

# Review of Safe Disposal of Feces

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<http://www.hip.watsan.net/>

**The challenge** In 2004, at the mid-term assessment of progress toward meeting the Millennium Development Goals, it was estimated that over 2.6 billion people still did not have access to improved sanitation, in the sense of safe excreta disposal. The situation is most serious in Asia and Sub-Saharan Africa. World-wide, twice as many people lack access to improved sanitation facilities as lack access to improved water supply; and, four out of every ten people do not even have or use a simple pit latrine (Lenton, 2005; WHO/UNICEF, 2004). This has significant health repercussions because indiscriminant defecation near the home is associated with increased morbidity and mortality, specifically, the incidence of diarrhoea (Stanton & Clemens & 1987; Han & Moe 1990; Curtis 2000) and worm infestation (Olson, 2001; Mara, 1999).

This paper provides an overview of experience and research about the benefits, strategies and technologies for improved disposal of human excreta. Reference is also made to a rich and growing pool of program experience that can be built upon the address this challenge cost-effectively.

The technology for safe excreta disposal usually requires some form of a toilet with pits or tanks of various designs or sewerage system, as distinguished from open air defecation, open channels and pits. However, research in such varied locations as Bangladesh, India, Indonesia, Malawi, Peru, Sri Lanka and Vietnam demonstrates that facilities and construction interventions alone are often not sufficient to provide a health advantage (Hill, 2004; Curtis, 2000, Bateman, 1995, Cairncross et al, 2004; Robinson, 2005; Varley, 1998). Typical of these findings, in 2005 the Asian Development Bank published an audit report of a project in Indonesia showing that in the 80 communities where some form of toilet was constructed in the absence of hygiene promotion, only about 30% were still being used after the intervention ended (Murray, 2005).

**Focus needed on hygiene behaviors**

- A small set of hygiene practices are essential to ensure that the facilities have a tangible and continuing health impact. These key behaviors are usually considered to be:

- Key behaviors**
- ◆ consistent use of the toilet by each person in the household;
  - ◆ safe disposal of the young child's feces; and
  - ◆ handwashing with soap (or ash) after defecation (Han et al, 1986; WHO, 2002).

Thus, safe excreta disposal should be targeted together with handwashing (Favin et al, 1999).

In addition to these personal hygiene practices, many programs also focus on

- ◆ increased demand as shown by the construction of improved toilets in the household;
- ◆ cleaning and maintenance of toilets are important because dirty toilets are less consistently used and are associated with increased morbidity (Kurup, 1994; Koopman, 1978, Hoque et al., 1999).

### ***Efficacy of safe excreta disposal***

#### **Benefits of safe excreta disposal**

The significant health benefits of safe excreta disposal have been widely documented. A land-mark report by Steven Esrey (1991; 1994; 1996) surveying data from 8 countries in Africa, Asia and South America found a median reduction in all-cause child mortality of 55%(range 20–82%) associated with safe excreta disposal. It was estimated that severe and moderate stunting may be reduced by 39% when sanitation improves. Five research studies from Bangladesh, Burkina Faso, Indonesia, Sri Lanka and Lesotho found a higher risk of morbidity ranging from 24% to 68% among children or families who did not dispose of faeces in toilets, compared to those who did (Aulia et al., 1994; Traore, 1994; Mertens et al., 1992; Rahman *et al*, 1985; Daniels *et al*, 1990). Reviews of relevant literature on reduction in diarrhoea associated with excreta disposal appear in papers by Hill (2004) and Curtis (2000).

Improvements in excreta disposal are also powerful measures to control the transmission of helminth infections that can impede growth and cognitive development of children (Smith et al, 2001; Khanom, 1989; Nokes et al, 1992; Esrey, 1994). It can significantly reduce the incidence of ascariasis (roundworms, currently infecting about 1 billion people world wide), Trichuris (whipworm, 500 million people) and Ancylostomiasis/Necator (hookworm, 900 million people) (Norhayati, 2003).

Health effects of safe excreta disposal appear to be greater in more densely crowded areas (Esrey, 1996; Bateman, 1991).

Beyond health, access to toilets, enhances privacy, dignity and safety particularly for women (MDG Task Force, chapter 6; UN habitat, nd.).

#### **Behavioral interventions make a difference**

Well-planned and executed interventions can make a difference. The effectiveness of interventions is usually measured by changes in behaviours, on the assumption that a change in behavior will usually be reflected in reduced morbidity and mortality (Curtis, 2000). For example, the SAFE project in Bangladesh found higher latrine use in the group that received hygiene education (94% compared to 57% in the control group for children over five) and disposal of infant feces (86% vs. 6%- Bateman et al.,1995). In another study, in Ecuador, the percentage of people who maintain and use latrines increased from 15% to 72%, while the percentage of people who use open fields for defecation decreased from 69% to 28% (Whiteford, 1996)

#### **New behaviors are sustained**

It is not inevitable that behaviours will fade after an intervention or that as years go by people will revert to earlier, less hygienic practices. Evidence of sustainability is provided by a recent study in six countries (Ghana, Kenya, Uganda, Nepal, Sri Lanka, India) showing that behaviors such as use of latrines and handwashing after defecation continue after the end of the interventions. These practices were seen to be similarly sustained whether the projects ended 4 years or only 1 or 2 years before the study(Cairncross et al, 2004; Shordt,

2004).

### ***Effective behavioral change programming***

#### **Hygiene Improvement Framework**

Effective programming leads to sustained hygiene and sanitation improvements. Effectiveness, as described in the well-known Hygiene Improvement Framework (HIF) derives from three interactive inputs: *Hygiene promotion*, *Access to hardware* and the *Enabling environment*. These key elements are described in a detailed and useful guidebook entitled: ***Sanitation and hygiene promotion: programming guidance*** published in 2005 by WSSCC and WHO with the support of USAID. As shown in the HIF framework, *hygiene promotion* is based on behavioural/social change approaches which can be roughly categorized as: (1) *social marketing*, (2) *community and institutional mobilization* and (3) *community participation in problems identification and solutions*. Each of these is discussed on the following pages. These approaches not new, although through experience, some of it at large scale, they are being refined, and in a sense, taking on new life.

#### **Social marketing**

##### ***Social marketing***

Social marketing for sanitation usually begins by identifying products such as toilets or soap as well as services and behaviors (Fox, 1988; WELL,1998). Gil (2004) notes that it is important to target specific practices such as improving children's use of latrines, not only general messages. However, it is equally important to target only a small number of risk practices, for too many create confusion.

#### **Target a small number of key risk behaviors**

Building on the reasons and motivations of men and women, richer and poorer, different age groups to adopt new behaviors is a cornerstone of social marketing. Methodical background surveys and/or participatory research are usually the basis for identifying current practices and the motives for changes in these (Appleton et al, 2003; Favin, 2004). For example, in Benin and the Philippines, people using new sanitation facilities ranked lack of smell/flies, cleaner surroundings, privacy/safety, and pride in having visitors as some top reasons for getting a latrine, rather than health reasons (Cairncross 1992; WSP, 2004). Gender differences need to be considered, as demand by women appears to be stronger than for men in some countries (Lenton, 2005; Kurup, 1996). For example, joint WSP-IRC participatory evaluations in Cambodia, Indonesia and Vietnam showed that women in all three countries gave higher 'value for cost' scores to their toilets than men did. The women valued most highly convenience, privacy and a clean home environment. In contrast, men in Cambodia and Vietnam valued the use night soil from latrines as fertilizer (Mukherjee,2001).

#### **Demand for toilets**

Kotler and Roberto (1989) believe that social marketing must be formulated not only for target adopters but also for distribution services such as producers of parts, local retailers and masons/contractors. The same strategy can also useful for those who influence these groups, such as local politicians. For example, it appeared that when local politicians in Kerala, southern India, were convinced

that an effective household/community toilet program would enhance their chances of re-election, they supported and contributed community resources for it (Kurup et al, 1996).

**Channels for social marketing**

Social marketing also involved identifying the channels, locations, and activities that reach each target group. For example, in the SAFE project in Bangladesh, it was difficult to have effective contact with men. Thus “spot sessions” with men, organized at tea stalls, markets, and other locations as opportunities arose, were more successful than the usual courtyard sessions in reaching men (Bateman, 1995). Observers like McKee (2000) recommend the use of multiple channels and activities. Indeed, the SAFE project in Bangladesh found that multiple channels were more successful. Thus, the results of a mix of courtyard sessions at the water point, school sessions, child-to-child sessions for non-school children, and training of key community persons were more success in reaching hygiene and sanitation targets than the courtyard sessions alone (Bateman, 1995).

