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Maximizing the Benefits from Water and Environmental Sanitation

By invitation of the
Ministry of Water, Lands and Environment
Kampala, Uganda

DIRECTORATE OF WATER DEVELOPMENT

NATIONAL WATER AND SEWERAGE CORPORATION

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Maximizing the Benefits from Water and Environmental Sanitation

31st WEDC Conference

Speke Resort Conference Centre, Munyonyo

Kampala, Uganda, October 2005

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PREFACE

Welcome to the 31st WEDC Conference in Uganda

Maximizing the Benefits from Water and Environmental Sanitation

Safe water supplies and environmental sanitation are vital for protecting the environment, improving health, and alleviating poverty. In spite of spending billions of dollars in this sector, the benefits do not always reach the poor and powerless, especially women and children. Yet the Millennium Development targets for water and environmental sanitation are critical to achieving the UN's overarching goal of poverty eradication, and directly impact on achievement of the targets for health, education, and promotion of gender equality and women empowerment. In recognition of this fact, the UN declared the period from March 2005 to 2015 the 'International Decade for Action, Water for Life', whose primary objective is to achieve the water-related MDG targets.

WHO estimated that about US $13.7 billion is required to achieve the MDG target for access to safe drinking water and improved sanitation using minimum cost solutions. Besides the enormity of resources required, another issue of concern preoccupying water sector professionals, managers and policy-makers in many middle- and low-income countries is how the available resources can best be utilised to maximise the benefits there from. This is the focus of the 31st WEDC Conference. I am glad that this conference is taking place at the beginning of UN 'International Decade for Action, Water for Life'. It will therefore provide directions to maximize the benefits from water and sanitation to meet the internationally agreed targets for water and sanitation by 2015, and build the foundation for further progress in the years beyond as envisaged by the United Nations.

The primary aim of this conference is to create a platform for sharing of ideas and experiences, and enhance learning of professionals involved in the water and environmental sanitation sector in the middle- and low-income countries. During the conference, both academic and practitioner-based papers will be presented on best practices for maximising the benefits from water and environmental sanitation. Organisers of the WEDC Conference believe that the written or spoken language should not be a barrier in promoting and sharing experiences for maximizing benefits from water and environmental sanitation. Hence there will also be a few presentations which are not in conventional papers, but in visual form as posters, or as purely verbal discussions and demonstrations.

The pre-prints for the 31st WEDC Conference are arranged in sections based on four themes of environmental sanitation, institutional issues, water resources and water supply. You are most welcome to pass any constructive comments on the papers to me, during the course of the conference.

Ladies and gentlemen, as researchers, professionals and/or practitioners in the sector, we have an obligation to maximize benefits from the investments already sunk in the water and sanitation sector. I wish you fruitful discussions during the conference, and an enjoyable stay in Uganda, 'the Pearl of Africa'.

Dr Sam Kayaga
Editor of the 31st WEDC Conference 2005

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Theme: Environmental sanitation

Scientific Papers
(Academic or Practitioner based papers - Option B)

31st WEDC International Conference, Kampala, Uganda, 2005

MAXIMIZING THE BENEFITS FROM WATER AND ENVIRONMENTAL SANITATION

Prevalence of diarrhoeal diseases - indicator for poor environmental sanitation

Ms. Chitra Grace Arthur and V. Mohanan Nair, India

Kerala (India) has a low prevalence of diarrhoeal diseases, but recently there has been an increase in water –related diseases. Prevalence of diarrhoea (in two rural communities of Kerala) among under-five children was selected as the indicator, to assess the factors leading to a resurgence of diarrhoeal diseases. Related factors studied were access to clean drinking water, sanitation facilities, and hygienic behaviour prevalent. Methodology involved a cross-sectional household survey, using a pretested interview schedule. Among the 1028 under-five children, the prevalence of diarrhoea was 8.7% in the two week period preceding the survey. Occurrence of diarrhoea was significantly associated with the socio-economic status of the household, age of the child, breast-feeding practises, hygiene behaviour, availability of drinking water, presence of sanitation facility etc. Washing hands was significantly associated with occurrence of diarrhoea in some instances. The need for a region specific health education and increased availability of water was realised.

Introduction

It is expected that a State like Kerala (in South India), with excellent social and health indicators in terms of low infant mortality rate, low maternal mortality rate, high literacy rate (Aravindan, 2000) would be having a good environmental sanitation system in place. But the inadequacies of the water supply and sanitation systems get expressed as disease outbreaks and with higher prevalence of water related diseases, at some point of time. The state of Kerala, has excellent health indicators, and is undergoing "epidemiologic transition" from infectious diseases to non-communicable diseases. But it is reported to have the highest rates of morbidity among the Indian states. The prevalence of water related diseases are affected by a plethora of factors like availability and access to water and sanitation facilities, prevailing hygienic practices in the community and many other physical, biological and social aspects etc. Though there has been a dramatic fall in the number of diarrhoeal cases over the years, diarrhoea is still reported to be one of the major causes of morbidity (Aravindan, 2000; Thankappan, 2002). A study conducted in rural Kerala shows a higher prevalence of diarrhoea in coastal areas, which was explained in the context of backwardness and poor health facilities (Aravindan, 2000). Some parts of Thiruvananthapuram district (capital city), particularly the area selected for the study had a cholera outbreak and there was an increase in the diarrhoea related hospital admissions during the month of October- November 2002 (The Hindu, 2002). Assessing the community's access to clean drinking water and sanitation services, hygienic practises and health seeking behaviour of the community, was needed to adopt proper intervention strategies. For this purpose, the prevalence of diarrhoeal diseases in the high-risk group of under-five year old children, (an effect indicator), was used in the present study.

Methodology

A community based cross-sectional survey was carried out in the study area. Two adjacent Gram panchayats of Thiruvananthapuram district, Vizhinjam and Venganoor were selected for the study. Vizhinjam is predominantly a coastal village with majority of the people undertaking fishing and related work and Venganoor is the adjacent gram panchayat. Both these panchayats have different cultural and social factors.

The study population consisted of children under-five years of age, in the study area. Sample size required for the study (with 95% confidence limits), was calculated to be 733 (N), with the assumed prevalence of diarrhoea as 12% (IIPS, 2001). Cluster sampling technique (Henderson & Sundaresan, 1982) was used as the sampling method. So 40% of N was added to the sample, so that the sample size was 1000 under- five children from the sampling area. A total of 35 clusters were selected, so that from each gram panchayat 500 children were selected to make up the total sample of 1000 under- five children.

Data collection

Period of data collection was from December 2002 to March 2003. A pre-tested schedule was administered to the person who was with the child at the time of the interview viz., the informant, preferably the mother. The start point of each cluster, the first household, was randomly selected using random number method. The direction to follow was decided by drawing of lots in front of the first household.

Selection began in the first household and then continued to the next nearest household until the desired numbers of children were got. All children under five in any particular household was included in the study. In the last household, all the under five children were included in the study, even if it exceeded the required cluster size. Household of every tenth child was personally observed for its drinking water and sanitation facilities by the investigator. Data was entered in Excel (Version 4.0) and was analysed using SPSS (Version 11).

The schedule consisted of questions for eliciting information on the occurrence of diarrhoea, household and child characteristics, knowledge, attitude and practises about diarrhoea and its management, drinking water facility, sanitation facility for the household and the hygienic practises of the household.

The main outcome variable considered was the prevalence of diarrhoea (WHO, 1996) for children under five years of age in the 2- week period preceding the survey. Prevalence was calculated by taking the percentage of children with diarrhoea with that of the total number of children.

Table 1. Charateristics of children in the study

Characteristics of children	No of children with diarrhoea (%) (N = 1028)	P-value
Age of child		
Upto 11 m (n=197)	25 (12.7)	
12-23 m (n=183)	23 (12.6)	
24 –35 m (n=171)	19 (11.1)	
36 – 47 m (n=220)	15 (6.8)	
48 – 59 m (n=257)	7 (4.3)	0.046*
Sex of child		
Female (n=496)	39 (7.9)	
Male (n=532)	50 (9.4)	0.382
Period (Exclusive breast feeding)		
> 4 months (n=196)	40 (20.4)	
4 months & above (n=832)	49 (5.9)	<0.0001*
Period (breast feeding)		
Still continuing (n=345)	17 (4.9)	
>= 12 months (n=221)	51 (23.1)	
< 13 months (n=462)	21 (4.5)	<0.0001*

Results and discussion

A total of 1028 under-five children from 661 households were included in the study. The overall prevalence of diarrhoea was found to be 8.7% in the study area. Venganoor gram panchayat had a diarrhoea prevalence of 6.7%, while Vizhinjam gram panchayat had a prevalence of 10.6%. The mean number of children in the households was 1.9 children (range: 1-6) in a household. There were 48.2% and 51.8% female and male children respectively in the sample (Refer Table 1).

Age of the child was found to be a significant factor for the occurrence of diarrhoea (p value: 0.04). The majority of diarrhoeal cases were under two years of age (25.3%). This corroborates with the evidence from many other studies too (Lye, 1984; Sunoto, 1982). Weaning practises, which may start early or at about 5-6 months, might introduce food that may be contaminated with faecal bacteria. The occurrence of diarrhoea came down to 4.3% in the 48-59 months age group. Maternal education, education of the father and occupation of the father were found to have a significant association with the occurrence of diarrhoea. Since a majority of the mothers were housewives, no association could be tested between the occupation of the mother and the disease.

Characteristics of the children were important predicator variables in the study. Sex of the child was not a significant factor for the occurrence of diarrhoea with a p-value of 0.382. The characteristics of the usual caregiver, such as age, education, occupation and relation to the child were not significant for the occurrence of diarrhoea. The age of the mother (p-value:0.09) and father (p-value: 0.4) of the child were also statistically non- significant in the study. Breastfeeding was highly prevalent among the community and almost all children under four months of age were being breastfed. This practise is in accordance with the criteria as suggested by the WHO. Prevalence of diarrhoea was higher among those children who were exclusively breastfed for less than four months. Studies in Northern Brazil(Lima et al, 2000) have shown the importance of exclusive breastfeeding. There was an eight-fold higher rates of diarrhoea in children who have been weaned. The exact weaning time was not enquired about, in the study, but it could be seen that occurrence of diarrhoea was lower in the age group that was still being breast-fed (5.9%), when compared to the other group (20.4%).

Sex of the child was not significantly associated with the occurrence of diarrhoea, in the present study. But proportionately the disease was more seen in male children (9.4%). Many studies also suggest that, when sex was a significant factor, male children had more chance of experiencing diarrhoea than female children (Mock et al, 1993)

Many studies have shown that the contamination of drinking water and difficulty in access to water are significant contributing factors to the occurrence of diarrhoea. (Derslice & Briscoe,1995; Cifuentes et al. 2002). In the present study, the source of drinking water, over which the household had no control over, for preventing contamination, were found to be contributing more towards the disease burden namely, private well, given for public use (11.2%) and tanker services (15.3%). The main source of drinking water for the households in the study area was protected dug wells (43.4%). Only about 28.8% of the children in households included in the study had access to piped drinking water, of which 9.3 % of was collecting water from a public tap. The source of drinking water and occurrence of diarrhoea were found to be significantly associated (p value: 0.002), in the present study (Refer Table 2).

About 131(12.7%) of children did not have toilet facility in their household. 11.6% of the household had flush toilet

Table 2. Occurrence of diarrhoea and source of drinking water

Drinking water facility for the household	No of children with diarrhoea (%)	P-value
Source of drinking water(N=1028)		
Piped into dwelling/yard & bottled water (n=200)	8 (4)	
Public tap (n=96)	11 (11.5)	
Tube well & protected dug well (n=448)	32 (7.1)	
Private well, given for public use (n=134)	15 (11.2)	
Tanker services & others (n=150)	23 (15.3)	
Total (N=1028)	89 (8.7)	0.002

and majority had pit latrine connected to the septic tank (85.3%). In 54.4% of households only the adults used toilets. The presence of an own toilet facility for the household was found to be significantly associated with the occurrence of diarrhoea (p value: <0.001), as also seen in other studies (Aziz, 1990). In the absence of such private facility, the use of alternatives like defecating in the open or using public latrine was found to be significantly associated with the occurrence of diarrhoea.

There was a higher incidence of diarrhoea, where water purification was not practised (20.6%). But water purification by some method was highly prevalent (90.1%) in the study area. This may have due to the increased awareness of the population after the health education campaign that happened in the area. The most preferred way of purifying water was through boiling and the water was not usually stored for more than one day.

The storage of water and the method it was drawn and by whom in the household was all significantly associated with the occurrence of diarrhoea. Even though the practise of water purification was highly prevalent, the households were not following hygienic practises in drawing water. Dipping of a cup/vessel for drawing water (53.7%) seemed to be the preferred method, which increases the chance for contamination. The water purified may be contaminated by these conflicting practises, which increases the occurrence of diarrhoea in these households.

Hygiene should be maintained in the handling (storage, purification and drawing) of drinking water. It is also necessary that personal hygiene should be maintained to avoid contamination. Practice of washing hands after "critical times" is important in this context. The practise of washing hands (with or without soap) after post defecation and after handling/washing post child defecation was found to be significant, while the practise of washing hands before feeding, before preparing food, before eating food and after handling of animal, if present was not statistically significant. The frequency of washing hands during these were also not significant except for washing hands before feeding and preparing food for the child (Refer Table 3).

The prevalence of diarrhoea was higher in the instances where hands were never washed i.e., before preparing food and before feeding the child (41.2%). The practise of washing hands with soap after defecation and after handling or washing the child post defecation seemed to associate with lesser prevalence of diarrhoea.

Table 3. Occurrence of diarrhoea and Practise of washing hands

Drinking water facility for the household	No of children with diarrhoea (%)	P-value
Post defecation (Practise)		
Does not wash (n=4)	-	
Wash without soap (n=555)	68(12.3)	
Wash with soap (n=469)	21(4.5)	<0.001*
After handling/washing the child post defecation (Practise)		
Does not wash (n=4)	-	
Wash without soap (n=525)	67(12.8)	
Wash with soap (n=438)	21 (4.8)	
Not applicable (n=60)	1(1.6)	<0.001*
Before preparing food (Frequency)		
Always (n=427)	28 (6.6)	
Frequently (n=439)	44(10)	
Occasionally (n=130)	10(7.7)	
Never (n=130)	7(38.9)	
Not applicable (n=14)	-	<0.001*
Before feeding (Frequency)		
Always (n=405)	27(6.7)	
Frequently (n=426)	44(10.3)	
Occasionally (n=134)	10(7.5)	
Never (n=17)	7(41.2)	<0.001*

In the cross sectional household survey, the occurrence of diarrhoea was significantly associated with the socio-economic status of the household, age of the child, breast-feeding practises etc. Environmental sanitation factors like availability of drinking water, presence and usage of sanitation facility, was significantly associated with the occurrence of diarrhoea. Majority of households were purifying drinking water, but were adopting unhygienic practises to dispense the water. Practise of washing hands was significantly associated with the occurrence of diarrhoea in some instances. Studies have shown hand-washing interventions to achieve a median reduction in diarrhoea incidence of 35%, but it has also been found that only adequate water supply makes it possible (or at least more feasible) for people to adopt safe hygiene behaviours (Hill Z et al, 2001; Hutley et al, 1997; Esrey S, 1996.). The reduced availability of water may be the impeding factor for adopting safe hygienic practises. Therefore, it is necessary to provide adequate water to the community, followed by education to improve key human behaviours. This would greatly reduce the risk of diarrhoeal diseases (including cholera epidemics) in the area.

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Notes

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MAXIMIZING THE BENEFITS FROM WATER AND ENVIRONMENTAL SANITATION

A critique of approaches to measuring effective hand washing in Mpumalanga, South Africa

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Diarrhoeal disease was ranked fifth on the list of causes of premature mortality in South Africa in 2000. High standards of hygiene and access to safe water and sanitation services can be related to a reduced risk of diarrhea. Based on the understanding and interpretation of good sanitation, hygiene and related practices in South Africa, all sanitation programmes and interventions in the country focus to some degree on hand washing practices and behaviours. Health and hygiene interventions are implemented from the knowledge that hand washing can act as a barrier to several of the transmission routes of diarrhoeal pathogens. As a result, many sanitation interventions in South Africa begin with a baseline assessment which includes a review of present sanitation, hygiene and related practices. This paper focuses specifically on the measurement of one aspect of health and hygiene awareness in South Africa, namely hand washing behaviours. The paper is a critique of methods used in assessing these household behaviours in two villages in the Mpumalanga Province of South Africa.

Introduction

South Africa's mortality profile reflects a quadruple burden of disease arising from HIV/AIDS, chronic disease, pre-transional conditions relating to poverty and under-development, and finally injuries (Bradshaw et. al., 2000). Loss of life in the country, due to pre-transitional disease, can be attributed to diseases and conditions such as TB, diarrhea, lower respiratory infections and low birth weights. Diarrhoeal disease was ranked fifth in the list of causes of premature mortality in South Africa in 2000 (Bradshaw et. al., 2000). It is also a major cause of death among children under the age of five (Choi, 2003).

The World Health Report for 2002 identified unsafe water, sanitation and hygiene as one of 10 risk factors that account for more than one-third of all deaths worldwide (WHO, 2002a). High standards of hygiene, access to safe water and sanitation services can be related to a reduced risk of diarrhea (Choi, 2003). Since transmission of diarrhoeal disease occurs in the domestic domain, it may be prevented through changing domestic hygiene behaviours with all of the transmission routes of diarrheal pathogens being blocked by changes in these practices (Curtis et. al., 2000). Barriers which can be employed for this purpose include safe disposal of faeces, washing hands at crucial times, protecting water suppliers, water treatment, fly control and a clean surrounding environment.

As a result, basic sanitation in South Africa, and thus sanitation programmes and interventions have the purpose of the provision of a basic sanitation facility which is easily accessible to a household; the sustainable operation of the facility, including the safe removal of human waste and wastewater from the premises where this is appropriate and necessary, and the communication of good sanitation, hygiene and related practice (DWAF 2003a).

The South African government presently offers all poor households in the country a sanitation subsidy to assist in accessing basic sanitation services. Approximately 12,5 % of this subsidy is made available specifically for "soft cost" including health & hygiene issues. The national Guidelines for Using the Household Sanitation Subsidy, which are presently undergoing review, indicate that municipalities must resource pre-project sanitation hygiene awareness and demand creation activities as well as ongoing post project sanitation hygiene promotion and monitoring (DWAF, 2003b).

Based on the understanding and interpretation of good sanitation, hygiene and related practices in South Africa, all sanitation programme and interventions focus some attention on hand washing practices and behaviours. Health and hygiene interventions are implemented from the knowledge that hand washing can act as a barrier to several of the transmission routes of diarrhoeal pathogens (Curtis et. al., 2000). According to Curtis et. al. (2000), hand washing acts both as a primary barrier through the removal of faecal matter after contact with faeces, and a secondary barrier to transmission through hand washing before preparing food, handling fluids, feeding and eating.

Hand washing with soap may not be a new idea, but this simple hygiene act at critical times can save millions of lives annually. Research has shown various statistics for a reduction in diarrhoal disease as a result of hand washing. Research by Aldemon et. al. (1997) showed that hand washing with water and soap reduces diarrhoeal disease by

35%, while a systematic review conducted by Curtis and Craincross (2003) showed that interventions to promote hand washing with soap resulted in a 47% decrease in risk of diarrhoeal disease.

As a result, many sanitation interventions in South Africa begin with a baseline assessment which includes a review of present sanitation, hygiene and related practices. There is no standardized format for this review and very few follow-up assessments of behavioural changes and impacts which have resulted from the sanitation programmes health and hygiene interventions. The paper focuses specifically on one aspect of health and hygiene awareness in South Africa, namely hand washing behaviours. The paper is a critique of methods used in assessing these household behaviours. The paper does not focus on the actual behaviours but rather on the methods used in two assessments of hand washing behaviours. The assessments were conducted in Mpumalanga focusing on measuring hand washing during (1) a baseline survey and (2) a follow-up impact assessment of a health and hygiene promotion programme.

Measuring effective hand washing

There are a number of international studies relating to the measurement of hand washing. Hand washing techniques advocated by FANTA (1999) include two elements, namely washing hands at critical times and the technique of washing of hands. Washing hands at critical times involves performing this task (FANTA, 1999):

- Before preparing food
- Before eating
- Before feeding children
- After defecation
- After cleaning the babies' bottoms

The second element to assessment of hand washing behaviours is measurement of the technique used in performing the task. The techniques advocated by FANTA (1999) for hand washing are:

- Use of water
- Use of soap or ash
- Washing of both hands
- Rubbing of both hands together at least three times
- Drying of hands hygienically – by air drying or using a clean cloth

Finally, EHP 2004, mentions a third element to appropriate hand washing which necessitates an assessment of the availability of supplies required for hand washing. Washing of hands at critical times is reliant on the availability of the following (EHP 2004):

- Water from a tap or container
- Soap, ash or other detergent
- A device that facilitates unassisted hand washing such as a basin, sink, bucket or tippy tap
- Clean towel or cloth, although this is optional because air drying is an acceptable alternative.

Thus, any assessment of effective hand washing should include measurement or observation of all knowledge and application of this, as well as the techniques and supplies listed under the three elements above.

Method

Two approaches were used in the study to determine hand washing behaviours in the Mpumalanga Province of South Africa.

Method 1: The baseline study

A baseline study was conducted in the Mpumalanga Province in 2003 (CSIR, 2003). The study covered six villages in two district municipalities of the province. The purpose of the baseline study was to determine the status quo of sanitation, hygiene and related practices in these villages prior to implementation of a sanitation programme. The intention being that these data would act as baseline information for tracking sanitation attributed changes in the villages as the programme progressed. The study was a rapid assessment using a household questionnaire to determine:

- the socio-economic status of household;
- water and sanitation supply in the areas;
- water and sanitation behaviours, i.e. storage, treatment etc.;
- the health and disease status of the households; and
- Health and hygiene behaviours.

Household interviews were carried out randomly within the villages, the resulting interviewees ranging in age, gender and roles within the households. Statistical analysis of the data was carried out making use of the SPSS package. For the purpose of this paper, the data for Vlakbult and Phosaville villages were extracted from the dataset generated from the processing of these questionnaires. A total of 317 households, 296 from Vlakbult & 21 from Phosaville, were interviewed during this assessment. The number of interviewees comprised approximately 10% of households in each village.

Interviews were carried out by locally based field workers who had been trained to administer the questionnaire.

The dataset which is most relevant to this paper is that which covers hand washing behaviours. The data were collected by asking household representatives whether they washed their hands:

- Before handling of food and food preparation
- Before eating
- After visiting the toilet
- After housecleaning work
- After disposing of rubbish.

The list of activities was read out to the interviewee, with them responding yes or no to washing their hands after each activity. The results of the data analysis are shown in Figure 1.

Method 2: The health & hygiene impact assessment study

Another study that relates to hand washing was conducted in Mpumalanga in June 2004 covering the same Vlakbult

and Phosaville villages (Caillet-Pariel, 2004). At the time of the H&H Impact Assessment study a sanitation programme was being implemented in the villages. This programme includes a health and hygiene education and awareness programme offered to local community health workers which included a:

- General health module on (1) Personal domestic and community hygiene issues such as hand washing; bathing and laundering; and (2) Community hygiene.
- Safe drinking water and waste disposal module which covered water collection, storage, treatment, and waste water disposal;
- Disease module (spread and impact) covering Faecal-oral routes of disease transmission and Vector borne diseases;
- Module on Safe disposal of children 's faeces; and
- Participatory approaches covering how to conduct Focus groups and Small community discussions.

These trained health workers were expected to transfer health and hygiene to the individual households once the sanitation programme began in the village. Health workers formed part of the project staff and were paid a salary during the programme.

The main purpose of the Impact Assessment study was to evaluate the impact of this health and hygiene promotion programme at a household level and based on the data collected from the baseline survey, be able to determine change in hygiene behaviour as a result of this programme. Data on water, sanitation and hygiene in the studied villages were collected using Participatory Rural Appraisal (PRA) techniques. The PRA techniques were chosen because they are suited to the mission of collecting data on hygiene behaviour. PRA tools used in this particular study were based on those used for hygiene monitoring and evaluation as advocated by Almedom et al (1997). This included:

- Observation Walks
- Stakeholder interviews
- Focus group discussions

Triangulation was done using the interviewer's observations. The observation walks were used to orientate the interviewer regarding the location of village facilities, where different groups lived (those with or without a yard tap), and allow the observation of hygiene behaviour, for example during water collection. The problem encountered was that both villages were large and the researcher could only cover a small area of each. A total of 56 households, 28 from each of the villages were interviewed. Before the assessment, households were pre-divided into four equal categories according to the sanitation facilities and the intervention; i.e:

- People interviewed in the baseline study and who had a toilet facility;
- People interviewed in the baseline study and who did not have a toilet facility;
- People not included in the baseline study and who had a toilet facility;
- People not included in the baseline study and who did not have a toilet facility.

The households which were to be interviewed for this study were chosen using the above categories, by locally based health workers trained during the sanitation programme. Neuman (2003) presents this type of sampling as nonprobability sampling. More precisely, it is quota sampling. This is to "get a preset number of cases in each of several predetermined categories that will reflect the diversity of the population."

The interviewer was a French first language speaking student from the University of Cranfield in the United Kingdom. She was accommodated within the villages for the duration of the impact assessment. This allowed for discrete observations of health and hygiene behaviour practices and habits within the villages. These informal observations were used to support or refute formal data collected through the questionnaire.

For the focus group discussion only women were asked to participate because they are more involved in the health and hygiene issues.

During the structured interviews with the individual households, the interviewer asked the same questions relating to hand washing as those used in the baseline survey. However, respondents were not given a list of activities to which they should respond positively or negatively relating to hand washing. Rather, interviewees were asked before or after which activities would they normally wash their hands. This required the interviewee to list the activities without prompting from the interviewer.

This divergence between the baseline and the present study methodology will influence the results shown later in the paper. As a result a comparison of the two hand washing behaviour results should be handled with sensitivity. The paper focuses rather on the method of assessment and the effect of this on the hand washing results shown below.

Results

Baseline study

From the baseline study responses, 50% of households indicated that they had a sanitation facility in their backyards, 45% indicated that these were pit latrines, while 3% had VIPs. The remaining 49% of households had no sanitation facility in their yard, with 41% of these using the veld for relieving themselves; 44% making use of other people's toilets; 4% making use of communal toilets and the remainder making use of other means (6%) or rivers and streams (2%).

At the time of baseline survey no sanitation intervention had occurred in either of the villages. As a result, households and interviewees had not been exposed to a sanitation related health and hygiene education programme. The Researcher therefore expected that few interviewees would respond positively to hand washing behaviour questions. However, Figure 1 below shows that between 70% & 91 % of the 317 interviewees indicated that they washed their hands before/after the listed activities.

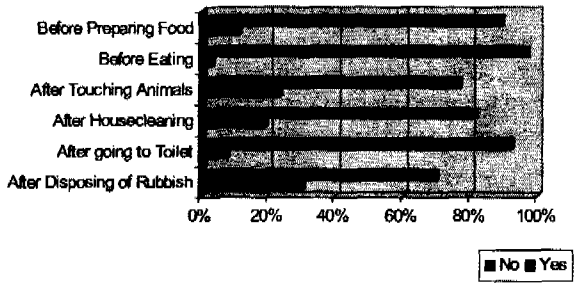

Figure 1. Respondents Knowledge of Hand Washing at Critical Times in the Baseline Study

Source: CSIR, 2003

The activities which the majority of the interviewees associated with hand washing were before eating (97%) and after visiting the toilet (92%). The activities least associated with hand washing were after house cleaning (81%) and after disposing of rubbish (70%). However, it is important to note that all activities scored high when related to hand washing.

From the 92% of interviewees who reported washing their hands after visiting the toilet:

- Approximately 86% had access to basic water service in both the dry and wet seasons. However, reliance on yard taps drop from over 75% in the wet season to less than 45% in the dry seasons. Use of yard taps appeared to be replaced by collection of water from rivers and streams and street taps during this season;
- Approximately 77% indicated that they sometimes did not receive sufficient water for drinking. This was chiefly attributed to maintenance of infrastructure (27%); a water supply problem (25%), and water shortages within the villages (11%). As a result of these problems, villages in South Africa have developed a culture of water storage. The availability of water in terms of quantity is a constraint because it obliges people to store water and to limit their consumption. This limited amount of water for personal hygiene (hand and body washing) and for domestic use (drinking water) is one of the key problems to maintaining good health.
- 52% made use of a 200Litre water storage container, which was usually covered. Approximately 94% of this group thought is was necessary to cover the storage container and to clean it regularly. However, the majority of the interviewees (58%) mentioned that they never washed the storage container or only washed the container once a week. In South Africa, it is also common to scoop water out of the storage container with a small bowl or jug;
- Approximately 71% of this group indicated that household members shared the same cup for drinking. This increases the contamination risk and the possible spread of water related diseases within a household;
- Although 77% of this group indicated some difficulty at time with water supplies, only 49% were treating their drinking water, the majority of these (76%) making use of Jik for this purpose. Jik is an inexpensive household bleach consisting of 3.5% sodium hypochlorite, which is commonly advocated as a method of water treatment during sanitation related health and hygiene training in villages in South Africa and in cholera infected areas (SANTAG, undated; Dept. of Health, 2001; Institute for Water Quality Studies, undated)
- An estimated 25 % of these respondents, who indicated that they washed their hands after visiting the toilet, reported 1 or more incidents of diarrhea in their household in the last 6 months. These respondents attributed the disease chiefly to contamination of water sources (31%) or were unsure of the cause (24%). The remaining listed unclean food (8%), hand washing or hygiene issues (7%); not using the toilet (5%); and cholera or contaminated air (3%). Although there were diverse views on the cause of diarrhea, 92% of these respondents believe that it could be prevented. However, there were once again diverse views on how this could be achieved. These varied from purify water (29%), to visiting a clinic, hospital or doctor (19%) to rehydration mixture (11%) and food hygiene (8%).

