Checklist for planning better sanitation projects

—WSSCC Working Group on Promotion of Sanitation

This checklist has been drawn from the *Principles of better sanitation programmes* and *Features of better sanitation programmes*.

If you are interested to know how closely a planned project follows the "principles" and "features", you may wish to try this checklist. If your answer to these questions is consistently "yes", you have followed the "best practices".

If any answers are "no" you might examine whether changing this feature would improve the project.

Project formulation

- Are communities being selected for sanitation change because of their **keen desire for improvement** Yes ❒ No ❒
  or because it is at **high risk** for sanitation-related diseases? Yes ❒ No ❒
- Is the project planned in a way that **changes** can be made as lessons are learned? Yes ❒ No ❒
- Is the sanitation project accepted as a **priority** in its own right, rather than viewed as an add-on to a water programme? Yes ❒ No ❒
- Does the sanitation project have its **own budget** Yes ❒ No ❒
  and **own time-frame** Yes ❒ No ❒
  separate from any water supply project that may be taking place concurrently?
- Is the project assessing how the community's improved sanitation system will be a successful part of its **larger ecosystem, cultural beliefs and practices**? Yes ❒ No ❒
- Does the project have a component either to create demand for sanitation or to encourage the **expression of demand** that is already there? Yes ❒ No ❒
- Is the project assessing whether the principles of **social marketing** can or should be applied to the project to understand consumer preferences in the design of facilities? (See *Social marketing for sanitation programmes.*) Yes ❒ No ❒
- Is the project learning about and considering the cultural beliefs and practices of the community in designing the hygiene behaviour-change component? Yes ❒ No ❒
- Is the project involving the community in collecting information on the current sanitation situation for use in developing the project? Yes ❒ No ❒

Project management

- Is the community involved in setting the project's objectives? Yes ❒ No ❒
- Is a realistic time-frame being allowed for the project? Yes ❒ No ❒
- Is the project identifying what additional support from other sectors might be needed to make the project successful? Yes ❒ No ❒
- Is the project developing a plan for how the sanitation project will be managed? Does this include:

  defining roles and responsibilities? Yes ❒ No ❒

  setting out supervisory structures? Yes ❒ No ❒

  developing reporting systems? Yes ❒ No ❒

  coordinating activities? Yes ❒ No ❒

  outlining communication systems? Yes ❒ No ❒

Community participation

- Is the project considering how (whether) the essential elements of **social mobilization** can or should be applied? Yes ❒ No ❒
- Is the project assessing how (whether) **participatory approaches** can or should be applied to encourage better dialogue with the community and to involve it actively in decision-making? (See *Participatory approaches to community empowerment.*) Yes ❒ No ❒
- Is the project creating an environment in which the community feels a sense of responsibility and ownership for the project? Yes ❒ No ❒
- Is the project trying to **use existing community organizations** rather than creating new ones? Yes ❒ No ❒
- Is the project consulting with people trained and experienced in methodologies for achieving effective community participation? Yes ❒ No ❒
- Is the project creating an environment in which **private producers** can be involved in providing the hardware for the project and can thrive economically in doing so? Yes ❒ No ❒

Gender sensitivity

- Is the project employing a **gender specialist** and using the gender checklist? (See *A gender perspective in sanitation projects* and the associated gender checklist.) Yes ❒ No ❒
- Is the project using both **male and female personnel** to reach out to the community and households? Yes ❒ No ❒

Hygiene behaviour change

- Do the project personnel recognize that **hygiene behaviours are as important** as facilities for improving community and household sanitation? Yes ❒ No ❒
- Is the project identifying **behaviour changes** that need to occur in the community and households to get the benefits of facilities? Yes ❒ No ❒
- Does the project have a **strategy for bringing about behaviour changes**? (The *Checklist for planning hygiene behaviour-change in sanitation projects* is a useful source of further information on this subject.) Yes ❒ No ❒
- Are hygiene behaviours and facilities being **promoted together**, in a complementary way, in the project? Yes ❒ No ❒
- Is the project trying to involve community groups in **formulating their own hygiene education programmes** and own messages and methods rather than having these designed from outside the community? Yes ❒ No ❒

Selecting technologies

- Is the project using information collected about what people in the community are **doing now** for sanitation, and trying to build, step by step, upon these traditions to improve sanitary conditions? Yes ❒ No ❒
- Are the project personnel keeping an open mind about what kind of **sanitation technologies** might be possible for the community? Yes ❒ No ❒
- Is the community being advised about a **range of technical options** from which it can choose? Yes ❒ No ❒
- Are these options affordable to the great majority of households, **without subsidy**? Yes ❒ No ❒
- Do community members have opportunities to **assess for themselves** various sanitation technology options, and to Yes ❒ No ❒
  participate in a meaningful way in their selection? Yes ❒ No ❒
- Do community members have opportunities to suggest adaptations to the various sanitation technology options presented, so that they can be made more appropriate to the local situation? Yes ❒ No ❒
- Are some **household financing schemes** being offered to the community to help them pay for facilities? Yes ❒ No ❒

Promotion

- Is the project trying to win the **support of slightly wealthier and higher status people first** before approaching the poorer households or groups? Yes ❒ No ❒
- Does the project have **political support** from the highest possible level within this social context? Yes ❒ No ❒
- Is the project **letting the people in the community know** that this sanitation project is supported by higher-level political figures? Yes ❒ No ❒
- Does the project include and involve **schools** Yes ❒ No ❒
  schoolchildren or Yes ❒ No ❒
  other community children? Yes ❒ No ❒

- Is the project planning for the promotion of sanitation and hygiene behaviours to be a **continuous activity** rather than a one-off effort with a limited time-frame? Yes ❒ No ❒

Capacity-building

- Is the project building capacity for the community to take over the **operation and maintenance** of any new facilities? Yes ❒ No ❒
- Is the project offering additional training to its personnel to help them accomplish the above? Yes ❒ No ❒

Backup

- Is the project planning to provide the necessary support to the community until it is able to sustain the project on its own? Yes ❒ No ❒

Feedback

- Is the project involving the community in developing a monitoring system that it can use to measure progress and as a basis for continued improvement? (See *Participatory monitoring and evaluation of sanitation projects.*) Yes ❒ No ❒

Checklist for planning sanitation in emergency situations

—*Mayling Simpson-Hébert*[1]

This checklist is intended to help plan for sanitation in emergency situations. In preparing this checklist, certain assumptions have been made. These are:

- The emergency situation to which this article refers is one in which people have been displaced and who are now living temporarily in camps or shelters until they can return to their homes.
- The sanitation facilities will be set up quickly and are not intended to be permanent or used in the long term.

The checklist has been derived from *Principles for sanitation in emergency situations*, an output of a workshop on sanitation in emergency situations (1).

"Sanitation" is taken here to mean interventions to reduce people's exposure to disease by providing a clean environment in which to live. This includes disposing of human excreta, refuse, and wastewater; control of disease vectors; and providing washing facilities.

As you plan your sanitation programme in an emergency situation, check the following to see if you have done them. If your answer to these questions is consistently "yes", you have followed the "best practices" identified by the workshop participants. If your answer is "no", you might examine whether changing this practice would improve your programme.

Checklist

- Is the sanitation programme seen as a priority in its own right (needing its own resources and time-frame) and not as an add-on to the provision of water? Yes ❐ No ❐
- Do programme staff recognize that providing sanitation in emergency situations is the first barrier to disease transmission (both faecally-transmitted and vector-borne diseases) and equally if not more important than providing medical services for the population? Yes ❐ No ❐
- Do programme staff recognize that providing sanitation to the population will improve the dignity and morale of the displaced people? Yes ❐ No ❐
- Do programme staff recognize the political context of refugee camps and that sanitation decisions must be made within it? Yes ❐ No ❐
- In all decision-making, is there an effort to involve representatives of the population in the emergency situation from the beginning? Yes ❐ No ❐

[1] WHO, Geneva, Switzerland.

- Is the programme sensitive to what will be provided inside the camp or temporary locations as compared to the sanitation needs of the local population living nearby? Yes ❒ No ❒
- Are programme staff, in consultation with community representatives, defining sanitation priorities Yes ❒ No ❒
  and establishing sanitation objectives Yes ❒ No ❒
  (global and specific) before beginning any sanitation work?
- Is an effort being made to understand the population's traditional sanitation practices and beliefs and to build on them whenever possible? Yes ❒ No ❒
- Is an effort being made to understand the differing needs of women, men, and children in planning the sanitation programme? Yes ❒ No ❒
- Are hygiene behaviours and facilities being planned and promoted together? Yes ❒ No ❒
- Is there a plan to promote sanitation, continually, at all levels, rather than viewing it as a one-time effort? Yes ❒ No ❒
- Is there a plan for the users to become involved in maintaining the sanitary services after the initial period? Yes ❒ No ❒
- Is the programme considering the environmental effects of sanitation on the larger environment and attempting to minimize their potential negative impact? Yes ❒ No ❒

Reference

(1) Derived from *Sanitation in emergency situations*. Proceedings of an international workshop held in Oxford, December 1995. An Oxfam Working Paper. Available from Oxfam, 274 Banbury Road, Oxford OX2 7DZ, UK.

Checklist for planning hygiene behaviour-change in sanitation projects

—*Mayling Simpson-Hébert*[1] *and Sara Wood*[2]

A hygiene behaviour-change programme can help individuals, families, and communities to become aware of the links between behaviours and disease. It involves encouraging and helping people change behaviours, to achieve the greatest reduction in disease possible. This requires community participation in deciding which behaviours it wants to work on changing and which sanitation options are most appropriate to its needs.

In many settings, ideal sanitation facilities are not within the community's reach. But communities and individuals can still adopt improved hygiene behaviours that will lead to better health. It is also recognized that even when good facilities are available, they will not necessarily translate into major health improvements, unless they are accompanied by changes in hygiene behaviours. Therefore, with or without improved water supply and sanitation facilities, improved hygiene behaviours can improve health.

This checklist is intended to help sanitation project personnel plan better sanitation projects. It should be used to check whether all important elements of planning are in place.

As you plan the hygiene behaviour-change component of your sanitation programme, check the following to see if you have done them. If your answer to these questions is consistently "yes", you have followed the "best practices" identified by the Working Group. If the answer is "no" you might consider whether collecting such information would improve your project.

Collection of basic information

Helpful hint: Data collection should be a joint activity between the programme and the community. (References are included at the end of the checklist, should you wish to find out more about different data collection methods, and when to apply them.) Some of the information needed may already exist in previous surveys or in the records or files of other agencies operating in the area. It may save much time to check what information is already available. You then need only collect what is missing or update information that is out of date.

Have you collected the following basic information about the community? Please note: this is not a survey form.

Demographic	*information collected*
population size	Yes ❒ No ❒
household sizes	Yes ❒ No ❒

1 WHO, Geneva, Switzerland.

2 WHO Consultant, Geneva, Switzerland.

information collected

proportion of households headed by women Yes ❒ No ❒

ethnic groups or economic groups and their sizes Yes ❒ No ❒

high-risk groups Yes ❒ No ❒

Health determinants

major health problems in the community Yes ❒ No ❒

relative importance of water/sanitation-related diseases Yes ❒ No ❒

seasonal variations in diseases Yes ❒ No ❒

Current and traditional hygiene practices

where men defecate Yes ❒ No ❒

where women defecate Yes ❒ No ❒

where children defecate Yes ❒ No ❒

where babies faeces are disposed of Yes ❒ No ❒

where sick people defecate — particularly those with diarrhoea Yes ❒ No ❒

anal cleansing practices Yes ❒ No ❒

handwashing practices after defecation Yes ❒ No ❒

handwashing practices after handling babies' faeces Yes ❒ No ❒

handwashing practices before feeding children and eating Yes ❒ No ❒

important beliefs and taboos related to location and sharing of latrines Yes ❒ No ❒

latrine emptying and excreta reuse practices, if any Yes ❒ No ❒

food handling and preparation practices and possible sources of contamination Yes ❒ No ❒

water handling practices and possible sources of contamination Yes ❒ No ❒

bathing habits (men, women, children, and babies) Yes ❒ No ❒

face-washing practices (men, women, children, and babies) Yes ❒ No ❒

places where flies breed Yes ❒ No ❒

other important personal and domestic practices in this society Yes ❒ No ❒

all of the above, differentiated by age, economic class, and ethnic group if potentially useful Yes ❒ No ❒

Environment

availability of water, distance, amounts, and quality Yes ❒ No ❒

availability of services, such as schools and health clinics Yes ❒ No ❒

Social structures *information collected*

- Has the programme identified:

  the formal power structures, e.g. for election of politicians and officials? Yes ❒ No ❒

  informal structures, such as community leaders, opinion leaders, and elders? Yes ❒ No ❒

  characteristics that tend to make people's opinions carry weight (such as money, children, age, education, cattle, spouses, and gender)? Yes ❒ No ❒

  persons having the most influence over community health decisions? Yes ❒ No ❒

  how and by whom household decisions are made, specifically decisions on health and hygiene-related matters? Yes ❒ No ❒

  the status of women? Are they able to participate actively and equitably in community matters? Yes ❒ No ❒

- What structures already exist in the community that could be used to support the intervention? How representative are they by gender, social status, etc.? How effective have they been in the past? Yes ❒ No ❒

Planning community participation in the hygiene behaviour-change programme

- Has the programme planned how the community will participate in planning, developing and implementing the hygiene behaviour-change programme? Yes ❒ No ❒

- Has the programme determined which methodology/methodologies would be most appropriate to use for the hygiene behaviour-change programme? Yes ❒ No ❒

Determining key hygiene behaviours for the programme

- Has the programme determined, from collecting basic information, which behaviours are harmful to health and which are good healthful practices? Yes ❒ No ❒

- Has the programme determined the underlying reasons for poor hygiene behaviours? Yes ❒ No ❒

- Are poor hygiene behaviours due to socioeconomic factors, religious or cultural beliefs, availability of water or latrines or both, educational factors, social norms or social pressures, or decision-making at the household level? Yes ❒ No ❒

- Has the programme considered, along with the above, whether new sanitation facilities will require entirely new behaviours for this society? Yes ❒ No ❒

- Has the programme determined, from the above, the key hygiene behaviours on which the hygiene education programme needs to focus? Yes ❒ No ❒

- Has the programme determined who and how many people in the community already practice the key hygiene behaviours? Yes ❒ No ❒

- Has the programme prioritized, from considering the above, the key behaviours to be promoted? Yes ❒ No ❒

Helpful hint: The programme should select those hygiene behaviours, which if altered, will have the greatest effect in reducing the transmission of disease.

- Has the programme identified what the community considers to be its needs and priorities for hygiene behaviour-change? Yes ❒ No ❒

Helpful hint: Hygiene behaviours that the community sees a need for and which do not conflict with traditions are a good place to concentrate initial efforts. Success here will help when it is time to tackle hygiene behaviours that the community does not see as important or that conflict with cultural traditions. These require more effort to change. Experience acquired in the former situation will help when addressing more complex situations.

Determining the monitoring and evaluation requirements of the intervention

Has the programme determined the following aspects of the monitoring and evaluation activity?

- Whose responsibility will it be? Yes ❒ No ❒
- How frequently will it be done? Yes ❒ No ❒
- Which indicators will be used to measure progress? Yes ❒ No ❒
- How will the results be reported to the community? Yes ❒ No ❒

Planning the hygiene behaviour-change intervention

- Has the programme identified, from collecting basic information, the desired outcome and set measurable objectives for the intervention? Yes ❒ No ❒
- Has the programme identified the target audience for the hygiene behaviour-change intervention? Yes ❒ No ❒
- Has the programme analysed the target audience to determine if it needs to be segmented further into groups that share similar beliefs and perceptions? Yes ❒ No ❒
- Has the programme identified how each change should be promoted? Yes ❒ No ❒
- Has the programme encouraged community representatives to participate in creating the hygiene education intervention? Yes ❒ No ❒
- Has the programme identified who should implement the hygiene behaviour-change programme? Yes ❒ No ❒
- Do those chosen have the necessary skills, experience, and training to undertake the task of implementing the programme? Yes ❒ No ❒
- Has the programme considered the need for both male and female extension workers? Yes ❒ No ❒
- Has the programme considered working through schools and with children as change agents? Yes ❒ No ❒

- Has the programme identified, contacted, and integrated its activities with other sectors that should be involved in the hygiene behaviour-change programme? Other relevant sectors could be water supply, housing, primary health care, environmental health services, schools, and home economists. Yes ❒ No ❒

Planning the hygiene behaviour-change messages

- Are the messages based on an understanding of factors that influence the community's behaviour, including what it believes and understands? Yes ❒ No ❒
- Are the messages easy to understand? Have the messages been pretested with a group of people who have the same characteristics as the target audience? Yes ❒ No ❒
- Are the messages persuasive enough to make people change? Do they provide an incentive for change that makes sense in the context of the community in which they will appear? Yes ❒ No ❒
- Does the behaviour-change programme message meet a need that the target audience has said is important for it to satisfy? Yes ❒ No ❒
- Have behaviour trials been carried out to check whether people can do what is being asked of them? Yes ❒ No ❒

Determining the potential for different communication methods

- Has the programme collected the following information on the potential for different communication methods? Yes ❒ No ❒
  - — literacy levels of men, women, and children; Yes ❒ No ❒
  - — existing formal channels of communication (health centres, schools, public meetings, churches, mosques, temples); Yes ❒ No ❒
  - — existing informal channels of communication; Yes ❒ No ❒
  - — mass media access in the area (radio, TV, video, newspapers, magazines, etc.); and Yes ❒ No ❒
  - — ongoing health education activities. Yes ❒ No ❒
- Has the programme analysed what health information is already being conveyed through existing communication channels? Yes ❒ No ❒
- Do the new messages agree with or contradict the messages of this intervention? Yes ❒ No ❒
- Has the programme worked out how to overcome the problem of contradictory messages if it exists? Yes ❒ No ❒

Managing the hygiene behaviour-change intervention

- Has the programme developed a plan for managing the intervention? Yes ❒ No ❒
- Has the programme worked out the full cost of the intervention, including the cost of personnel, facilities, equipment, supplies, transport, travel and an allowance for contingencies, such as cost increases and any unforeseen costs? Yes ❒ No ❒

- Has the programme worked out how the cost of the intervention will be funded? Yes ❒ No ❒
- Has the programme obtained the necessary funds to implement the intervention? Yes ❒ No ❒
- Has the programme worked out how the funds will be managed, including book-keeping, payment of bills, and a system of regular audits to check for any irregularities? Yes ❒ No ❒
- Has the programme considered running a training workshop at the intervention's outset to brief those involved, provide necessary training, and present the opportunity for any confusion or misunderstandings to be resolved? Yes ❒ No ❒

Helpful hint: A management plan could include the following:

— the responsibilities (job specifications) of all those involved;
— to whom they are responsible;
— how often they are expected to report their results;
— the form of report that is expected (written or verbal);
— how all the activities of individuals involved will be coordinated;
— frequency of meetings (weekly, monthly, quarterly, etc.);
— the support that will be provided to project members; and
— how information will be communicated efficiently to those involved in the project.

More information about planning a hygiene education programme can be found in the further reading listed below.

Further reading

Almedom AM, Blumenthal U, Manderson L. *Hygiene evaluation procedures: approaches and methods for assessing water- and sanitation-related hygiene practices.* International Nutrition Foundation for Developing Countries, 1997.

Boot MT. *Making the links: guidelines for hygiene education in community water supply and sanitation*. The Hague, The Netherlands, IRC, 1990 (Occasional Paper No. 5).

Boot MT. *Just stir gently: the way to mix hygiene education with water supply and sanitation*. The Hague, The Netherlands, IRC, 1991, Technical Paper Series No. 29.

Boot MT, Cairncross A. *Actions speak: the study of hygiene behaviour in water and sanitation projects*. The Hague, The Netherlands, IRC, 1993.

GTZ. *Community participation and hygiene education in water supply and sanitation*. Federal Republic of Germany, Technical Cooperation, 1989.

Wood S, Sawyer R, Simpson-Hébert M. *PHAST step-by-step guide: a participatory approach for the control of diarrhoeal disease.* Geneva, World Health Organization (unpublished document WHO/EOS/98.3).

Gender checklist for planning sanitation projects

—*Angela Hayden*[1]

This checklist has been developed as a starting point for gathering data on gender issues in sanitation projects. The answers to these questions will show you where there are obstacles to be avoided or overcome, and where there are opportunities for making the sanitation project more successful.

Try to make certain that the people using the checklist have been trained in gender issues or are at least aware of what an appropriate gender approach is. If you feel those using the checklists lack experience in gender issues, try to organize training. If possible, find a gender specialist to help you. Gender specialists can be sought in government departments, universities and training institutions.

Basic Questions

The basic questions to answer at each stage of the sanitation project are:

- How can men participate?

- How can women participate?

- How can women and men together participate?

- What skills and capacities do they need?

- How can men benefit?

- How can women benefit?

- How can women and men benefit together?

[1] Independent consultant, Geneva, Switzerland.

Institutional background

- Are gender specialists included in the project staff? Yes ❒ No ❒

  If not, arrange training to sensitize staff to gender issues.

- Is there an official government policy on gender issues? Yes ❒ No ❒

  If there is, find out about it and see how it can be used to enhance the sanitation programme.

- Is there a government agency or ministry specifically concerned with gender issues? Yes ❒ No ❒

  If so, write down its name and make contact.

  _____

- Can the local government agency responsible for sanitation offer training or experience in gender issues? Yes ❒ No ❒

  If it can, see whether sanitation project staff can benefit from such training or experience.

- Are there organizations, particularly women's organizations, involved in sanitation or related activities? Yes ❒ No ❒

  If there are, write down their names and contact them to see whether they can be of help.

  _____

  _____

  _____

- Can lessons be learned from the experience of the ministry, local government agency or voluntary organizations (especially women's organizations)? Yes ❒ No ❒

  Review that experience and see if you can pick up any useful tips.

- Are voluntary organizations (particularly women's organizations) capable of providing training? Yes ❒ No ❒

  If so, find out who they can train and what sort of training they can provide.

- Do women, men or both play an active role in any community organizations or committees concerned with sanitation?

  Try to find out if they attend meetings and if they speak at meetings.

  _____

Project area sanitation facilities

- Where do men defecate?

  _____

- Where do women defecate?

  _____

- Where do children defecate?

  _____

- Are there any toilets? Yes ❒ No ❒

- If there are toilets, do men use them? Yes ❒ No ❒
  Do women use them? Yes ❒ No ❒
  Do children use them? Yes ❒ No ❒

  If men, women or children do not use them, try to find out why.

  _____

  _____

- Were the toilets constructed by men, women or both?

  _____

- Are the toilets maintained by men, women, both or no one?

  _____

- Would men, women or children prefer different sanitary facilities? Yes ❒ No ❒

  If yes, what type of toilets would they choose?

  _____

- Would men, women or children like to change the location of the toilets? Yes ❒ No ❒

  If yes, where would they like the toilets to be?

  _____

Cultural and religious factors

- In this culture, is it acceptable for men and women to share toilets? Yes ❒ No ❒
- Is it acceptable for women to be seen walking to use toilets? Yes ❒ No ❒
- Are the above attitudes changing? Yes ❒ No ❒
- Have people seen or heard about more modern facilities and are their expectations changing? Yes ❒ No ❒

Social and economic conditions

- Who is available to construct and maintain sanitary facilities (taking migratory patterns into account)?

  _____

  _____

- Are there large numbers of female-headed households? Yes ❒ No ❒

  If so, can the women who are heads of households get involved in constructing or maintaining the toilets, or in promoting their use? Yes ❒ No ❒

- Are there significant economic differences among the target population? Yes ❒ No ❒

  If there are big differences, how can you make sure that all the different groups get involved in the sanitation programme?

  _____

  _____

- Can women make decisions in the household or in the community?

  Yes ❒ No ❒

  If so, how can their decision-making power be helpful in the sanitation project? If not, how can they become involved?

  _____

  _____

Current gender roles

- Whose role (men's, women's, or both) would it be to:

pay for a latrine?	men's ❒	women's ❒	both ❒
construct a latrine?	men's ❒	women's ❒	both ❒
maintain a latrine?	men's ❒	women's ❒	both ❒
clean a latrine?	men's ❒	women's ❒	both ❒
train children to use a latrine and wash their hands?	men's ❒	women's ❒	both ❒

- Could any of the above gender roles be changed?

  _____

Women's potential for participation

- Are women interested and do they have the means and opportunity to express their interest?

  _____

  If women are uninterested, consider ways to link their concerns with sanitation.

  If women lack the means and opportunity to express their interest, participatory methods can be used. These are designed to overcome these kinds of difficulties. More information on participatory approaches can be found in *Participatory approaches to community empowerment*.

- Are women able and willing to contribute labour or materials (in line with their traditional roles)?

  _____

  If they can, try to ensure that the sanitation project is designed to make use of their potential.

- If women have the time, skills, or willingness do they contribute to:

decision-making?	Yes ❒	No ❒
construction?	Yes ❒	No ❒
communication?	Yes ❒	No ❒
hygiene education?	Yes ❒	No ❒
monitoring and evaluation, including establishing project indicators?	Yes ❒	No ❒
Does this vary by season?	Yes ❒	No ❒
If they lack skills, can training be provided?	Yes ❒	No ❒

- Have women a special interest in sanitation projects, for example because of using humus for gardening? Yes ❒ No ❒

  Make a list of any particular interests and explore how these interests could motivate women to participate in the sanitation project.

- Are women aware of the health benefits of improved sanitation and hygiene practices? Yes ❒ No ❒

  If not, what sorts of activities or materials would be best for increasing their awareness? How could the group work together to identify what their health education needs are?

_____

_____

Men's potential for participation

- Can men contribute labour or materials (do they go away from the home for long periods to work)? Yes ❒ No ❒

  Make sure that the sanitation project takes account of their availability.

- Do men have the time or skills to enable them to contribute to:

  decision-making? Yes ❒ No ❒

  construction? Yes ❒ No ❒

  communication? Yes ❒ No ❒

  hygiene education? Yes ❒ No ❒

  monitoring and evaluation, including establishing project indicators for measuring gender sensitivity? Yes ❒ No ❒

  If they lack skills, can training be provided? Yes ❒ No ❒

- How can men be motivated to participate in the sanitation project?

  Perhaps community leaders can set an example.

_____

- Are men aware of the health benefits of improved sanitation and hygiene practices? Yes ❒ No ❒

  If not, what sorts of activities or materials would be best for increasing their awareness?

_____

_____

- How can men be sensitized to what women perceive as the sanitation priorities?

_____

_____

References consulted

Hannan-Andersson C. Ways of involving women in water projects. *Waterlines*, July 1985; 4(1):28–31.

Perrett HE. *Involving women in sanitation projects*. Washington, DC, Technology Advisory Group (TAG), United Nations Development Programme (World Bank, Washington, DC), 1985 (TAG Discussion Paper No. 3).

Wakeman W. *Gender issues sourcebook for water and sanitation projects*. Washington, DC, UNDP/World Bank Water and Sanitation Program/PROWWESS (World Bank, Washington, DC), January 1995.

Wakeman W et al. *Sourcebook for gender issues at the policy level in the water and sanitation sector*. Washington, DC, UNDP/World Bank Water and Sanitation Program, Water Supply and Sanitation Collaborative Council, October 1996.

Promotion through innovation

An important and key requirement for the promotion of sanitation is innovation. This field has lacked innovation, both in promotional techniques and in sanitation technologies. Innovation and the exchange of information about these innovations is greatly needed.

Permanent mechanisms for the exchange of information on innovations need to be established, such as Internet conferencing and websites, professional meetings and associations and a professional scientific journal devoted to sanitation. Some of these mechanisms are beginning to appear.

Contained here are articles on innovative approaches showing success. This part is divided into three sections: ***Child-centred approaches***, ***Participatory approaches***, and ***Innovative technologies***.

The group of articles on ***Innovative technologies*** are included here to familiarize readers with some new (and old) rather unconventional ideas being tried on large and small scales. This section does not address most of the classical sanitation technologies which have been endorsed by different sector organizations over the past decades, for that would be a separate and very large task. Here we are promoting the idea that innovation on all fronts and the sharing of information on these will move sanitation forward. These efforts, however small scale and outside walls of conventional thinking, should be supported because they may offer us alternatives for the future. Technologies of the future should recycle nutrients and prevent water pollution and further water scarcity. Without application of these key principles, we will create increasingly worse environments and greater sanitation problems. The articles should be regarded as promising steps and not necessarily as an endorsement by the World Health Organization or the WSSCC.

Promoting sanitation through children

—*Angela Hayden*[1]

Changing sanitation habits, challenging long-held beliefs or mentioning the unmentionable, calls for promoters who have energy, enthusiasm, commitment and time, and who are open-minded and willing to try something new. These are typical characteristics of children and adolescents.

Children's willingness to change sanitation habits and generate demand for better sanitation systems can provide a basis for successful health education programmes. It has also been recognized that older children often care for younger children and can influence them in changing their habits and beliefs. This has recently led to development of a child-to-child approach to transmitting improved hygiene practices.

This article explores how communities can be motivated to improve their sanitation and hygiene situation and practices through children. The approach seems to offer considerable promise for the sector since it taps an abundant and widespread resource. While not many such experiences have been documented, the case studies that follow from India, the United Republic of Tanzania and South Africa indicate a need to share this promising development as a priority.

What are the advantages of child-centred approaches?

Sustainability

Involving children offer obvious hope for sustainability because as children grow into adults, they will continue to implement improved sanitation practices and will influence their own children and communities to do so.

Another aspect of sustainability is the sheer mass of children potentially ready to carry out a sanitation initiative. In many developing countries, half the population is under 15 years old.

Community involvement

Involving children almost inevitably involves their parents and teachers. Children are present in every community, within every group, and even if their status is low, their energy and enthusiasm are hard to ignore.

Innovation

Changing entrenched beliefs and practices is one of the greatest obstacles sanitation programmes face. Young minds are more open to new ideas. In areas where discussing sanitation is taboo, working through children may be the only way of introducing a community to improved sanitation practices.

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[1] Independent consultant, Geneva,Switzerland.

How could child-centred approaches be implemented?

The following aspects of implemention of child-centred approaches require consideration, along with the necessity of obtaining policy commitment and specifying the results expected from programmes undertaken by children.

Training

Appropriate training is needed for:

— facilitators;

— child promoters; and

— teachers and supervisors.

Training should ensure that improved sanitation and hygiene practices are learned, assimilated, and accepted.

Follow-up

A one-off activity is unlikely to have lasting results. The successful case studies include long-term follow-up, in one instance through training, in the other through repeated house visits. It therefore seems important to ensure that activities are repeated or reinforced over a long period so that changes to sanitation and hygiene practices become firmly established.

Evaluation

Activities should be evaluated periodically, perhaps once a year, for two reasons:

— to make certain that objectives are being attained and, if not, to adjust the project so that it eventually achieves the desired results; and

— to encourage children and adults in the community to continue their efforts by showing that those efforts are helping to improve sanitation, hygiene, and health.

Empowerment

As the case studies demonstrate, sanitation and hygiene promotion can have wider implications in empowering children and communities. Children become leaders and the organizational structures of communities are strengthened.

Content

While promoting appropriate sanitation and hygiene practices, the project itself should embody other development ideals. For example, the project should actively promote gender equity and environmental protection. It must not only build local capacity, but should recognize and reward achievements. In the examples, the project provided prizes, such as school-bags and teaching materials.

Checklist for planners wanting to use a child-centred approach

- Read the case studies which follow and, if necessary, contact the authors for further information.
- Consider how children could be instrumental in improving community sanitation and hygiene, taking into account their social status.
- Contact groups of teachers or parents to test their reaction to possible projects.
- Use other articles to help in designing and implementing your project, in particular, the articles on *Participatory approaches to community empowerment,* and *Social marketing for sanitation programmes,* as well as the more practically-based articles such as the *Checklist for planning better sanitation projects*, the *Checklist for planning hygiene behaviour-change in sanitation projects*, and the *Gender checklist for planning sanitation projects*.

The Bal Sevak programme in India

—*Nandita Kapadia-Kundu and Ashok Dyalchand*[1]

Young community agents of change

Schoolchildren are a valuable community-based resource and can participate actively in improving sanitation systems. This case-study illustrates a number of mechanisms through which children can be mobilized to promote sanitation. It demonstrates the impact that Bal Sevaks (children who serve their communities) have had on handwashing after defecation in a rural area of Maharashtra, India. It describes a process of empowering children, and the community-wide effects of their activities. (See also *Promoting sanitation through children*.)

Project description

The villages of the drought-prone Marathwada area of Maharashtra, India, present a sanitation scenario similar to that of much of the rest of rural India — scant sanitation facilities, deeply-ingrained, inadequate hygiene habits and a low demand for improved sanitation systems. Furthermore, cultural inhibitions prevent village workers from addressing issues such as defecation hygiene because villagers are embarrassed to talk about defecation.

