Ecological Sanitation in the Lake Zone: Awareness Creation and Action

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Abstract
The paper expresses the concern on the haphazard over flowing sewage within the unplanned settlements of the lacustrine communities of Lake Victoria basin and its impact on human health and Lake Biodiversity. The paper reviews the present sanitation methods and opens its weakness/failure in the light of persistent poverty and population density within the area. The ecological sanitation principle is given as the viable option. Participatory Hygiene And Sanitation Transformation (PHAST) approach is pointed out as an effective method of dealing with the community in creating awareness. The PHAST is linked to field – based testing techniques, which can be analyzed at local level. It is anticipated that by involving the community ecological sanitation can gain popularity and acceptance. Finally the paper provides the South African experience on PHAST linked with water testing techniques and cost involved.

Keywords: Ecological Sanitation, Community involvement, PHAST approach, Water Quality, Human excreta, re-use.

Introduction

In many developing countries the provision of safe tap water to town residents is usually below the demand for water. As a result springs , rivers ,lakes ,dams and shallow wells usually serve as alternative sources of drinking water. Sewerage systems are also inadequate and therefore pit latrines and septic tanks remain the dominant sanitation systems. Drangert, (1998) writes that most countries are facing sanitary problems especially in the expanding cities in the Southern Hemisphere. Several studies have also reported that more than 90% of all sewage in developing countries is discharged into the environment completely untreated (WHO, 1997)

The Lake Victoria basin is one of the areas where the environment has continued to deteriorate. The basin supports the population of about 30 million peoplemaking it one of the most densely populated areas in East Africa. Majority of people within riparian communities are poor. Some of their strategies to cope with poverty in the light of inadequate enforcement of environmental laws and regulations have resulted in improper use of resources and environmentally unsound social practices. Poor sanitation is cited as a big environmental problem in the lake basin.
Mwanza city was taken as a case study to determine the extent to which poor sanitation has weakened the carrying capacity of the lake basin'ssupporting ecosystems. The study showed strategies that can help in reducing sanitation problem and hence arrest the environmental degradation in the lake basin.

Mwanza city, located on the Southern shore of Lake Victoria in North West Tanzania is one of the rapid expanding towns in the Lake basin. The city is part of Mwanza region, which comprises seven districts; Ukerewe, Magu, Kwimba, Misungwi, Sengerema, Geita and Mwanza itself. Mwanza City is the second largest city in Tanzania and the largest industrial and commercial center in the northwest Tanzania.

Due to expansion of fishing activities and being well integrated with the national and international communication networks, Mwanza expands faster than the other regional towns of Musoma and Bukoba. Currently there is a big influx of people from rural areas to Mwanza City, and the sanitation problem is alarming.

Methodology

Focus Group Discussion, Observation and Secondary data have been used in this study. Both qualitative and Quantitative analysis have been applied to describe the situation and ecological sanitation in the study area.

Results

Population and Settlement

Available data show slow expansion of population from 1940s to early 1970s, and rapid expansion from late 1970s to date.

Table 1. The trend of population increase from 1948 to 1998 in Mwanza Municipality

YEAR	1948	1958	1968	1978	1988	1998
POPULATION	13,300	19,900	21,495	197,670	223,013	419,000

Source: Ngallaba (1999) pg. 134

Regarding settlements, the city covers an area of 425 km^2 dry land, of which 86.8 km^2 (20.4%) is urbanized. Out of 86.8 km^2 urbanized area 32.6 km^2 is used for residential purposes. According to Mwanza Master Plan 1994, 6.9 km^2 (29%) is occupied by unplanned settlement and this hosts more than 74% of the total population of Mwanza City (Land use inventory, 1994). The unplanned residential area includes steep hills, stony shores and wetland portions around the city centre. There has been no enforcement of laws and regulations, which would govern the establishment of residential houses in the hills and wetlands.