The health & hygiene impact assessment study

As a result of this predetermined grouping of interviewees during the Impact Assessment study, 50% of respondents in the exercise indicated that they had a sanitation facility and 50% had no sanitation facility. The majority of respondents with a facility still used the unimproved pit toilets (75%), however, as a result of the sanitation programme a larger number of respondents had access to adequate sanitation in the form of a VIP (21%).

The Impact Assessment results shown in Figure 2 indicated very different results to those obtained from the Baseline Survey. Indeed, people wash their hands especially before and after eating (80%) and after visiting the toilets (79%). The results however showed lower percentages of hand washing behaviours than that of the baseline survey.

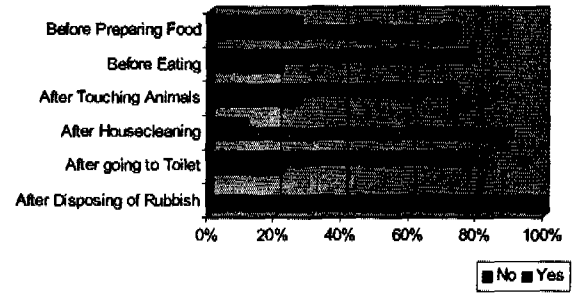

Figure 2. Respondents knowledge of hand washing at critical times during the impact assessment study

Caillet-Pariel, 2004

Researchers concluded that although a health and hygiene programme had been initiated in the villages, the baseline survey results were skewed as a result of the manner in which the hand washing questions were asked. Results from the Impact Assessment study gave a more accurate indication of people's knowledge of hand washing at critical times as interviewees were not prompted to respond positively or negatively to whether they washing their hands before/after a listed activity.

Concerning hand washing after visiting the toilet, 79% of respondents indicated that they do wash their hands after visiting the toilet. From the 79% of interviewees who reported that they wash their hands after visiting the toilet:

- Approximately 90% had access to basic water service in both the dry and wet seasons. However, all respondents indicated that they sometimes had difficulty getting sufficient water for drinking.
- As a result, water storage was common in the villages. From the questionnaire, only 41% of this group of respondents said that they used the same scoop for collecting and drinking water from the storage container. However, the interviewer observed some people taking water from the storage container using a glass or a jug. These people's hands were in contact with the water and most of the time, their hands were dirty. Swerdlow et al (1992) stated that the introduction of hands into the drinking water during washing or scooping is "strongly associated with illness". Moreover, water was not stored in separate containers depending on its subsequent use.
- Approximately 27% of respondents made use of a 200 Litre water storage container; however, 91% indicated that they do cover the storage containers. All respondents of this group believed it was necessary to cover the storage container and to clean it regularly. Surprisingly, although 32% of the respondents washed the container at least once a day, 30% washed the container only once a week.

However the interviewer's observations allowed nuancing this information. Most people in the village wash their hands before eating. This was done in a bucket with either cold or hot water, without soap with the water being shared by the whole household before the meal. It is important to note that it is common in the rural areas of South Africa for people to eat their meal with their hands. As a result, there is a direct contact between the hands and mouth during meals. In addition, only 25% of the interviews washed their hands before handling food. This percentage is small compare to the risk associated with this practice, because the pathogens ingested will be in greater quantity than those ingested via the hand washing water.

Critique of two approaches used to measure hand washing in Mpumalanga

A number of problems were highlighted with the methods used in both of the studies listed above. With reference to the Baseline Survey, these problems included that:

- The manner in which the hand washing questions were administered during the study was not acceptable. Respondents were required to respond positively or negatively to washing hands after certain activities were listed to them. This seems to result in respondents over reporting desired behaviour. Researchers concluded that answers given by respondents were not a true reflection of actual knowledge of "good" hand washing behaviours. This is reinforced when assessing interviewee's responses to the cause and prevention of diarrhoeal disease. Few made the link between hand washing or sanitation and the cause, and none of the respondents listed these as a means to prevent the transmission of disease. Food hygiene or more specifically "clean" food was listed as a means of preventing the disease. According to FANTA (1999) interviewers should not prompt answers to the interviewees as was the case with this survey. The results shown for the baseline survey are purely a reflection of interviewees knowledge of what they think are "good" hand washing behaviours and does not reflect whether hand washing actually takes place after each of the activities. The survey therefore, neither measured knowledge of hand washing at critical times, nor whether hand washing was actually taking place before/after these activities.
- The data did not reflect whether the infrastructure is available for hand washing before/after these activities or what techniques were used by households to carry out hand washing.
- The baseline survey was a rapid assessment of the status quo in 5 villages in this municipality of the province. A total of 44 interviewers had to conduct 459 interviews in just 2 weeks. A total of 22 interviewers were used in Vlakbult, while 2 administered the questionnaire in Phosaville. As a result, a number of locally based interviewers had to be trained to administer the questionnaire. This may have resulted in different interpretations and thus application of questions at a household level.
- A single questionnaire required approximately 20 minute of the interviewee' time to be completed. Households made mention of "questionnaire fatigue" during this assessment as this was not the first time a survey had been carried out in the villages. Mention was made of ongoing questionnaires being completed within the village, with little feedback to the communities and very little visible project activities as a result of the assessment.
- Collection of survey data was done by local community members, however, capturing, collation, analysis and interpretation of the results was done by a different group of people based outside the community. This group of researchers were unable to observe behaviours in the field and were therefore, only able to interpret behaviours based on the results of the survey.

The baseline questionnaires were administrated using a formal method while the Impact Study was able to use a more informal method. Respondents were asked to list activities before/after which they would wash their hands. They were not offered this list of activities, as was the case

in the baseline survey. Thus they reported on known behaviour rather than on what they "thought" was good hand washing behaviour. Although the survey indicated that most respondents were aware that they should wash their hands before eating and this was reinforced by the observation of this activity at household level, it is very common in the rural areas of South Africa to share the basin of water for this activity. Observation of hand washing behaviours thus indicated a lack of understanding of the techniques required for hand washing recommended by FANTA (1999).

Although the Impact Assessment study was planned and carried out with the utmost care, the results obtained are likely to have been affected by a number of factors. These factors include that:

- The sample size used in this assessment was small. It was only possible to interview 28 people in each of the villages. This amounted to approximately 3% of the population. Where as the baseline sample size was 10% of the population. A small sample size results in each individuals' response having much greater weighting in the analysis, making it difficult to reveal underlying trends and relationships.
- The interviewer was an outsider and more specifically from Europe. As a result, respondents may have modified their answers as they usually associated Europeans with aid agencies and thus the supply of goods or services.
- The respondents' impression of the interviewer affects the answers that the respondent gives. Very rarely do Europeans (and even white South Africans) visit the study villages and they are sometimes viewed with suspicion. This is likely to have had a significant effect on the responses and could only be resolved by using local interviewers.
- The language barrier between the interviewer and the interviewees may have also affected the results. English was not the first language of the interviewer and very few of the interviewees could speak this language. As a result, an interpreter had to be used during household interviews and group discussions. This made it difficult for the interviewer to be fully engaged in the conversations, asking questions where appropriate or following up on issues as they were raised. The translator also did not use English as a home language which resulted in some answers being translated without important nuances or there were errors of interpretation. For example, relating to the disease questions of the survey, the word "prevention" was often mixed up with "cure".

Finally, factors which were common to both studies and may have influences to result of both included that:

- The assessments only took note of one element of hand washing measurement, namely measurement of hand washing at critical times. However, even in this part of the assessment, neither included a measurement of mother-child knowledge of hand washing.
- The assessments also made no reference to the technique of washing of hands. Although a large percentage of the interviewees indicated that they had access to basic water supplied through-out the year, many mentioned interruptions to this supply which has resulted in a culture of water storage in the country. Both assessments made mentioned of the same cup being used for scooping and drinking of water from the storage container. This could result in transmission of disease between household members through contamination of the household water source.
- Finally, the assessments lacked measurement of the third element appropriate to hand washing which was an assessment of the supplies needed for hand washing. Although an assessment of water from the tap or container was part of the surveys, no measure of availability of soap, ash or detergent or a device that facilitates unassisted hand washing was made.

In another study done by CSIR in February 2004, an investigation was carried out into the effectiveness of hand washing devices and their application in the National Sanitation Programme in South Africa (CSIR, 2004). Although the assessment was not carried out in the villages listed in this paper, the results shown for the Mpumalanga Province as a whole, indicated that the majority of respondents interviewed (81%) in the province had no hand washing device at the toilet facility, 4 % made use of an open bucket, 10% used a close bucket with a tap attachment while 3% were "using" other methods of washing. It is therefore possible, that an assessment of hand washing facilities within these villages may have yielded similar results.

It is critical for researchers to realize that by asking whether people wash hands at critical times alone is not sufficient. Washing of hands could be hampered by other factors such hand washing supplies. Unavailability of hand

washing supplies will impact negatively on hand washing, thus assessing or measuring all elements of appropriate hand washing is important. This will aid both researcher and developers to focus their attention where there are gaps in appropriate hand washing.

Recommended solutions to measuring hygiene behaviour (hand washing)

Measuring sanitation-related hygiene behaviour is critical for two reasons (EHP, 2004):

1. to obtain information for improving the health and hygiene component of a sanitation programme; and
2. to demonstrate whether the sanitation programme made a difference or an impact on health and hygiene knowledge, behaviours and practices.

A number of methods developed to measure behaviour change have been field tested and experience has proved that they are best used in combination to check for consistency and to see whether outcomes are reliable (WELL, 2004). It is important to realize that when measuring hygiene behaviour the use of a combination of tools might yield better results as was the case in the Impact Assessment study in Mpumalanga. INCO 2004 recommended the following tools

to study hand washing behaviour which could be used in combination, based on the extent of the study:

- Questioning to measure knowledge
- Observation of hand washing skills
- Pocket voting to measure actual practice
- Observation of location of soap and water.

Questions in survey should also be structured in a manner which yields the most "honest" response from the interviewee. Supplying interviewees with options to which they may answer yes or no as was the case in the baseline survey has a significant on the results of the assessment. Prompting of responses will result in overstating of the survey results.

Hand washing assessments need to cover measurement of people's knowledge to carry out this task at critical times, as well as observation of whether the actual hand washing is taking place. Assessment must also include measurement of hand washing techniques and availability of hand washing supplies. As mentioned above, a combination of methods may be needed to cover all these in the assessment.

In addition it is important to allow enough time between baseline surveys and the evaluation of hygiene behaviour.

Finally, these types of studies should note that when conducting baseline and impact assessment surveys, training of interviewers is critical to the outcome of the study. Insufficient training of interviewers, in their mother tongue, may have significant impacts on the interpretation questions within the questionnaire and thus the administration of these. This could be detrimental to the results and long-term applicability of these in tracking changes and impacts within a community.

Conclusion

Although different approaches were used to measure hand washing in Mpumalanga, it is clear that neither approach assessed effective hand washing in a holistic manner. Specifically, the baseline survey did not apply assessment techniques such as group discussion, community walks or observation. The Impact Assessment study endeavored to include observation to some extent, however, the assessment was limited to knowledge of hand washing and not the techniques or supplies needed for these activities. Measuring hand washing behaviour requires understanding of the tools which are available to measure these behaviours since the methods used can have significant impact on the results of the assessment.

To better understand the impacts of sanitation and hygiene interventions in South Africa, a more structured standardized methodology of baseline and impact measurement will need to be developed and tested. It is recommended that more resources, both human and financial, be utilized in further test methodologies for baseline assessment and more studies should be carried out to measure the impact of sanitation programmes on sanitation, hygiene and related practices in the country. This would include the use of a multi-disciplinary team in this research, allowing a broader overview of the situation through cross checking of survey information by direct observations.

Finally, sanitation assessment, both baseline and impact, needs to be taken a step further than once off assessments. It is necessary to find methods and tools to be able to track changes within a household or community as a result of sanitation interventions, as well as the means to link a particular intervention or group to this change. To ensure sustainable sanitation service delivery in the country, it may not be sufficient to be able to track what changes in hygiene behaviours, awareness or practices have directly resulted from a sanitation intervention.. It may also be necessary, for future follow-up initiatives and implementation of further sanitation initiatives in other areas, to be able to attribute this change to a particular activity/s within the sanitation programme. The how the change was achieved would be invaluable for targeting and the planning of future sanitation interventions.

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MAXIMIZING THE BENEFITS FROM WATER AND ENVIRONMENTAL SANITATION

Proposals for a rapidly deployable emergency sanitation treatment system

Parneet Paul, UK

This paper discusses a novel concept design for a sanitation treatment system, based on membrane bioreactor (MBR) technology, to be used as a rapidly deployable unit in emergency situations such as a refugee camp. This study carried out on behalf of Oxfam GB, firstly, took a look at the types of emergency scenarios a MBR system may become applicable for such as site situations that preclude the use of traditional sanitary solutions like pit latrines. Secondly the study then assessed the feasibility of using a MBR to treat the wastewater generated from such a refugee camp environment. Three different concept designs were successfully developed to meet the sanitary needs of the emergency situation and some recommendations were made for testing these designs in the field. This study concluded that the use of a MBR in these difficult circumstances could prove appropriate on technical and operational grounds if not purely financial ones.

Introduction

The purpose of this study is to confirm the feasibility, both technically and financially, of using a MBR to treat the wastewater generated from a refugee camp environment. In particular for situations and site conditions that highlight inherent technical constraints of the more traditional sanitary solutions such as pit latrines (Paul 2003). The writer feels that in the majority of situations on-site sanitation would be the obvious and most appropriate method of excreta disposal, whether by using pit latrines, septic tanks, defecation fields, etc (Davis & Lambert 1995). In terms of off-site systems, then depending on land availability and soil conditions, a low maintenance waste stabilisation pond system may prove appropriate for most other instances. However, in certain extreme limiting situations a portable off-site system may be applicable. Such situations include:

1. Rapid, complex (and urbanised) emergency situations causing a large build up of refugee numbers where a pit latrine construction programme will take too long to implement and defecation ditches are not practicable due to severe land limitations or underlying-soil/groundwater conditions (or the possible long-term environmental pollution affects associated with these solutions).
2. In emergency situations where scarce water resources mean expensive water trucking/bowsering is required, and hence greywater recycling would prove advantageous.
3. For military expeditionary forces to use in their camps in order to reduce environmental pollution of surrounding areas and the reliance on existing, usually inadequate, treatment facilities.

At first glance it may appear an odd suggestion in using an energy-intensive packaged, portable sewage treatment works in a refugee camp context or similar setting to treat wastewater, where the camp itself is meant to be a transitory set up for a period of anything from 3 months to 2 years or more and where financing for such a system is limited. More especially the suggestion would seem even more unreasonable if it was advocated that a membrane bioreactor (MBR) system be the main form of wastewater treatment, which so far have been only used in heavily industrialized countries for treating of strong industrial wastewaters or for meeting stringent discharge standards for sensitive waters receiving treated municipal effluent.

The main reason prohibiting the use of an off-site sanitation system such as a packaged plant in a refugee context would be cited as the extremely high initial capital costs and the daily operation and maintenance costs including availability and cost of highly trained technical personnel. In contrast most traditional on-site systems such as pit latrines have very low capital costs and zero electro-mechanical energy requirements when compared to most other types of off-site treatment and/or storage systems.

Oxfam criteria for a rapidly deployable portable wastewater treatment system

Oxfam GB has specified the following criteria for a rapidly deployable system that will meet their needs out in the field (Walton-Knight 2002):

1. Ideally it should be pre-packaged into a kit form that can be rapidly and easily assembled on site, and should be capable of handling excreta produced by a camp population of 5,000.
2. Assembly should be possible by untrained personnel under Oxfam technical supervision.
3. It should meet Oxfam's volume, height and weight re-

strictions of being able to be transported on a 6 m length 4 tonne flat bed truck.

4. The capital and operating costs of the system should meet Oxfam's criteria of US$25,000 overall and US$5,000 per month respectively, i.e. US$5-00 and US$1-00 per head of camp population respectively.

The writer has added the following additional criteria to make a more comprehensive and flexible design (Paul 2003):

5. The design should be simple (i.e. a single flow train with no recirculation), easy to operate by unskilled (but trained) labour, robust with little chance of breakdown, reliable in effluent quality produced, and very quick to start up.
6. The system should be capable of producing effluent of sufficient quality so that greywater recycling is possible to alleviate possible camp water shortages.
7. The sewerage delivery system (if used) and the communal toilet trays/pans with toilet float system should also come as a matching quick assembly kit.
8. To increase flexibility on very flat or congested sites where a sewer system is impractical, then a matching latrine vault and vacuum truck/cart system should also be offered.

Site conditions and land considerations – why is a system of this type required?

The principle areas in which pit latrines can prove ineffective are as follows (Cairncross & Feachem 1983):

- *Rocky ground* - Latrine construction in solid rock areas can become both difficult and expensive since large mechanical diggers and/or jackhammers are needed.
- *Sand* - Building latrine pits in loose, sandy, unconsolidated soils can be hazardous as they are prone to collapse. The lining must also control the seepage rate of faecal liquors into surrounding soil that has a very high porosity and permeability.
- *High water table* - Digging pits in high water table areas is difficult as they will soon fill with water and are prone to collapse in the wet season.
- *Water contamination* - Surface and ground water sources can become polluted by nearby latrines leaking effluent.
- *Land constriction and congested camps* - Often refugee camps are constructed around an existing permanent settlement so that the refugees can understandably access nearby services and facilities. This usually means that the land area is already congested in these usually illegal squatter camps with more refugees arriving daily. Consequently existing communal latrines can begin to fill up at a much faster rate than safely designed for and this leads to an almost constant latrine construction programme in an already congested site.

Methodology

The design flow and load for the system are critical factors since they determine the size of the aeration basin and the number of membrane units required, both of which are important factors in determining the overall system's capital and operating costs. When sizing the treatment plant the loading rate of BOD (biochemical oxygen demand) produced per person per day is needed together with the amount of water put down the pit per person per day. The design engineer can design the facilities so that only urine, faeces and flush/cleansing water are put into the system thus reducing plant size by omitting other "unnecessary" and uncertain flows and loads from the system.

Accurate treatment plant sizing using a Monte Carlo simulation for a range of flow and load conditions

Since no data is available for a system of this type, a simple Monte Carlo procedure was developed to more accurately estimate the design volume of the aeration basin and the MBR membrane area required for a wide range of influent conditions. Under this procedure the flow and load parameters were not entered as single integer values but as a range of possible values (see Table 1). Thus the Monte Carlo simulation generated up to 10,000 randomly calculated volume and area values within the parameter ranges specified, and the 95th percentile optimal value for volume and area was determined as 88 m^3. This means that the designer can say with a strong degree of confidence that a standard Oxfam T95 tank of volume 95 m^3 should be able to cope as an aeration basin for a refugee population of 5,000 (see Fig. 1).

A universal discharge standard for effluent

As there is no existing universal sewage discharge standard for either normal or emergency situations, Walton-Knight (2002)

Table 1. MBR Design using 10,000 Monte Carlo Simulations for Various Parameter Ranges

Variable	Units	Range
Per Capita BOD per day	g BOD/p/d	3 - 9
Per Capita flow per day	l/p/d	5 - 15
Camp population	persons	2,500 - 7,500
Food / Microrganism ratio	1/d	0.05 - 0.10
Mixed liquor suspended solids ratio	mg/l	8,000 - 18,000
Membrane flux rate	$l/m^2/h$	15 - 30
Influent concentration from septic tank	mg BOD/l/d	600 - 600
Daily flow rate out of tank	m^3/d	12.5 - 112.5

carried out a comprehensive review of existing world-wide standards and produced the following universal one: absolute limits of 20 mg/l BOD, 40 mg/l TSS, 15mg/l ammoniacal-nitrogen and a maximum of 5,000 faecal coliforms per 100 ml. It is important to note that it costs 5 times more in energy usage terms to remove the last 20% of BOD then the first 80% (Horan 2003). So for a system of the type described here, a more realistic consent of 50 mg/l is advocated that would mean real cost savings in aeration tank volumes and even more significantly in aeration rates and thus the power rating of aeration equipment employed.

Design of the sewerage network/vault emptying system

Two types of delivery system can be employed to match up with the prefabricated toilet kits and the kit for the deployable MBR system:

- *A set of small bore* simplified sewer pipes with quick-fit joints for rapid assembly to be laid at very shallow falls requiring the minimum of excavation.
- *A desludging system* employing hand-pumps, vacuum trucks or vacuum carts to regularly desludge the holding vaults coming from the toilet blocks. The desludgers would empty their contents directly into the head of the treatment works (see Fig. 2).

Other design considerations

The inclusion of a septic tank at the head of the works means a 70% reduction in incoming BOD levels for design temperatures above 25°C (Mara & Mills 1994). This means significant reductions in aeration rates and costs. With a six day retention time, it would also preclude the need for coarse screening and grit removal. The only pretreatment suggested after the septic tanks is by using 3mm disposable sack screens which affix to a nose box holder (IWEM 1992). Out of the various submerged membrane systems currently available (see Photo.1) it is recommended that the Kubota system is selected because it has the lowest energy requirements in terms of hydraulic pressure and simplest

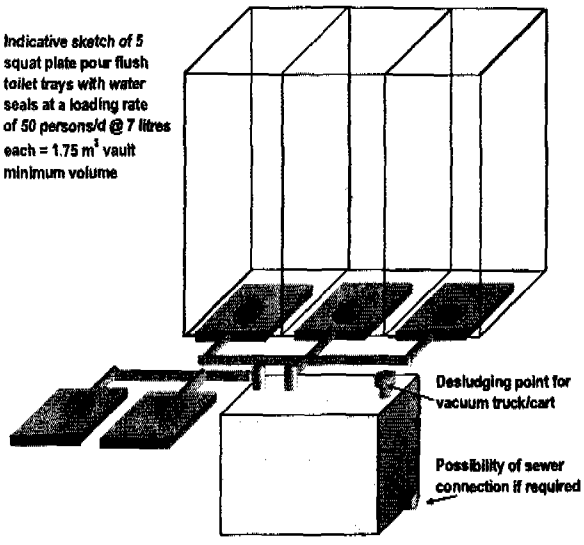

Figure 2. Proposed pre-fabricated toilet trays, vault and connector pipes

Source: Paul, 2003

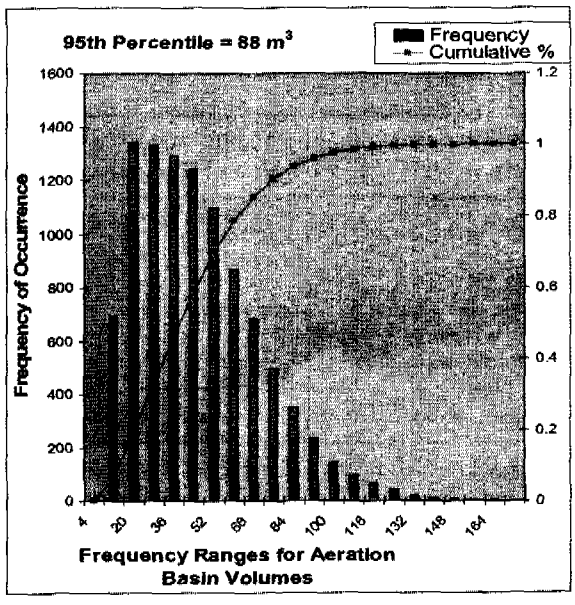

Figure 1. Outcome of 10,000 Monte Carlo simulations for a submerged MBR system connected to a septic tank

Source: Paul, 2003

Photograph 1. Typical submerged membrane module

and lightest cleaning regime (Churchouse 1997, Judd 2002). The overall hydraulic head requirements of the whole train should be no more than about 2 metres altogether, so in very flat areas this can be still supplied by raising up some of the tanks accordingly. The advantage of the Kubota system is that it is operated under gravity so no energy is required for pumping. The membrane modules themselves consist of either 100, 150 or 200 flat panel plate and frame membranes sandwiched together, and theoretically only require a 2 hour caustic chemical clean every 6 months.

Aeration system and other supporting mechanical equipment

The only energy requirement for this concept design is that of aeration. A slightly higher effluent quality requirements of 50mg/l will give a substantial reduction in the aeration rate needed and hence the energy cost in fuel usage terms. There are a multitude of aeration systems available on the market that would all need to be looked at closely to see which performed the best for this situation.

Recommendations

Three different concept designs were developed for Oxfam under this study to suit slightly different field conditions and population requirements (Paul 2003). Only Option C is described in further detail in this paper as it is thought to be the most flexible and economical solution. The idea behind Option C is the use of existing pre-packaged Oxfam water tank kit combined with an aerated lagoon design. A mechanical aerator located on a floating platform is used in the design to aerate the lagoon. The lagoon outfall discharges into the membrane module (see Fig. 3). This design can be used for very large camps with fluctuating populations and is flexible in that various lagoon sizes can be specified. Table 2 summarises the calculations carried out for this system with basic costs attached to give an indication of whether Oxfam's financial constraints for a system of this type can be met.

As noted this design should be used for very large populations located in an urbanised context and only uses a mini-aerated lagoon about the size of a swimming pool (see Box

Table 2. Summary of Entire Calculations for Design Option C that uses Aerated Lagoon as Aeration Basin

a) BOD Concentration Out & Area and Volume of Aerated Lagoon	
Soluble BOD_5 in effluent in mg/l = 24.24 Assume depth of lagoon, D = 3 m Then mid-depth area, A in m^2 is 66.67 And lagoon volume, V in m^3 = 200 ∴ choose 1 square lagoon 9m x 9m = 81 m^2	
b) Aerator Sizing	
Aeration Power, P in kW = 1.38 Power for complete mixing in kW, P_M = 1.00 ∴ choose 1 central 1.5 kW aerator for lagoon	
c) Total Capital Cost Calculation for System (includes equipment needed for 6 months operation) - 2003 values	
3 x T95 Oxfam Tanks (with full accessories)	$ 12,704
1 x Butyl Rubber Liner (12m x 8m)	$ 547
1 x Set of pipes, valves, etc	$ 2,000
1 x 100 Panel Kubota Unit (in $4m^3$ plastic tank)	$ 8,330
1 x 1.5 kW Submersible Aerator	$ 3,870
1 x 1-2.5 kW Diesel Genset	$ 3,909
1 x Sack screen housing	$ 1,000
10 x 50 packets of 3mm Sack Screens	$ 1,000
1 x Spare parts, filters, etc for aerator and Genset	$ 3,000
5% for contingencies	$ 1,818
TOTAL Estimated Capital Cost in US dollars	$38,177
d) Estimation of Monthly Fuel Usage Costs for the System - 2003 values	
Using the formula given in the US EPA's Wastewater Technology Fact Sheet for Aerated Partial Mix Lagoons Sept 2002, where electrical energy in kWhr/yr, $E = 6598(HP)^{1.026}$ where HP is the aerator horsepower, hp. To convert kW to hp, use 1 hp = 0.7457. Therefore aerator power in hp = 1.85 and Energy Usage in kWh/month = 1,100 Assuming continuous operation, and using a fuel usage rate of 0.3 litres/kWh taken from Davis & Lambert (1995), then for a 30 day operation: Amount of diesel fuel needed for a month = 330 Assuming a diesel cost per litre of US$ 1.50 in-country, then month fuel bill in US$ will be = 495	
Diesel Fuel	$495
Desludge costs	$1,000
Labour	$1,000
5% for contingencies	$125
TOTAL Estimated Operating Cost in US dollars	$2,620

Box 1. Design Option C - Pre-fabricated Kit Version using Oxfam Storage Tanks & Aerated Lagoon

Advantages
- Can deal with populations greater than 10,000
- Comes as kit so easily transported
- For larger populations simply add more tanks in series & increase lagoon size
- Only sac screening required
- Simple aeration system to install & operate
- Probably will meet Oxfam's capital cost requirements

Disadvantages
- Mechanical aerator not efficient but cheap
- Will need to desludge septic tank every 6 mths
- Will need to double tank & lagoon lining as safeguard against puncture, & seepage
- Will need to take rainwater in account when designing lagoon
- Major excavation work needed for lagoon
- Footprint much larger than other design options

1). The lagoon would be lined with butyl rubber to prevent groundwater seepage and hence will need substantial excavation works. However any excavated material can be re-laid and compacted to form the lagoon bund walls. This design is robust enough so there is no need to worry about the forces generated by the mechanical aerator. The lining also prevents bank erosion by any wave action induced. The lagoon can be shaped to reduce hydraulic short-circuiting, and is designed as an extended aeration, complete mix system. The lagoon would need only very occasional desludging.