**Social marketing in Bangladesh (1990s)**

Social marketing interventions must be well-managed to succeed (Hill, 2004). Galway reported that in 1992, a three-year intensive social mobilization and marketing program was undertaken by the government of Bangladesh and UNICEF in areas totaling about 5 million people. Activities included door-to-door promotion, discussion groups, forming local committees, use of flip charts, diagrams and videos. In a survey, the use of sanitary latrines showed a three-fold increase to 91% (Shamsuddin, 1995). Based on this success, the program was scaled up with some modifications throughout rural Bangladesh. Coverage reached a high of 44% in 1996, then dropped and remained stagnant for several years at about 37%. There had been several implementation problems. The social marketing/mobilization had little impact in changing behaviours related to handwashing and disposal of children’s feces. In part this was because many of the social marketing activities lacked enough personal or household contact. Communication materials were strongly biased towards health benefits, without a clear targeting to different audiences. Lastly, the weakest link in the institutional chain was the local committees made responsible for overall planning and implementation which were too large (40 government workers and local leaders), took little interest in promotional activities and lacked accountability. (Galway, 2000). This experience highlights the need for responsive programming—with the flexibility and will to change activities or direction in response to challenges that appear during implementation.

**Participatory methodologies**

*Community participation in problem identification and solutions*

Participatory methodologies represent another approach to improving latrine use/coverage and related hygiene behaviors. *Participation* is a word whose meaning derives from two main pools of experience. First, participation refers to what different stakeholders and their institutions do, that is, their involvement in making payments, in implementation, in planning, management and decision-making. Secondly, *participation* refers to three main methodologies described by

the acronyms PRA, SARAR<sup>1</sup> and PHAST. These are labels for community-based participatory approaches which overlap considerably. These approaches aim to go beyond hygiene promotion so that groups in the community can analyse their current situation, solve problems and then plan to carry out these solutions (Appleton et al, 2003). The approaches usually begin by stratifying the community by geographic location, by gender and/or relative wealth. For example, poorer women using public water points could form a group. Then views on a single topic are investigated and cross-checked among the groups by using a number of techniques. The techniques are meant to stimulate and organize discussions, interviews, debates and to visualize or record the results. The 'basket of techniques', from which the most relevant are selected, include: mapping, ranking exercises, trend analysis, transect walk, household and/or school hygiene self-survey, non-serial posters, pocket charts, sorting, gender analysis and so on (Appleton et al, 2003; Sawyer et al, 1998). These participatory activities are meant to motivate community members and groups to learn about their current situation, change current behaviours and lead to planning for improving that situation.

**Participatory approaches: the PHAST experience**

PHAST (Participatory Hygiene And Sanitation Transformation) is an application of participatory approaches. The PHAST strategy was developed and implemented on a small to mid-scale, in at least eight African countries beginning in the mid-1990s. It motivates for new sanitation/hygiene behaviors and leads to community management. As such, it is meant to be compatible with the current shift toward decentralization. PHAST is implemented by involving community member in activities for self-assessment, community diagnosis, analyzing constraints to change, planning for hygiene/sanitation change. It was developed by UNDP, World Bank and WHO to addresses the full complement of fecal-oral transmission routes. As with other participatory approaches it relies on well-trained field teams, visual materials that are locally relevant, and sufficient contact time in the community (See the PHAST guidebook by Sawyer et al, 1998). A review carried out in 1998 in Africa Assessment found that the PHAST methodology is effective in promoting sustainable sanitation and hygiene behaviours. However, PHAST, which has many adherents in Africa, has not been systematically evaluated, an omission that appears to delay improving and implementing it on a larger scale (WSP, 1998).

**Identifying the mix of activities and methods**

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<sup>1</sup> **Participatory Rural Appraisal** (PRA) developed by Robert Chambers comprises a well-known set of techniques aimed at shared learning between local people and outsiders. **SARAR** stands for **Self-esteem, Associative strength, Resourcefulness, Action planning, Responsibility** an education/training methodology for working with stakeholders at different levels developed by Lyra Srinivasan within the interesting PROWESS/World Bank programme in the 1980s and 90s.

**Quantification of qualitative techniques** Another major challenge facing PHAST and other participatory approaches has been the difficulty of quantifying the data from the results of activities to produce comparable reports (Appleton, 2003). However, a recent methodological development—called Qualitative Information Systems or Methodology for Participatory Assessment (QIS/MPA) enables the quantification of qualitative data from participatory approaches. QIS/MPA was developed through a multi-country, joint WSP/IRC research programme in 15 countries. In this, community members, project staff and external evaluators can quantify qualitative findings from participatory approaches using rating scales of various types. Data is disaggregated by gender and socio-economic levels. This makes it possible to compare the findings across projects, communities and community groups, and statistically analyse the quantitative information (Gross, 2000; van Wijk, 2002)

#### *Community and institutional mobilization*

#### **Community mobilization**

Mobilization refers to involving multiple actors and institutions working toward a common purpose. Experience in Peru, Nicaragua, Bangladesh, South Africa, Uganda, among others, shows the importance of engaging a range of partners at the community level (Favin, 2004; Bateman, 1995, Kurup, 1995; Robinson, 2005; WSSCC/WHO, 2005). Typical of the groups who are involved in sanitation and hygiene promotion are: local government, health institutions, schools, community-based groups (savings groups, women and youth groups, religious groups, sports groups), the private sector (retailers, contractors, suppliers, plumbers, masons), neighborhood committees and NGOs. Community mobilization is relevant to the success of both social marketing and community participation.

#### **Total sanitation programs**

An example of large-scale, nation-wide community and institutional mobilization is *total sanitation*, developed in India and Bangladesh aiming to stop indiscriminant, open defecation. It emphasizes community-wide action in a campaign mode. Total sanitation usually has these elements (Robinson, 2005)

- Mobilization of local government, institutions, community organizations, NGOs
- Community analysis using PRA tools
- Demand-driven with social marketing approaches to increase demand for toilets and ensure hygiene behaviors
- No or low-subsidy for household toilets
- Diversity in technology and design
- Budget for software provided to districts or communities

One conclusion of an assessment of eight total sanitation programs carried out by Robinson (2005) relates to management capacity. He notes that the large-scale sanitation programmes need carefully thought out, coordinated with locally appropriate policies, have strong emphasis on ‘software’ matters such as social intermediation, hygiene promotion, sanitation marketing, financial incentives, accountability to users with monitoring feed-back loops.

Institutional mobilization can focus on one sector such as schools. For this,

**School programs**

SSHE (school sanitation and hygiene education programs) have developed over the past decade with a range of aims: as a strategy to improve child health, retain girls in school and influence households for improved hygiene and excreta disposal. Some evidence shows that school interventions can improve the child's academic achievement and increase girls' enrolment and school attendance (Cairncross, 1999; Nokes, 1992). However, program experience in Ghana, Kenya, India and Uganda has shown that among children knowledge of hygiene and sanitation exists, but hygienic practices are lower, specifically: toilet use, handwashing after defecation and before eating (Karanja, 2003; Nyavor, 2003; UNICEF, 1998; Bitature, 2000). To succeed, the SSHE program needs to be well-managed with particular attention to the organizing children and teachers for effective use and maintenance/cleaning of facilities. UNICEF states that important elements for successful SSHE include: teacher training, supervisory visits to schools, mobilizing children through, for example, health clubs as well as ensuring effective coordination between key institutions leading the program (UNICEF, 1998).

*Selecting the mix of hygiene promotion activities*

There has been an on-going debate between adherents to social marketing and adherents to participatory approaches such as PHAST. These discussions have significance because of the need to identify and invest in a cost-effective mix of actions in interventions related to hygiene and excreta disposal. The choices of activities are numerous:

**Multiple methods and channels**

- (a) mass and traditional media (television, radio campaigns, newspapers, drama, videos, camps, rallies),
- (b) group or personal communication (training classes, meetings, formation of women's groups, home visits, neighborhood or compound meetings)
- (c) participatory techniques and community/neighbourhood planning (mapping, ranking, community survey, sorting exercises). (Shordt et al, 2004).

In reality, many interventions seem to include elements of marketing, mobilization and participatory strategies. For example, Robinson (2005) assessed eight total sanitation (excreta disposal) programs in Bangladesh, India and Pakistan, three of which cover more than 60,000 households each year. However of the four programmes that were most successful, none had the same mix of promotional strategies: two used mass media, three used participatory activities, two had institutional incentives, three had social marketing targeted messages (Robinson, 2005). No two had the same configuration of activities. There does not seem to be a simple answer to the question of which mix of activities is most cost-effective in which situations. This may be an area for further research: the identification of a cost-effective mix of strategies and activities.

*Interpersonal and small group communication*

One set of activities which seem more, however, are those involving interpersonal and small-group communication. Thus, in the six-country study of

**Importance of small group and interpersonal communication**

behavioural sustainability, Cairncross notes that project variables determine sanitation/hygiene behaviours. He identifies: attendance in hygiene classes, personal communication, intensity of the programmes, support from influential groups in the local as probably having a tangible and sustained impact (Cairncross, 2004; Shordt, 2004). Similarly, the sanitation-with-education programme in southern India, combined used elements of mobilization, participatory and social marketing strategies with at least 8 different activities for behavioural change. Interestingly, although there is a positive tendency overall between the project activities and outcomes, it was the required group classes which were significantly associated, statistically, with use of latrines and handwashing up to 9 years after the intervention ended (Zacharia et al, 2004).

