Composting Latrines in Guatemala

Half of all children in rural Guatemala die before the age of five from diseases directly related to unhygienic sanitation, according to a 1980 governmental diagnosis of health conditions (1). The survivors suffer two-thirds of the time from cyclically transmitted diarrhea (2). Even among adults, infectious diarrhea remains the most common form of disease (1).

Most Guatemalans live in tiny communities, of which all but two percent have less than 2000 inhabitants. Only one-tenth of these people have piped water supplies or latrines, and most seldom see a doctor. Life expectancy is 45 years—16 years less than in the cities—and reflects the precarious environmental and economic conditions of rural subsistence.

The absence of sewage disposal systems turns lakes and rivers into receptacles of fecal contamination and transmitters of disease. With the pressure of increasing population, the primitive way of defecation in the fields behind houses and in the bushes off pathways can no longer be sustained by the environment. The Centro Mesoamericano de Estudios sobre Technologia Apropiada (CEMAT), an organization established following the earthquake that racked Guatemala in February 1976, has attempted to relieve these problems through the introduction of latrines in rural communities.

CEMAT's investigations, which began with earthquake reconstruction activity in what happened to be the lowest income areas in the country (Figure 1), quickly revealed the need for a wide range of improvements in stoves, shelter, water supply, family-scale agricultural production, and waste recycling. However, the inclusion of the most rudimentary sanitary infrastructure in house construction increased costs by 40 percent. Outdoor latrines offered the hope of a cheaper alternative for hygienic waste disposal.

Under contract to the World Bank, CEMAT conducted a survey in 1977 in San Pedro La Laguna, a Tzutuhil village of almost 5000 inhabitants beside Lake Atitlán, as part of a study of appropriate technology for water supply and waste disposal in twenty American, Asian and Latin American countries (3). The population of San Pedro lives at a density of 603.6 persons/km^2 in two-room houses of mud and stone. The infant mortality rate is high—116 per 1000. The volcanic bedrock and the lack of space are not conducive to the construction of conventional pit latrines, and at the time of the survey only 11.2 percent of the households had latrines (4). The rest defecated in the fields. A concurrent study of fecal contamination in Lake Atitlán (5) revealed evidence of a high degree of pollution due to water run-off from surrounding settlements.

Previous attempts had been made to promote the use of latrines. A government promotional program in 1930–1944 made them compulsory. The low level of cooperation in San Pedro led to a second attempt (1958) to seek the support of local leaders. Demonstration latrines were built for them at a user cost of US $8–10 (and a total unit cost of US $30, equivalent to US $60 in 1980 dollars). Momentum ceased, however, when personnel and material re-

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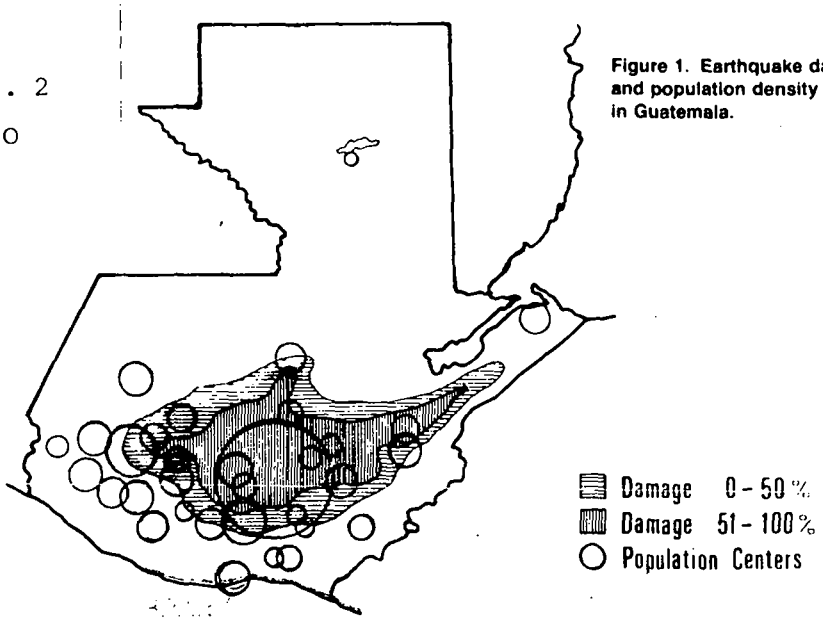

Figure 1. Earthquake damage and population density in Guatemala.