Design of the greywater recycling system

Considerable water savings maybe made if expensive water bowersing operations are being used to provide the camp with sufficient daily potable water. Up to 95% recovery is common for a MBR system. It is advocated that greywater produced is first chlorinated using a simple chlorine doser and then stored, before being pumped to a high level mixing tank where it is premixed with fresh water to give a better nitrate and colour dilution since microfiltration is not good at removing these contaminates (see Fig. 4). Theoretically this greywater would be good enough to be utilised as a potable supply but whether it is ethical to do so is another issue as well as the attitude of the refugees themselves towards this. However this greywater can be used as a secondary water quality source designed for clothes washing, body bathing and flushing of pour flush latrines.

If activated sludge is not available in-country to seed the works then bioaugmentation can be used to allow a rapid build up in heterotrophic bacteria which digest the wastewater BOD organics. This commercially available seed material comes either as a liquid preparation or in solid pellet form so can be pre-stocked beforehand. The following further points have to be considered when deciding whether to install a system of this type: power supply requirements and reliability of supply, length of duration of the refugee camp, sludge handling and disposal methods, and the critical issue of maintenance of mechanical equipment, spare parts availability and standby capacity.

Flow train for Design Option C) - Pre-fabricated Kit Version using Oxfam Storage Tanks & Aerated Lagoon Design with Butyl Rubber Lining & Floating Mechanical Aerator

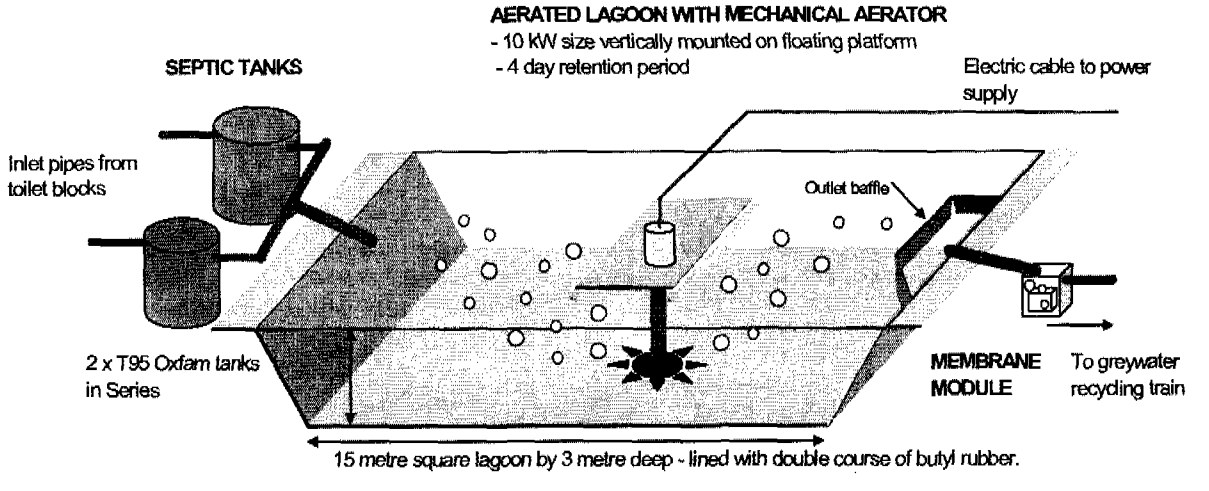

Figure 3. Recommended Oxfam rapidly deployable emergency sanitation design system

Source: Paul, 2003

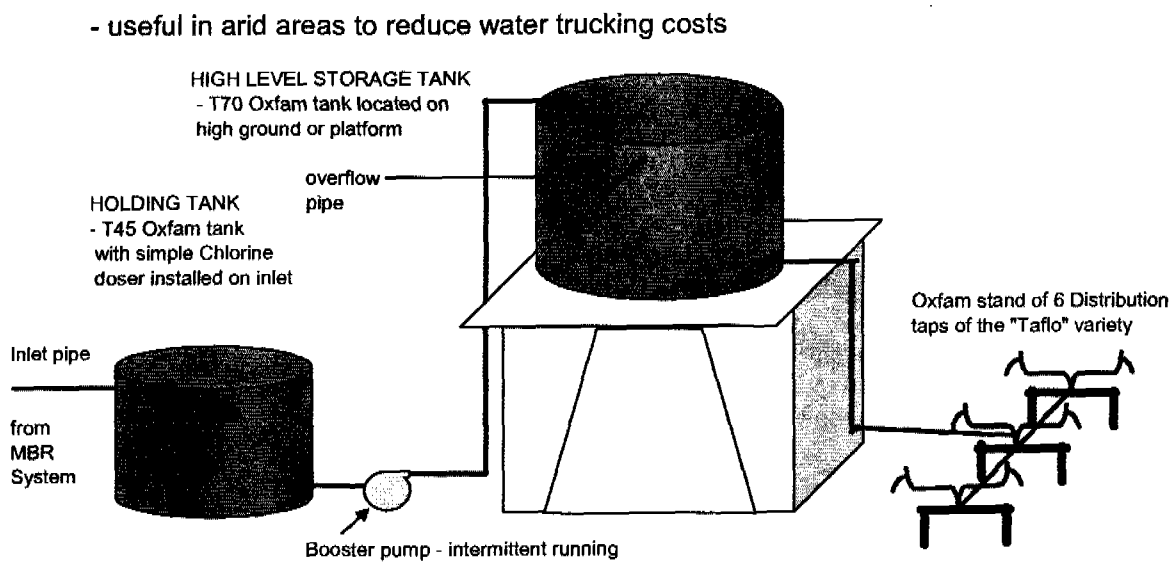

Figure 4. Proposed greywater recycling system

Source: Paul, 2003

The military camp situation

Where a system of this type is certainly cost effective is when used by a military expeditionary force. By contrast to the usual refugee camp scenario, a military camp normally has heavy moving equipment to allow easy plant installation, a readily available fuel supply, more money to run the system, and technical expertise on-hand to operate it. However, the influent characteristics could be far different in terms of BOD flow rates per Capita than for a refugee camp, and would be more comparable to that produced by a small package treatment works. Hence a military camp design would have to be altered accordingly.

Conclusions

In terms of selecting a rapidly installable system for an emergency context which can start producing good quality effluent straightaway; where speed of sanitary treatment is more essential and money is a lesser issue, then a septic tank system coupled to an MBR system via an aeration basin could be the only quick option capable of handling the type of population build-ups that occur in refugee camps, whilst still being relatively easy to maintain. Further compared to other aerobic treatment methods, since a submerged MBR effectively divorces the hydraulic retention time from the sludge age, then the process is extremely robust in process control terms. On the other hand conventional activated sludge processes (ASP) are much more easily upset with flow and load variations, and complicated further by recirculation flows. In comparison a submerged MBR is only a single, simple flow-train with the operator not having to worry so much about what's happening in the aeration basin so long as sufficient aeration is taking place.

In conclusion, the basic argument being presented here is that a rapid onset emergency situation developing into a possible catastrophe is unique and can break the normal rules applied to long-term sustainable development or any transitional phase of post reconstruction works, since the speed and rapidity of sanitation coverage is what is required, and sustainability is of lesser concern due to the temporary nature of the situation. However, as there have never been kit versions before that can be rapidly assembled, that are portable, and more importantly reusable at different sites, then careful testing in the field has to be conducted to verify this concept. It would initially involve pilot plant testing to measure flow and load data into the works. Several toilet block and sewer system designs, which connect into the plant, would also be simultaneously tested and investigated to obtain the optimal system configurations and operating ranges of this plant.

Hence it is anticipated that a system of this type will be used:

1) by agencies like Oxfam in a refugee camp setting, or by a military force in an expeditionary camp setting; and

2) that this design will give Oxfam a greater flexibility and responsiveness when it comes to meeting the sanitary needs of refugee camp communities in future complex emergency situations; and

3) it will also give the sanitary engineer a greater selection of sanitary options particularly when facing technically challenging topography and/or soil conditions.

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Theme: Environmental Sanitation

Practitioner Papers
(Practitioner or Knowledge sharing papers - Option A)

31st WEDC International Conference, Kampala, Uganda, 2005

MAXIMIZING THE BENEFITS FROM WATER AND ENVIRONMENTAL SANITATION

Policy: The bane of urban solid waste management problems in developing economy (a case study of Lagos State, Nigeria)

Oluwole O. Akiyode, Nigeria

The objective of the paper is to review the old and existing policies on Urban Solid Waste Management Practices in Lagos State, Nigeria. This is the most populous State in Nigeria with a population projection of 13.4 million in the year 2000AD. The Urban Solid Waste Management Practices in the State has been experiencing policy changes since Nigeria Independence in 1960 which results in continuous dumping of solid waste in the median of roads, waters, drains and other illegal places in the urban setting of the state. The state is donned with solid waste even with the huge financial input of the state. The paper attributed the failure of the Solid Waste Management Practices to imposing of new waste policy on the public year in year out without consideration of their opinion and lack of sustained public education.

Introduction

Nigeria is regarded as the most populous country in Africa. It has a population projection of about 120 million people at present. It is also an oil rich nation. The increase in the earnings of petroleum resources particularly during the 1970 led to increase in industrial and economic activities in the country.

The urban settings of the country are donned with solid waste, thereby calling the attention of policy-makers and the citizenry to its health implications.

Lagos State is the smallest of the 36 States of the Federal Republic of Nigeria with area of 3,577sqkm representing 0.4% of the nation. It is the most populous state in the country with a population projection of 13.4million in the year 2000 and 23.2million in the year 2015 A.D (World Bank/UNFPA, 2001). It was estimated in 1988 that Lagos State population is growing at an annual rate of 8% in Urban areas and 3% in rural areas which is enhanced by in-migration (Napep 2004). This is because about 60 to 70% of Nigerian Industries are situated in Lagos State. It has the busiest seaports and airports in the country. The in-migration of the people to Lagos State is for economic purposes (greener pasture).

It is observed that "Recently emerged urban centers throughout the country have similarly experienced growth process and heaps of refuse are common sight in urban areas of the federation" (FMHE undated). Bamigbose et al (2000) attributed the in-migration of people to Lagos to the oil-boom of the 1970's in Nigeria and the consequential neglect of the rural areas (due to industrialization of the urban areas). The in-migration is due to increase economic activities which invariably leads to the huge solid waste being generated in the state. Population and industrialization are major determinant of global waste generation. 'This is corroborated by US Municipal wastes, which increase five times as quickly as population over the fifty-year period of 1920 to 1974'(Meleosi 1981)

The rapid increase in Lagos metropolis "far outstrip the physical planning efforts of governance and the private sector as well as development of infrastructure facilities (The mega cities project, 2000-2002). Meyer (1994) also said "the waste disposal problems have also led to land despoliation, dumping problems has visual and olfactory pollution even in the absence of disposal of specific toxins".

Longe et al (1997) said Lagos faces serious environmental and health risk due to uncontrolled municipal refuse on the streets and in public areas and clogged urban drainage system from indiscriminate dumping of refuse which could lead to both surface and groundwater contaminations. There is obvious littering and dumping of solid waste in streets, drains, streams and waters of Lagos which authority responsible for managing the environment in the state are still looking for a way to effectively manage even with the huge financial input of the state.

Integrated waste management problems

Integrated Waste Management is a frame of reference for designing and implementing new waste management system and for analyzing and optimizing existing system. Integrated approach allows the participation of public, private and informal sector actors in the role appropriate for each. It has affordable technology and multiple approaches to solve waste management problems (UNEP1997)

The treatment and management of solid wastes starts from the source of generation, having storage, collection and transportation system as backbone and disposal system as final point. Collection of solid waste could be done through (a) House to house (b) street to street (c) by cart pushers.

In Lagos, the PSP (Private Sector Participation) is tasked

with the collection of solid waste from residential and markets, garages and public institutions and its onward transportation to the designated landfill sites. The concept is that Government intended to hands off refuses management completely by licensing the private operators. The PSP are expected to go from house to house to collect waste and transport them to the landfills. The PSP engaged are expected to have "big" tipping vehicles. In the Integrated waste management of Lagos state the SCARVENGERS (waste pickers for resource) and the CART PUSHERS are banned from the system. Thus their activities are illegal. The cart pushers charge less or affordable prices. The cart pushers have the sympathy of the masses and could penetrate the inter lands or areas where PSP's vehicle could not. This is hindrance in making the system works. There are only three Transfer loading station in the whole of Lagos State. Transfer Loading Station is facility where wastes are unloaded into large vehicle which will convey it to disposal site. The absence of this in many areas lead to frequent offloading of waste in roads, median, lands and waters of the state because of the distance of the landfills and transfer loading station to respective communication.

Inefficient operational arrangement

We have several bodies saddled with the responsibilities of monitoring and enforcing environmental sanitation programmes in the state. They are KAI, LAWMA, LASEPA, HIGHWAY MANAGERS, SEHMU, Drain ducks, Health Officers, Environmental Sanitation Officers, and Environmental Officers etc. The agencies function overlaps, interferes and duplicates. Also the enforcement procedures of all these agencies involved in managing of wastes are looked at as a revenue generation mechanism not corrective procedure.

State waste policy formulation

Nigeria has been under the military rule for several years before the new democratic dispensation in 1999. The citizens and local officials were rarely consulted in the adoption, creation or implementation of policy under the military rule. This has really affected our environment for policy on environment changes regularly which result in continuous environmental degradation.

A leaf could be borrowed from Bulgaria Solid Waste Policy demonstration project which leads to comprehensive national legislation. Bulgaria is a former communist nation whose government had been managed in a centralized manner with the citizens and local officials not consulted on the creation or implementation of policy. It was found that "illegal waste disposal was an all too familiar sight with waste strewn along the roadsides, rivers, and streams. The country has 1,600 uncontrolled landfills which impacted the air, land and water (ground & surface).

In 1995, the leadership in the Bulgaria Ministry of Environment recognized the need to reframe and develop their environmental policy. Thus they agreed to a multi-level open policy development process which included seminars or workshops, field testing in demonstration communities and public participation and education.

The outcome of the project could be summarized in the statement of US EPA deputy administrator William Muzynski (Nov. 1996). He said under 2 years Bulgaria has defined a program that took 25years to evolve in the US. The success of the programme was believed to have come through the "building burning public opinion and utilizing that energy in promoting systemic change in environmental management".

The non involvement of the public in Lagos State environmental policy is a minus to the State environmental sanitation programme.

Regular failure of citizenry complying to laid down solid waste management policy is always due to lack of sustained public enlightenment or education.

Public education enhances compliance and boost enforcement

A new waste policy became operational in October 1st 2004 where Mega PSP operators are licensed to do the refuse clearing. In the new arrangement the flat-fee-for-service system is employed. This is in variance with the former variable-rate pricing (pay as you throw). The opinion of the public is essential in policy formulation for the environment. In this case it was not given consideration in the new waste management initiative. The Ministry was also not sensitive nor considers the contract agreement entered by the citizenry with the former PSP operator servicing them. The state Government started introducing the policy to the public barely two months to the time of its commencement (Home and Property, 2004).

Lagos is yet to develop recycling policy. "There are few formal systems of material recovery through public agencies or the private sector in Africa"(UNEP 1996). In Lagos State, material recovery takes place only in the informal sector.

Plastics, bags, bottles, papers, cans and cardboard may be re-used or recovered at household level. Berlin based institute of Ecological Recycling claimed that up to 90% of pollution results from the products and this underlies the rationale for the radical Environmentalist demands for a focus on waste reduction at the source rather than a policy emphasis in post consumer waste (Mathew 1994).

In page 9 of "Policy on the environment"(LASEPA, undated) it was stated the "collections of industrial waste have not been differentiated from that of domestic and both are disposed off together". This is dangerous. Since the only available disposal unit in the Landfill (dumpsite). The State is having 3 recognized dumpsites but there are also several illegal dumpsites. The possibility of underground water contaminations could not be ruled out. This is dangerous to those that depend on well water for consumption in these areas. Also obnoxious gases are continuously sent to the environment by these landfills (dumpsites) since they have no landfill gas management programme. Only one of the landfills has monitoring well. Based on the "policy of co-disposal" of solid waste, Akiyode (2003) in a study of

one of the landfills (Solous landfill) found that it accepted different kinds of wastes both hazardous and non-hazardous and leachate composition showed the presence of Pb 0.52mg/l, Cd 0.04mg/l, Ni 0.66mg/l, Fe 92.27mg/l depicting heavy metal toxicity of the environment and with BOD 440mg/l, DO 1.08mg/l, pH 8.2 and TDS 19,108mg/l. Also Osuntogun (1999) found the average concentration of gases at the so-called landfills (dumpsites) to be CO 10.76ppm, NOx-0.222ppm and sulphur (1V) oxide 0.070ppm. All these were higher than the national standards for ambient air NOx-0.04-0.06ppm, CO-10ppm and Sulphur (1V) oxide-0.01ppm respectively.

Recommendations

1. The opinion of the citizenry should be given consideration in the policy formulation for solid waste. Also the current policy on the environment needs to be looked into for its variation with normal good waste management practice.
2. Waste characterization data is an essential tool in Integrated waste management. This is currently lacking. The researchers in collaboration with authority involved in managing wastes should always make this available for effective determination of suitable waste management stream for the system.
3. There is need to streamline the agencies involved in managing wastes and their duties and functions demarcated. They should also be made to discharge their duties with commitment and sincerity of purpose.
4. There is need for transfer loading station to be built in different locality and close to the populace and the waste management could only be integrated if the cart pusher and scavengers are incorporated.
5. There is need for dissemination of information about the waste technology employed to the generality of the people. Public enlightenment is a plus to every waste policy in a community.
6. Environmental offences should be tackled not with punitive cum fund generation ideas but a way of abatement of the harm done to the environment.
7. Incinerators, Composting facilities and Sanitary landfills are essential for the State waste streams.
8. Recycling should be encouraged.

Conclusion

The paper is affirming that unhealthy and unstable Environmental Policy is the bane of Urban Solid Waste Management Problems in Lagos. Thus the development and reframing of the Environmental Policy to suit the "burning public opinion" of the citizenry is essential to tackle the huge Waste Management problems of the Developing Economy. Also an acceptable policy should be allowed to face the test of time to access is adequacy and inadequacy. This will go hand in hand with public sensitization cum enlightenment. Nevertheless, a well defined waste management policy is expected to be based on the principles of sustainability and resource conservation. This could be done by choosing waste management practices according to the solid waste management strategies hierarchy. The US EPA ranked the most environmental strategies following this order. Source reduction (including re-use) which is the most preferred option which is followed by recycling and composting and lastly disposal in combustion facilities and land fills.

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MAXIMIZING THE BENEFITS FROM WATER AND ENVIRONMENTAL SANITATION

Health and hygiene situation in Northern Areas of Pakistan: Pre and post WASEP interventions

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The overarching goal of Water and Sanitation Extension programme (WASEP) is to reduce diarrhoeal morbidity by 50% in its partner communities. WASEP includes water supply, sanitation, drainage, water quality and health and hygiene education in its interventions. To calculate the possible impact of health oriented intervention, it is very important to have knowledge of existing health situation and it is always valuable to know about local beliefs and practices concerning hygiene behavior. Unfortunately, hygiene education has been an ignored subject and has not been key objective to the organizations responsible for providing rural water supply schemes and has never been an attractive option to the villagers of Northern areas and Chitral. Health should be one of the prime objectives for investing money in a water supply and Sanitation programmes. The prevailing situation requires a thorough thought to address this subject. There is a large vacuum in this field, which needs to be filed with better planning. There are many aspects of rural life in the Northern Areas and Chitral region of Pakistan where people have unhygienic traditional practices. Unfortunately, sometimes these unhygienic practices are linked with beliefs and religions. Some people for example believe that all flowing water is clean i.e. river; channels etc. regardless of its source. Also, cloths after washing with soap are not considered clean (Paak) if not dipped in water at least one meter deep. Women are main procurer and user of water and entirely responsible for sanitation and hygiene of the family at home. In many parts of northern areas, acute shortage of water, ignored sanitation and hygiene have made life difficult for women. A water and sanitation programme, should therefore involve women in the development process. The central role of women in water, sanitation and hygiene has been emphasized in throughout WASEP's five years progamme. WASEP has been aiming to provide safe water at injection rather than at source or at tap stand. As discussed above, women shoulder responsibility of providing water to their families. Therefore, primary target group was the women who also carry out the risk practices. i.e. cleaning children, handling children's stool and responsible for excreta disposal.

Prevailing situation

Unfortunately, hygiene education has been an ignored subject and not been key objective to the organizations responsible for providing rural water supply schemes and has never been an attractive option to the villagers of Northern areas and Chitral. Health should be one of the prime objectives for investing money in a water supply, Sanitation and health and Hygiene. However, the prevailing situation requires a thorough thought be given to address this subject. There is a large vacuum in this field, which needs to be filed with better planning. There are many aspects of rural life in the Northern Areas and Chitral region of Pakistan where people have unhygienic traditional practices.

Collecting baseline data

To investigate and find out need, existing practices and requirement of target community, information is collected through individual house hold visits, for the design of health and hygiene programme. WASEP's health and Hygiene Promoters collect pre- intervention baseline data through individual household visits on personal hygiene, domestic hygiene and environmental hygiene. The parameters (shown in the table) were used as indicators to test out the existing knowledge of the communities (women) about exiting hygienic practices. In fact these were taken as foundation for the improvement of personal and domestic hygiene and emphases were given to these parameters in achieving the overall objective of the WASEP' health and hygiene program. Through direct observation and using some of PRA tools, information was gathered from the villages. Each indicator was given a score say 1 to 10 through observation. For example:

Condition of storage vessel

a. Dirty and uncovered	0
b. Dirty and covered	4
c. Clean and uncovered	6
d. Clean and covered	10

Data was analyzed and presented in the graph. This data was collected from on an average 20 villages each year covering 100 house holds from each village. It is worth mentioning

Table 1 Parameters for Health and Hygiene assessment

Name of indicator	
1) Use of clean utensils	2) Knowledge that dirty water may cause diarrhoea
3) Covering of utensils against dust and flies	4) Knowledge that flies may cause diarrhoea
5) Provision of cover on water storage vessel	6) Knowledge that germs may cause diarrhoea
7) Presence of human faeces in courtyard	8) Knowledge that open deafecation (faeces) may cause diarrhoea
9) Presence of human faeces outside of houses	10) Knowledge that dirty hands may cause diarrhoea
11) Presence of animal faeces in courtyard	12) Hand washing before eating
13) Cleanliness of courtyard	14) Hand washing after deafecation

that same health and hygiene promoters collected this data pre and post intervention.

Data is also collected for diarrhoeal incidences and other water and sanitation borne dieses. i.e. cholera, typhoid and hepatitis etc. However, only diarrhoeal diseases were considered because many other factors contribute to the incidences of other diseases and those are difficult to measure. Data from household is verified from nearby health facility (Hospital, dispensary etc) and group discussions during PRA exercises.

Parameters in Table 1 were considered as indicators for the improvement of health and hygiene practices pre and post implementation of WASEP interventions.

Involving women

There is still a large room to improve despite the women's decade (1975-1985) is over.

Women are main procurer and user of water and entirely responsible for sanitation and hygiene of the family at home. In many parts of northern areas, acute shortage of water, ignored sanitation and hygiene have made life difficult for women. A water and sanitation programme, should therefore involve women in the development process.

The central role of women in water, sanitation and hygiene has been emphasized in throughout WASEP's five years progamme. WASEP has been aiming to provide safe water at injection rather than at source or at tap stand. As discussed above, women shoulders responsibility of providing water to their families. Therefore, primary target group was the women who also carry out the risk practices. i.e. cleaning children, handling children's stool and responsible for excreta disposal.

Community Health Intervention Programme (CHIP)

This programme was started with individual household visits by Health Promoters in partner villages to achieve following objectives:

- To create awareness about personal, domestic and environmental hygiene.
- To help them understand how water and sanitation borne disease are spread and what preventive measures can be taken.
- To make villagers aware how their children are cured infected by diarrhoea.
- Promotion of latrines and their usage.

In theory, much has been written about women's role in water and sanitation, but women still have not been given real importance in these projects.

WASEP has employed female health and hygiene promoters (HHPs) who have relevant professional backgrounds and can speak local languages. They carry out hygiene education to women and children. A variety of methods to put the health education messages across the partner communities are included:

- Group discussions
- Posters and pamphlets
- Role-playing
- Demonstration
- Local radio

In addition, household visits for monitoring purposes provide unique opportunities both for Health and Hygiene Promoters (HHPs) and families for sharing experiences on a given hygiene behavior.

Just after identification of the project a female member from each village is also selected by the communities for the position of Water and Sanitation Implementer (WSI) to take care of the health and hygiene activities being undertaken in her village. As the change of behavior is not a one time job, it is a long process. Therefore, WSI remains as a link between community and WASEP after withdrawal of WASEP and responsible to continue facilitating communities with hygiene promotion. WSI is remunerated by the endowment fund already in place by the beneficiaries.

Involving school children

School Health Intervention Programme (SHIP) was initiated to focus on school children in the partner villages. Because, after home, schools are the most important place to learn. Children have an important role in their houses. Elder chil-

dren take care of their younger sisters and brothers and they eager to learn new things. Therefore, children can play an active role and can be a stimulus and a change agent for the improvement of hygiene behavior in the community.

Curriculum development

In Most of the Northern part of Pakistan, there are schools run by Aga khan education services. Therefore, it was not difficult to incorporate the curriculum of health and hygiene education in school hours. Local government education directorate was also kind enough to include a period (zero periods) in the schools located in WASEP interventions. Follow up visits showed that most of the teachers were enthusiastic in continuing this programme in their schools.

"Hand washing with soap and water after contact with faecal material can reduce diarrhoeal diseases by 35% or more" and "using a lean pit latrine and disposing of children's faeces in a pit latrine can reduce diarrhoea incidences by 36% or more: (Almedom et al (1997)

For bringing about changes in hygiene behavior, on the basis of the research of Water, Sanitation, Health and Hygiene Programme following were taken into account while developing curriculum and messages:

- Be relevant in local context
- Be locally acceptable
- Be action oriented

The curriculum developed for SHIP consists of eight topics.

- Clean hands (washing with soap or at least with ash or soil)
- Safe disposal of faeces
- Latrine usage
- Diarrhoea (causes and preventive measures)
- Worms
- Clean and safe water (at point of use/while drinking)
- Safe food
- Personal hygiene

Visual messages were developed on some of above topics. Latrine usage and washing hand, for example. All these topics were passed on to the target audience during house hold visits and in focus group discussions. Rubbing hands with soil (locally called Tayamum) in absence of water is a local practice (probably people have drawn the idea from Islamic beliefs) therefore, this was incorporated in the message, that if soap is not affordable, washing hands with ash can be helpful. Local females who read Quran (holy book) and religious leaders were included in disseminating the messages about the importance of cleanliness in the light of Islam. The Institute for Education Development (IED) of the Aga Khan University also provided guidance on the development of the curriculum.

Conclusion and recommendations

- Sanitation facilities should be culturally appropriate and acceptable to the users.

Mainly existing practices of the sanitation options were improved i.e. twin pit composting latrines, on the basis of the extensive research of the predecessor of the WASEP. Pour flush latrines were constructed by many organizations but they were rarely used by the beneficiaries for many reasons.

- Apart from quality, quantity of water also helps in achieving broad health impacts.

Although, WASEP provides potable water to its partner communities, however finding during research phase revealed that ample quantity of water available in the areas had contributed a lot to improve the health.

- Close access to water fosters the use of hygiene practices related to water.

During technical monitoring and evaluation of the WASEP interventions it was found that the households having tap stands in their courtyard had been using more water for washing cloths and cleaning themselves than those not having tap stand in the courtyard. It is worth mentioning that WASEP provides tap stand in the courtyards only when there is provision for the disposal of grey water.

- Water supply interventions should be integrated with sanitation facilities and health awareness activities to achieve health benefits.

In WASEP interventions, 100% sanitation coverage could not be achieved. Therefore, follow up visits by health and hygiene promoters showed that those households not having improved latrines were suffering from diorrhea more often than those having improved latrine.

- Knowledge of local norms, beliefs and practices is vital to tailor health and hygiene education.

In Northern areas of Pakistan almost there is 100% Muslim population. Therefore, religious leaders were involved in propagating health and hygiene messages in the context of Islamic teachings. This resulted into a good response.

