funded by the EU 7th Framework Programme, Programme "Environment". The overall objectives of CLARA are:

- to strengthen local capacities to adopt, implement and operate integrated water supply and sanitation for small communities in rural areas and peri-urban areas, and
- to contribute to the achievement of the UN Millennium Development Goals and to climate change adaptation in the African water sector.

Figure 2: CLARA logo

CLARA's specific objectives are:

- to assess and adapt existing low cost technologies for integrated decentralized water supply and sanitation systems for African conditions with the focus on reducing risks in water use and reuse of sanitation products.
- to improve the capability of water supply and sanitation systems to provide demand oriented water quality for reuse as well as products from sanitation,
- to develop a simplified planning tool for integrated water supply and sanitation systems for small communities and peri-urban areas that incorporates the key factors for success, i.e. operation and maintenance issues as well as reuse potential, and can be tailored to available local capacities, and
- to test and evaluate the simplified planning tool in different geographical regions in Africa to incorporate different economic, cultural and social boundary conditions.

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Notes

Next issues:

Issue 5, October 2010: **"Sanitation as a Business"**
Contributions due to 1st August 2010

Issue 6, January 2011: **"Toilets"**
Contributions due to 1st November 2010

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