DRY LATRINES FOR URBAN AREAS

The findings of the Second Sanres Workshop
Mexico City, 23-26 November 1994

Eric Dudley
Uno Winblad

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Contents

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This document was prepared by Eric Dudley and Uno Winblad.
Illustrations by authors, Hans Mattensson and various local artists

Glossary

aerobe	A micro-organism which requires oxygen to maintain life.
anaerobe	A micro-organism which will not grow in the presence of oxygen
AKHS	Aga Khan Health Services
AKRSP	Aga Khan Rural Support Programme
CEMAT	Centro Mesoamericano de Estudios Sobre Tecnologia Apropriada, a voluntary agency in Guatemala
chukan	Traditional latrine in the Valley of Hunza, Pakistan
colones	Currency unit in El Salvador
facultative	Conditional; having the power of living under different conditions
FHIS	The Social Investment Fund in Honduras
FUNHABIT	Fundacion Ecuatoriana del Habitat, a voluntary agency in Ecuador
GTA	Grupo de Tecnologia Alternativa, an activist consulting company in Mexico
LASF	Letrina Abonera Seca Familiar
lempira	Currency unit in Honduras
ODA	Overseas Development Authority (UK)
purdah	A practice in some Muslim and Hindu societies in which women must avoid to be seen by male strangers
quem	Traditional latrine in the Valley of Hunza, Pakistan
quezales	Currency unit in Guatemala
RWSS	Rural Water Supply and Sanitation
Sanres	The Low-cost Sanitation Research project, a SIDA-funded international action research project
SIDA	Swedish International Development Authority
SIRDO-SECO	A double-chamber, solar-heated composting latrine developed in Mexico
VIP	Ventilated Improved Pit latrine
VO	Village organization (Pakistan)

Letrina Abonera Seca Familiar (LASF)

Background

SIDA is currently funding a 3-year action research project on low-cost sanitation. The aims of the project are:

- to develop affordable and replicable sanitation systems for the poorest quarter of urban and rural households in the third world;
- to establish, in selected countries, a local capacity for R&D on sanitation for low-income groups;
- to facilitate South-South cooperation in the field of applied sanitation research.

The anticipated project outputs are:

- a document outlining affordable strategies for the improvement of sanitation for urban low-income groups;
- a manual detailing technical solutions;
- in each participating country a national seminar on project findings and their implications on policy development;
- an informal network of collaborating individuals actively engaged in continuing applied research on low-cost sanitation.

The project is to address the following issues:

- the lack of affordable, replicable sanitation alternatives for a majority of urban and peri-urban households in the third world;
- latrine construction under difficult conditions (high ground water table, difficult soil conditions, limited availability of building materials, extreme poverty);
- on-site sanitation at high population density;
- protection of the environment against pollution, particularly the protection of groundwater and other water sources;
- prevention of vector breeding;
- the use of human excreta as a resource;
- hygiene education focusing on women and school children.

Approach and organization:

The project is seen as a means of encouraging concerted efforts to solve the hitherto neglected issue of affordable sanitation for low-income urban and peri-urban households. Project activities should primarily be the responsibility of the local partners supported by an international network. A Project Coordinator (presently Mr Uno Winblad) provides a link with the funding agency.

In November 1993 the first Sanres workshop was held in El Salvador. The workshop identified three questions:

- How can today's rather crude, low-status, dry-box prototypes be turned into elegant, well-functioning, desirable products suitable for mass production?
- How can we close the gap between what households are prepared to pay and the cost of our products?
- How can we develop better ways of promoting sanitation, eliciting community participation, and providing training and follow-up?

The second Sanres workshop in Mexico in November 1994 attempted to explore these questions through the consideration of case studies from around the world. In addition, at the El Salvador workshop it was decided to develop and test two new prototypes based on the LASF and SIRDO latrines trying to take the best features of both. The modified LASF should have one chamber and be solar-heated, while the modified SIRDO should have urine separation. A second modification of the LASF included an experiment in evapo-transpiration. The Mexico workshop reviewed the experience during the year since the previous workshop with these new experimental latrine.

Workshop findings

In the sanitation options which we are developing, we are trying to do three things:

- Prevent the spread of infectious diseases.
- Turn human excreta into a non-offensive material.
- Re-cycle the valuable organic material

In the world of sanitation, earlier efforts concentrated on finding the ideal design for a latrine and lately on developing marketing techniques to promote these designs. In the second Sanres workshop in Mexico in November 1994, the principal theme was less the details of the device and more the process used, since it was observed that the same physical device could be used in more than one way. The major findings were:

- There are two distinct processes being employed: decomposition and desiccation. These processes require different forms of management. Desiccation requires humidity to be less than 30% while decomposition works best at humidities greater than 60%.
- Using rapid desiccation, new forms of pile management can be employed which result in a rapid turnover and hence require smaller volumes and lower construction costs.
- Single-chamber, solar-heated LASF latrines are feasible. Under

certain circumstances, still to be fully explored, single-chamber, non-solar-heated latrines also appear feasible.

- The redesigned glass-fibre, urine-separating seat-risers developed in Mexico work well, are economical, and look good. They may prove to be a viable alternative to the rather crude concrete seat-risers currently being used in Central American sanitation projects.

The individual papers presented have each been summarised for this document. Each abstract ends with a brief summary of the major observations which emerged in the discussions on the paper. The following are the major findings of the papers:

Josefina Mena, Mexico

- The same physical device can be used for both processes: decomposition and desiccation.
- Fibre-glass moulding for prefabrication is easy to learn and economic.
- For households living on land without title, a latrine design which is moveable can be an attractive option.

Kajsa de Asturias, Guatemala

- The most effective single strategy to reduce costs when constructing a latrine is to utilize an existing house wall.

Hilde Calderas, Honduras

- Latrine delivery programmes without participation in research, motivation, and hygiene education are likely to have a high failure rate.

Enrique Siliézar, Miguel Santamaria, Elton Membreno and Herbert Gonzales, El Salvador

- With intensive pile management, a single chamber latrine can rapidly and successfully process faeces.
- The single-chamber, solar-heated prototypes recently completed cost 17% less than a conventional LASF. A model with evapo-transpiration costs a bit more and appears slightly less effective.
- There appears to be potential for substantially reducing the volume of the latrine and so drastically cut construction costs.

Homero Silva, Costa Rica

- Under laboratory conditions, using high temperatures, very rapid and effective processing from solar energy is possible. The viability of the relatively high technology option in practice has yet to be tested.

Edgar Flores, Ecuador

- At high altitudes, with intense sunshine and a dry atmosphere, simple solutions can work which do not require urine separation.
- Double-chamber designs can cause confusion if the system is not properly understood and managed.

John Collett, Pakistan

- There is scope for developing very low or zero-cost options.
- Various of the recommendations and norms in the literature had to be modified to accommodate local cultural characteristics.
- Community discussion, regular follow-up, and cost contributions by householders were important elements.

Eric Dudley, UK

- There is a rich tradition of indigenous composting sanitation technologies that we can learn from.
- The modernity of the appearance and the respectability of the device are vitally important considerations in people's decision to adopt a technology or not.

Gunnel Dalhammar, Sweden

- We can control pathogens in latrines by manipulating a few key environmental factors like oxygen, temperature, pH value and water availability plus storage time.

Questions

By the end of the workshop a number of key questions had emerged:

- Can the modified single-chamber LASF be made drastically smaller so reducing costs and the need for the high steps?
- Is the solar heating lid really necessary?
- Can the fibre-glass seat-riser developed in Mexico, or a modification of it, be readily incorporated into the LASF design?
- Can improved zero or very low-cost options be developed?
- The Honduras study clearly demonstrates the need for participation and hygiene education. What is the best way to proceed with the communications component? Are we in a position to identify a definitive set of key messages?
- Can we develop rapid, reliable testing techniques for indicator organisms, simple enough to be handled by people without laboratory training?

The Barrón project in Mexico

The paper presented by Josefina Abraham Mena of the Grupo de Tecnologia Alternativa S.A., (GTA), in Mexico described an action research project on desiccating and composting single-chamber latrines currently in progress in the Barrón area, Municipality of Nicolás Romero, on the outskirts of Mexico City.

GTA has over the past 15 years developed the "SIRDO-SECO" composting latrine. The system was presented to the participants of the previous Sanres workshop in San Salvador, November 1993. During that workshop the participants agreed to develop a new type of latrine by combining some of the characteristics of the LASF and the SIRDO-SECO. The Barrón area project was carried out by GTA with grants from Sanres during the period June-November 1994.

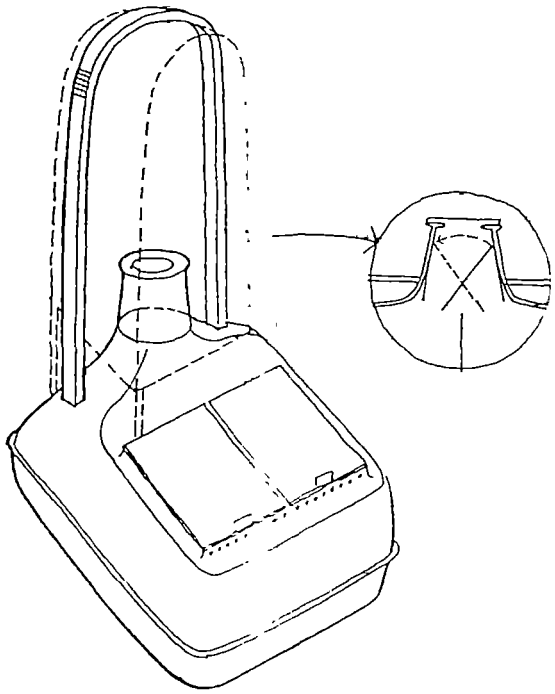

Fig 1: The "SIRDO-SECO" double-chamber composting latrine, Mexico

The specific objectives of the project were:

- to develop fibre-glass seat-risers with and without urine separation;
- to develop three latrine types (with solar-heater and urine separation, with solar-heater and no urine separation, and no solar-heater but urine separation);
- to develop a solar heated lid for desiccating latrines;
- to select and instruct the 24 households to be provided with test latrines;
- to build eight units of each latrine type, complete with super structure;

- to follow-up and support the 24 households during a 3-4 months period to ensure the proper use of the test latrines;
- to measure direct and indirect manufacturing and building costs;
- to carry out a preliminary evaluation and present a report to the Workshop to be held in Mexico City in November 1994.