- Women, being responsible for health matters, Children, the most susceptible to the water associated dieses, must be involved in development process

This was the major difference between WASEP and other Govt and NGOs in WATSAN sector. WASEP was first of its kind it the Northern region of Pakistan to involve women in identifying location and design of tap stand and latrines and given representation in the water and sanitation committees.

In addition, children were given opportunity to learn about the health and hygiene engaging them in SHIP.

- A woman may be culturally more acceptable as health and hygiene educator.

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MAXIMIZING THE BENEFITS FROM WATER AND ENVIRONMENTAL SANITATION

Factors influencing equitable distribution of water supply and sanitation services in Uganda

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Inequitable distribution of water and sanitation services has received national recognition and equity has been adopted as a key theme that should be monitored and measured every year as part of the sector's performance review. The study revealed that existing policy prescriptions, strategies and guidelines are largely inclusive of equity provisions. The problem is more of policy translations and application at the district and lower levels. The study concluded that, whereas other factor such as natural occurrence of water, hydro-geological factors and availability of funds combine to dictate the choice of technology for water service delivery, political influence seems to be decisive in actual allocation of water points to be constructed especially where there is no accurate information and uncertainty about the technical criteria to use.

Introduction

WaterAid Uganda in consultation with the Sector Performance Thematic Team[1] (SPTT) carried out this study between May and August 2005 to ascertain factors influencing equitable distribution of water and sanitation services in Uganda. The purpose of the study was to generate information that will contribute to equitable water and sanitation delivery in both rural and urban areas and to identify feasible means by which service provision can be improved. The SPTT developed a Performance Measurement Framework, the basis for annual performance assessment which considers the agreed "Golden Indicators". The indictors require focused and in-depth analysis in order to generate information useful for coherent policy decision-making and for improved performance of the water and sanitation sector. This study is a step in addressing the recommendation of the Sector Performance Report (2004) that highlighted the need to conduct more research and consultation to assess further the factors that contribute to high and low equity and the need to develop district guidelines for the equitable distribution of water sources.

The equity indicator attempts to measure the Mean Parish Deviation (MPD) from the district average in terms of the number of people per water point[2] (MWLE, 2004). The Sector Performance Report (MWLE, 2004) reveals that there are high levels of inequity of water access in Uganda as measured by differences in people per water point by rural district, small towns and large towns which has existed over a long time.

[1] The SPTT has representatives from MWLE, DWD, NWSC, Civil Society Representatives and Consultant/Private sector.

[2] Developed by WaterAid.

Ugandan water and sanitation sector in attempting to achieve equity using the principle *'some for all, rather than all for some'*. Equity is of paramount importance as it is closely related to poverty reduction, for it is often the poor that are inequitably served with safe water and sanitation services.

This paper is a summary of the whole study. It provided a brief synopsis of the methodology used to generate the data, the main findings and recommendations. The findings were presented to the SPTT in August 2005 in feedback/consultative workshop and have been used in the preparation of this year's Sector Performance Report by MWLE.

Methodology

This study adopted qualitative methods. A purposive sampling technique was employed in selecting the study districts, areas and study participants.

A total of eight (8) districts in Uganda were purposively sampled in consultation with the SPTT for inclusion into this study. The eight districts included: Apac, Nebbi, Sironko, Mayuge, Hoima, Mbarara, Wakiso and Luwero.

Districts were sampled on the basis of the following criteria: Regional representation i.e., a district will at least represent each region: Central, Western, Eastern and Northern; a mixture of districts on the basis of approach regime i.e., demand-driven vis-à-vis supply-driven under which safe and clean water was provided; rural and urban characteristics;

Socio-economic and demographic statuses and characteristics; Hydro-geological factors, which potentially influence the type of water technology adopted; Climatic factors; and other factors such as safe water coverage, dominant technology et cetera.

Data were collected through documentary reviews and interviews at national, district and sub-county levels, as well

as focus group discussions at community level. Within each district, one sub county was purposively selected and two parishes were also selected from each sub county purposively. At the parish level, the study team visited two (2) water user communities/local council 1s/villages.

Study findings

The study revealed that there is wide recognition at all levels of inequitable distribution of water and sanitation services in Uganda despite increased coverage. Increasing national safe water and sanitation coverage levels (estimated at 58.4% and 55.5% respectively) are masking increasing inequities in access within districts, sub-counties and parishes. Water Point Density (WPD) for majority of districts in Uganda fall less the national target of 3.3 per 100 people. The WPD at sub-county level revealed wide variations in coverage across sub-counties, while calculations at parish level revealed even greater disparities.

Safe water and sanitation coverage

National

There is a wide variation in coverage throughout the country ranging from 20% (Pader), in the least served district, to 95% (Rukungiri) in the best served (MWLE/DWD, 2005). In the urban sector, coverage levels stand at 65% (June 2004). However, there are also variations in coverage across towns, with the highest being Mbarara (79%), and the lowest being Soroti estimated at 34% (NWSC, 2004).

There is wide variation of latrine coverage from district to district, with as low as 2% and 2.8% in Kotido and in Nakapiripirit Districts respectively and over 90% in Rukungiri district in the southwest part of the country (MoH, 2004). Coverage of public latrines is also very low (19%) with all located at institutions. most of these latrines located in primary schools, markets and health units.

Districts

There is concern that whereas the national safe water coverage has been showing an increasing trend, water services are inequitably distributed within districts. According to data obtained from DWD, Kanungu District has the most equitable distribution of water points with an average sub-county deviation of 44 (i.e., the average sub-county is within 44 people per water point of the district average). On the other hand, the district with the most inequitable distribution of water points is Kotido with a sub-county deviation of 1,015—Kotido where some sub-counties have many water points and other with very few.

Sanitation coverage within districts like safe water coverage varies widely. For instance, latrine coverage in the sub-counties of Luwero district is over 80% in the 3 Town Councils (Luwero, Wobulenzi ands Bombo), but less than 50% in the sub-counties of Kamira, Kikyusa, and Wakyato (Data of July 2004 from Luwero District). In Apac, it was reported that areas near the lakeshores have low latrine coverage compared to other areas.

National policies, strategies and guidelines

Uganda's water and sanitation sector is based on an institutional and legal framework that has been continuously revised and updated since the early 1990s. Reforms have been implemented in the various sub-sectors, aimed at improving the performance of the sector. There are different policies, strategies and guidelines developed for the different sub-sectors, which potentially have implications on equitable distribution of water and sanitation services. Overall, the National Water Policy (1999) provides an elaborate set of strategies and approaches to be used in the sector.

In the rural water supply and sanitation sub-sector, the goal and targets are: Sustainable safe water supply and sanitation facilities, based on management responsibility and ownership by the users, within easy reach of 77% of the rural population by the year 2015, with an 80%-90% effective use and functionality of facilities. The objective is to reduce the walking distance to improved water sources in rural areas to 1.5 km so as to enable people devote the rest of the saved time to increasing their incomes as well as improving the quality of their lives. Sanitation in rural households, is a responsibility of individual households, while the government's role is to provide hygiene education and sanitation promotion messages. Local governments have responsibility for construction of latrines in public places and institutions such as primary schools, and markets.The objective of the urban water supply is to reduce the walking distance in urban areas to 0.2 km for common/ public point sources thereby allowing the people a chance to devote the time saved into increasing their incomes as well as improving the quality of their lives. The goal and targets are: to expand the service coverage to give 100%, to achieve sustainability of service delivery, to ensure that a basic adequate level of service is affordable via low-cost service delivery and the implementation of a subsidy and tariff system, which is equitable and beneficial to the poor, and to ensure that water, as a social and economic good, is managed in the best way

Demand responsive approach and equity

One of the key policy requirements in the provision of safe water and sanitation services is the demand-driven approach (DRA). However adherence to the principles of DRA means that communities that fail to express effective demand are left un-served. These are usually the low income groups, with less influential politicians and many times lack information. Actual adherence to demand responsiveness is also sometimes hampered by late release of funds and the pressure to spend funds in time. Overall DRA is partially abused in order to fit in the existing circumstances which leads on to inequitable resource distribution.

Interpretation and understanding of sector strategies and policies

The district and sub-county technical staff are aware of the policies and guidelines from the center. On the other hand,

the politicians are averagely aware of the broad guidelines from the line ministries and not specifically how they should be applied. Equity is affected by limited or lack of knowledge of procedures that have to be followed in acquiring new water sources from the districts or sub-counties by the communities.

Applicability of policies and guidelines

Although there is wide knowledge of the guidelines especially among the technical staff of local governments, the district and sub county officials only partially apply these guidelines, or ignore them altogether.

The interplay of political influence, lack of full knowledge by politicians, and inadequacy of resources undermines their application. The strategies and guidelines for the urban sub-sector emphasize financial viability, sustainability and water as an economic good. Majority of the low-income earners in urban areas actually pay more per unit of water than consumers with house connections.

Resource allocation

Existing resource allocation mechanisms at the center, though based on a worked formulae that considers population and coverage, have continued to lead to substantial amounts of grants disbursed to districts whose coverage levels are well above the national average, even above the 77% target for 2015. Planning and budgeting within ceiling limits also means that districts receive inadequate resources to meet their needs in a given year, leaving some deserving areas unserved. The districts use various criteria with varying degrees of inclination to one or the other, with no weights assigned to each factor and no clear ranking schemes, which impacts on equitable distribution of the services. In an attempt to ensure fairness across all sub-counties as a result of political pressures, some districts promote more inequity in the distribution of water services. With respect to resource allocations for sanitation, a higher proportion of the on-budget funds (between 37% to 63%) go to latrine construction in schools, 13% to 21% go to piped urban sewerage, while only 20% to 27% go to hygiene education in communities. Household sanitation is basically a matter of each individual household and hence often relegated to the periphery by decision-makers. There is lack of prioritization of sanitation both in terms of financing by central government as well as implementation and enforcement by district and lower level implementers.

Strengths and Weaknesses of National Policies and Guidelines

Strengths	Weaknesses
The guidelines spell out theroles of different stakeholders, thus enhancing participation and avoiding role conflicts.	They allow decision-making by politicians, which provides room for ignoring or influencing the technical considerations.
The guidelines promote coordination and collaboration in the sector.	The politicians are not fully aware of the guidelines.
The guidelines promote a bottom-up participatory approach which enhances participation, with high chances of meeting people's needs including equitable distribution.	Some communities are not aware of the guidelines, and do not have mechanisms for monitoring or demanding their enforcement.
	Parish Development Committees are not functional in all communities.

Donor and NGO funded projects

Donor funds meant for projects as well as funds brought in by NGOs are channeled to specific districts or localities without necessarily following an equity criteria, although overall, it can be argued that donor projects and NGOs tend to target districts or areas that are deemed to be underserved or unserved with watsan facilities. There are no formal mechanisms at national level to direct the activities of projects and NGOs to the most deserving districts. Inequities tend to result in cases where some districts that were previously under-served have continued to receive project and NGO support for a very long time.

Water coverage and monitoring data

Calculation of safe water coverage based on estimated number of users per improved water source alone is not adequate to reveal the equity situation. The efforts at DWD to improve on this method of calculating coverage by including the walking distance to the water source are anticipated to improve the equity sensitivity of this procedure. There are also problems related to consistency in data between the districts and the center. At national level, calculations of coverage stop at district level, covering up inequities at lower levels. In turn, district calculations of coverage for sub-counties obscures the inequities existing at parish and community level. Validity of data is also affected by non-functionality, due to lack of a proper mechanism to report non-functional water sources. Validity of data on sanitation is more challenging due to complexity of sanitation.

Other factors affecting equity

There are other factors that potentially affect the equitable distribution of water and sanitation services. These include, population distribution and mobility, under-prioritization of community software activities as opposed to hardware, community socio-economic status, leadership and commitment in relation to promoting sanitation, people's attitudes and values, and insecurity. it is important to consider natural hydro-geological factors, cost of water technology and political influence (real and perceived), natural resource endowments.

Recommendations

The recommendations for the improvement of equitable distribution of watsan services are so interrelated, and hence they need to be implemented as an integrated package instead of prioritizing them. These range from policy matters, planning, resource allocation at all levels; data collection and monitoring; and balancing of expenditure between hardware and software.

Policy planning and resource allocation at national level

Develop, disseminate and implement equity guidelines at national level and oversee that these are adhered to by local governments.

More resources should be earmarked to support construction of water sources in underserved areas. This might require channelling more funds to alternative technologies that are feasible in such areas..

The centre should direct and devote special attention and financial support to un-served areas with limited water technology options (water scarcity/water stressed) instead of leaving it to districts till certain time when the coverage levels of such places have also picked up.

Planning and resource allocation at district level

At district level, calculation of coverage figures should be at parish level, rather than stopping at sub-county level. This could be improved further by introducing other methods of determining need, as the Water Point Density (WPD) method, applied at parish level, calculated by the district water office annually. Districts with high Mean Parish Deviations (MPDs) should be required to allocate new water points to those parishes with the highest number of people per water point..

Strengthen the practice of participatory planning and adherence to it. Allow time for the demand-driven approach to be applied.

Institute mechanisms/procedures that increase the transparency of decision-making at district level, regarding water sources allocation.

Data collection and monitoring systems

Tools should be developed that can assist to collect, analyze and present data on coverage and equity. This may include water resources maps, population density maps, table formats and other means of demonstrating the magnitude of inequity. Information should be used as an advocacy tool. Improve data collection and information flow about non-functional water sources so that accurate calculation of coverage can be achieved. District data on number of people per water point by parish should regularly (annually) be published or made available to all councilors and all sub-counties as a means of promoting transparency. When this data is used to make decisions on water source allocation, then the leaders of the disadvantaged areas can question or understand the basis of the decisions. Decision-makers should in this respect be regularly furnished with equity data to enable them take informed and poverty sensitive decisions. Finalize work to revise procedures for calculation of safe water coverage levels, including the walking distance variable

Balance between hardware and software activities

Increase software budget for both water and sanitation, Promote closer integration of sanitation activities of MoH with those of DWD/DWO

District software activities should go beyond communities selected for water source construction (or at least pay similar attention) to even communities that are not yet served with water sources. Software activities for un-served communities should include information about available support at district and sub-county, procedures and requirements for getting a water source, requirements and conditions for different water technologies, and hygiene and sanitation.

NGO Involvement and Advocacy

Equity should form an important element on the agenda of the NGOs in the sector for advocacy especially at district level. Develop or institute formal mechanisms for other actors such as NGOs to feed data to districts and vice versa to enable accurate and comprehensive data collection and use.

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MAXIMIZING THE BENEFITS FROM WATER AND ENVIRONMENTAL SANITATION

NGOs as software providers in Uganda: Lessons from Kichwamba pilot project, Kabarole district

C Baguma, Uganda

In a bid to improve the competence, efficiency and effectiveness of PAF funded programmes, leading to accelerated and quality delivery of services to the end user in the water sector, Government sought out the involvement of NGO's/CBO'S and the private sector in the development of the rural water and sanitation sector. This is envisaged to entrench the current gains, thereby maximizing benefits from the water sector through strengthening the software component of rural water and sanitation projects. Under this strategy, through HEWASA programme involvement, government implemented a pilot software component project on the Kicwamba gravity flow scheme whose findings are documented in this paper.

Background

One of the overall objectives of the 1997 Poverty Eradication Action Plan (PEAP) is improving the quality of life of the poor and one of the key strategies under this is provision of water and sanitation services with a special focus on the poorer sections of society. Accordingly, 1998 Poverty Action Fund (PAF) channeled recourses resulting from debt relief of highly indebted poor countries (HIPC) initiative to key sectors of the country including the water sector where government provided District Water Development Conditional Grants (DWSCG) to all districts. This targeted water supply and sanitation improvement in rural areas including rural growth centres/trading centres with a population of less 5000 people.

Government sought to improve the competence, efficiency and effectiveness of PAF funded programmes, leading to accelerated and quality delivery of services to the end user. Of the measures taken in the considerations to achieve the above is the involvement of NGO's/CBO'S and the private sector in the development of the rural water and sanitation sector. Terms of reference were in light of this developed to enable districts procure and engage NGOs/CBOs/private sector as consultants to carry out community mobilisation and organisation for operation and maintenance of water and sanitation activities.

Kicwamba software pilot project

Under the said terms, HEWASA programme implemented a pilot software component project on the Kicwamba gravity flow scheme during the period of February 2004 to April 2005. The project covered 13 villages with 24 public tap stands serving 1,167 households that house 5,955 persons of whom 2,900 are females and 3,055 males. HEWASA implemented the project to the satisfaction of all the stakeholders who included DWD, UWASNET, Kabarole local Government, Kicwamba Sub County and the Kihondo parish community population. The total cost of the project was (UGX 32,000) thirty two million Uganda shillings.

Coordination

The need for proper coordination between hardware and software is so paramount especially where software events must precede hardware implementation namely community awareness raising, sensitization, mobilisation and capacity building phases. Capital contribution raises an even more profound concern because it may never get realised at all and its purpose of creating ownership lost if it ever was not gathered before the physical constructions are seen in the community. The pilot was constantly plagued by the fact that the hardware private sector partner is a contractor, it is time and speed that tends to matter most to contractors. The fact that donors for hardware and software were different and all with different timing requirements immensely encouraged the uncoordinated flow of events. Many times hardware contractor was found to zoom ahead of the software in order to beat deadlines of the donor, yet software persons wanted to spend a little more time to complete software issues on community mobilisation.

It is important in this regard that the funding sources for both hardware and software are properly synchronised or best still if it is one source to avoid situations where the hardware contract has to zoom ahead as a requirement from the funding source.

The other alternative could be that an NGO with capacities both in hardware and software be the one contracted so that the management of the NGO can be used to harmonise the activities of the two components.

It was also felt that the District Water Office other than the collaborative and support capacity to the two components, it lacked the power and authority to rebuke, reprimand or hold

payment in cases on none compliance with the day-to-day important aspects of co working, take the example of the traditional time concern of contractors. It is here proposed that a senior officer at the district, either the Chief Administrative officer, or the Assistant Chief Administrative Officer in charge of the host county be the coordinating authority. This way the hardware and software providers shall be under one command line so that one commander can call hardware into action after being satisfied that the software is ready for that hardware component.

The timing of funding could also resolve this by planning for the first three phases of the software to be funded in the financial year preceding the one where hardware is to be funded.

Adherence to steps

The Kicwamba experience has shown the need to strictly adhere to the courtesy of involving local communities much earlier than the traditional respected NGO timing doing this at the beginning of the project. Even for technologies so technical like the GFS their input is of paramount importance. The Mahyoro and Kaisula villages had been left out during the design stage. It caused so much upraising to the point that a mini gravity flow scheme had to be arranged to handle the potentially disastrous effects though it had a very convincing technical explanation that could not make any sense to the population up the hills. The downhill communities also had their fears of going ahead with a scheme that left out uphill communities explainable by historical issues between the two communities. It is believed that this could have been avoided if the local communities were part of the initial aloud thinking.

Bureaucracy

If funding could be sent directly to the NGO than through the Network, or if it should, let there be fewer committees, managers and bureaucrats to handle the funding process. This shall avoid delays and other regretted effects of the NGO having to constantly find other monies to keep the project afloat.

Facilitation

It may be important to facilitate the government staff that co-work with NGOs for the good of the work. These include the District Water Officer, the Assistant Water Officer for Mobilisation, the County Water Officer and the extension staff.

Flexibility

It is very important to keep flexible to allow for learning along the way or to take corrective action. Radio programme, Drama presentations and village record books were found to enhance the quality of work yet they had been left out but were later incorporated.

Capacity

Government may have to think of building capacity of NGO's to do this kind of work because the pilot showed that not any indigenous NGO could do this kind of work

General protection code

The pilot showed a nee to establish an enforceable NGO code of conduct that can protect government funds in events of NGOs defaulting or mishandling funds. On many occasions funds were sent to HEWASA accounts and all there was to count on the side of government was the good will of the organisation. UWASNET could be assigned the duty of developing and enforcing this.

Need to reposition

Many time the programme pre financed operations to keep pace with deadlines and other related times. This clearly spelt that NGO' to properly deal with government in this kind of co work, NGOs may need to have their own money to prefinance operations. There is therefore a need to reposition from the traditional NGOs that spend donors' money on specific activities to using money to deal with districts including the situations where a district expects the consultant to carry on work and pay after a certain percentage of work is done.

Supervision

Government may have to build capacity of supervisors at the district and sub county to monitor and ensure quality of work by the NGO for them to effectively see things that are already clear to the NGO, else they are currently depending on the supervisee for what they should be looking for in quality work.

National standards

The pilot also showed a need for an evaluation mechanism for the impact of the software implementation and Visual aids and training materials and formats for uniformity across the country for comparison purposes

In this government will also have to establish clear-cut indicators and certifiers of software well done else, it is not as standardised as hardware

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MAXIMIZING THE BENEFITS FROM WATER AND ENVIRONMENTAL SANITATION

Girl's education movement (GEM) clubs in school hygiene and sanitation promotion

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Access to good and safe sanitation is a right; hence the need to protect the rights of girls, boys and women to improved sanitation, hygiene and safe water. It is in this context that the school sanitation program was designed. This paper outlines the various initiatives undertaken by children and youth in school hygiene and sanitation promotion through Girl's Education Movement (GEM) clud. It also discuses the respective outcomes.

Background

The school sanitation programme is designed to protect the rights of girls, boys and women to improved sanitation, hygiene and safe water in realisation of the rights of children to learning, survival and development. The programme aims at contributing to the national priority of improved water and sanitation coverage and girls' enrolment, and reduced dropout rates. This includes reducing the pupil / stance ratio, separate facilities for girls and boys, in primary schools from 328:1 to 40:1; ensure that at least one female and one male teacher in every school facilitates hygiene behaviour and; ensuring that child-to-child activities on sanitation and hygiene take place in primary schools.

Access to good and safe sanitation is a right! Investing in schools in the developing world is central to meeting children's rights, confronting issues of gender and ethnic discrimination and preparing young people for their roles in civil society. The Convention on the Rights of the Child (CRC), which has been ratified by most of the world, including Uganda, provides that children have a right to a safe environment for enhanced learning, health and development of good citizens. To date over 260 schools have been reached with over 600 children so far trained and up to 2500 GEM members in 16 focus districts.

The inputs required are training of children, giving a water tank, bathroom and sanitary towels to the school It takes about 2 months to start a program in a school after training has been done for 3 days.

Gender disparities in education are mostly caused by high dropout rates of girls in upper primary school characterised by low retention, repetition, and non-completion. Thus while countrywide enrolment figures for girls are fairly good in P1 and P2 (48% for girls and 52% for boys), from P4 onwards there is widening of the gender gap. For example at this level for the year 2003, the dropout rate for girls was at 7% in 2003 compared to that of boys, which was 6% in the same year. The completion rate for girls in the same year was 65% while that of boys was 71%.

Figure 1. Bathroom made of permanent materials

Unfriendly school environment also serves to discourage girls from persisting in school. Many girls drop out due to inadequate sanitation and hygiene facilities to cater for their needs during menstruation, few female teachers, inadequate school infrastructure such as classrooms and furniture and sexual harassment by teachers or boys. Girls are also affected by violence, gender discrimination in the classroom and poor enforcement of policies and laws regarding issues such as corporal punishment, child labour, school charges/fees and re-entry into school especially when girls have become pregnant.

A study[1] showed that approximately ninety-two percent (92%) of schools in the sample had six (6) latrine stances or less and sixty-seven (67%) had no latrine stances exclusively for girls. Management in several schools stressed the lack of latrine stances for girls as a serious concern. It was also observed that mature girls had no changing facilities. They

[1] Carasco, 1996

would have to move to neighboring homes to change during their menstruation periods. In addition they found that the children's worst experiences centred on water and latrines particularly for girls. The pupils were also concerned about the few teachers that were available in the schools. Other problems specific to pupils included lack of a senior woman teacher for female pupil guidance.

Methodology

Child Participation is key. Various means of involving the young people are used. Children need to get involved in the issues that concern them because they are the experts in this. Various clubs are being promoted like school health/sanitation clubs, child rights clubs and Girl's Education Movement (GEM) clubs.

GEM is a child-centered, girl-led global movement of children and young people whose goal is to bring about positive social transformation in Africa by empowering girls through education. It is a movement and operates through groups of children and young people in schools and communities with girls taking the lead; boys acting as strategic allies while the adults - women and men - provide the wisdom of age. It is these groups that subsequently make the decision on how to interact with and help one another at community, district, national, regional and international levels in co-operation with appropriate government, civil society and donor organisations.

GEM was launched in August 2001 in Kampala by the President of Uganda, Yoweri Kaguta Museveni and the UNICEF Executive Director Carol Bellamy and was also introduced at the Smart Partnership Conference.

From the start, young people were involved in different activities of the GEM launch conference. Fifty of these boys and girls from various schools and institutions of learning were equipped with exciting and highly creative facilitation skills that prepared them to play a leading role in the activities of the launch.

The Girls' Education Movement (GEM) in Uganda has become a highly child-centred, girl-led grassroots movement for addressing barriers to girls' education in Uganda. Girls have characteristically taken the lead in expanding school/community strategies for getting girls into school and have co-opted boys as strategic allies.

Peer Guidance and counseling

With the advent of GEM, another important aspect of pupils' relationships has emerged. This is peer guidance and counselling and mentoring. Children, especially those in leadership avail themselves to others for counselling. Girls who need counselling about issues like menstruation for example find a willing ear in their peers. Older children have also taken on the responsibility of mentoring younger children, helping them cope with situations that would otherwise been hard for them to deal with. The girl-child has also benefited from these training programmes. Schools are now sensitive to the special needs for girls. Children, through their GEM clubs also discuss how to keep their toilets clean.

GEM Income generating Activities

Children have realized that they need a certain degree of self-reliance and have therefore taken on growing of vegetables, which they sell to get money to support their club activities. They also stage drama and music performances for the communities and these too earn them some income. Children themselves keep records of daily sales. The GEM club members, out of the money from their income generating activities, buy sanitary pads for managing menstruation and items like soap.

Music and drama

The music and drama shows have been a very useful tool for mobilisation and sensitisation of the communities on issues such as girls' education hygiene and HIV/AIDS. The demand for these visits is high. They also advocate and lobby the school management for the school to provide sanitation materials like soap and water. They acquire all these are the skills from the training they undergo where they also gain knowledge on sexuality and reproductive health issues as well common barriers to girl's education.

Development of IEC materials

Various communication and education materials have been produced and distributed by the GEM clubs. These help reinforce the verbal messages and are also used as teaching and learning aides.The main themes are proper personal hygiene during menstruation, hand-washing, proper use and cleaning of toilets, and girl-child promotion.

Building bathrooms

Many of the children in primary schools in Uganda are over age. This means most girls will have started their menstruation periods while still in primary school. In addition, the age of onset of menses has decreased from 11-13 years to 9-11 years. Washrooms are provided in schools for girls to give them an opportunity to manage menstruation hygienically and with less embarrassment through provision of water and privacy. The GEM clubs participate in the construction and maintenance of their bathrooms.

"We saw the value of girls having a bathroom so now we made one out of local materials for boys..... they use it after sports and agriculture activities", Headteacher Mbarara

The original idea was to provide washrooms/changing rooms for girls, but some schools have appreciated the concept to the extent that they have provided bathrooms for boys.

"We have a bathroom also. We use it when we have sweated after sports" Boy FGD Mbarara

Outcomes

Improved facilities: As a result of GEM in action, schools are also increasingly providing special facilities for girls such as, separate latrines, bathrooms and sanitary materials and the government recently allowed schools to use part of the UPE funds for this.

"When the GEM club came then we now have sanitary pads for times when they are needed" (FGD health prefects Mbarara)

"I have been in this school for six years. There was a time I was teaching and a girl had her MP. I told everyone to leave but her. Then I gave her my jacket to cover herself and told her to go home. There was no alternative. But now we have a bathroom and emergency sanitary pads" (Teacher Mbarara).

Clean and safe school environment: Attracts children to school and impacts on enrolment. Parents feel comfortable to send their children to such schools. This can be seen in most communities both rural and urban, where schools with high sanitation standards and cleanliness have higher enrolment. The GEM clubs have sanitation and hygiene as one of their key concerns and organise themselves to clean their toilet's and compound. They have attained a high level of awareness concerning their sanitation and hygiene. They manage water for washing hands and they say that ever since GEM was introduced in their school, they always have enough soap to wash hands and to use in their bathrooms. The bathrooms are simple, made of local materials, but the children are happy that they have such a vital facility.

Breaking the silence: GEM members openly discuss issues that were formerly taboo. The silence is being broken on issues of menstruation. With the training the children receive in hygiene, sexuality, sexual maturation, guidance and counselling and HIV/AIDS, they have become more open to discussion issues and myths. Teachers are also becoming more open.

"The children are now free to talk about menstruation" (Male Head Teacher)

"We teach them how to make their own sanitary towels" (Senior Woman Teacher)

Health has improved: The GEM clubs carry out hygiene education through training they receive from teachers. There, the girl is taught proper ways of managing menstruation, good hygiene and they are expected to pass this information to their own daughters in the future and thus prepare them to cope better as they grow up and therefore not to drop out of school. Children are brought into the development process as active participants and are becoming change agents within their families and catalysts for community development.