A third source which supports a similar conclusion appears in a report of the MPA participatory assessments in Cambodia, Indonesia and Vietnam. Two of the four 'keys for success' that Mukherjee (2001) identified were interpersonal:

- Peer pressure and collective community responsibility;
- Using neighbourhood and community networks;
- Understanding community preferences and offering a range of options; and,
- Development of local enterprise to provide services.

Program experience also supports the need for strong interpersonal communication. In the large-scale Total Sanitation Campaign in India, for example, districts have spent far more for mass media in the communication component (called IEC) of the programme than for inter-personal communication, presumably because mass media are easier to organize (personal communication, Government of India). However, the government now reminds districts that mass media "results in change in cognitive level but change of attitude for new behaviours can not be achieved through mass communication". Interpersonal communication is needed (Government of India-[http://ddws.nic.in/tsc-nic/html/tech\\_iec\\_pop.htm](http://ddws.nic.in/tsc-nic/html/tech_iec_pop.htm)).

**Behavioral change among resistant groups**

All of the preceding examples are drawn from situations where initial coverage was low; less than 40% of the populations had and used toilets. Curtis, in her study in Burkina Faso, draws attention to reaching non-practicing groups when hygiene practice is already high. Curtis (2001) reports: "We found no evidence of a change in the frequencies with which children defecated into potties or with which children's stools were disposed of in a latrine. This is not surprising given that the recommended practices were already common in the population while hand-washing with soap was relatively rare. In general it is easier to demonstrate convincing changes when starting from a low base. People resistant to change may belong to a different target group that requires different promotional strategies." This finding reminds us of the salience of entering behaviours: intervention strategies need to be tailored for different groups and different levels of initial practice.

*Costs of hygiene and sanitation promotion*

The cost of sanitation and hygiene promotion can be less than the cost of its

**Promotion costs less than hardware**

hardware (Lenton, 2005). For example, in the rural and peri-urban Kerala program which covered more than 300,000 people, the cost of all mobilization through local committees, management costs, field work, promotional materials, door-to-door motivation, exhibitions and 'sanitation theatre' targeted averaged 4% up to a maximum of 10% of construction costs (Kurup, 1996). In the eight sanitation programs assessed by Robinson (2005) in Bangladesh, India and Pakistan, the software costs ranged from \$2 to \$45 while toilet construction costs to the programs ranged from \$2 to \$71.

**Length of interventions**

*How long should an intervention last?* While interventions often allocate a fixed number of months or years for hygiene/sanitation promotion, the question seems to remain open as to how much time is needed to ensure sustained practices. Experience in Cambodia, Nepal, India indicates that ample time is needed, before and after construction (WSP, 1992; Shordt, 2004; Kurup, 1996). The 6-country study (Ghana, Uganda, Kenya, India, Sri Lanka, Nepal) of behaviour sustainability could not find a relation between the length of the intervention and the level of hygiene/sanitation practice (Cairncross, 2004; Shordt, 2004). The research in India stated that the length of the intervention was, in fact, determined by how long it took the NGO and local government to carry out the project according to plan, to achieve its goals. It argued that rather than pre-determining the length of sanitation promotion, differential timelines may be needed in different communities to continue the intervention until its objectives are achieved. (Zacharia, 2004).

**Coverage**

*How high should coverage be?* Indiscriminant defecation affects more than the people in one household: it can affect the whole neighbourhood or community. Thus, to have a health impact, a high proportion of the people living in an area must consistently use latrines. The proportion most frequently quoted is 75% from Bateman (1991) and Esrey (1994) who found stunting of children in communities at coverage levels below 75%, whether the individual child lived in a home with a latrine or not. Thus, this implies that intensive interventions are needed with the community or neighborhood as the primary unit of change, not only the individual or household.

**Incremental improvements in sanitation facilities**

***Facilities for disposal of feces: the hardware***

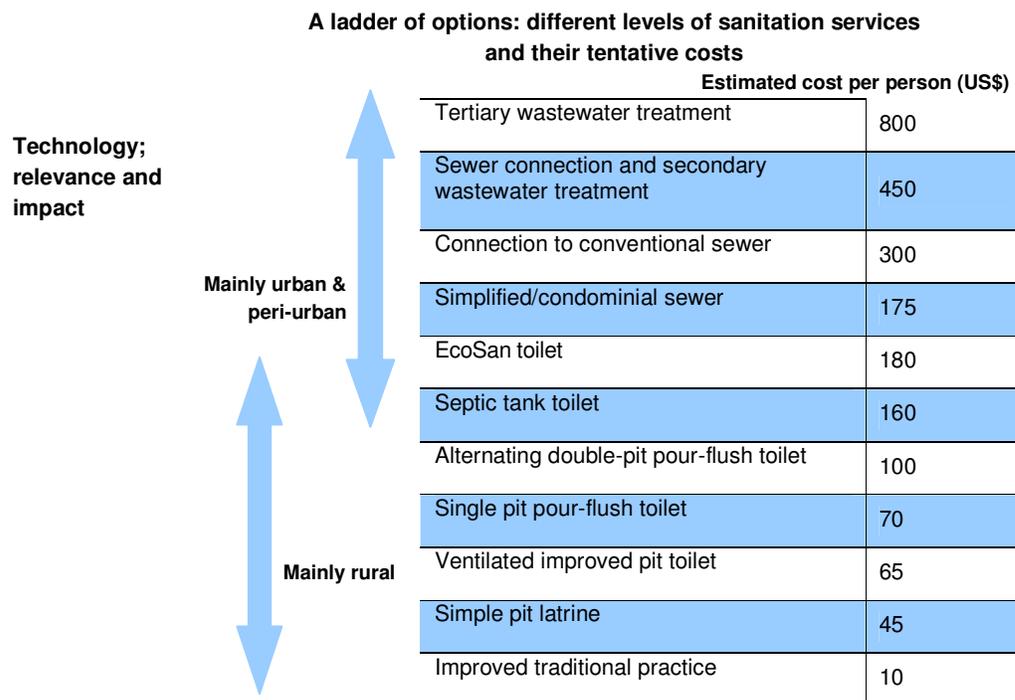
Hygiene promotion must be supported by adequate facilities so that the new behaviors can be practiced effectively. *Safe facilities reduce the possibility of human contact with fecal matter.* Observers state that consumers should be able to choose from a range of options or steps in latrine technology as part of a promotion strategy, in contrast to a uniform model. This implies the possibility for *incremental improvements*, moving 'up the steps' with sanitation facilities (Lenton, 2005; WSSCC/WHO, 2005).

**Technology options**

Relevance and impact are two of the considerations in technology choice. For example, flush toilets may not be relevant where water is scarce or people can not pay water costs. In terms of impact, an early study by Esrey (1991)

concluded that toilet technology was associated with health impact. Specifically, reductions in diarrhoea mortality appear to be greatest for flush toilets because they reduce the possibility of human contact with fecal matter, compared, for example, to pit latrines. One solution in water-scarce areas where pour-flush toilets are not appropriate could be to introduce of other technologies such as ecosan models in.

Useful references related to the technology and design of facilities are: *DFID Guidance Manual on Water Supply and Sanitation* (WELL, 1998) and *Linking technology choice with operation and maintenance* (Brikké, 2003-Chapter 8)



Note: cost includes operation and maintenance costs. 15% has been added to the costs for overhead.

Source: adapted from van de Guchte and Vandeweerd, 2004 and Mara, 2005

Actual costs may vary from those in this indicative table and, in some instances, be less. For example, in seven total sanitation programs in India and Bangladesh, toilet costs ranged from \$2 to \$71 per family. (Robinson, 2005).

*Some observations on technology*

(Lenton, 2005; WSSCC/WHO, 2005)

*Simple pit latrine:* Excreta is collected and decomposes in the pit. Liquid infiltrates into surrounding soil. Low water usage. Suitable for low water table areas, low soil permeability, low to medium housing density.

Option: Dig two pits and use one at a time until contents of first pit are fully decomposed and safe to handle. The Sanplat is an improved pit latrine

**Technology options**

slab that is smooth and slopes to promote hygienic cleaning. It has a cover for the hole, to prevent fly-breeding. It uses less cement than usual slabs and is light-weight. ([www.sanplat.com](http://www.sanplat.com)).

Practice: One challenge with pit latrines is to ensure safe construction that removes fecal matter from contact with flies or people.

*VIP latrine* is a pit latrine with a screened vent pipe and a darkened interior in the superstructure which is designed to keep flies out and minimize smell.

Practice: VIP was developed in Zimbabwe in 1970s (500,000 built), also used extensively in other parts of Africa.