The 24 test households were selected on the basis of criteria laid down by The Citizens Participating Council ("part of an urban settlement, enough space on the plot for the test latrine, not connected to any sewage system, owner of the house or in possession of a lease at least until 1996, interested in improving its sanitary condition, willing to collaborate in the project, not be an active member of any political party"). Another two households were selected for the testing of GTA's all-prefab model "SS-6M".

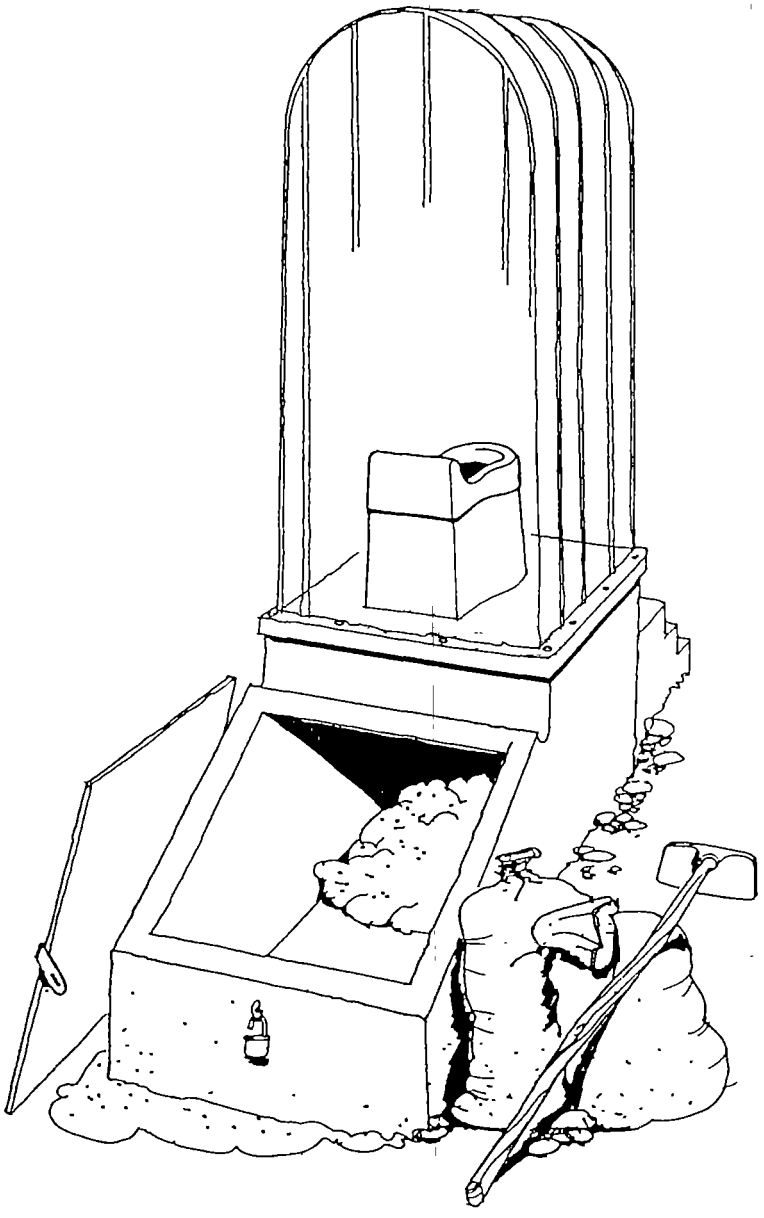

Fig 2: Single-chamber, solar-heated latrine with urine separation - the first prototype built in the Barrón project

Construction work was carried out by community members trained by GTA staff. Two women were trained in the manufacture of the fibre glass components. The unites were completed and put to use in the months of September and October 1994.

The participating households were instructed in the proper operation and maintenance of the experimental latrines by GTA staff. The latrines were managed as SIRDO-SECO composting latrines, that is to say the input into the single chamber consists of human excreta, organic refuse and toilet paper. One of the types also receives urine. For the other two types urine is piped into a small soakpit close to the latrine.

Although the latrines have been used only for a short time it is possible to draw some conclusions:

- The sub-structure costs (material and labour) of the two solar heated types is Mex. Pesos 1080 (= US$ 328, exchange rate in Nov. 1994) and of the non-solarheated type Mex. Pesos 885 (= US$ 269). To this should be added the cost of administration and supervision, estimated at Mex. Pesos 100 per day for three days, Mex. Pesos 300 (= US$ 91). The cost of the prefabricated type SS-6M is Mex. Pesos 1488 (= US$ 445). The cost of a prefabricated fibre glass super structure with door is Mex. Pesos 360 (= US$ 109)
- The new seat-riser developed specifically for this project looks good, is easy to use, works very well and has become popular among users.

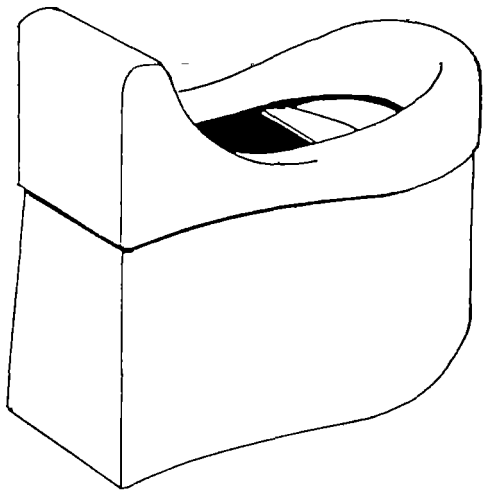

Fig 3. Prefabricated seat-riser with urine separation - developed by women for women

- The pre-fabricated latrines have had the unexpected benefit of being attractive to people who do not have legal title to their land. It is a sanitation technology which may be moved.

Discussion

The Mexican SIRDO project is important as the only project seriously pursuing the idea of full-scale industrial production both for latrine components and complete latrines. Ignoring for a moment the construction technique, conceptually the experimental latrines in the

Barrón project are in principle identical to those in the Tecpán project in El Salvador. The difference is in the process: in Mexico they have been managed as composting latrines while in El Salvador they function as desiccating latrines. The desiccating process seems to work better but on the other hand it requires more involvement from the users.

The Tecpán project in El Salvador

The paper presented jointly by Enrique Siliézar, Miguel Santamaría, Elton Membreño and Herbert Gonzales of the Ministry of Health, El Salvador, described an action research project on single-chamber, desiccating latrines currently in progress in the village of Tecpán, Municipality of San Juan Opico, about 28 km north of San Salvador.

This is a collaborative project involving the Ministry of Health in El Salvador through its Department of Environmental Sanitation, UNICEF through its Water, Sanitation and Environmental Education Programme for Central America, SIDA through its Low-cost Sanitation Research Project, and the Tecpán community.

The purpose of the action research project is to develop and improve the LASF concept of sanitation and to test some of the ideas put forward at the previous workshop (San Salvador, November 1993) The project basically attempts to answer the following two questions:

- Can the LASF concept be adapted to a single-chamber latrine?
- Does the addition of a solar-heat collector and/or an evapo-transpiration bed improve the performance of a LASF latrine?

A total of 36 latrines are to be tested. So far six have been completed: three of type I and three of type 2, see figures 4 and 5.

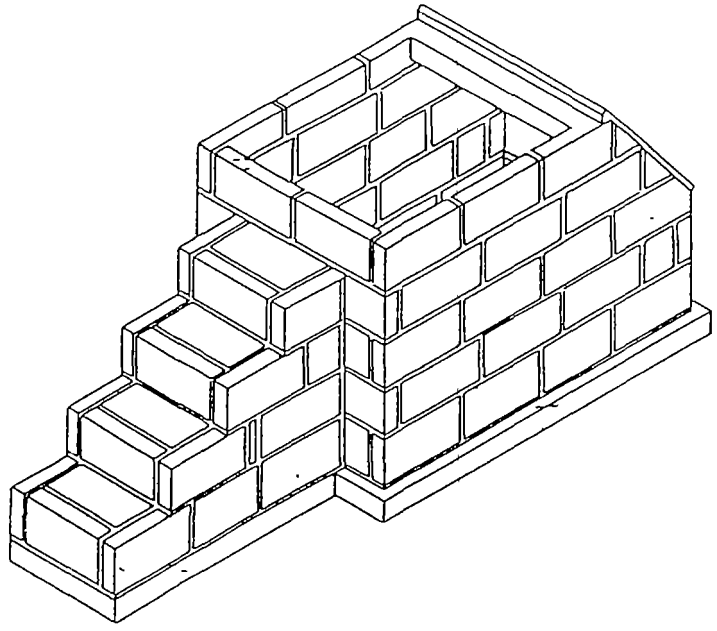

Fig 4: Type 1 - single chamber, urine separation and solar heat collector

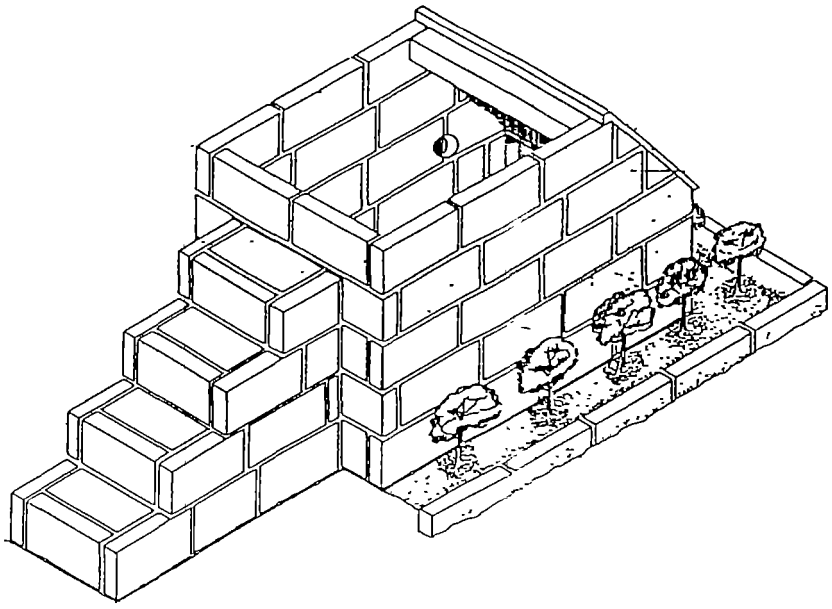

Fig 5: Type 2 - single chamber, urine separation, solar heat collector and evapo-transpiration bed

In November 1994 the six latrines built so far have been in use for about eight weeks, each serving a household with from two to nine members.