"I learnt how to smoke latrines and wash hands after using the latrine at school and so I do it at home now" (FGD primary pupils Mbarara)

Increased enrolment: Music Dance and Drama seems to be the most popular GEM activity. It also seems to be the main incentive of children coming back to school. Many children testify that after seeing plays by GEM or listening to them sing, they are attracted to join school. A school in Mbarara, reported that they have debates on different issues including HIV/AIDS and sanitation. A recent debate was on *" Sanitation has helped children in school to be smarter than those out of school"*.

Figure 2. GEM girls map out the sanitation and water situation in their school area

Recommendations

Girls' can do it. Given the required support, children and especially girls can work to address issues that affect them. Boys need to remain as strategic allies and be mobilized to give space to the girls. Support by school management critical. Where the head teachers and other teachers are available, accommodative and flexible, GEM has had success. Management needs to be convinced that children can also develop strategies and produce results to improve their learning environments.

More partnerships are required in education. The young are key partners, and need to be involved and encouraged to participate. There is need to invest more in them for capacity building and sustainability.

Without follow up and supervision implementation can be a problem. Schools that are not monitored tend to have poorly constructed installation; weak GEM clubs and the teachers who were trained never implement what they have learnt in workshops.

Behavior change calls for participatory approaches and continual reinforcement.

More children and teachers need be trained and more effective sessions should be introduced to cater for the student body represented by their leadership. This will ensure sustainability and promote the children's participation.

The highest political office in Uganda launched GEM. Political will is still an important ingredient for success of any grassroots interventions.

Further Work

- More support: GEM needs to partner with other NGOs and Government so they are not left on their own since some issues are systemic and need large investments.
- Lobby for free secondary education.
- Scale up to rest of country. 25 more districts still remain on the agenda for training of primary school children.
- Train more trainers. More TOTs will be carried out so those districts are self-sufficient and do not need to rely on national facilitators.
- Documentation is critical. Comprehensive documentation of GEM activities is to continue as well dissemination of reports.
- Acknowledge and reward efforts: In 2001 Government had put up a reward for schools that had provisions for girls' special needs, such as a bathroom, sanitary materials and games uniform for girls.
- Expand partnerships: Other young people partnerships like girl guides and boy scouts need to be mobilised to promote the GEM agenda and hygiene an sanitation issues.

Figure 3. GEM Chairperson gives her report

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Note/s

We would like to acknowledge the following:

1. Netwas-U and Ministry of Education and Sports.
2. District Education Officers, pupils, and teachers of Mbarara District:
   - Rubindi Boys' Primary school
   - Rubindi Girls' primary school
   - Rwenstunga Primary School
   - Kikagate Primary school
3. District Education Officers, pupils, and teachers of Masaka District
   - Ggulama primary
   - Nakatete Primary school
   - Rubindi Boys Primary school

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MAXIMIZING THE BENEFITS FROM WATER AND ENVIRONMENTAL SANITATION

Donor harmonization in Uganda: Water and sanitation sector

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The Poverty Eradication Action Plan (PEAP) adopted a multi-sectoral approach calling for implementation through various programs including the Water and Sanitation Sector (WSS). The Government of Uganda (GoU) then undertook to reform the WSS by carrying out in depth studies which resulted in the preparation of Sector Strategic Investment Plans with appropriate policies and strategies and Action Plan to implement the measures. This enabled the move from the conventional discrete project implementation to better planning and quality assurance of service delivery. This paper describes the above process and the challenges the sector has met.

Background

The Uganda Government (GoU) has put in place a Poverty Eradication Action Plan (PEAP) as a national comprehensive strategy for poverty eradication. The Poverty Eradication Action Plan (PEAP,) prepared in1997 and, revised in 2000 and in 2004, is the guiding framework for the achievement of poverty eradication. It adopted a multi-sectoral approach, recognizing the multi-dimensional nature of poverty and the inter-linkages between the influencing factors, and will be implemented though various programmes including water and sanitation. In the revised PEAP 2004, the Water and sanitation sector falls under two pillars: (i) Pillar 3- Enhancing Production, competitiveness and incomes, which include Water for Production and water resources management and (ii) Pillar 5- Human Resources Development, which includes water supply and sanitation.

GOU undertook to reform the water and sanitation sector with the objective to ensure that services are provided and managed with increased performance and cost effectiveness, so as to decrease Government's burden while maintaining its commitment to equitable and sustainable provision of services in Uganda. The whole subject required in-depth studies, a situation analysis, and a study of experiences in African . Rural WSS and Urban WSS reform studies were completed in 2000, Water for Production Reform study was completed in December 2003 and the Water Resources Management Reform study completed in January 2005. The reform studies prepared sector strategic investment plans (SIPs) with appropriate policies and strategies and action plan to implement the measures.

Moves to sector wide approaches (SWAP)

For long, the GOU's development activities have been based on implementation of a series of discrete projects. This approach had several weaknesses. First, it fostered piecemeal approaches as opposed to comprehensive strategic sector wide investment programmes. Secondly, it was largely donor-driven and lacked domestic ownership. Thirdly, it lacked adequate coordination among the various stakeholders, resulting in duplication of efforts and inappropriate sequencing of projects to be implemented. The project based financing of sectors has proved very expensive demonstrated inefficiency in the Government system as it's, often incompatible with the decentralization process and fragmented approaches leading to poor sustainability.

To address the above shortcomings, the GOU conceptualized a strategy for a radical shift from a project-driven approach to development of comprehensive sector-wide programmes and is implemented through various programmes, including water and sanitation. The Health, Education, Law and Order, and Water and Sanitation sectors have developed sector-wide approaches (SWAPs). The Water Sector Reform studies and their documentation were done in a highly consultative process whereby consensus in general was reached on a Sector Wide Approach. The SWAP framework for the WSS sector was adopted in September 2002. SWAP is a mechanism where Government and development partners agree on strategy to achieve improvement in sector performance, increased resource flows through government systems, more effective use of resources through programmes other than projects. The role of donors and the areas where support is required is fully elaborated in this process. The move towards SWAP calls for GoU/donors to promote uniform disbursement rules, uniform and stronger accountability rules, common indicators, joint appraisals and reviews as follows:

- **Budget/planning process:** GOU has initiated a more

consultative and participatory approach in the management of public finance as a mechanism to increase transparency and accountability in the planning and utilization of resources. The beginning of this process was marked by the budget for FY 1998/99, which involved both Public Expenditure Review and an open discussion on the Medium Term Budget Framework (MTBF) Paper involving the main stakeholders in government, private sector and the donor community. A sector working group comprising of representatives from MWLE/DWD and other line ministries (MFPED, MOH, MOLG) were established to prepare the MTBF paper.

- **Donor financing:** The partnership principles between GOU and development partners rank donor support modalities, in descending order of preference as (i) General budget support, channeled directly to partner groups using their won allowance, procurement and ac counting systems and is not linked to specific project activity (ii) Budget support earmarked to the Poverty Action Fund (iii) Sector budget support (also called partnership funding) and (iv) Project aid. The World Bank PRSC has provided general budget support since 2000/01. Danida, Sida and ABD are providing budget support earmarked to PAF for Rural WSS and channeled directly to districts as District Water & Sanitation Development Grant. Danida, Sida, DfID and Austria(Germany intends to join soon) have pooled funds together under the Joint Partnership Fund to implement four central programmes/components. Most funds for Urban WSS investment are still project-based with support from EU, AFD/France, AUSTRIA, DFID, JICA, GTZ/KFW, BADEA, ADB. Such projects are approved by the Water Sector Working Group (WSWG). and implemented along the GOU sector strategy/guidelines other than project specific.

- **Sector level dialogue:** Since 2001, GoU, through Ministry of Finance, Planning and Economic Development, has established coordination framework to include:

Water Sector Working group (WSWG): The WSWG is chaired by PS/MWLE and comprises senior officials from MWLE/DWD and other line ministries (MFPED, MOH, MOLG, MoES, MAAIF, MPS) and Development Partners, UWASNET (NGO representatives). It creates a policy consensus, draw up investment programs, formulates sector strategies, prepares Medium Term Budget framework (MTBF) and budgets, and oversees the implementation of water supply and sanitation services.

Development Partners' Forum: In the past 4 years there has been increased joint donor participation in Water Sector Working Group and processes and getting more confidence in the new approach. The Development Partners' group meets monthly to reach consensus of such projects sector development issues.

NGO Forum: There are over 190 NGOs and CBOs currently undertaking water and sanitation activities in Uganda and are members of Uganda Water and Sanitation NGOs Network (UWASNET) an umbrella association was formed in 2001 to improve coordination, sharing of experiences and liaison with GOU and Donors.

Joint sector review process

Since 2001, Joint GoU/Donor Reviews are held twice in a year (Joint Technical Review (JTR) in March and Joint Sector Review (JSR) in September), where broad consensus is reached on strategic policy issues and undertakings to improve sector performance and service delivery. At each JSR, the status of implementation of undertakings of previous year and new undertakings for the next one year is recorded in "Agreed Minutes".

Monitoring and reporting: DWD/MWLE has established monitoring protocols that draws on routine reports from the districts and other service providers, the annual household and service delivery surveys, independent surveys and Annual sector performance reports with benchmarks for WSS.

Effects on harmonization and alignment

Since adoption of SWAP for the sector the following have been achieved:

- Roll out of WSS service delivery to all local governments.
- Donors are increasingly using Government systems, therefore harmonization and alignment with GoU systems in almost automatic.
- Sector/donors part of the Joint Reviews, sector working groups and donor groups and technical consensus often reached in the dialogue between GOU and donors.
- Focused capacity-building and technical assistance. Donors are increasingly using joint diagnostic instruments.
- Policy dialogue increasingly harmonized within the sector/areas.
- Increasing understanding of the areas within which GoU and partners can work together which facilitates dialogue.

Key ingredients of success of DP harmonization

A number of enabling factors exist in Uganda that have helped to streamline and strengthen the harmonization of Development Partners support. These include:

- Government of Uganda is committed and undertaking a number of reforms aimed at spearheading the country's development. These are spearheaded by the MFPED.
- Strong and dedicated leadership provided by the lead sector Agency DWD/MWLE
- Good governance and management, allowing democratic

process in planning, budgeting, reporting and reviews have improved efficiency and cost effectiveness.
- Transparency and openness by most sector players has given opportunity for clear dialogue and greater trust.
- There has been consensus-building between Government Agencies and development partners.

Key issues and challenges

There are a number of challenges that need to be addressed in order to maximize benefits and outcomes of harmonization of Development Partners input. These include:

- Water and Sanitation sector is a shared responsibility and thus there is need to strengthen the interaction between MWLE, other line ministries and development partners in order to promote a sector-wide approach to developments in the sector;
- Inadequate resources: GOU is committed to increasing the water coverage from the present 57% in rural areas to 77% by 2015 and urban water from 65% to 100% by 2015. The investment requirements are estimated at US608m for Rural WSS, US$ 481m for Urban WSS, US$ 393m for WFP and US$ 21m for WRM.
- There is inadequate capacity at National level, in particular DWD/MWLE, the Lead sector Agency and this further coupled with some staff still glued to project aid approaches. This necessitates capacity building and institutional reform at the national and local government to undertake their roles.
- There is inadequate capacity at local governments and community levels. This necessitates capacity building and institutional reform at the local government to undertake their roles including sustainable operation and maintenance of established facilities.
- Governance conditions have not always been consistent with Government ownership

Conclusion

The Harmonized Donor approach has put the Government team in a challenging situation and GOU is slowing adapting to ensure effective coordination of all stakeholders (line ministries, local governments donors/NGOs). The focus is now to realign and mentor capacities of Center and Local Governments by providing the required resources and the new approach offer such a good opportunity. At the central government level, Institutional attention should shift from implementation to better planning and quality assurance of service delivery.

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MAXIMIZING THE BENEFITS FROM WATER AND ENVIRONMENTAL SANITATION

Compost bin – stepping stone to a improved village level environmental sanitation

Ananda Dissanayake, Shirani Dayananda, Sri Lanka

Improved environmental sanitation is essentially an important aspect for the well being of people. Clean environment can only be created with changes in human behaviors on proper disposal of sewage, wastewater and solid waste etc. Poor environmental sanitation is a serious issue in both rural and urban areas in Sri Lanka and as a result high incidence of water borne and water/environmental related epidemics are common. Appropriateness of approaches adopted so far for the behavioral change of people in environmental sanitation are somewhat debatable but the fact remains that possibilities are in existence if initiatives are provided with quick incentives for the people. The multifaceted approach adopted by the CWSSP with the reawakening of traditional practices has created a new order in the environmental sanitation programs in Sri Lanka. Introduction of Compost Bin, which was a new version of the traditional compost pit, for household waste management has become a stimulant device for people to participate. Today approximately 300,000 rural families use compost bins and contribute to making better environmental sanitation in their villages.

Introduction

Improved environmental sanitation is an essentially important aspect for the well-being of people. A clean environment at household and village levels, which brakes the cycle of disease, can only be created with proper disposal of sewage, wastewater, solid waste and drainages for runoff control. Water hygiene and domestic hygiene should also be an integral part of a clean environment.

Poor environmental sanitation causes the following:

- Water pollution, outbreak of water borne and water related diseases
- Degradation of lands and decrease of productivity due to long-lasting solid waste
- Depletion of water sources due to poor water absorbent capacity of soil, which consist of solid waste.
- Low productivity of people due to regular illnesses

Poverty, unavailability of an effective mechanism to address the causes of adverse environmental sanitation issues, lack of awareness among the people on the relationship between environment and their livelihood and community negligence on their part of environmental conservation are the main reasons for poor environment sanitation.

Impact of poor environmental sanitation in Sri Lanka

Status of environmental sanitation in rural areas in Sri Lanka is poor. Solid waste disposal is presently becoming a major environmental threat in rural areas, as there is no mechanism to collect and dispose of solid waste. Household wastes are generally dumped in their backyards and/or in common places such as roadsides, marsh lands, riverbanks etc. These sites have become breeding grounds for all vectors and have caused many seasonal epidemics especially dengue, malaria and lepto spirosis. Details of reported water borne and water/environmental sanitation related epidemics during years 2002-2004 are presented in the Table-1. These data indicate the gravity of poor environmental sanitation practices in the country.

At present water pollution in Sri Lanka is taking place at an alarming rate. It is revealed that nearly 53% of the rural

Table 1. Water Borne and Poor Environment Related Diseases in Sri Lanka

Diseases	2002	2003	2004 (6 mths)
Cholera	27	1	0
Dysentery	9629	8064	3544
Dengue	4969	4838	2791
Typhoid	2951	3114	1470
Lepto Spirosis	992	2232	866
Hepatitis -A	2920	2977	269
Malaria	41411	10510	3720

population does not have proper latrine facilities and Open Air Defecation (OAD) is a common practice in many rural areas. Latest water surveillance reports reveal that 85% and 46% of domestic water sources in Central and North Western Provinces respectively have been contaminated with coli-form bacteria with an e-coli count of 51 or more per 100ml. This has resulted in the increase of the incidence of water borne diseases in rural areas and reported incidences between 2002-2004 are indicated in the Table 1.

Challenges in creating improved environment

Improvement of environmental sanitation should begin with households and subsequently move into the community level. The challenges identified in improving environmental sanitation were:

- Provision of substantial and immediate incentives for participants
- Absence of properly designed sequence of activities to motivate people
- Unavailability of appropriate approach, strategies and mechanisms
- Inability to provide continuous assistance for activities

In addition, the tradeoff in implementation of environmental sanitation activities at households has a significant influence on participants.

Sri Lankan approach

The World Bank funded Community Water supply and Sanitation Project (CWSSP) is a community-based demand driven project implemented in Sri Lanka, providing assistance to 900 rural communities to improve their water supply and sanitation along with intensive hygiene and environmental education. Under the environmental sanitation improvement component, the project adopted a multifaceted approach with especial emphasize on increasing family income. In this approach, household ***Compost Bin*** has been used as a device to sensitize people on environmental issues and to undertake further actions such as latrine construction, changes in land-use, soil conservation and protection of water sources to achieve total environmental sanitation improvements in their villages.

This paper discusses the approach and strategies adopted by the CWSSP in implementation of environmental sanitation program. The phases of "approach-action relationship" in this program are illustrated in Figure 1.

Phase-I: Compost bin - a device to create community interest

Mobilizing people to participate in an environmental sanitation program depends largely on the demonstration of immediate incentives from the program and the expenses from participants on improvements. These two factors influence

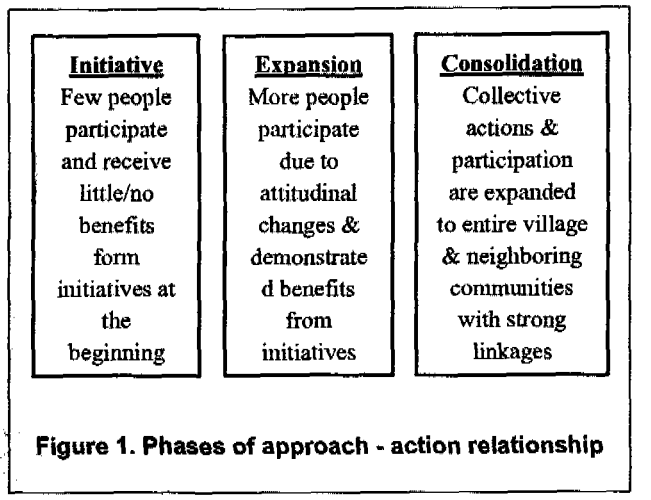

Figure 1. Phases of approach - action relationship

greatly on keeping the improvement of environmental sanitation in the lower order of people's priorities.

In order to overcome the above constraints, traditional practices have to be harnessed together with today's programs providing more opportunities for people to increase the family income. Traditionally household wastes have been managed within, and at household level by way of feeding the waste into a ground level pits. This provided adequate organic manure for their agriculture purposes and shifting of cultivation with artificial fertilizer, which provided high yield, has made household compost pits worthless. Since then people dump their household waste directly into their gardens as well as roadsides, marsh lands, riverbanks etc. in village and caused many environmental issues.

As an initiative taken on the long road to the broader objectives of village environmental sanitation, introduction of compost bins received positive reaction from people. Solid waste coming out of their kitchens combined with out-door waste such as leaves, was used to feed the composting bin that ensures clean home compounds. The organic waste collected from the kitchen, with approximately 1.8 Kg from

Photograph 1. Organic compost bin – an initiative with hopes

Photograph 2. Refilling of compost bin and backyard gardening

a family size of 5, is fed into the compost bin daily along with the regular collection of about 500g to 900g dry leaves (depending on the season) from their garden.

Making a compost bin does not involve any money. This can be prepared with 40 live tree stems (Glidezeria) collected from their own garden. Regular hard labour is not required for the mixing of waste together in these compost bins like traditional compost pits. The compost bin model ensures the proper natural airflow inside the bin, and maintains the temperature suitable for the composting process. During the dry season kitchen wastewater or water should be added to maintain the moisture level with composted cow dung to speed up the composting process.

Sorting-out of garbage and composting of the organic waste at domestic level is becoming very popular especially among the middle and lower income families. Also they were very happy about the new experiences as they could see the immediate changes taking place in their households and in neighborhood.

Phase-II: Diversification of environmental sanitation activities

Consciousness creation among people and simple initiatives taken collectively to build-up their confidence will certainly make vast changes among individuals and communities. Similarly, in village environmental sanitation improvement program, people were made to observe the impact of their activities and how important their contribution was to the household and village level environmental sanitation improvements. This has motivated people to diversify their activities such as home gardening, latrine construction and water source protection etc. Such diversification helps to improve the village level sanitation and to increase the family income and reduce the family expenditure on poor health.

Productive home gardens for income generation

Increasing the family income by improving the productivity of home gardens and marginal lands is becoming a popular activity among families. Comprehensive training has been provided to people on sustainable land use, soil conservation, and protection of soil erosion and cultivation techniques in small plots. Compost bins provided a substantial amount of organic manure for every six months and many people started the organic farming in their backyards. The majority of people grow vegetables and a few who own medium sized lands grow cash crops (pepper and ginger etc.) and earn substantial seasonal incomes.

The most important outcome of the home gardening program was the food security of the family and improvement in the nutritional status of their children. Women who were generally unoccupied during the daytime have got involved in the preparation of their backyard for cultivation. With the substantial income earned from previously neglected and uncultivated lands it was easy to convince people to work together and concentrate more on the household and village level environmental sanitation improvement activities. In some instances families have increased their seasonal income from cash crops from $70 to $250 due to the adoption of soil conservation methods, and application of compost produced in their bins. Due to the demonstrated effects other families in village and neighboring villages also started home gardening in their unproductive backyards.

Latrine construction for diseases control

The project introduced a community based latrine construction program through Sanitation Revolving Fund (SRF). Community Based Organizations (CBOs) in villages were provided with seed funds equivalent to 50% of the cost of the latrine construction in their respective villages. Comprehensive training has been delivered to improve the capacity of CBOs in revolving fund management. Families who do not own latrines were provided with a construction loan of $30 and recovered it in 10 installments.

The amount given from the SRF was not at all adequate to complete the construction but people matched the balance

Photograph 3. Home garden with new ideas

Photograph 4. New latrine-contribute to clean household environment

funds with the small income they earned from the home gardening. So far CBOs in project area have completed around 12,500 latrines in their villages and have planned to complete the total latrine requirement in their villages in the current year. The seed fund will be revolved until total latrine construction is completed and also to address the future latrine needs to make their villages free of OAD.

In many villages recovery rate of the SRF is 100%. This shows the possibility of creating high community commitment to eradicate environmental sanitation issues in their villages if they are properly mobilized and guided with incentives.

Phase-III: From household to village level environmental improvements

Finally the project diverts the people's attention from household to village level environmental sanitation improvement activities. Protection of water sources where their scheme intakes are located, and catchment area preservation through restoration of watersheds, both in vicinity of water sources and other abandoned lands, were given high priority. People were provided with comprehensive training in catchment area preservation, soil conservation methods and other environmental development aspects

In all communities people work hard to protect the water sources and plant indigenous trees and other suitable trees around the water sources. In many instance people managed to persuade Local Authorities in the area to declare the water source catchments a protected zone. There is evidence as to the increase of water accumulation and decreases of runoff in catchment areas, including home gardens. Increases of frequency of biodiversity are seen in the lands of the catchment areas too.

The project promotes the construction of drainages and culverts in villages to control the runoff water with the provision of funds to meet the material costs.

Children's participation-strategic change for sustainability

Although the total responsibility of the program was vested with respective CBOs, Children's Clubs have been used to implement and monitor the environmental sanitation program to ensure the long-term sustainability. Children motivate their parents and neighbors and ensure the construction of compost bins and latrines in each house. They visited every family in the village in groups and assisted them in supplying required material to make compost bins. Often Children's Clubs start the excavation of latrine pits where adults have not taken the initiative. Children have visited families every month to monitor the status of household environmental and hygiene practices at household level

Conclusion

The results from the approach adopted in improving environmental sanitation were extremely encouraging. An important lesson learned from the program was that initiatives for the improvements are only possible when the activities are provided quickly and with substantial incentives for the participants. It is demonstrated that communities are ready to change the situation at households, villages and neighboring communities if living proof is in front of them.

Poor environmental sanitation, poverty and low productivity are interrelated issues and therefore any environmental improvement efforts will be successful if it is aimed to break at-least one single link of the vicious cycle which poor /low income people are entangled in.

There is evidence that income from the home gardening activity under the environmental sanitation improvement program has increased the health and nutrition status of participating families. Subsequently this has an effect on the increase of family productivity.

Involvement of children for the implementation and monitoring of the program will be the key for sustainability and continuity of village environmental sanitation improvement program. At present, they support their parents and neighbors to implement activities and monitor the program implementation. Such responsibilities given to children will change the attitude of the new generation on environmental sanitation, which is needed today. Involvement of children will provide them with an experience in solving common issues in their communities and will also certainly have an influence on the stock of social capital.

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MAXIMIZING THE BENEFITS FROM WATER AND ENVIRONMENTAL SANITATION

Performance studies of hybrid reactor for the treatment of Sago waste water

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In India the sago producing industries are located mainly in the southern region. The waste water from Sago industries is complex and highly organic. The conventional treatment technologies require large space, power intensive and requires skilled monitoring. Hence the industries are looking for compact, efficient and cost effective treatment options. One of the most advanced option is fluidized bed bio-reactor, where the biomass is cultured on small media kept fluidized in the rector. It has the advantages of both the attached and suspended growth systems in order to improve the efficiency, reduce the number of media and overall space and cost, studies were done on a hybrid reactor using polypropylene media. The hybrid reactor is a combination of Activated sludge and FBBR. The efficiency for organics removal, nitrification suspended solids removal for various initial parameters was studied.

In India sago is manufactured from tapioca tubers. Tapioca is grown extensively as a subsidiary food crop. Sago globules are made from tapioca (cassava) starch. For the preparation of tapioca starch the tubers are peeled and disintegrated to obtain starch, which is washed, dried partially and made in to small granules by passing through sieves. The granules are gelatinized, dried and graded.

The starch manufacturing industrial units, such as sago mills, both in medium and large scale, suffer from inadequate treatment and disposal problems due to high concentration of suspended solids present in the sludge. Sago mill wastewaters and wastewater coming from the Vegetable-tanning factory are more polluting in nature. Their effect on the water bodies is magnanimous when they are discharged without any treatment. The wastewaters are highly organic and also complex in nature. Therefore the treatment of such wastewaters with aerobic technology is possible due to the development of many advanced reactor designs.

Central pollution control board has reported the national effluent standards for sago and starch industry based on WQA 1987. The limits are pH 6.5 – 8.5, BOD at 27oC for 3 days 100 mg/l, Suspended solids 150 mg/l, BOD shall be made stringent up to 30 mg/l if the recipient fresh water body is a source for drinking water supply. BOD shall be allowed up to 350 mg/l for applying on land, provided the land is designed and operated as a secondary treatment system with the requisite monitoring facilities. The drainage water from the land after secondary treatment has to satisfy a limit of 30 mg/l of BOD and 10 mg/l of nitrate expressed s 'N'. The pet addition to ground waste quality should not be more than 3 mg/l of BOD and 10 mg/l of nitrate expressed as 'N'. Suspended solids shall be allowed up to 450 mg/l for discharge into town sewer, if such sewer leads to a biological secondary treatment system.

All conventional treatment methods used for the treatment of industrial waste are associated with its own inherent drawbacks. Aerated Lagoons and Stabilization ponds can be provided only where land cost is low, where the system can be installed some distance away from residential areas and climatic conditions are low. Activated Sludge Process has problems like sludge bulking, need of sludge recycling, regular monitoring of MLSS etc. Trickling Filters are susceptible to environmental stresses and clogging problems. The Hybrid Reactor is an attempt to give a solution to avoid all those problems as it combines all advantages provided by Activated Sludge Process as well as Fluidized Bed Bioreactor, at the same time avoiding the worst effects from all conventional methods.

A laboratory scale treatment system with hybrid reactor was fabricated. The reactor was made up of perplex glass. The column was of 1.8m height and the effluent was filled up to 1.5m height. The diameter of the column is 0.15m. A plate with perforations was used to separate the reactor in to two halves. The top portion is the Fluidized bed reactor and the bottom portion acts like Activated Sludge. The peels of sago will enter the bottom portion as the recycled sludge through the perforations hence no special recycling unit is necessary for Activated sludge portion. In the top FBR of 0.75m height 20% of the volume of the reactor was used for filling the biomass carrier media. The reactor was designed as operating in three phases i.e., in gas-liquid-solid phases. The influent feed of sago wastewater was supplied continuously by using a peristaltic pump of 30l/h capacity and the flow was controlled. Since the process is aerobic, continuous aeration was given with the help of an air compressor. The oxygen flow rate was calculated and adjusted throughout. The aerator used was a spiral copper tube with holes all around which provided diffused air for keeping the media

in fluidized state. The influent was flowing downwards and the air was supplied from bottom to top. The elevation view of the experimental set up is given in Figure 1.

Spiral media was used in the first phase and in the second phase specially designed carrier media was used, the details of second media are listed in Table 1. A comparative study was performed with use of each media in different phases. The effective height of the reactor was 1.5m, in which 0.75m is FBR. The reactor was filled with media to the required volume. To develop the biomass the start up was done with acclimatization using activated sludge from the treatment plant. Activated sludge was diluted and fed in to the reactor. Seeding was done till sufficient biofilm was formed on the media. This was achieved within 10 days in both phases. Feeding of sago waste was started after sufficient biofilm formation on the media.

Sago waste representing the effluent from sago industry was prepared synthetically in the lab. Sago granules were powdered and the powder was dissolved in tap water and fed in to the reactor with the help of a peristaltic pump. For a fixed pollutant concentration the weight of sago powder required was calculated. Thus the characteristics of the influent were maintained steady for each particular run.