*Pour-flush toilet*. For its operation, small quantities of water are poured from a container by hand into the toilet pan to flush away feces. Water seal in the trap reduces smells and flies. Medium water use. Suitable for soil of low soil permeability, low water table, low to medium housing density.

Option: two pits where one pit is used at a time, rested alternatively, then reused. The decomposed contents of the rested pit can be safely emptied.

Practice: Appropriate for cultures where water is used for canal cleansing. Extensively used in India.

*Septic tank* is a tank or container, normally with one inlet and one outlet that retains sewerage and reduces its strength by settlement and anaerobic digestion. Used with pour-flush toilets. High water use. Suitable for soil of low permeability, medium-high housing density if correctly managed, high water table areas.

**Ecosan**

Practice: Discharge from septic tanks dangerous. Technology is sensitive to bad management.

*Ecosan toilet (ecological sanitation)*

In many countries, ecosan is a new technology. It operates on three principles: a) waterless toilets; b) on-site treatment rendering of human excreta safe to prevent of pollution; and c) the production of a safe fertilizer that can be applied to agricultural crops. Sustainable closed-loop system where human excreta are processed on-site, sanitized before its reuse. Usually urine is sterile and useful as fertilizer.

Options: There are many designs. Design options derive from two methods for handling urine: urine is diverted away, not mixing with feces or urine is separated from feces. There are two methods for sanitizing feces: dehydration and decomposition. More information about designs can be found at:

<http://www.ecosanres.org/PDF%20files/Ecological%20Sanitation.pdf>

Practice: Suitable for rural and urban environments. Ecosan produces fertilizer to grow crops and improve nutrition. It is being implemented in many countries such as Botswana, China, Ecuador, El Salvador, Ethiopia, Guatemala, Mexico, Palestine, South Africa, Sweden, and Vietnam, Zimbabwe. Because Ecosan has unfamiliar features, it requires more promotion, technical support and training than other on-site systems. For

**Urban challenge**

example, in Vietnam, excreta tended to be applied to the field too early implying a need to re-direct the sanitation promotion. (Esrey, 1998). As with other technologies, ecosan is sensitive to bad management.

Websites for Ecosan include:

<http://www.sanicon.net/titles/topicintro.php3?topicId=17>

<http://www.nlh.no/research/ecosan/hoved/case/>

<http://www.ecosan.nl/>

**Pits and septic tanks in cities**

*Urban technologies and services*

The safe disposal of feces is a major challenge in cities. For example, piped sewerage systems appear to serve less than 20% of the people in Ho Chi Minh, Manila and in Jakarta. In Latin America where feeder and trunk sewage systems have been constructed, only about a third of them have treatment plants.

**Safer pit emptying technologies**

As a practical approach in cities, the MDG Water and Sanitation Task Force (2005) advocates starting with immediate household access to sanitation facilities and then gradually moving up to collective systems. This implies, as with rural programs, an incremental approach that begins with improving the construction quality of on-site technologies (septic tanks, pit latrines, ecosan) and their management. Of these options, ecological sanitation (ecosan), if managed correctly, is the safest. However, Individual or communal septic tanks are currently the main alternative to piped sewerage serving, for example, a third or more of Phnom Penh's and Jakarta's population (McCommon, 1998; Lenton, 2005). While in many cities, there are household latrines for millions, these have not been supported by sanitation infrastructure that takes into account the final disposal of sewerage. Many on-site toilets/septic tanks are poorly constructed. Sewerage is often discharged into the environment without treatment; and this untreated waste affects the poor who are not connected to public systems and who live near open sewers or downstream (Lenton, 2005; World Bank, 1995).

**Simplified sewerage**

Starting with on-site toilets in households requires a mechanism for removing wastes from the dwelling and neighborhood. In urban areas where land for new pits is unavailable it is necessary to consider emptying pit latrines. However, emptying pit latrines in cities is unsafe and dangerous, unless composted. Pumping trucks often can not manoeuvre the lanes and neighborhoods where they are most needed. Alternative technologies have been devised, for example the MAPET (Manual Pit Latrine Emptying Technology) which has been used in Dar es Salaam and the VACUTUG, a small motorized suction pump and vacuum tank that was used in Nairobi. These technologies for pit emptying, usually provided by the private sector, reduce the health risks to workers who often empty pits manually. These deserve more support and experimentation (WELL, 1998; Wegelin-Schuringa, 1998; Muller & Rijnsburger, 1997).

Another technology – an alternative to on-site pits and conventional sewerage-- was developed in the 1980s and called by labels such as *simplified sewerage* or *condominial systems* works to address these problems. More detailed

information and links are available from Mara (2005) and Melo (2005). Basically simplified sewerage has these components:

- Services directed to blocks (neighborhoods, groups of buildings) – shorter length of pipes, smaller diameter pipe, laying sewers at shallow depths away from heavy traffic loads, often across private land
- Community participation and mobilization required among residents to reach consensus about system design, labor and cash contributions. Promotion is needed relating to proper system use and maintenance, the motivation for household connections, and the public health benefits associated with using the service.
- Decentralized treatment. into small natural drainage basins, usually natural treatment processes, such as stabilization ponds, anaerobic reactors and soil absorption. (Melo, 2005; Mara, 2001)

Simplified sewerage has been implemented in many countries such as Bolivia, Brazil, Colombia, Indonesia, Nicaragua, Pakistan, Paraguay, Peru, Sri Lanka and South Africa. (Mara, 2005)

#### **Public toilets**

Mobilization/promotion the costs of simplified sanitation are more expensive than for traditional sewerage systems; however, these can be off-set by much lower hardware costs. For example, in Natal, the capital costs of simplified sewerage were about one-fifth of conventional sewerage per household. In the Orangi Pilot Project (Karachi), which is now being replicated in seven cities of Pakistan, the cost of community-based sewerage was about one quarter of that of conventional sewerage provided by government agencies. (Mara, 2005)

#### *Public toilets*

Group or public toilets are not usually considered to provide safe excreta disposal. For example, the Joint Monitoring Program excludes these from its definition of improved facilities. However in South Asia, viable public latrines are successfully operating, on a payment basis, in public locations such as bus stops and where there is inadequate land and infrastructure for other solutions. In this sense, public toilets can serve populations that have no other alternatives. One institution, Sulabh, in India has constructed more than 4000 pay-and-use community complexes catering to the poor and low-income sections. It provides toilets, urinals, bathing facilities with water and soap. Generally, it charges Rs1 (\$0.02) per use of toilet or bath and the use of urinals is free. Sulabh prides itself on a high standard of monitoring, operation and maintenance of facilities managed by caretakers (Srinivas, 2003). In the southern Indian city of Thiruchirapally, WaterAid and local NGO partners –Gramalaya, SCOPE, and SEVAI- helped form, federate and train the self-help women's groups whose members not only benefit from the facilities, but also from the group income which is generated. Safe drinking water, clothes washing and in some cases bathing facilities, are also provided. Payment is made upon use, or through a monthly payment pass system; and, children under six use the facilities for free. The NGOs and government have constructed about 400 toilet blocks, covering 80 percent of the slum settlements. (WSP, 2004; see also Gramalaya,

#### **Enabling**

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### ***Enabling environment***

A favorable social, political and economic environment is required for programs to transform hygiene and sanitation behaviors. Elements of the enabling environment include:

- Policy improvement
- Institutional setting & capacity strengthening
- Monitoring and evaluation
- Private sector involvement
- Financing and cost recovery

### **Mobilizing institutional support**

The WSSCC/WHO publication *Sanitation and Hygiene Promotion: Programming Guidance* (2005, <http://www.wsscc.org/dataweb.cfm?code=586>) addresses many aspects of this enabling environment (see section 3).

Only four national policies for sanitation and hygiene promotion were found (Bangladesh, Nepal, South Africa and Uganda). The WSSCC (2005, section 3.3) suggests that a unified policy may not, in each situation, be required. However, some targeted guidelines, regulations and agreements are essential such as, for example, agreements to enable collaboration between institutions or regulations to allow government staff to take part in activities.

### **Innovative institutional arrangements**

#### *Intermediate institutional level*

Schouten (2003) emphasizes that community management is not a reason for agencies to escape from their responsibilities. To scale up sanitation and hygiene promotion within the community, attention needs to be given to the mid-level. Working at large scale for safe excreta disposal usually involves some combination of national government, district/local government (including line officers active in communities but answerable to district government), urban government, non-governmental groups, private sector (WSSCC/WHO, 2005). The capacities and motivation of intermediate government and regional institutions to support actions at the community level may be key to scaling up decentralized management (Lockwood, 2004).