The participating households were given a three-day training on personal hygiene and the proper operation and maintenance of the experimental latrines by the project staff. In addition there have been frequent follow-up visits by members of the Community Association. The latrines are managed as follows:

- They are used as regular LASF latrines. The input into the single chamber consists of human excreta and wood ash and/or a soil/lime mixture (proportions 5:1). Urine is piped into a small soakpit close to the latrine. Toilet paper is placed in a bag or box kept next to the seat-riser and burnt periodically according to normal practice in El Salvador.

- Every one or two weeks the lid acting as solar-heat collector is removed and the pile of faeces + ash/lime/soil accumulated under the seat riser is shifted to the rear of the chamber.

- Once a month or every second month the pile at the rear of the chamber is shifted to a sack and stored outside the latrine until reused in the garden or in some cases recirculated through the latrine in place of ash. (The editors of this report were able to revisit the Tecpán project at the end of January 1995, when the six units had been in use for about four months, and can verify that the procedures outlined here were in fact being followed even though the project workers had not visited the site since November 1994.)

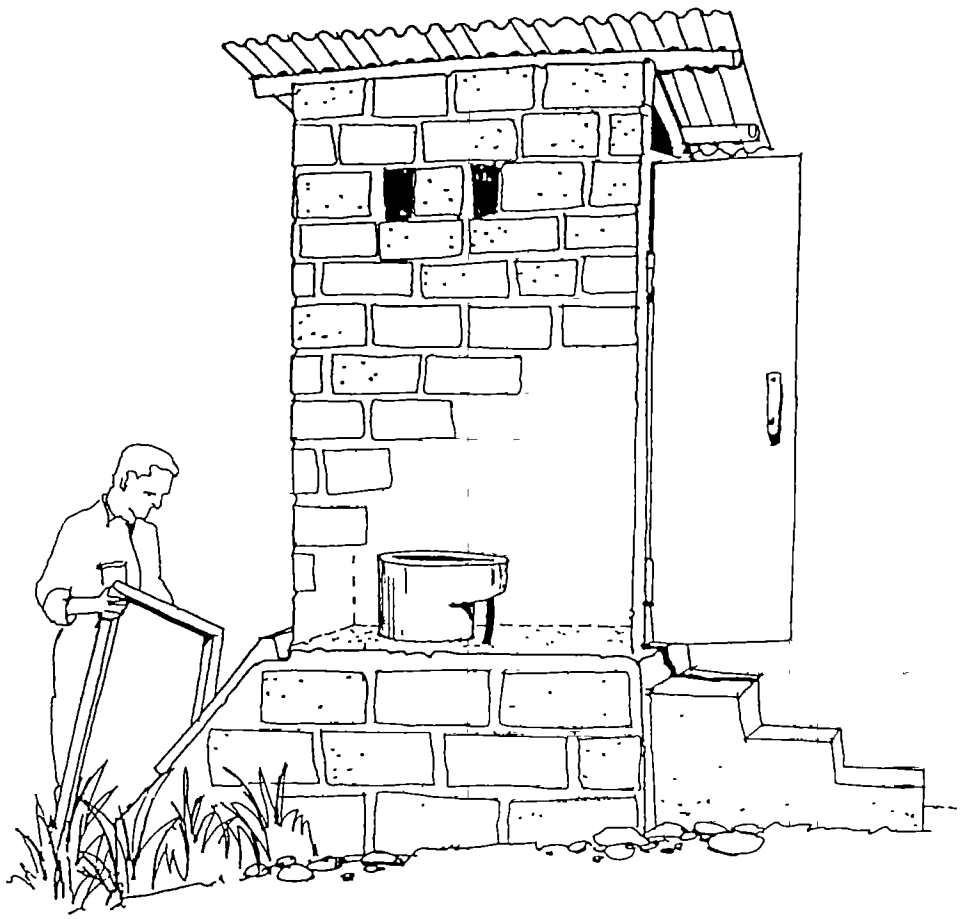

Fig 6: One of the test units in Tecpán

The content of the test latrines is regularly sampled and tested at the FUSADES Laboratory and at the Microbiology Laboratory of the Faculty of Medicine, University of El Salvador.

The project is still in its early stages but already now it is possible to draw a number of important conclusions:

- The cost (materials and labour, direct costs only) of a latrine type 1 is colones 1,472 (= US$ 225) and of type 2 colones 2,140 (= US$ 243). The corresponding cost for a standard LASF latrine is colones 2,377 (= US$ 271).
- The test latrines are completely odour-free and there is no fly-breeding, though the latrines have yet to be experienced over the complete annual climatic cycle.
- The operational instructions have been followed by all the participating households and both latrine types have worked very well.
- Type 2 (with evapo-transpiration bed) is slightly more expensive than type 1 and shows a tendency to be marginally more humid (less dry rather, as these latrines are extremely dry when operated properly).

Discussion

The project demonstrates, perhaps more than any other so far reported in the literature, that careful management of a latrine resulting from high motivation and understanding on the part of the families involved can make an extremely simple technology work very well. It is now clear that if the same level of care can be maintained over time and at scale then the dimensions of the latrine chamber can be drastically reduced with the inevitable cost savings. Also, the odour-free character of the latrine suggests that in the future latrines might be attached to the house so leading to further cost reductions. These considerations should be taken into account when building the remaining 30 latrines.

In the long term the success of this approach will depend on a successful communication strategy to translate the high motivation of a handful of pilot families to a large population. This system would seem to have a good head start in its inherent communicability because unlike some other systems it is readily demonstrable and it produces results extremely quickly. When people can see results with their own eyes they will not need elaborate flip-charts and posters, they will seek out the information for themselves.

Cost reduction in Guatemala

The paper presented by Kajsa de Asturias of CEMAT, Guatemala, described an ongoing action-research project initiated by UNICEF as part of its "Water, Sanitation and Environmental Education Programme for Central America" and implemented by CEMAT (Centro Mesoamericano de Estudios sobre Tecnologia Apropriada).

During 1978-79 CEMAT carried out a number of experiments with latrines in an effort to find the one that best suited the conditions of Guatemala's rural population. After an evaluation based on field assessments, costs, laboratory analysis and acceptance, the double-chamber Vietnamese latrine was selected. Its Guatemalan equivalent was eventually named "LASF" (Letrina Abonera Seca Familiar - family dry composting latrine). During the 1980s the LASF latrine has been promoted in rural Guatemala by a number of national and international organizations.

The current project is carried out in the community of Chinautla, Dept of Guatemala, 12 km from the centre of Guatemala City.

The objectives of the project are:

- to reduce construction costs of LASF latrines by using local materials, by promoting self-help and by using new construction materials for large-scale production with prefabricated components.
- to optimize the functioning of the LASF by adding different drying materials as well as solar heat.

- to disseminate information on the construction, use and maintenance of the LASF to the general public and to government and non-government institutions through manuals and guides.

The first phase of the project was scheduled to last three months beginning in November 1993 with an awareness workshop for the target group and other community members. Ten different latrines were constructed, detailed cost analyses were made and manuals produced.

The project has so far completed ten latrines of various designs and specifications. The cost of a double-chamber LASF (excluding the superstructure) varies from US$ 334 for a latrine built of local stone to US$ 507 for a latrine of burnt bricks.

The second phase will last for two additional years beginning in November 1994 and will consist of an assessment of the use and maintenance of the LASF latrine prototypes. More research will be done on the solar heated latrine as this is the first of its kind built in Guatemala. Experiments will be done with and without ventilation and with and without urine separation. A manual for decision makers is to be produced as well as a document on sanitation strategies and improved manuals and leaflets for promoters.

Discussion

In this project a wide range of walling materials have been employed in an attempt to save costs. While burnt brick was significantly more expensive in the Guatemalan context, the differences between the other techniques was relatively marginal. By far the greatest saving achieved (20% on the standard design) resulted from building the latrine next to an existing house or other building in order to make use of an existing wall. To take advantage of this simple and well understood technique for saving materials it is important that the construction techniques promoted are flexible to on site conditions. Prefabricated elements reduce the opportunities for local on site cost saving. This also underlines the desirability of achieving odour-free sanitation; if a latrine can be actually inside a house the additional construction costs may be minimal.

Solar-heated latrines in Ecuador

The paper presented by Edgar Flores of the Fundacion Ecuatoriana del Habitat (FUNHABIT) described a project started in 1992 to build 100 double-chamber composting latrines in the dispersed rural community of Cachi Alto (185 households) in the Province of Cotopaxi in the high Andean region of Ecuador.

The project, funded by the Catholic Children's Foundation, emerged from an earlier project in which FUNHABIT provided Cachi Alto with

technical assistance for the construction of a communal sheep stable. This successful collaboration established a relationship of trust from which grew the idea of a housing improvement programme. The central elements of this programme were improved cookstoves and latrines. A composting solution was chosen for the latrines in an attempt to address the chronic problems of falling soil fertility in the high altitude (3,500-4,000 m) region where the community is situated. Also members of the community had seen a demonstration latrine at FUNHABIT's rural technology centre, *Sinchaguasin.*