Box 1. The Double Vault Composting Dry Latrine

The composting dry latrine, or Double Septic Composting Vault System, has been used successfully for 25 years in Vietnam, where it is now reported to be producing annually more than 600 000 metric tons of organic fertilizer each year; its introduction has resulted in a substantial reduction in intestinal disease. For a population of 50 million, there is now, on average, one latrine for every 1.4 households in the northern half of Vietnam, and a similar program is being adopted in the South.

The composting dry latrine contains two chambers built above ground level and used in rotation for defecation and composting (Figure 2). The urine is channelled off by a groove in the squatting plate, or in the Guatemalan model by a protruding lip in the plate, and collected in a jar. After defecation, ashes are sprinkled on the feces. Thus the receptacle contains only feces and ashes (toilet paper is burned separately). The bulk is therefore greatly reduced, the contents are reasonably dry, and anaerobic decomposition takes place (9).

Construction materials are selected from among those customarily used in the region. The double-chambered base is built of compacted soil, adobe, brick, concrete, lime-pozzolana or stone blocks on a raised base to ensure isolation from groundwater (Figure 3a). An upper plate, made of concrete or a substitute on an armature of bamboo or cane, covers the chambers. Beside the holes to the chambers, a groove is hollowed out in the upper surface to channel away the urine (Figure 3b). A seat riser can also be used. Fitted lids keep one

Figure 2. The composting dry latrine contains two chambers built above ground level and used in rotation for defecation and composting. The urine is channelled off by a groove in the squatting plate.

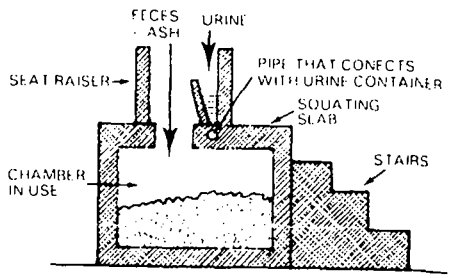

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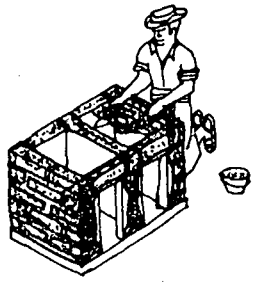
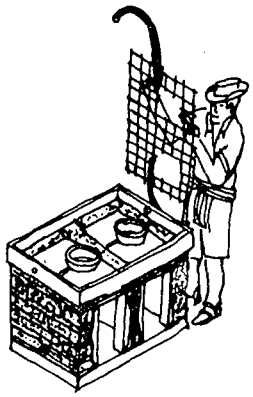
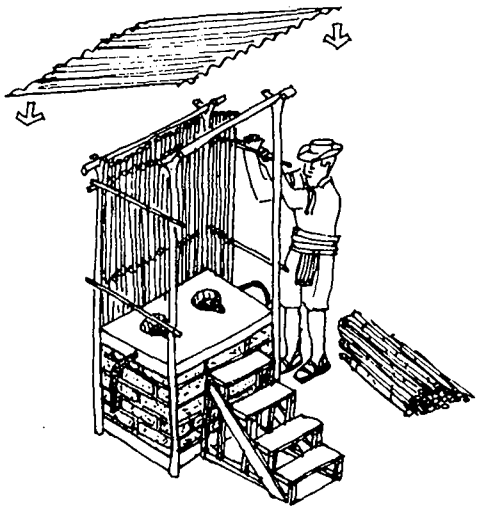
Figure 3.
Construction of the Dry Composting Latrine (LASF).



A. Construction of the double chamber



B. Construction of the squating slab that covers the chambers



C. Construction of the shelter

chamber closed between defecations and seal the other shut for composting. At the back of the structure, doors to the two chambers are cemented shut while the chambers are in use or composting is taking place. A shelter made of local materials (Figure 3c) is erected above the platform.