### **Integrated programming**

In the effort to mobilize institutions to lead in behavioural change programmes, innovative institutional arrangements have been developed. For example, the handwashing initiative in Central America created partnerships among private soap manufacturers, governments and ESAs/donors--USAID, UNICEF and EHP (Saadé, 2001). In Bangladesh, the use of networks in an 'NGO-franchising' approach is illustrated by the way NGO-Forum activated its hundreds of partner NGOs for the first social marketing effort for sanitation (Galway, 2000). Unicef (1997), in its manual on hygiene promotion, noted that programmes implemented by NGOs/private sector with communities, in collaboration with government, are more likely to succeed than are programmes implemented by government alone. This does not necessarily imply, however, that the only or

the optimum approach to activate this collaboration is for local government to hire NGOs for activities such as social marketing.

#### *Sanitation, water and/or health programming*

There has been a long history of programming water and sanitation together. In some cases, this is advantageous. Promotion of toilets can be more successful during the period before construction of water facilities. Interest among households may be greater at this time (Kurup, 1996). On the other hand, integrating safe excreta disposal with water programs can mean that the former tends to be under-emphasized.

**Monitor behaviors, rather than health impact**

Sectoral integration has been developed within health programming. For example, in a new effort to ensure improved disposal of feces and handwashing, targeting about 17 million people in Bangladesh, the non-governmental organization BRAC, is implementing through its health division. The time-bound plan was developed by BRAC staff to ensure sufficient emphasis on safe excreta disposal through strategies that may enhance other health programming. Within this, health staff have clear targets against which they will be monitored and semi-voluntary village volunteers will be able to gain some small financial benefit from the sale of soap. For the hardcore poor, there will be some small subsidies that will be administered by the health groups with local government and checked by health staff (BRAC, 2005).

#### *Monitoring and Evaluation*

**Measuring behaviors**

Cairncross (1990, 1999b) and Curtis (2001) counsel against health impact studies on the grounds that the results of health impact assessments are unpredictable and frequently offer no firm interpretation. They note that epidemiological studies are subject to confounding, not separating the impact of the intervention from the impact of other background events. In addition, such studies are expensive and time-consuming. Cairncross states that “measuring behaviour is a more direct, immediate, and useful way of gauging impact...studying patterns of hygiene behaviour has far greater diagnostic power, in terms of indicating opportunities for project improvement. Since it is further back up the causal chain, it is easier to attribute to the project intervention.” In addition, behaviours can be measured before the intervention to establish baselines.

*Measurement:* some variables are fairly easy to measure. For example, knowledge of critical handwashing times can be measured by asking. Observation indicates whether a toilet is clean and used. However, two issues more difficult to measure are: use of the toilet consistently by all members of the household and handwashing after defecation (Lafond, 1995). Asking someone if he/she washes hands after defecating can solicit responses of questionable validity. Monitoring latrine use and handwashing can be done through several participatory or community-based techniques such as focused group interviews with rating scales; pocket voting; informant interviews; asking children and

observation. (Shordt, 2000). For example, in a project in southern India, neighborhood women in the sanitation committee inspected the toilets a few months after construction to check about use and cleanliness. The act of monitoring itself motivated people to clean their household toilets. Community monitoring needs to be carefully designed, to involve those who are naturally interested in checking a particular indicator but not by asking people for self-assessments. For example, the householder who pays for a latrine is a better and more interested judge of construction quality than the mason who constructs it (Shordt, 2000).

### *Private sector involvement*

The importance of private sector in toilet and sewerage provision is immense. The range of this involvement includes:

#### **Preference for private providers**

- Construction of toilets and sewerage systems: contractors, masons, plumbers and so on. Most latrine construction not carried out by householders themselves is probably private.
- Retail of parts such as platforms, traps, pans: vendors, sanitation marts
- Production and transport of parts for domestic and institutional toilets, pipes, treatment plant equipment and so on.
- Pit emptying services, particularly in urban areas (Lenton, 2005)

For example, even without public investment, more than a million septic tanks were installed in Manila and Jakarta. Eight percent of the rural households in India invested with small private providers to construct toilets (Lenton, 2005).

#### **Support for private sector involvement**

Private providers can be the preferred choice. In Bangladesh, assessments show that customers often prefer latrines produced by private producers despite the lack of subsidy. They tend to be cheaper because the designs are simpler and transportation costs for materials tends to be less than in government centres. Private producers also offer a wider variety of products (Galway, 2000).

#### **Range of financial mechanisms**

The private sector can benefit from judicious support as indicated in this example from Bangladesh. Twenty-five years ago, there was little private sector involvement in provision of toilet and sewerage facilities. There are now about 4,500 latrine production and retail centers in Bangladesh, of which 3,000 are private, representing about 65% of the toilet market. (Robinson, 2000). At various times some support has been given to private providers in the form of training and start-up costs from UNICEF, NGO-forum and other institutions. Many small-scale providers also supply materials unrelated to sanitation such as cement posts, blocks and house decorations. This diversification can increase sales, offsetting the lumpy demand for latrine parts, for example, in the rainy season. The private providers tend to be located in areas where income is more assured, such as around towns and cities. Thus, some more heavily subsidized production centres are located in more rural, less profitable areas (NGO-Forum communication; Robinson, 2000).

#### **Arguments**

#### **Finance and credit**

**against  
subsidies**

Another element of the enabling environment is finance. Some current financing and cost recovery mechanisms for toilets and sewerage systems are:

- Subsidies
- Credit: loans, revolving loans, bank loans
- Urban: infrastructure charges, connection fees, local taxes, cross-subsidies, service charges usually included in water bills (WSSCC/IHE,2003)

**Arguments for  
subsidies, at  
low levels**

*Subsidies:* The debate about subsidies focuses on effectiveness and sustainability. One current of thinking espouses eliminating subsidies and focusing instead on marketing improved sanitation options (WSP, August 2004, Shayo, 2004). The argument is that, in the past, latrines were built to optimal—meaning expensive—standards and then subsidized so that target users could afford them. However, high subsidy strategies were difficult to scale up; and the subsidies themselves can be very difficult to manage honestly. Often funds did not reach households most in need, but were appropriated by richer groups. The poorest people did not seem to benefit from subsidies. (Cairncross 1992; WSP August 2004). Furthermore, there have been interventions, without subsidies, where intensive promotion has resulted in a high level of coverage. These include, for example, the large district of Midnapore in West Bengal and the extensive pilot districts of the UNICEF-Bangladesh social marketing program, as well as many urban areas around the world (Robinson, 2005; Galway, 2000).

The counter argument is that the cost of safe facilities is a significant proportion of annual income of the poorest people (“hardcore poor”) who may, in any case, lack disposal income (Lafond, 1995). Pro-poor strategies (Poverty Reduction Strategy Papers, prepared by governments with the World Bank) indicate that the very poorest people need subsidies, although at lower levels than in past decades. With a small subsidy, they can at least have a pit latrine with an adequate slab (Bangladesh, 2005). The MDG Water and Sanitation Task Force in its report of 2005 agreed that there is a place for targeted subsidies to reach the poorest groups (Lenton, 2005). At this time, the governments of India and Bangladesh have instituted subsidies for the hardcore poor amounting to about \$8 to \$10 per household, which, in the case of India, is about one-fifth the level of the earlier subsidies of the early 1990s (Bangladesh, 2005; India, 2005). Perhaps, the quality of management may be an issue. Two well-managed NGO programs demonstrated the ability to administer subsidies. First, the Kerala latrine-with-education project was able to monitor, with community groups, showing that it had correctly located the poorest groups who then received subsidized toilets at the end of the normal program (Kurup, 1996). In Nigeria, WaterAid was similarly able to implement a dual subsidy, with poorer households receiving up to an 80% subsidy against construction costs and wealthier households only 20%. Note, however, that both of these examples are drawn from the NGO sector. The implication here is that subsidies, if provided, should be at low levels and carefully-administered only for the very poorest people.

**Innovative  
approaches to  
providing  
credit**

The complex relation of poverty and subsidy is illustrated by a case study from

**Reducing  
costs to  
consumers**

Mozambique. Saywell (2002) reports on a program to subsidize the cost of latrine slabs which for peri-urban dwellers around Maputo, many of whom, as a study indicated, were destitute. The subsidy reduced the costs of latrine slabs to the client from \$22 to \$4.50. The subsidy was then eliminated in 1997 and over the following two years, sales of the slabs fell by about 80%, indicating that both the poor and above-poverty-line groups reduced purchases.

*Credit:* There is far more agreement that the availability of credit can be important for the success of toilet and sewerage programs (Lenton, 2005). Credit comes in many forms. For example, women's groups (savings groups) have provided loans for members for latrine construction (BRAC, 2005). In Jamaica, credit for sanitation services was provided through network of outlets managed by a financial institution and mixes with commercial leading and concessionary loans. In Bangladesh, small private providers extend credit in the form of instalment payments. In Kerala, India, the NGO did the same (Kurup, 1995). In Peru, hygiene products and children's potties were made more accessible within the community through a revolving community fund. (Favin, 2004).