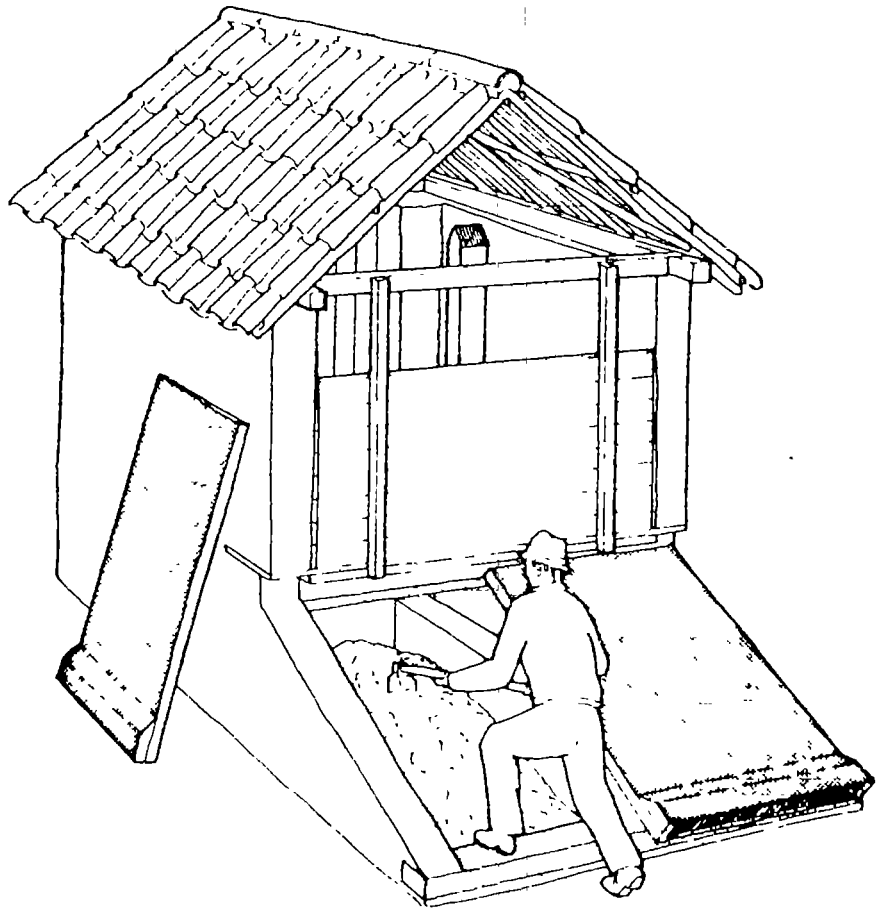

Fig 7: Double-chamber, ventilated, solar-heated composting latrine in Ecuador

Funhabit has had experience with assisting in the construction of over 200 composting latrines since 1985 and so had developed an understanding of how best to use these latrines prior to the Cachi Alto project. Apart from human waste other organic substances can be added such as kitchen waste, animal dung, and agricultural residues. Due to the dry atmosphere at high altitudes there has been no need to develop techniques for urine separation. After each use a handful of sawdust or, preferably ash, is added. Each chamber is used for six months before switching to the other chamber. Each chamber has a lid made of a wooden frame covered with thin galvanised iron painted black in order to absorb the sun's energy and assist the composting process. The chambers are ventilated by a vent-pipe and the chamber lids each include a vent to let air in. The vent-pipe and the lid-vents are covered

with metal fly-screen mesh.

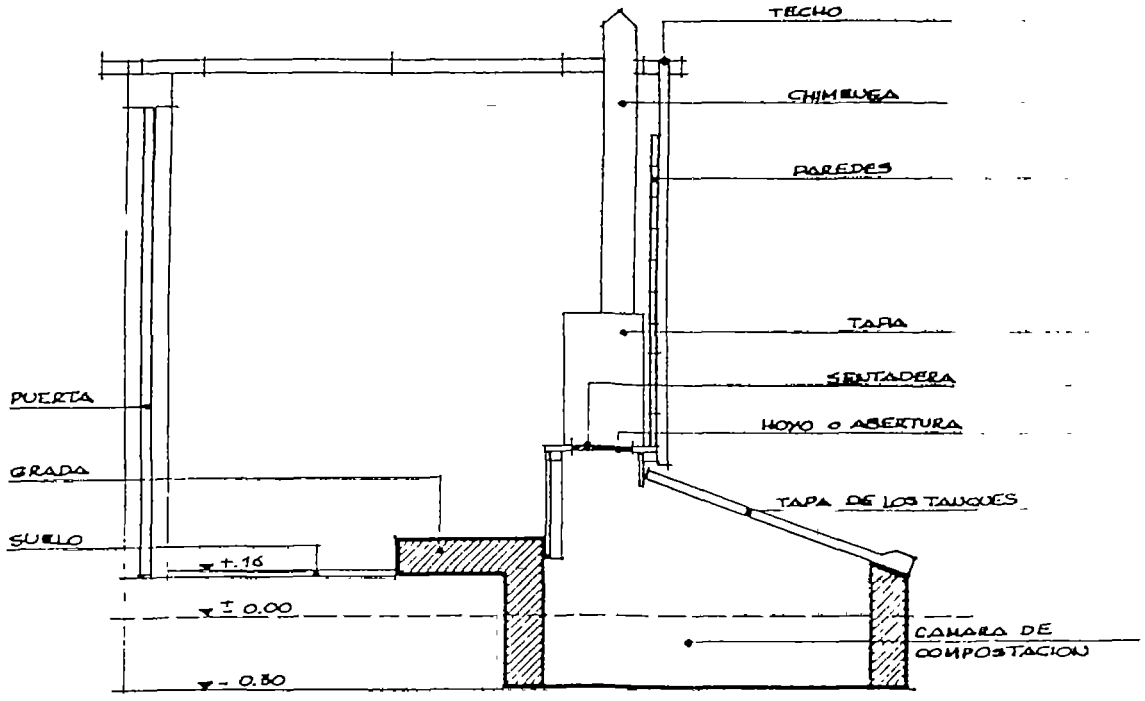

Fig 8: Section through the composting latrine

The latrines are built from sun-dried mud bricks made on-site combined with prefabricated wooden elements: the seat-riser, the chamber lids, the vent-pipe, and a door. The wooden elements are fabricated in a communal carpentry workshop which was established by this project. A number of demonstration latrines were built in different parts of the community to act as training sites for the other households.

Since the construction of the latrines, professionals from FUNHABIT have conducted follow-up meetings in the community to gauge the success of the project. Resulting from the comments of users and the observations of FUNHABIT a number of problems have emerged which need to be addressed in future work:

- People would prefer latrines attached to the house.
- People throw water into the storage chambers.
- Frequently, both chambers are in use simultaneously.
- When not properly used, or cleaned, the latrines can become very smelly.
- With large families, the latrine chambers can be too small.
- The latrine contents are not regularly stirred so they are inadequately aerated.
- There is a resistance to using human excrement for fertiliser.
- Animals such as mice and dogs get into the latrine chambers if inadequately closed.

- There is insufficient scientific advice available to know exactly what to recommend about how to obtain the best fertiliser and how to use it.

Discussion

The experience in Ecuador is interesting in that the high altitude creates conditions which alter the performance of composting latrines. In particular the dry atmosphere appears to eliminate the need for urine separation so making the technology and use simpler. Also while the black painted metal lids seem effective at raising temperatures, the high levels of solar radiation and the dry air makes one wonder whether the latrines could function quite satisfactorily without these lids, like the latrines described in the papers by Collett and Dudley in Pakistan and India. The problems in use, combined with the dry climate, also suggest that a single-chamber dry-box solution might be more appropriate. Indeed, it raises the question of whether composting is actually taking place or is it simply desiccation? Whether or not this proves to be the case, the Ecuador experience underlines the need to avoid trying to develop standard solutions which can be copied from country to country but rather the need for well understood principles which can used to develop location-appropriate solutions.

The other characteristic of the Ecuadorian project is that, apart from the community's contribution of labour, it was entirely financed from outside. In future phases mechanisms are going to have to be found to make the sanitation technology work within the local economy. Also the external funding has dictated the pace of technology introduction. Many of the problems in use may have been avoided if the latrines had been introduced into the community more slowly.

Modified indigenous latrines in Pakistan

The paper presented by John Collett of the Aga Khan Health Services (AKHS) described aspects of the Water, Sanitation, Hygiene and Health Studies Project currently in progress in the Islamic communities of the high mountainous region of northern Pakistan. The three year project, funded by the ODA, started work in the field in mid-1993. It's purpose is to develop achievable technological options for future rural water supply and sanitation (RWSS) projects in the region. The project is based on several hypotheses:

- Earlier RWSS projects in the region have largely neglected the sanitation component.

- The pour-flush latrines which have been promoted are often technically unsuitable and have largely been adopted for purposes of status rather than function.

- Due to the diverse climatical and social conditions, there is a need

for a range of alternatives including low- or zero-cost options.

- Several indigenous forms of composting sanitation in the area can be improved upon and promoted to neighbouring areas.

- The single chamber composting latrines currently found in the region are not satisfactory on health grounds since at the time of emptying there will be a quantity of fresh faeces.

From this foundation the project has developed a programme of research and experimentation. An important element of the project is to develop an understanding of indigenous forms of sanitation, water management, and hygiene. The project staff include two anthropologists who are exclusively working on developing this understanding. Over one hundred households in fourteen villages have been interviewed. In Chitral, in the west of the region, there is no evidence of composting sanitation while in Baltistan, to the east, virtually every family has some form of sanitation which recycles human waste. Many of the latrines in Baltistan have four squat holes. This appears to be partly to allow women to go in groups, often at night for reasons of *purdah*, and partly to allow for the even distribution of the material in the chamber. In areas without a latrine, people either use the fields directly or defecate in small enclosures built largely for reasons of privacy. It is also common to use animal pens.

In some villages the latrine is virtually a soil-reconditioning unit where large amounts of soil from the fields are revitalised. In other villages even more material may be added such as sediments from rivers and irrigation channels, in which case the latrine becomes a soil producing unit. A third case, typical to the central region of Hunza, is where very little material is added and the latrine is simply recycling human excreta. Where soil-processing is a major element soil is usually added after each defecation. Depending largely on the amount of soil added the health risks would appear to vary from negligible to very high.

After discussions with villagers a basic design for a double-chamber composting latrine was developed. The process of discussion and research led to the rejection of three characteristics of composting latrines frequently mentioned in the literature:

- The separation of urine which was considered impractical due to the Muslim belief that urine is unclean.
- The addition of ash which is either not available or is used as a pesticide for seedlings, or which in some villages is believed to attract malevolent spirits.
- Periodic movement or mixing of the chamber contents is not part of the existing routine and the idea appears unacceptably distasteful.

The design has two chambers, a screened vent-pipe, a screened ventilator from the outside into the room, and a single squat hole for each chamber fitted with a lid. The opening to each chamber is vertical

and completely sealed with stones set in a mud mortar which are broken out when the chamber needs to be emptied. The floor of the latrine chamber is simply earth. Cost estimates have been made for a range of wall, floor, and roof materials, the total costs varying from $180 to $270 per unit. These costs are higher than a pour-flush latrine and one and a half to two times the cost of a VIP latrine. So far, eight experimental units have been built in six villages with the project contributing between 35-45% of the costs. All six villages are in areas where there is already indigenous knowledge of waste recycling. As optional extras, the project has suggested incorporating separate ablution places to try and avoid any problems of water entering the latrine. Where this is done a separate soakage pit is built. The idea of an ablution place in the latrine has been met with enthusiasm by many of the users.