Unplanned land do not come under the jurisdiction of the City Management Authorities. (DANIDA, 1998)

Sanitation Condition

Most of these settlements have little or no access to public utilities such as the central sewerage system or solid waste collection points. It is estimated that about 58% of the total population of the city use pit latrines, 30% use soak pit and septic tanks while 12% are connected to central sewerage system. In unplanned settlement the situation is different. 83% use pits latrine 3% use septic tanks and 14% do not have toilets at all. (Mwanza Squatter Settlement Situations Report, 1994).

Most of these pit latrines have medium depth of less than one metre due to the rocky nature of the area or high ground water table. Therefore most of the latrines are constructed in such a way that their sewage discharges into the lake, either through storm

water drains or via natural springs and rivers. During the heavy rains the pit latrine overflow flushing the faecal waste directly into the lake. In addition the residents deliberately pull out the stoppers from their toilets and discharge them into the lake.

Water Quality

A water quality assessment conducted in selected villages of rural Mwanza as a component of the Water Care and Rural Health Training Project (WCRHTP) gave shocking results as follows: of 44 drinking water sources tested, more than 90% were found contaminated with faecal bacteria. More importantly, more than 60% of well-protected shallow wells with pumps were also contaminated. These results were according to the Patho Screen test .

The water care and Rural Health Training Project was aimed at reducing the incidence of water related diseases in the rural areas around Mwanza through education and stimulating action. The project was conducted by TAHEA in partnership with local institutions and Canadian Community Colleges.

In addition water samples taken at Capri Point, the intake of the City's piped water system shows that the faecal coliform count at times reaches as high as 820/100 ml This is according to International Council for Local Environmental Initiatives (ICLEL ,1997a).

There is inadequate provision of tap water. The piped water supplies 32,715 m^3 of water daily, which is only 32% of the total requirement. The estimated requirement of water for 450,000 people is 102, 334m^3 daily. Therefore 78% of water requirement is obtained from springs, rivers, dams, shallow wells and the lake. It was observed that many people especially in the squatter settlement consider well-water as clean and safe for drinking owing to sand filtration process under the ground. Therefore no further treatment is done before drinking. People seem to have little knowledge about possible contamination routes including infiltration of faecal effluents.

Impact of Poor Sanitation on people's health

Table 2 shows the trend of diseases related to poor sanitation in Mwanza City. The figures are presumably lower than the actual number of cases due to inadequacies in the recording system and the low propensity to report to hospitals. One can say that most of the diseases affecting the majority of the city residents are caused by polluted drinking water, poor sanitation and poor housing facilities.

Table 2: Trend of diseases related to poor sanitation in Mwanza City

Disease	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Schistosomiasis	60,160	45,034	1,316	2,456	2,943	3,720	4,109	3365	3074	3,518
Worms	1,703	790	4,417	3,777	8,032	7,921	7,212	6,743	7,911	6,744
Meningitis	4,303	3,339	16	199	147	129	132	112	97	88
Typhoid	572	167	-	-	925	1,799		939	967	4234
Diarrhoea	5	-	4,683	18,192	18,848	1,907	2,127	2.544	23,216	29,996
Skin diseases	8,731	7,856	692	5,114	6,130	6,731	523	347	281	161
Cholera	1,905	2,000	35	40	13	266	32	2,342	0	0

Source: Mwanza District Public Health Department and Bugando Medical Centre-Community Health Department (2001).

Impact on Lake Victoria resources

The pollution on the lake is alarming. Rocky shores which are breeding sites of fish species are constantly being degraded by untreated effluents. Wetlands which are potential filters, trapping sediments, nutrients and pathogenic bacteria are constantly threatened. Through out the city, smaller seasonal wetlands in urban areas have virtually disappeared, while riverine wetlands are constantly under threat of being turned into residential areas.

Over-enrichment of the lake have resulted in rapid growth of algae and water weeds such as water hyacinth, thus creating high Biological Oxygen Demand (BOD) at the lake shores where the waste water is being discharged. This has contributed to the observed loss of fish species. Presently over 300 out of 500 known species in the Lake have disappeared. (CBEM, 1998).