*Costs to consumers*

Where possible, price should be used as an incentive to increase uptake of the sanitation product being promoted. Ensuring the lowest feasible price for an adequate product is salient to more than latrine construction (Fox, 1988; WELL, 1998). In one project for which information is available, Kurup (1996) reports that householders as well as local masons were oriented about the cost, quality of materials and amount of time needed for construction. When both clients and masons knew how long it took to build a latrine, the labor costs could be controlled. To identify good quality materials at lowest cost, the prices and quality from local suppliers retailers were also compared and posted locally. Through such strategies construction costs were reduced by 15% to 40% below government estimates, depending on the location. In an EHP report on a project in Peru, it was noted that the original soap was a typical hand bar which costs about \$0.30, now is another type which costs about \$0.10. The idea behind this change is to make soap more accessible to families, whether it is for home use or in the fields. (Favin, 2004). Cost reduction is an area where more literature and case studies could be useful.

***Lessons learned: managing for success***

Program managers face many choices in large-scale interventions for the safe disposal of human feces. These choices should, of course, be made on the basis of factors such as culture, current levels of practice and interest, available water, institutional, financial resources. The experiences described briefly in this paper show that there is much experience to draw upon in making these choices. The task is not impossible; however, it is not 'business as usual'. To address this task, here are twenty conclusions and suggestions for action in programs for safe excreta disposal. They also provide an overview of this paper.

- Behavioural change and mobilization of community and intermediate institutions are crucial. Construction alone may be easier, but it will not ensure that interventions succeed.
- Handwashing promotion should be merged with efforts for the safe disposal of feces.
  
- Target a small number of key risk behaviors as well as promotion to create effective demand for toilets and their use by all.
- Overall, promotion costs less than hardware. The expense lies in effort/planning for institutional mobilization, capacity and time.
  
- Three over-lapping approaches to sanitation and hygiene promotion are: social marketing, participatory community strategies, community/institutional mobilization. Both marketing and participatory strategies disaggregate their audiences, into homogeneous groups. In marketing there are different messages and channels for reaching each group.
- Hygiene promotion should be targeted specifically to men and male leaders, not only women. Studies showed that in typical interventions that target women only or largely, the men may be less likely than women to use latrines or wash hands consistently after defecation as a result of the project interventions that largely focused on women (Bateman, 1995; Zachariah, 2004).
  
- No optimum mix of communication/participatory actions has been identified that will fit each situation. However, studies have identified the importance of small group and interpersonal communication in changing behaviors. Specifically, this may include:
  - Group meetings not just repeating 'same old messages'
  - Peer pressure and collective community responsibility;
  - Using neighbourhood and community networks
- Ensuring effective interpersonal/group communication poses a management challenge that deserve more attention, particularly for scaling up. For example, at different levels micro-planning would be needed to ensure the number and content of group and interpersonal contacts.
  
- More research on effectiveness of participatory methods, particularly PHAST. The new approaches to quantification of participatory techniques (QIS/MPA) be exploited in more programs.
  
- Community and institutional mobilization is at the heart of all strategies for behavioral change. The 'right' mix of groups to mobilize at community level should be determined in large part on the strength of existing groups. Mobilization also focuses on practical mechanisms for collaboration among different institutions and partners; the need for capacity development at the intermediate level (districts, municipalities, counties); clear institutional responsibilities. The capacities and motivation of intermediate government and regional institutions to support actions at the community level may be key to scaling up decentralized management.
  
- Many program failures relate to poor management. Management must be responsive—with the flexibility and will to change activities or direction in response to challenges, problems and opportunities that appear during implementation.

- Several innovative institutional arrangements have been applied, some on a large scale. These include: public-private partnerships, NGO-local government collaboration, NGO-umbrella outreach. Integrated programming of sanitation/hygiene within health can work effectively, although the integration should be seen to benefit the health institutional development.
- Researchers strongly recommend monitoring behaviors, rather than health impact. Community-based monitoring, while more time-consuming to set up, can be effective and, in itself, motivating for behavioural change.
- In general, interventions for the safe disposal of feces and handwashing seem to require:
  - Participation of community members. Interpersonal and group communication.
  - The optimum mix of participatory strategies and social marketing
  - Important roles of NGOs and community-based organizations as well as local government
  - Need to create demand.
  - Need for access to credit
  - Existing policies and regulation are a barrier to urban informal settlements
  - Planning for incremental improvements.
- A range of sanitation technologies are recommended where consumers are able to choose from a range of options or *incremental improvements*, moving 'up the steps' with sanitation facilities. However, the least expensive technologies should still be safe: reducing the possibility of human contact with fecal matter.
- Ecosan and simplified sanitation are newer technology options which deserve particular attention. Both require mobilization and promotion.
- Safer pit emptying technologies need to be reviewed and applied in urban settings.
- Cost reductions to consumers can increase demand. This needs more study and sharing of information among programs. For example, in high water table areas, reducing costs of ecosan could be particularly effective.
- The small-scale private sector is key to the development of sustainable interventions. Support for small-scale providers may include features such as credit facilities, training, setting up vertical linkages with suppliers. It is essential that consumers know where and how to get the product, service, or information about it. Hygiene promotion can create the demand that is met by innovative solutions from the private sector.
- A wide range of financial mechanisms were briefly described in the form of low-level subsidies and credit in a many forms.
- Further study is needed on the type and scope of regulations, government orders and agreements that are normally needed to support effective programming.

## Bibliography

Ahmed NU et al. (1993). A longitudinal study of the impact of behavioural change intervention on cleanliness, diarrhoeal morbidity and growth of children in rural Bangladesh. *Social Science and Medicine*, 37(2):159–171.

Appleton, Brian and Christine van Wijk (2003) Hygiene Promotion: Thematic Overview Paper. IRC International Water and Sanitation Centre, Netherlands. <http://www.irc.nl/page/3321>

Aulia H et al. (1994). Personal and domestic hygiene and its relationship to the incidence of diarrhoea in south Sumatra. *Journal of Diarrhoeal Diseases Research*, 12(1):428.  
[http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list\\_uids=8089455&opt=Abstract](http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=8089455&opt=Abstract)

Aziz KMA et al. (1990). Reduction in diarrhoeal diseases in children in rural Bangladesh by environmental and behavioural modifications. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 84:433-438.

Bangladesh (2005). Ministry of Local Government, rural Development and Co-operatives. National Sanitation Strategy. Dhaka. [http://www.buet.ac.bd/itn/publications/NSS\\_2005.pdf](http://www.buet.ac.bd/itn/publications/NSS_2005.pdf)

Bateman, O. Masee and Shelley Smith. December 1991. A Comparison of the Health Effects of Water Supply and Sanitation in Urban and Rural Guatemala. WASH Field Report No. 352.

Baltazar JC, Solon FS (1989). Disposal of faeces of children under two years old and diarrhoea incidence: a case control study. *International Journal of Epidemiology*, 1(Suppl.):16–19.

Bateman MO et al. (1995). Prevention of diarrhea through improving hygiene behaviours: the sanitation and family education(SAFE) pilot project experience. Bangladesh, International Centre for Diarrhoeal Research/CARE Bangladesh/Environmental Health Project, USAID.  
[http://www.ehproject.org/PDF/Joint\\_Publications/JP004SAFEr.pdf](http://www.ehproject.org/PDF/Joint_Publications/JP004SAFEr.pdf)

Billig, Patricia and Diane Bendahmane, Anne Swindale (1999). Water and Sanitation Indicators: Measurement Guide. USAID Food and Water Project.  
<http://www.fantaproject.org/downloads/pdfs/watsan.pdf>

Bitature, A.; Sidibe, M. (2000) Evaluation report. School Sanitation, Hygiene Promotion in Uganda: The Challenge. WSP and UNICEF.  
[http://www.unicef.org/evaldatabase/index\\_19010.html](http://www.unicef.org/evaldatabase/index_19010.html)

Budds, Jessica and Amaka Obika, Guy Howard, Marion Jenkins, Valerie Curtis (2002) Social marketing for Urban Sanitation: Literature review.  
[http://wcdc.lboro.ac.uk/projects/proj\\_contents/WEJX9%20-%20Social%20Marketing/www/outputs/Revised%20literature%20review%20\(pdf\).pdf](http://wcdc.lboro.ac.uk/projects/proj_contents/WEJX9%20-%20Social%20Marketing/www/outputs/Revised%20literature%20review%20(pdf).pdf)

BRAC (2005) Water, Sanitation, and Hygiene Programme: Attaining the MDG Targets on Water and Sanitation in Bangladesh. Dhaka.

