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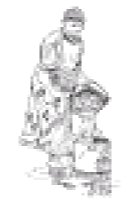

Eco- Sanitation Solution in Peri-urban areas Dar Es Salaam

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Introduction

As urban growth continues in the city of Dar Es Salaam and its unplanned settlements, governments have not been able to meet the demand for piped water and sewage services. Sewage treatment is particularly costly, so the installation of treatment systems often lags behind the need, especially in rapidly growing areas.

Sustainability is forging a new paradigm to change the way that people manage the world's resources. The same basic processes are causing a rethink in all areas of natural resource management. (Esrey, S.A, 2001).

The approach set out below looks at the purpose of a project to provide a low-cost, zero water use, sustainable system that could be used in areas lacking sewage infrastructure. From the resident's point of view, the key determinants of a successful sanitation system are that it produces no smell or flies. A system has been found that achieves this goal at the Majumbasita pilot area. The project involved the private sector and institutions, all have been engaged in the project implementation and sharing the outputs result for replication under the Unicef fund.

There has always been an interest in the reuse of human waste as a fertilizer, and there has been much recent work on the development of composting and other processes to permit human waste reuse. This paper examines the practice of ecological sanitation (EcoSan) with reuse in Majumbasita Tanzania, with a particular focus on health issues and the lessons to be learned from pilot study and experience.

Methods

Public acceptance of reuse projects is vital to the overall future of wastewater reuse and the consequences of poor public perception could jeopardize future wastewater reuse projects (Asano and Levine, 1996). The selection of ecological sanitation technology was accompanied in advance by a detailed examination of the self-sufficiency and technological capacity of the community. The project was comprised of three components implemented simultaneously (training, construction and laboratory works). Due to the fact that the ecological sanitation concept was introduced for the first time as one of the best and safest solution to the areas like Majumbasita with piped water shortage, high water table and so on, it appeared to meet most of the requirements of the area and community priorities, being manageable by local community.

The hygiene education and sanitation, which involved the introduction of PHAST (Participatory Hygiene and Sanitation Transformation) methodology, to stressed the intended benefits of adopting and using EcoSan with accompanying changes in hygienic behaviour towards ecological sanitation. The community lacked awareness links between health, hygiene, sanitation and water. The cultural pattern and perceptions on the EcoSan technology were explored through this method. The project conducted surveys and analyses of urine and faeces quality produced from the EcoSan units to determine the Physical-chemical parameters of fertilizers. A total of twenty-eight ecological sanitation toilets with urine diversion design were sampled. It mounted to a multifaceted IEC (Information, Education and Communication) campaign and pictures helped to mobilized community awareness and action by creating two PHAST committees and training 21 change agents CORPs (Community Owned Resource Person) in participatory development approaches. The training also backed the Majumbasita 12 masons and the construction of ecological sanitation toilets in households and schools. The project supported the installation of sanitary facilities at the school compound, helped households to construct the base chamber of EcoSan and roofing.

To determine the number of households to be installed with Ecosan technology, the PHAST committee receives requests on a weekly basis from neighbours interested in installing an ecological dry toilet. Their reasons are diverse: sometimes it is due to the lack of potable water services; presence of high water table, privacy, aesthetics and status. However it is particularly relevant that they also receive requests from those who do have such systems and want to change their W.C s or pit latrines for a dry system. These requests although still limited, demonstrate a growing interest for these alternatives, which far from being an option for people lacking in services, represent a viable option to contributing towards the viable technology for peri-urban areas.

Results

The project improved sanitation services through EcoSan and changed ideas on sanitation and hygiene. One hundred per cent of envisaged EcoSan toilets were constructed, 96 during the project period and now the total number 110 units which are in operation and many more are under construction without the subsidy from the organization, utilizing fully the community masons trained during the project implementation. An important accomplishment of the pilot has been the greater awareness that has been generated regarding sanitation-related environmental and health issues. Training workshops given by EEPCO (Environmental Engineering and Pollution Control Organization) provide PHAST CORPs with methodological tools to increase their impact, so that the community in the area may support the improvements with sustained behaviour change needed for improved health. A thorough understanding (awareness) of ecological sanitation, proper use of latrines and hygienic consideration together with the project sustainability once the donor funding is phased out, was created by involving the UDSM (University of Dar Es Salaam), and line ministries; that is, Ministry of Health, Agriculture, and Water. The experience gained when conducting the awareness creation showed that, when people see for themselves how a well-managed ecological sanitation system works, most of their reservations disappear (Chaggu and John, 2002). Community groups analyze the relationship between water scarcity, pollution and conventional sanitation approaches. As a result, the replication of technology continued beyond the pilot project (EEPCO Final Report, 2002).

The CORPS involved in this project easily grasp the importance of safely recycling human wastes and families have been quite open to experimenting with urine as a fertilizer. Replication of the technology in school and households level is also underway as demanded in other regions with support from the government and UNICEF. In a related effort, EEPCO installed Ecosan in 5 households and a school double-vaulted urine-diverting toilets at the Hai District in Kilimanjaro Region (located in the northern part of the country). However, no follow-up research has been done on these systems.