In 1990, the Institute of Health Management, Pachod (IHMP), a grass-roots NGO, faced an unusual dilemma. Although over 75 per cent of the village households where it was working had soap, less than 25 per cent washed their hands with it after defecation. In addition, the Institute's health workers expressed extreme reluctance to address the culturally sensitive defecation issue. This situation required an alternative approach, so the Institute embarked on a child-to-community programme. Children, called "Bal Sevaks" (children who serve their communities) were mobilized to change defecation hygiene behaviours in adults. Bal Sevaks work in pairs; each pair is responsible for 30 households.

The project's objectives were:

— to generate a demand for sanitation facilities in 186 villages in Maharashtra;

— to change hygiene-related defecation behaviours, specifically to increase handwashing with soap or ash after defecation, in these villages in Maharashtra;

— to develop leadership potential in children by establishing children's groups; and

— to encourage community initiatives for environmental cleanliness and sanitation.

Although the programme began with hygiene education, it now addresses sanitation demand, and maintenance and sustained use of latrines, leadership development among children, cleanliness and beautification of the environment.

[1] Institute of Health Management, Pune, India.

The Institute's programme covers a total population of 150 000. The Bal Sevak Programme includes four primary activities:

— house-to-house visits by children;

— establishment of children's groups (*Bal Sanghatans*);

— *Bal Shakti*, a newsletter for rural children; and

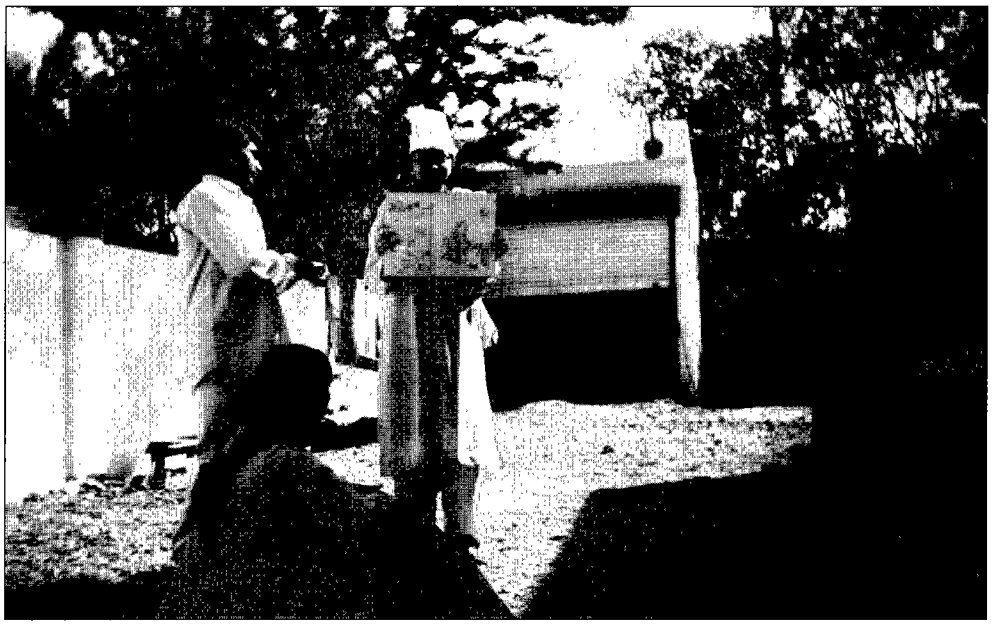
— community organization involving environmental initiatives.

Children participate in the programme as volunteers. As an incentive for their participation, Bal Sevaks are provided with school books.

Bal Sevak house visit.

Home visits by Bal Sevaks

Since Bal Sevaks tackle the difficult challenge of habit-related behaviour change, they employ an intensive, interpersonal, persuasive strategy. A Bal Sevaks pair visits each household twice a month. The younger child (8–10 years old) holds posters as the older child (10–14 years old) speaks. The children focus on a specific number of behaviours as new topics are addressed. The Bal Sevaks also monitor the programme at a household level.



The Bal Sangathans simulate village councils, by which children prepare themselves for future leadership roles.

Monthly in-service meetings are held for the children. The school-teacher supervises the Bal Sevaks at the village level.

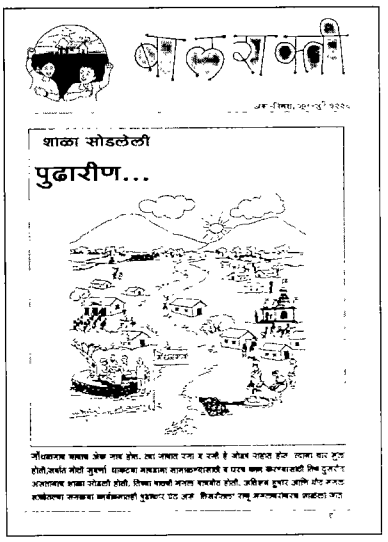
Children's groups (Bal Sangathans)

Children are organized into groups called "Bal Sangathans" that are formulated along the lines of village councils. The village council is the primary body involved in implementing village-level development programmes. Bal Sangathans have been formed in 25 villages. The children elect leaders who are then trained by the IHMP. The Sangathans meet regularly to plan specific village-level activities. By simulating village councils, children prepare themselves for future leadership roles.

Some of the activities and programmes that the Sangathans have undertaken include fund-raising at the village level for a children's park, voluntary labour for cleaning defecation sites and handpump surroundings, and children's parades for disseminating sanitation and health messages. The formation of local street theatre troupes, which began as a spontaneous initiative by one of the village Sangathans, is now being replicated in other programme villages.

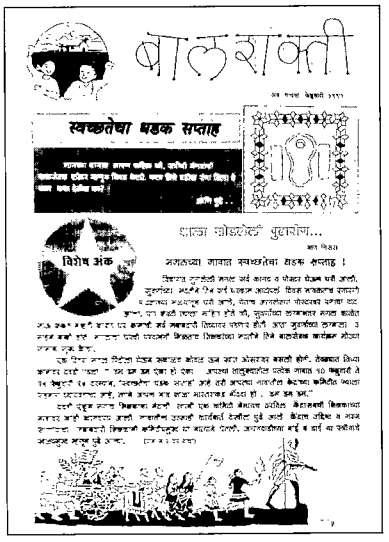
Bal Shakti: children's newsletter on sanitation

Since the Bal Sevak Programme was expanded from 25 to 186 villages, a mechanism was required to keep children and school-teachers updated on programme issues and activities. The IHMP decided to produce a monthly newsletter for children that provides them with reading material outside of their school curriculum. A 1995 survey indicated that 98 per cent of 300 rural school children in the Bal Sevak villages had no access to reading material other than their school books.


बालशक्ती

शाळा सोडलेली

पुढारीण...


बालशक्ती

स्वच्छतेचा मडक सप्ताह

शाळा सोडलेली पुढारीण...

विशेष अंक

Two workshops were held in 1995 with village school-teachers and children to finalize the content, format, and frequency of the newsletter. The children named the newsletter "*Bal Shakti*" (*Bal* means child; *Shakti* means power) and recommended that it be published monthly. An 11-member advisory committee was formed, comprised of village school-teachers, children, and the IHMP representatives.

The newsletter focuses on different aspects of health and sanitation. It is distributed to the 186 villages with one copy for every three households. Recent issues have included articles on selection and training of Bal Sevaks, gender issues, how to conduct a promotional sanitation campaign, and personal hygiene behaviours. The newsletter includes activity sheets.

Organizing the community for environmental initiatives

Intervention with children at household, school, and community level culminates with communities initiating projects the children identify. For example, the initiative of the Bal Sangathan in the Dabrul village resulted in a villager donating land for a recreational park adjacent to the school. The village council followed with a financial donation of 1000 Rupees. This recreational park has been planned as a "garden of learning", with the goals of providing children with play facilities and demonstrating various elements of environmental sanitation.

Children are applying social pressure on adults to demand better sanitation systems and to work towards a cleaner environment. The children's enthusiasm has triggered activities that allow adults to make important sanitation-related decisions and actions at household and community levels. For example, children in the Harshi village wanted to put basalt around the platforms of seven handpumps in their village. They succeeded in persuading farmers to donate two bullock carts for this purpose, even though it was the middle of the peak harvest season.

The Bal Sevak approach rests on the belief that change is most effective when it emanates from the community. This approach demonstrates a productive application of an abundant and energetic human resource, often ignored by programme planners. It ensures sustainability, since it involves working today with tomorrow's adults. The programme promotes equity because the children involved come from the most marginalized families and special priority is given to girls. (See *Paying attention to gender in sanitation programmes.*) Finally, it is rooted in prevention with the goal of breaking the faecal–oral cycle of transmission.

Accomplishments

The programme has had both intended and unintended outcomes. The intended impact has been in the area of hygiene behaviour. The unintended outcome has been the creation of a powerful force in the children themselves. As many Bal Sevaks enter young adulthood, they continue to retain a strong spirit of voluntary cooperation and commitment.

Personal hygiene behaviours

A community-based trial of the Bal Sevak intervention showed that women in the intervention group were four times more likely to wash their hands with soap than women in the non-intervention group, after controlling for literacy, occupation, and age (1).

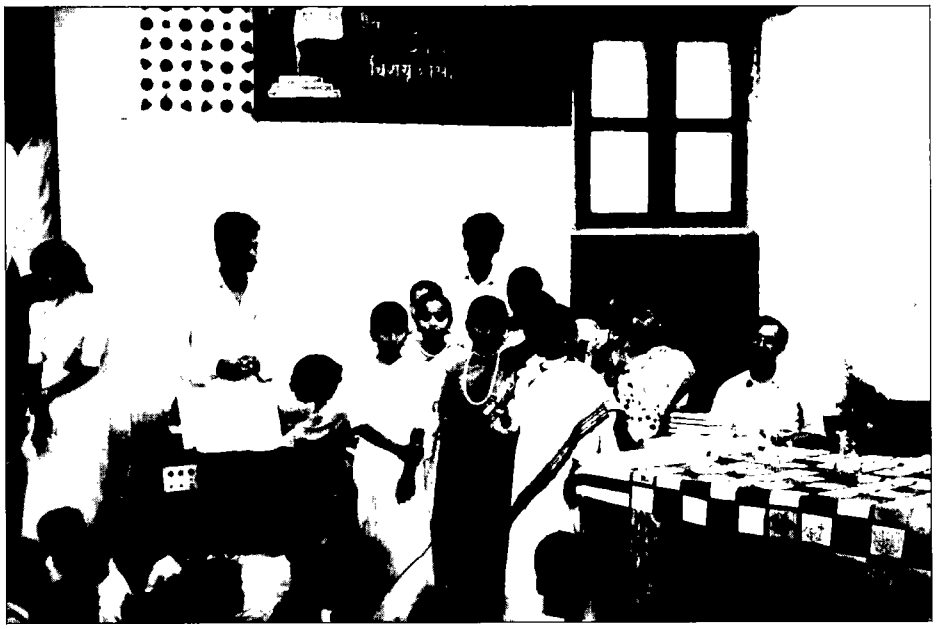
Table 1. Women's soap use by number of reported Bal Sevak visits in past month (N=264)

Number of times women were visited in past month	Number of women	Number of women using soap for handwashing	Per cent using soap
0	91	44	48
1	56	36	64
2	59	42	71
3	39	30	77
4	19	16	84

In 1990, handwashing levels were 25–28 per cent in the intervention and control groups. Three years later, 66 per cent of the respondents reported washing hands with soap or ash in the intervention group, compared to 32 per cent in the control group. Table 1 indicates how soap use increased with the number of Bal Sevak visits in the intervention group.

Gender

An important goal of the programme is to reduce inequities. IHMP believes that encouraging gender sensitivity among children, especially boys, will address a deeply entrenched inequity in Indian society.



The Bal Sevak approach promotes equity because the children come from marginalized families, and special priority is given to girls.

The programme focuses on gender in two main ways: girls are recruited as Bal Sevaks, and the content and visuals of the newsletter promote gender equity. Additionally, a special issue on gender was published recently.

Bal Sevaks leadership development

Some of the Bal Sevaks who participated in the early phase of the programme are now young adults. They are demonstrating a strong inclination to continue their involvement in development work. Many want to continue living in their villages and serving their communities.

An example of this leadership development is demonstrated by Bal Sevak "graduates", who, while still in their teens, started Bal Sevak programmes in neighbouring villages, helped prepare audiovisual materials for a sanitation campaign, and trained Bal Sevaks for the Institute's urban slum programme. Their greatest contribution is in serving as role models for younger children.

Box 1. Should a female Bal Sevak drop out of school to look after a sibling?

Children were asked in one issue of the monthly newsletter, *Bal Shakti*, to complete an unfinished story in which Mangal, an intelligent 10-year-old Bal Sevak girl, is forced to drop out of school to look after a younger sibling. Her brother, Raju, 8 years old, continues going to school. Children were asked to write responses to the question: "Should Mangal drop out of school?"

IHMP received more than 500 letters in response to this query. Most boys who sent letters stated the need for boys to participate more actively in household chores. Here are a few excerpts:

"You're talking about one Mangal, I can show you a hundred such Mangals in our villages. Mangal's brother should help their mother with household chores and take over some of Mangal's household responsibilities. Mangal should go to school."

Amol Vadhane, 12-year-old boy, Panranjangaon village.

"Raju should help Mangal with housework and look after the youngest sibling. Mangal must continue her education."

Mangala Narke, 12-year-old girl, Takli Ambad village.

"In our Maharashtra, girls are deprived of an education, even if they're intelligent; but a boy is given a chance to continue his education, even if he's not. Mangal should continue with her education and fulfil her ambition of becoming a village leader."

Vaidya Bhagwat, 13-year-old boy, Unchegaon village.

Public policy

The Maharashtra government recently appointed IHMP as advisor to a large-scale rural sanitation campaign in four districts of Maharashtra. The government has accepted the premise that children are an optimal medium for reaching people in rural areas.

Difficulties encountered

- Initially, parents were not willing to let their daughters be Bal Sevaks. This was resolved by asking school-teachers to motivate the girls' parents.
- Some Bal Sevaks were teased by village youth. This issue was addressed during an in-service training session. The children were told to report to their teacher or IHMP supervisor if the situation became difficult.
- Despite the children's intervention, some families did not change their handwashing behaviour. One successful alternative strategy was developed by two Bal Sevaks, who delegated the responsibility of persuasion to talkative and influential women.
- The topic of defecation causes embarrassment. The children had to overcome their own embarrassment before approaching their community.
- Establishing a viable and efficient distribution system for the newsletter has been difficult. The same has been true of other audiovisual materials used by Bal Sevaks.
- The frequent transfer of policy-makers at district and state levels created difficulties in influencing policy.

Lessons learned

The key lessons learned from this programme are:

- Children are an abundant, energetic grass-roots resource.
- Children constitute an important pressure group with the potential to propel communities into action.
- Children's groups can be an effective tool for promoting better sanitation systems.
- Children can influence adult hygiene habits.
- Children are effective in applying group pressure on households.
- Change in habit-related hygiene behaviours requires intensive interpersonal contributions.
- To maintain behaviour change, additional contributions need to be incorporated into the programme planning process.
- Children's involvement generates change in two generations.
- The programme hinges on the support received from various community resources, such as village school-teachers and local groups. Sustaining the school-teachers' interest and motivation in the programme is key to its success.
- Community-based participatory approaches are essential for the creation, use, and sustainability of better sanitation systems.

Key institutions and responsible persons

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Reference

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Prepared in association with SARAR Transformación SC.

The HESAWA school health and sanitation package

—*Eben S. Mwasha*[1]

Participation of villagers in their own development is a key factor in the success of any community development project because participation is an essential part of human growth. Communities can be mobilized by the army to dig a trench for their own water supply or build better houses for their families without going through the dynamic process that leads to true community participation. True community participation must be able to release the people's own creative energies for their development.

Sustainability and replicability of community based development projects depends entirely on how well the community participates in the project from the early stages of planning and phasing in to the final stages of evaluation and phasing out. The process of soliciting community participation is long, slow and tedious. Often donors press for quick results and implementers are tempted to take short cuts in order to meet pre-set deadlines. There are no short cuts for soliciting true community participation. It takes time but in the long run this time will be compensated for during the implementation phase because once the community is properly sensitized and mobilized, implementation becomes easier and faster.

The problem based learning (PBL) methodology, on which the HESAWA School Health & Sanitation Package is based, has proved to be a very appropriate way of entering communities to start community based development projects because it presents a dynamic process which enables villages to become more aware of their own situation, of their real health problems, the causes of these problems and the actions that they themselves can take to change their situation. This process of awakening and raising levels of consciousness constitutes a process of self-transformation through which people grow and mature as human beings.

The school health approach has been used in the Sida (Swedish International Development Authority) supported HESAWA (Health through Sanitation and Water) project in the lake zone (Tanzania) and has proved to be a very effective tool for sensitizing and mobilizing communities to participate actively in solving their sanitation related health problems. The package consists of screening school children to identify the main health problems affecting them and calling a parents' meeting to analyse these problems by identifying underlying causes for each problem and agreeing on specific actions that they will take collectively and individually to solve the problems.

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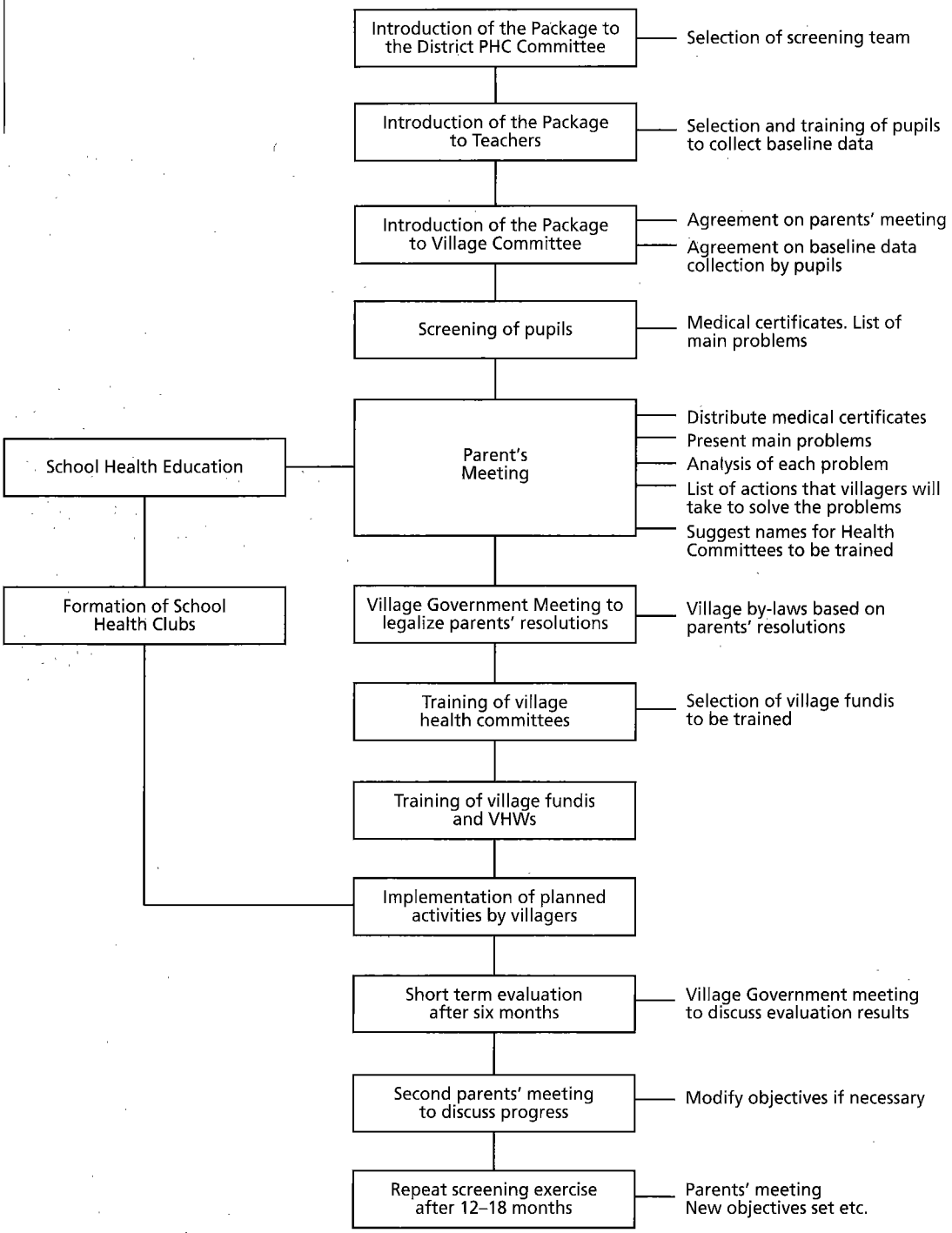
[1] PHC Ambassadors Foundation, Moshi, Tanzania.

Steps for implementing the HESAWA school health and sanitation package



Pre-screening procedure

Stage 1: The chief facilitator organizes a workshop for the district PHC (Primary Health Care) committee to introduce the main concepts contained in the package and solicit intersectoral collaboration. The necessary resources for carrying out this exercise are listed and the feasibility of implementing the package in their district is discussed in great detail. At the end of the meeting the committee selects the screening team that will be taught how to implement the package practically.

Introducing the idea to the teaching staff.

Stage 2: The district health promotion team discusses the idea of screening children with the teaching staff of the selected school, stressing the importance of health education to school children, school health clubs and intersectoral collaboration. The teachers are also introduced to simple forms that will be used by senior pupils to collect environmental sanitation baseline data from their village.

Stage 3: The screening team, together with the head teacher, make an appointment to discuss the program with the local village committee. This meeting should stress the community participation and prevention aspects of the program.

During this meeting the promotion team must explain clearly the importance of the parents' meeting to work out a prevention strategy for their children and the community as a whole. The success of this program will depend, by and large, on the quality of this meeting.

Stage 4: Ask the head teacher to appoint 20–30 intelligent pupils from senior classes and teach them how to fill in the special home visiting forms for collecting baseline information on the current state of latrines, refuse pits, drying racks in the village. Teachers should assist the pupils to collect this information before the actual screening is done.

Prior to the screening exercise, the teachers will record the name, age, sex, class, weight and height of each child on a special form to be provided by the health team. Make an appointment with the head teacher to specify the actual days for implementing the activities in his/her school. Make sure you have the following staff and equipment.

Technical staff (selected by the district PHC committee)

1. Clinician — one medical assistant or RMA
2. Lab technician or a trained microscopist
3. Trained nurse
4. Nursing assistant or health assistant

Non-technical staff (selected by the screening team)

1. For weighing — one person
2. For measuring height — one person
3. For registering — one person
4. For assisting the lab technician — two persons

Equipment

1. One ream of duplicating paper or rough paper
2. Seven marking pens and two rulers
3. Three marking pens to write on slides and test tubes
4. Waterproof brown adhesive tape for marking slides and test tubes
5. Slides — 400
6. Test tubes — 200 (10cc)
7. Spirit 500 mls
8. Cotton wool — one roll
9. Disposable prickers — 600
10. Applicators — 100 (can be made locally)
11. Gloves — six pairs
12. Antiseptic — 100 cc
13. Microscope — one
14. Hand centrifuge — one
15. Filter paper #1 — two pieces
16. Tallqist chart for Hb. estimation
17. Test tube rack for 100 tubes — one
18. Tape measure — one
19. Pair of scissors — one
20. Weighing scale — one

With the above equipment and staff the screening team can examine about 100 to 150 pupils daily for the following:

1. Height
2. Weight
3. Haemoglobin

4. Stool for immediate microscopic examination
5. Urine for immediate microscopic examination
6. Clinical examination which should include answering one or two specific questions, e.g. episodes of diarrhoea in the last month, eating habits, etc.
7. Quick physical examination for obvious clinical abnormalities

Note: The non-technical staff listed in Stage 4 can be teachers from the school, senior pupils, the driver, or existing Village Health Workers (VHWs).

Detailed screening procedure

On the screening day, the teachers should give each of the 100–150 pupils listed for that day a small clinical form (10 x 15 cm) with the pupil's name and serial number on it. Each pupil will then carry this clinical form through the following steps:

Step I : Collection of stool specimens

One day prior to the screening day, the head teacher will ask the first 100–150 children on the roster to bring a small amount of stool specimen in an empty match box. One of the non-technical staff will collect these specimens and label them ready for immediate microscopic examination by the microscopist.

The microscopist/lab technician will record the findings on a separate urine and stool examination form to be handed over to the clinician for compilation at the end of the day.

Step II: Collection of urine specimens

Immediately after receiving a stool specimen the nursing assistant gives a labelled test tube to each pupil and asks him/her to fill it up with his/her own urine. One of the non-technical assistants will centrifuge each urine specimen before handing it over to the laboratory staff for immediate microscopic examination. If a centrifuge is not available, the urine specimen should be allowed to settle for 30 minutes before the sediment or the last drop at the bottom of the test tube is put on a clean slide for microscopic examination. The technician records his/her findings accordingly.

Step III: Haemoglobin estimation

After handing over the urine specimen each pupil moves to the next step where a nurse estimates his/her haemoglobin using the Tallqist method. The nurse records this estimated haemoglobin on the pupil's clinical form.

Step IV: Short history and clinical examination

At Step IV, the clinician takes a short clinical history, conducts a quick clinical examination and records all positive findings on the clinical form. This form remains with the clinician after the examination.

Screening of children

Data analysis and report writing

At the end of the day, the clinician, in collaboration with the other members of the technical staff, completes entering data from the technical staff on the original forms which had partially been filled by the teachers. Examination/interview results from the technical team on stool, urine, Hb, history of diarrhoea, eating habits etc. are added to these forms.

The clinician in charge, in collaboration with the technical staff, will now work on data analysis and report writing for each pupil, as well as for the entire school as a community. The team will identify and list the top five health problems affecting the children. The health team will prepare relevant health learning materials based on these problems to be ready for the parents' meeting which should be held not later than seven days after completing the examinations.

Parents' meeting

Parents' meeting

The parents' meeting is a crucial event in this program. In order to strengthen intersectoral collaboration, key actors from sectors other than the health and education departments should attend this meeting. Ward leaders and village chairpersons from neighbouring villages should also attend.

The first activity during this meeting is to present a written medical report to each parent. This report should list the health problems affecting each child. It should also

state clearly what action the parent should take to solve the child's problem as soon as possible. The health team must see to it that medical ethics are observed when communicating individual reports to parents. The parents whose children have no medical problem should be congratulated and encouraged to maintain their children's good health.

Having done this, the district team, which should include the District Medical Officer (DMO) and other members of the district health promotion team, will go over the top five medical problems affecting the children and discuss them in detail with the parents. Problem Based Learning (PBL) and other learner centred adult teaching techniques should be used. The health team members will act as facilitators rather than lecturers. At the end of this meeting, parents should be able to:

- State the top three to five health problems in the school.
- Describe underlying causes of each problem.
- State/list possible solutions for each problem.
- State what they have agreed to do to solve each problem.

During this meeting, the parents will be facilitated by the health team, under the chairmanship of the village chairman, until they have worked out a detailed plan of action specifying:

- What is going to be done?
- Who is going to do what?
- When it is going to be done?

Selection and training of a village health committee

The parents' meeting should elect a village health committee (VHC) if it does not exist. This new or reinforced committee should consist of about 8–12 people, of which half should be women. The committee should be empowered to deal with all health and sanitation problems in the village. The village chairperson and secretary should be ex-officios in this committee.

Soon after the parents' meeting the overall village government should meet to discuss all parents' resolutions to legalize them while re-enforcing existing village by-laws on sanitation when and if necessary. District and sub-district trainers should organize a six-day seminar for the (VHC) not later than 30 days after the parents' meeting. Recommended are four hours of training three times a week for two weeks. This seminar should cover, among other topics, the following:

1. Detailed health education on the main health problems affecting their children.
2. More detailed plans for implementing the parents' resolutions.
3. The role of Village Health Workers (VHWs) and Village Fundis in implementing their plan of action including recruitment, selection, supervision and motivation of these key workers.
4. Write their own constitution to outline how they will run their affairs.
5. Other program specific concepts like HESAWA concept and gender issues.

Selection and training of village health workers (VHWs)

At the end of the seminar, the VHC should be given two weeks to work with the village government and villagers to select VHWs and Village Fundis for training. Ideally, they should select one VHW/VF for every 50 households. It is recommended that training of the selected VHWs/VF be done within the village by sub-district trainers.

Six hours of training per day, three days a week for three months should be enough to cover the Ministry's syllabus for VHWs.

Training of VHWs

Health education and school health clubs

Organize a workshop for the teachers in the village primary school where the screening was carried out. Two hours a day, two days a week for three weeks running concurrently with VHW training within the village would be ideal.

This workshop should aim at equipping the teachers with the knowledge and skills for implementing an effective health education campaign in the school. It should be based on the health problems found among the pupils. The teachers will be provided with the necessary books and other materials for health education. Pre and post tests will be given to pupils to assess the amount of knowledge transferred to them. AIDS shall be included in the health education curriculum as a special subject for all schools.

Formation of school health clubs can be discussed in detail during this workshop. The following steps will be discussed and adopted:

1. Teachers select 20–30 pupils (from Std V and above) who are always clean and smart.
2. One teacher accompanied by a trainer will visit the homes of each of these 20–30 pupils to certify whether they have a good latrine, refuse pit and drying rack. Those who qualify are then officially declared the founding members of the school health club. Each one is given a school bag, mathematical set, T-shirt or any other incentive that will raise the other children's interest to join the club. The founding members should then elect a chairperson, a secretary and a treasurer. The health teacher or domestic science teacher should be their patron/matron.
3. Each group should establish specific and detailed criteria for joining the club. They will take over the role of inspecting other pupils' personal hygiene and homes for qualification to join the club.
4. The district health promotion team will facilitate and encourage health clubs from different schools in a given ward to compose health songs, stories and short plays, or design posters to educate the public on health and sanitation related problems. The best performers will be rewarded accordingly.

The Health team will also be expected to facilitate health clubs to run mini projects like rabbit farming, vegetable gardens and raised stoves.

Evaluation

The teachers will keep copies of all data related to this program for the purpose of monitoring and evaluation. The district team will conduct KAP studies from time to time to evaluate changes in knowledge, attitude and practices related to school health and environmental sanitation activities in the village as a whole.

As stated earlier, each village will be encouraged to discuss their progress regularly. At the end of each year, the whole exercise will be repeated from Steps 1 through 6. The parents will be congratulated for any improvements achieved during the year and new problems will be dealt with accordingly. This will lead to appropriate modification of their plans of action to be implemented in the following year. This process will be repeated until the villagers are satisfied that the problems in question have been reduced to an acceptable level.

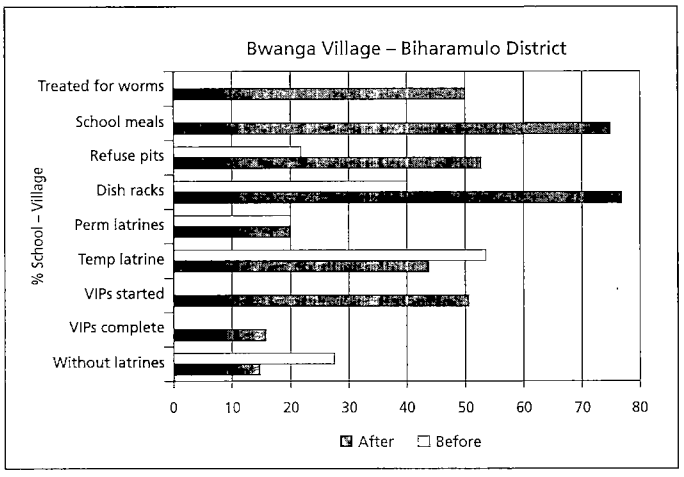
Results from implementation in pilot districts

In 1993 this methodology was tried in three districts in the program area, and the following results were obtained:

- Over 80% attendance at parents' meetings.
- Active participation by all parents during meetings.
- Action oriented meetings — implementation of village action plans effective up to 75% within six months in some villages (see Bwanga results below).
- Villagers were willing to use locally available materials for latrine construction.

In October 1993, the Department of Health Behaviour and Education of AMREF was asked by Sida to evaluate this approach and make recommendations accordingly. AMREF came up with the following main conclusions.

Figure 1. SHP effect on village environmental sanitation



1. The school health package (SHP) has succeeded in creating awareness on environmental sanitation related health problems, their causes and solutions among the target populations.
2. Communities have been motivated to participate actively in implementation of environmental sanitation activities.
3. The school health strategy has made remarkable progress in promotion of the use of available materials and in increasing sanitary facilities (latrines, dish racks, refuse pits and bathrooms). There is a high potential for sustainability of construction of these facilities.