Brikké, François and Maarten Bredero (2003) Linking technology choice with operation and maintenance in the context of community water supply and sanitation: a reference document for planners and project staff. World Health Organization and IRC Water and Sanitation Centre. Geneva, Switzerland.  
[http://www.who.int/water\\_sanitation\\_health/hygiene/om/wsh9241562153/en/index.html](http://www.who.int/water_sanitation_health/hygiene/om/wsh9241562153/en/index.html)

Cordova, Ann. Large-scale dry sanitation programs: preliminary observations and recommendations from urban experiences in Mexico. Cornell University, HDRU, 2001.  
<http://www2.gtz.de/ecosan/english/publications-projects.htm>

Cairncross, Sandy (1999) Why promote sanitation? WELL FACTSHEET , WEDC, UK.  
<http://www.lboro.ac.uk/orgs/well/resources/fact-sheets/fact-sheets-htm/wps.htm>

- Cairncross, Sandy (1999b). Measuring the health impact of water and sanitation. WELL FACTSHEET <http://www.lboro.ac.uk/well/resources/fact-sheets/fact-sheets-htm/mthiws.htm>
- Cairncross Sandy (1990). Health impacts in developing countries: new evidence and new prospects. *Journal of the Institution of Water and Environmental Management*, 1990, 4 (6): 571–577.31.
- Cairncross, Sandy and Kathleen Shordt (2004) It does last! Some findings from the multi-country study of hygiene sustainability. *Waterlines*. Vol 22. No. 3. <http://www.irc.nl/page/9971>
- Curtis, Valerie and Bernadette Kanki, Simon Cousens, Ibrahim Diallo, Alphonse Kpozehouen, Morike Sangaré & Michel Nikiema (2001) Evidence of behaviour change following a hygiene promotion programme in Burkina Faso. *Bulletin of the World Health Organization*, 79 (6): 518-527. <http://www.who.int/docstore/bulletin/pdf/2001/issue6/vol.79.no.6.518-527.pdf>
- Daniels DL et al. (1990). A case-control study of the impact of improved sanitation on diarrhoea morbidity in Lesotho. *Bulletin of the World Health Organization*, 68(4):455–463. <http://www.scielo.br/pdf/rsbmt/v36n1/15306.pdf>
- Daniels DL, Cousens SN, Makoae LN, Feachem RGA (1990) case-control study of the impact of improved sanitation on diarrhoea morbidity in Lesotho. *Bull World Health Organ*. 1990;68(4):455-63.
- EHP/USAID (1999). Preventing Child Diarrheal Disease: Options for Action. Arlington, EHP/USAID. [http://www.cmhealth.org/docs/wg5\\_paper23.pdf](http://www.cmhealth.org/docs/wg5_paper23.pdf)
- Esrey SA, Feachem R, Hughes JM (1985). Interventions for the control of diarrhoeal diseases among young children: improving water supplies and excreta disposal facilities. *Bulletin of the World Health Organization*, 63(4):757–772. [http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list\\_uids=3878742&opt=Abstract](http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=3878742&opt=Abstract)
- Esrey SA, Habicht JP (1988). Maternal literacy modifies the effect of toilets and piped water on infant survival in Malaysia. *American Journal of Epidemiology*, 127:1079–1087. <http://aje.oxfordjournals.org/cgi/content/abstract/127/5/1079>
- Esrey SA et al. (1991). Effects of improved water supply and sanitation on ascariasis, diarrhoea, dracunculiasis, hookworm infection, schistosomiasis, and trachoma. *Bulletin of the World Health Organization*, 69(5):609–621.
- Esrey S.A., J.B. Potash, L. Roberts, and C. Shiff (1991). “Effects of Improved Water Supply and Sanitation on Ascariasis, Diarrhoea, Dracunculiasis, Hookworm Infection, Schistosomiasis, and Trachoma” *Bulletin of the World Health Organization* 69(5):609-21.
- Esrey, SA. (1996) Water, waste, and well-being: a multicountry study. Pp. 608-623 *American Journal of Epidemiology*, Vol 143,
- Esry, SA and Jean Gough, Dave Rapaport, Ron Sawyer, Mayling Simpson-Hebert, Jorge Vargas, Uno Winblad (1998) *Ecological Sanitation*. SIDA, Stockholm. <http://www.ecosanres.org/PDF%20files/Ecological%20Sanitation.pdf>
- Favin M, Yacoob M, Bendahmane D (1999). Behaviour first: a minimum package of environmental health behaviours to improve child health. *Environmental Health Project: Applied study no. 10*. Washington, DC, USAID. [http://pdf.dec.org/pdf\\_docs/PNACF961.pdf](http://pdf.dec.org/pdf_docs/PNACF961.pdf)
- Favin, Michael and Gail Naimoli, Lisa Sherburne (2004) *Improving Health through Behavior Change A Process Guide on Hygiene Promotion*. EHP Environmental Health Project, Washington, DC
- Galway, Michael (2000). *Field Note New Approaches to Promoting Sanitation in Rural Bangladesh*. Water and Sanitation Program- South Asia. March 2000 [http://www.wsp.org/publications/sa\\_approach.pdf](http://www.wsp.org/publications/sa_approach.pdf)
- Grimason AM et al. (2000). Problems associated with the use of pit latrines in Blantyre, Republic of Malawi. *Journal of the Royal Society of Health*, 120(3):175–182.

Guchte, Cees van de and Veerle Vandeweerd, Targeting Sanitation in Our Planet Vol 4, No. 4, UNEP, pp 19-22.

Gross, Bruce, Christine van Wijk and Nilanjana Mukherjee (2001) Linking sustainability with demand, gender and poverty: a study in community-managed water supply projects in 15 countries. World Bank Water and Sanitation Program, USA.

<http://www.worldbank.org/gender/resources/briefing/watersanitation.pdf> ]

Han AM, Khin DN, Hlaing T (1986). Personal toilet after defecation and the degree of hand contamination according to different methods used. *Journal of Tropical Medicine and Hygiene*, 89(5): 237–241.

Hill, Zelee, Betty Kirkwood and Karen Edmond (2004) Family and community practices that promote child survival, growth and development : a review of the evidence. World Health Organization.

Hoque BA, Briend A (1991). A comparison of local handwashing agents in Bangladesh. *Journal of Tropical Medicine and Hygiene*, 94(1):61–64.

Hoque BA et al. (1995). Post defecation handwashing in Bangladesh: practice and efficiency perspectives. *Public Health*, 109(1):15–24.

Hoque BA et al. (1999). Effects of environmental factors on child survival in Bangladesh: a case control study. *Public Health*, 113(2):57–64.

Huttly SR, Morris SS, Pisani V (1997). Prevention of diarrhoea in young children in developing countries. *Bulletin of the World Health Organization*, 75(2):163–174.

Huttly SR et al. (1994). Observations on handwashing and defecation practices in a shanty town of Lima, Peru. *Journal of Diarrhoeal Disease Research*, 12(1):14–18.

Hutley S.R.A., S.S. Morris, and V. Pisani (1997). "Prevention of Diarrhoea in Young Children in Developing Countries" *Bulletin of the World Health Organization* 75:163-74.

India (2005) Department of Drinking Water. Ministry of Rural Development. *Central Rural Sanitation Programme Total Sanitation Campaign*. Delhi, India. <http://ddws.nic.in/tsc-nic/html/index.html>

Karanja, Beth and Vincent Njuguna (2003) SUSTAINING CHANGES IN HYGIENE BEHAVIOURS STUDY: Summary of Key Findings – Final Version Kombewa and Maseno Divisions, in Kisumu District, Kenya. NETWAS International, Kenya.

Khanom K, Leonard RC. A hygiene experiment in rural Bangladesh. *Sociol Perspect*. 1989 Summer;32(2):245-55.

Khosla, Prabha and Christine van Wijk, Joep Verhagen, Viju James (2004) Gender and Water: Thematic Overview Paper. IRC, Netherlands.

Lenton, Roberto and Albert Wright, Kristin Lewis (2005) Health, dignity and development. What will it take? UN Millennium Development Task Force on Water and Sanitation. New York. <http://www.unmillenniumproject.org/documents/WaterPart1-lowres.pdf>

Lockwood, Harold and Ton Schouten (2004) Scaling Up Community Management of Rural Water Supply: Thematic Overview Paper. IRC, Netherlands. <http://www.irc.nl/page/8857>

Koopman, J.S. (1978) Diarrhea and school toilet hygiene in Cali, Colombia. *American Journal of Epidemiology*, Vol 107, Issue 5 412-420, Copyright © 1978 by Oxford University Press

Kurup, K. B. (1996) The community-managed sanitation programme in Kerala: learning from experience. IRC International Water and sanitation centre, Netherlands/SEU Foundation, Kerala. 81 p.

LaFond AK (1995). A review of sanitation program evaluations in developing countries. Environmental Health Division, EHP Activity Report No. 5.