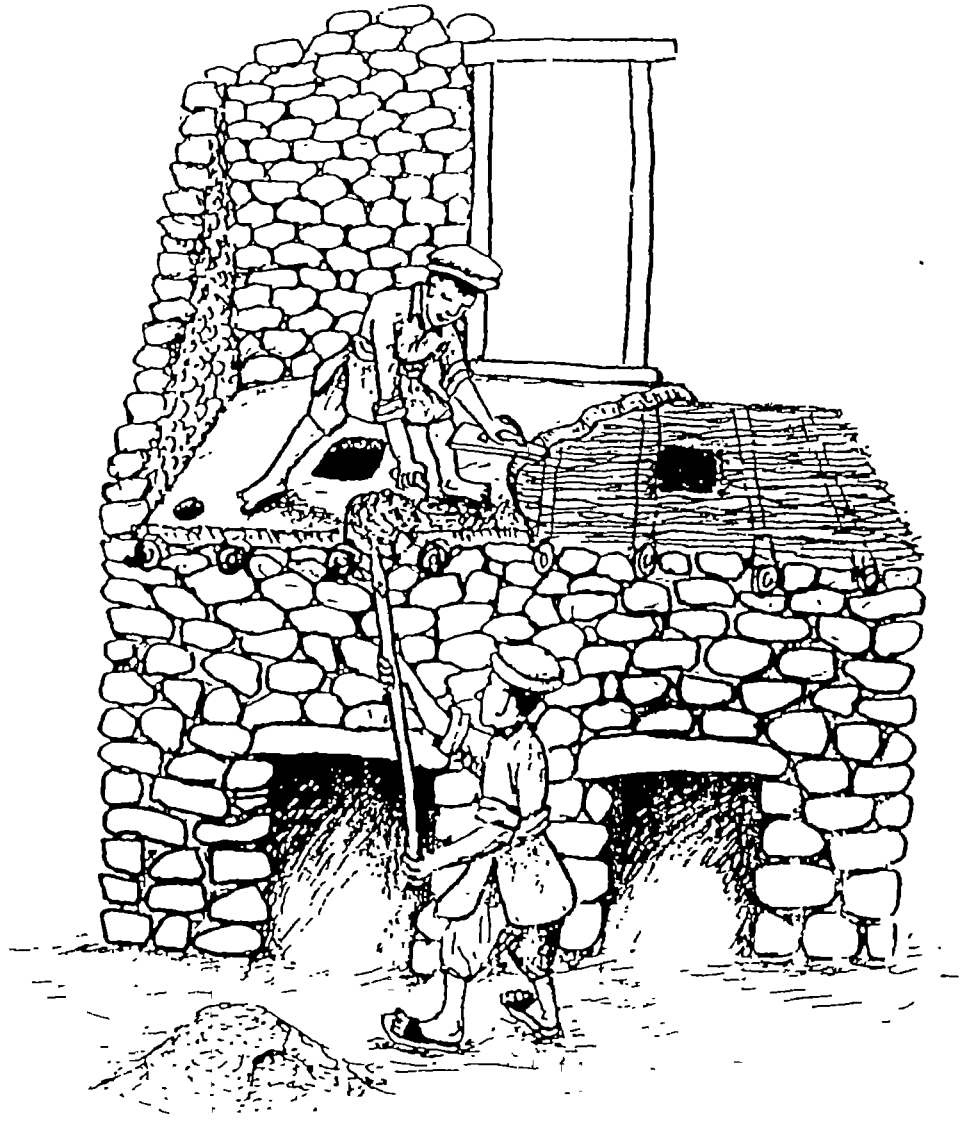

Fig 9· Double-chamber, ventilated, desiccating latrine under construction, Pakistan

In addition to the double-chamber composting latrine, the project is also developing a series of experimental proposals for extremely low, or zero-cost solutions as intermediate options between defecating in the field and having a latrine. Most of these solutions involve low-

or zero-cost solutions as intermediate options between defecating in the field and having a latrine. Most of these solutions involve low terrace walls which effectively create a clean and a dirty distinction between high and low. So far these options have not been tested in practice.

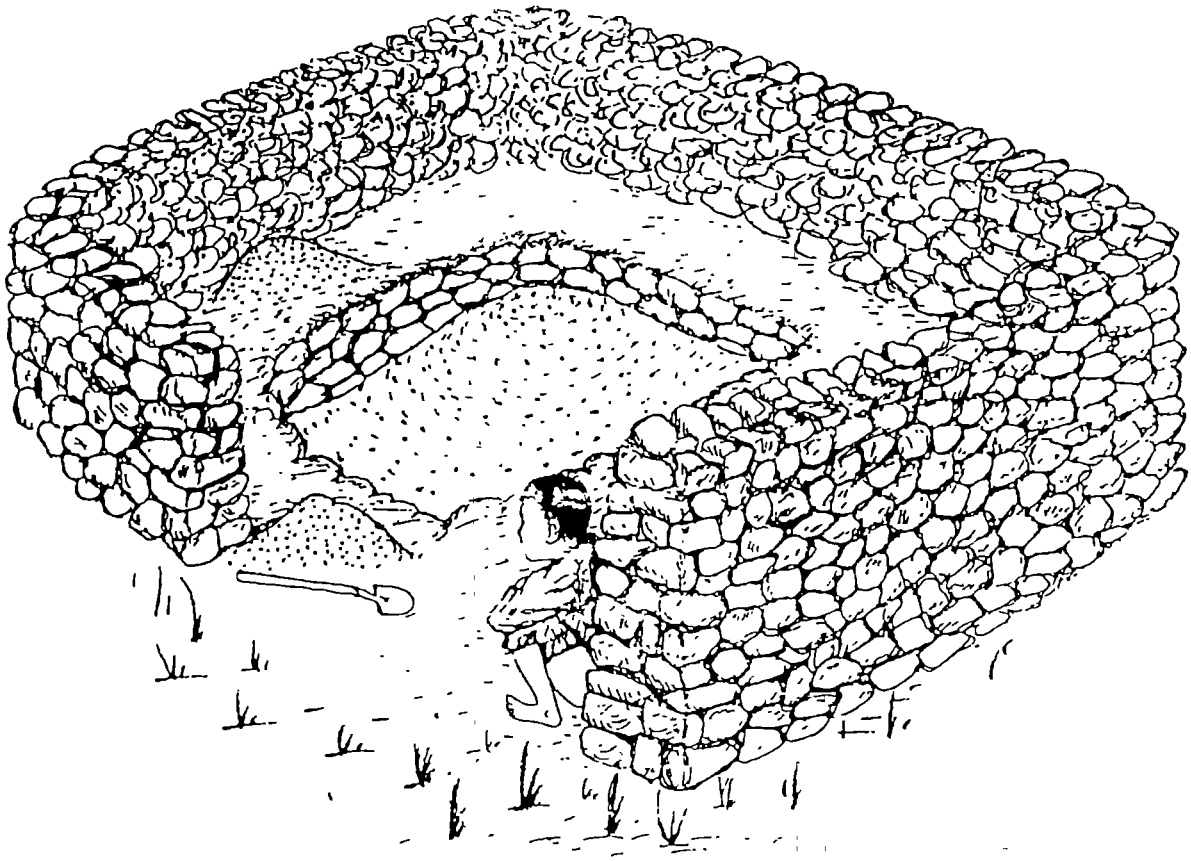

Fig10: Modified traditional latrine

The work being carried out by the Aga Khan Health Services on latrines forms part of a larger programme of work of the institutions of the Aga Khan Development Network. In particular, the latrine programme exploits the organisational infrastructure established by the Aga Khan Rural Support Programme (AKRSP). Most villages in the region have been encouraged by AKRSP to establish a Village Organisation (VO). These VO's are the forum in which the idea of experimental latrines have been introduced. In a meeting with the VO the ideas of the project are introduced using large drawings and more recently a large wooden model. Volunteers are invited but at the same time it is stressed that the families involved will have to contribute their own materials and labour and also they will have to participate with follow-up visits. When a family has been selected their house is visited by an engineer and a site chosen and the householder is given detailed instructions. So far the instructions have all been verbal though an explanatory leaflet is currently being prepared. The engineer continues to visit during the construction and also delivers the external inputs of cement and the vent-pipe. When finished the engineer gives detailed instructions on how to use the latrine. This is followed by a health education session

for the whole family to ensure that men, women, and children all think about the proper use of the latrine. These sessions make use of participatory education materials prepared by an education unit within the project which is developing and testing educational materials in parallel with the technologies. The work of this unit is expected to become more important as the project develops and the issue of promotion and education becomes central.

The project is still in its early stages. So far microbiological testing has been limited to existing latrines. It is too early to draw any conclusions about pathogen destruction in the experimental latrines but in other respects a number of problems have emerged:

- The dialogues between engineers and household heads has largely excluded women from the process. Steps are now being taken to involve women earlier in the process through the greater use of women project staff.
- Local masons are reluctant to build latrines, they feel that it is not respectable work.
- Construction took longer than expected and required more skilled labour.
- Local materials, like stone and wood, proved more expensive than anticipated.
- Villagers have difficulty understanding the need for a specific retention time to compost the manure.
- The intensity of project inputs is establishing a norm which it is difficult for others to replicate without similar levels of assistance.
- Villagers have come to expect assistance in copying the latrine.
- A format that was developed for families to monitor their latrines was unsuccessful.
- Visits by project staff to the experimental latrine sites has created uncomfortable feelings among the owners.

<u>Discussion</u>

Of the projects presented at this workshop, this project is unique in two important respects: firstly, it is studying and building on well established indigenous practices of composting and secondly it is starting to give serious consideration to very low or zero-cost options. These low-cost options are a particularly exciting development though they may well prove difficult to test and promote since they will inevitably be seen as of a low status. It is also unusual in that even at the experimental stage the project is insisting that householders contribute significantly to the costs. One of the five fundamental hypotheses of the project, listed above, was that a single- chamber latrine is, by its nature, unhealthy. Given experiences elsewhere and the potential problems of expense and misuse involved with double-chamber latrines there is probably value in questioning this hypothesis, particularly since the single-chamber latrine is already widely used in parts of the region.

High temperature desiccation - an experiment in Costa Rica

The paper presented by Dr Homero Silva Serrano of the National University of Costa Rica described his experiences with the Organización Panamericana de Salud in developing a solar heated latrine. In the urban peripheries of Costa Rica, as in many other locations, the families live in poverty, the plot sizes are small, there is shortage of potable water while at the same time there is a high water table and many of the areas are subject to flooding. In these circumstances the available options for safe sanitation are limited.