4. The SHP has promoted interaction between government extension workers, teachers and community members in finding solutions to prevalent health problems, especially at the community level.
5. There exists a high potential for replication of environmental sanitation activities promoted through the SHP.
6. To some extent, the SHP has promoted community participation in decision making through parents' meetings.

VIP latrine melam type

The following graphs are extracts from the AMREF evaluation report that was submitted to the Sida/HESAWA annual review mission in November 1993. Based on this report, Sida accepted the HESAWA school health and sanitation package and recommended that this approach be used throughout the HESAWA program area with effect from July 1994.

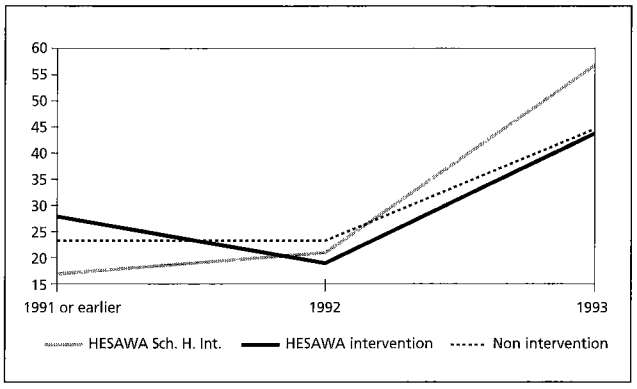


Figure 2. New latrine growth profile

The growth of latrines since 1991 was investigated. Results are shown in Figure 2.

In all the three sites, there is a remarkable growth in the number of new latrines during the year 1992/93. However, the school health intervention villages registered better performance compared to other sites.

Construction and use of new dish racks, refuse pits and bathrooms showed similar growth profiles and the following conclusion was made by AMREF:

"Overall the assessment of the construction of latrines, dish racks, refuse pits and bathrooms shows a better performance in the HESAWA school health intervention villages compared to the control villages. The better performance of the HESAWA school health intervention villages can be attributed to the influence of the problem based learning approach."

A comparison was made on existing facilities in the non intervention villages and villages neighbouring the school health intervention area. The results are shown in Figure 3 overleaf.

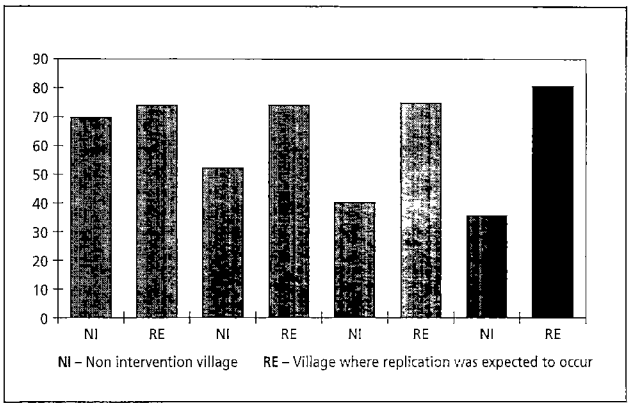


Figure 3. Level of replication of sanitary facilities

As shown on the graph, the villages neighbouring the school health intervention areas (RE) have performed much better than the non intervention areas.

Children as health and hygiene promoters in South Africa

—Edward D. Breslin[1], Carlos Madrid[2] and Anderson Mkhize[3]

The importance of hygiene and health promotion in maximizing the impact of water supply and sanitation interventions is well known. These are also commonly recognized as the most difficult programmes to plan and implement. In practice, health and hygiene promotion is often uninspired and underfunded add-on to water supply and sanitation programmes. Most health/hygiene programmes are targeted at adults or formal health care sector personnel and emphasize the one-way communication of pre-fabricated hygiene information and practices. Mothers, fathers, care-givers, doctors, and community health workers are then responsible for transferring the acquired health/hygiene knowledge and modifying inappropriate practices at the household and community level.

The growing child-to-child movement has begun to challenge the notion that adults and formal health sector personnel are the only, or even the best, promoters of behaviour change and better health within the household and broader community.

The potential benefits and advantages of the child-to-child approach are many. First, children are unusually candid about hygiene-related beliefs and practices. They often identify critical gaps in the transmission and enforcement of health/hygiene messages from the "educator" to the adult and into the household.

Second, children are stable members of households with relatively plentiful supplies of free time and energy. In contrast, adults who have been "trained" are often not home while they search for work or complete other household tasks.

Third, children's behaviour is often unaffected by promotional campaigns targeted at adults. It is not uncommon for children to be excluded from hygiene facilities or discussions on hygiene practices. These problems are compounded by confusion over who within the household or broader community is responsible for teaching children about health and hygiene issues. For instance, it is not always clear who is specifically responsible for teaching children to use a toilet (mother, father, grandparents, teacher) and what to do when that particular person is absent from the household/community for long periods of time.

Fourth, peer groups and peer pressure for acceptance often have a far greater influence on child behaviour and attitudes than adult – child interactions.

In addition (perhaps because of preconceptions about differences in how adults and children learn), child-to-child programmes tend to be much more interactive. Children are not simply lectured on appropriate behaviours but rather encouraged to act upon these messages at school and within the home. Broad experience shows that practices

[1] Mvula Trust, Johannesburg, South Africa.

[2] Operation Hunger, South Africa.

[3] Operation Hunger, South Africa.

that are familiarised and repeated over a long period of time (and in many respects monitored) within school have a better chance of being applied at home than promotional campaigns where the gap between the training course and the home is often great. Children also take on the initiative as a project, which breaks the monotony of school and creates a greater sense of self-respect and control over the process.

Finally, it seems likely that health/hygiene practices learnt at an early age will have a beneficial impact on future household health as these children become parents.

This article describes a child-to-child programme that is being implemented in Maputuland, KwaZulu/Natal by Operation Hunger, a South African NGO providing sanitation support in the area (1). The programme emerged as staff realised that previous hygiene initiatives were having very little impact on behaviour within the household or at local schools.

Learning from Children

Operation Hunger initiated the programme at the Mabadleni High School with Standard 9 pupils. The students indicated that they wanted to initially explore issues of handwashing, but the initiative expanded to address the problems of the safe disposal of infant and toddler faeces as well.

A modified version of the game snakes and ladders as well as other SARAR methods (2) was used to establish the framework for the programme. The strategy was to first identify the reasons why handwashing and the safe disposal of infant and toddler faeces was not occurring, and then develop a plan of action to address at least one aspect of the problem.

Despite showing a good awareness of why handwashing is important (germs, the transmission of germs from hand to mouth, or hand to food to siblings' mouth) the children argued that people do not really wash their hands after using the toilet. As the programme developed, it became clear that people in the area do not wash their hands for both structural and social reasons. According to children at the school these included:

— limited knowledge within the community on why handwashing is important;

— water shortages in the area mean that there is not enough water for handwashing;

— people are uncivilised;

— people do not see handwashing as important for health;

— people think hands are clean (germs not visible); and

— while people have been told of the linkage between handwashing and disease, many do not believe there is a direct link.

Children debated many of the points raised above, particularly over the issues of being uncivilised and lacking adequate water. As one child said, "do you think I am uncivilised because I do not wash my hands? If so, then we are all uncivilised because none of us wash our hands after relieving ourselves." This discussion highlights a gap between widely-held knowledge (handwashing is recommended) and prevailing attitudes (handwashing is not truly valued) which will have to be overcome for this project to be successful.

Children also discussed the disposal of infant and toddler faeces.[4] At first, children

[4] In Kwa-Jobe, toddlers are encouraged to use a toilet when they reach the age of 4, which is unusually young when compared with other parts of the country where children often do not use toilets until they reach the age of 6 years.

concentrated on a structural issue — the toilet holes are too large and children will be afraid. This is a common claim and often leads to strategies to make child-friendly toilets with small holes. However, when the issue was explored in more depth, it was found that this problem masked an additional obstacle to changing practices in the area: people do not believe infant and toddler faeces are harmful. And as a result, people do not believe infant and toddlers' faeces needs to be covered or disposed of safely (3). User-friendly child toilets will therefore not have a dramatic impact on child use unless this belief is countered.

Children Take Charge

Children in Standard 9 developed a series of strategies designed to combat the problems identified above. To begin with, they committed to promoting proper hand washing within the school. As a first step, they designed signs which were placed at all toilets reminding students to wash their hands after using the sanitation facilities. Secondly, Operation Hunger committed to purchasing a basin, towel and introductory supply of soap for each toilet within the school compound. Children would have to ensure that the basins had water in them and would resupply soap or ash once the original supply was used. Children would also monitor whether the basins were being used by all the children and teachers at the school.

From this, a number of additional interventions are being considered or will be implemented shortly. First, Operation Hunger has committed to constructing additional toilets at the school. Children will be involved in the construction of the toilets so that they can better promote VIP systems at home and at other schools. Second, Operation Hunger will conduct a hydrological survey at the school to determine whether a handpump can be installed to reduce the burden of collecting water for hand washing. The children will have to manage, maintain and repair the water system as part of a school project.

Third, students committed to conducting a similar exercise at other village schools so that the message and programme can spread from Mabadleni High School. Operation Hunger will only play a support role to this process and monitor the messages conveyed. The organization has also committed itself to providing hand washing materials (basin, towel and introductory supply of soap), assisting the children to construct additional toilets, and if feasible, water systems at the schools where students to outreach education.

Finally, children have committed to bring home messages about hand washing, the importance of proper sanitation facilities and the need to safely dispose of infant and toddler faeces.

The next step is for Operation Hunger to begin measuring the impact of the children's efforts by determining (through observation, qualitative and quantitative surveys) whether:

— households have hand washing materials (basin, towel, soap/ash and water) readily available (and perhaps exclusively available);

— children from other schools become part of the initiative;

— children and toddlers can demonstrate proper hand washing;

— infant and toddler faeces are covered or disposed of properly;

— there is an increase in applications for toilets in the village; and

— whether household members can verify whether the points listed above were the direct result of their child's influence.

Methods for including children (as well as community health workers) in monitoring this programme will have to be explored.

Conclusions

Although still in its infancy, the child-to-child programme emanating out of Mabadleni High School offers practitioners an alternative approach to conventional health/hygiene promotion strategies. The potential capacity of children to actively promote, health/hygiene campaigns is significant and under-exploited. They can complement health/hygiene efforts originating in the formal health care sector, and may often have a greater influence on other children's behaviour than programmes where the main facilitators are adults.

There may also be indirect benefits to the school. In addition to infrastructural developments such as new toilets, hand washing facilities and water systems, students who have proven their capacity to manage and promote a project which they developed may take a greater interest in school itself.

Operation Hunger must also continue to develop its capacity to support children's educational efforts. Messages communicated through children are unlikely to be universally accepted by adults unless they are reinforced through other channels. In addition, support for children's programmes must be offered in such a way that children see it as constructive and supportive rather than stifling and controlling.

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Promoting sanitation through community participation in Bolivia

—*Betty Soto T.*[1]

The Bolivian YACUPAJ project engages men and women in scattered Bolivian highland communities in the process of choosing technologies appropriate to their sanitation needs and economic capacity. The technical component of the project is matched by a strong hygiene and environmental sanitation education programme, sensitive to the cultural characteristics of the region. In helping communities decide their own development needs, implement the project, and acquire new skills, it assures the long-term sustainability of services.

A demand-driven, decision-making approach that works

The YACUPAJ basic sanitation project for scattered rural populations uses a demand-driven, decision-making approach that permits both men and women to identify technical options and select service levels according to their water and sanitation needs and economic capacity. Technical choices are made within the framework of nationally developed and tested appropriate technologies. The implementation strategy, including a community development component, allows for different participatory tools to be used and true community participation to take place. The specific contents of the hygiene and environmental sanitation education programme are inspired by the cultural and economic characteristics of the region.

Project objectives

- To improve the economic and health conditions of the inhabitants of widely scattered communities in the highlands of Bolivia, by providing potable water, sanitation, and sanitary education — with special consideration given to sustainable strategies, appropriate technology, and the active participation of women.
- To assist the Government of Bolivia in developing strategies for supplying sustainable water and sanitation services to the scattered, rural highland population. This should serve as a foundation for designing sector policy and large-scale investment programmes.
- To help the department of Potosí develop its capacity to plan and implement water supply and sanitation services, by preparing plans for three provinces and implementing model projects that will benefit some 75 000 people.

Project description

The YACUPAJ project was initiated in 1990 in response to deficient water and sanitation services in the rural areas of Bolivia. Conditions included the following:

[1] Community Development Advisor, YACUPAJ Project, UNDP-World Bank Water and Sanitation Program.

— weak sector institutions, including an absence of sector and funding policy;

— lack of coordination between donor agencies and investment funds;

— excessive focus on the technical aspects of water and sanitation projects;

— limited consideration of service sustainability; and

— limited coverage of water and sanitation services (24 per cent and 17 per cent, respectively) in rural areas where 42 per cent of the country's population lives.

Project site

YACUPAJ was implemented in the department of Potosí, located in the southeastern Bolivian highlands. Potosí comprises about 10 per cent of the country's total population, with a higher ratio of rural population (66 per cent) than the national average. The department is one of the most economically depressed in the country, with annual per capita income of US$ 434, life expectancy of 52 years, infant mortality of 118 per 1000, a 38 per cent illiteracy rate, and a 96 per cent migratory rate.

Eligibility criteria for community participation in the project included:

— villages with a population of 50 to 250 inhabitants;

— request generated by the community itself; and

— technical viability for service provision.

If accepted into the programme, beneficiaries were expected to abide by the project's funding policy and take responsibility for operating and maintaining the services long-term.

Project strategy

The YACUPAJ programme strategy was based on the following elements.

Community management. Community members played a key role in managing the entire process. To assure sustainability, they were expected to define their own needs and identify the level of their participation and the type of project they were willing to work for and contribute to financially.

Involvement of women. The active participation of women in each stage of the project was ensured.

Appropriate technology. Facilities were simple, low-cost, and easily maintained by users.

Latrine construction. Household latrines were constructed by family or community personnel.

Community contribution towards investment costs. This facilitated local ownership of the programme and reduced state subsidies.

Hygiene and sanitation education and training. This key activity ensured the effective and sustained use of services.

Strengthening of local resources. State and private institutions remained involved after the project was concluded, to ensure sustainability.

The YACUPAJ project was implemented from 1991 to 1994 at a total cost of US$ 2.8 million. The main funder was the Dutch Government.

The project operated in over 520 communities, training rural teachers, health workers,

and water system operators (for examples of training material used in the project see Figure 1). Water systems and basic sanitation services were installed, providing basic sanitation facilities for 30 000 and drinking water to over 31 000. (See Table 1 overleaf for the stages of the project's implementation strategy.)

To reduce costs and ensure user maintenance, the project promoted technologies that were within the financial and technical means of the community. Technical options were chosen according to the physical and hydrological conditions of the area, including community distribution and distance between houses. The types of latrines built were:

— VIP;

— water seal; and

— double alternating pit.

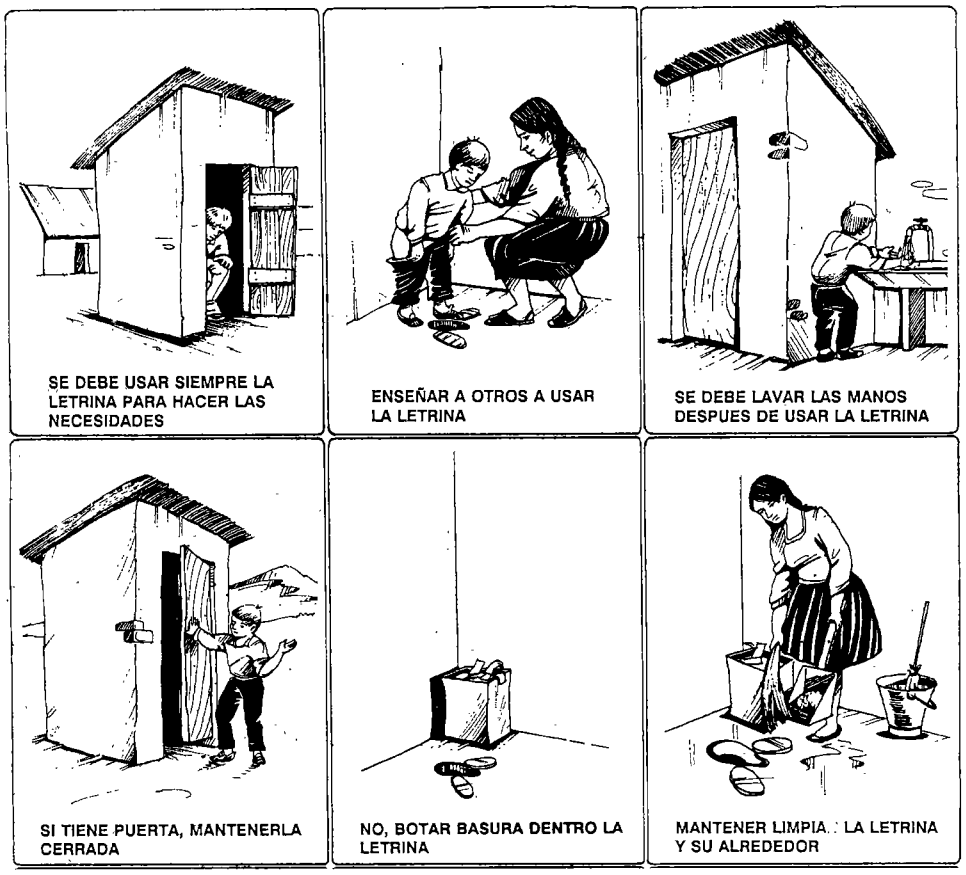


***Figure 1. Rules for correctly using a latrine* — Reglas para buen uso de letrinas**

Training methodology

The SARAR non-formal education and training methodology was followed in the project. The methodology was a critical element for stimulating the communities' capacity to make decisions, plan, create, organize, express ideas, and take collective responsibility. The process fully respected the communities' cultural, social, and economic characteristics.

The approach clearly demonstrated that participatory methods and tools should be carefully selected, with a clear understanding of the expected results. The SARAR

Table 1. Project implementation strategy at the community level

Duration	Stages	Activities/Materials used/Objective
1 month	Assessment of target communities	Potential communities are identified
1 month	Project promotion	Communities receive information about the project, including scope and funding policy
	Community self-diagnosis	Initial contact is made through the following SARAR[1] participatory activities: • **Community mapping** — population, distribution of houses, etc. • **Water sources/water uses** — identification of community water sources • **Customs and habits** — related to disposal of excreta and garbage • **Unserialized posters** — creating awareness of predominant customs and problems • **Healthy child/sick child** — identifying causes of sickness in children under five years of age
1–2 months	Generation of a demand for sanitation	• Variety of model latrines constructed in centrally located communities and in schools and health centres. • Masons trained as sanitation promoters during construction process
		Reflection and analysis on the problem of excreta disposal: • **Contamination cycle** — identification of excreta contamination routes • **"Tom Cat"** slides — recognition of the need for a place for sanitary disposal of excreta • **Three-pile sorting** — analysis of diarrhoea-related diseases and excreta contamination routes (especially effective in schools) • **Faecal–oral cycle** — recognition of the importance of clean hands and basic hygiene • **"Higinia"** — focus on total community development
	Communities request participation	Communities request the project to improve their sanitation systems
1 month	Technical and social feasibility	Technical and social base-line information is gathered
	Presentation of different sanitation technical options and service levels	• **Flip chart** demonstrates different technical options (including advantages and disadvantages) for family, multi-family, and school facilities • Cash and in-kind contributions are defined
	Latrine selection	Latrine is constructed by family or community, with support of trained masons and advice from project personnel
1 month	Operation and maintenance of latrines	Effective and hygienic use of latrines is reinforced: • **Healthy latrine/sick latrine** • Posters in schools with guidelines for latrine care • Booklets and pamphlets on cholera
	Follow-up and evaluation	Provincial teams provide ongoing follow-up and evaluation

[1] SARAR participatory methodology: Self-esteem, Associative strengths, Resourcefulness, Action-planning, Responsibility for follow through.

methodology assisted the communities in determining their own development priorities, implementing the project, and acquiring new skills for effective use and sustainability of the services.

Rural teachers, nurse aides, and extension personnel participated in designing visual, audiovisual, and written materials that were thoroughly field-tested with the communities.

The methodology:

— facilitated a participatory process for reflection, analysis, and information-sharing with groups of illiterate women in 85 per cent of the communities;

— encouraged schoolchildren to participate in the process and to share information in new ways;

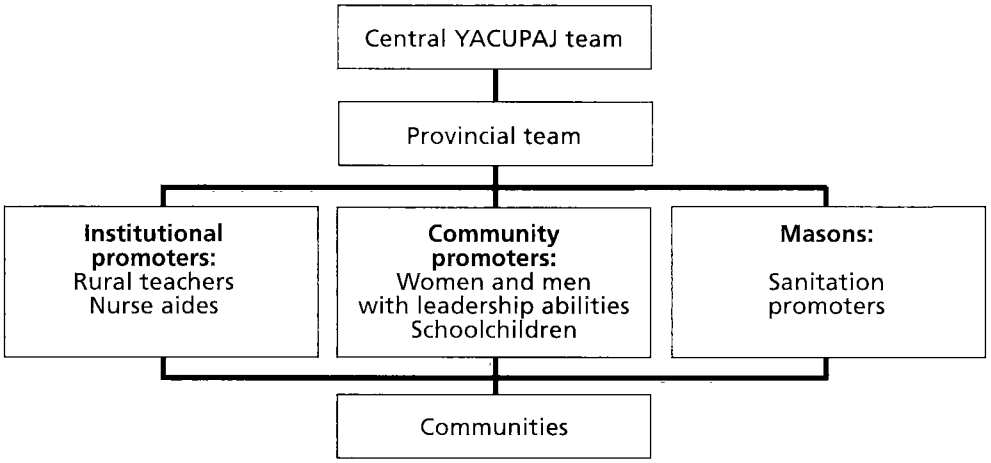
— stimulated rural teachers to use innovative methods and participatory tools in the classroom; and

— facilitated the training of health care workers in health, hygiene, and sanitation.

Training process

The structure of the training programme is summarized in the table below.

Table 2. Structure of the training programme



The central project teams provided training and ongoing support to provincial teams, which in turn worked closely with promoters in replicating the process in the communities.

Achievements

- Even though the project worked with the poorest people in the country, more than 50 per cent of the funding was provided by the communities, including 30 per cent of the cost of non-local materials.
- Within their economic means, communities selected the best technical option and service level for covering their sanitation needs.
- Demand for latrines surpassed programme expectations.

- 596 community operators were trained, including training in the sanitation component.
- More than 4200 community development activities were implemented, with over 125 000 persons participating — 35 per cent women, 43 per cent men, and 22 per cent children.
- A sustainability study in 1995 showed that 82 per cent of the latrines were still in use.
- Sixty per cent of the families perform regular maintenance tasks — cleaning the slab periodically and disposing of paper used for anal cleansing.
- Showers and washbasins have been installed in 40 per cent of water seal latrine facilities.
- Trained masons continue to build latrines with direct responsibility to client families and no need of external support.
- A notable change of attitude relating to latrine use has taken place.

Difficulties encountered

- Some technical personnel were reluctant to explore a participatory approach.
  This was resolved experientially, by encouraging them to be on-site trainers at the community level.
- There was resistance to changing the predominantly technical, and conventional approach to implementing sector projects.
  This was overcome when preliminary results of project performance indicated a clear advantage over projects with a strictly technical focus.
- In some male-dominated communities, women's participation was not permitted — even in meetings of an informative nature.
  Information was given first to groups of men, initiating demand-generating processes. Later, the importance of sharing this information with women became evident, considering their primary role and responsibility for family health care.
- Women were resistant to attitude and behaviour changes, because of deeply-rooted traditional beliefs revealed in the following comments: "No personal hygiene or hair combing! The extent of dirt crusts on the body is a sign of a person's wealth. There is fear of losing identity, of ceasing to be what we have always been. Cattle may be lost — or loved ones' lives."

  Health and hygiene training was begun with children and young women. Although adult and elderly women took part in the sessions, they were not influenced in the same manner as the young people.
- Elderly women rejected the use of VIP latrines. They believe the hole represents a permanent opening in the "Venerable mother earth, to whom we owe respect and must not keep open, because she becomes angry and makes women sick, blowing into their natural opening (vagina)."

  The use of the VIP latrine was promoted among younger women and children, with good results, proving that latrine use does not cause common female illnesses.

  Also, women were provided with information about these illnesses and how to prevent them.

Lessons learned

General

- Poor beneficiaries are willing to choose and pay for sanitation services.

Training process

- Training processes are most effective when they empower people to learn to do things for themselves.
- The best training strategy focuses on enabling people to eliminate the obstacles that prevent sanitation facilities from producing health benefits.

Human resource capacity-building

- The implementation team must be multidisciplinary, because success depends on the synergy of different specialties.
- Extension workers or fieldworkers must recognize and accept indigenous campesino knowledge, forms of organization, authority structures, and decision-making processes. They must acknowledge that campesinos are acting on their own territory, within the context of their economic situation and family life.

Community development

- Sustainable development cannot be achieved by imposing technology. Local choice, management, control, and responsibility imply the freedom to make one's own mistakes. When the community takes the initiative, this freedom exists, and there is potential for building something greater than just water or sanitation facilities.
- Community self-financing is at the core of community management and is the fundamental element for developing a sense of ownership.
- The community's assimilation rate is different from the physical implementation schedule; the time designated for training should reflect this situation.
- The training and community participation plan should take into account that a high percentage of campesino women are illiterate.

Future plans

The YACUPAJ project was designed as a demonstration project to test service provision strategies for the widely scattered rural population of Bolivia and to use this experience to prepare a nationwide programme. YACUPAJ highlighted innovative ideas: in terms of cost-efficiency, demand-based investment, government cooperation, use of intermediaries, women's participation, and hygiene education. By creating awareness of these ideas among sector personnel, YACUPAJ helped create the foundation for developing national policy.

The YACUPAJ project results have been essential for preparing the IDA-financed Basic Rural Sanitation Project — PROSABAR, whose preparatory phase began in 1993 and nationwide implementation in 1995.

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Strengthening a rural sanitation programme using participatory methods in Uganda

—*John Odolon*[1]

The Rural Water and Sanitation (RUWASA) Project (Phase I) of the Ugandan Government was started in January 1991 with the aim of improving the standard of living of various rural populations by reducing diseases related to unsafe water and poor sanitation.

Specific objectives included the following:

— to provide protected water sources and hygienic sanitation facilities to the population in the project area; and

— carry out information, education, and training activities for both project-level staff and users aimed at adoption improved hygiene behaviour.

Problems faced by the RUWASA Project in 1993

In 1993, the findings of the Joint Review Mission,[2] project monitoring reports and studies, as well as observations by project visitors, indicated that the efforts of social mobilizers (health assistants and community development assistants) were not bringing about the desired behaviour, especially at the level of the water-user committees (WUC). In particular:

- WUC members could not easily identify who was using their water source.
- Precise details of the sanitation situation of the water users were not known.
- There was a tendency for the community to rely heavily on external support (from health workers, RUWASA or NGOs) to identify and provide interventions for sanitation and hygiene problems.
- There was hardly any evidence of extensive practice of hygienic behaviour, for example, handwashing, after latrine use.

So what was the problem? Partners' participation at household and community level had been limited to providing cheap labour and available materials. It was assumed that, having been duly instructed on their roles, the WUC would ensure water source maintenance and the practice of hygienic behaviour.

A closer look at the mobilization and training techniques revealed that the approach did not adequately equip the mobilizers with the necessary skills to bring about participation or a sense of ownership at community level. The training methodology was

[1] Network for Water and Sanitation (NETWAS), Entebbe, Uganda.

[2] The RUWASA Joint Review Mission, an independent body that does not include project staff, is part of the project's monitoring and evaluation mechanism. Membership includes: Ministry of Health (Departments of Environmental Health and Health Education), Ministry of Gender and Community Development, Ministry of Finance/Planning, Consultants (Engineers and Socio-Economists), and DANIDA.

mainly didactic, interspersed with classroom-based discussions, role playing and video shows on operation and maintenance. The result was that the WUCs had little contact with the realities of hygiene, sanitation, and the water use and behaviour around them.

Response to the problems identified

On the recommendation of the Joint Review Mission, and in collaboration with WHO and with SARAR training experts from the UNDP/World Bank Regional Water and Sanitation Group in Nairobi, the project undertook to develop and try out PHAST participatory tools. A *Guide for training water user committees using participatory tools* was developed to assist the social mobilizers in their training activities. A pilot project was carried out in Mukono District, and on the strength of its success, the participatory training methodology was extended to cover the other districts where RUWASA was active. The subjects covered included community map-building, hygiene education, WUC responsibilities, and evaluation. The designed training was not limited to hygiene education and sanitation. The tools used were:

— mapping;

— sanitation ladder;

— poster and picture activities for discussion of faecal routes and barriers;

— gender task analysis;

— story with a gap; and

— other planning exercises.

(See Table 1 for more detailed description of the tools.)

Results of using the PHAST participatory approach

The principal benefits of using the PHAST participatory methodology were that the WUC and other community members actively participated in discussions related to sanitation, hygiene behaviour, water source maintenance, gender, and planning. The use of pictorial illustrations facilitated and generated discussion. This was a positive departure from the previous didactic approach.

The community members demanded the tools so that they too could train others. This reflected a feeling of empowerment: community members wanted to take charge of project activities themselves. It also showed that the tools were easy to understand and use at grass-roots level. Lessons learned included:

- The methodology is user-friendly.
- The methodology is interesting, provokes discussion, and brings out real-life experiences that cannot be brought out using traditional training methods.
- The approach is learner-centred, empowering the learner to think, and to identify and address (find solutions to) problem situations.
- The methodology eases work on the side of the trainer–facilitator.
- The methodology can be used in a structured manner, as in the RUWASA Project, or in a non-structured manner (e.g. Water Aid and KUPP use informal community members who are trained to train other community members).
- Training is continuous at the community level.

Table 1. Description of participatory tools

Tool	Description
Mapping	Group participants use whatever materials are available to them to create a map of their community showing its water-supply sources and sanitation facilities. This helps communities to visualize their overall situation. The simplest method is to use a stick to draw in the earth. If paper is available to the group, it can draw on this and stick cloth, feathers, beads, and seeds, etc. to it, for the purposes of illustration. The group then uses this map as a discussion point to look more deeply into the water and sanitation issues that the community is facing. This activity is an investigative one and helps the group to identify important issues.
Sanitation ladder	This uses a set of pictures or photos of different sanitation options. Participants arrange these on a scale from worst to best, like steps on a ladder. They identify their own situation and look at the merits and feasibility of moving up the scale (ladder).
Poster and picture activities for discussion of faecal routes and barriers	This activity starts with a set of posters–pictures showing different ways in which faecal–oral contamination can occur. Participants organize these pictures based on what they know about diarrhoeal disease transmission. The second part of the activity involves working out how these transmission routes can be blocked. To help with this part, participants are provided with pictures of common "barriers" (both technological and behavioural) that can be used to block any of the transmission routes of faecal–oral disease. The "barriers" are then looked at and classified according to their effectiveness and practicality.
Gender task analysis	This activity involves group participants sorting a set of pictures which depict normal household and community tasks on the basis of who would normally perform them: a man, a woman, or a man and woman jointly. This activity enables the group to objectively assess the way tasks are distributed by gender. It highlights any disproportion between the tasks done by men and those done by women.
Story with a gap	Members of the group use two pictures, one showing a "before" scene (a problem situation) and the other showing an "after" scene (a greatly improved situation or the problem's solution). The group uses these two pictures to stimulate discussion on the steps that would have been involved in moving from the "before" situation to the "after" situation. In this way, they fill in the "gap" in the story. This is a useful planning tool for group participants because it helps to simplify the planning process by breaking it down into a series of steps.
Three-pile sorting	Participants sort pictures or photos of hygiene- and sanitation-related situations, according to whether they are considered "good", "bad" or "in-between".

Assessment of the tools used

Table 2 overleaf shows the tools that were pretested and adapted by the project, and the experience of their use.