- Mara, Duncan and Andrew Sleight, Kevin Tayler. (2001) Simplified Sewerage: Condominial systems.. University of Leeds, UK.  
<http://www.efm.leeds.ac.uk/CIVE/Sewerage/articles/condominial2.pdf> General webpage:  
<http://www.efm.leeds.ac.uk/CIVE/Sewerage/main.html>
- Melo, Jose Carlos (2005) The Experience of Condominial Water and Sewerage Systems in Brazil: Case Studies from Brasilia, Salvador and Parauapebas. Water and Sanitation Program.  
<http://www.wsp.org/publications/BrasilFinal2.pdf>
- Mertens TE (1992). Excreta disposal and latrine ownership in relation to child diarrhoea in Sri Lanka. *International Journal of Epidemiology*, 21:1157–1164.
- Muller M, Sanchez RM, Suswillo RR (1989) Evaluation of a sanitation programme using eggs of *Ascaris lumbricoides* in household yard soils as indicators. *J Trop Med Hyg.* 1989 Feb;92(1):10-6.
- Mukherjee, N. 2001, Achieving sustained sanitation for the poor: Policy and strategy lessons from participatory assessments in Cambodia, Indonesia, Vietnam, WSP field note, Water and Sanitation Programme for East and the Pacific, Jakarta, Indonesia.
- Muller M, Sanchez RM, Suswillo RR (1989) Evaluation of a sanitation programme using eggs of *Ascaris lumbricoides* in household yard soils as indicators. *J Trop Med Hyg.* 1989 Feb;92(1):10-6.
- Murray, B.; Walter, G. and Kolkma, W. (2005). Rural Water Supply and Sanitation Sector Project (Loan 1352-INO) in Indonesia. (Project performance audit reports). Manila, Philippines, Operations Evaluation Department, Asian Development Bank.
- Nyavor, E.T. and Joan Awunyo-Akaba (2003) REPORT ON SUSTAINABILITY OF CHANGES IN HYGIENE BEHAVIOUR-GHANA. Volta Rural Community Water and Sanitation-Ghana.
- Nokes, C., Grantham-McGregor, S.M., Sawyer, A.W., Cooper, E.S., Robinson, B.A. and Bundy, D.A.P. (1992) Moderate to heavy infections of *Trichuris trichiura* affect cognitive function in Jamaican school children. *Parasitology*, 104: 539-547.
- Norhayati M, Fatmah MS, Yusof S, Edariah AB.(2003) Intestinal parasitic infections in man: a review. *Med J Malaysia.* 2003 Jun;58(2):296-305
- Ocasio, Raymond. Identification of financial resources and credit mechanisms for the urban sanitation program in Jamaica: Activity Rept. No. 39.. EHP No. 357-CC. 1997.
- McCommon, Carolyn S. and Eduardo Perez, Fred Rosensweig (1999) Providing Urban Environmental Services for the Poor. EHP, Arlington, Va.
- Rahman M, Rahaman MM, Wojtyniak B, Aziz KM.(1985) Impact of environmental sanitation and crowding on infant mortality in rural Bangladesh. *Lancet.* 1985 Jul 6;2(8445):28-31
- Saadé, Camille and Masee Bateman, and Diane B. Bendahmane (2001) *The Story of a Successful Public-Private Partnership in Central America: Handwashing for Diarrheal Disease Prevention.* USAID, UNICEF, EHP.  
[http://www.basics.org/publications/pubs/Handwashing/handwashing\\_advocacy-English1.pdf](http://www.basics.org/publications/pubs/Handwashing/handwashing_advocacy-English1.pdf)
- Srinivas Chary V.; Narender A.; Rajeswara Rao K. Pay-and-use toilets in India [Waterlines](#), Volume 21, Number 3, 1 January 2003, pp. 12-14(3)
- Robinson, A.J. (2005) Lessons Learned from Bangladesh, India, and Pakistan: Scaling-Up Rural Sanitation in South Asia. Water and Sanitation Program-South Asia.  
[http://www.wsp.org/publications/SANITATION%20STUDY\\_PRESS.pdf](http://www.wsp.org/publications/SANITATION%20STUDY_PRESS.pdf)
- Sawyer, R. and M. Simpson-Hébert, S. (1998) Wood PHAST Step-by-Step Guide: a participatory approach for the control of diarrhoeal disease. WHO, Geneva, 1998 (WHO/EOS/98.3)
- Saywell, Darren (2002) The national sanitation programme in Mozambique: pioneering peri-urban sanitation WSP Africa Region Field Note 9. [http://www.wsp.org/publications/af\\_bg\\_moz.pdf](http://www.wsp.org/publications/af_bg_moz.pdf)

- Shordt, Kathleen and Sandy Cairncross (2004) Findings of a multi-country research study and implications for water and sanitation programmes: Booklet 2. IRC International Water and Sanitation Centre, Netherlands.
- Shordt, Kathleen (2000) Action monitoring for effectiveness. 2 vols. IRC International Water and Sanitation Centre, Netherlands.
- Srinivas Chary V. and A. Narender, K. Rajeswara Rao (2003) Pay-and-use toilets in India [Waterlines](#), Volume 21, Number 3, pp. 12-14(3) : [ITDG Publishing](#)
- Traore E et al. (1994). Child defecation behaviour, stool disposal practices and childhood diarrhoea in Burkina Faso: results from a case-control study. *Journal of Epidemiology and Community Health*, 48:270–275.
- TSC- Total Sanitation Campaign.(2005) Frequently Asked Questions. Government of India. <http://ddws.nic.in/tsc-nic/html/Final%20TSC%20FAQS.HTM#IEC>
- UNICEF, EHP, USAID.(1997) A Manual on Hygiene Promotion Towards better programming Water, Environment and Sanitation. Technical Guidelines Series - No. 3. EHP Applied Study No. 5 First Edition: May 1997 A Sanitation Handbook 80 pp
- Unicef and IRC (1998). A Manual on School Sanitation and Hygiene. Water, Environment and Sanitation Technical Guidelines Series - No. 5, Unicef-Delhi and IRC, Netherlands. <http://www.irc.nl/content/download/10482/154340/file/manualssh.pdf>
- Varley, R.C.G., Tarvid, J. & Chao D.N.W. 1998. A reassessment of the cost-effectiveness of water and sanitation interventions in programmes for controlling childhood diarrhoea. *Bulletin of the World Health Organization*, 76(6):617-631.
- Varley, Robert and May Yacoob and Scott Smith (1996) Beyond Participation:Locally Based Demand for environmental Health in Peri-Urban Areas, EHP, Washington
- Wegelin-Schuringa, Madeleen and Manus Coffey (1998) Small Pit Emptying Machine an Appropriate Solution in Nairobi Slum.UN Habitat <http://hq.unhabitat.org/cdrom/water/HTML/Small%20Pit%20Emptying%20Machine.htm>
- WELL (1998) DFID Guidance Manual on Water Supply and Sanitation Programmes. LSHTM/WEDC London.<http://www.lboro.ac.uk/well/resources/Publications/guidance-manual/guidance-manual.htm>
- Wijk, Christine van and Leonie Postma. MPA: A new methodology for participatory monitoring. IRC International Water and Sanitation Centre, 2003.
- van Wijk, Christine. The best of two worlds? Methodology for participatory assessment of community water services. Wageningen University and IRC, the Netherlands. 2002
- Wilson JM, Chandler GN (1993). Sustained improvements in hygiene behaviour amongst village women in Lombok, Indonesia. *Transactions of the Royal Society of Tropical and Medicine and Hygiene*, 87:615–616.
- Whiteford, Linda and M., Laspina, Carmen, and Torres, Mercedes.(1996) Monitoring the Effect of Behavior Change Activities on Cholera: A Review in Act. 245-RC, October 1996.
- World Bank. (1995) Operations Evaluations Department. Sewerage and Sanitation: Jakarta and Manila. Project P004479/003827. <http://lnweb18.worldbank.org/oed/oeddoclib.nsf>
- WHO (2002). Improving child health in the community. Geneva, World Health Organization (WHO/FCH/CAH/02.12).
- WHO/UNICEF (2004) Joint Monitoring Programme for Water Supply and Sanitation; Meeting the MDG drinking water and sanitation target: a mid-term assessment of progress.
- WSP. 98-99 Water and Sanitation Program Report. World Bank.

WSP (2004) Integrated Sanitation Program of the Tamil Nadu Urban Development Program. Sixteenth Meeting of the Urban Think Tank. Pune, India Nagari.

[http://www.wsp.org/publications/Nagari-16\\_Press.pdf](http://www.wsp.org/publications/Nagari-16_Press.pdf)

WSSCC (Water Supply and Sanitation Collaborative Council) and WHO (World Health Organization) (2005) Sanitation and Hygiene Promotion: Programming Guidance. Geneva.

<http://www.wsscc.org/dataweb.cfm?code=586>

WSSCC/IHE (2003) Issues concerning institutional options in waste water and sanitation in developing countries: Synthesis report for the Institutional and Management Options Working Group Water Supply and Sanitation Collaborative Council.

Zacharia. S. and K. Shordt (2004) People-centred approaches to water and environmental sanitation: How to change and sustain hygiene behaviours, research in India. 30th WEDC International Conference, Vientiane, Lao PDR, 2004

<http://wedc.lboro.ac.uk/conferences/pdfs/30/Zacharia.pdf>