Pathogens can be eliminated through heat. In the diagram below (based on Fecham) we can see that at a temperature of 62 degrees centigrade it is possible to eliminate most of the pathogens. An exception to this is the hepatitis virus which requires a temperature of 180 degrees for an hour.

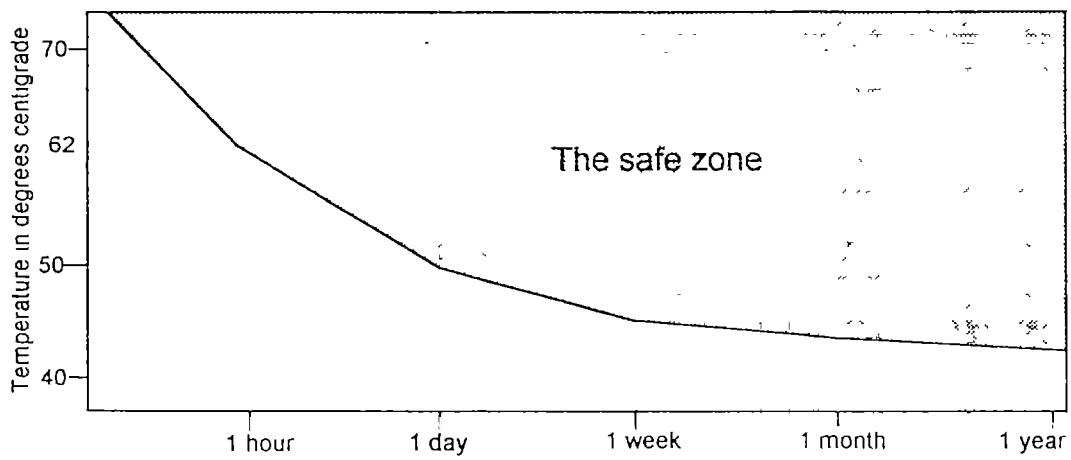

Fig 11 Pathogen elimination through heat

In Costa Rica solar radiation is a potentially valuable resource for heat-treating faeces. The average annual radiation is 1500 kW hours per m^2. Studies suggest that only 167 kW hours per year are necessary to treat the faeces produced by a typical family. In Costa Rica the sun is out for between 41% and 69% of the daylight hours. The days with more than five hours of brilliant sunshine varies between 48% and 70% of the year.

A prototype latrine was designed an built in which a rotating disc moves the fresh faeces into a solar oven which can reach temperatures exceeding 100 degrees centigrade. Even though this was only a prototype, it was estimated that a production model constructed in glass fibre might cost less than $100. The faeces used were taken from those which had been analysed at health centres. During the experiment the temperature in the oven and the intensity of solar radiation was recorded. Also the bacteriological content and faecal coliforms of the sample was measured when fresh and then at daily intervals up to six

days. The experimental periods included both sunny and cloudy days. In two of the four experiments conducted the average temperatures were recorded at 53 and 71 degrees centigrade. The results were similar in all four experiments. The faecal coliforms were totally eliminated, the initial counts varied between 10 and 200 million. The bacterial count went from these initial values down to between 1 and 10 thousand, which are insignificant levels.

Even though the experiments were conducted over several days it is apparent that the pathogens were largely eliminated during the first day. If the day is sunny, the pathogens may be eliminated in a matter of hours but more experiments are required to verify this. During this first day the foul odours from the faeces grew but after five days the smells were reduced considerably. It may be that the limiting factor determining the period of retention with this technology is the elimination of smells rather than pathogens.

Discussion

The experience from Costa Rica is important in that it represents one approach taken to an extreme. By using high temperatures the destruction of pathogens in ensured, the retention period is very short and so the volume of the device is kept to a minimum. As a theoretical strategy it is valuable. What remains in question is the viability of the technology when used in practice. Will the moving parts be reliable? Will it be correctly used? And will the solar oven be adequately maintained to continue to reliably reach the high temperatures required? Future experiments will be watched with interest.

Communication in Honduras

The paper presented by Hilde Calderas described a project of the Honduran Fund for Social Investment (FHIS) to build pit latrines as a measure to prevent an epidemic of cholera spreading from neighbouring countries. Each latrine has a concrete slab, a partly lined pit, a concrete seat-riser and a superstructure of asbestos-cement. The project was funded by the International Development Bank with technical assistance from the Ministry of Health. The project was started in 1993 and so far over 33,000 latrines have been built, using private contractors, at a cost of approximately $160 each.

Much of the population in the rural areas concerned live in extreme poverty with low levels of environmental hygiene. Yet, it had been observed that many of the intended beneficiaries of the 20,000 latrines donated under an earlier programme (1990-92) were not using the latrines. It was realised that greater attention needed to be paid both to promoting educational messages and understanding the priorities and concerns of the intended beneficiaries. A rapid diagnostic survey was carried out before construction started to try to understand attitudes. A number of the key findings were:

- Many people do not see a relationship between sanitation and health, specifically, most people do not realise that a latrine is fundamental in preventing the contamination of water.
- A badly built or poorly maintained latrine acts as a disincentive to neighbouring families who do not yet have latrines.
- The distance from the house means that many women and children are scared of using it at night.
- Earlier experiences of latrine collapses discourage latrine use.
- People use the materials intended for the latrine to help build or repair their houses.
- The concrete seat-riser is uncomfortable and for people used to defecating in the fields sometimes difficult to use.
- There is a widespread belief that children's faeces are not dangerous and so children are not encouraged to use the latrine.
- People are scared of being bitten by animals and mosquitoes through the hole, also children are scared of falling through the hole.
- Where latrines are used it is often only by women and girls who use it for reasons of modesty.
- Water is often not available to clean the latrine so it becomes unpleasant.

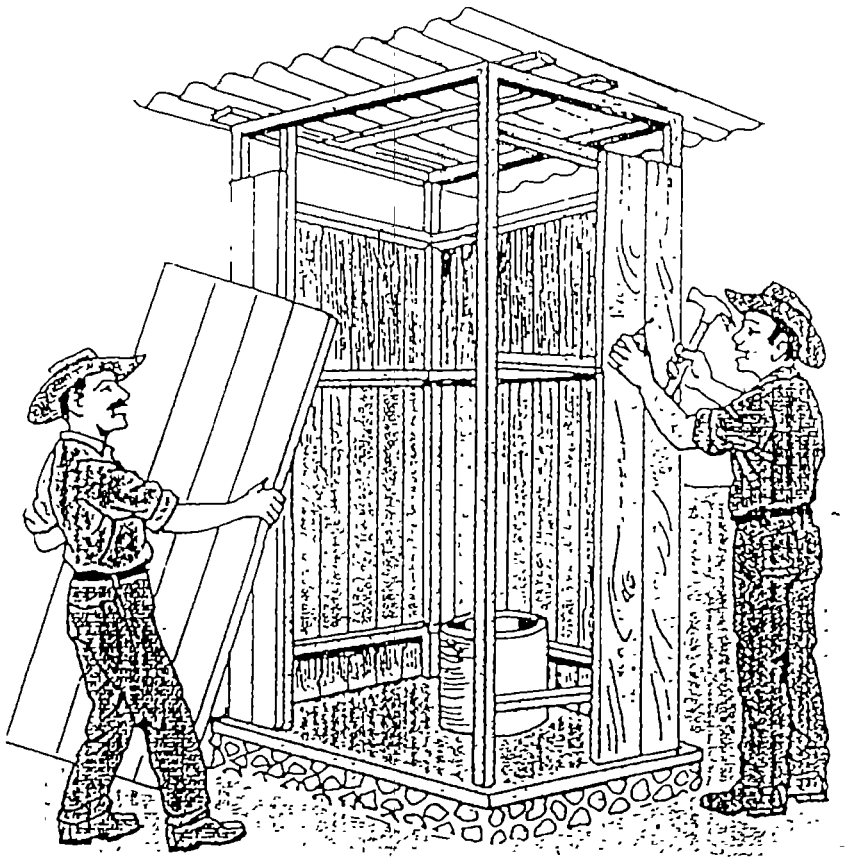

Fig 12. Traditional pit latrine under construction, Honduras

As a result of these and other findings an education strategy was developed in which facilitators from local NGO's are given training, educational materials, and support. The main objective is to stimulate communities to take responsibility for monitoring and promoting the use of their own latrines. To this end, the facilitator is responsible for encouraging the creation of support committees in each community. The first step in doing this is identifying the authorities and respected figures within the community and enrolling their support. The support committee is formed and then the programme and the educational messages are promoted through the committee, the facilitator slowly taking more of a back-seat role.

A range of educational materials have been produced some to be used by the facilitators, others to be left in the community to permit continuing promotion. The process of developing materials started with a review of materials produced elsewhere. These were then modified and tested locally. The printed materials were supplemented by events such as radio programmes which helped to raise the profile of the programme.

Recent surveys suggest that 88% of the latrines are being used.

Discussion

The project demonstrates not only the need for a communication strategy but also that communication is a two-way process. The effective education programme developed in Honduras depended on the first step of learning about the intended beneficiaries attitudes before doing anything else. Also, the project shows that even under circumstances of emergency, here the fear of an impending epidemic, a sensitive diagnostic survey was possible and made an invaluable contribution to the programme, leading to suggestions for both the technology needed and the focus for the educational programme. Here, as in many other cases, fear of latrine collapse proved to be a significant factor in user-resistance and helped to suggest a more robust concrete construction. The survey also led to a redesign of the seat-riser to accommodate user concerns.

Composting latrines in high mountain areas

The paper presented by Eric Dudley differed from the others in that it was not about one specific project but rather dealt with the broader topic of both indigenous and introduced composting latrine technologies in high mountain areas. The hypothesis being presented was that composting latrines are particularly well suited to high mountain areas in the tropics since in high mountain areas the air is dry and the sun is intense. As a result human faeces dry rapidly and urine evaporates. Moisture levels may be kept down even without urine separation. In addition, there are usually fewer flies and no mosquitoes. Due to these climatic conditions the technical problems usually associated with

aerobic decomposition are reduced or disappear. There are other factors which also favour composting in high mountain areas.

- Firstly, soil fertility is generally a problem. In most mountainous tropical regions only a small proportion of the land is fit for cultivation. In these circumstances people tend to be acutely aware of the need to conserve organic matter.

- Secondly, water is usually a problem, because of a general lack of water or the seasonal shortages when water sources freeze.

- Thirdly, the rocky ground on which many mountain settlements are built makes the digging of conventional pits impossible.