Outcomes of the RUWASA Project

To closely monitor the effect of using the PHAST participatory methodology for training at the grass-roots level, the mobilization and training units of the project followed up 19 WUCs in three different subcounties of Ikumbya (Iganga District), Bussede (Jinja District), and Kauga (Mukono District). A checklist of indicators of good WUC performance was drawn up as follows:

— proper record of water source users;

— existence of operation and maintenance funds, collection and use;

Table 2. Pretested tools adapted by the project

Tool	Experiences
Unserialized posters, photo parade	Easy to use as starters
Community mapping	Very good for establishing base-line — sanitation, infrastructure, etc.
Sanitation ladder	Easily understood and used; also establishes sanitation base-line
Faecal routes	Useful to start off a hygiene education discussion
Faecal barriers	Enables community members to think of solutions to hygiene problems that are within reach
Gender task analysis	Evokes lively discussion, which is difficult to halt; brings to light gender roles and distribution; ice breaker
Story with a gap	Eases planning discussions
Three-pile sorting	Useful for hygiene behaviour discussion
Health case study	Not much used
Roles and responsibility chart	Has been applied with success in RUWASA area by mobilizers

— existence of caretakers (for preventive maintenance and hygiene education);

— good general condition of the water sources (fencing, cut grass, soakaway, drains); and

— hygiene education activities (e.g. production of posters on hygiene).

The following observations were made:

— 79 per cent of WUCs had updated lists of water source users;

— 64 per cent of WUCs had collected and were using operation and maintenance funds to pay handpump mechanics, and buy grease and spares;

— 71 per cent of WUCs had proper records related to using operation and maintenance funds;

— 100 per cent of caretakers had spanners and were carrying out preventative maintenance;

— 15 per cent of the WUCs remunerated their caretakers with Shs 800–2000 (US$ 0.90–2.10);

— 100 per cent of WUCs had hygiene and sanitation messages embedded in their by-laws (for example, stipulation of use of clean utensils for collecting water) but there was no indication of direct intervention, such as meetings on hygienic behaviour; and

— 5 per cent of WUCs had an updated list of latrine and sanplat coverage of its water users as a basis for follow-up on sanitation activities.

A total of 18 homes of water users were visited. Of these, latrine coverage was 89 per cent: 72 per cent of the latrines were hygienic (clean floor with sanplats), and 6 per cent had a hand-washing facility. The availability of these data contrasted sharply with the previous situation when it was difficult to obtain accurate information at the WUC committee level.

Acceptance of participatory approaches at institutional level

So far, the acceptance and use of the PHAST participatory methodology has largely been limited to water and sanitation projects. At policy level (ministries or agency headquarters), the Ugandan Ministry of Health supports the Uganda Community Based Health Care Association, which uses a lot of PRA approaches, although support is still very limited. The methodology is sometimes thought to be time-wasting! Training institutions, such as the Nzamisi School of Social Development and the School of Hygiene, Mbale, have embraced this methodology, especially for the practical training of students in the field.

Generally, decision-makers exposed to the methodology have shown serious interest and implicitly supported its use.

Acceptance at the community level

The communities appreciate use of the PHAST approach during training. In the RUWASA Project area, WUC members have requested PHAST tools because they would like to use them to mobilize other community members! They have been spurred into action.

Reactions of other community members

- There is full community participation in discussion, irrespective of gender, social status or educational levels.
- Communities have recommended the use of PHAST for all training activities and that everyone should be trained using this approach.
- The participation in training is consistent throughout the period.
- During community-level meetings, tasks are allocated and sanctions agreed on for non-performance.
- Some behaviour changes have been observed, including handwashing.
- The general level of cleanliness has improved.

Constraints experienced

- Supervisors and policy-makers not exposed to the methodologies have shown a lack of support.
- Tools have not been durable enough, although lamination has been tried out with some success.
- Artists who draw pictures for the participatory tools are not always available and need training when present.
- Producing materials on a small scale is expensive.
- Training costs may be prohibitive, since a full-scale workshop requires about 10 working days.
- The participatory approach is time-consuming.

Conclusion

The RUWASA Project experience has largely consisted of re-activation of the roles of WUC committees, extension workers, and their supervisors.

Over the last two years, PHAST participatory techniques, based on the SARAR methodology, have been successfully tried out, to bring about community-level transformation of hygiene practices related to sanitation, and water collection, storage, and use.

Information on participatory approaches can also be found in the following articles: *Participatory approaches to hygiene behaviour-change and sanitation*, *The PHAST initiative*, and *Using participatory methods to promote sanitation in Bolivia*.

Background reading

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Towards an ecological approach to sanitation

—*Uno Winblad*[1]

Many of us have a bathroom; we turn a tap and get water, we flush the toilet and get rid of whatever we have put there. We take these facilities for granted. But most people in the world have no piped water in the house and many (WHO estimates nearly 3000 million) lack even the most basic sanitation (1).

There is a need for a paradigm shift away from the present non-ecological, "flush-and-discharge" approach, to a holistic approach, taking into account that sanitation is a system where the environment is an important component. To meet the requirement for ecological sanitation we must have ecological toilets. This article presents a tentative list of criteria for ecological sanitation systems and gives examples of ecological toilets from around the world. The basic theme of this article is: Don't mix!

Definition

"Sanitation" is a better term that "toilets". A flush toilet is basically a machine for mixing human urine, faeces and water. Sanitation, on the other hand, is a system. The main components of that system are nature, society, process and device (Figure 1).

When discussing sanitation, and particularly sanitation in relation to the environment, we have to consider all these components. We cannot afford to neglect any one of them.

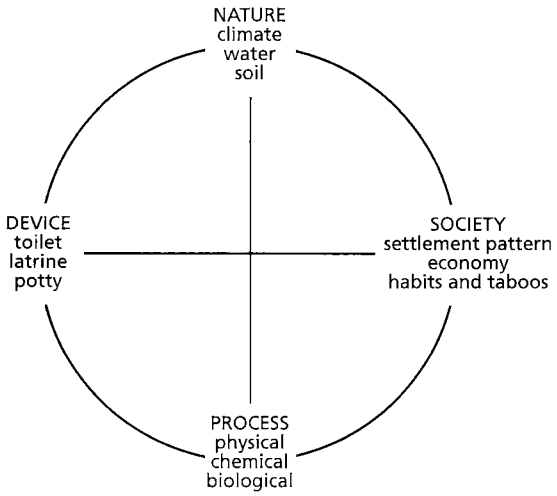


Figure 1. The main components of a sanitation system

The crisis in sanitation

Sanitation is a problem that in many places around the world has reached crisis proportions (2). The main reasons behind this global sanitation crisis are rapid population growth and an unsuitable technological response.

Rapid population growth

Rapid human population growth results in ever increasing densities, in urban growth, in the establishment of squatter areas and in a high burden of disease.

[1] WKAB, Pataholm 5503, S-384 92 ALEM, Sweden. The views expressed in this article are controversial and not necessarily shared by all members of the Working Group on Promotion of Sanitation or the World Health Organization. However, the author's viewpoint stimulates thinking and debate in the sector and may encourage further research, development and field trials of alternative sanitation systems. Some of the alternative systems are featured in other articles in this book.

Densities. There was a time in history when sanitation was less of a problem – or no problem at all: the human population was small and dispersed over a large area.

But the situation is changing rapidly. The human population is now 1000 times greater than it was 10 000 years ago. Over the past 30 years it has doubled and it may double again in the next 40–50 years. One consequence of this population growth is that we now live closer together, at ever increasing densities, putting higher and higher pressure on the environment. The closer together we live, the more important it is for us to have access to, and make use of, good sanitary facilities (Figure 2).

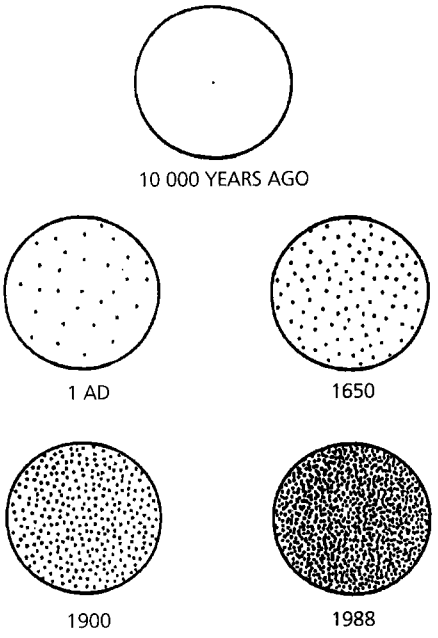


Figure 2. Human population density changes over the last 10 000 years; 1 dot = 5 million people (3).

Urban growth. Today 2500 million people live in urban areas. Thirty years from now the urban population will reach 5000 million (Figure 3).

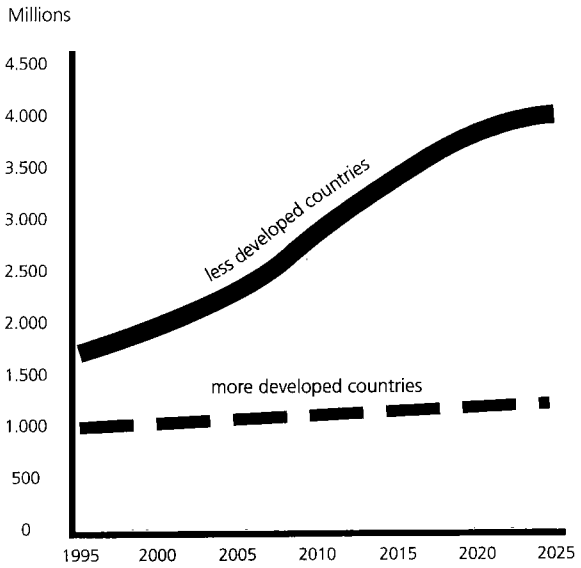


Figure 3. Urban population 1995–2025, less developed and more developed countries (4).

Squatter areas. If present trends continue the majority of urban dwellers in the world will live in unplanned, unserviced squatter areas in small and medium-sized towns. The typical urban dweller of the next century is not going to live in a pleasant, comfortable flat or house, with paved streets, electricity, a sufficient, pure and reliable supply of water, flush toilet, garbage collection and everything else that we tend to take for granted. Twenty to thirty years into the next century the typical urban dweller is more likely to live in a health-threatening environment: in a temporary shack along a filthy unpaved lane, water collected from a communal tap with erratic supply or bought from a water vendor, no toilet, and no garbage collection.

Disease burden. There is a marked difference in health between those who live in poor and in non-poor areas as reflected in the respective infant mortality rates. Infant mortality rates (meaning number of infant deaths per 1000 live births in one year) are far higher in the poor sections of many cities than in better-off sections. The examples in Table 1 show that the infant mortality rate in poor areas is 3–10 times higher than in the non-poor areas (5).

Table 1. The effect of poverty on the infant mortality rate

City	Poor	Non-poor
Manila, Philippines	210	76
São Paulo, Brazil	175	42
Guatemala	113	33
Karachi, Pakistan	152	32
Delhi, India	180	18

Poor environmental conditions give rise to high rates of diarrhoeal diseases, to helminth infections like ascariasis and hookworm, and to vector-borne diseases like malaria, dengue fever and Japanese encephalitis. More than three million people die of diarrhoea every year, most of them infants and young children; 1500 million people are currently infected with intestinal worms, all of which are spread through human excreta (6).

Unsuitable technological response

Conventional sanitation based on flush toilets, sewers and central treatment plants cannot solve these problems. Nor can they, in high-density urban areas, be solved by systems based on pit latrines of different kinds.

Flush-and-discharge. Flush-and-discharge systems make the problems of sanitation much worse. Under these systems a relatively small amount of dangerous material — human faeces — is allowed to pollute a huge amount of water. In spite of this, flush-and discharge is universally regarded as the ideal option for urban areas. Almost without question it is promoted in cities and town around the world, even in poor countries where people cannot afford it and in arid areas where there is hardly enough water for drinking (Figure 4).

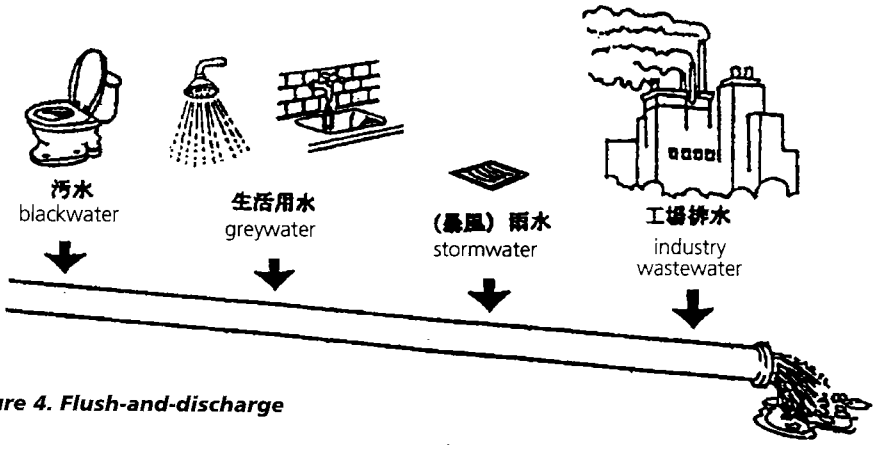


Figure 4. Flush-and-discharge

This glorification of flush-and-discharge is based on a number of assumptions:

— that the problem is one of "sewage disposal";

— that fresh water is an unlimited resource;

— that at the end of the pipe the sewage is treated; and

— that the environment can take care of the discharge from the treatment plant.

However, none of these assumptions is correct;

— the basic problem is the disposal of human faeces and urine, not "sewage";

— outright shortage of water is, or will very soon become, a major problem for most Third World cities;

— only a tiny fraction of all sewage produced in the Third World is treated; and

— all over the world we can find examples of natural ecosystems destroyed by the discharge of untreated or partly treated sewage.

Each of these points is discussed in more detail below.

Sewage disposal vs. management of urine and faeces. A human body does not produce "sewage". Sewage is the product of a particular technology. The human body produces urine and faeces. These are often referred to as "human excreta" but it is important to remember that they are in fact two different substances which leave the body through separate openings and in different directions.

Each person produces about 500 litres of urine and 50 litres of faeces per year. Fifty litres of faeces should not be too difficult to manage. It is not a very pleasant product and may contain pathogenic organisms. But the volume is small: when dehydrated it is actually no more than a bucketful per person per year. The real problem is that in the flush-and-discharge system faeces are not handled on their own. They are mixed with urine. This means that instead of 50 litres of a heavily polluted substance we have to take care of 550 polluted, dangerous and extremely unpleasant litres.

One of the reasons behind the unpleasantness of the mixture of urine and faeces is that faeces contain a bacterium, *Micrococcus ureae*, which when mixed with urine produces a very unpleasant smell (7).

Water scarcity. A flush system does not work without water. To flush away the 550 litres of faeces and urine in a sewered toilet each person uses about 15 000 litres of pure water every year. In most cities in the world there is nowhere near enough water to provide that amount for each of its inhabitants. The typical Third World city solves this problem by providing flush-and-discharge only to the rich, which of course means that there is even less water available to the poor.

Globally, some 80 countries with 40 per cent of the world's population are already suffering from water shortages at some time during the year (8). Chronic freshwater shortages are expected by the end of the decade in much of Africa, the Middle East, northern China, parts of India and Mexico, the western United States, northeastern Brazil and in the former Soviet Central Asian republics. China alone has 300 cities facing serious water shortages (9).

Wastewater treatment. Ninety-five per cent of all sewage in the Third World is discharged completely untreated into surface waters (10). Many cities do not have any sewage treatment system at all, and of those that do, most serve only a small fraction of the population.

Even where there is treatment, the vast majority of sewage treatment technologies in use today still contribute significant amounts of pollutants to the environment. Even modern treatment facilities cannot cope with for example phosphates and nitrates. Nor are treatment plants designed to detoxify chemical wastes. Primary treatment simply filters out floating and suspended material; secondary treatment facilitates the biological degradation of faeces and urine and other similar material; and disinfection destroys infectious organisms. Most of the industrial and household toxic wastes released into sewers are either discharged into receiving waters, or remain in the sludge.

Ecosystem overload. In the past it was a common assumption that the pollution which results from conventional sanitation technologies can be safely assimilated by the environment. This assumption is not correct. Some chemicals will decompose and be removed by natural processes, but most will remain in the environment. The inevitable end products of a sewage system are polluted waters and toxic sludge.

The four conventional sludge disposal methods are ocean dumping, landfilling, incineration and application on agricultural land. From an environmental point of view all these methods are unacceptable and from all over the world we have reports of the degradation of the environment due to sewage discharge and sludge disposal.

Drop-and-store. The alternative to flush-and-discharge is "drop-and-store" (Figure 5).

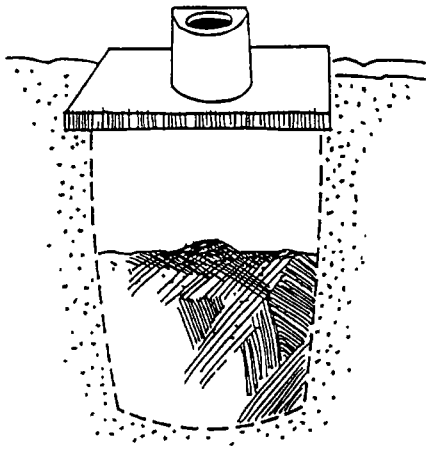


Figure 5. Drop-and-store

Such systems can be simple and relatively low-cost, and they are easy to understand and to operate. But they have many drawbacks: smell, fly breeding, risk of pit collapse, and often a relatively short life. From time to time new pits have to be dug. This may be difficult on crowded sites. In many cases drop-and-store systems cannot be used at all: on rocky ground, where the groundwater table is high and in areas periodically flooded. Recent experiments using biotracers indicate that the risk of groundwater contamination from pit latrines is greater than generally assumed (11).

Drop-and-store systems resulting in large number of excreta-filled pits are not feasible in densely built up urban areas. Nor is the Japanese *jokaso* system (*"jokaso"* is a Japanese technology for collection and treatment of nightsoil) a realistic option for poor countries. With manual collection the jokaso system is unacceptable for health reasons. With collection by vacuum pump truck, as in Japan, the system is extremely expensive in terms of initial investment, operation and maintenance.

A new approach

Conventional sanitation in the form of flush-and-discharge offers no solution to the global sanitation crisis. We need a new approach, a new paradigm in sanitation.

The major question in sanitation today is: How can a rapidly growing city short of money and water and with limited institutional capabilities achieve safe, non-polluting sanitation for all its inhabitants?

A new approach to sanitation must be based on equity, prevention and sustainability. Sanitation systems of the future should:

— ensure equity in the distribution of water;

— prevent harm to human health;

— achieve zero pollution discharge;

— enable us to recycle human urine and faeces as plant nutrients;

— adjust to small municipal budgets and low-income households; and

— offer a level of convenience comparable to that of conventional options.

We can call this new paradigm ecological sanitation. The first principle of ecological sanitation is: Don't mix!

Don't mix:

— human urine and faeces;

— human excreta and water;

— blackwater and greywater;

— household wastes and industrial wastes; or

— wastewater and rainwater.

By keeping urine and faeces apart, problems of bad odours and fly-breeding are reduced or even eliminated, and storage, treatment and transport are made easier.

If urine is not going to be used, it can be soaked into the ground or evaporated. However it is better to recycle urine because it contains nitrogen and phosphates in forms that are easily absorbed by plants. Urine, diluted with water, can be used directly in the garden or it can be stored and used at a later date (Figure 6).

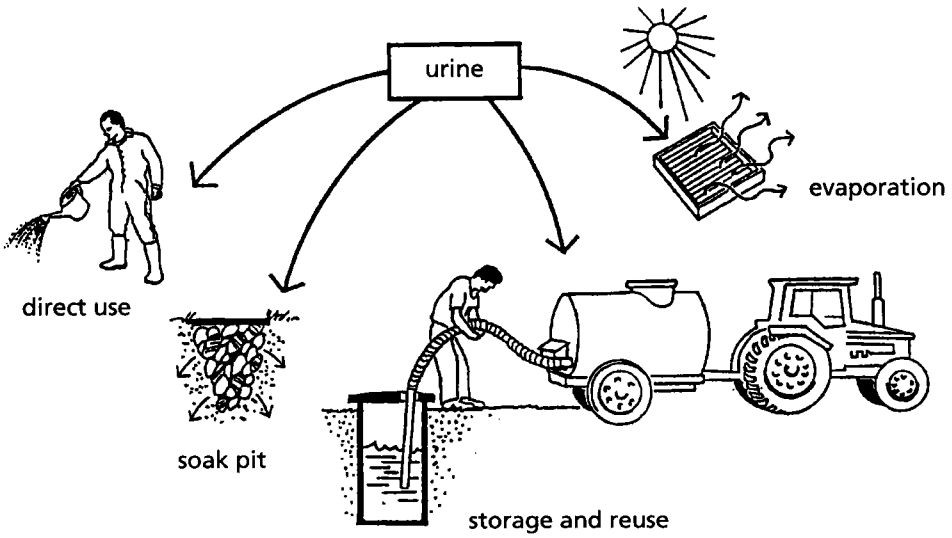


Figure 6. Alternatives for managing urine

Faeces can, if necessary, be processed in several steps before they are reused (Figure 7).

In an ecological toilet, that is a dry toilet with urine separation, they are subject to primary treatment, basically dehydration, which also effectively destroys most of the pathogenic organisms. If this local primary treatment is insufficient, the dry output from the toilet can be transported to a neighbourhood composting station for secondary treatment. If a sterile product is required a tertiary treatment could be incineration.

The amount of treatment required depends on the health status of the users as well as on the intended end use of the product. Most pathogenic organisms can be destroyed by the primary on-site treatment which is usually dehydration or decomposition. Where intestinal parasites are common, some form of secondary treatment may be required,

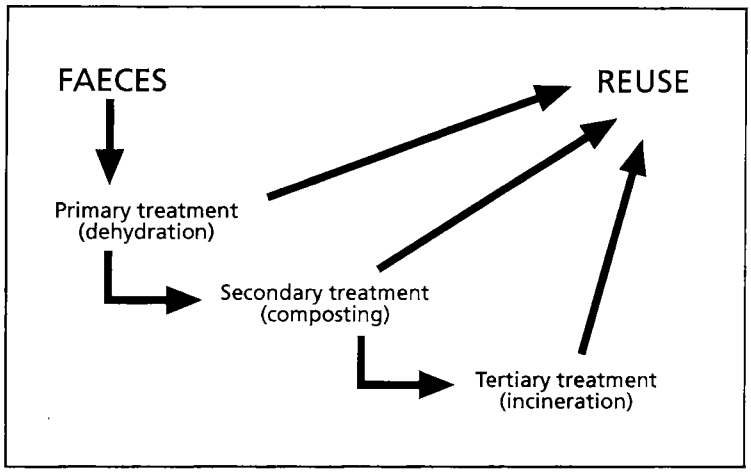


Figure 7. Treatment of faeces in stages

for example high-temperature composting. Tertiary treatment by incineration, for example, should not be necessary but remains an option in exceptional circumstances.

By not mixing human excreta and flushing water the sanitation problem is limited to managing a comparatively small volume of urine and faeces. As a result, a lot of water can be saved, expenditure on pipe networks and treatment plants is reduced, jobs are created and the environment is preserved.

By not mixing greywater and blackwater a number of relatively simple on-site treatment methods can be used for the wastewater generated by food preparation and washing.

By not mixing stormwater and wastewater relatively simple methods can be used to store, treat and recycle stormwater locally (12).

Industrial wastewater containing dangerous, poisonous chemicals must of course be taken care of at source, by the industry generating it. All the heavy metals and toxic chemicals used in industrial processes must be retained in closed loops. This can be accomplished by the introduction of the polluter-pays principle. Such a change is economically and technically feasible but in many places politically difficult.

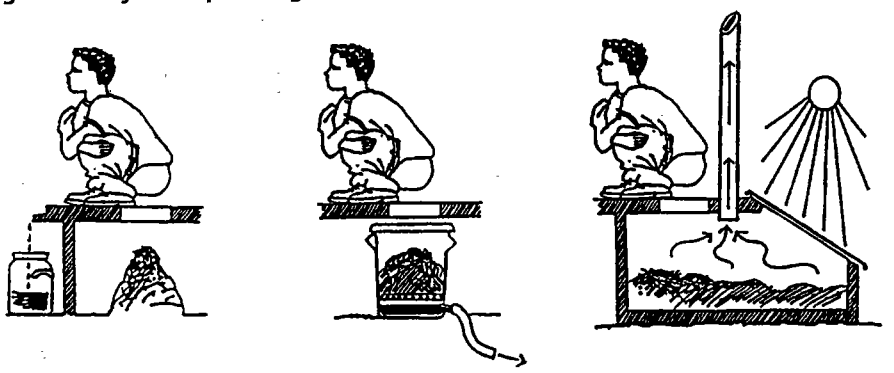
Examples of ecological sanitation

"Don't mix" is central to the new paradigm and to the concept of ecological sanitation.

There are three methods by which urine and faeces can be kept apart (Figure 8). The most straightforward method is never to mix the two. This way the urine remains relatively sterile and can be reused without any further treatment. Another possibility is to mix and then drain. The third possibility is to mix and then evaporate. These different methods are illustrated in the examples of ecological sanitation, some old, some new, described below.

The first example is from Sanaa in Yemen (Figure 9): a one-chamber dehydrating toilet with urine separation placed in a bathroom several floors above street level. In a traditional Yemeni town house the upper floors have toilet-bathrooms next to a vertical shaft that runs from the top of the house down to the level of the street. The faeces drop through a hold in the squatting slab. The urine drains away through an opening in the wall of the house, down a vertical drainage surface on the outer face of the building. Anal cleaning with water takes place on a pair of stones next to the squatting slab.

Figure 8. Ways of separating urine and faeces



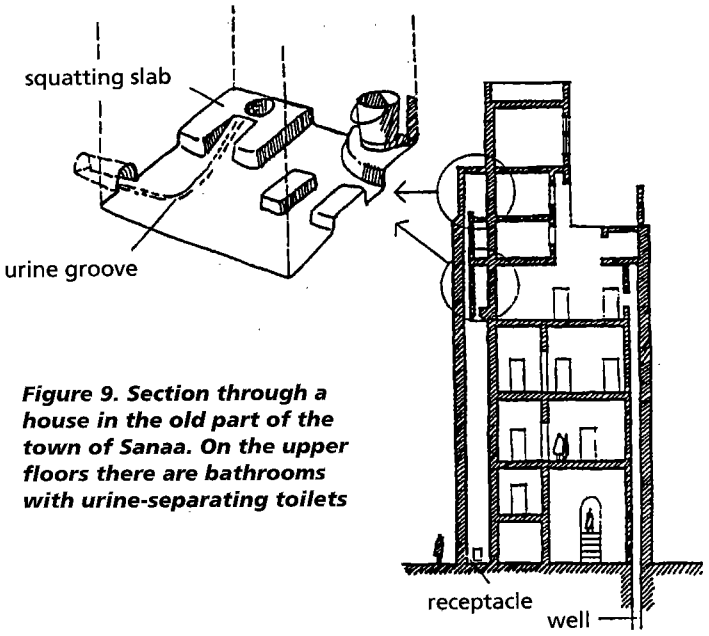


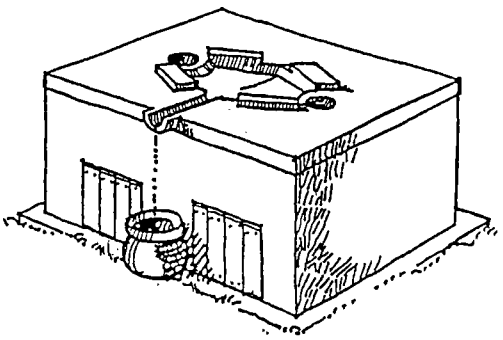
Figure 9. Section through a house in the old part of the town of Sanaa. On the upper floors there are bathrooms with urine-separating toilets

The water is drained away the same way as the urine. As Sanaa has a hot, dry climate the faeces quickly dry out. They are collected periodically and used as fuel (13).

The second example is from Vietnam and Guatemala. It is a two-chamber dehydrating toilet with urine separation (Figure 10). The toilet chambers are built above ground. Urine is collected and piped into a container or soakpit. Faeces are dropped into one of the chambers, the other one is kept closed. Papers used for anal cleaning are put in a metal bucket and burnt.

Each time they defecate, people sprinkle some ashes, lime or soil on the faeces. When the chamber is nearly full it is topped up with soil and the drop hole is sealed with mud. (In Guatemala a plastic bag is placed over the seat.) The second chamber is then used. When that one is nearly full, the first chamber is opened and emptied. The dehydrated faecal material is used as a fertilizer and soil conditioner.

Figure 10. The Vietnamese double-vault, dehydrating toilet, here shown without superstructure. The LASF toilet in Guatemala is of similar design although provided with two seat-risers rather than a squatting slab with two holes



This type of latrine is also used in high-density urban squatter areas, for instance in Hermosa Provincia, in the centre of San Salvador, the capital of El Salvador (Figure 11).

In a further development of the LASF toilet is has been equipped with a solar heater. The main purpose of the heater is to increase evaporation from the chamber. The example below is from the community of Técpan near San Salvador (Figure 12).

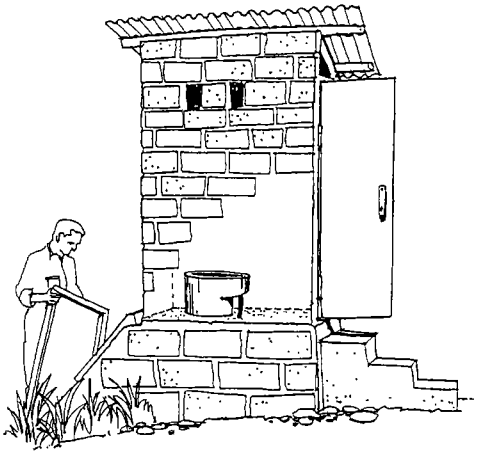


Figure 12. A dehydrating toilet with urine separation and solar-heated vault, El Salvador

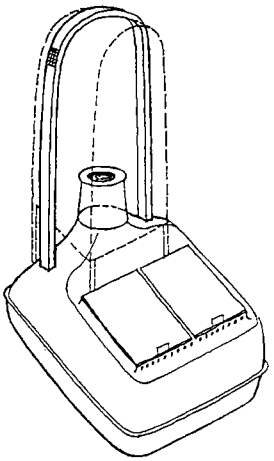


Figure 13. A composting toilet with solar heating but no urine separation, Mexico

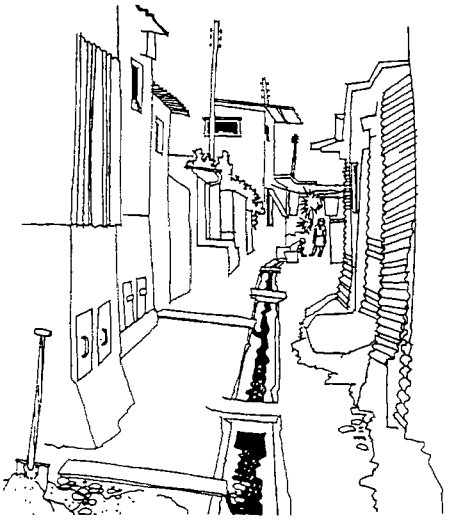


Figure 11. LASF toilets in a densely-populated squatter area in central San Salvador

A prefabricated version of the solar-heated toilet has been produced in Mexico for more than 15 years (Figure 13). It can be used either as a dehydrating toilet or as a composting toilet; there are versions with and without urine separation and with one or with two chambers.

Ecological sanitation is not only for poor countries. In Sweden a number of ecological toilets have been on the market for many years. One type, "WM Ekologen" system, is based on urine separation and dehydration (Figure 14). Urine is stored in an underground tank until reused as a fertilizer. Faeces are dehydrated in a bucket directly under the toilet seat. The toilet is placed indoors. The system is usually combined with separate, on-site treatment of greywater.

Another example, the Clivus Multrum (Figure 15), has no urine separation and is based on decomposition of faeces and organic household wastes. Urine and faeces are mixed with organic household refuse, in this case via a refuse chute from the kitchen. The chamber is placed in the basement, directly under the bathroom and kitchen. This system is by now well

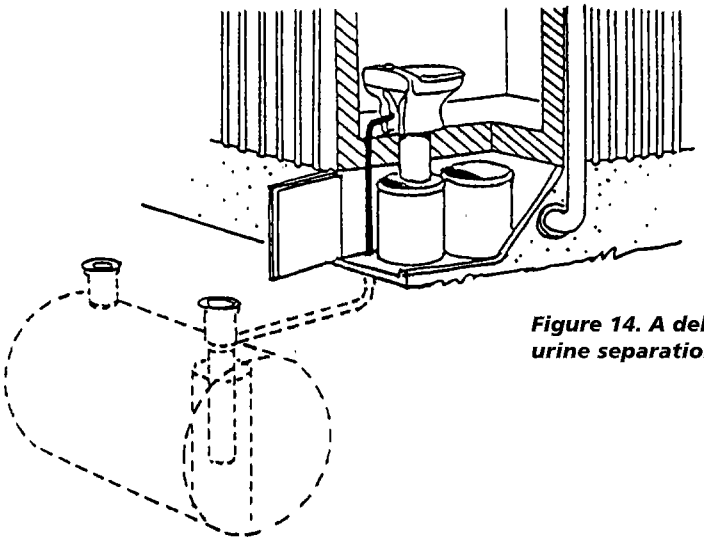


Figure 14. A dehydrating toilet with urine separation, Sweden

tested in Scandinavia as well as in North America and has actually been on the market for nearly 50 years.