Discussion

The traditional sanitation system proves to fail in the face of massive population growth, persistent poverty and gaps in knowledge leading to environmentally unsound social practices. The high latrine density in crowded settlements (squatters) is detrimental to surface and ground water quality .The faecal contamination observed in sealed shallow wells might be caused by infiltration of faecal effluents, which intercept ground water pathways leading to the wells. Investing in sewerage system would be wise if resources were available to meet the cost of treating the resulting effluents. The excreta is usually flushed down the same pipe as industrial and domestic wastewater with lots of chemical contaminants. This makes it more expensive to treat.

Given the meagre resources , investing in sewerage system without ensuring funds for treatment, will inevitably result in spreading of raw sewage in the environment. Safe disposing sewage sludge has become an issue even in developed countries. In Britain for example, as Debora Mackenzie(1998) writes, farmers were allowed to put raw sewage on their land as long as users follow voluntary guidelines based on European Union requirements. These prohibit the spreading of sludge on fields were fruits or vegetables are already growing, and say farmers must wait three weeks before harvesting fodder or letting animals graze on sludge land and ten months before harvesting crops that touch the soil and are “normally eaten raw”.

This is no longer the case in Britain. As Alec Kyriakides (1997) writes,
"Using raw sewage sludge to fertilize food crops is simply not accepted any more"
There is little proof that Escherichia Coli 0157, a bacteria strain survive in animal manure in fields for months. Also that, ploughing raw sewage into soil may actually help pathogens to survive by keeping them in dark, damp conditions. (This week 14 June 1997 pg 12).

In Europe, scientists advocate the separation of industrial and domestic waste from sewer and letting them ferment at 70 C. (Gardner, 1998 pg 28). Gardner admits that separating domestic and industrial waste water from excrement streams will be difficult for industrialized countries that already have mixed sewage system. "Developing countries that haven't invested in sewers yet could avoid the mistake of combining human and industrial wastes" he says.

Ecological Sanitation System.

Given the growing awareness of sanitary problems worldwide there is a need to know what is being done in other countries in order to consider the appropriate options. The best option, which has gained momentum in many countries, is the use of ecological sanitation (ECOSAN) in place of more traditional methods. The ECOSAN principle relies on the sanitization and reuse of human excreta, where pathogenic bacteria are destroyed through composting and the composted matter returned to the soil. This principle considers human excreta as a resource not a waste. It assumes that excreta can be made safe for reuse not only in protecting people's health but also using the excreta to promote better nutrition and food security.

The unfamiliar aspect of this principle is that urine and faces are kept separately as supplied by the body. Faecal material is not mixed with water. It is composted dry. This is made possible by using recently developed toilets which have the bowel divided into two parts, a front one collecting urine and a rear one collecting the faecal materials.

Some characteristics and benefits of the Ecological sanitation system are listed below: -

- The system uses little or no water at all, this reducing the faecal effluent and serve water.
- It involves simple technology and low cost that individual households manage the installation.
- It has little or no smell, so can be inside the house.
- It involves recycling of human waste, thus turning potential waste into useful resource
- It protects the surface and ground water
- It simplifies treatment of the remaining wastewater.

If the Ecological Sanitation System was adopted to a reasonable degree in the Lake Zone the overflowing sewage from pit latrines would be reduced and there would be little chance for faecal waste infiltrating the ground water. This would in turn reduce

likelihood of direct contact with fresh faecal matter thus reducing disease transmission routes.

Over enrichment of the lake by nutrients from sewage discharged directly into the lake would be reduced. Most of the human waste would be returned to the soil as fertilizer. Studies on the reuse of excreta reveal that almost all-mineral nutrients in food a person eats in a year appear in excreta. Those nutrients almost equal what is needed to grow the corresponding food, provided that urine and faeces are composted separately since mixing them cause reactions that degrade the nutrients (Drangert; 1998).