Potential for reuse of human excreta and Health aspects of excreta reuse

Recovery of human wastes nutrients and reuse in agriculture has been practiced widely, In China, 0.3 million tonnes of nightsoil are produced daily and collected by more than 200 million people; in most cases the night soil is transported out of the city for use as fertilizer in land-based agriculture or fish production Bo *et al.*, (1993), other countries are Mexico, Sweden, Ethiopia, Uganda-Kabale, Kenya- Kisumu, Mozambique, South Africa and in Tanzania – Majumbasita and Hai. Habits and attitudes were explored through a hygiene survey that observed actual behaviour on the whole issues pertaining to the recycling of urine and sanitized faeces nutrients as fertilizer. The laboratory results (figure 1 below) show the potential of the by-product of defecation (faeces and urine) as the fertilizer. In order to grow plants that supply our food, fertilizers such as nitrogen, phosphorus, potassium and about 25 other additional elements have to be supplied (Wolgast 1993). However, nutrients are removed from fields with the harvested crops. In sustainable agriculture therefore, the same amounts of nutrients that are removed from a field should be returned to it (Jonsson, 1997) Dry sanitation incorporating human waste reuse has been applied based on Double-vault urine-diverting toilets which store fecal waste for a period of time under conditions that promote inactivation of fecal pathogens. The treated sanitized-faeces are then removed and disposed of, for gardening, agricultural purposes. Such an option has an intuitive appeal, as it appears to satisfy both objectives of human health and environmental protection.

The need of fertilizers in Tanzania is well known since the fertilizer factory in the country has been closed during the eighties. Presenting to the Member of Parliament the financial budget for year 2003/4 the Minister of Finance, Honorable Mramba, declared that the coming budget has allocated the subsidy fund for importation of fertilizers for only four priority regions out of 25 to feed the entire nation.

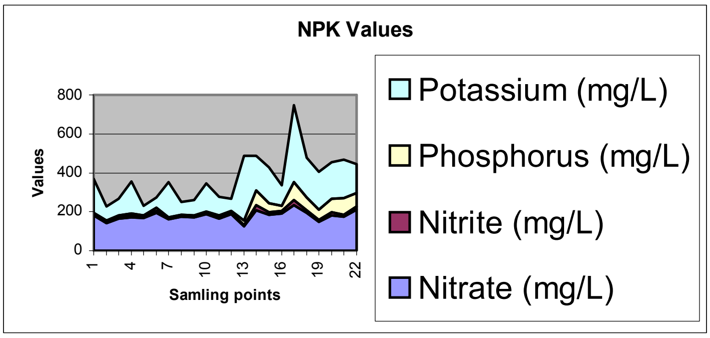

Figure: 1 NPK Values

NPK Values in Urine: The mean concentrations for the physical-chemical parameters of urine from the sampled households showed that the urine sample contains high proportion of amount of nutrients as compared to most chemical fertilizers found in the market in Tanzania. The EEPCO recent survey showed that 46.6% of households are using urine properly as a fertilizer in their garden, trees or farm.

As a result of this project, studies researching the effectiveness and safety of these systems have been initiated. In 2000 UNICEF provided funds to EEPCO to conduct research on the plant products grown by human urine as fertilizer, construct of more Ecosan toilets and to train the local community on hygienic behaviour change. The training was focused on project implementation and skills development as well as health and hygiene education related training. In conducting the research on health aspects of Ecosan toilet, a total of 28 Ecosan toilets have been sampled at a variable interval of two weeks monitoring the urine concentration/ quality. Only 20-80 No/100ml of faecal contamination has been found in four samples. This was due to accidental mixing of anal cleansing water contributed by the Ecosan pan mould, which was then rectified for good performance. The presence of faecal coliforms was assumed to die with a storage time of three weeks. However the storage of urine for six months in Sweden has been found to be enough to eradicate bacteria, viruses and helminths. Time for removal of faecal coli at ambient tropical temperatures like that of Majumbasita will be shorter. Faecal material is also hygienized by storing in compost for six months, (Rahman and Drangert, 2001) Monitoring and analyses are still ongoing, and special attention is being paid to examining the rates at which pathogens die-off, as a result of treatment. However, as part of the research, urine is now applied directly to the garden. There was no standard scientific measure that was applied to determine the taste of harvested products from urine-fertilized crops. People ate the produces grown by urine and according to them application of human excreta to crops does not have a negative impact on the smell or taste of the produces. Comparison made by them could not differentiate the smell or taste of urine fed produce from produce from control gardens.

Apart from urine application sanitized faeces as been utilized as fertilizer at the household level with precaution not to take the matter while it is fresh. As it takes longer to fill one chamber and shift to another and takes time for complete sanitization of waste, it is not applied as frequently as the urine.