The failure of conventional sanitation technologies to prevent pollution is of particular concern on small islands. Nearly every Pacific island nation has identified critical environmental problems resulting from conventional disposal methods. The CCD toilet in Yap was developed by Greenpeace in an attempt to achieve zero-discharge (Figure 16). It is a single-chamber composting toilet combined with a greenhouse for evapotranspiration of urine and water. A nylon fishing net, hanging from hooks imbedded in the chamber walls, is used to separate solids from liquids. A mat woven from palm leaves sits in the net to catch solid materials deposited through the toilet seat. In some units, strips of polyester from old clothing hang from the net to enhance evaporation by acting as wicks to draw up liquids into the airflow generated by the large diameter vent pipe (14).

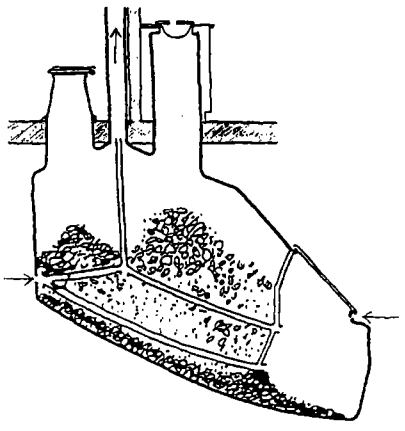


Figure 15. A composting toilet without urine separation, Sweden

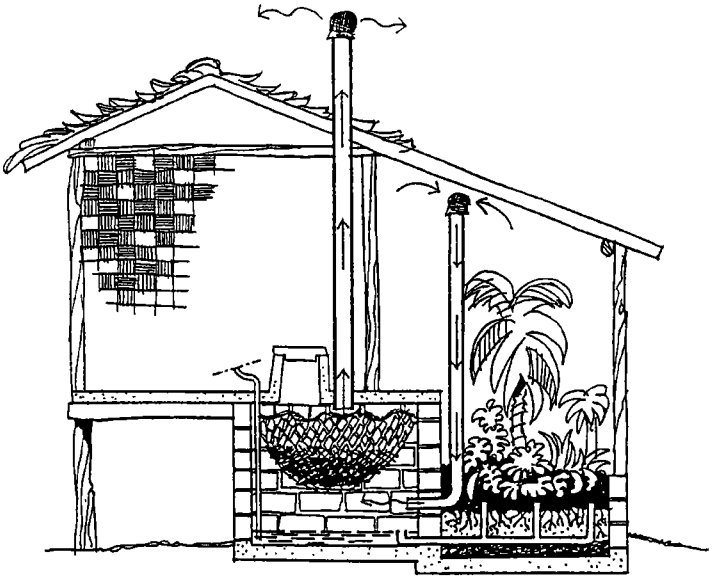


Figure 16. The CCD composting toilet with evapotranspiration, Yap

The final example is a two-chamber, solar-heated composting toilet from Ecuador, high up the Andes mountains (Figure 17) (15). At this altitude there is no need for urine separation as natural evaporation takes care of any excess liquid. Although called a "composting toilet" it is more likely to function as a dehydration toilet.

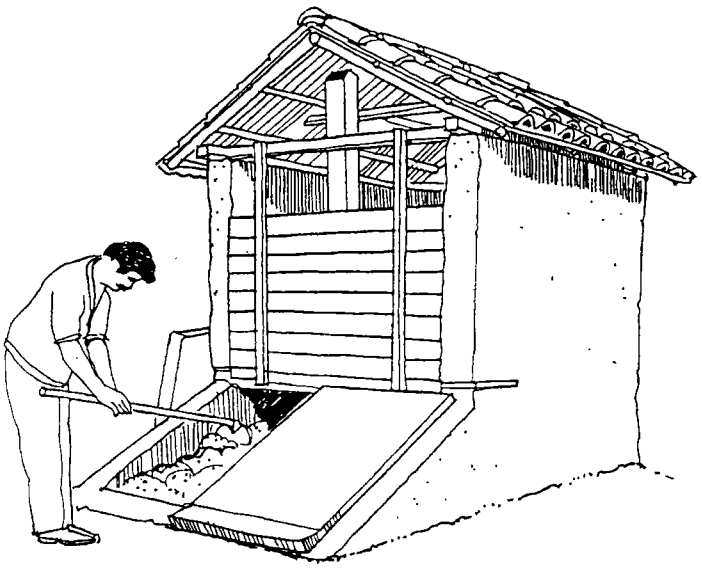


Figure 17. A solar-heated dehydrating toilet developed by FUNHABIT in Ecuador

These examples from around the world show that ecological sanitation exists, that it works and is feasible.

Conclusions

This article has raised a number of issues related to the environment and toilets. The conclusions are short and simple: Don't mix! Don't flush! Don't waste!

- Don't mix urine and faeces — keep separate!
- Don't flush away faeces — dehydrate!
- Don't waste a valuable resource — fertilize!

Ecological sanitation is not merely an option for the future of our cities — it is a necessity!

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Promoting composting toilets for Pacific Islands

—*Leonie Crennan*[1]

This article summarises the process of introducing composting toilets in two countries of the Pacific region. The first was in Micronesia in the Republic of Kiribati 1994–1996 and the second in Polynesia in the Kingdom of Tonga 1996–1998. Although Tonga and Kiribati have some cultural and development differences, the lessons learnt in Kiribati were carried into the subsequent Tongan project.

Objectives

The overall objective of the trial was to explore an innovative technology and its promotion in contexts where alternatives to existing systems were obviously needed owing to groundwater pollution. The specific objectives of the activity were to promote a sanitation technology that:

— would minimise pollution of the groundwater with pathogens or undesirable nutrients;

— would not use limited water resources;

— was easily maintained; and

— would create awareness of the value of recycling nutrients and the health risks associated with inadequate sanitation.

The technology selected was a double bin composting toilet.

The composting toilet

The composting toilet is a dry sanitation technology that requires the addition of carbonaceous material such as leaves or sawdust to be added after use. This is to obtain the necessary carbon/nitrogen balance and provide aeration for composting. After a required period for composting and destruction of any pathogens in the material, the end-product can be used as a fertiliser or disposed of safely in the ground.

The design uses an alternating bin system so one side could be used while the other side is composting (Figure 1). Any excess liquid that does not evaporate in the composting process drains through a slotted plastic pipe into a lined evapotranspiration trench and is absorbed by adjacent vegetation (Figure 2). In areas where the groundwater is high, the evapotranspiration trench is lined with builder's black plastic (polyethylene) sheeting to stop any effluent leaching down to the groundwater. (Fibreglass or ferrocement could be used instead of plastic sheeting but involves more expense and extra work.)

[1] Ecological Sanitation, Stockton, Australia.

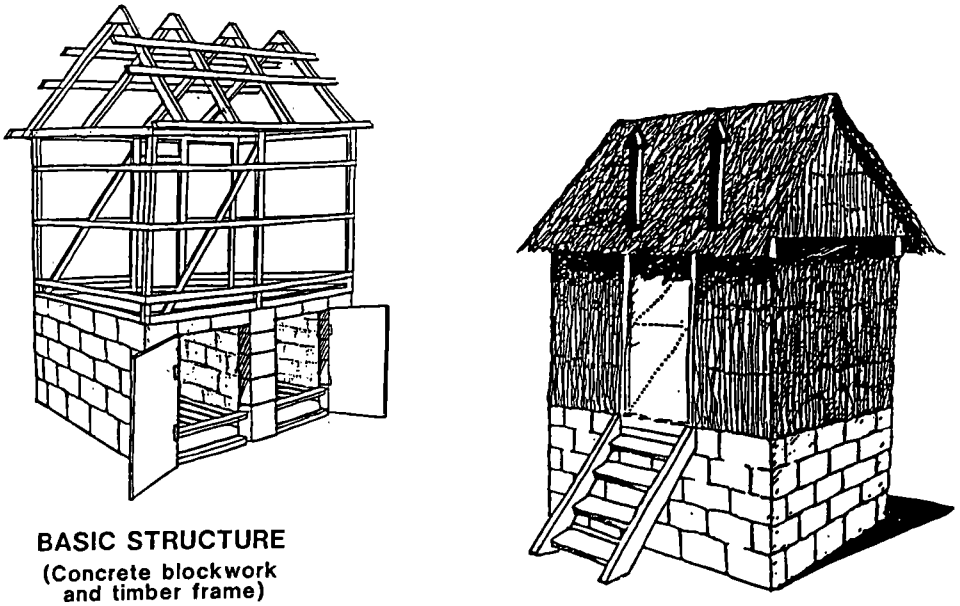

Figure 1. Alternating batch composting toilet, Kiribati

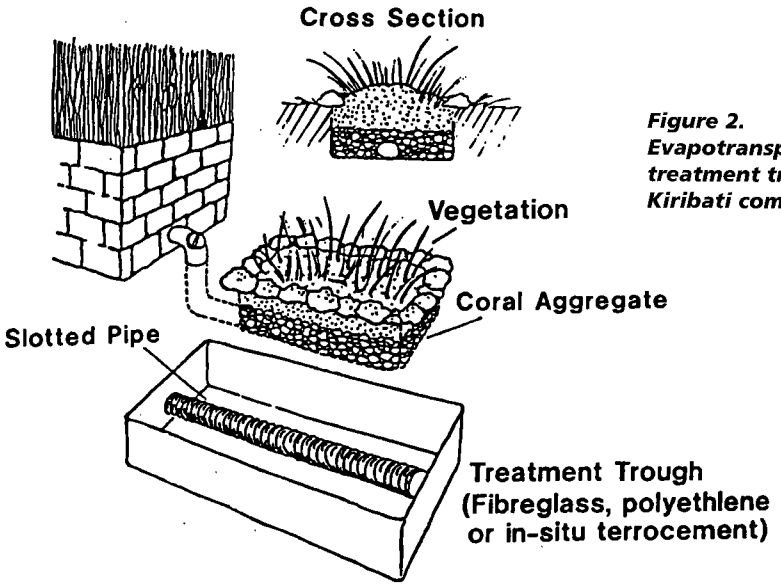

Figure 2. Evapotranspiration treatment trough of Kiribati composting toilet

Background to the Kiribati Trial

In the early 1970s on the coral atoll of SouthTarawa, Kiribati (7.2 square kilometres and population in 1998 of 35 000), a reticulated sewerage system had been installed which had over time been problematic technically and culturally. It was apparent that an alternative was required. The donor agency, AusAID, did not wish to trial a new method on this densely crowded main island so a sparsely populated coral atoll 3300 kilometres from Tarawa was chosen. Kiritimati (or Faraway Island as it is known in local language) had approximately 4000 residents. As it was a large atoll (363 square kilometres), the traditional habit of defecating on the beach was effective and reasonably hygienic

outside the village area, however for convenience, especially for women, on-site house toilets were desirable. Septic tank flush toilets or pit latrines were available in most government employee houses and some private homes. From the donor agency's point of view, composting toilets were appropriate because the agency was about to replace individual wells with a reticulated water supply system. The source of the reticulated system was the same groundwater and it was being polluted by seepage from the pit latrines and septic tanks. Pathogens that were causing common enteric diseases in the population were found in the groundwater. Dye tracing experiments had indicated routes of ingress from the toilets to the groundwater. The water supply project had been planned since 1982. The sanitation component was an enlightened afterthought.

Process of the Kiribati Trial

Initial meeting. Two Australian consultants, both women, visited Kiritimati for three weeks to connect with local health workers and the community. One was the designer of the toilets and the other was a community facilitator. The local counterparts were the Health Inspector and the Community Health Officer, also both women. This was the first time a sanitation system had been introduced by expatriate or local women. The team held introductory discussions using photographs and illustrations with the residents in the local meeting house *(maneaba)* and with women's groups and with government officials. There were to be twelve toilet units (ten in domestic locations and two at schools) trialed and after the presentations were completed, people were asked to volunteer to be participants. Fortunately, a suitable cross section of the community volunteered. The local government officials were inclined to use the project to fulfil their obligations to provide toilets for government employees, but gentle insistence by the team extended the trial to other residents.

It was obvious on this first visit that most people were interested in the new toilet because it was an aid project and it would not cost them anything to have one. It was also apparent that they would not really understand the design and its purpose until they could see a working example. The link between existing toilets and pollution of village water was demonstrated by pouring cup of vegetable dye in the bowl of a flush toilet connected to a septic tank and the colour was observed some weeks later in a nearby well. Most I-Kiribati[2] did not believe the germ theory of disease transmission but had a strong aversion to faeces based on beliefs in sorcery. So they were horrified to think they might be drinking or washing in another person's body products. And some started making connections between the severe ongoing diarrhoea of their children and the well water.

Construction. Materials for construction of the toilets were then transported from Australia to Kiritimati. This took about 5 months due to irregular shipping. During the next visit of three weeks by the Australian team (the female designer and a male colleague), the toilets were constructed using local labour, and much time was spent with the participants showing them how to use and maintain the toilets. At the same time an educational video was shot by the team involving the participants and scripted by the Kiritimati counterparts. A design was prepared for a project T-shirt and poster and a song composed with the assistance of the Chief of Police (who was a poet) and the Curriculum Development Officer. The song was taught to the school children and this was filmed using a video camera. The educational materials illustrated the relationship between the use of the toilet and clean water, clean environment, fertile gardens and

[2] Local name for people from the Republic of Kiribati.

good health. The teachers from one of the schools choreographed a dance that demonstrated the message contained in the song. The teachers from the other school intended to compete with an "even better dance" but this did not eventuate, probably due to insufficient ongoing contact with the sanitation team. The Kiribati counterparts had to continue their other duties as Heath Inspector and Community Health Educator and probably did not give enough time to the sanitation project between visits by the Australian team members.

Further Construction and Monitoring. Four months later the Australian team members returned with the completed video, posters and T-shirts to monitor the composting process and the use and acceptance of the toilet. The donor agency had also been persuaded by the Australian team members to allow construction of three more toilets using locally available materials. The first twelve toilets had been prefabricated in Aus-

The Kiribati Sanitation Promotion T-shirt

tralia and did not really fit into the local environment. The prefabricated toilets required dependence on aid or imports for repairs.

The locally constructed toilets had thatched roofs and walls (Figure 1). The male householders collected the thatch and the women wove it for the roofs. The video was shown in all the meeting houses and was followed by discussion. There was no television or local radio on the island. Some residents had video machines in their homes. For many I-Kiribati this was the first time they had seen themselves, their neighbours or anyone from their country on the screen. This attracted a lot of interest and so easily spread the word about the toilets, the polluted water, and necessity to wash hands after defecating and before handling food. The second half of the video had an English section and showed the same type of composting toilets being used in rural and urban homes in Australia. This had quite an impact, as residents had thought this simple new technology was "only for poor backward people like us". It was considered a status symbol to have a flush toilet although very few of them functioned for long and quickly became blocked and unusable. More people became interested in the composting toilet when they saw Australians dressed in business suits using them in modern bathrooms. The video ended with an Australian clown singing her own song about her preference for composting toilets. In a Pacific Island country where everyone is a musician, this was much appreciated. Both the Kiribati and Australian toilet songs could be heard being sung and whistled about the villages.

The posters were widely distributed but did not often appear on the walls of people's homes. With some feeling of frustration, the project team decided to sell the T-shirts. $A10 (approx. $US7) was the agreed price, quite costly in an economy where nurses only earned $30 a month, middle level public servants earned about $US100 a fortnight, and extended families of up to twenty persons were often dependent on one wage earner. To the team's surprise, 300 T-shirts sold in a couple of days without any advertising. A message was received from a religious minister requesting that next time the T-shirts should be made with collars, as more than half his congregation were wearing them to church! The money from the sale of the T-shirts was used to buy prizes for a gardening competition. The competition was a Health Department initiative to encourage the community to eat a more balanced nutritious diet. During this visit the Australian team distributed non-hybrid flower and vegetable seeds to those interested, and assisted with fencing off areas in preparation for use of the compost.

Further monitoring. Four months later the Australian team returned to Kiritimati and participated in the opening of the fallow bin of the composting toilet to observe the end-product. This was a tense and very public event as the I-Kiribati were convinced that the excreta could not possibly transform into an acceptable fertiliser. The appearance of a sweet smelling leafy soil amazed everyone and the team were suddenly inundated with requests for toilets. The compost was tested and found to be safe and then used around fruit trees such as pawpaw and banana.

The evapotranspiration trenches were dug up to monitor what was happening to any liquid run-off from the bins. The trenches were surprisingly dry in all cases, with roots of nearby pawpaw trees observed to be growing down into the damp area at the bottom of the trench in two sites.

To ensure that the compost was safe to handle, microbiological studies were carried out throughout the trial. This process included taking fresh sample of faeces from the householders to establish what enteric diseases they were suffering from. Also, samples from the top of the pile in the toilet bin were taken to ensure that these pathogens had been excreted into the toilet, and then samples of the end-product or compost were taken to observe whether or not the composting process had destroyed the patho-

gens. No bacterial enteric pathogens were isolated from the compost that had matured in the fallow bin for six months. Microscopic examination demonstrated absence of all parasites found in fresh faecal samples with the exception of trichuris ova *(trichuria)*. However none of the ova contained embryo and were therefore not infectious. Collecting faecal samples was a slow and delicate business. For cultural reasons people were very reluctant to provide body products to someone they did not know well and trust. It required many return visits and much consultation before the samples were provided.

A required time for safe composting was built into the design of the alternating bins of the toilet. This was done by estimating the volume required by an average extended family (10–20 people) for six months which allowed the fallow bin to remain untouched for six months while the active bin was in use.

End of trial. Fifteen months after the AusAID trial began, the monitoring visits by the Australian project team ceased as the donor agency decided to "see what would happen" to the programme without any external support. In the writer's opinion this was unfortunate, as the project had just started to take off in the community and the Australian team members had become familiar and accepted. The two local counterparts felt somewhat abandoned and the promotion programme slowly died. It was too soon to withdraw support for such an under-resourced and controversial project.

Expansion. Learning from this experience that ongoing promotion is necessary, the donor agency decided to install 300 composting toilets along with the reticulated water supply system. The extension project had just begun at the time of writing (March 1998) using a new expatriate sanitation team and a new composting toilet design. The Health Inspector and Community Health Educator were not included in the new team.

Outcomes from the Kiribati project

The sanitation promotion programme achieved its goals despite the short period over which it was conducted.

- A technology was introduced and trialed that does not pollute the environment either with pathogens or undesirable nutrients.
- The toilet system does not use the limited water resources for flushing.
- The toilet system is easily maintained by the household.
- Using leaves the women sweep up every day, carbon is added to the toilet. Formerly they burnt these leaves, but now they collect them in bags or baskets and leave them by the toilet.
- Emptying and disposal of the compost is also managed without problems.
- Songs, dances, videos and T-shirts were successful in creating awareness of the value of recycling nutrients, and the health risks associated with inadequate sanitation.
- Of the twelve initial imported prefabricated composting toilets, four were still being used to varying degrees two years after the promotion programme was terminated. Of the three locally built toilets, one was being used in an exemplary fashion and one occasionally. The primary cause for the non-use of toilets was lack of sustained promotion. However, other causes such as change of resident family, structural damage and septic toilets being built in adjacent meeting houses also contributed to non-use. As the I-Kiribati Health Inspector commented "it took twenty years for the septic (flush toilet) to be accepted — we can't expect everyone to like this already".

- As a result of the trial on Kiritimati, many people on the main island of South Tarawa were interested in the composting toilet as a solution to the serious public health and environmental pollution problems. To extend the composting toilet to a densely crowed application, the main challenges would be finding sufficient bio-mass to use as a carbon additive to the toilet and space to dispose of the compost. Neither of these challenges would be prohibitive however.

Lessons learned

- Active local participation in the design and production/performance of any educational material is essential. The trial allowed technological adjustments to be made to the design that suited the cultural preferences of the community. It also indicated which methods of promotion were most effective.
- It is important to maintain the working relationships and momentum of the promotion programme during the period between the trial and the extension (which in this case was two years). This saves time, energy and money at the extension stage, validates the efforts of those involved in the trial and encourages locals to develop their own contributions to the programme in the interim. It is also a valuable monitoring period, both technically and culturally.
- Friendships and cooperative working relationships established between the Australian and I-Kiribati team and other members of the community were important determinants in the success of the promotional exercise. The I-Kiribati and most Pacific Islanders value good relations above all else, and they will politely ignore programmes that are introduced by people with whom rapport is not established. This can initially take time and patience but is well worth the effort in the long term. When the new sanitation team arrived to undertake the extension, the community reacted to another set of strangers, to the consultation process beginning all over again and to a different composting toilet design being introduced. This lack of continuity was partly due to the way tendering processes are conducted and aid projects are administered.
- It was beneficial to link the promotion to other well-established ongoing local programmes, such as the gardening competition and the nutrition and fitness project.
- In an oral society (and perhaps in most societies), story-telling in the form of dance, drama and song, and physical demonstration are far more effective in promoting new ideas than is written material.
- Graphics are effective if they are also useful, for example on a T-shirt.
- It was an empowering model for the Kiribati women to have a predominantly female team introducing a new sanitation technology. Access to women in their homes was also facilitated. However the local women leading the project needed ongoing visible external support to maintain the status of the project, as the project could have been denigrated by the local male bureaucrats and expatriate technicians as "just women's business".
- The use of media and other interactive educational methods was important, as the residents did not feel comfortable inspecting participants' composting toilets unless the participants were closely related. This was despite assurances by the sanitation team that it was OK to do so. Again there were issues of sorcery involved.
- It is essential to ensure that conflicting programmes are not being conducted at the same time. In the Kiritimati project, introduction of the toilets to the schools did not work successfully, as none of the teachers was motivated to carry on the work of the

sanitation team. At the time of the sanitation project, the government was building new houses for the teachers in the school grounds with septic tank flush toilets. This was despite the fact that existing flush toilets at the school had long been abandoned because of insufficient water for flushing and blocking of the toilet from rough materials used for anal cleansing. All the children were using the nearby beach or the bush to defecate which was a confined area and most unhygienic, especially due to the presence of hookworm. There was no tap available in this area for them to wash their hands and no associated education to do so. The children knew the teachers were using their new flush toilets and so became suspicious of the composting toilet and stopped using it.

- It is important to find common ground between the priorities of the locals and the values of the promotion team. If people don't believe in the germ theory, then one must find out what they do believe that can be targeted in the education programme. This often takes considerable detective work, as people can be reluctant to expose their beliefs to the contempt of western scientific scrutiny.

Extending the Kiribati trial to Tonga

In relation to sanitation promotion, Tonga differs from Kiribati in the following respects:

— the quality of the soil is rich and productive and therefore not so much in need of compost for use as a fertiliser;

— many people have relatives in Australia, United States, and New Zealand who send money and provide access to the wider world;

— almost every household has a toilet of some kind: pit latrine, pour flush or septic tank flush; and

— some villages have a reticulated water system.

Tonga is similar to Kiribati in the following respects:

— dependence on groundwater that is polluted by toilets;

— insufficient or inconsistent water supply for flushing;

— toilet paper being unavailable or too expensive resulting in use of materials that block the toilet;

— groundwater chemicals destroying fittings in toilets causing malfunction and leaks which wastes copious amounts of precious water;

— lack of awareness or conviction of the need for handwashing or covering food; and

— defecation by small children in and around the house.

The composting toilet trial was a joint Tonga Water Board/Ministry of Health experiment to try and find solutions to common problems. Also funded by AusAID, this trial differed from the Kiribati trial in the following aspects:

- The lead time for the Tongan trial was longer. Over several months, the Australian sanitation facilitator conducted informal in-depth discussions with a cross section of the households in the selected village on all manner of water and sanitation practices and attitudes. This allowed a more planned promotion strategy based on the resident's needs and priorities.
- Technology transfer was more comprehensive, as construction was managed entirely by a local contractor which meant that further construction could promote local business. Fifteen toilets were built from locally available materials, thirteen in private homes

and one in a school and another in a school/church compound. The units were more robust, better drained and easier to empty than the Kiribati version of the design.

- To increase a sense of ownership, the first households that volunteered to be part of the trial were required to pay 100 pa'anga or $US95 for their toilet to be built. It was too complex to have a sliding scale, so some were burdened more than others by this contribution. All except one family demonstrated an active control and management of their system.

After the experience of introducing the toilets to the schools in Kiritimati, the sanitation facilitator was reluctant to trial the system in a school or any public application. One of the schools requested to be part of the trial, as their water bills for the school's flush toilets were using half of the monthly budget. They were also having trouble with the flush toilets being blocked and overflowing when rough material was used instead of toilet paper. Contact was made with the science teacher to try and solve the problem. Boys were told they could no longer use the flush toilets and would be responsible for a new composting toilet. After use, they could not return to the classroom unless they washed their hands and the tap was in view of their classroom. After initial shyness and reluctance, the boys became most enthusiastic about the new toilet. Other classes wanted to use the toilet. The water bill for the school dropped 70%. The principal sought funding from another donor, CanadaFund, to build a unit for the girls only two months after the trial began. The education programme was tied to a UNESCO project demonstrating groundwater pollution from existing sanitation system. The news about the new toilet and its purpose spread quickly to the community through the children.

After four months of the trial, many residents expressed the opinion that a trial was unnecessary. They said they were already aware of the advantages of the new system and were waiting for expansion of the programme. However before expanding, it is necessary to observe reactions to the final stage of maintenance, that is, the removal of the compost from the fallow bins before it can be concluded that the composting toilet is an appropriate and accepted sanitation alternative for Tonga. The fallow bins should be ready for emptying at the end of 1998.

Conclusion

It is apparent that alternatives to established sanitation systems are needed in some circumstances. Research into these alternatives has largely been undertaken by committed individuals and small businesses and is generally in the early stages of its full potential. Thorough research and development should be encouraged and institutionally supported to the same extent that existing systems are supported, so that in any country the most appropriate technology can be applied in each location. Selection from a range of equally accessible options should be based on a appraisal of the cultural, socio-economic and ecological context to be serviced.

Key institutions and responsible persons

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Peri-urban sanitation promotion in Mozambique

—Darren Saywell[1]

National Programme for Low-cost Sanitation (PNSBC)

The programme is a widely acknowledged success in Mozambique. It has established a series of well-functioning production units in every province in the country that provide poor, peri-urban communities with access to affordable and durable low-cost improved latrines. The sanitation technology used is based on a simple, but effective, unreinforced domed concrete slab with a tight-fitting lid to reduce odour and insect nuisance. A flexible mix of construction options has been developed to cater to varying physical and socioeconomic conditions. The programme runs in parallel with a strong social development effort, based on employing sanitation animators, to promote the latrine programme and reinforce hygiene behaviour and education messages. Efforts to help alleviate poverty are being made through creation of employment opportunities in latrine production units. Future plans are to decentralize programme activities to municipal city councils.

Programme objectives

Programme objectives were to:

— identify and develop a suitable technology and method for large-scale implementation of improved sanitation in peri-urban areas; and

— contribute to improved living conditions and alleviate poverty by reducing the morbidity and mortality resulting from unhygienic living conditions; and creating local employment opportunities and management capacities, focusing on the needs of vulnerable groups, through establishment of latrine production and sales units.

Programme description

Mozambique is one of the world's least developed nations, with general development having worsened over the last three decades. Human development indices and measures of economic wealth and prosperity fell markedly during the 1980s. Sixteen years of civil war, drought, and related economic and social factors have left between 60 and 90 per cent of Mozambicans living in serious poverty. Estimates of those living in absolute poverty range between 50 and 60 per cent.

After Mozambique's independence from Portugal in 1975, the Government identified sanitation as a critical factor in improving national health. In 1976, the Ministry of Health launched an intensive national self-help latrine construction programme that comprised the construction of thousands of latrines over a short period. However, insufficient technical guidance in latrine design and construction, a shortage of building materials and the lack of awareness of environmental conditions meant that many of these latrines became structurally unsafe, unusable, and a health hazard to users. The

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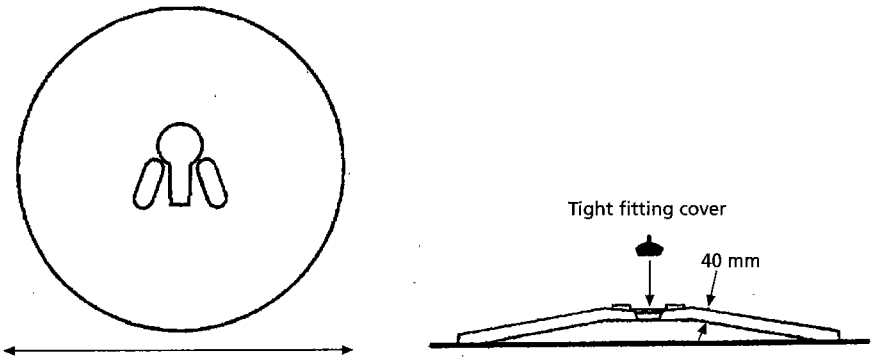
consequences of technical weaknesses and negative impacts on health were most severely felt in densely-populated peri-urban environments, where the majority of the nation's urban population settled. In response, a research project was commissioned in 1979 to identify and develop a suitable technology and methodology for large-scale implementation of improved sanitation in peri-urban areas. Project results led to creation of the PNSBC in 1985, implemented through the National Institute of Physical Planning.

The pilot project identified and tested a technology based on the concept of a simple, unreinforced domed concrete slab that is placed over a lined or unlined pit. Slabs are built to a standard 1.5 m in diameter and a thickness of 40 mm, rising 100 mm from ground level at the centre, to give the characteristic flat dome. Its shape reduces the need for expensive steel reinforcement, since the weight of the load is distributed to the peripheral zone and kept within the range of what the non-reinforced concrete can support. A small inward slope of 100 mm width around the squat hole is incorporated to direct any waste into the pit. Footrests placed on either side of the squat hole guide the user to the correct position for defecation. A tight-fitting lid is placed in the squat hole when the latrine is not in use, as an effective seal to prevent odour from escaping or insects from entering the pit. The lid can be attached to the latrine superstructure by a wire or cord to prevent deposition in the pit. The exterior surface of the slab is compacted and smoothed to facilitate cleaning. It bears the initials of the mason who constructed it and the quantities of cement, sand, and aggregate used, as a means of quality control.

Figure 1. Unreinforced domed slab



Construction techniques are fairly simple, and have been aimed at using the least possible amount of cement, normally three-quarters of a 50 kg bag. A flexible mix of construction options have been developed, and differ, depending on varying physical and socioeconomic conditions. Complete latrines, with lining blocks for pits, predominate in areas of high-water tables or difficult soil conditions, whereas in most other areas, slabs placed over unlined pits are the norm. A characteristic superstructure, without roof, made of local materials (reed and palm leaves), surrounds the latrine, as a privacy screen for users.

The activities of the PNSBC are based on:

— the construction, promotion, and use of improved latrines in peri-urban settlements;

— sanitary education through the activities of animators, health officials, and theatre groups to maximize latrine use and the benefits of construction;

— coordination of sanitation interventions with water supply; and

— development of local capacity to construct latrines.

The programme operates in 15 cities nationwide, with 35 production units centred in peripheral settlements, employing 271 workers. Each production unit employs a number of workers drawn from the local community. Twenty per cent of all workers are women.

The PNSBC is funded by three major sources: donors, the central government and user communities. Donor funding supports technical assistance, equipment, production costs (purchase of cement), and some operation and maintenance costs. Government funding has focused on a direct subsidy for part of the production costs, in addition to some support for staffing and running costs. Communities pay a proportion of production costs, through direct sales of latrines, construction of the superstructure to surround the latrine, and transport of the slab from production unit to household plot. Communities pay about 4 per cent (US$ 1) of the total production cost of a simple slab, and US$ 7 for a "complete" latrine (with concrete lining blocks for the pit). Donor agency and government contributions to production costs are 83 per cent and 13 per cent respectively.

The PNSBC works in poor communities in peri-urban settlements. The programme's target population falls under three categories:

— most vulnerable families, existing in conditions of absolute poverty (as defined by health and income indicators, such as elderly over 60 without income, or family income per capita below MT 13 000, US$ 1.3). Families classified as vulnerable will get their slab free of charge and where necessary have their pit lined.

— families functioning at minimum survival income levels (minimum income was defined in 1996 as US$ 20 per person per month); and

— families surviving on an income of 2 or 3 minimum incomes.

Households dig their own pits and decide the location of the latrine.