A study conducted in Sweden (Table 3) gives details of three important nutrients in human (Swedish) excreta and the amount of nutrients required for cereal production.

Table 3: Need for fertilizers (Nitrogen, Potassium and Phosphorus) to produce 250kg of cereals and the content in (Swedish) faeces and urine.

Important	**Urine**	**Faeces**	**Total**	**Nutrient needs For 250kg cereals**
Important nutrients	Urine 500 l/yr			
Nitrogen (N)	4.0kg (88%)	0.5kg (12%)	4.5kg (100%)	5.6kg
Phosphorus (P)	0.4kg (67%)	0.2kg (33%)	0.6kg (100%)	0.7kg
Potassium (K)	0.9kg (71%)	0.3kg (29%)	1.2kg (100%)	1.2kg
Total N+P+K	5.3kg	1.0kg	6.3kg	7.5kg

Sources SEPA, 1995 and Wolgast 1993.

Note from the above data that urine is far richer in nutrients than faeces. It is too rich in nutrients to be ignored. In this respect, given the high costs of commercial fertilizers and since urine and faeces cost nothing to produce the nutrients in these resources deserve more consideration.

People's Perception

It is quite reasonable to invest in the innovation and promotion of Ecological Sanitation Technology in the Lake Victoria lacustrine communities, since it has shown potential to protect people's health and serve the lake resources. However there must be some concern about cultural acceptability given that the system requires some handling of the products at household level. Attitudes and perceptions about health hazards and revulsion apply more to faeces than to urine. Hamlin (1990) and Reid (1991) write that faeces are regarded as offensive and unpleasant to handle. Tanner et al (1993) also support by writing that faecal may carry definite cultural meaning for example that one's faeces, not urine, can be a medium for revenge and therefore must not be seen by others. It was also found by Drangert (1998) that both professionals and laymen may still consider plain urine as harmless and inoffensive. This analysis points to the fact that it is the smell of faeces, which is considered offensive.

But the identification of smell and revulsion are subject to social conditioning process. As noted by London (1977) it is a matter of common observation that among individuals accustomed to the smells of putrefaction, such as those involved in specialized occupations, conditioning modifies or suppresses a response which may well have a biochemical bias even through reinforced by psychological factors.

An assessment of Mwanza City situation in this respect provides useful inference. The practice of emptying pit latrines by pulling out stoppers from the latrine, flushing faecal waste to the environment not only causes contamination of drinking water sources but also exposes the residents to the persistent smell of faeces. Also individuals who pull out the stoppers and handle fresh faecal effluents, are no longer strongly subjected to social cultural norms and perception, otherwise this social practice would have been impossible.

With this outlook as explained by London, the Mwanza City residents might have a more relaxed view of what is considered offensive because of the social conditioning processes. The extent to which the assumed relaxed views on human excreta make people prepared to adopt the technology is subject to assessment, however it is not anticipated that there will be too much resistance to the technology.

Community awareness

If pilot projects are initiated and the public is well motivated the adoption can be achieved. The main challenge is how to generate community awareness and participation. This is particularly important because many such development initiatives have experienced failure when they receive inadequate community participation.

Some of the issues to be addressed in creating awareness leading to action include:

How can the community know that due to haphazard sinking of pit latrines the shallow wells (whether protected or not), are at risk of faecal contamination;

How can they know that the water they drink is contaminated with fresh faecal matter (if not treated) and this is the cause of frequently experienced diseases such as schistosomiasis, typhoid, diarrhoea and cholera;

How can they know that the faecal effluents discharged in the environment contribute to the loss of fish resources of Lake Victoria which most of them depend on for their livelihood?

How can they gain understanding of different viable options, and get motivated to take action. In this case to adopt the Ecological Sanitation toilet system that reduces excreta from the environment.

Therefore, there is a need for an effective participatory approach in initiating this programme in order that the target community is engaged from the start and play a key role. Approached this way the programme can gain community support and hence be

sustainable. How to gain the community support in this initiative is another concern of this paper.