OPERATION

The key factor for successful operation is the dryness of the composting process inside the sealed chamber. Unlike mouldering toilets, this does not require handling of wastes, but proper use of the latrine each day is essential for maintaining dryness. The urine flows into a separate container and is either diluted with water or absorbed in soil, lime or ashes and used direclty as liquid fertilizer. Few diseases are transmitted through urine in comparison with those due to fecal contamination.

Each defecation is accompanied by an application of ashes or a soil/lime mixture (Figure 4a), to ensure dry decomposition of the feces. Every week the chamber content is stirred and more ashes are added (Figure 4b). After 2-3 months, when the first chamber is almost full, it is topped up with soil and its openings sealed shut. For the next 2–3 months while composting proceeds, the other chamber is used; when this in turn is full, the first is emptied (see Figure 4c).

Latrine costs range from US $35 for adobe to US $70 for concrete block construction. For building the squatting plate and making the chambers water-tight, it is difficult to use lower grade cement substitutes. The primary bottleneck in construction and diffusion has become the cost of cement.

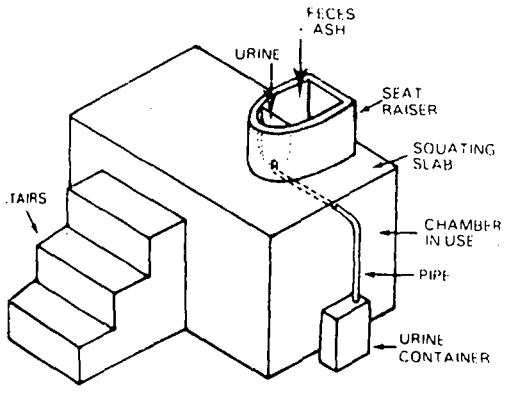
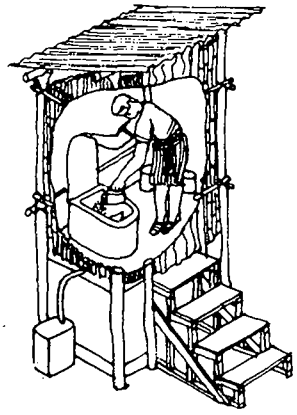
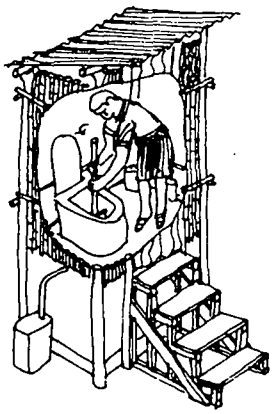


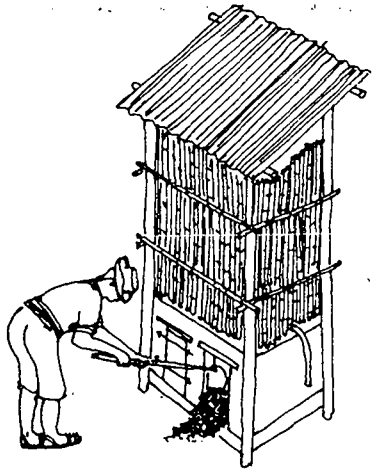
Figure 4. Maintenance of Dry Composting Latrines.



A. Daily adding of ash to the feces.



B. Weekly stirring of biomass.



C. Semestral extraction of compost.

sources were no longer provided. In 1974 a third attempt failed completely because only materials were provided and no promotion.

However, the population of San Pedro felt the need for latrines. In the World Bank survey, latrines were cited as a priority as often as fertilizer and second only to money (4). Preference was expressed for individual latrines, but 30 percent were willing to use a public facility. The primary reasons given for not having taken any initiative were the absence of skills and lack of cooperation. CEMAT also found that conventional latrines conflicted with the benefit of fertilization provided by open-air defecation: they consume scarce financial resources with no visible productive return, and they fill quickly and require laborious emptying or frequent relocation.