Promotion techniques

PNSBC promoted sanitation in the following ways:

- The social development programme was consolidated to emphasise hygiene education activities (through inputs from Ministry of Health staff). Greater appreciation of the importance of sanitation was achieved through the appointment of a series of **'animators'**, who helped to assess the individual needs of those without sanitation, to monitor and evaluate the performance of the programme in the community and to reinforce hygiene behaviour practices.
- Selection of **appropriate communication channels** was critical in reaching target audiences and reinforcing core messages. Messages built on ideas and concepts which are already present in the community (for example, the fear that children would fall into latrines was addressed through poster campaigns highlighting the benefits of the keyhole shaped squat hole).
- A mixture of promotional techniques and methods were used. These included use of **indigenous media** (such as employing dance/drama troupes to visit a district) in conjunction with more traditional communication channels (lectures, activities at church and voluntary level, poster campaigns, and radio/television broadcasts). One innovative promotional idea was the distribution of T-shirts, caps and other promotional clothing to publicise the programme. Given the high demand that exists for affordable clothing in Mozambique, this method was an effective way of communicating

the programmes' central message (through slogans on the front and back of the T-shirt).

- **Production units** were a source of information and promotion within the heart of the community. Mobile production units were used to reach small-medium sized towns. Production units acted as catalyst for generating demand.

Accomplishments

- Despite economic and political difficulties, from 1979 to May 1996, 170 496 improved latrines were sold and installed, benefiting more than 1 022 916 persons. Production sales capacity is between 25 000–35 000 latrines per year.
- The programme proved to be successful despite the fact that institutionally no one really wanted to house the PNSBC.
- A social development programme was consolidated to emphasize hygiene education activities, appreciation of sociocultural influences on the latrine programme through training of sanitation animators, and support to various community outreach activities, such as theatre and radio campaigns.
- Poverty alleviation was enhanced by creating employment through the establishment of local production units.

Difficulties encountered

- Most of the population continues to live in extreme poverty and the economic situation is worsening. At the end of the civil war, over five million refugees returned to peri-urban settlements throughout the nation. Low-income groups cannot afford to purchase improved latrines.
- The State's excessive political/administrative centralization weakens decision-making capacity, affecting programme management.
- Sector coordination at national and local levels is inadequate. This is particularly true regarding national departments dealing with water, sanitation, and the urban sectors.
- The programme is very dependent on external donor funding.

Lessons learned

- Different levels of purchasing power exist within the peri-urban communities. The programme needs access to this information so that pricing structures for latrines may be targeted more appropriately, in line with the different economic capacities of the populations.
- Monetary incentives and other social benefits can be used as a means for recruiting and retaining qualified staff within the programme.
- It was found that introducing productivity bonuses for production units did not work adequately because there was no direct relationship between what is effectively produced and what is sold. A scheme of "food for work" has proven successful as a motivating factor for workers, bringing direct benefits to them and their families.
- It was found that target communities frequently did not have the means to construct latrines (i.e. dig pits) or erect superstructures, hence latrine slabs were being purchased but not used.

- The Mozambican example proved successful because of its combination of rigid standardisation of low cost slabs and complete freedom for the families to build the superstructure as they want. Excluding subsidies from the superstructures resulted in considerable community contribution.

Future plans

- Decentralizing activities and responsibilities for basic infrastructure services to municipal councils will continue. More attention must be paid to creating management capacity within these units.
- A mechanism that enables subsidies to be provided to the private sector for acquiring tools and production equipment to produce and market improved latrines will be developed.
- Mobile production units to cover areas that are currently isolated or distant from existing production centres will be introduced.
- The programme will be expanded into rural areas, introducing pilot projects into an additional province each year.

Key institution and responsible persons

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Prepared in association with SARAR Transformación SC.

Urine as fertilizer in Mexico City

—*Yoloquetzatl Ceballos*[1]

An innovative programme success story

As a means of alleviating increasing poverty in Mexico City's slums, the NGO network ANADEGES (Autonomía, Descentralismo y Gestión, A.C.) and its affiliate, CEDICAR (Centro de Investigación y Capacitación Rural, A.C.), have perfected an approach of growing vegetables in containers, with domestically-produced organic fertilizers. The key to this cultivation technology is the organic, domestically-produced, liquid fertilizer, **urine**, and a rich compost produced by worm colonies from ordinary organic kitchen waste. Using these free, readily available organic wastes, together with discarded containers, the project is successfully producing luscious vegetables, and over 5000 urban residents are rediscovering their traditional capacity to cultivate food. Plans for the future include cultivating fruit trees and introducing small backyard animals, such as chickens and rabbits. Dry latrines will also be introduced, especially in areas without sewers.

Project description

During the past decade, the "neo-liberal" structural adjustment policies applied in Mexico have provoked a massive migration of the traditional rural poor to urban areas. But yet another major devaluation of the national currency at the end of 1994 has meant that life in the urban and peri-urban areas continues to deteriorate rapidly.

Responding to rapid inflation, high unemployment, and inadequate nutrition, the NGO network ANADEGES launched an urban agricultural project nine years ago. This project, managed by CEDICAR, an ANADEGES affiliate, seeks to help the residents of Mexico City slums develop their capacity to grow their own food organically in small backyards or on patios, balconies, and rooftops. The technology used was selected and adapted to fit the local circumstances, which bore the following profile:

- Peri-urban residents have minimal or no land that can be utilized for conventional kitchen gardens.
- Poor project participants can afford only minimal investment in infrastructure, or none at all.
- Programme participants cannot afford to purchase chemical fertilizers, insecticides or other synthetic inputs; and
- Growing containers had to be made of lightweight materials to permit rooftop cultivation.

The project is based on a cultivation technology originally developed in California by Dr Barbara Daniels.[2] Vegetables are grown in containers (ideally 18 to 20 litres) stuffed with deciduous tree leaves or grass clippings up to four-fifths of their capacity, and

[1] SARAR Transformación SC, Mexico.

[2] Daniels, B. *Growing plants in containers. new guidelines for a deck garden.* Multi-copied. Farifax, CA, 1981.

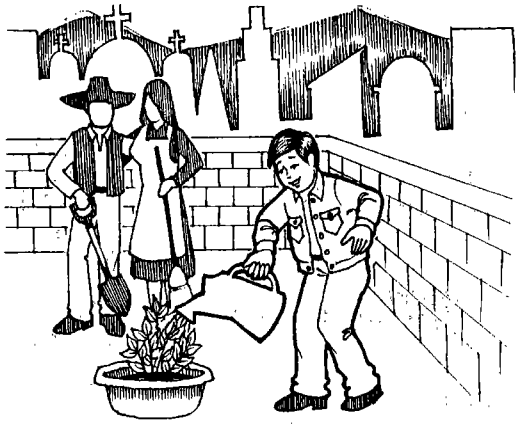
topped with a 3–5 centimetre layer of good soil, into which seeds are planted or seedlings transplanted. To maintain a permanent reservoir of water in the container, a drainage hole is perforated in the side, 5–10 centimetres from the bottom. The exact height of the hole depends upon the type of plant grown. A container thus prepared weighs far less than one filled with regular soil.

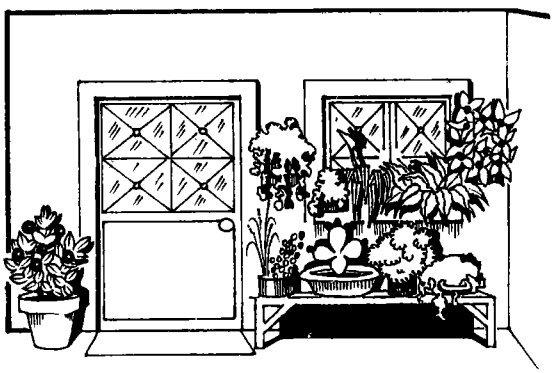
The key to this technology is an organic, domestically-produced, liquid fertilizer — urine (referred to as "liquid organic fertilizer," or LOF) — which is free and abundantly available. Once fermented, LOF is an excellent source of nitrogen for plants, and also contains traces of other nutrients. Urine is collected in a one-quart to one-gallon glass or plastic bottle. A small handful of good soil is added to accelerate the fermentation process. The container is then covered loosely and stored for three weeks at some distance from the living quarters, since it soon develops a strong ammonia odour. After diluting the LOF with water at a ratio of 1:10, the now-odourless liquid can be applied to the plants. (A higher ratio of LOF to water is used during the rainy season; a lower ratio, once the leaves have decayed.) Raw, unfermented, or undiluted urine must never be used.

After initial experimentation demonstrated that the technology worked well, a three-year pilot stage was initiated in 1989, with a group of about 30 families. When it could be seen that these families accepted the use of LOF and the overall results were satisfactory, the project was expanded. In the last six years, approximately 850 families have participated, benefiting 5000 persons in 10 different barrios (neighbourhoods) of Mexico City.

The programme has been tried in different kinds of low-income neighbourhoods. Whereas most programme areas are fully sewered, others, especially poorer squatter settlements, have pit latrines, usually of unsatisfactory design and quality. As a result much of the urination by men has been done in the open. Use of this technology, however, is a good means of dealing with this potential public health problem. More-over, urine diversion, collection, and use as a fertilizer has been successful because of the perceived economic and nutritional benefits to the families involved.

The project is in the process of establishing autonomous resource centres to continue to support urban gardening in each of the communities, thus permitting ANADEGES to expand into new areas.





Illustrations from a promotional brochure for the project

Preliminary findings

The results of initial trials can be summarized as follows:

- LOF was an excellent source of nitrogen, readily absorbed by the plant and essential for leaf growth.
- Plants grew more rapidly, larger, and healthier than those grown with conventional agricultural techniques — and less water was needed.
- There was a deficiency of phosphorus and potassium in the fertilizers, which inhibited fruiting.
- Thus a need for testing for minor nutrients was identified.
- The initial intense aerobic composting of the leafy material raised temperatures and acted as a hot bed, which helped plants in their early growing stages.
- The resistance of plants to pests and diseases was puzzling. In one instance, tomato plants grew near a tree heavily infested with white flies. Although many of these flew around the plants, rather than attacking, as normally takes place, they simply flew back to the tree without even landing on the leaves. Apparently the process taking place inside the container helped the plants to become not only stronger, but also resistant to pests.
- At the end of a year the composted leaves turned into beautiful, rich soil. Each container produced enough soil to supply the top five-centimetre layer in 10 new containers.
- In areas that are sewered, the programme confers an additional water-saving benefit because urine is not flushed in conventional waterborne toilets. A rough estimate is that a typical six-member family can save about 53 litres per day. (With a totally dry toilet, the water saved could increase to 89 litres per day.) Finally, kitchen refuse is recycled, instead of being added to the mountains of garbage that are being generated by Mexico City.

Modifications

After the initial trials, the deficiency of phosphorus and potassium was corrected by using synthetic, chemical fertilizers. Nevertheless, for the technology to be really affordable for poor families, a cheap, abundant, and readily available organic source of these elements was needed. Moreover, since the three- to four-month growing cycle of the plants is so short, these two major nutrients had to be available in a form that could be immediately absorbed. Organic materials requiring longer decomposition periods were ruled out.

As is often the case, the solution was found serendipitously. ANADEGES had already begun to experiment with raising red worms (*Eisenia foetida*). Worm colonies are capable of converting ordinary organic kitchen waste into a rich compost. Their castings, which are produced abundantly and at virtually no cost, provided the readily absorbable phosphorus and potassium that the plants needed. In addition, the worm castings provide necessary minor nutrients which are not supplied by LOF and decaying leaves.

The problem of how to provide adequate space to grow root crops or very wide leafy vegetables was solved by using discarded car tyres as large pots, an idea contributed by a group of Nicaraguan campesinos on a study tour in Mexico. The ANADEGES experimental centre is now testing a prototype machine for cutting and folding used tyres inside-out to form wide-mouth containers which have sufficient room for crops of this type. The use of tyres also recycles another waste product.

Financing accomplishments

Since the programme beneficiaries are mostly very poor families, they could not afford to pay for the full cost of setting up the required infrastructure in each of the community resource centres. Consequently, some financial support has been received from the St. Nikolaus Foundation in Sweden, GATE-ISAT in Germany, Caritas Sweden, the Swedish Government, and the Demos Foundation in Mexico. In addition, a chain of Mexico City supermarkets has donated a supply of discarded containers. Financial support has recently also been forthcoming from the Mexican Government. The programme's ultimate goal is to become self-financing, rather than to require a permanent subsidy.

ANADEGES sells a kit to each family that includes 10 containers, 3 tyres turned inside out, a wide variety of plant seedlings, and a kilo of worms. Although the full value of the kit is approximately US$ 35 ($270.00 Mexican pesos), the families are required to pay only about 20 per cent of the value in cash. The balance is covered by a loan from a revolving fund. Thus the families can begin to benefit from their garden after paying a very small down payment. Fed on kitchen scraps, the worms reproduce quickly. After only a few months, two kilos of worms, worth more than US$ 32 ($250 pesos), are returned to ANADEGES, thus paying off the loan with interest to the revolving fund.

Lessons learned for promotion and implementation

- Initially, mostly women are interested in container vegetable gardening, but eventually the whole family becomes involved. Gardening is always a community activity and children enjoy it and benefit the most.
- LOF was readily accepted, as long as the decision was reached after discussion and medical assurance given that LOF is harmless when properly fermented.

Preparing rooftop containers from used tyres for growing vegetables

Planting vegetables in soil fertilized with urine

- People need to be adequately motivated to tend their vegetable gardens consistently. Motivating factors include: improved nutrition; economic savings; a hobby for the whole family; healthy, fresh organic food; revival of agricultural skills — most elders come from rural communities; closer contact with nature; increased independence from government assistance; ecological concerns: recycling of garbage and containers; ornamental plants; relaxation from urban stress; and friendship with others who are also raising plants.
- With appropriate financing mechanisms, families were willing to pay the actual cost of the kit. Produce harvested during the first year is usually at least equivalent to the cash down payment, thus fully recuperating initial costs.
- Women eventually requested ornamental flowers, in addition to vegetables. These were readily provided by the project.
- It is important to work through organized community groups, so the implementing agency does not need to take responsibility for organizing people and promoting the project from scratch.
- Communities selected for this type of programme should have relative social stability, to ensure that people have enough time and energy to dedicate to their gardens.

Future challenges

- To expand the project to include approximately 1200 families by the end of 1997.
- To seek additional external financing and government support for developing various aspects of the project, including introducing dry, urine-diverting toilets, and the reuse of tyres as wide-mouth containers (which would also help to address a staggering ecological problem in Mexico City — the virtual mountains of used tyres).

- To work more effectively with the scientific community to encourage more research in to this new horticultural technology to improve sanitation and save water in urban environments.

Key institutions and responsible persons

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(ANADEGES affiliate, responsible for managing the project)

Prepared in association with SARAR Transformación SC.

Experimenting with dry toilets in El Salvador

—Ron Sawyer[1] and George Anna Clark[2]

A successful solution to an environmental challenge

Environmental factors, including a chronic water shortage, and high groundwater in parts of the country have made it necessary to adopt drastic measures in El Salvador. Increasing priority is being given to constructing dry toilets, which require no water for the disposal of human waste and, when properly maintained, represent a safe, sustainable alternative for family sanitation. Committed NGOs, the Ministry of Health and the Social Investment Fund, with the financial and technical support of UNICEF, USAID, and Sida have constituted a strategic alliance to bring this appropriate technology to El Salvador. This technology is being replicated, adapted, and sustained on a large scale. A comprehensive educational strategy that integrates the construction, use, and management of dry toilets with personal hygiene and ecological sanitation is a key component of the programme.

Programme description

Environmental factors in El Salvador have made it necessary for the country to adopt extreme measures for improving its sanitation coverage. A chronic water shortage in much of the country has made conventional water-borne sewerage unrealistic, while the high water table characteristic of much of the coastal area of El Salvador makes traditional pit latrines virtually unthinkable. One significant change has been the increased priority given to the construction of dry toilets, which require no water for the disposal of human waste, while the use of impermeable above-ground chambers prevent the contamination of sub-surface water.

A growing awareness of environmental problems and the commitment of NGOs, the Ministry of Health and the Social Investment Fund, together with financial and technical support from UNICEF and USAID, have helped to bring the modified Vietnamese double-vault toilet to El Salvador. As a result of experiments and evolving government policies, this appropriate technology is being replicated and sustained on a large scale. With approximately 100 000 of these dry toilets and an ongoing research and development programme funded by UNICEF and Sida, this Central American country is rapidly becoming a world leader in sanitation without water.

The dry toilet

The dry toilet relies on a special toilet bowl that diverts the urine to an absorption pit or to a container where it is collected for use as fertilizer. The faeces fall into the chamber below the toilet and are dehydrated to destroy pathogenic organisms, so that the substance can be reused as a fertilizer and soil conditioner.

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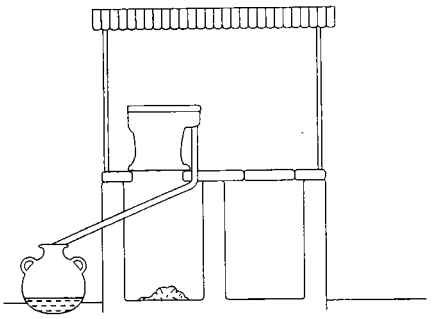
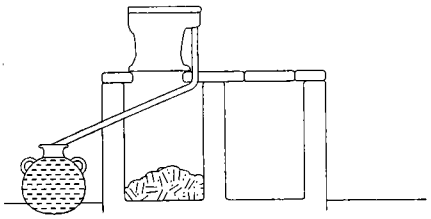
[1] SARAR Transformación SC, Mexico.

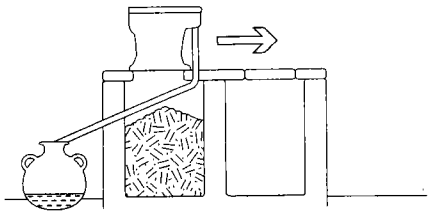
[2] Espacio de Salud, AC, Mexico.



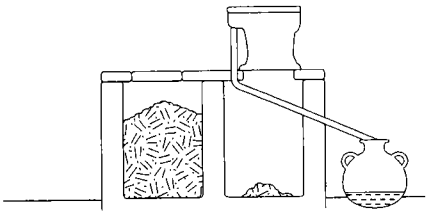
Begin use



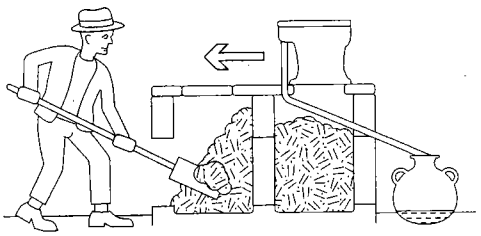
You must empty the urine receptacle regularly



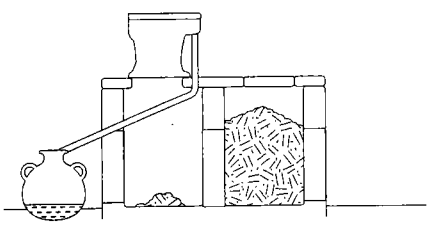
When the first chamber gets full, you move the toilet bowl to the second chamber



While the second chamber is filling, the first one is decomposing



Once the second chamber is full, you empty the first one, and you move the toilet bowl again



The cycle begins again

The maintenance of the system involves a set of simple activities. After defecating, the user sprinkles dry materials such as ashes or lime (or a mixture of dry soil or sawdust with ash or lime) over the faeces. Every week the contents of the chamber should be stirred with a stick and more dry material added.

The separation of urine from faeces and the addition of dry material, reduce unpleasant odours and flies, which are serious problems of traditional latrines. The toilet's double chamber allows the contents on one side to lie idle, while the family continues to use the other side. Under normal circumstances the chamber in use fills up in not less than six months, which is enough time to assure that the material in the other chamber has dried adequately. By drying the faecal material for at least six months, even the most long-lived pathogens will be destroyed, leaving an innocuous material that can be removed and disposed of or reused as a soil conditioner.

Pathogen destruction

To properly use and maintain a dry toilet, it is useful to understand how and why the system works. Whereas the term "dry sanitation" can refer to either dehydration or decomposition, it is helpful to appreciate the basic differences between the two processes.

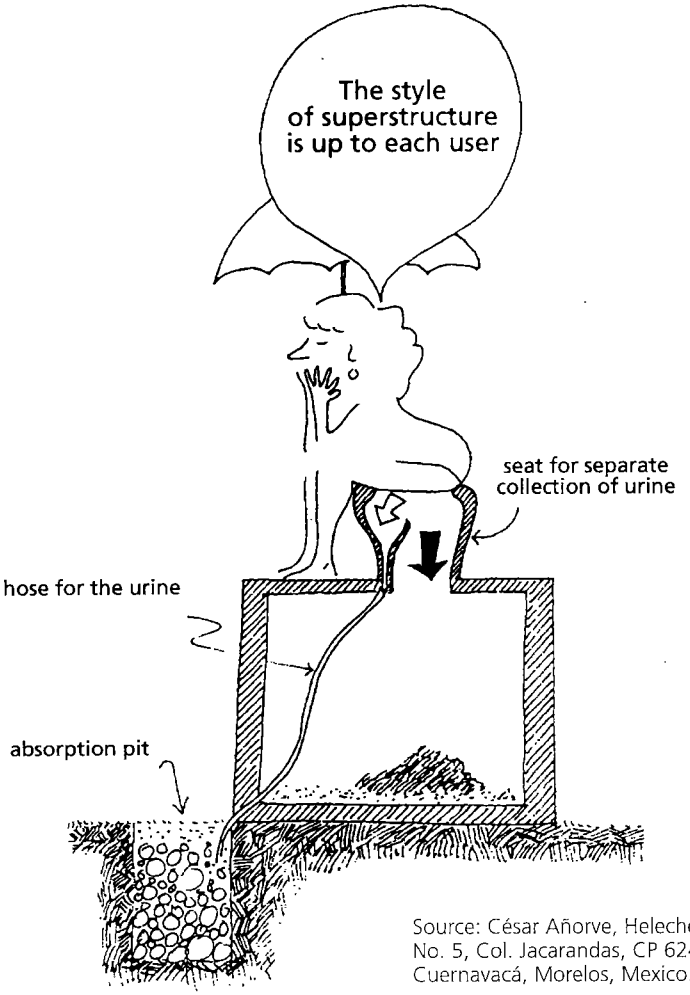
Dehydration means that the humidity of the contents of the vault is brought down to below 20 per cent. For effective composting, humidity must be kept above 60 per cent. In a dehydrating system, pathogens are destroyed by depriving them of water and by increasing the pH above tolerable levels. Users help the process by adding dry materials and lime (or ash) as part of routine management.

The humidity interval of 20–60 per cent should be avoided, because it results in incomplete dehydration, malodorous decomposition and fly breeding.

Dry toilet cycle.

Source: Redrawn from Letrinas secas: una política nacional en El Salvador and Saneamiento sin agua, El Manantial. *Boletín de la Red Regional de Agua y Saneamiento para Centroamérica* (RRAS-CA), Año 1, # 1, August 1996.

Figure 2. The double-vault (LASF) toilet



Source: César Añorve, Helechos No. 5, Col. Jacarandas, CP 62420, Cuernavacá, Morelos, Mexico.

Had these critical facts been better understood by many sanitation pilot projects worldwide, many unfortunate failures could have been avoided and the unjustifiable mistrust of dry sanitation technology much more quickly overcome.

Dry toilet		Compost toilet
20% ←		→ 60%
(Desiccation)	(microorganisms and odours flourish)	(Decomposition)

Education and mobilization

UNICEF has played a vital role in developing an educational approach that integrates the social and technical aspects of dry sanitation. Initially, the focus was at the family level, involving household visits by trained community promoters (visitadoras), who follow a programmed sequence of learning modules. This has been complemented by regular monitoring of key aspects of individual and family hygiene, as well as toilet use and maintenance.

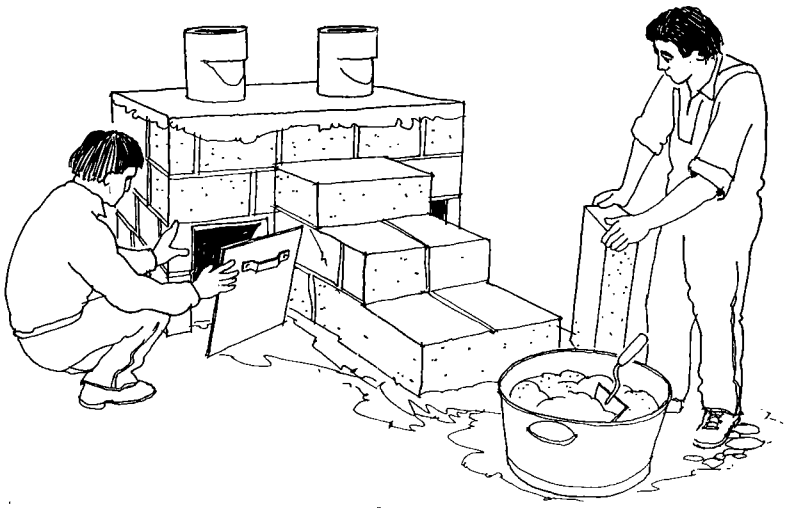
In 1996, to get communities more involved in the water and sanitation programmes, SARAR Transformación SC provided training in participatory methods (including PHAST) to technical and field staff of key NGOs, the Ministry of Health, and UNICEF. The

comprehensive educational strategy, which integrates the construction, use, and management of dry toilets with personal hygiene and ecological sanitation is proving to be critical for promoting the acceptance and sustainability of alternative sanitation approaches. An important result of this participatory learning process has been the consolidation of an inter-institutional team of trainers sponsored by UNICEF. These trainers, promoting participatory methods, train staff from other institutions and other sectors, and adapt and produce non-directive learning materials.

Three very different experiences are discussed below to illustrate the significant learning that is taking place in El Salvador.

Hermosa Provincia. After one child fell into a pit latrine, the Hermosa Provincia peri-urban neighbourhood in the capital city of San Salvador was motivated to build a dry sanitation system. As a result of intensive education in using and maintaining the dry toilets provided by the Ministry of Health, plus effective community organization and follow-up support from a local church, the 130 units in this community have been functioning successfully over the past six years. Although most of the toilets are actually built into the houses, there are no unpleasant odours, nor any flies. After a year, the dehydrated material is removed from the chamber and is used in a communal nursery, occasionally sold (at US$ 4.65 per 100 kg), or used as landfill on a nearby site belonging to the church.

Figure 3. Constructing a double-vault, desiccating toilet with urine separation



Source: Uno Winblad, Pataholm 5503, 38492 Ålem, Sweden.

Técpan. The Ministry of Health, with technical support from UNICEF and SANRES (see Box 1) is developing and testing experimental solar-heated toilets, with urine diversion in the semi-rural village of Técpan. Unlike most other dry toilets, this type of solar toilet has just one chamber and uses solar energy to accelerate the desiccation process. Built entirely above ground, the 36 experimental units include urine diversion, and produce a dry product from the human faeces that can be safely used after storage of at least six months.

Box 1. SANRES Project[3]

SANRES (Sanitation Research) is a Sida-funded project that has been supporting dry sanitation research and development activities in El Salvador since 1994. The SANRES project is currently active in seven countries (Bolivia, China, El Salvador, Guatemala, Mexico, South Africa, and Vietnam) and has created an informal network in 20 countries. SANRES holds that any intervention in sanitation must take into account that sanitation is a system including the natural environment; society (with its beliefs, values, practices, technologies); a device (the physical structure that receives the human excreta; and processes (the physical, chemical, and biological processes, such as dehydration or decomposition, that take place inside the device). Unless each of the system's elements is considered with equal rigour, effective and sustainable intervention will be difficult to achieve.

[3] For more information, contact Uno Winblad, SANRES, fax: +46 499 24253 or email: uno.win@wkab.se.

The Técpan toilets produce no flies or odours, but do require that the user shifts the pile under the toilet seat to the back of the chamber every one or two weeks. On some units, a mechanical "pusher" is used to shift the pile without opening the chamber. Because of the chamber's limited size, the material at the rear of the chamber must then be emptied every second or third month, to be stored until disposed of or used in the garden as a soil conditioner or fertilizer, composted or used as the drying agent in the toilet.

This project is demonstrating that the size of the dry toilet can be significantly reduced (the volume of the chamber has varied from 0.35 to 0.6 m^3), thus lowering the cost of construction materials. The direct cost (materials and labour only) of a solar toilet is US$ 225, compared to US$ 271 for a standard dry toilet. Space requirements have also been reduced significantly, which is a very important consideration in highly dense urban areas.

Studies are being conducted to reduce maintenance needs to a minimum while still assuring an acceptable level of pathogen destruction, before promoting and constructing solar toilets on a large scale. In addition, the project is continuing to experiment with optimal design and location. The 36 units now in use are being expanded to 500 units to test the applicability of the system on a larger scale. This next research phase will concentrate on the sociocultural issues (user education and training, extension support) associated with safe, sustainable use.

Chicuma. ProVida, an innovative national NGO, supported by UNICEF, has introduced a change to the traditional pit toilets in the rural community of Chicuma, inhabited by former guerrillas. In an otherwise traditional 1.5–2 m deep pit toilet, faeces and urine are kept apart by using the urine-diverting seat.

Over two years ago, about 70 families installed the seats for urine diversion, while a few households built traditional toilets. The latter continue to have odour, fly, and mosquito problems, while the former generally do not. Only during the rainy season, and only for a short period of time, when there is an increase of humidity in the otherwise dry pit, do flies and odour become a nuisance in the modified toilets. It has been observed that the depth of the pit in the modified toilet can be reduced. Overall the community is very satisfied with this innovative pit toilet, which is seen as a positive first step towards gradually introducing the standard dry toilet.

Although evaluations and additional technical studies (for example, on the die-off rate for pathogens and parasites) are necessary, El Salvador's experiences with dry toilets corroborate several basic sanitation principles. As with any sanitation system, to be safe

and environmentally sound, dry toilet programmes require a clear understanding of the technology to be used and the prevailing natural conditions. Community organization and education are important components to assure the system's sustainability. Since the family must undertake more maintenance than required for traditional toilets. But wherever these conditions are met, dry toilets have proved to be a sustainable solution for family sanitation.

Key institutions and responsible persons

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Meeting demand for dry sanitation in Mexico

—*Ron Sawyer*[1]

A viable sanitation solution to water-scarcity and pollution

Water scarcity and water pollution caused by inadequate and inappropriate sanitation services that use water to transport human excreta motivated César Añorve and the voluntary organization ESAC (Espacio de Salud – "Health Space") to develop a complementary strategy to increase access to and use of dry toilets in Mexico. The core elements of their approach are the production and sale of urine-diversion toilet seat risers, health and environmental education, organizational support, and technical training and follow-up. Clients include low-income community groups, governmental agencies, independent architects, and other NGOs. As the demand for these toilets increases in Mexico, César and ESAC are refining their range of products, while also grappling with the broader issues related to municipal and environmental planning and management.

The sanitation problem

Espacio de Salud works in southern and south central states of Mexico. In much of this area urban settlements are built upon very porous volcanic rock and beneath the volcanic rock are large aquifers. Wells tapped into these aquifers are the sources of drinking water for these populations.

Sewerage is not an option, firstly because hard volcanic rock would need to be blasted away to lay pipes, and secondly because communities with sewer systems have found that maintenance of these systems and treatment of the wastewater are too costly for their populations. Communities are not willing to incur these high costs and these systems generally fail as a result. Pit latrines are also out of the question. They cannot be dug and even if they could be, they would also pollute the aquifer. As a result, residents build flush toilets over the rock and sink PVC pipes directly into the aquifer below, or in areas that have a thin layer of topsoil, they dig shallow pit latrines that ultimately leach into the groundwater. These toilets have caused extensive pollution of the groundwater and undissolved faeces can actually be seen, through holes in the porous volcanic rock, floating in the aquifer, and in the springs which flow from it.

These areas, not surprisingly, experience frequent epidemics of diarrhoeal diseases, cholera and typhoid. More and more people are making the link between this inadequate method of sanitation and the epidemics. This connection has increased demand for sanitation options that do not pollute the groundwater. Espacio de Salud has tried to meet this need by promoting the use of dry aboveground toilets and removal of the sanitized faeces, usually one to two years later, to land safely away from the aquifer. Their education and promotion activities have raised awareness about dry sanitation options. More and more families and communities have become convinced of the advantages of this sanitation system for their health and want dry sanitation for all. They realize that pollution from one family can contaminate everyone's drinking water.