PHAST approach: From awareness to action

Growing in popularity among the participatory approaches is the PHAST. (Participatory Hygiene And Sanitation Transformation). PHAST was initiated by the UNDP, World Bank, (Regional Water and Sanitation Group-East and Southern Africa) and WHO, Geneva. It aims to empower communities to manage their water supply and to control sanitation related diseases. (Brislin, 1999).

PHAST uses methods and materials that stimulate the participation of women, men and children in the development process. It relies heavily both on the training of extension workers and on the development of graphic materials (tool kits) that reflect the cultural and physical characteristics of communities in a particular area (WHO, 1997).

For the purpose of raising awareness on the impact of poor sanitation on drinking water quality, it is very important to link the PHAST approach to field –based water quality testing technique. These techniques involve newly adopted simple faecal bacterial tests, which can be administered and analyzed at local level.

The test uses bacterial growth media that contain substrates which change colour on the presence of Escherichia coli or total coliforms. These media are: -
0 – Nitrophenol-d-galactopyranoside
4- Methyl-umbelliferly-d-glucuronide and
Pathoscreen system

The total coliform bacteria are special in that they have the enzyme galactosidase which break down o-nitro phenol-d- galactopyranoside to form a yellow product, 0-nitrophenol
0-nitrophenal-d-galactobyranoside midea applied to a water sample containing total coliforms bacteria turns yellow after it has been incubated for 24hrs at 37.C.

Eschirechia coli are also special because they have the enzymes, galactosidese and glucuronidase. The enzymes break down 4-methyl-umbelliferyl - d- glucuronidase to form the water fluorescent yellow substance 4-melthy-umbelliferone. A sample containing Escherichia coli and the bacterial growth media therefore fluoresces if it is incubated at 37oC for 24hrs. (Breslin, 1999).

The patho screen system is designed to test a sample of water for the presence hydrogen sulphide-producing bacteria such as salmonella typhoid etc. A sample of water containing salmonella typhi and the pathoscreen turn black after it has been incubated for 24 hrs at room temperature 25 .

The pathoscreen test is more useful in rural settings where power to maintain certain temperature do not exists, while the other two can be applied in places were power exist. The test give +ve/-ve or present/absent responses and are specific to faecal bacterial. Their limitation is that they do not give quantifiable results. However as a community

awareness tool, they have proved very effective since the villager simply wants to know, whether or not it is safe to drink the water. Therefore a simple "Yes" or "No" is adequate.

The main problem would be regarding cost. Given financial constraints it would be difficult to ensure regular supply of the test media and related reagents for villagers to use in any self-examination of their drinking water supply. However, the test can be used to conduct a water quality assessment once at the beginning of the project cycle in order to generate increased awareness and action. This would in turn bring an even greater sense of urgency to community members involved in water and sanitation development. In this way the tests remain cost effective and simple for the villagers to conduct. Experience from Mvula Trust, a South African Water and Environment Sanitation NGO; show that, by 1999, when Breslin reported this, one test costs R7 equivalent to US. $ 1.20. He reported further that, 2-5 field days were required to initiate the process and plan relevant actions with community members (Breslin, 1999).

Conclusion

It is evident that the population is increasing rapidly in the lake zone and the sanitation is getting poorer. Water Sources are increasingly degraded. Many households in the area are inevitably continuing to rely on unprotected source of water for domestic consumption. The government-sponsored better sanitation service is not likely to reach all individual households in the foreseeable future. In this situation, there is no avoiding the fact that if we don't want fresh faeces in the environment, and especially in drinking water sources we must go for ecological sanitation system. A no-mix approach is recommended because it has the advantage of an easy on-site treatment, storage and reuse potential from health perspective. Importantly, the evidence suggests that the costs for the overall programme are low and that individual households can manage the installation.

It remains the duty of the potential actors in the community to initiate pilot projects and conduct researches on issues around the technology for sustainable development. It should be clear that the ability, attitude and seriousness in the potential actors of the society could make the technology look important or useless.

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