Developing a method of using nightsoil from the latrines as fertilizer was one way of interesting villagers in building and using them. At the same time, other criteria for latrines, developed by various authorities, had to be satisfied (Table 1). CEMAT collected information on different latrine designs from national and international sources, and, after construction and evaluation of different types, decided to concentrate on the development and dissemination of a family-sized, composting, dry latrine which has been used successfully in Vietnam for many years (see Box 1). Other designs were also developed for large-scale communal use (6).

Table 1. Criteria for excreta disposal techniques

WHO criteria
1. No pollution of surface soil
2. No contamination of ground water
3. No contamination of surface water
4. Excreta inaccessible to animals
5. No handling of fresh excreta
6. No odors
Socio-Economic criteria (1)
7. A simple toilet routine
8. Cost less than 10% of the dwelling
9. Use of local materials and technology
10. Avoidance of excreta dilution in water
11. Applicability in high density areas
12. Reduction or elimination of pathogens
13. Availability of composted by-product as fertilizer
Both sets of criteria are met by the Guatemalan type of family double vault composting dry latrine, apart from the possible drawbacks of its applicability in high density areas.

Sources: WHO, reference 10.

From 1978 to 1980 CEMAT built 31 composting dry latrines and closely monitored them, using simplified but reliable field tests—including coliform counting, quantification of viable helminth eggs and tests for entero- and rota-virus—to ensure that the resulting nightsoil was effectively sanitized. The data indicate that the resulting fertilizer can be used safely, provided it is diluted by spreading and mixing into the land to be cultivated.

Its effectiveness as a fertilizer and its usefulness in improving the soil and increasing agricultural production is still being evaluated. Analyses (7) indicate that it is rich in phosphorus and organic matter (3–11 percent) but relatively low in nitrogen (0.3–1.1 percent), which suggests that its main value as fertilizer lies in the organic matter and its contribution to the formation of humus.

A promotional program was launched to spread the use of latrines, in some areas in conjunction with an earlier program to reduce fuelwood consumption through the introduction of improved "Lorena" stoves built of mud and sand. The technique of latrine construction and use is introduced in a village by means of slides or visits to other

Box 2. Why Dry?

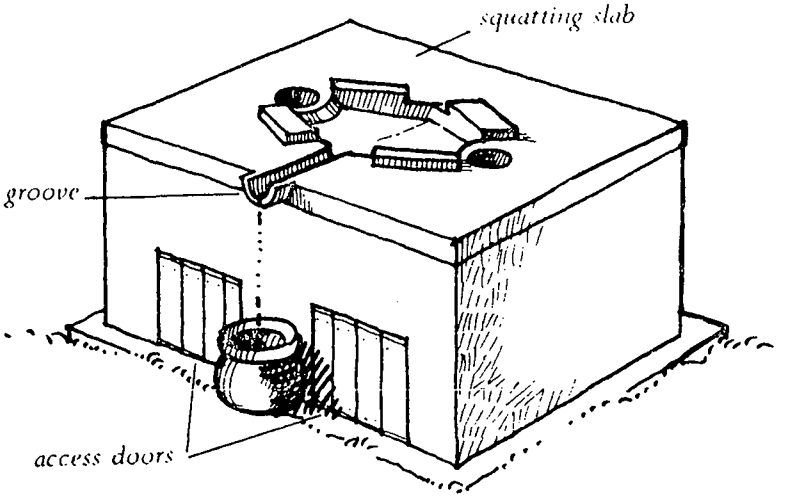
The technical simplicity of a latrine is deceptive. Most latrine projects in developing countries fail, sometimes for technical reasons but more often on social grounds. The Guatemala project seems to have been successful both technically and socially.

I would like to add a few comments. Why call this a "dry" composting latrine? The introduction of the term "dry composting" implies that there is also a "wet composting" process. But there is no such thing. Under "wet" conditions there is no composting, only digestion/fermentation. The difference is rather between composting latrines designed to take excreta (feces+urine) and latrines from which urine is excluded. Both types must be dry to function well, but may turn wet if not properly managed. Compost latrines for feces and urine require an additional input of non-fecal organic matter (kitchen and garden refuse for instance) to remain dry. If managed properly they are as dry as the latrine described by van Buren *et al.* On the other hand, a latrine from which urine is excluded may still turn wet, especially in cultures where water is used for anal cleaning.