The implication of the rocky ground issue is that the only sanitation options available are those which are constructed entirely above ground. This in turn implies a system which is empty-able since, unlike pits, an above ground tank cannot easily be abandoned. In many impoverished high mountain areas, where reinforced concrete is not a realistic option, the *only* form of latrine which makes sense is the raised desiccating or composting latrine. It is not surprising that in some high mountain areas such sanitation systems have naturally evolved.

Indigenous latrines

In the high mountains of central Asia people soon found that faeces left on the surface of the soil rapidly desiccated and the organic material blew away as a fine dust. Latrines were a mechanism for storing and processing the valuable organic resource of human waste until it was needed just prior to sowing.

In the remote Himalayan Buddhist kingdoms of Ladakh and Zanskar desiccating and composting latrines occupy an essential role in daily life and the yearly agricultural cycle. Virtually every home, from the smallest widow's cottage to the largest palace, has a dry latrine built into the house. The Ladakhi latrine is built on two storeys, the downstairs is a collection tank, the upstairs is a squatting platform. The storage chamber has an opening to the outside which is walled-up with stones. Once a year, at sowing time, the chamber is opened and the compost removed. The Ladakhi farming family understands well the need to achieve a good balance of carbon and nitrogen in the compost. The family put not only all kitchen waste in the latrine, they also go out and collect fallen leaves and brush to add to the mixture. Often the ground floor of the house is largely occupied by the animals. Frequently there is an opening linking the animal areas to the latrine so that the animal dung can also be added to the latrine. The squatting room usually contains a pile of earth with a wooden paddle so that after each use earth, and sometimes leaves, can be swept down the hole into the tank.

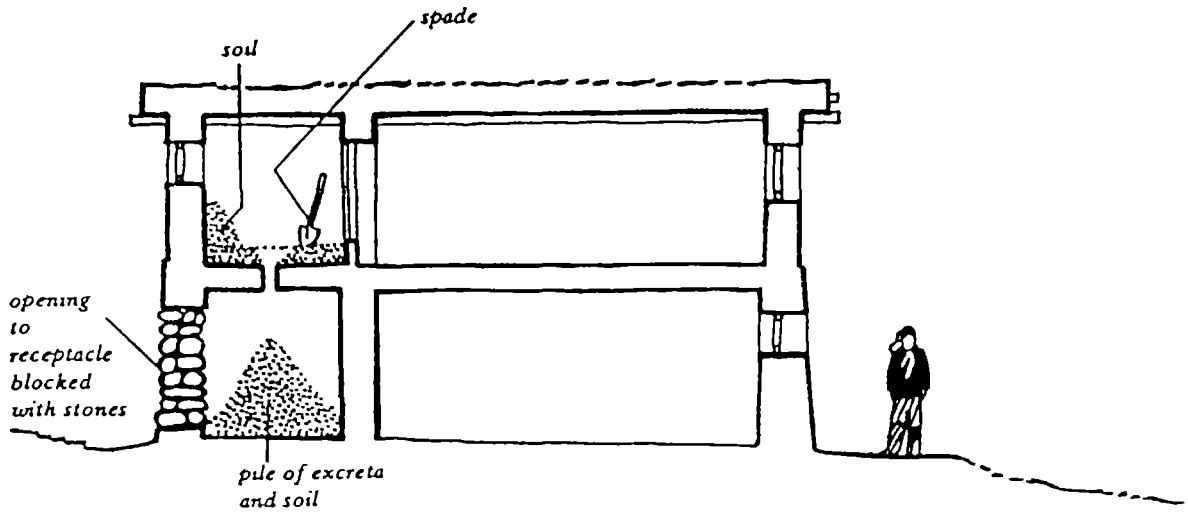

Fig 13 Section through an indoor latrine in Ladakh

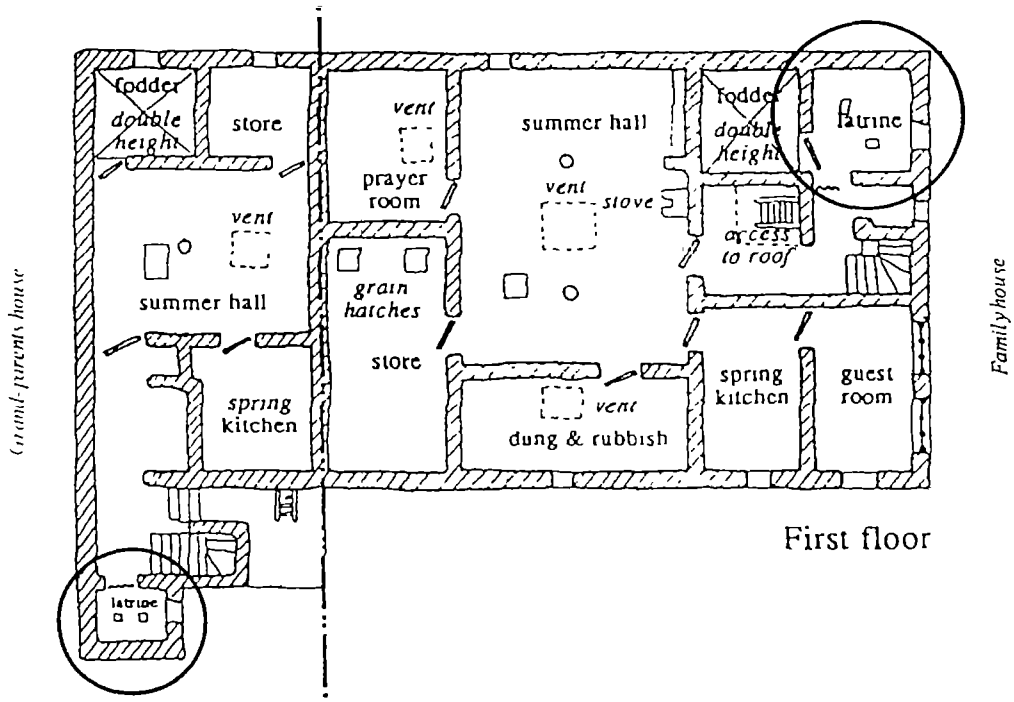

Fig 14 Plan (upper floor) of typical Ladakh family house

The neighbouring Islamic area of Baltistan shares many of the composting practices of Ladakh and Zanskar. The architecture and domestic typology is more varied, as are the types of latrine, but basically they all consist of a large raised tank with a squatting platform above. While in Ladakh all latrines are attached to houses, in Baltistan it is more common for the latrine to be a separate structure, often built near the fields. There are examples of public latrines built by landowners so that they may take advantage of the product. Some houses have animal housing, particularly for smaller animals like goats, on the upper floor, allowing the animal dung to be swept directly into the latrine. Throughout Ladakh, Zanskar, and Baltistan most latrines

have three or four squat holes since defecation, as in many rural places, is regarded as a social activity.

In the Islamic context, dry sanitation initiatives often run into problems because of the traditional practices of using water for cleansing after defecation. However, in remote Islamic areas, even though there is still a high awareness of personal cleanliness, there are accepted practices of using earth or corn husks after defecation, which again favours the composting latrines.

Moving further west into the valley of Hunza in the Karakorum mountains we still find composting practices but less sophisticated than those of Baltistan, Ladakh and Zanskar. Some latrines are like those of Baltistan but most have two forms of simple latrines, the "*chukan*" and the "*qem*". The *chukan* is a small raised platform enclosed on three sides by a low wall. The platform is typically about half a metre above the surrounding ground. The human waste simply accumulates in the small tank which is open to the air. The tank needs to be frequently emptied as it is not large enough to last a full year. The *chukan* is located in the fields and the product is spread directly onto the fields. During the summer the *chukan* is a major focus for flies. The *qem* is simply a walled enclosure like an enclosure for a small animal. People squat in the enclosure which offers some basic privacy. At the higher altitudes of upper Hunza the *qem* is replaced by the cow house which doubles as a latrine for humans.

Introduced composting latrines

As discussed in John Collett's paper, in Pakistan attempts are being made to build upon the traditional forms of sanitation. In the Ecuadorian Andes, the problem how to introduce an idea which on technical grounds seemed well suited to the environment but which required a change of perception about the nature of a latrine. In 1984, at Centro Sincha-guasin, a small centre for rural development began work on exploring and promoting rural housing and sanitation technologies. This work is now being continued by FUNHABIT as discussed in the paper by Edgar Flores.

The centre piece of the project was an earth and thatch house which included a double-chamber, solar-heated composting latrine. It had walls of earth 60cm thick and a roof of thatch. The superstructure, though roofed, was otherwise open to the outside facing a small garden, privacy being provided by a lockable garden gate. The solar heat came from the galvanised steel sheets used for the hatches to the two chambers and for a vent-pipe between the chambers. The vent-pipe was sealed with flyscreen.

The latrine worked very successfully over a period of years, functioning on a mixture of human waste, kitchen waste, and sawdust. At the beginning we operated the tanks on a regime of six months on, six months off. The contents were found to be well composted. We then switched to one year on, one year off, on the basis that it would be easier for people if they knew that they had to empty the latrine every

year at the same time - sowing season.

Despite the demonstrable technical success of the latrine, and the fascination shown by the neighbours, we were disappointed by the poor take up. The latrine was simply too odd. People did not see it as something in which they would wish to invest their scarce resources and the project was determined not to give any subsidies. After a while it was realised that it was not so much that the idea was odd, but that the image was unacceptable. The thatched roof and earth walls, though traditional, did not relate to the kind of urban life style to which people aspired. It was more an outsider's romantic view of indigenous technology.