The experiment was divided into two phases for studying the performance of the two different media. In each phase after the acclimatization sago waste resembling that from an integrated sago unit was fed. The experimental stages were varied with different organic loading rates but with the same hydraulic retention time.

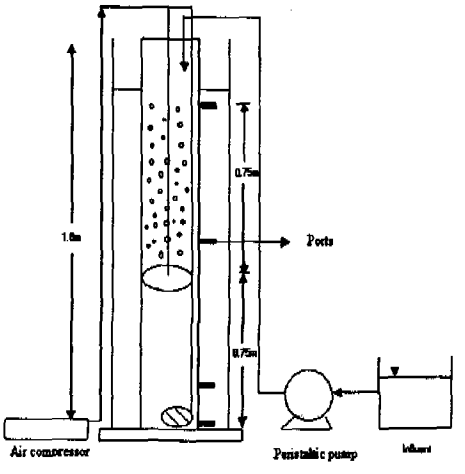

Figure 1. Experimental set

Table 1. Properties of media in phase 2

Material	Polypropelene
Density	0.94g/cm^3
Shape	Cylinder with a cross inside and with longitudinal fins outside
Dimensions	Length 20mm, diameter 15-10mm tapered
Specific surface area	300 m^2/m^3
Filling rate	20%

In first run an influent COD of 550mg/l (approx.) was maintained. By giving an influent COD of 750mg/l (approx.), 1000mg/l (approx.) and 2500 mg/l (approx.) the organic loading rates were changed. In all these stages the hydraulic retention time was 6hrs. For each run the air required was calculated and provided continuously.

As per the Central Pollution Control Board Studies (1982) the COD of the effluent from sago unit varies from 3000-5000 mg/l. Hence in the laboratory experiment Average COD values tested were 550, 750, 1000 and 2500 mg/l. With each organic loading the hydraulic retention time is 6hrs. But as the highest organic loading rate didn't give high removal efficiency with retention time (6 h).

At the start of each run BOD was calculated and Total Nitrogen was measured. In each run the parameters analyzed daily were, COD, Nitrate, Suspended Solids, Alkalinity, Dissolved Oxygen and pH. The pH and Dissolved Oxygen level in the reactor were checked continuously to note any change in the reactor due to the microbial activities. Sufficient numbers of days were allowed in between the runs when the experimental parameters were changed, for attaining the flow equalization. At the end of each phase the media was taken out for biomass measurement and microbial analysis. Details of loading in each phase are shown in Tables 2 and 3.

Results and discussion

The study was conducted for nearly eight months. Analysis of effluent started after getting a visible biofilm around the carrier media used in each phase.

After few days of feeding of activated sludge biofilm formation was seen on the surface of the media. The biofilm growth was more inside than the outer surface. This is mainly

Table 2. Details of loading rates on hybrid reactor in phase 2.

Parameters	Case 1	Case 2	Case 3	Case 4
Average COD in mg/l	530	756	1046	2459
Retention times in hrs.	6	6	6	6
Flow rate, l/hr	4.5	4.5	4.5	4.5
COD loading, kg/m3d	2.18	3.08	4.26	10.02
Air required, LPM	1.55	2.25	3.2	5.05

Table 3. Details of loading rates on hybrid reactor in phase 1.

Parameters	Case 1	Case 2
Average COD in mg/l	550	750
Retention times in hrs.	6	6
Flow rate, l/hr	4.5	4.5
COD loading, kg/m3d	2.241	3.056
Air required, LPM	1.55	2.25

because of the turbulence in the reactor. The biofilm will be scratched on the outside of the media; with in 10days biofilm formation was seen on the media. Then acclimatization is stopped and the reactor is fed with sago waste.

The treated effluent was analyzed for COD, Nitrate, Suspended Solids and Alkalinity. Daily monitoring was done for Dissolved Oxygen and pH in the reactor.

In phase 1 with spiral media, the biofilm started developing after one week of acclimatization. The feeding of sago waste was started after the development of biofilm which was visible in the inside part of the media. On the outside part less biofilm was seen. In phase 2 with the cylindrical media with four chambers inside, the biofilm growth needed nearly 10 days time to stabilize. The treatment of sago waste started after that period.

Depending upon the organic loading rate and media used, the reactor showed varying performance. In case 1 with spiral media, for an organic loading rate of 2.24 kg/m3d the COD removal efficiency was 70.5%. When reactor was operated with second chambered cylindrical media the COD removal efficiency was by 94%.

The reactor performance was evaluated based on the organic loading rate and the media used.

When the loading rate was 3.1 kg/m3d the COD removal efficiency was 66.9% for spiral media and for the same organic loading rate 83.8% for chambered cylindrical media .

When the organic loading rate was 4.1 kg/m3d the COD removal efficiency for chambered cylindrical media was 80.6%.

The maximum loading rate tried was 10.19 kg/m3d. In the reactor with chambered cylindrical media the efficiency was 43.5%.

The comparison of the performance efficiency with two media is shown in Figure 2. The Effluent filtered COD for each loading is shown in Figure 3.

Removal of suspended solids

The removal of suspended solids in the reactor was better with chambered cylindrical media than with spiral media. Due to some undissolved sago powder the influent showed some fluctuations with the organic loading rate adopted. The variation of the influent was from 125 to 192mg/l under different loading conditions. The effluent obtained had suspended solids of only 48 mg/l with second media in case 1. The performance of the reactor in suspended solids removal is shown in Figure 4 and 5.

Biomass measurement was done to find attached and non-attached biomass on media. Sample medias were transferred to 125ml flask and rinsed three times with distilled water; rinsate was filtered through 1 µm glass fiber filter for determination of Total Suspended Solids. This TSS value was used as a measurement of non-attached solids and expressed in mg/L of fluidized bed. The rinsed bed material was dried at 105oC, weighed and digested in concentrated nitric acid for 24 hours. The digested sample was rinsed and dried again at 105oC. The change in dry weight following the acid digestion was used to calculate the attached biomass of the

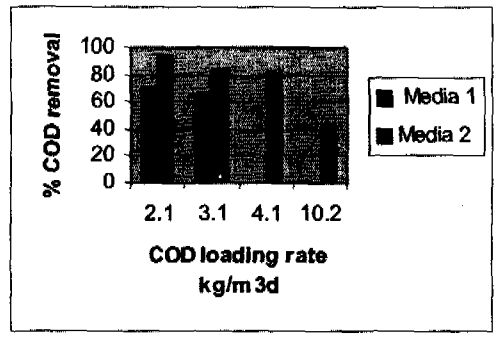

Figure 2. Comparison of both media in COD removal efficiency

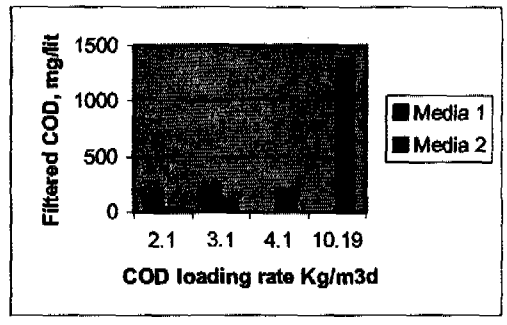

Figure 3. COD loading rate vs filtered COD

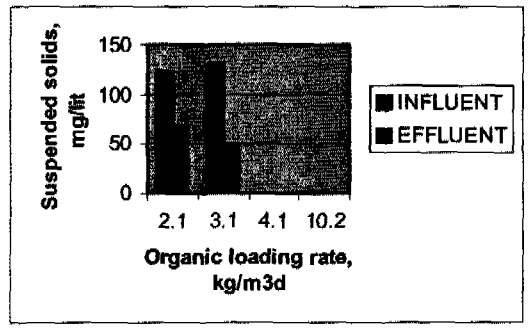

Figure 4. Suspended solid removals in phase 1

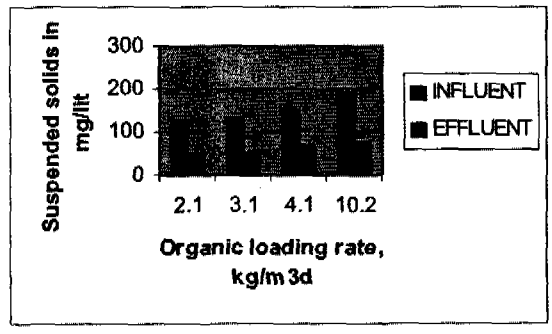

Figure 5. Suspended solid removals in phase 2

Fluidized bed (mg/l).

The growth of biomass was more in the inside of the media than on the outer side for both the media. The attached biomass was nearly 10,000mg/l for first media and around 35,000mg/l for second media. The measurement of

non-attached biomass is very less when compared to these values. The non-attached biomass was 1500mg/l in phase one and 4500mg/l in phase two. This shows that the unit was operating in the extended aeration range, indicating that the final sludge production would be minimal. Also it avoids the need of monitoring of MLSS.

The dissolved oxygen level was maintained around 4 mg/l in all stages at steady state except when very high loading of 10 kg/m3d decreased D.O level to 0.45mg/l with corrugated cylindrical media usage.

The dissolved oxygen level and pH in the reactor was found to be suitable for the normal aerobic microbial activities. The slightly alkaline condition in the reactor indicated a complete aerobic degradation of the organic matter.

The differential staining of microbial film showed spore forming and non-spore forming bacterial growth. The long to very short rods, often in chains showed resemblance with lactobacillus. The gram-positive forms were seen in plenty and there was presence of some gram-negative cocci and diplococcal bacteria also. The biofilm scraped from the media showed big clusters of bacterial growth.

Summary

Biomass attachment was found to be significant on media with more specific surface. Thick growth was seen inside the chambers of the chambered cylindrical media. But the biofilm attachment was less in spiral media. The biofilm growth was negligible on the outside surface in both media as it was subjected to frequent collision. The treatment efficiency was high and removal efficiency of 95% was attained for an organic loading of 2.2 kg/m3d when chambered cylindrical media was used. With spiral media the efficiency reached to a steady state of 70.5%. When the organic loading rate was decreased there had been an increase in the performance efficiency. When the loading was reduced from 3.1 to 2.2 kg COD/m3d the efficiency increased from 67 to 70% with spiral media and in second phase with chambered media when the loading was reduced from 10.19 to 2.2 kg COD/m3d it varied from 44 to 94%. No protozoan growth was seen inside the media. The filamentous type biomass was sticking to the biofilm carrier media, hence avoiding the bulking problem.

Conclusions

1. The highly organic sago wastewater can be treated effectively using Hybrid reactor. Anaerobic pretreatment precedes aerobic process to bring down the load by 50%.
2. For a specific Hydraulic retention time, the organic removal efficiency decreases with increase in loading rate and hydraulic loading rate.
3. No clogging or channeling in the reactor as the media is in motion. No recycling of sludge is necessary as the biomass enters the activated sludge through mesh.
4. Hybrid reactor is found efficient in nitrification as the nitrate is increasing with increased nitrogen loading rate.
5. The suspended biomass was less and hence the reactor can meet the effluent standards.
6. The carrier media used in the reactor plays a major role in the efficiency of treatment. The surface area, shape, roughness, specific density of the media affects the performance. The media used in 2nd phase is highly efficient than spiral media.
7. The Hybrid reactor is cost effective as the number of media can be reduced in Fluidized bed and no separate recycling unit is needed for activated sludge. The media is durable and need not be replaced for a long period. However proper aeration should be provided as the efficiency and steady state functioning of the reactor depends upon the microorganism's survival.
8. More research can be done in this field for treating high strength industrial wastewater like pharmaceutical, dairy wastewater using Hybrid reactors.

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MAXIMIZING THE BENEFITS FROM WATER AND ENVIRONMENTAL SANITATION

Handwashing hardware implementation imperatives

Stephen Harries, New Zealand

This paper considers ways that the practice of handwashing can be implemented in a community or family context. Given that handwashing has proven to be an effective barrier against diarrhoeal disease and respiratory infections and that people are particularly vulnerable to these diseases in low-income communities, it is vital that this practice is implemented. Yet little work has focused on implementation of the practise at a grass roots level. The paper further discusses why handwashing is difficult to implement and proposes a technical solution that may enable handwashing to be more accessible, convenient and possible.

Introduction

One hundred and fifty eight years after the Hungarian doctor, Ignaz Semmelweis discovered the benefits of handwashing, we are still struggling to implement this vital yet simple practice in developing countries. Nine studies conducted in developing countries showed that no more than 20% of child carers washed their hands after cleaning a childs bottom or after defecating themselves (Cairncross & Curtis 2003:279).

Though hygiene promotional literature speaks loud and clear of the necessity of handwashing and the need for handwashing facilities, there exists a large knowledge gap, which could be defined as, 'handwashing implementation'. Despite the weighty emphasis placed on the importance of the practice and the amount of literary material testifying to the effectiveness of the intervention, there is no publication, to the author's knowledge, that is dedicated to the practicalities of implementing the practice at a community or family level. This article will therefore only briefly outline the benefits of handwashing before becoming dedicated to the subject of handwashing implementation.

Why is handwash important?

Diarrhoeal disease is of faecal origin and kills 3.3million children each year (Curtis et al., 2000). Preventing faecal matter from entering the domestic environment should therefore be of utmost importance to all public health specialists. Recent studies provide overwhelming evidence that suggest handwashing can reduce the incidence of diarrhoea by between 27 and 89% (Curtis et al., 2000).

Added to the benefit of reduced diarrhoeal disease, recent studies (Cairncross 2003:677-678) suggest that Acute Respiratory Infections (ARIs) which kill nearly 4 million children each year, mostly in developing countries could be prevented by handwashing.

The eye disease Trachoma is a disease of underprivileged populations with poor conditions of hygiene and is the leading cause of preventable blindness in the world (Kanski, 2003:71). Because the disease is transmitted by fingers (amongst other routes), handwashing can prevent the spread of Trachoma (Sight Savers international, Undated).

The hard sell item

Handwashing promotion is the hard sell item of hygiene promotion. It is a uniquely ambiguous and awkward activity because ones hands must be used for the task of washing ones hands. A unique solution is required.

Furthermore, given the fact that increased convenience is the greatest motivating factor for behavioural change it should be highlighted that it is very difficult to make handwashing more convenient than not handwashing at all. It is more difficult still to establish the practice at the correct times using soap or an alternative.

In addition to the issue of convenience is the issue of unrealised consequence that also makes handwashing promotion difficult. People already realise the consequences of not collecting water; it is just a matter of where they collect water from. People are already well aware that they have to defecate somewhere; it is just a matter of where. It is quite likely however that people from low-income communities are not aware at all of the consequences of not washing their hands at the appropriate times with a cleaning agent and in the proper way. What is more they are not compelled to do so naturally by a thirst that must be quenched or a bowel or bladder that causes discomfort when full.

Because handwashing promotion is the hard sell item of hygiene promotion It requires an intensive effort to promote. It must be made as convenient to the users as possible by the existence of appropriate handwashing hardware.

Existing handwashing hardware

A few handwashing solutions have been used in the past

to make handwashing easier, more convenient and more accessible. The container fitted with a tap is the most common hardware used for handwashing. This implement has however proved to be most unsatisfactory. Taps are often too expensive or not available for families or communities to purchase, the taps leak or break before long and using a tap means that water is wasted. Water wastage is a big issue for those that are responsible for carrying it. The containers are also likely to be stolen for personal use.

Taps are also problematic in that they become contaminated by dirty hands when they are turned on and then transfer the contamination back onto the clean hands when the tap is turned off. Given the importance of the practice it is clear that a new hardware is needed.

Handwashing implementation

Handwashing implementation will require handwashing stations to be established close to latrines. Recently in Banda Aceh, Indonesia the author noted that in no case where he observed post tsunami latrines to have been built, were there handwashing facilities close to the latrines. Yet Shordt (2004) of IRC makes a clear point with her comment that having well maintained latrines without consistent handwashing will not result in the intended health benefits.

Handwashing stations should include appropriate handwashing hardware, some cleaning agent and a drainage system to dispose of waste water. The drainage system can be as simple as a hole in the ground filled with stones, beneath the handwashing area.

To ensure that the implementation of hardware is sustainable the author has fashioned some design parameters which any handwashing hardware should meet. The hardware must:

- Be replicable using local materials and skills
- Use less than 300mls of water per handwashing procedure
- Be child, cross gender and cross generation friendly
- Be affordable
- Be robust - Strength and durability
- Be theft resistant
- Have fitness and function for purpose, it must work well enough to meet the needs of the users
- Have time economy - complete handwashing in less than 40sec.
- Have a one-touch-action, the device stems the flow of water negating the need for the user to touch device after handwashing

The author has designed a device that meets the above parameters. The device has been field tested in an Internally Displaced Peoples camp in Liberia in conjunction with Oxfam. The device is called 'The Captap'. The Captap was found to increase the compliance of handwashing and resolve recurrent problems such as water wastage and leaky or broken taps.

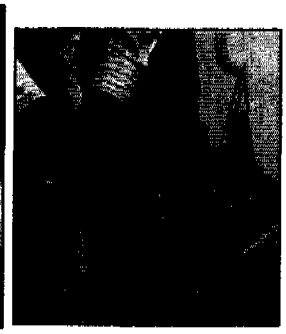
The Captap

The Captap is a spring loaded device that fits into the cap of any jerry-can. It dispenses water through the center of the cap by moving the handle up or down. The Captap stems the flow of water by using a rubber seal that is pulled against the inside of the cap under the tension of a spring. The seal is made out of a bicycle or car tyre tube (See Photograph 1).

The Captap comprises of eight pieces (or nine if the knob is included) all of which are likely to be found in a medium sized market place within a low-income community. There is scope within the design to allow different sized pieces to be used. For example if a 70 x 8mm bolt cannot be found a 4" x 5/16" will work just as well. The most difficult component to find will be the spring. Again however an exact size is not necessary because the tension of the spring can be easily adjusted by tightening the nut.

The water dispensed from the Captap flows into a hand-wash reservoir that is suspended by string or wire from the jerry-can handle (See Photograph 2). The container has two 3mm holes drilled into the bottom, which allows the water to flow out at a rate of approximately 10ml/second. The hand-wash reservoir affords the user hands free hand-washing, thus avoiding the recontamination of clean hands by having to touch the device a second time (See photograph 3). Photographs 2 and 3 show the hand-wash reservoir and the two steps required to complete hand-washing. The Captap uses between 200 and 300ml of water to complete one hand-washing procedure.

Photograph 1. The Captap operation



Photograph 2. Utilisation of Captap

Photograph 3. Utilisation of Captap 2

The Captap: How to make it

The Captap is made in 5 easy Steps (See Figure 1 for schematic detail):

1. **Collect all necessary components.**

2. **Drill the center of the cap out to 11mm.** A small diameter pilot hole may need to be drilled to guide the larger drill bit through the plastic. If a hand or power drill and drill bits are not available; pierce the centre of the cap and carefully, using a sharp knife enlarge the hole to approximately 11mm.

3. **Cut out the rubber seal.** Take a 50mm wide section of car or bicycle tyre tube, lay it on a flat surface and place one of the penny washers on top. Draw around it and draw around the inside of the washer too. Then cut the shape out with a pair of scissors making sure that the seal is 1-2mm bigger than the washer all the way around. The inside circle must also be cut out 1-2mm bigger than the central hole of the washer to allow the water to flow through.

4. **Assemble and fix the bolt and the nuts.** The washers require cementing or welding to the bolt. This is so that when the bolt is moved in operation, the washer that holds tension on the seal moves responsively. The washes can be cemented to each other and to the bolt using a two-pot glue such as araldite epoxy resin. Or alternatively they can be welded or braized. If the option of welding is chosen, the weld and surrounding area will require thorough cleaning and painting to guard against corrosion.

5. **Assembly.** Assemble the components as per the diagram below. Only a little spring tension is required to force a water tight seal. It should be remembered that children must be able to use the device. So do not use too much spring tension. If the Captap leaks, then apply more tension by winding in the hex nut.

An opening can be cut into the top of the Jerry-can making it easier to fill and rendering it unsuitable for use as a water carrying or storage vessel, thus making it theft resistant.

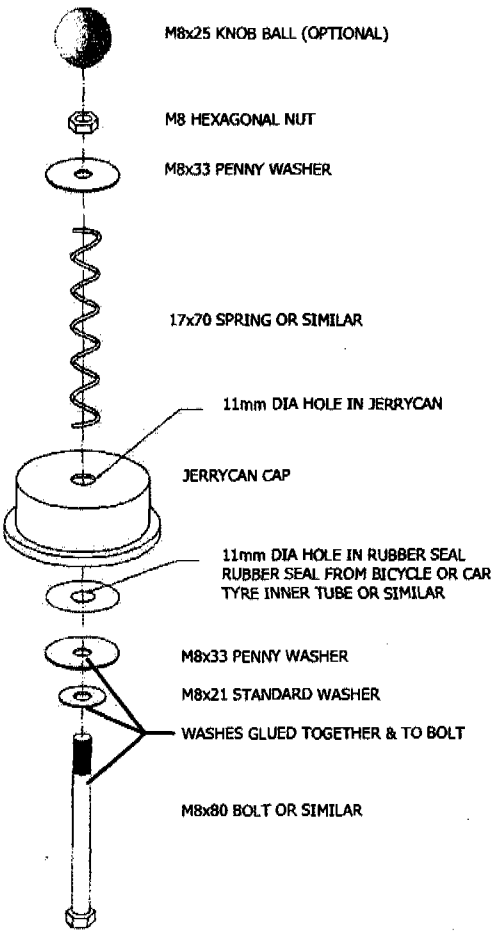


Figure 1. Captap assembly drawing

Handwashing software

Handwashing promotion is also necessary if the practice is to be sustained. Though the scope of this paper does not allow for discussion of this topic it should not be ignored. For information on handwashing promotion ideas and activities, contact the author using the details below.

Conclusion

Without a commitment to implementing the vital practise of handwashing at a grass roots level, the valuable contribution of those that discovered and have since studied the practise, is emanciated.

If Semmelweiss (1983) could survey the impact of his work today he would be proud of the progress made in North America, Europe and Australasia, for in these places, there are handwashing facilities suited to each and every need. But because Semmelweiss was a man with a concern for the sick and the dying, he would be disappointed to notice that the most vulnerable people in low-income communities still are not aware of the need to wash their hands and still do not have the appropriate facilities to do so.

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MAXIMIZING THE BENEFITS FROM WATER AND ENVIRONMENTAL SANITATION

Why traditional approaches to on-site sanitation provision are failing poor households

D Jones, South Africa

Towns and cities across Africa are growing fast and poor settlements are under increasing pressure. The numbers without adequate sanitation continue to grow. Health and hygiene education and social marketing aim to address this, persuading poor communities to change behaviours and invest in household-level sanitation. However, recent BPD work on 'sanitation partnerships' in five African cities highlighted two worrying issues. Firstly, many urban poor are tenants rather than owners, whose incentives to invest in sanitation are weak at best. Secondly, to the detriment of many poor communities, the emptying of latrines is often overlooked. This note discusses the impact of these two issues and goes on to propose how 'mapping the territory' and the linkages of a 'sanitation service' can help external agencies. We also suggest a short checklist for those working with on-site sanitation.

The urban African context

The challenge of providing sanitation in urban Africa is rapidly mounting (it comprises around 25% of the overall 'backlog' and absolute numbers without are rising fast) as urbanisation rates across Africa are significant. African cities are growing at an impressive speed thanks to migration from rural areas and high birth rates.

Often the majority of newcomers rent their accommodation (in Kisumu, Kenya, an estimated 82% of all housing is rented) – as pressures on housing rise fewer rural migrants are able to stay with urban relatives, and many rent from 'landlords' (both formal and informal) with whom they share little connection. Yet rental markets remain overwhelmingly unregulated. Much of this strain is being felt in poorer communities, both formally recognised and informal or "illegal" settlements.

Tackling the problem

In these towns and cities typically less than 30%, and often far fewer, citizens are connected to the sewerage network. The remainder live with on-site sanitation. As bucket latrines have been increasingly phased out, and septic tanks are costly, most poor households resort to some variety of pit latrines (traditional or 'improved'), defecating in the open, or the 'flying toilets' for which Kibera in Nairobi (Africa's largest slum) is famous.

In contrast to network sewerage (often a focus for policymaking) on-site sanitation concerns primarily household-level infrastructure, and is typically considered a household responsibility. Support from external actors is often very limited. Wider public health goals do prompt some interest from outside – this typically manifests itself in community health and hygiene education campaigns and programmes to promote the building or improvement of sanitation infrastructure.

Although various approaches have been tried over the years, the current vogue is in trying to promote households to invest in building or improving on-site sanitation facilities, such as pit latrines. Building or equipment subsidies are generally in decline, and methodologies like social marketing or the demand responsive approach are to the fore.

These approaches aim to raise awareness of the benefits of good sanitation infrastructure and practice, targeting individuals within poor communities and offering them some assistance (often technical, sometimes financial) to encourage construction of new or 'improved' latrines. Occasionally support caters to the 'supply side' as well, working with local masons and others to improve the product on offer to 'sanitation customers'.

Box 1. BPD research programme

In order to gain a better understanding of where partnerships fit in the debates around sanitation, BPD set out in 2004 to work with a series of sanitation-specific case studies. The first challenge was to find such partnerships, less easy than first supposed; eventually Dar es Salaam, Durban, Maputo, Maseru and Nairobi were chosen. The focus was on programmes and approaches relevant to on-site sanitation.

BPD is a not-for-profit organisation that promotes, supports and researches partnerships between different sectors (public, civil society and private) to provide water and sanitation to poor communities worldwide. It has been active since 1998 and has solid experience in its specialist niche of how best to structure, manage and evaluate collaborative relationships (partnerships) that provide services to poor communities (in both urban and rural settings). (See www.bpdws.org)

However, DRA and social marketing are less relevant to renters ...

BPD's findings1 questioned how appropriate these approaches are to current trends in urban African. Both social marketing and demand responsive approaches rely on creating or reinforcing a desire at household level to invest in sanitation facilities. The problem comes when one considers the growing trend of 'rented' accommodation in poor urban settlements.2 The incentives for tenants, rather than 'owner-occupiers', to invest time and money in fixed infrastructure are much less strong. This should spring few surprises: by definition, tenants do not own the property they live on; they pay rent, and typically rely on the landlord to provide amenities like a latrine. The BPD study also suggested that landlords providing low rental accommodation often attach little importance to water and sanitation services and, where provided, facilities are generally rudimentary at best.

Lack of land tenure is a further complicating factor. Here fear of being forcibly removed and losing the investment further reduces the incentives of residents to invest in fixed and immobile infrastructure.

Box 2. What low-cost rental housing means for sanitation

In the cases BPD visited for its study there is a broad inverse correlation between the prevalence of low-cost rental accommodation and sanitation coverage. There is generally greater investment in sanitation facilities where people have secure tenure or own their houses, and owner-occupiers are more likely to invest in improvements.

Tenants living in low income rental accommodation may well want the same sanitation benefits as owner-occupiers, but their ability and desire to invest in fixed infrastructure is typically much lower.

In Lesotho there has been a large influx of people into Maseru in the last five years – the majority of these live in corrugated iron line housing (malaene) and pay short-term rental. Sanitation facilities are rudimentary, in sharp contrast to most owner-occupiers who, thanks to a government awareness and support campaign, have invested in sturdy VIPs.

In Dar es Salaam and in Kenya many of the respondents spoken to were renting a single room in a shared house and it was not uncommon to find fifty or more people sharing one pit latrine.

The results were that many tenants live in squalid surroundings, with little leverage, few acknowledged rights, and little incentive or ability to invest their own resources.
rural settings). (See www.bpdws.org)

These two factors have important implications for approaches aiming to increase sanitation coverage. Slum landlords often have little reason to provide more than a crude structure that must be shared. Neither tenants nor 'absentee landlords' are likely to be as responsive as owner-occupiers to external assistance. In a context of high tenancy, social marketing and other demand responsive approaches thus risk falling wide of the mark.

... furthermore, pit emptying needs to be part of the equation

Pit latrines (the most common infrastructure being 'promoted') generally evolved in a context of space and household-level responsibility. When the pit was full, the family would dig another pit, relocate or rebuild the top-structure, and close the old pit. However, thanks to significant densification in urban slums, there are now more people and more dwellings per plot; in many areas there is no longer space to bury the contents of a full pit on-site or build a replacement pit and latrine. As settlement densities rise in a finite area, households increasingly share facilities, and loading per latrine climbs. All too often informal settlement occurs on marginal land – in areas that are poorly drained, have a high water table or shallow rock; all of these factors contribute to pits filling more rapidly than the assumed seven to ten years. The waste must now be removed and taken away.