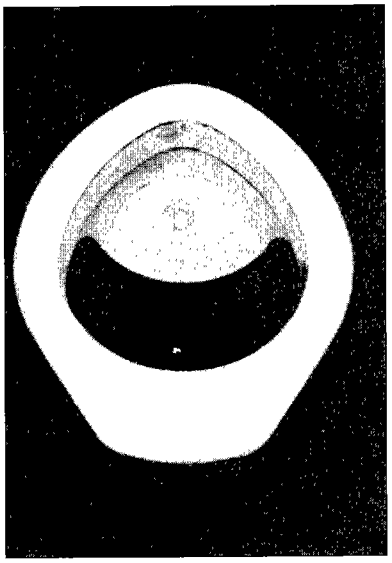
[1] SARAR Transformación SC, Mexico.

Espacio de Salud works in these areas of difficult terrain and groundwater pollution, offering assistance to households and communities wishing to convert their existing sanitation systems to dry systems.

Programme description

Production – César Añorve

César Añorve is an independent entrepreneur who has spent the past fifteen years producing and advocating the use in Mexico of modified Vietnamese double-vault toilets. ESAC is a small NGO concerned with promoting improved health and environmental conditions among low-income groups. Over time, César and ESAC have evolved a collaborative, symbiotic relationship that has contributed to significant improvements in the sector.



Urine-diversion toilet seat

César's operation is deliberately unsophisticated. As a family-run business, his workshop produces approximately 30 urine-diversion toilet seat risers per week. More than 6000 toilet seats have been sold. The profit from the sale of the polished cement seats (approximately US$ 17 or 126 Mexican pesos per unit) is used to finance his overall operation, including low-key promotion, training in toilet construction and use, and advocacy for change in environmental sanitation policies and legislation. César receives visitors to his home almost daily to order toilets or simply to request information. He is assisted in his outreach by three persons, including his brother.

César provides short-term technical training and support, which is included in the cost of the hardware, to individual clients, bricklayers, governmental agencies, and NGOs. An additional quota is often charged for institutional training workshops and special presentations. The pricing structure of the toilet seats permits César to partially subsidize the costs of the toilet seats for extremely poor clients who do not have access to adequate financing.

Education and empowerment — Espacio de Salud A.C.

ESAC works primarily with women and provides health and environmental training to organized groups, community leaders, extension workers, and teachers in the states of Morelos, Guerrero, and Oaxaca. Although ESAC does not promote a specific technology, cholera outbreaks in Guerrero and rapid environmental degradation in Morelos have generated frequent requests for improved sanitation, in general, and dry toilets, in particular.

ESAC responds to communities' demands by using participatory methods to assist them in analysing the causes of their problems and to identify possible solutions. When and if the community members decide to build dry toilets, ESAC trains them in construction, use, and maintenance, and provides follow-up monitoring and support.

Because of its limited resources on the one hand, and a focus on empowerment and fortifying democratic processes on the other, ESAC only responds to requests from organized popular groups. The NGO's experience and expertise in training community workers and in strengthening organized groups has spread by word of mouth, especially among grass-roots religious communities whose motivation for changing current conditions — including environmental conditions — is based on Biblical reflection. These

groups expect to participate actively in decision-making.

All individual and group requests for hardware support are referred to César, who sells either the toilet seats or the fibreglass moulds and provides training in the production process. Although the groups are also offered advice on how to use modified buckets to make their own urine-diverting toilet seats, almost all prefer to purchase their seats ready-made.

As the demand for dry toilets has increased, César and ESAC have decided to make the training of community workers their highest priority. As a result of this focus, they have jointly developed and produced educational and training materials — including an attractive, full-colour poster showing a range of dry toilet models, as well as the basic technical design drawing.

Technology — modified Vietnamese double-vault toilet

The modified Vietnamese double-vault toilet is designed to permit reuse of human excrement for agricultural purposes after it has been "treated" by keeping it in a sealed chamber for a minimum of six months. During that time the faeces become very dry, making it impossible for pathogens to survive. The two sides of the double vault toilet are alternated every six months at minimum. As excreta are not traditionally used as fertilizer in Mexico, there is no incentive to open a vault before the minimum six months of drying time is complete. The usual waiting period is 8 to 18 months before removal. It is estimated that a family of five to six members can produce a little less than half a cubic metre "harvest" per year.

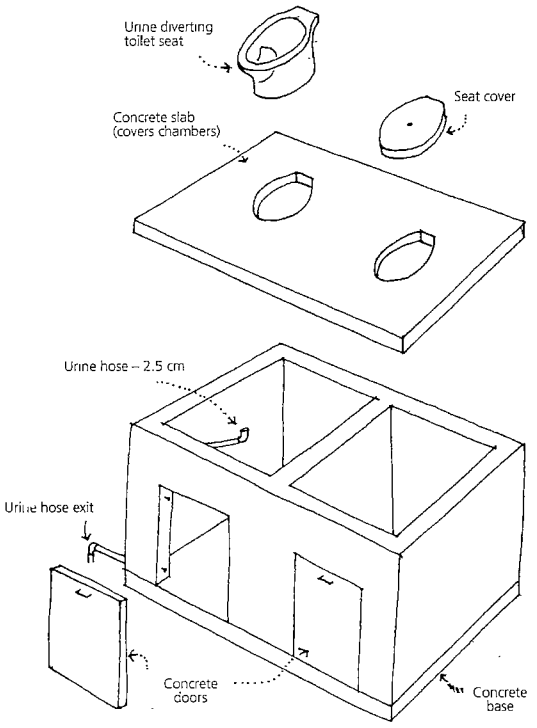


Figure 1. The modified Vietnamese double-vault toilet

Because of the impossibility of laboratory analysis for every toilet in use, it is recommended that the product not be used in vegetable gardens. However, it can be used in fruit orchards and to grow grains. Composting to improve the product's texture and fertility, and to modify its pH, can be undertaken.

Fermented urine is recommended as a fertilizer. Before sealing the container to avoid loss of nitrogen, users often add a handful of soil as a catalyst for the fermentation process. For fertilization purposes, users have reported varied dilution ratios of urine to water (from 1:5 to 1:20).

Unfermented urine can be sprayed as a fungicide. Indigenous people in southeastern Mexico claim that the use of urine as a fungicide was a traditional Mayan practice.

Accomplishments

Raising awareness. One of the most important accomplishments of the programme has been the greater awareness that has been generated regarding sanitation-related

environmental and health issues. Dry toilets are less often requested primarily on the basis of convenience, and more often on the basis of health concerns.

An increase in requests for dry systems from local architects reflects a greater environmental awareness (and demand) on the part of their middle-class clients.

Product development. In response to the increasing demand from diverse sectors of the population, César has been able to develop a broader range of products, including improved designs of toilet seats, using a variety of different materials. The brightly painted polished concrete remains the standard material used for the urine-diverting seat, as well as a companion urinal for men who are so inclined. César has produced a prototype portable fibreglass seat for public fairs, large private parties, and other special events; and together with another nongovernmental group, he is experimenting with recycled-plastic seats. An up-market ceramic seat is also under consideration.

Replication. Although the marketing is very low-key, the demand for urine-diversion seats is gradually increasing. To satisfy requests for dry toilets further afield, César sells the moulds (for 2500 Mexican Pesos, or approximately US$ 320) and assists local groups in establishing small workshops to produce the seats and to generate local employment. Beginning with the establishment of three independent workshops in Oaxaca in 1990, there are now about 15 independent, small-scale manufacturers of urine-diversion units, in different parts of the country.

Policy and regulatory environment. César is a political cartoonist, often commenting on environmental problems. His aesthetically appealing drawings, used in educational materials, invite the reader to reflect upon broader social and political values. As part of an awareness-building campaign and to increase social pressure for modification of the state environmental legislation, he also writes articles for local newspapers. An important, recent "victory" is that the state Architects Association will be submitting a proposal to the municipality of Cuernavaca, a city of over half a million people, whereby dry toilets become acceptable under the standards permitted for issuing housing permits.

Difficulties encountered

The most significant difficulty has been overcoming the negative reputation of project "failures". When an external agent imposes its own resources and rhythms on the community, the project often fails. In these cases, the community has not identified alternative sanitation as a necessity. It has no knowledge, much less interest, in the dry toilet or in how it should be built and maintained. Fieldworkers are often uninformed about the technology, as well as community empowerment approaches.

A classic example is during election times, when a government entity decrees that a given number of toilets will be built, whether the community wants them or not. Likewise, in an economically stressed country, with a history of paternalistic relationships, many communities have become accustomed to passively receiving a variety of project offers from governmental and nongovernmental agencies. Often the community agrees to whatever is proposed, whether the need is felt or not, expecting that some advantage will be gained.

The families in these cases typically use the constructed toilet as storage space or a pigpen. When the dry toilets do not "work", word gets around very fast. Overcoming the negative reputation of a technology is extremely difficult.

As the "flush and forget" mentality invades Mexico, choosing dry sanitation over conventional sanitation is rare. Having "modern" conveniences is a status symbol, while being environmentally "correct" carries no prestige.

Owing to the large and increasing demand, coupled with institutional financial constraints, consistent follow-up has not always been possible. At times, it has been necessary to make the difficult choice between either responding to another, new community or continuing with the old. Under these circumstances it has been equally difficult to give adequate attention to systematic monitoring and evaluation. For example, there is no clear data on how many of the 6000 urine-diversion seats produced are actually in use.

Lessons learned

The programme has discovered that:

- Large-scale promotion of dry sanitation should be avoided. Experience has shown that the lack of adequate education and institutional follow-up can lead to failure and abandonment of the approach.
- The various advantages of the dry toilets can be better appreciated and assimilated by users when they are explained and supported by established, organized groups.
- Dry systems are significantly less expensive than conventional waterborne systems. Although the costs of the specific components vary considerably, depending upon the materials used, a complete unit, including the superstructure and a cement roof, is approximately 1200 Mexican Pesos (US$ 150+);
- There are important environmental advantages to using dry toilets. Rather than producing 100 000 to 150 000 litres of contaminated sewage water per family per year (enough to fill a 2 x 2.5 x 30 m cistern), the dry system produces approximately 5000 litres of liquid fertilizer (urine) and 300 to 500 litres of "composted" soil conditioner.
- Seeing is believing! A visit to a home with a dry toilet, preferably one which is integrated within the house, rather than operated as a separate structure, is especially helpful for convincing potential users.
- Extension workers, who are generally considered of high status, are taken quite seriously when they have dry toilets in their own homes. This is a particularly important consideration when working in a region where past dry sanitation projects are considered to have "failed".
- It is advisable not to talk about financing mechanisms (whether revolving loans, outright gifts or demonstration models) during the first discussion. Otherwise, there is a strong likelihood that this subject will become the focus, and distort the needs assessment.
- Encouraging families to be responsible for their own wastes is certainly acceptable; forcing them to accept any one technical solution is not. Extension workers should know when to bow out gracefully, leaving communication lines open, when communities decide (whether explicitly or implicitly) not to accept an innovative sanitation approach.
- Rather than succumb to the temptation of building the first toilet for public use, it is best to wait patiently until a few families decide to take the risk to experiment. Public toilets are notoriously dirty. Dry toilets are no exception.
- Several demonstration models are better than just one, to prevent the "brave" family from being pressured from all sides — either to succeed or fail. A "brave souls" support group can be helpful, with frequent trouble-shooting check-ups of the toilets by community workers.
- To counteract the destructive impact of "modern values" and conventional wisdom,

groups should be actively involved in a participatory critical analysis of their situation. If provided with the tools to make informed choices, participants will generally assume responsibility for making decisions regarding their impact on the environment. Whether they decide to construct a dry toilet or not, this learning process should benefit them.

- Alternative systems should be attractive. Supplying "modern-looking" urine-diverting toilet seats in a wide range of colours has helped tremendously, as have educational posters, which show dry toilets installed within a variety of settings, including "luxurious" bathrooms.

Future plans

Proposals for future work include:

- Developing a guide for the handling and use of the processed faecal material (including guidelines for laboratory analysis).
- Developing a guide on the handling and use of the urine.
- Updating the existing construction manual, including a range of toilet styles and construction materials.
- Updating the existing users operation and maintenance guide.
- Developing small posters on proper use, appropriate for hanging in the bathroom.

ESAC is particularly interested in modifying the dry toilet system to incorporate red worm "vermi-culture". It is anticipated that this innovation might require only one chamber, thus reducing construction costs, and result in a far superior compost product. ESAC is presently experimenting with vermi-composting of the harvested dry toilet compost, mixed with horse manure.

Additional laboratory analysis and research is necessary to determine acceptable levels of pathogen counts during different stages of the process and under different conditions. Thus far, the programme has relied exclusively on tests done by others.

The programme is beginning to make links with parallel urban composting centres to establish practical mechanisms for reuse of dry latrine output as the programme continues to expand.

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Low-cost sewerage

—Duncan Mara[1]

Research and development undertaken by the World Bank during 1976–1986 (1, 2, 3) has shown clearly that possession, proper use and maintenance of a sanitation facility are more important, in terms of improving health, than the actual sanitation technology employed, provided that it is affordable and socioculturally acceptable. Nevertheless, sanitation technology choices have to be made, and the principal choice is between on-site and off-site systems, as follows:

On-site technologies:
- VIP latrines (or other types of pit latrine)
- pour-flush toilets
- septic tanks

Off-site technologies:
- conventional sewerage
- low-cost (unconventional) sewerage
  - — settled sewerage
  - — simplified sewerage

These technologies are described in the literature (see, for example, Mara (4, 5), Mara and Sinnatamby (6), Otis and Mara (7), Sinnatamby (8), Bakalian et al. (9) and, more generally, Mara (10)). The two low-cost sewerage technologies are less well known. Yet, in low- income areas with an adequate water supply these are viable sanitation options —often, depending on housing density, they are the *only* feasible options. This article reviews these low-cost sewerage options, their potential and their limitations. It also provides guidance on how to choose the most appropriate option, and gives examples of their successful application (see also (16)).

Nomenclature of low-cost sewerage

Both settled sewerage and simplified sewerage use small-diameter sewers laid at shallow depths and in which the flow is, ideally, due to gravity. Other terms, such as small-bore sewerage, small-diameter gravity sewerage or shallow sewerage are unclear. The definitions used in this article follow the Portuguese terminology developed in Brazil (see (11)) and are outlined below.

Settled sewerage: a system in which wastewater from one or more households is discharged into a single-compartment septic tank (usually called a solids interceptor tank). The settled (or solids-free) effluent from the septic tank is then discharged into shallow, small-bore gravity sewers. Settled sewerage is thus the same as small-bore sewerage as described by Otis and Mara (7), small-diameter gravity sewerage (12) and common effluent drainage (13). (In Portuguese it is called *redes de esgotos decantados*; in French, *réseaux d'eaux usées décantées*; and in Spanish (17), *alcantarillado sin arrastre de sólidos*.)

Simplified sewerage describes shallow sewerage as used by Sinnatamby (8) and its in-block variant called backyard or condominial sewerage (15). This system does not

[1] Professor of Civil Engineering, University of Leeds, UK.

convey presettled sewage, and is essentially conventional sewerage stripped down to its hydraulic basics. (In Portuguese, it is called *redes de esgotos simplificadas*; in French, *réseaux d'eaux usées simplifiés*; and in Spanish, *alcantarillado simplificado*.)

Disadvantages of conventional sewerage

Conventional sewerage has two principal disadvantages — high cost and the need for an in-house water supply.

Costs

A World Bank study (1) of eight large cities in Africa, Asia and Latin America showed that, while the costs of conventional sewerage are highly site-specific, they are always very high. Capital costs in the 1980s ranged from US$ 600 to 4000 (1980 $) per household, and annual economic costs (i.e. amortized capital costs plus operation and maintenance costs, including the economic cost of water used for flushing toilets) were US$ 150–650 per household (1980 $). Low-income communities evidently cannot afford such costs, unless they are massively subsidized (which is unlikely in practice).

Water

Generally, conventional sewerage requires an in-house multiple-tap level of water supply service. This is because cistern-flush water-seal toilets (water closets) are normally connected to the in-house water supply. Most low-income peri-urban communities in developing countries do not have this high level of water supply. Instead, they often rely on hand-carried supplies from public tapstands (standpipes), shallow wells or surface waters. At best they may have a yard-tap supply (one tap per household, usually situated immediately outside the house). It has been reported that conventional sewerage can be operated with this level of water supply — for example, at Tondo Foreshore, Manila (17). However, this was before development of simplified sewerage, which is more appropriate with yard-tap water supplies.

Promotion of low-cost sewerage

As with all sanitation technologies, low-cost sewerage systems need to be promoted effectively so that they will be accepted by the community, and operated and maintained properly — this generally requires an effective partnership to be developed between the sewerage authority and the community.

Low-cost sewerage can be cheaper, depending on housing density, than on-site systems; and, when housing densities are too high for on-site systems (as in many peri-urban areas), low-cost sewerage — principally the condominial variant of simplified sewerage — is generally the *only* viable sanitation option.

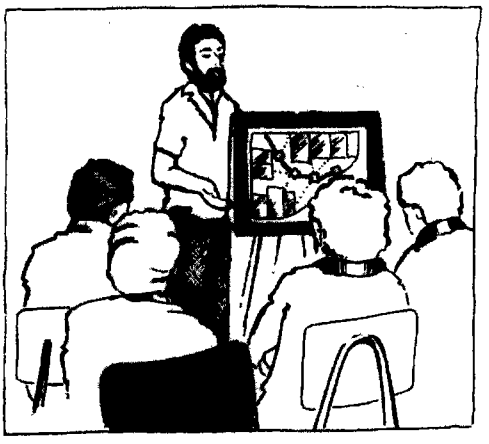

Figure 1. Promotion of lost-cost sewerage — here an engineer from the sewerage authority explains to the community how the system works, why it is appropriate, how much it will cost and what the operation and maintenance requirements are.

The sewerage authority must work closely with the community to promote low-cost sewerage (Figure 1). Costs and operation and maintenance responsibilities must be carefully explained, and an explanation also has to be given why other sanitation technologies are inappropriate.

Low-cost sewerage — technical descriptions

Settled sewerage

In a settled sewerage system (Figure 2), the sewers receive only settled sewage, and are designed very differently from conventional sewers. The most obvious differences are that they are not designed for self-cleansing velocities (i.e. velocities to ensure transport of solids), and that the flow in the sewers can change along their length, from normal gravity open-channel flow to full-bore pressure flow and then back to open-channel flow. In comparison with conventional sewerage costs, settled sewerage costs are quite low. This is mainly due to the shallow excavation depths and the use of small-diameter pipework (commonly 75–100 mm PVC), and the use of simple inspection boxes instead of large manholes. The pipes are carefully laid and simply embedded to avoid damage (this is usually easy as they are laid away from vehicular traffic).

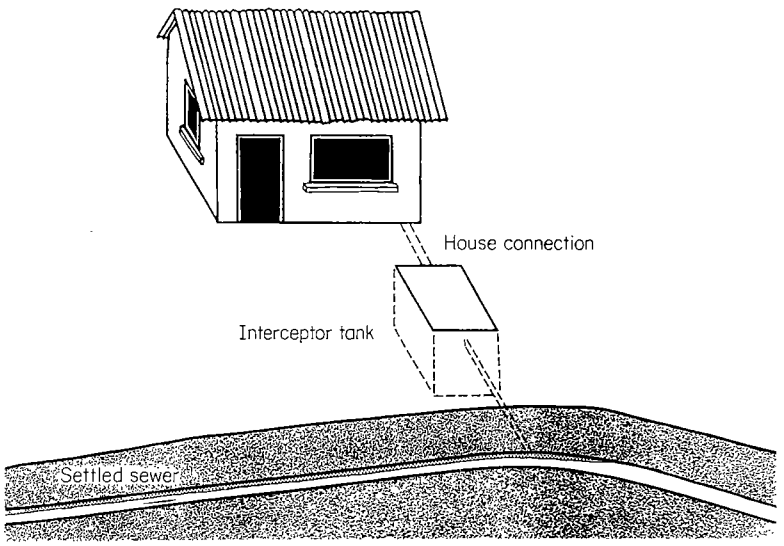

Figure 2. Schematic diagram of settled sewerage. The interceptor tank can be shared between adjacent houses to reduce costs in peri-urban areas.

Settled sewerage is most appropriate for areas which already have septic tanks, but where the soil can no longer accept all the septic tank effluent. So it is often a lower-cost solution in middle- or upper-income areas. Saving money in this way should mean that more public funds become available which can be used to serve low-income areas.

Settled sewerage was developed in Zambia (see below), and is now frequently used in Australia (where it is called common effluent drainage), and also in the United States, Colombia and Nigeria. Its increasing use in the United States for new housing developments is due to its low cost (around 50–60 per cent of conventional sewerage) and the fact that, from the users' perspective, it differs little from conventional sewerage.

Simplified sewerage

Simplified sewerage systems are designed to receive all household wastewater without settlement in solids interceptor tanks. Small-diameter sewers laid at shallow gradients are used to convey the sewage. The sewers are often laid inside housing blocks (Figure 3), when the system is known as condominial sewerage; or they may be laid outside the block, usually under the pavements on both sides of the street, rather than in the middle of the road, as is the case with conventional sewerage.

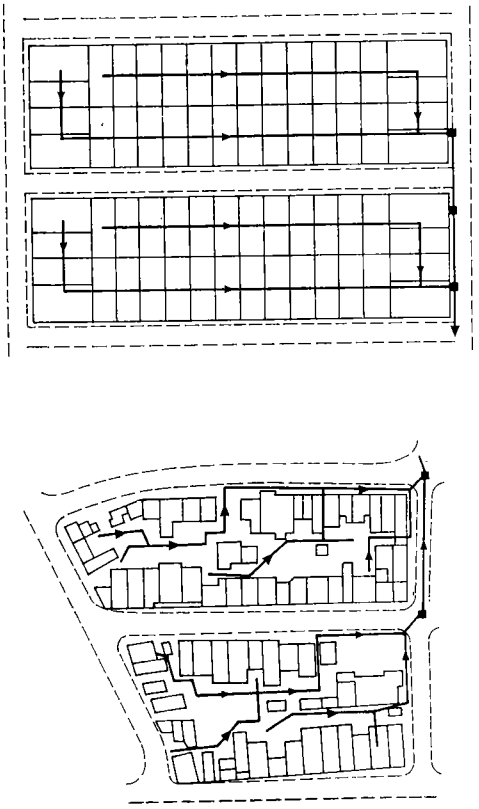

Figure 3. Schematic diagram of condominial sewerage in both planned (top) and unplanned (bottom) peri-urban areas.

The costs of simplified sewerage systems are low (see below), sometimes even lower than those of on-site sanitation (Figure 4). This is because simplified (especially condominial) sewerage, in common with settled sewerage, uses shallow excavation depths, small-diameter pipework and simple inspection units (in place of large manholes). Additionally, the sewer gradients of a simplified sewerage system are much flatter than those of a conventional sewerage system. For example, UK practice for conventional sewers is to lay a 150 mm diameter sewer at a gradient of 1 in 150 (i.e. 1 m vertical to 150 m horizontal, or nearly 0.007 m/m) (18). In contrast, the earliest simplified sewerage schemes in northeast Brazil used 100 mm diameter sewers laid at 1 in 167 (0.006 m/m), and more recent schemes (based on minimum tractive tension, rather than minimum self-cleansing velocity) use a 100 mm sewer laid at 1 in 255 (0.004 m/m).

Simplified sewerage is most appropriate in high-density, low-income housing areas which have an on-plot level of water-supply (i.e. one tap or more per household) and no space for on-site sanitation pits or for the solids interceptor tanks of settled sewerage. It was developed as condominial sewerage in the early 1980s by CAERN, the water and sewerage company of the state of Rio Grande do Norte in northeast Brazil, as an affordable solution to the until then intractable problem of how to provide sanitation in high-density low-income areas (see below). It works well owing to the high initial rate of connection to the network (often well over 90 per cent; with conventional sewerage it can take many years to reach this level of connection), and when resulting sewage flows are correspondingly high. Blockages are very rare, even in the upper reaches of the network where the flow is intermittent: solids progress in a sequence of deposition, transport, deposition, transport until the sewer has drained a sufficiently large area for the flow to cease being intermittent. This deposition-transport-deposition-transport sequence is more efficient in small-diameter sewers than in large-diameter sewers.

Simplified sewerage systems are now used widely in Brazil and elsewhere in Latin America, and were introduced to Pakistan in 1985 in Christy Nagar, a very low-income slum area of Orangi in Karachi (see below). Simplified sewerage, especially its condominial version, without doubt represents one of the most important advances ever made in sanitation. Given the extremely high rate of urbanization which is creating high-density

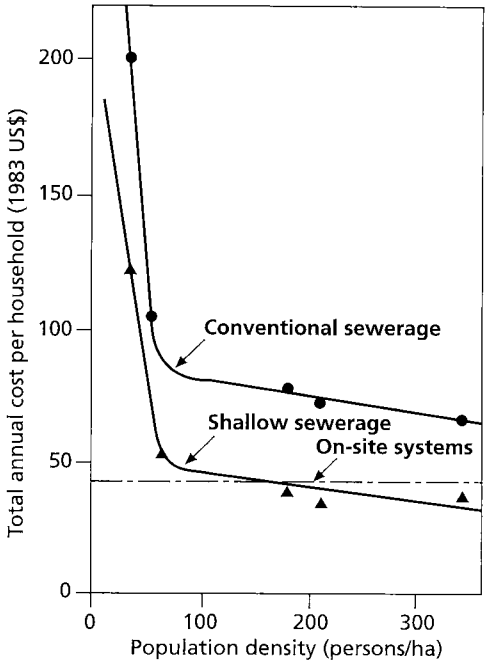

Figure 4. Variation of annual costs per household of conventional sewerage, condominial sewerage (formerly called shallow sewerage) and on-site sanitation systems with population density. Data from Natal, northeast Brazil, showing that in this case condominial sewerage becomes cheaper than on-site sanitation at a population density of 160 persons per hectare.

low-income areas in many developing countries, it will often be the only technically and institutionally feasible, economically appropriate and financially affordable sanitation option.

The case for settled sewerage

The case for settled sewerage has to be made on financial grounds. If the community already has septic tanks, and assuming the soil can no longer accept the septic tank effluent, settled sewerage will probably be cheaper than simplified sewerage. This must of course be checked in each case.

If the soil can no longer accept septic tank effluent because in-house water consumption is high (>100 litres/caput/day) and wastewater generation correspondingly high, in-house water conservation techniques, such as the installation of water-saving plumbing fixtures (see (19)) should be seriously considered in order to reduce the wastewater flow so that the soil's capacity to accept the septic tank effluent is restored.

The case for simplified sewerage

Simplified sewerage is worth considering as the sanitation technology of first choice for low-cost urban sanitation programmes and projects, especially those for high-density areas. But only if simplified sewerage is confirmed as:

— cheaper than on-site sanitation, and

— cheaper than settled sewerage.

Generally, though, the only areas for which simplified sewerage would not be the cheaper alternative are areas of low population density or areas already served by septic tanks (even currently malfunctioning septic tanks).

A decision must also be made concerning whether to adopt condominial (or backyard) sewerage or in-street sewerage. The former is more generally favoured in northeast Brazil, for example, and the latter in southern Brazil where SANEPAR, the water and sewerage company of the State of Paraná, often installs "double sewers", i.e. a sewer on each side of the street under each pavement. Whether the reasons for this are always valid is not clear, but "double in-street simplified sewerage" is around two-thirds more expensive than condominial sewerage (10, 20).

Selection criteria for low-cost sewerage

Costs

Cost — both economic and financial — is the most important criterion (1, 2). Costs must be evaluated with care taken to ensure that all costs, including, for example, those borne by the householders are taken into account. Generally, the most appropriate method is to determine the total annual economic and financial costs per household based on average incremental costs using the techniques of discounted cash flow analysis (i.e. converting future capital and operation and maintenance costs to their present values — see (2), chapter 4).

Unfortunately such annual costs are not usually calculated. The World Bank (9) and the Pan American Health Organization (21) quote the following ranges for the capital (i.e. investment) costs of sewerage (excluding the cost of sewage treatment) in Brazil:

Settled sewerage (northeast Brazil)	US$ 35–85 per person
Condominial sewerage (northeast Brazil)	US$ 65–105 per person
Simplified sewerage (southern Brazil)	US$ 170–240 per person
Conventional sewerage (southern Brazil)	US$ 240–390 per person

The costs of settled sewerage obviously depend on whether or not households already have septic tanks. As for simplified sewerage, the condominial (backyard) version is significantly cheaper than the non-condominial version (and very much cheaper than conventional sewerage). Condominial sewerage is therefore generally to be preferred. The financial costs of condominial sewerage are still very low though. In Natal in northeast Brazil (where condominial sewerage was developed in the early 1980s), capital costs in 1981 were USS$ 325 per household; the Water and Sewerage Company was able to recover its costs over a 30-year period by surcharging the water bill by only 40 per cent (rather than by the 100 per cent for households served by conventional sewerage). The charge for water was the "minimum tariff" (i.e. an assumed unmetered consumption of 15 m^3 per household per month) of US$ 3.75. So the financial costs of simplified sewerage were really low: only US$ 1.50 per household per month (8, 22, 23).

Water supply

Ideally, an on-plot level of water supply should be available, although in Pakistan, simplified sewerage works well with a hand-carried water supply service level (see below).

Population density

As shown in Figure 3, population density is a key parameter in determining the cost and appropriateness of low-cost sewerage. In Natal in northeast Brazil, condominial sewerage was cheaper than on-site sanitation systems at a population density of 160 persons per hectare, but this must be checked in each particular case.

Community participation

The success of condominial sewerage in northeast Brazil is the result of an effective partnership between the sewerage authority and the community. The community is responsible for the operation and maintenance of the condominial sewers within the housing block. The sewerage authority is responsible only for the public sewers (i.e. the sewers outside the housing block). Assignment of these responsibilities must be dis-

cussed with the community before such a scheme is implemented. Community members must understand what their responsibilities are to be and why these responsibilities have been assigned to them (generally to reduce sewerage costs and enable a service to be provided). Essentially these responsibilities tend not to be great, involving only the removal of blockages (which are extremely rare and normally due to wilful abuse of the system). In Brazil, the community usually devolves its responsibilities to individual householders. In practice, this means that they are responsible for operation and maintenance of the length of condominial sewer which passes through their property (24, 25).

Institutional appropriateness

Usually, sewerage authorities are perfectly willing to accept responsibility for low-cost sewerage schemes. This is very important as they do not generally accept responsibility for on-site sanitation systems, leaving this to the municipal council, which may or may not be able to discharge the associated tasks (especially emptying of latrine pits) effectively. On-site systems are consequently often not fully satisfactory. In contrast, a good partnership between the sewerage authority and the community means that low-cost sewerage systems are operated and maintained very well (25).

The wastewater collected in low-cost sewers requires **treatment** before discharge into a surface watercourse or reuse for crop irrigation or fish culture. Usually, the most appropriate treatment process is carried out by **waste stabilization ponds** (see 26, 27 and 28). It is also worth noting that on-site systems can be upgraded over time, with corresponding improvements in water supply, to settled sewerage systems (see 2, 10).

Table 1 summarizes the characteristics, advantages and disadvantages of both settled and simplified sewerage.

Field examples of low-cost sewerage

Settled sewerage in Zambia

Settled sewerage was originally developed in the late 1950s by Mr L J Vincent, Manager of the then African Housing Board of Northern Rhodesia (now the Zambian National Housing Authority) (29). Conventional and sullage aqua-privies did not work well in Northern Rhodesia and so settled sewers were developed to remove the settled wastewater (toilet wastes and sullage) from the aqua-privy tanks. The first such system was installed in 1960 at Kafue, an industrial township 50 km south of Lusaka (30). The land here, known as the Kafue Flats, is very flat, with a fall of only 1 in 2000. The sewers were designed for daily peak velocity of 0.3 m/s, and the pipes were 100 mm minimum in diameter, laid at a minimum gradient of 1 in 200. They were designed to flow when only partially full and not, unlike the more recent North American systems described by Otis (7), for surcharged flow. The system at Chipanda in Matero Township, Lusaka, is described below; but several others exist and are described elsewhere (31, 32, 33).

The Chipanda system was installed in 1960 and serves 532 households. Each aqua-privy block serves four households. Each household has a water tap and a sink immediately outside its toilet compartment which discharges its sullage into the aqua-privy tank (Figures 5 and 6). The tank effluent discharges, via a 100-mm diameter asbestos cement connector pipe, into a 150-mm diameter asbestos cement lateral sewer which runs between most of the compounds. Originally the settled sewage was treated in a series of waste stabilization ponds, but these were abandoned when the settled sewers were connected to the city's expanded conventional sewerage system.