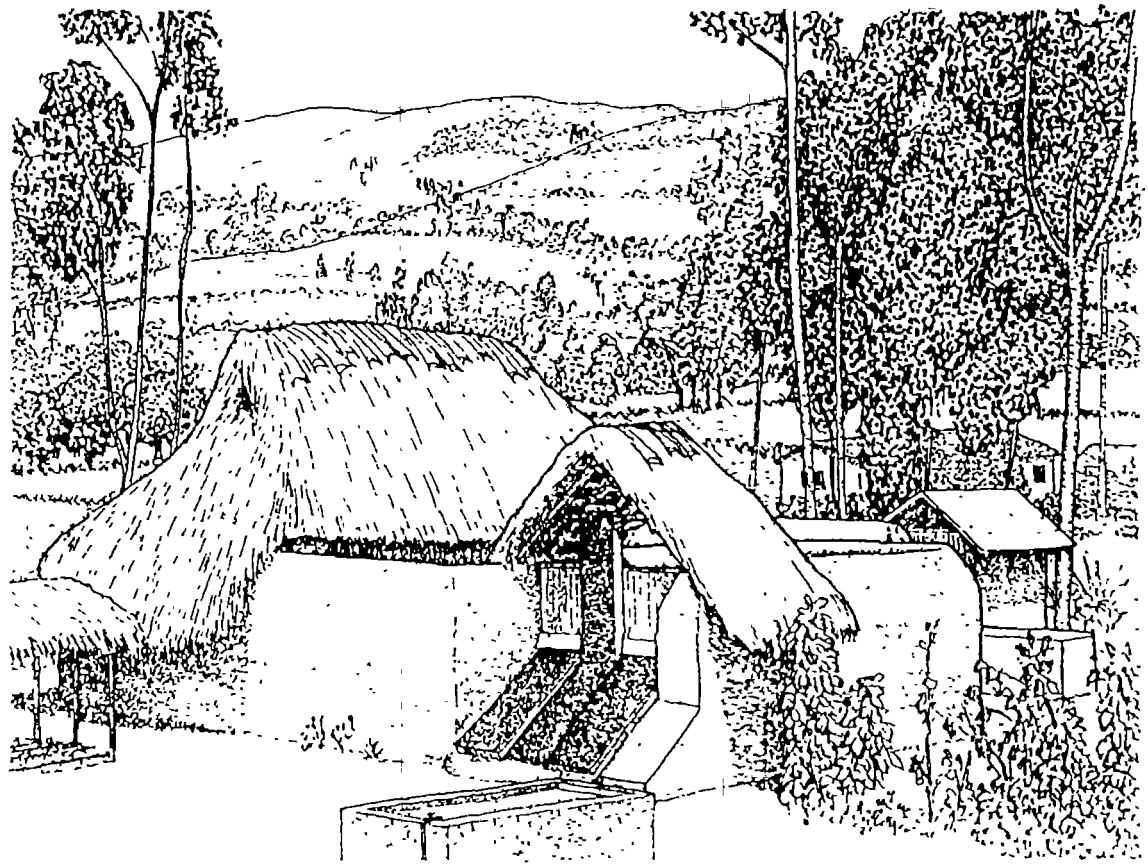

Fig 15: A composting latrine at the author's house in Ecuador

On the basis of this analysis a second demonstration latrine was built, quite intentionally seeking a modern urban image, with white walls, a tiled roof, and bathroom tiles and a shower inside. The second latrine immediately stimulated more favourable responses since it conformed to the image of the way of life to which people aspired. The experience demonstrated that it is not enough to have a "sensible" idea, the idea has to be presented so that it makes sense and is attractive to the intended beneficiaries.

A later evaluation uncovered a farmer who had seen the composting latrine and decided to build his own. He had understood the basic

principles but rejected the actual design. His latrine was almost identical to those seen in Baltistan - a single storey-height tank with a squat platform above and an opening walled up with stones which was opened before sowing. The farmer had accepted the general idea of composting but rejected the sophistication of twin chambers, solar-heating, and a vent-pipe. It seems that the clean, modern image was necessary to *sell* the idea but once adopted as a *respectable* idea, in the practice, people were prepared to build actual solutions even more rustic than the original design.

Discussion

The paper reinforces the message that the environmental conditions and the culture should never be forgotten in considering the technology and use of composting latrines. Technologies which would be quite inadequate in many hot and humid locations are apparently highly effective in cold dry situations. It also raises questions as to how many of these indigenous examples are true composting latrines and how many are desiccating dry-box latrines.

The experience of promoting composting latrines in Ecuador is the only one among the examples in these papers which attempted to promote the technology without subsidies. The experience helps us to question the extent to which we should be promoting detailed designs, with measured drawings and the like, and how much we should be trying to promote ideas. If the latter, we need to ask which of the cluster of ideas relating to composting sanitation in high mountain environments are expendable and which ideas are essential?

Microbiology and sanitation

The paper presented by Gunnel Dalhammar of the Royal Institute of Technology, Sweden, was an introduction to our discussion on micro-biological and parasitological testing of the contents and output of desiccating and composting latrines.

We can control harmful microorganisms by manipulating certain environmental factors like oxygen supply, temperature, acidity/ alkalinity (pH value) and water availability. Time is also an important factor in pathogen destruction.

The human body provides a favourable environment for the growth of many microorganisms. It is rich in organic nutrients, it provides relatively constant temperature and pH value. In the large intestine counts of 10^{11} cells per gram of intestinal contents are not uncommon. Various species of *Bacteroides* account for the majority of anaerobe organisms. Facultative aerobes, like *Escherichia,* are also present but in smaller numbers. During the passage through the gastrointestinal tract water is withdrawn from the digested material. Gradually, as this material becomes more concentrated, it is converted in faeces. Bacteria, chiefly dead ones, make up about one-third of the weight of faecal matter. Although most bacteria in the large intestine are harm-

less, a few harmful types may be present, and certain pathogens live primarily in the intestinal tract.

By controlling certain physical and chemical parameters that all micro-organisms are dependent on we should be able to control the pathogens. If the temperature is high enough bacteria will be killed. When ashes or calcium is added to the latrine chamber the pH value will be high enough to kill many pathogenic organisms. When humidity is very low, as in a desiccating latrine, there will not be enough water for the cells. The main resistance is found among the eggs and cysts of certain parasites. The environmental factors listed above will also kill these types of organisms although it may take longer time.

For us it is now important to develop rapid, reliable monitoring techniques that are simple enough to be used in the field, also by people without laboratory experience.

Discussion

The main question for us to determine is when the output from a dry latrine is safe enough to be used as a fertilizer and soil conditioner. Studies by CEMAT in Guatemala indicate that a retention time in a LASF of about 12 months is required to kill virtually all Ascaris eggs. Can we develop a reliable, simple way of monitoring the presence of viable Ascaris eggs in the latrine output? How is the destruction of Ascaris eggs in a latrine influenced by a solar heater?

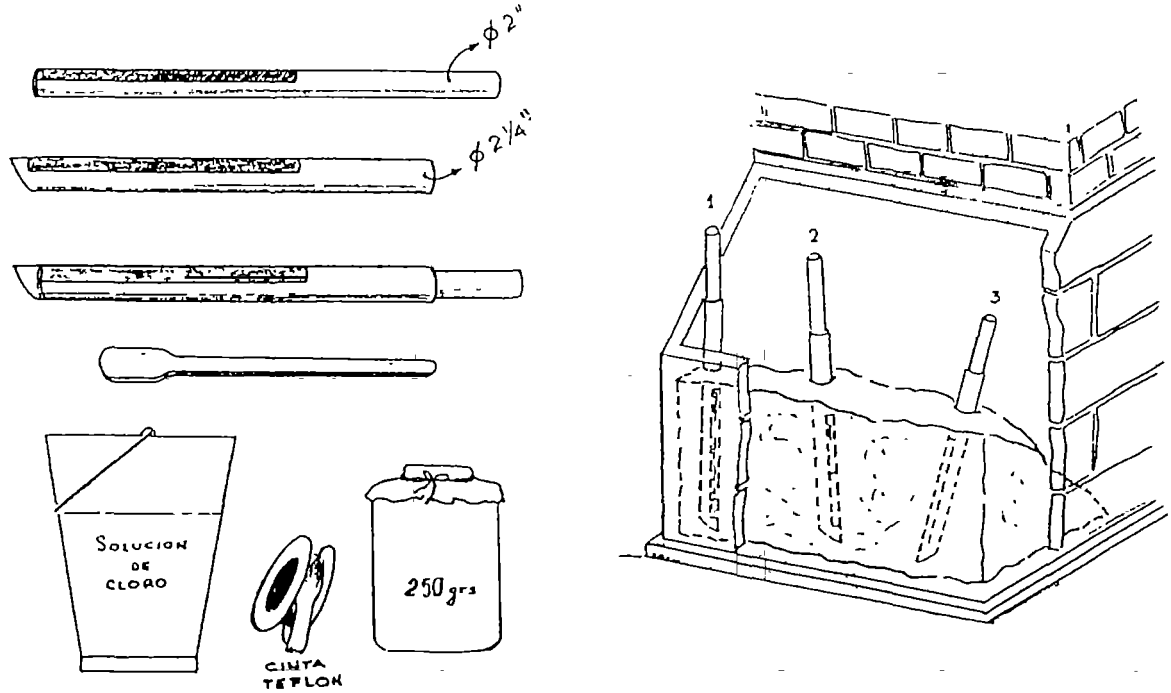

Fig 15: Equipment for collecting compost samples, Tecpan project, El Salvador

Annex 1

Workshop programme and papers presented

Wednesday 23 Nov

1600-1900 Arrival at the Xochitla Conference Centre, Registration
1900-2000 Dinner

Thursday 24 Nov Chairperson: Jean Gough

0830-0845 Practical arrangements (Josefina Mena)
0845-0900 Introduction (Uno Winblad)
0900-1000 The Mexico project (Josefina Mena)
1000-1300 Visit to project site (Josefina Mena)
1300-1400 Lunch
1400-1600 Discussion of Mexico project
1600-1800 Fibre glass moulding by participants
1900-2000 Dinner

Friday 25 Nov Chairperson: Hans Spruijt

0830-0945 The El Salvador project (E Siliézar, Miguel Santamaría, Elton Membreño, Herbert Gonzales)
0945-1100 The Guatemala project (Kajsa de Asturias)
1100-1200 Composting latrines in high mountain areas (Eric Dudley)
1200-1300 The Ecuador project (Edgar Flores)
1300-1400 Lunch
1400-1500 The Pakistan project (John Collett)
1500-1530 The Costa Rica project (Homero Silva)
1530-1800 Working groups:
1. Definitions, basic concepts (JC, ED, LE, UW)
2. Criteria (HG, EF, HS, JM)
3. Technical specifications (EM, KA, HS, JG)
4. Strategies for going to scale (HC, TR, JV)
5. Costs (KB, ES)
1900-2000 Dinner

Saturday 26 Nov Chairperson: Jorge Vargas

0830-1000 The Honduras project (Hilde Caldera)
1000-1100 Microbiology and sanitation (Gunnel Dalhammar)
1100-1300 Presentation/discussion of groupwork findings
1300-1400 Lunch
1400-1600 Presentation/discussion of groupwork findings continued
1600-1700 Discussion of network activities for 1995
1700-1750 Conclusions (Eric Dudley, Jorge Vargas)
1750-1800 Closing of the workshop (Uno Winblad)
2000-2130 Farewell dinner

Annex 2

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