Mechanical emptying (often via a 6m3 vacuum truck), for which there is often a vibrant private market in wealthier parts of African cities, is often unaffordable or inappropriate; trucks cannot gain access to pits in poor communities as alleys have narrowed and the terrain worsened. Pit emptying in these circumstances becomes overwhelmingly a manual affair, with informal entrepreneurs relied upon to empty pits by hand. Historically the waste was buried 'on-plot' but high water tables and a lack of space make this increasingly difficult and in many instances the waste must be transported and dumped (sometimes into the sewer network, more often in the nearest stream). In coastal East Africa a further option is to wait for the rains, whereupon pits flood and can be 'flushed' with the waste being washed away in the floodwater or into local gulleys.

In a context of dense urban settlement, pit latrines have thus become a hybrid approach, neither a fully stand-alone decentralised system, nor a reticulated centralised system. They need to be serviced - irregularly and intermittently – to extract the waste and transport it away. Instead of waste transport by water to a central treatment facility, as in sewered systems, they require waste removal, transport and disposal by various means and involving various roleplayers (with parallels to solid waste).

Pit emptying, often ignored or underestimated by 'build and improve' sanitation programmes, thus needs to be considered an integral part of the equation. A 'sanitation service' would encompass: a) storage of waste; b) its removal and transport; and c) its final disposal and treatment.

A holistic 'sanitation service'

A rethink is required to achieve this goal of sanitation provision as a 'service' (such as we think of for water supply and for solid waste). Confining the 'service' to either infrastructure delivery (building or improving latrines) or maintenance (emptying them) is unhelpful: decisions about

the building have financial implications for emptying, while the reliability and cost of emptying can influence decisions about building (for instance low-cost small sized pit latrines would only work if emptying could be relied upon). Pit emptying is often at least as important to householders as the provision of a pit – particularly where the water table is high or in areas prone to flooding.

Yet the links between the two are often not made. It is common for social marketing campaigns to provide extensive information on construction approaches and costs, yet the requirements for ongoing maintenance are not addressed. Typically, the provider and policymaker concerned with building or improving latrines are different to those concerned with emptying them. Thus the many examples of 'non-joined-up-thinking' out there: the building of pits that cannot be emptied, or the promotion of infrastructure without due regard as to its ongoing maintenance needs. For a true and effective sanitation service, this disjoint needs to be addressed – with a better understanding of what an affordable and sustainable service is over time.

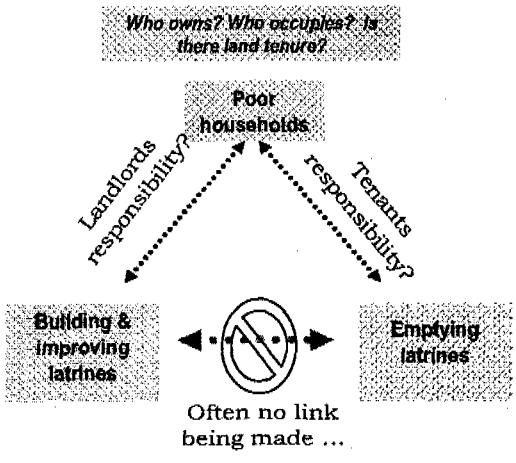

Figure 1.

A way forward?

The BPD research suggests two key steps to be taken when policies are being developed and programmes planned.

First of all we need to better assess the context in which on-site sanitation is relevant, and in particular understand the situation as regards tenancy and tenure.

Secondly we need to create better linkages between the building of latrines and their emptying.

'Mapping the territory'

At the household level, the first question to ask is who makes decisions about investments. In the case studies we often found that this person is a landlord while the actual 'user' is a tenant. Emptying is more usually the responsibility of the actual occupant, but the picture here becomes blurred once sanitation facilities are shared beyond the immediate household (as is the case in line-housing in Maseru, or for most of the pit latrines in Kibera). Men, women and children all have different attitudes and approaches to sanitation, which can vary widely depending upon the culture. Thus even the apparently simple term 'householder' can be confusing and even downright misleading.

We need also to understand the picture as concerns land tenure. While progress can and should be made in settlements where there is no land tenure, the disincentives for investment in fixed infrastructure pose a real challenge. Ascertaining the 'level of comfort' of existing residents is one first step (for instance, have they spontaneously invested in fixed

Box 3. A checklist for on-site sanitation

The work undertaken by BPD suggests the following checklist for those working on on-site sanitation in poor communities:

Is tenancy a major consideration?
Who is responsible for household level investment? If latrines are an option, who is responsible for their emptying? What incentives do householders face on either side of the equation?

Do policymakers on the building side dialogue with their counterparts on the emptying side?
If not, how can this be encouraged? Would an 'honest broker' help achieve this, and who could play this role?

Are providers on the building side the same as on the emptying side?
How is the market on each side of the equation structured? If they are different players how important is it that they speak to each other and how can we bring this about?

Are roles and responsibilities clear (from the perspective of planning, financing and communications)?
Do these aspects serve to link or delink the two halves of our 'sanitation service'? Are the stakeholders the same or different on either side of the equation?

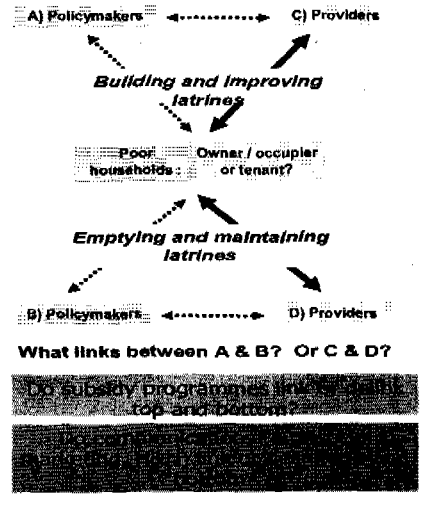

Figure 2. Mapping a 'sanitation service'.

infrastructure themselves?). Engaging policymakers on the issue is sometimes, but not always feasible. In particularly precarious contexts where encouraging significant 'own' investment is especially difficult, stepping back and looking holistically at the challenge may help. For instance it may be possible to bring about improvement in pit emptying, communal facilities, or hygiene practices, where appropriate measures are less hampered by the lack of land tenure.

Creating better linkages

The lack of linkages being made between strategies to build or improve pits and their eventual emptying is a concern. Acting on one side without addressing the other may in fact make some groups worse off, as well as spurning the opportunities for synergies. We need to understand better who is responsible for what; first at the household level itself and then amongst policymakers and service providers (in both the formal and informal sectors). Moreover, if we find that the players on either side of the equation are very different, then innovative strategies to link two sides may be worth developing. For instance a partnership approach between the different policymakers may ensure that policies and actions are at least complementary.

Another option is to see if landlords and tenants can be brought together, taking common action that benefits each. Working together may also help aggregate demand across a community. The latter is important as the disaggregated nature of demand (both geographically and through time) reduce economies of scale and raise already high transaction costs (for builders and emptiers alike) making sanitation even less 'affordable'.

Conclusions

The challenge of urban sanitation is alarming, but BPD's work in five African cities exposed some worrying trends. We observed that the challenges of providing urban sanitation are amplified in a context of insecure tenure and transient residents, and where relationships between landlords and tenants range between 'limited' and 'fraught'. For public authorities, the problems posed by low income tenancy arrangements often seem intractable; the relationship between landlord and tenant is private, but the consequences of inadequate sanitation frequently impact very publicly. Viewed pragmatically, where should primary responsibility for remediation lie – with landlords, or with government? Does the onus fall on the tenants themselves? Which organisations, if any, can straddle the divide? The target of sanitation improvement programmes may need to be re-assessed and ways found to reach out to landlords, rather than just owner-occupiers.

Moreover, it is not enough to promote provision of latrines and toilets; we need to acknowledge the lifecycle of on-site sanitation, and attend to the linkages and partnerships needed to sustain a usable toilet. Core questions around viable approaches to long-term pit maintenance need answering; a 'sanitation service' must be more holistic than just providing a facility in the first instance. For without closer attention to the challenges of human waste removal and disposal, support for expanded provision of on-site sanitation introduces as many problems as it solves.

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Note/s

This paper relies heavily on the BPD study referenced above and in particular trigger papers prepared by Kathy Eales for a discussion workshop in May 2005.

UN Habitat suggests that in several African countries tenancy rates are rising, a fact borne out in our five cases.

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MAXIMIZING THE BENEFITS FROM WATER AND ENVIRONMENTAL SANITATION

Socio-economic impact analysis of sanitation projects

Ms Glenda Malubane and Professor Charles Machethe, South Africa

A number of sanitation projects have been implemented in rural areas of South Africa (S.A) since 1994. The monitoring and evaluation of sanitation projects in S.A was based on the number of toilets built and budget amount spent. Softer issues such as jobs created, income generated and people trained are also measured, very little data are available to show how the projects have impacted on the household economically, socially and in terms of health and hygiene. The objective of the case study was to evaluate the socio-economic impact of sanitation projects on rural communities. Social, economic, and health and hygiene indicators were identified to measure the impact on health awareness and hygiene practices, to quantify the economic impacts of sanitation projects, and to determine the social impacts of sanitation projects. The results of the study revealed that the sanitation projects had a positive socio-economic impact on rural communities.

In 1994, an estimated 21 million people, which is more than half of the population in South Africa lacked basic sanitation services. By 2004, 6.9 million people had been provided with basic sanitation while 17 million people were still without adequate sanitation services out of a total of 42 million people. From 1994 to 2004 a budget of 910 million rands had been allocated to the Department of Water Affairs and Forestry's (DWAF) Community Water Supply and Sanitation (CWSS) Capital Programme to address the sanitation backlog (DWAF, 2004).

The Department of Water Affairs and Forestry has developed a Monitoring & Evaluation (M&E) system and database on water and sanitation which monitors the implementation of water and sanitation projects in the country, the indicators and thus the data generated from this system, are focused on sanitation programme implementation and infrastructure delivery, i.e. sanitation in the country is measured on the basis of the number of toilets built and the amount of the budget spent on the building of the toilets.

Softer issues such as jobs created, income generated and people trained are also measured but very little has been done to measure the performance of these sanitation projects in terms of their socio-economic impact on rural communities.

The objective of the case study was to evaluate the socio-economic impact of sanitation projects on rural communities. Research was carried out to identify social, economic, and health and hygiene indicators to determine the impact of sanitation projects on health awareness and hygiene practices, to quantify the economic impacts of sanitation projects, and to determine the social impacts of sanitation projects.

The case study area

The study was carried out in Mopani District, one of the district municipalities in Limpopo province of South Africa. A total of 60 households participated from two villages, namely Dzingidzingi and Mbatlo within the Greater Giyani Municipality which is one of the local municipalities of Mopani District Municipality. According to the sanitation Project Steering Committee (PSC) of the two villages, Dzingidzingi village has an estimated population of about 2880 and about 608 households and Mbatlo village has an estimated population of about 1668 and about 334 households.

Data collection method

A sample of 30 households out of a population total of 43 households that were beneficiaries of the sanitation project and sanitation project steering committee (PSC) were interviewed in each of the two villages involved in the study. The households interviewed represent 70% of the beneficiary households

Respondents were interviewed using a questionnaire that was developed specifically for the study. Interviews were conducted in face-to-face encounters. Rather than asking respondents to read a questionnaire and enter their own answers, the researcher conducted oral interviews while recording the respondent's answers. The fieldwork was conducted from 1 to 5 November 2004.

Case study results

Baseline studies were not conducted before project implementation in the two villages and the study results are based on the respondent's perception.

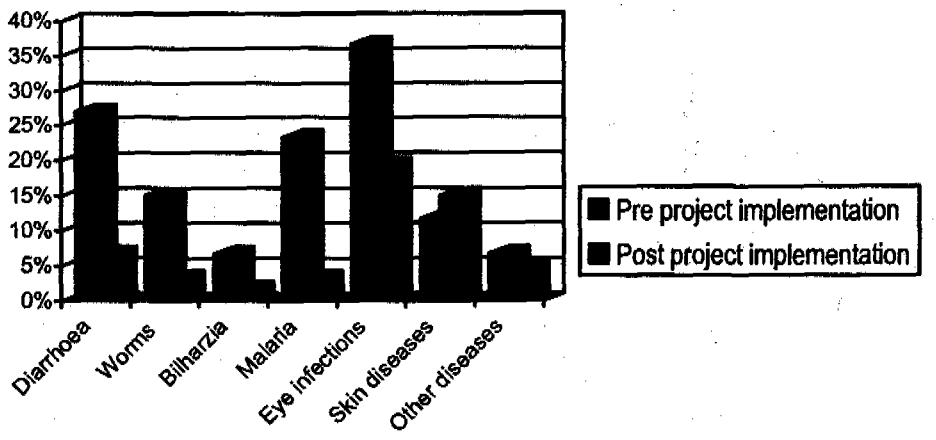

Figure 1. Disease incidence before and after sanitation project

The results of the study revealed that the sanitation project had a positive socio-economic impact on rural communities. The majority of the households indicated that sanitation was a priority for their community and it was perceived to have benefits such as job creation, reduced health costs, reduced rape incidences, convenience and privacy.

Health awareness and hygiene practices impact

The projects were found to have a positive impact on health awareness and hygiene practices of the population. Hand washing has increased and the incidence of diseases reduced due to the increased health and hygiene awareness.

There is a huge difference in the incidence of diseases before and after the sanitation project. The incidence of diseases has reduced by significant percentages e.g. diarrhoea has been reduced by 20.3%, worms have been reduced by 11.7% and Malaria has been reduced by 20%. The only disease that has shown an increase after project implementation is skin disease which has increased by 3.3%.

Hand washing behaviour has improved after the implementation of the sanitation project. The percentage increase in hand washing behaviour ranges from 5% to 45%. Hand washing after visiting the toilet improved by 45%. However, these figures do not reflect whether hand washing actually takes place, but rather people's perception of whether they were washing their hands before sanitation project implementation and whether do they wash hands after the implementation of a sanitation project.

Social impact

The project has had a positive social impact. The people do not have to walk long distances to relieve themselves, especially women girls who faced the risk of being raped and their dignity has been restored by the sanitation project.

Before the implementation of the sanitation project, 80% of the population was always using the veld to relieve themselves, and approximately 1.7% always used the stream and after the implementation of the sanitation project, 96.7% relieve themselves in their own VIP (ventilated improved pit) toilets always, 5% used pit toilet often, and only 1.7% used communal toilets often.

Table 1. Hand washing practices before and after project implementation

	Always %	Often %	Never %	Always %	Often %	Never %
After changing baby's nappy	16.7		1.7	23.3		
Before handling of food and food preparation	45			63.3		
Before eating	93.3			88.3	1.7	
After a visit to the toilet	50	3.3	1.7	95	3.3	
After housecleaning/disposing of rubbish	38.3			53.3		
After touching or contact with animals	11.7			16.7		

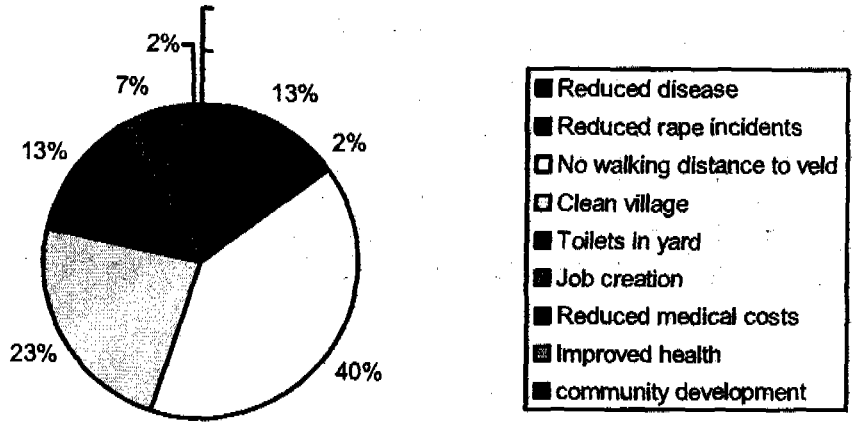

Figure 2. Perceived benefits of sanitation project

Economic impacts

Benefits

The results show that the project has benefited the villages in many ways. The project is perceived to have had a positive economic impact because it created jobs, reduced the incidence of diseases and improved the health of the population, and also led to community development.

Project costs

Contribution

Most of the households (95%) contributed towards the erection of a toilet in their household. The amounts contributed towards the construction of a toilet ranged from R84 to R1000.

Operation and maintenance costs

After sanitation project implementation most households spent money for the operation and maintenance of the toilet. The amount spent for O&M ranged from R3 to R200 and most of the money was spent on a monthly basis. At Mbatlo the households spend 5.5% of their monthly income on O&M while at Dzingidzingi the households spend 4.5% of their income on O&M. The money was spent purchasing cleaning materials and cleansing paper and soap for washing hands.

Table 2. Household contribution (N = 57)

Contribution	
Amount contributed Category (R)	N (%)
R (84-200)	20 (35.1)
R (201-400)	28 (49)
R (401-600)	6 (10.5)
R (601-1000)	3 (5.4)
	57 (100)

Table 3. Operation and maintenance of the toilet

Operation and maintenance pre project implementation		Operation and maintenance post project implementation	
Amount spent Category (R)	N %	Amount spent category (R)	N (%)
R (5-30)	3 (100)	(5-30)	26 (50)
R (31-60)	0	(31-60)	12 (23.1)
R (61-100)	0	(61-100)	8 (15.4)
R (101-200)	0	(101-200)	6 (11.5)
	3 (100)		52 (100)

The way forward

South Africa has seen a large number of water and sanitation projects implemented in the last number of years. Sanitation facilities and health and hygiene awareness training have been provided to thousands of South Africans. In order to maximize the benefits of improved sanitation, it is important for the communities to have access to a suitable and sustainable water supply. The results show that the villages have benefited from improved sanitation even though 95 % of the respondents mentioned that they did not get enough drinking water. Sometimes they can go for three weeks without water coming out of the taps. This indicates that with a sustainable water supply, the benefits of improved sanitation can be increased.

In order to effectively measure the socio-economic impacts of sanitation projects, the collection of baseline data of a site before implementation of a sanitation project should be the first step of implementation. The most important factor for realizing the benefits of basic sanitation benefits is not only the construction of the facility for the household but water supply and behavioural change are very important.

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MAXIMIZING THE BENEFITS FROM WATER AND ENVIRONMENTAL SANITATION

Design of a modified dry toilet ventilation systems to accelerate drying

M.K. Ntabadde., C. Niwagaba , A.I. Rugumayo

A study was carried out to develop a modified ventilation system to accelerate drying, which would be useful in shortening the retention period required before faecal matter can be rendered safe for handling. This would result in smaller units and reduced overall costs. The data analysed showed that all the Ecosan systems were operating on natural ventilation, but often with a number of shortcomings such as small vent pipe diameters as well as, improper and weak materials. It was concluded that a minimum vent pipe diameter of 150mm is required for efficient ventilation and better results could be obtained by incorporating a rotary vent turbine. The rate of drying in the vaults could be further increased by the use of one-way glass for the vault covers and insulating the walls, to optimise direct sunlight and minimize heat loss. These conditions are very important, if accelerated drying is to be realised.

Introduction

To promote the concept of ecological sanitation in Uganda, pilot units were constructed in Kisoro and Kabale districts from 1997, by the Directorate of Water Development (DWD) under the South-Western Towns Water and Sanitation (SWTWS) project. The SWTWS project has since constructed over 500 units. The dehydrating (dry) EcoSan systems are preferred to composting systems in Uganda due to the convenience in handling of faecal matter after drying. Also according to Esrey et al, 1998, dehydrating methods are said to kill pathogens more effectively than other simple methods.

Despite the enormous benefits of Ecosan systems, they still have a number of constraints in their design, which restrict optimum performance. Among these is the low rate at which faeces in the dehydrating vaults dry up. Thus there is need to develop an improved design of the ventilation system and other components to accelerate drying of the faecal matter which would result in shorter retention periods before the faecal matter can be rendered safe for handling. Thus providing smaller and more cost effective dehydrating ecosan units.

In a research carried out at Makerere by John Senkungu to investigate the efficiency of the ecosan with modified ventilation, a ten percent moisture content reduction on average was realised in the improved model ecosan, more than was realised in the control ecosan.

Objectives

The main objective of the study was to design an innovative dry toilet ventilation system to accelerate drying.

The specific objectives were:

- To study the ecological sanitation systems available, their performance and operation;
- To identify shortcomings in the design and operation of current systems;
- To produce adequate modifications to accelerate drying, depending on the findings above;
- To develop a model of the modified system,
- To produce design drawings of the modified system with the aid of a CAD software,
- To estimate the cost of construction of the modified ecosan toilet.

Materials and Methods

Site Visits

Site visits were made to the SWTWS project area in order to obtain the necessary information on Ecosan systems. A random sample of twenty units was selected and analysed to get a qualitative representation of the characteristics of the entire population of about two hundred dehydrating ecosan units within the sampled area.

Twenty questionnaires were used to establish general information whereas checklists were used to record more technical information obtained either by measurement or observation. For quality control, all measurements taken were averaged from at least three values.

Selection of materials and sizing of components

Introduction

Natural ventilation is driven by pressure difference across the building envelope, caused by wind and/or a difference in air density due to temperature differences (stack/thermal effect) between indoor (or vent pipe) and outdoor air (Arch-hku, 2001).

In order to maximise airflow through the ventilation system due to thermal effect, the temperatures within the vaults and the vent pipe should be maximised and the stack height (vent pipe height) optimised (Lowndes, 2000).

Selection of vault materials

A material with a high transmittance was selected for the vault doors and for the walls; materials were selected so as to have much of the heat absorbed within the processing vaults being retained, by providing some kind of insulation. Thus one-way glass was selected for the vault doors because it allows in direct sunlight in one direction into the vaults and hinders light-movement in the reverse direction. A double wall was selected for the vaults with a small space between the two walls to accommodate some form of insulating material that may be available.

Sizing of the vent pipe

The pipe diameter size was selected such that the recommended ventilation rate of 20m³/hr could be achieved either by thermal effect or stack effect, assuming there would be a point when the system would be operating independently, either on thermal or stack ventilation.

The predominantly used size of 100mm diameter was checked to establish if it can achieve the recommended ventilation rate of 20m³/hr. Having been found inadequate, a larger size of 150mm was tested.

The ventilation rate due to the wind effect was calculated using equation 1(Arch-hku, 2001)

$$Q = C_v A v \quad \ldots \quad (1)$$

Where

Q = air flow rate (m³/s)

A = free cross-sectional area of vent pipe inlet opening (m²)

v = wind velocity

C_v = effectiveness of the opening (0.25 to 0.36 for diagonal winds)

For design purposes as the wind velocity used was half the average seasonal wind velocity calculated because from climatic analysis there are very few places where wind speed falls below half the average for many hours in a year (Arch-hku, 2001).

The ventilation rate due to stack effect was calculated using equation 2 (Arch-hku, 2001)

$$Q = K.A\sqrt{(2.g.\Delta h.(T_i - T_0)/T_i)} \quad \ldots \quad (2)$$

Where

Q = air flow rate (m³/s)

K = Discharge coefficient for opening (usually assumed to be 0.65)

A = free cross-sectional area of vent pipe (m²)

Δh = height of vent pipe (m)

Ti= Vent pipe air temperature

T_0 = Outdoor air temperature

The temperature values used were measured for selected units in Kabale-Kisoro and Mbarara for three consecutive days, three times each day (at 7.00am, 2.00pm and 7.00pm) and the average values used.

Selection of a rotary vent turbine

Ventilation systems operating purely on natural ventilation have been found not to be very effective, (Liddament, 1996), especially when poorly designed. A mechanical wind-driven turbine (turbine vent) was therefore incorporated into the design to accelerate the rate of evaporation from the processing chambers.

Construction of a model

A model of the designed ecological sanitation toilet was constructed at a scale of 1:4, using 9mm thick plywood. The vault doors were made of 5mm-thick one-way glass and the vent pipe was fabricated from 1.2mm-thick mild steel plate. The rotary vent air extractor of 14 blades was locally fabricated from aluminium.

Table 1. Qualitative Summary of the results

Height of vent pipe above roof (m)	<0.5	0.5-0.7	>0.7
Number	8	8	4
Percentage	40	40	20
Orientation of the vault doors	**Vertical**	**Slanting**	**Horizontal**
Number	6	12	2
Percentage	30	60	10
Number and location of vent pipes per stance	**1, centre of 2 vaults**	**2, centre of each vault**	**2, at centre of each vault**
Number	11	7	2
Percentage	55	35	10
Vent covers	**With**		**Without**
Number	13		7
Percentage	65		35
Pipe material	**PVC**		**Others**
Number	20		Nil
Percentage	100		0

Results and Discussion

Field results

The results obtained from the site visits in Kabale, are summarised in Table 1. From the results, it can be observed that;

- A good percentage of the dry toilets had slanting vault doors made of 1.2mm gauge steel plates painted black to increase the amount of heat absorbed, thus accelerating the rate of drying and the rate of die-off of pathogens in the processing vaults (Moe Christine and Izurieta Ricardo, 2003)
- Only twenty percent of the twenty units had vent pipe height above the ideal recommended height above the roof to prevent interference to wind flow due to turbulence around the top of the pipe (at least 0.5m above the highest point of the roof.

- Thirty five percent vent pipes of the twenty units visited were without vent caps, thus rain would find its way through the vent pipe into the processing vaults thus increasing the moisture content in the vaults.
- Sixty percent of the toilets had one vent pipe aerating two vaults. This was done in such a way that a groove would be created in the upper part of the partitioning wall between the two vaults and the pipe fixed just above this space. This approach greatly hinders the free flow of air into the vent pipe since the effective area of entry is reduced, thus reducing the rate of ventilation (Parmley *et al*, 1988).
- One hundred percent of the units had 100mm diameter PVC pipes of a poor grade, which was easily damaged.

Design of Ventilation System

Sizing of Vent Pipe

In order to come up with an appropriate size for the pipe, equations 1 and 2 were used to calculate the ventilation rates due to stack and wind effects that would be obtained by the sizes of 100mm and 150mm diameter. By substitution of the necessary parameters into equations 1 and 2 the results in Table 2 were obtained.

Table 2. Ventilation Rates achieved by different diameters

	Ventilation due to Thermal effect (m^3/h)		Ventilation due to Wind Effect (m^3/h)		Recommended value (m^3/h)
Pipe Diameter (mm)	100	150	100	150	20
Kabale	16	37	13	28	
Kisoro	15	36			

From the results obtained, the 100mm diameter pipe was found in all cases not to achieve the recommended ventilation rate of $20m^3/hr$. Whereas is all cases the 150mm diameter pipe achieved the recommended value Since all other variables in the equations 1 and 2 will remain constant for a given area (and constant height), the only variable that could change the ventilation rate Q will be the pipe Diameter. The minimum pipe diameter for effective ventilation in the toilet was thus concluded to be 150mm.

Design of Vault walls

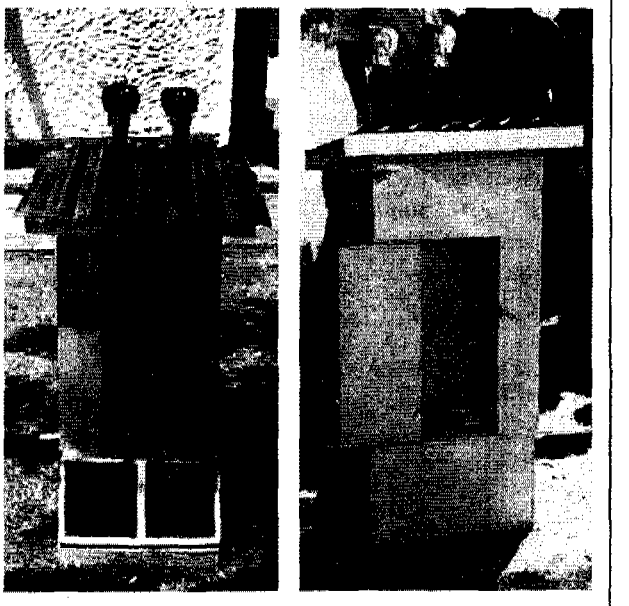
An attempt was made to maximise the temperatures in the vaults so as to accelerate drying. This was achieved by incorporating insulating materials with a higher R-Value, (this is a measure of resistance to heat flow that a given material offers). A double wall was used with the space between the walls having half-inch gypsum board and quarter-inch plywood. The new design of the wall had an R-value three (2.93) times that of the single wall (0.96) This would imply that a given amount of heat conducted through the single wall in a given time (t) would take three times (3t) the same time to be conducted through the double wall.

Vault Doors

One-way glass was used for the vault doors, to maximise the temperatures within the processing vaults, to accelerate drying. Though glass in a vulnerable material susceptible to damage, the material could be protected by use of a wire mesh of appropriate spacing tightly stretched over the glass, leaving a clearance of a few centimetres between the glass and the mesh. This would shield the glass from foreign objects that could damage it.