Table 1. Summary of characteristics, advantages and limitations of settled and simplified sewerage

	Settled sewerage	Simplified sewerage
Initial requirements:	Adequate water supply (preferably on-plot, although the system can work with hand-carried supplies).	Adequate water supply (preferably on-plot, although the system can work with hand-carried supplies).
Main characteristics:	Household wastewater is settled in a solids interceptor tank (single-compartment septic tank). Tank effluent discharged into small-diameter (75 mm minimum) commonly plastic pipes laid at shallow depth, at an inflective gradient. Wastewater treated in facultative and maturation ponds (or discharged into conventional sewer system).	Household wastewater discharged directly (i.e. without settlement) into small-diameter (100 mm minimum) plastic or vitrified clay pipes laid at shallow depth and low gradients (e.g. 1 in 270 (0.0037 m/m) for a 100-mm diameter pipe serving up to 1200 people). Wastewater treated in anaerobic, facultative and maturation ponds (or discharged into conventional sewer system).
Suitability criteria:	Most suitable in areas with existing septic tanks.	Most suitable in high-density low-income areas.
Principal limitations:	Sewerage authority has to assume responsibility for regular (e.g. annual or biennial) emptying of solids interceptor tank, and ensure that only settled sewage connections are made to the sewers.	Community has to accept responsibility for operation and maintenance of condominial sewers laid within the housing block.
Requirements for operation and maintenance:	Sewerage authority: regular inspection of sewers; maintenance of any lift stations; interceptor tank desludging; operation of treatment works.	Community: removal of any sewer blockages within housing block. Sewerage authority: regular inspection of ex-block sewers;* maintenance of any lift stations; operation of treatment works.
Costs: (These are indicative costs. Local costs must be properly estimated).	USA: capital costs of around 50–60% of conventional sewerage in areas where new solids interceptor tanks are installed (less in areas with existing septic tanks).	Northeast Brazil: capital costs of US$ 300–500 per household (compared with US$ 1500 per household for conventional sewerage).

* Ex-block sewers are laid in the public domain, i.e. under a pavement or street, as opposed to inside a housing block or within a private domain. The community would be responsible for maintaining sewers inside housing blocks.

Condominial sewerage in Natal, Northeast Brazil

Shallow sewerage was first developed in the low-income settlements of Rocas and Santos Reis in the city of Natal, the capital of the northeast Brazilian State of Rio Grande do Norte, by the Sanitation Research Unit of the State Water and Sewerage Company (CAERN) (8, 22). Rocas and Santos Reis are two neighbouring squatter settlements where approximately 15 000 people have settled, giving an overall population density of 350 persons per hectare. These settlements were spontaneous and essentially wholly unplanned.

The 3100 houses and buildings in the area were distributed over 86 blocks. Over half the houses were located on plot sizes less than 80 m^2 and had constructed areas of less than 60 m^2. They were therefore contiguous on at least one side with neighbouring properties with little or no space between them. Some space was usually available at the back of the house for a small garden. Income levels were exceptionally low, with two-thirds of the population earning subsistence wages below the country's poverty line.

Despite such a low level of income, the granting of land titles to the householders had, over the years, encouraged the use of good quality construction material throughout most of the two areas. A yard-tap level of water supply was available and only a minimum water tariff levied from the majority of the premises, because of the small sizes of the plots. A quarter of the houses were not connected to any water-supply service, but shared supplies with their neighbours. Most houses had a conventional but manually-flushed ceramic toilet bowl which was connected to leachpits constructed within the plot area; sullage was discharged into the street in front. The high density of the settlement and the need for frequent leachpit desludging meant that the community was very dissatisfied with the system.

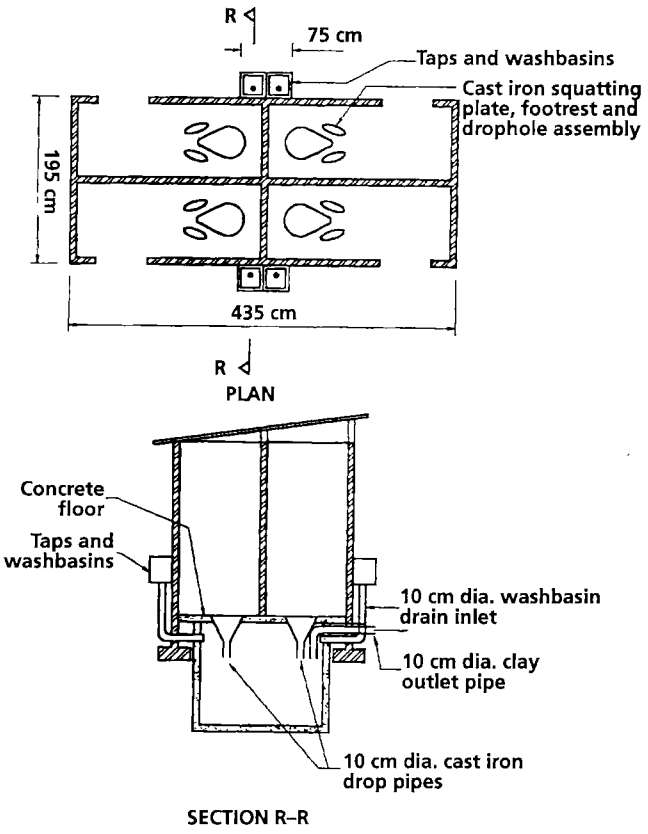

Figure 5. Typical sewered aqua-privy in Chipanda, Matero (Zambia).

Although CAERN had a plan to serve the area with conventional sewers, it was evident that this would prove neither technically nor economically feasible, and that only a small proportion of house connections could be made. Meetings were held with the community to discuss the problem of sanitation in the area, and the advantages and disadvantages of various sanitation systems, including conventional and condominial sewerage. A condominial sewer system was proposed but the community feared that its operation might not be trouble free. One block, consisting of 28 houses, was therefore selected for a pilot test, and plans for laying in-block sewers were prepared. Each household consented to the construction of a common house connection in its backyard and agreed to be responsible for the

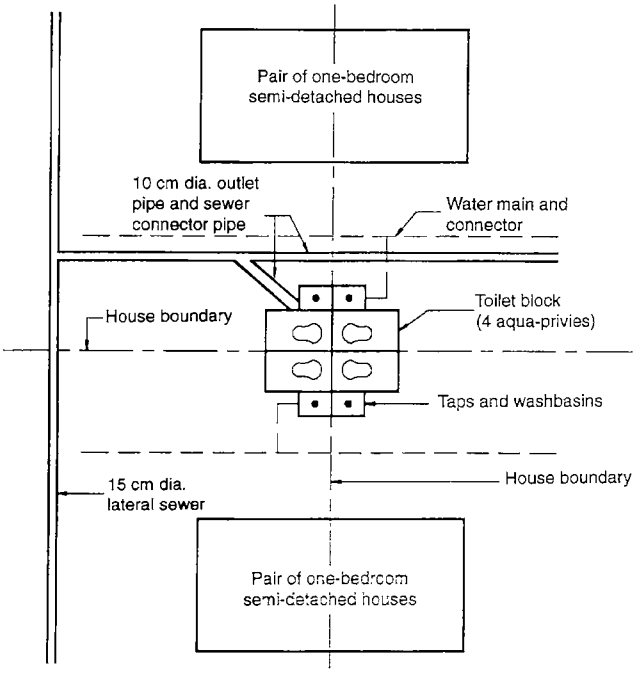

Figure 6. Typical sewered aqua-privy block in Chipanda, Matero (Zambia).

maintenance of the length of sewer laid within its property; a simple inspection chamber was built for this purpose at each household connection to the sewer.

The pilot in-block condominial sewer was constructed in 1981 and operated for over a year while the planning of other block and street sewers proceeded. Block meetings were then arranged for the remaining 85 blocks, and residents in these blocks were encouraged to visit the pilot block and talk to the people living there to obtain their views on the system. This led to spontaneous acceptance of the system and a great demand to extend it to the remaining blocks. An unprecedented connection rate of 97 per cent was achieved in the first year of construction.

Within five years, the shallow sewer system was also being used in other towns within Rio Grande do Norte and was being implemented in all low-income housing schemes in the State without exception. During this period, it also began to be used in other states in Brazil such as Pernambuco, Rio de Janeiro, Minas Gerais and Sergipe. More recently, condominial sewerage has been used on a very large scale in Brazil through the World Bank PROSANEAR I Project (Table 2).

Table 2. World Bank PROSANEAR Project statistics

State	City	Number of beneficiaries	Capital cost per person (US$)
Pará	Belem	126 000	232
Ceará	Fortaleza	186 000	78
Pernambuco	Recife	9 000	209
Rio de Janeiro	Rio de Janeiro	445 000	87
Angra dos Reis		70 000	61

Source: World Bank. *People, poverty and pipes: the power of community participation and low-cost technology to bring water and sanitation to Brazil's slums*. Washington, D.C., The World Bank (Infrastructure and Urban Operations, Department 1, Latin America and Caribbean Region), 1996.

Condominial sewerage in Orangi, Karachi, Pakistan

Approximately 40 per cent of Karachi's population lives in squatter settlements (locally termed "katchi abadies"). Orangi, the largest squatter settlement in Karachi and in Pakistan, is situated 12 km from the centre of the city. It has an estimated population of 800 000, settled in sub-standard conditions in an area covering approximately 2000 hectares. At the start of the project, average household incomes were at subsistence levels, and infant mortality and the incidence of excreta-related infections were both high.

The settlement was a result of migration from the former East Pakistan, which had taken place during the period immediately before and after the creation of Bangladesh. Although the largest of the katchi abadies, Orangi lacked the minimum of basic infrastructure and essential amenities. In March 1983, the Bank of Credit and Commerce International Foundation (BCCI), in collaboration with UNCHS (Habitat), initiated a three-year community development project, aimed at improving the living conditions of the people of Orangi (see (8)).

The project aimed to promote implementation of low-cost infrastructure interventions, particularly for sanitation, given the urgent need for sanitation improvement in the project area. The water supply to Orangi was via unevenly distributed communal standpipes which operated for four hours a day only, in the afternoon. Water was stored in in-compound tanks in most of the houses; on average, 20 to 30 litres were used by each household member each day. Only rudimentary plumbing fixtures were present in the area, and most washing was confined to a special wet room used for both bathing

and washing clothes and utensils. The most common form of sanitation in the area was bucket latrines and the socio-religious custom of using water for anal cleansing necessitated the carrying of water to the toilet. "Scavengers", who undertook the removal of excreta from the bucket latrines, charged US$ 1 per month for the service, but no provision existed for the disposal of sullage.

In 1984, Chisty Nagar, a Bihar community within Orangi, was selected as the first location to start the condominial sewerage programme. The project area contained 555 plots, 408 of which had houses built on them, and an average gross population density of 193 persons per hectare. A remarkable feature of the area was the regularity of its urbanization, with average plot sizes of 100 m^2, 50 per cent of which, on average, was occupied by the house. Even more remarkable was the existence of a service lane, designed to provide access for nightsoil removal by the scavengers.

General community meetings were held after midday prayers at the mosque on Fridays. Local community leaders were selected and the programme was described. Discussions held with the community revealed a preference for some form of waterborne sanitation, but conventional wisdom dictated that the unreliable intermittent water supply and low levels of water consumption in the area would rule out use of conventional sewerage. Average water consumption was found to be 27 litres per person per day; with conventional sewerage, consumption is much higher, generally over 100 litres per day.

Only condominial sewerage offered any chance of success. Although condominial sewers had not been previously installed under conditions of such limited water use, and with manually flushed ceramic toilet squat pans, their mode of operation suggested that they would nevertheless function satisfactorily. An analysis of the costs of various sanitation options also indicated condominial sewers to be one of the cheapest options. It was therefore decided that condominial sewerage should be implemented in Chisty Nagar.

Meetings were held with the community to present the proposed designs and to establish a procedure for raising the required capital which had to be found in full by the community. The community nominated a trusted member to be the custodian of the funds raised. It was also envisaged that maintenance committees would be established as social mobilization advanced, in order to maintain the condominial sewers after installation.

Condominial sewers, laid in the service lanes (until then only used by scavengers for emptying nightsoil buckets), were designed according to criteria similar to those developed in Brazil; they received the wastewater from the manually flushed squat pans and all household sullage. A grit/grease trap, made of cement mortar (including fine aggregates) was provided in each house, as the main point of sullage collection and as a preventive maintenance device. One inspection chamber was provided to serve two plots, and each water closet connection was appropriately ventilated. In addition to the service lane sewers, an interceptor sewer was constructed to drain the lane sewers into a communal septic tank. The effluent from the tank was discharged to the nearby dry water course.[1] The shallow sewer layout adopted in Chisty Nagar is shown in Figure 7.

The internal plumbing and lane sewers comprised 30 and 31 per cent respectively of the total cost, which amounted to approximately US$ 45 per plot. An alternating twin-pit pour-flush toilet, which disposes of excreta only, would have cost approximately US$ 51. As in northeast Brazil, condominial sewerage was cheaper than on-site sanitation.

[1] In most circumstances this is not the best solution. Whenever possible, wastewater should be treated before discharge.

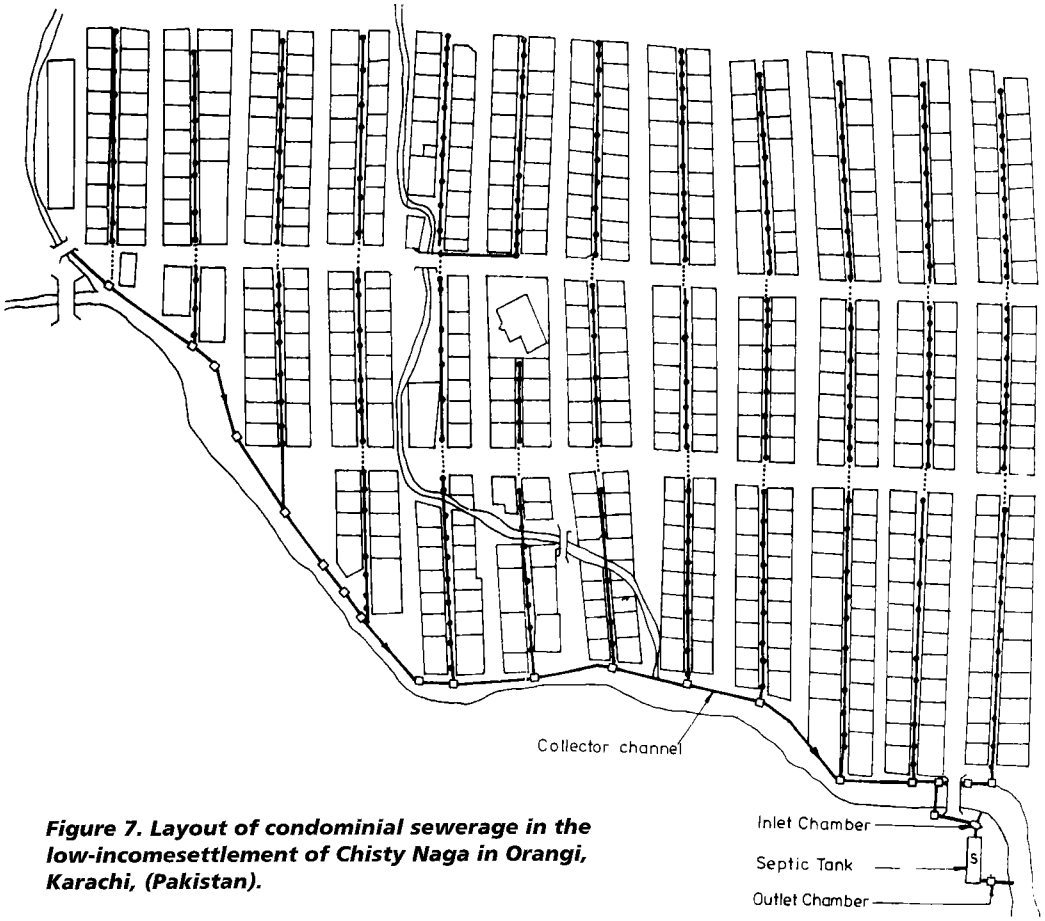

Figure 7. Layout of condominial sewerage in the low-incomesettlement of Chisty Naga in Orangi, Karachi, (Pakistan).

Following the success of this first BCCI/UNCHS condominial sewerage project in Chisty Nagar, the system was soon also applied in other parts of Orangi, eventually becoming known as the Orangi Pilot Project. So far, around 750 000 poor people have been served by condominial sewerage — a very successful example of technology transfer from one developing country (Brazil) to another (Pakistan).

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Worm composting and vermitechnologies applicable to sanitation

—*S. Zorba Frankel*[1]

The past two decades have seen renewed interest in finding ways to harness earthworms to convert our increasing amounts of organic waste into humus. Various types of earthworm are being used to turn "waste" into a useful resource and enabling some existing waste treatment systems to be operated more efficiently. Waste treatment systems that incorporate worm technologies can accept a wide range of organic matter inputs, including human excreta, can destroy pathogens over time, and create a nutrient-rich soil amendment as a product.

Some of these systems can be built with simple materials, and on small budgets. They can be built to varying sizes to serve different-sized families and communities. Many require little or no water beyond the amount provided by the organics.

This article provides basic definitions and explanations of vermicomposting and "vermiculture ecotechnology", and describes their successful use in many different settings. More information on these projects may be obtained from the publications listed at the end of the article.

What is vermicomposting?

Vermicomposting (worm composting) is the conversion of organic wastes by surface-dwelling earthworms into worm castings (excreta). The redworm species *Eisenia foetida* and *Lumbricus rubellus* are most commonly used in vermicomposting. In nature they are often found where leaf or other organic litter falls onto the surface of the soil and remains damp. In that setting they play the role of "emergency clean-up crew." When harnessed, their natural abilities in reproducing quickly and eating up to their weight in organic materials each day are taken advantage of.

In many vermicomposting systems, and particularly those in homes, schools and industries in industrialized countries, redworms are housed in bins. Bins are most often made of wood, but plastic, metal or any material which is not dangerous to the worms' survival can also be used. Some manufacturers offer popular plastic bins for home use, designed with holes for aeration. Models also exist that sport such features as a lower chamber and spigot to collect and drain "worm tea" for watering plants, as well as multiple-worm composting layers, and even a mechanical device for harvesting castings.

As with traditional composting, a balance is sought between carbon-rich materials like leaves and straw, and nitrogen-rich material like food waste and manures. Usually, these two types of material are mixed or layered in the worm beds to ensure more complete decomposition and a good finished product. Worm bins in home settings are first filled with moistened carbon-rich bedding like straw, leaves, or shredded newspa-

[1] Managing Editor, *Worm digest*, Eugene, Oregon, USA.

per. Then a small amount of garden dirt is added (the tiny rock particles aid the redworms' digestion), and finally the redworms are introduced into their new homes. Feeding can be daily or less often, depending on the user's schedule. Redworms will eat about half their own weight in food wastes per day (in most bins, under average conditions). As the bedding decays via the activity of bacteria, the worms will simply begin eating it, too! Castings can be harvested within three to five months, depending on how finished a product is desired. After harvesting (there are several methods), the worms are put back into their bin with fresh bedding, to begin the process over again. These are the most basic instructions for small worm bins. For more detailed information, consult the publications listed at the end of this article.

The following are project examples using redworms which have been reported by *Worm digest*, a US magazine.[2]

School lunch "wastes" not wasted

At Mill City Middle School in Mill City, Oregon, USA, sixty 5th-grade students use redworms, in a well-designed bin, to vermicompost their food waste. They built five OSCRs (Oregon Soil Corporation Reactor, named after the company that designed it) from plans they purchased. The OSCR is a tall, rectangular plywood bin with large upper and lower chambers separated by nylon rope weaving back and forth every few inches. The upper chamber houses the redworms, and there is a plywood lid to keep pests and light out. Students add food and paper waste to the upper chamber each schoolday. As the composting mass grows higher and the redworms move upward, they leave their castings below, suspended above the nylon rope. The lower chamber, accessed through a hinged door, is a collection area for finished castings. A small rake is used to dislodge the castings into the lower chamber, from which they are easily removed. Although only a year old, this project has converted the food wastes of these sixty students into worm castings, and both students and teacher are enjoying working with worms.

Turning hog manure into a resource

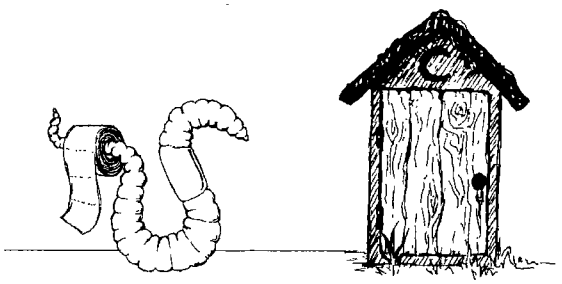
Vermicycle Organics, Inc., in Charlotte, North Carolina, USA has tested the use of redworms to process hog manure into organic fertilizer on a farm in their region. Partners Tom and Chris Christenberry (who, as farmers, had previous experience with worm composting) and Michael Edwards began their tests with open-field worm composting, but found that weather created problems, including a poor end-product. Now they separate the liquids from the solids in the manure and each week spread over five tons of manure solids in thin layers on top of several long, raised wooden worm beds in a greenhouse. A shade cloth, automatic misters, fans and greenhouse curtains help to keep conditions optimal for the redworms. Their product, Vermicycle™ Worm Castings, has been received well by retail outlets and the three partners plan to expand their work to more farms soon.(1)

[2] *Worm digest* began publishing in 1993 with the aim of promoting the raising of redworms to convert organic wastes into humus in households and schools. The range of vermitechnologies known and promoted has widened since then, but vermicomposting with redworms in bins remains the most well-known method. Interest in worm composting in the US seems to be growing, judging from the increased media coverage of worms, worm curricula in schools, and the growing number of requests for *Worm digest* subscriptions, publications and assistance.

Vermicomposting toilets

Clivus Multrum

Aerobic composting toilets are already used in many parts of the world to turn human waste into soil (2). Redworms can enhance their operation, requiring only the addition of a simple moistening system. Such has been the experience with the Clivus Multrum system which has made regular use of redworms for the past five years. The Clivus system was first created in 1939 in Sweden, and sold in the US and elsewhere by Clivus Multrum, Inc. beginning in 1973. A typical home might include an ultra-low-flush toilet, a kitchen waste-disposal chute and a large composting chamber below the floor or in a basement. "Clivus" means slope, named for the sloping plane within the composting chamber that directs liquids to a separate area below the composting mass, from which it is then removed by pump. A fan-driven ventilation system vents odours from the toilet room. A family of four can expect to remove small quantities of (solid) compost via a door at the front of the composting chamber after a period of one to several years. An estimated 10 000 Clivus Multrum toilets are in use worldwide.



AlasCan

Clint Elston of Minnesota has developed a worm composting system for colder climates. He had experience selling Clivus Multrums while living in Colorado. But when he installed them in Alaska (where most rural villages do not have adequate sanitation systems), he found that the Clivus systems did not operate well due to the extreme cold. So, over twenty years ago, he began work on the AlasCan system, a complete organic conversion system for households. At the heart of the system is the vermicomposting tank, which accepts toilet wastes from an ultra-low-flush toilet (a marine toilet) and from a dedicated kitchen sink with a waste-disposal unit. The tank is super-insulated (R-20+) and pre-warmed by house air in a heat exchanger. The other main component of an AlasCan system is the wastewater treatment system, which accepts all household greywater (including from showers, bathtubs, sinks and washing-machines). The AlasCan system is designed for minimal user involvement and uses motor-driven agitators, a pump, sprayer and exhaust fan to ensure continuous good functioning. According to AlasCan, the system produces about 10 cubic feet of vermicastings per year for a household of two adults and two children. The system's cold-weather capabilities have won it some acclaim. At this time, Buckland, Alaska, a village of 82 homes, has passed resolutions to install the AlasCans exclusively, and has contacted another village in order to help them do a pilot project.

Vermiculture ecotechnology

Dr Uday Bhawalkar is director of the Bhawalkar Earthworm Research Institute in Pune, India. He researches and designs systems that use aerobic bacteria and burrowing earthworms to convert organic wastes (including human excreta) into humus. He calls the basic method he developed "vermiculture ecotechnology" in which "diverse organics, via an already-operating ecosystem (bacteria, managed by burrowing earthworms), are turned into plant nutrients." The key players are aerobic bacteria living in the earthworm's burrow, gut and surrounding soil, plus the earthworms themselves, which

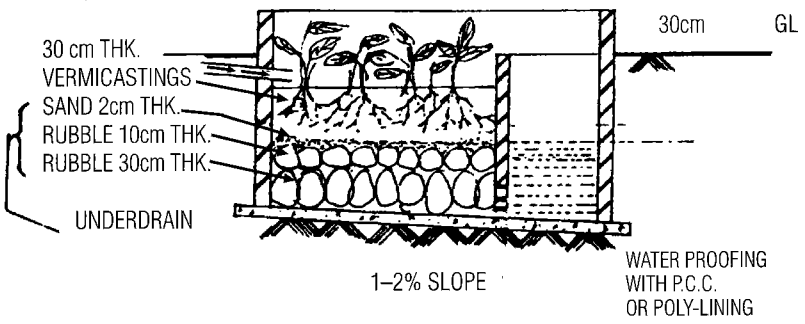
preferentially encourage good bacteria while discouraging unwanted (anaerobic and pathogenic) bacteria.

When choosing a site for vermiculture ecotechnology, a root zone must be available. If the site does not already have plants growing on it, then some trees or taller bushes must be planted there. Next, a thin layer of organic wastes is applied directly on the soil, along with some rock dust (powder) to provide necessary plant minerals and to balance the pH. A moisture-retaining layer of leaves or straw, etc., may be added. When available, some of the vermicastings from another site will get things started more quickly, especially if the soil is not already very biologically active. Food waste can be added at an increasing rate, as bacteria and worm populations grow. Again, for more detailed instructions, consult the books in the resources section.

In India, Dr Bhawalkar has put vermiculture ecotechnology to work at many sites with varying organic waste sources. Most notable has been the project at Venkateshwara Hatcheries, Ltd., in Pune. This poultry processing plant produces four tons of poultry offal daily, which goes to twenty 120 m^2 concrete bins inoculated with a culture of the native burrowing species, *Polypheretima elongata*. Trees have been planted along the mid-line of the bins and, judging by their health, provide assurance that the vermiculture is proceeding well. Bhawalkar calls what is left after the bacteria and worms have worked through the material "biofertilizer". These microbially-rich vermicastings, full of beneficial bacteria, are sold to farmers under the name of "Biogold". Venkateshwara Hatcheries, Ltd. plans to use vermiculture ecotechnology at its other 12 operations in India as well.

Although Dr Bhawalkar has shifted his focus to another, newer vermitechnology, several people are still very active in spreading the use of vermiculture ecotechnology. Rahul Babar, a partner in NRG Tech Consultants, offers expertise in vermiculture ecotechnology for setting up complete and ready-to-use solid and liquid waste management projects. Shantu Shenai, director of the Green Cross Society and SOS (Save Our Selves) in Bombay, India, has initiated nearly 20 projects in that area using the Bhawalkar method.

Figure 1. Cross-section of vermifilter



In the vermifilter a group of selected plants provide an active root matrix that creates the desired microclimate for both bacteria and earthworms. This root matrix feeds on the inorganics and other growth factors produced by the bacteria and earthworms, while at the same time sending biofeedback to the bioprocessors, letting them know what the plants need. There is little operation and maintenance required, provided the designed loading rate is not exceeded. (Typical design parameters: Hydraulic loading up to 0.5m/day and organic loading up to 1kg/m2/day). Stephen White, from *Worm digest* #8.

Vermifiltration of sewage

The vermifiltration of sewage (3) is an application of vermiculture ecotechnology designed by Uday Bhawalkar. It was adopted at the Sahjeewan School at Panchgani (Maharashtra) after the failure of their septic system due to clayey soil. The project was set up by Bhawalkar, and by 1995, was handling the waste of over half of the school's student population of 750.

The Sujala technique

Dr Bhawalkar is currently involved in promoting his newest technique, "Sujala" (which means "clear water" in Hindi). The technique makes use of the beneficial bacteria fixed on the castings of a specific species of earthworm (again, *Pheretima elongata* in projects in India). Sujala is in use at the Taj Group of Hotels in India. These hotels, located in remote sites, sought to use natural methods for wastewater treatment. V. Mahendrakar and B. B. Hallett (4) report in issue #15 of *Worm Digest*: "In the existing septic tanks, by adding Sujala, BOD [biochemical oxygen demand] levels were reduced from 200 mg/l to about 30 mg/l and odour was reduced and water clarity increased in 3–4 weeks of operation. Approximately 150 kg of Sujala bacteria were added to a 15 m^3 septic tank." To summarize, after three to four months they saw an increase in pH from 6.5 to about 7.1 and an end to odours, a BOD and COD [chemical oxygen demand] reduction of between 50 and 80 per cent, water output at a quality level for use in the garden and a savings of about US$ 16 per day in electricity.

Conclusion

Presently we have a great need for efficient systems that process our increasing organic wastes. At the same time, in many parts of the world, our soils are growing poorer because we do not return to them as many or more nutrients than we take. Both problems have a common solution: we need only ask the capable earthworm for its help.

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(2) Rapaport R. Aerobic composting toilets for tropical environments. *Biocycle journal of composting and recycling*, July 1996, 77–82. (*Biocycle*, 419 State St, Emmaus PA 18049, USA. Tel: +1 610 967 4135.) Single copies US$ 6.

(3) White S. Vermifiltration of sewage, now being done in India. *Worm digest* #8, 1995. (*Worm digest*, PO Box 544, Eugene, OR 97440-0544, USA. Tel: +1 541 485 0456. E-mail: zorba@wormdigest.org)

(4) Mahendrakar V, Hallett BB. *Worm digest #15* (see address above).

Background reading

Worms eat my garbage by Mary Appelhof (2nd ed., 176 pgs). The definitive book on small-scale vermicomposting for adults. (Available from *Worm digest* for US$ 13.)

Worms eat our garbage: classroom activities for a better environment by Mary Appelhof (215 pgs). (Available from *Worm digest* for US$ 25.)

Squirmy wormy composters by Bobbie Kalman & Janine Schaub (32 pgs). The definitive book for young people on worm composting. (Available from *Worm digest* for US$ 9.50.)

Turning garbage into gold by Dr Uday Bhawalkar of the Bhawalkar Earthworm Research Institute (40 pgs.). A good theoretical introduction to vermiculture ecotechnology work. Not a how-to book. (Available from *Worm digest* for US$ 15.00.)

Vermiculture ecotechnology by Dr Uday Bhawalkar of the Bhawalkar Earthworm Research Institute (283 pgs). A treatise on commercial-scale vermiculture. (Available from *Worm digest* for US$ 150.00. Colour plates version also available for US$ 190.)

Art of small-scale vermicomposting and vermiculture ecotechnology. A 16-page pamphlet teaching the basics of these two worm technologies. (Available from *Worm digest* for US$ 5.00.)

Turning garbage into gold (47-minute video) by Dr Uday Bhawalkar of Bhawalkar Earthworm Research Institute. See book description above. (Available from *Worm digest* for US$ 28.00.)

OSCRTM worm bin design plans (Bin: 3' x 4' x 3' high). Vermicomposts up to 12 pounds of food/paper wastes daily, food added from top, castings empty below. (Available from *Worm digest* for US$ 35.00.)

The toilet papers (1995) by Sim Van der Ryn. Available for US$ 10.95 + US$ 4 shipping from Chelsea Green Publishing Co., 205 Gates-Briggs Building, PO Box 428, White River Junction, VT 05001, USA.

The humanure handbook (1994) by Joseph C. Jenkins. Available for US$ 19 + US$ 4 shipping from Chelsea Green Publishing Co., 205 Gates-Briggs Building, PO Box 428, White River Junction, VT 05001, USA.

Networking

Worm digest, PO Box 544, Eugene, OR 97440-0544, USA. Tel/ Fax: +1 541 485 0456. Subscriptions: US$ 12/yr. to US, US$ 16 to Canada/Mexico, US$ 20 to other countries. Back issues: US$ 3.50 to US, US$ 4.25 to Canada/Mexico, US$ 5.50 to other countries. Set of 15 back issues: US$ 36 to US, US$ 40 elsewhere. E-mail: mail@wormdigest.org. Website: http://www.wormdigest.org

Biocycle journal of composting & recycling. Biocycle, 419 State St, Emmaus, PA 18049, USA. Tel: +1 610 967 4135. Single copies US$ 6. A monthly publication. One- and two-year subscriptions: US$ 63/US$ 103 to US, US$ 85/US$ 147 to Canada, US$ 90/US$ 157 to other countries.

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Prepared in association with SARAR Transformación SC

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Further information on a wide range of sanitation topics and related publications (including some on finance issues) can also be found on the Internet at the following address:

http://www.access.digex.net/~ehp and http://www.soc.titech.ac.jp/titsoc/higuchi-lab/icm