There is clearly a potential risk from the existing pit latrines in the project area due to the presence of high ground water table Chaggu *et al*., (1993), More than 80% of the city residents are using pit-latrines which have a pollution load to groundwater in kg/day of BOD5 - 15,282; COD - 16,131; Suspended solids - 6,116; Dissolved Solids - 97,857; Total-N - 4,829 and Total-P - 915 (Haskoning and M-Konsult, 1989). They furthermore said that, about 50% of the pollution produced at domestic level per capita per day, was estimated to be received by pit-latrines, and 33% of the original COD remains in the water that infiltrates to groundwater (GW). Moreover, intermittent supply and scarcity of water has forced the government to drill more than 472 boreholes from 1997-2001 with a maximum total capacity of 120 m 3 /h (Mato, 2002) to meet the demand of the rapid expanding city. 85% of Majumbasita population relies on groundwater supply as their sole water source. From 1975 to 1997, the pace of borehole drilling remained very low except for shallow wells in areas without piped water connections. Today, there are more than 850 boreholes supplying water for drinking and industrial purposes. More than 35 boreholes are connected to the main distribution system of the city (Mato, 2002). It is therefore very important that groundwater is not contaminated and hence, good excreta disposal technologies and concepts are necessary.

Constraints

Barriers to change exist in all countries, societies, communities and organizations. The nature of such barriers have been highlighted and clarified by the challenges posed by the implementation of urine separation EcoSan toilets in Majumbasita. Some of the barriers relate to their religions, taboos and cultural foundation. Many people feel that they are breaking their inherited rituals by using Ecosan toilets. However, this should often be seen as a question of awareness, influence and relates as much to institutions, households and individuals. Sanitation is to a large extent social phenomenon, rather than a technical one according to Wegelin-Schuringa (2001) and therefore, the project has taken into consideration the background information on cultural, social, economic and environmental factors influencing sanitation behaviour before the implementation of an action plan.

Cost of Ecosan toilet.

The householders always bare the cost of building a toilet. Having a toilet in Majumbasita is compulsory but the standards and specification were not set for people to comply with. The cost of Ecosan toilet varies according to the type of materials used, but for Majumbasita due to the fact that the water table is high most of the toilets have to be raised up above the ground. Aspects that made it easier for people to accept Ecosan include: no sub surface digging needed, consumes little space, comfortable and can be constructed with local materials as see in the table 1 below.

Table 1: Majumbasita Toilets, Cost Comparison.

Type of Toilet	Substructure materials	Superstructure	Roofing	Urine tank 60 lts	Ventilation Pipe 100 mm	[1]Estimated Costs (USD)
Eco-san (Urine Diversion Toilet Double vaults)	Blocks 150mm	Blocks 150mm	[2]CIS	1	2	200
	Blocks 150mm	Palm leaves (Thatch)	CIS	1	2	120
	Blocks 150mm	CIS	CIS	1	2	140
	Burnt brick	Burnt brick	CIS	1	2	110
[3]Traditional latrine	Lined Blocks 100 mm	Blocks 150mm	CIS	-	1	82
	Lined Blocks 100 mm	Palm leaves, logs (Thatch)	None	-	-	65
VIP	Blocks 150mm	Blocks 150mm	CIS	-	1	250-300
SanPlat	Blocks 150mm	Blocks 100mm	CIS	-	1	185
	Blocks 150mm	[4]Timber & thatch	CIS	-	-	97

Source: Chaggu and John (2002) with authors' improvements

[1] Inclusive - community contribution, the costs varies due to types of superstructure materials used and economic status of Majumbasita
[2] CIS = Corrugated Iron Sheets
[3] When full, emptying costs per trip are 25-30 USD and high frequency of emptying during rainy season
[4] Frequent change of material which adds to cost

Conclusions

The ecological sanitation toilets in Majumbasita have shown to be an effective solution at the moment, especially in areas with high water table and waterlogging. As a result of this project, the communities are becoming self-sustaining for faecal resources within their settlement; Ecosan toilets are being built and properly used. New householders have become interested and are requesting and obtaining information from project communities and building toilets without intervention from EEPCO. In Majumbasita, after initial, partial construction subsidies were terminated, newly participating families now contribute full construction and maintenance costs.

Good community participation was also achieved from planning to implementation, with the community at household level contributing to the construction of the toilet (superstructure), operation and maintenance that involves both genders and so on.

The wide application of Ecosan toilets would lead into the protection of Majumbasita groundwater, which is utilized by more than 85% (John, 2001). Farmers and gardeners would require less amount of expensive chemical fertilizer because ecological sanitation systems enable farmers to make use of the high nitrogen-phosphorus-potassium content of human urine. This will reduce soil deterioration and improve the quality of crops and also save the amount of water required for about 35%. These are the reasons for adoption of the technology in the area. However, further research work is necessary in order to determine the suitability of the resources to be reused in agriculture.

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