Cost

The design plus construction of a one stance Ecosan unit of the proposed design was estimated at 1.4million Uganda shillings (about US$850)



Photograph 1 *(left)*. Rear view of model
Photograph 2 *(right)*. Front view of model

Conclusions and Recommendations

Conclusions

- All systems visited were operating purely on natural ventilation. Many times there was no flow recorded in the vent pipes especially those with a small vent pipe bore.
- It was concluded that a pipe diameter of at least 150mm is required for effective ventilation. Incorporating a rotary vent turbine would greatly increase the rate of extraction of evaporated water from the vaults.
- Temperatures in the vaults could be maximised by use of one-way glass to allow in as much direct solar radiation as possible into the vaults and use of insulating materials within the walls to ensure that the heat absorbed is not easily lost.
- The proposed improvements can be carefully selected so as to achieve increased rates of drying to some extent, without necessarily having escalated prices.

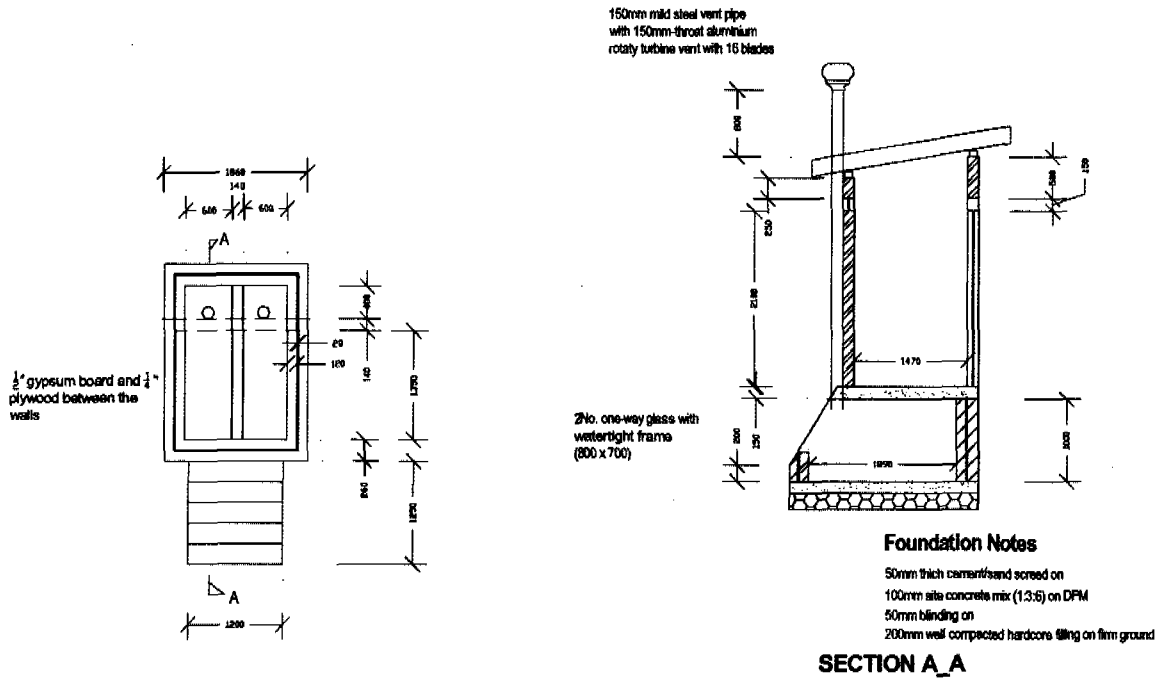


Fig 1. Design drawings for improved system

Recommendations

- The design should be redone with the temperatures recorded over a period of at least one year, so that there is greater confidence that the system designed can serve adequately even during those seasons when the lowest ventilation rates are achieved.
- The suggested improvements should be incorporated in the current dehydration Ecosan design and a prototype be made to monitor the performance of the improved design in comparison with the existing design.
- The minimum vent pipe should not be less 150mm.
- A black material of a stronger grade should be used for the vent pipe and the pipe should be located on the outside of the Ecosan unit to improve absorpativity and maximise the surface area exposed to the sun.

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MAXIMIZING THE BENEFITS FROM WATER AND ENVIRONMENTAL SANITATION

Promoting sanitation at the community level in Jigawa State: A case study of a dangling carrot

B Ogunjobi and A Radiu, Nigeria

It is a truism that demand for water supply does not require any inducement; it is almost an automatic offshoot of any interaction between development workers and the community. The reason is not farfetched; it is because water supply is known to everyone as essential to life and most especially, a commodity that has no alternative. Promoting sanitation on the other hand, deserves strategic moves that are sufficiently participatory not to be misconstrued as imposition. It requires what we call "dangling the carrot". This is the scenario in Jigawa State of Nigeria where communities are given support for construction and usage of latrines before water supply. Questions that quickly come to mind are "Where do they get water to practice hand washing?" "What motivate them to construct these latrines?" The experience in four communities and three primary schools provide answers to these and other questions.

Introduction

Jigawa state is one of the 36 states of the federal Republic of Nigeria and is located in the North Eastern area of the country. The state has a population of about 2.8 million living on a land area of about 22,400 square kilometers. The population is largely rural and agrarian with most of the farming done during the short rainy season. Largely, only about 40% of the rural populace has access to safe water supply while less than 40% practices safe defecation.

United Nations Children Fund (UNICEF) with support from the Department for International Development (DFID) began a WES project in 2003 with a view to contributing towards increasing access to water and sanitation services to the country's large population. The program also supports ensuring improved capacity for WES implementation in the country at all levels.

At the National level, the programme supports activities in policy and systems development while intervening in thirty six states and the Federal Capital, Abuja aiming at improving the quality of life through provision of water and sanitation services thereby reducing child mortality and morbidity from Water and Sanitation related diseases.

In Jigawa State, UNICEF/DFID-supported WES project focusses in two LGAs and four communities for intervention.

The baseline

Four communities of Kazura, Fagi, Kargo, and Kanya-Maikaho were selected in Jigawa State. In these communities, there were few traditional latrines most of which were in a state of disrepair. Open defecation was the order of the day as children's faeces were seen littering all over the place while nearby bush was not spared by the adults. Water supply was also in shortage; during dry season, women and their daughters spent hours looking for water thereby preventing the girls from going to school regularly. The primary schools neither had latrines nor water facilities; pupils used the nearby bush for defecation while school surroundings were not kept tidy.

The schools had dilapidated blocks of latrines already abandoned; hygiene was not being taught in schools even though it was in the curriculum. The teachers were not aware of this and more so needed skills for its teaching. Daily bathing was not practiced by pupils especially during dry season when water becomes a scarce commodity used only for cooking and drinking.

The process and the strategies

Interaction with the communities was done using Participatory Rural Appraisal methods which include Mapping; Transect Walk; Problem Tree while tools such as F-Diagram and Sanitation Ladder posters were used to generate discussion with the communities on issues around their defecation practices; prevalent diseases and the different types of people and their habit.

This was followed by a Community Action Plan Process which also adopted Participatory tools to help communities develop strategies to deal with identified WES related problems.

During Community Action Plan (CPA) process, in each

of the communities, men, women, youths and the children saw open defecation as a health hazard and a socially degrading habit.

All agreed to be responsible for the digging and lining of the pits in their household while support would be sought from the project for provision of slabs.

Pupils and teachers alike agreed that open defecation could stop if support was received from the project.

The project therefore aimed at quickly promoting safe defecation in communities since this was tipped as a priority. About fifty (50) householders volunteered to get pits ready for slab installation within a fortnight.

About a month after the Community Action Plan meeting, the WES unit of Birniwa and Garki LGAs received letters from these communities asking the sanitation and hygiene officers to come and inspect the latrine and make slabs available. Altogether, at this initial stage forty-two latrines were ready for slab donation.

RUWASSA and WES unit officers organized slab construction training in the communities that resulted in the construction of forty slabs. Each of the households was supplied a slab at the unit cost of $18. Furthermore, volunteers were sought among community members to dig latrines and do the lining. Within two weeks, about 35 latrines had been ready for slabs, which this was supplied immediately. Other members of the communities began to dig their household latrines and within a month the project had to facilitate another round of slab construction.

Furthermore, environmental sanitation groups were formed in the communities with members from the Water and Environmental Sanitation Committees (WESCOMs), vigilant groups and self help groups to take charge of environmental sanitation of their communities which is being organized once every month.

Impact so far

It may be too early to highlight the impact of the sanitation promotion in these communities but glaringly, the surroundings are neater as children's faeces are not seen everywhere any longer. The importance of the use of latrines in the households is described by community members as follows;

In Kargo community, Mallam Abdullahi popularly called "Tailor" had this to say "Now my wives do not go to the bush any longer due to the existence of latrines and I am sure nobody gets to share my wives' privacy with me. This is a thing of joy".

In Kazura community, Hajia Salamatu, a housewife, pointed out that her gain was that "Our husband now allows us (the women) to use latrine which was only meant for the men & grown-up boys in the family". The thinking among women in Kazura is that this is the beginning of more freedom for them.

The Village head of Fagi pointed out "we are like abandoned here but you came to find us; now we are not ashamed of receiving visitors since we now have latrines and safe water to exhibit to them. Look at our environment, sparkling clean"

Willingness to pay

As demand increased every day and the free slabs were not forthcoming, the WESCOM members and the communities mapped out two strategies in order to ensure easy access to slabs by all the members of the communities. Potential sani center operators were identified and plan is to establish sanicenters in these communities. With this, community members have ready access to sanitation materials and thereby avoid the hassle of going to the city and incur transport cost which is about $100 for about $700 worth of materials. In two communities, householders have adopted "weekly contributions" through which ten households pool money to produce a slab every week. The slab is mounted on the latrine of one household after digging and lining and the next week another household will get the same so that in ten weeks, ten households will have a latrine each.

WES in School- What is it now?

The needs assessment in the school was carried out with the pupils and the teachers and some community leaders in attendance. At that meeting, it was agreed that the communities would be responsible for digging the pits in the schools. Weeks later, communities did this with UNICEF supporting with cement and roofing sheets while the communities were responsible for provision of sand, labour and fee for the workers. In addition to the training provided for members of the WESCOMS, UNICEF trained teachers on hygiene and sanitation. These teachers were guided to develop a work plan to implement WES in their schools.

In one of the schools the headmasters explained how it was difficult at first to make pupils use the latrines. He said "first, we had to cut down a nearby bush so as to let these pupils know that we meant business, secondly, we teachers began to use our own latrines religiously and thus we became role models for the pupils"

And now, Hygiene clubs have been formed comprising girls and boys. The clubs managed by pupils and coordinated by the health teachers are charged with the responsibility of facilitating all WES activities in school. The Executive Council of the club meets once or twice a week. Environmental cleaning exercises are carried out weekly while the clubs do a monthly roster that assigns pupils to various duties ranging from sweeping, fetching water and inspection of latrines.

In two of these schools, there are a five-compartment la-

trines in the school with two each allocated to boys and girls while the remaining is used by teachers who are all men.

Using the simplified manual supplied by UNICEF, health teachers have began to teach hygiene in physical and health education, but a look at the lesson note shows that they teach the pupils in all classes the same topic which the WES officials have promised to address through another round of training. However, a health teacher in one of the target schools said "I'm not only using the knowledge in the school but also in my house; there is a latrine in my house installed with a hand washing facility and we clean our surroundings daily" In one of the communities, the village head revealed that some of the pupils have influenced their parents to construct latrines in their households through their attitude against open defecation.

Challenges

- Starting a WES project with Sanitation promotion makes hand washing a bit difficult as the scarce water cannot be used for hand washing. In the school, pupils have had to spend a great deal of time to fetch water from traditional source for anal cleansing.
- Donation of slabs free of charge at the initial stage to willing householders ended up supporting those who could have paid for slabs, so the subsidy was captured by better off households.
- Most of the communities are very far from the main road which makes sanitation materials transportation difficult and expensive. This increases the unit cost of a slab.
- Formation of Sani-Center could not have taken place from inception because high demand had not been generated otherwise, people would be procuring the materials for use other than slab construction.

Lessons learnt

- Child-to-Child methodology is very effective in promoting safe behaviors among children in the school and the community.
- A simultaneous support for latrine construction both at home and in the schools is key to sustainable safe defecation among pupils.
- Availability of sufficient water is essential to promote safe defecation & hand washing both in the school and the community.
- Whenever Community members understand that open defecation affects their health greatly and that support is available to help them out of this habit, they are ready to take a step to adopt safe defecation.
- As a result of demand and awareness created, the community members are ready to participate in a household latrine construction; and they are willing to pay for it.
- Teaching hygiene in schools by teachers is a key to proper hygiene practices by the pupils. However, this may not be possible unless teaching of hygiene is included in the curriculum either as a subject or topical issue in another subject.
- Supporting teachers to own latrines in their households and sensitizing them to adopt safe defecation in the school as well as in the communities make them become good role models among pupils and community members. This speeds up promotion of safe practices among all and sundry.

Mapped out Strategies

- Establishment of sanitation centers controlled by private business people in the communities to serve cluster of communities. This will create easy access to sanitation materials and reduce the cost of transportation.
- Scaling up of the intervention into twenty more villages that are not far from the four where the project started.
- Consolidation of the systems already in place and continuous strengthening of WESCOMs in each of the communities.

Conclusion

For a more effective implementation of an integrated Water and Environmental Sanitation, support would be given to the target communities for water supply. This will also go a long way in sustaining their interest in the program.

It is important, however, that people are not charged too much for slabs, as in Jigawa at least, the concept of sanitation is well accepted, but the main constraint is the cost. Hence, efforts are being made to reduce the cost of a slab and thereby reduce the subsidy being given to each household. This could be done through a Private Sector owned sanitation center. It may also be good to influence the state government to develop a subsidy policy as an essential component of sanitation implementation.

Community development committees (Ngomas) are institutionalized at the community level in Jigawa such that the State government channels funds directly to them for development activities. This means that Ngomas have funds for operation and maintenance of facilities. It is vital that the WESCOMs are linked to the Ngomas as this will be the conduit for government funds to communities in future.

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MAXIMIZING THE BENEFITS FROM WATER AND ENVIRONMENTAL SANITATION

Implementing a City-wide Wastewater Management programme in the Philippines

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This practitioner's paper shares and discusses recent outcomes of an ongoing project that formulates and implements a city-wide wastewater management programme in four selected cities of the Philippines. The paper initially discusses the need for urban sanitation in the Philippine context, and then moves on to discuss the framework for this project and its aims and objectives. Detail is given on how the wastewater management scheme is being implemented under the Philippine government's broader umbrella policy and strategy to improve the urban and peri-urban environment. This project takes all the experiences and lessons learnt from previous projects and initiatives of a similar nature, particularly the stakeholder driven approach, and replicates them in the Philippine context.

Introduction

Adequate, affordable, and appropriate sanitation system provision, operation and maintenance is probably one of the most complex and yet important problems facing large urban settlements, both formal and informal, in all developing countries. And yet most policy makers, at both national and regional levels, including most multi-lateral and bi-lateral donors, continue to largely give it lesser significance when compared to water supply provision for understandable reasons (Mara 2003).

In some ways we can appreciate why most stakeholders are wary of seriously addressing this critical issue, as it is usually very complex in nature and contains a whole host of other interrelated issues. Consequently, it is very difficult to provide sustainable solutions that meet and solve all the socio-economic, topographic and other multi-faceted constraints. However, it must be remembered that this complex problem is only going to get worse, particularly in the case of the Philippines, for the following reasons:

- Population growth in the Philippines is among the highest in Asia, but only about 7% of the country's 85 million people are connected to sewers and very few have adequate on-site sanitation facilities (World Bank 2003);
- Continuing urban drift and shift in population from rural areas has led to the continued expansion of informal settlements, i.e., squatter camps, that have little or no sanitation services;
- Increasing population densities and congestion, coupled with lack of sanitation services and poor hygiene, has resulted in high incidences of waterborne diseases—the Philippine Department of Health reported that 31% of illnesses over a 5-year period were due to water-related diseases.

Local initiatives for Affordable Wastewater Treatment (LINAW) Project in the Philippines

Water pollution due to inadequate wastewater collection and treatment facilities is a serious problem in the Philippines with more than 90% of the sewage generated not disposed of or treated in an environmentally acceptable manner (World Bank 2003). To address this huge problem, the Philippine government enacted the Clean Water Act in 2003 which requires local government units (LGUs) to play a central role in water quality management, including providing domestic sanitation facilities, but provides no direct funding support.

It has long been recognized that the most effective urban sanitary projects are those that are managed and implemented at a local level by largely financially autonomous community-based units that use a participatory approach to project design and system selection (Shaw and Smout 1999, Pickford 1991). Exclusive reliance on central government and/or external donors often leads to uninformed project design, implementation problems, and a limited sense of community ownership which negatively affects project sustainability (Tayler et al, 2003).

The Local Initiatives for Affordable Wastewater Treatment (LINAW) Project was created to facilitate local responses to the urgent need for sanitation services in the Philippines. Funded by the United States Agency for International Development (USAID) through the US-Asia Environmental Partnership (US-AEP), the project is assisting four pilot cities, namely Iloilo, Naga, Muntinlupa and Dumaguete, to develop and implement low-cost wastewater treatment systems to improve water quality management. The authori-

ties in these four cities recognized the detrimental impact of water pollution on the quality of life in urban areas, and consequently decided to play a proactive role in identifying and developing innovative solutions for reducing wastewater pollution. In particular, they have been pilot testing small-scale, low-cost treatment systems and developing longer-term plans and projects to tackle their domestic wastewater challenges.

Methodology

Before designing a very specific wastewater management plan for a particular city, it is best to consider a much broader framework of strategic ideas and concepts regarding the overall environmental aims the cities are trying to achieve. Hence the intention of this framework is to ensure that any citywide plan is not made in isolation to any other relevant sector (i.e. water supply sector), and fits into a coherent and logical approach to wastewater systems design. In other words, any other wastewater projects that run concurrently or at a later date than the LINAW project do not seriously conflict in technical terms with its aims and objectives.

This LINAW scheme is really a demonstration project to show how a phased and systematic approach to wastewater management need not be prohibitively expensive to yield real improvements in the environmental quality of water-courses. Hence, the overall framework for this project puts the specific ideas and strategies used under the LINAW project into the larger and more difficult context of the sustainable management of a congested city environment of a developing country. A basic project framework for a typical city is outlined and summarized below:

1. Set major objectives

- Lower morbidity/mortality rates amongst residents of LGUs, particularly infants; improve quality of life due to cleaner environment and economic gains.

2. Preliminary investigative work

- Collect technical data on major sources of water pollution, i.e., industrial, commercial, residential, roads, drainage, etc.
- Identify local partner agencies, NGOs, CBOs, and other relevant stakeholders.
- Collate existing historical data, records, WatSan and health reports.
- Develop a phased short, medium and long-term strategy to implement the water pollution agenda highlighted under the Clean Water Act.

3. Technical/engineering aims

- Existing combined sewer system to receive relatively clean wastewater from various sources, i.e., encourage and foster pretreatment on-site;
- Reduction in foul flows into system through vigorous enforcement of local legislation, i.e., fines/penalties.
- Regularly clean out storm water drainage channels, i.e., set up eventually self-financing solid waste management agency.
- Set up sludge/septage treatment facilities, including plant operation and management agency.
- Introduce a city-wide septage management scheme, i.e., contract out septage collection by vacuum truck, collect fees to cover operation and maintenance costs, etc.

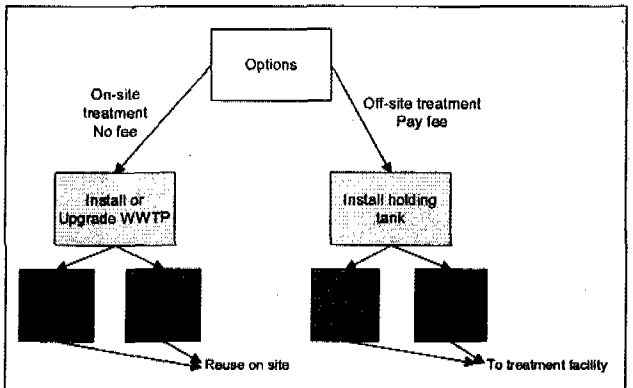

Figure 1. Short-term strategy options for major polluters

4. Short-term pilot projects

- Tackle large city-owned sources of pollution first, such as public markets and slaughterhouses, that produce large concentrated waste streams.
- Use the pilots to test the introduction of appropriate technologies to carry out on-site treatment of wastewater.
- The pilots set a good example for residential and industrial wastewater generators, and they have revenue streams to pay for on-site system operation and periodic desludging.

5. Short-term strategy

- Firstly concentrate on major city-wide industrial and commercial polluters, such as large hospitals, and reduce their wastewater generation (see Fig.1).
- Move on to SMEs.

6. Medium to long-term projects

- Concentrate on individual residential wastewater sources (see Fig. 2).
- Build and commence operation of septage treatment facility, i.e., waste stabilization ponds.
- Set up septage management programme and associated organization to collect and transport septage and levy user fees, etc.
- Extend existing sewerage network using simplified sewerage technology and local financing.

7. Medium to long-term strategy: Water course clean up and rehabilitation

- Set up community river councils, particularly in squatter

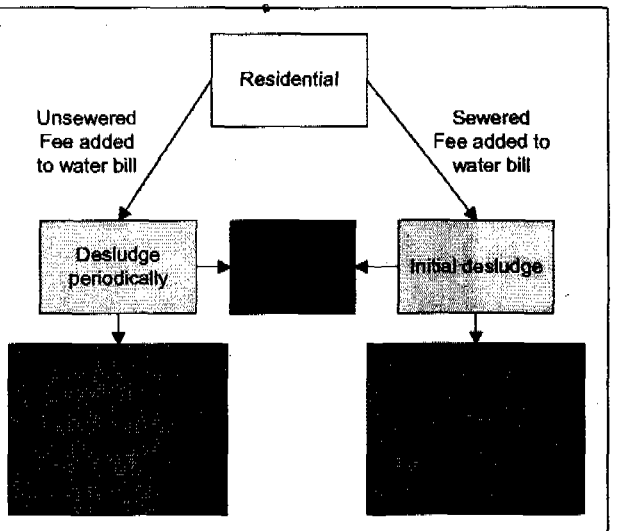

Figure 2. Medium to long-term strategy options for residential polluters

settlements located adjacent to watercourses.

- Identify sources of incoming pollution.
- Initiate community-based and financed sanitation program to upgrade and/or repair existing systems to requisite standards, and to install new systems where necessary, i.e., communal pour flush latrines and septic tanks (Cairncross and Feachem 1983).
- Close off direct river discharge latrines; dredge the river bed to remove accumulated solid waste; remove aquatic vegetation growth due to eutrophication; where technically and financially possible install manual bar screens at outfalls; initiate health and hygiene promotion activities.

The strategic planning process for LINAW

After setting up a generic framework, the LINAW project helped each city develop strategic interventions and solutions based on a participatory action planning process where city officials and stakeholders worked together to identify and develop priority projects. The LINAW project is assisting the four LGUs in this complex process by providing:

a) Targeted technical assistance, including project design and packaging support;
b) Site visits to other regional countries to learn about best practices and technology options;
c) Participatory planning workshops;
d) Information and resource materials on technology and financing options;
e) Assistance in developing and implementing public awareness campaigns; and
f) Sharing project results in both local and national forums.

Operating under a two-track programme, LINAW has been supporting the development of "rapid response" solutions that address immediate pollution problems through specific on-the-ground interventions. For the second track, LINAW and the cities are addressing more significant wastewater challenges that require more comprehensive assistance in planning, project design, technology and financing solutions, project packaging, and outside funding where required. At all times the major stakeholders are the drivers for the development of each city framework and strategic planning process with the LINAW project team acting as facilitators and technical advisors.

Current projects and activities

Dumaguete City's overarching goal is to improve the quality of the water in the oceanfront along the city's popular boulevard promenade. To achieve this, the city is building an offsite treatment facility consisting of a series of eight lagoons to treat septage from the city's septic tanks, from over 21,000 households and all commercial establishments, schools, hospitals, the public market, and city hall. The city also plans to undertake onsite effluent treatment for the public market and a collection and treatment system for wastewater from three of the outfalls flowing into the sea along the boulevard.

In Muntinlupa City, a wastewater treatment facility is being built at the public market that will allow for 25% of the treated water to be reused. A pilot project is being developed for a housing subdivision in which the homeowners have purchased prefabricated septic tanks and a piping system that will allow for the effluent to be collected and treated onsite. Three informal communities within Barangay (village) Sucat will build community-based sanitation centers with three toilets and three baths each, using labour from the community and building materials donated by the local Rotary Club and Barangay.

In Iloilo, a septage management program is being designed for a community of 150 households, and a decentralized treatment system is being developed for a private hospital. Two or three communities along the coast will develop community-based sanitation systems with toilets and baths.

In Naga, treatment systems are being developed for the public market for wastewater current flowing directly into the Naga River, and the public slaughterhouse. Two communities will develop community-based sanitation systems with toilets and baths.

Other project activities include:

- A training course on operating and maintaining wastewater treatment systems was held in February and a course for local engineers on designing low-cost wastewater treatment facilities will be held in May.
- Information, education and communication campaigns are starting in each city to raise awareness of the extent of the problem, the need for action, and develop support for septage treatment user fees.
- City representatives and key stakeholders have participated in study tours to Indonesia and the US to learn about the effective low-cost technologies.

Conclusion

Although the LINAW project does not in itself claim to introduce any new ideas, management tools, organizational strategies or low-cost technologies in the context of urban sanitation provision, it is a genuine stakeholder-driven initiative with only limited central government and external donor financial input. This is largely due to the recognition that local pollution generation should be dealt with locally including local financing of all strategic interventions. Consequently it is hoped that if the LINAW approach proves successful in the context of these four pilot cities, it can be extended to other Philippine cities. To achieve this, the project is enlisting the support of the League of Cities of the Philippines to share the information with their members, and training local engineers on designing low-cost wastewater treatment systems for LGUs.

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MAXIMIZING THE BENEFITS FROM WATER AND ENVIRONMENTAL SANITATION

Capacity building for improved performance of water and sanitation NGOS/CBOS in Uganda

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This paper highlights the 5 year capacity building programme for more than 94 NGOs/CBOs in the Ugandan water and sanitation sector. Capacity building activity implementation aimed at developing an effective civil society which can complement and inform government towards achievement of sustainable access to water & sanitation takes place at regional level, and is being co-coordinated by 8 regional coordinator in 8 different parts of the country. The 1st year implementation built capacity of NGOs/CBOs in areas of practical skills, report writing and records management using training methods such as workshops, apprenticeship, coaching and internship. By the end of the 1st implementation year, there was visible improvement of co-ordination, knowledge and experience sharing among beneficiary NGOs/CBOs. All of them streamlined their legal status, and service provision/operational focus as well.

Background

The government of Uganda together with its development partners are funding a Capacity building program for NGOs/CBOs that are registered with the Uganda Water and Sanitation NGO Network [UWASNET]. UWASNET is an umbrella organisation for NGOs and CBOs in the water and sanitation sector.

The Capacity building Program is targeting a total number 94 NGOs/CBOs that are operating in the water and sanitation sector in Uganda.

Although these NGOs/CBOs are well suited to providing water and sanitation services to poor rural and urban communities, some of them do not necessarily have the range of skills, knowledge or resources to enable them undertake this role effectively and on a large scale. Their potential to contribute to increasing access to safe water and sanitation varies widely in terms of competence, experience, and access to funds.

The government is funding the NGO Capacity Building Program using the GoU/Donor joint Funding mechanism.

The aim of the component is to, enhance sector capacity amongst key stakeholders at all levels to plan, implement, monitor, manage, and report sustainable water supply and sanitation development.

The purpose of the Capacity Building Program is to develop an effective, dynamic and independent civil society in the water and sanitation sector which can both complement and inform government in achieving sustainable access to safe water and sanitation in Uganda.

The objectives of the programme are:

- To strengthen the Capacity of UWASNET member NGOs/CBOs to serve as an effective hub for increased access to safe water and sanitation.
- To enable UWASNET to effectively coordinate NGOs/CBOs in the sector and manage the Capacity building programme.
- To enable UWASNET member NGOs/CBOs to respond and influence the Ugandan policy and institutional environment in relation to water supply and sanitation.

At the stage of preparing this paper, the first year of the program had just been completed. The paper therefore highlights the design, implementation and Outcomes/ Experiences/Lessons of the program.

Program design

The program targets all the water and sanitation NGOs/CBOs in the Country registered with UWASNET.

It is based on a framework which was developed by WELL resource Center Network.

The programme; includes Participatory training needs identification by member NGOs/CBOs. Thus it does not prescribe specific capacity building activities but recommends that they are specified in response to the needs identified. Annual cycles of evaluations, activities prioritization[according to a set selection criteria] and planning for activities are undertaken. Planning, Capacity Building activities and evaluations are undertaken by NGOs/CBOs arranged in groups at regional level.

Activity implementation takes place at national and regional levels. The regional level is divided into 8 regions depending on the number of Organisations in the area. The regions are units similar to the government's Technical Support Unit (TSU) divisions.

The regional activities are Coordinated by regional Coordinators (RCs) who are members of UWASNET. They were selected through a bidding process that capitalized on