In their brief description of the composting process the authors state that "anaerobic decomposition takes place" and refer to the SIDA published handbook *Sanitation without Water* by Winblad and Kilama. This is not quite correct. What Winblad and Kilama are stating (p 18 of the 1978 edition of their book) is "Composting processes are often classified as either aerobic or anaerobic but both types are actually going on at the same time in a compost heap. Near the surface the process may be aerobic while in the interior it is anaerobic."

The article is well illustrated but the authors do not make clear how they have solved the tricky detail of connecting the urine collector of the movable seat riser to the pipe. the Vietnamese prototype with a squatting slab instead of a seat riser has an elegant solution, see the figure below.

Uno Winblad



villages where latrines have already been built. Instruction courses are organized by indigenous promotors, in villages which show sufficient organization and which have expressed interest. Over the three days of the course, latrine use and maintenance are explained and a demonstration unit is built. Each participant in the course is required to build a latrine for the use of his own family and to serve as a teacher and promotor for others. Participants are asked to contribute $1 for their tuition—it has been demonstrated that this helps to ensure attendance for the whole of the course; they also raise the money for their own construction materials. In return they acquire technical competence and a completed latrine.

PROGRESS TO DATE

In some villages the adoption of latrines has been rapid. This occurred in San Pedro La Laguna, where the indigenous promoters had already acquired considerable experience and success in the dissemination of "Lorena" stoves. In Santiago Atitlán, on the other hand, the initial demonstration prototype did not give rise to immediate replication. Response was slow but confidence gradually rose, and within a year of the first installation other groups started asking for demonstration units at their own villages around the lake, often as a continuation of the "Lorena" stove program.

In 1978 a network of groups developing waste recycling technologies was organized under the name of REDEBIO and a two-year project was established to introduce and monitor methods of sanitary control (8). Since the completion of the project, separate families and groups have come forward with requests for assistance in erecting latrines of this type, which they see as useful and suited to their needs. Governmental institutions have recently begun to express interest in programs to disseminate latrines on a large scale.

The two-year lifetime of the project provided opportunities for experimentation and construction of 20 demonstration latrines, for 10 instruction courses, and for the presentation of preliminary data at six national and international seminars. At the time of writing, approximately 100 latrines were known to be in use. The total, however, is unknown, since unrecorded numbers have been built in inaccessible villages and by people who have not attended courses. Recently CEMAT has extended its work to a new area of Guatemala in the eastern low-lands where the water table is high, the climate hot and where very different environmental and socioeconomic problems emerge. Courses are being held there in conjunction with INDAPS, the government's Institute for Rural Healthworker Training. Eighteen more latrines have been installed in a few months in this new region, and acceptance is being demonstrated by the communities.

Information about composting dry latrines has also reached other Central American and Caribbean countries. Demonstration latrines are in operation in Honduras, and in Nicaragua, where the weight of the government has been put into the program and accelerated its implementation, at least 50 were built during the first year. Design improvements are continually being made, both abroad and in Guatemala's Highlands, where the original work was begun. The interchange between developing countries, evident in the construction of composting dry latrines, may prove useful in other places, as a model for the identification, design, development, and the gradual upgrading of technologies useable by the Third World.

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6. Anaerobic fermentation was chosen for community scale excreta disposal. A biogas digester was built at the request of the San Pedro Development Committee, with the help of the School of Engineering at the University of San Carlos. Costs were high because of heavy masonry requirements and the shortage of masons at that time. Problems encountered in digester operation and local acceptance have been analyzed. CEMAT has gone on to build more than 20 digesters of continuous, semi-continuous, and batch types which are all now functioning. For further information refer to their book *Bioenergías para el Ecodesarrollo Rural* (available from CEMAT).
7. CEMAT, Adaptacion de Metodologias para el Control Sanitario de Bio-Abonos y Efluentes con Respecto a los Microorganismos de Transmision Fecal in OLADE-SMHEN, *Manual de Biogas* (Guatemala, Ed CEMAT, 1981).
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Experts Issue Upbeat Agenda for World Environment

World prophecies on the environment are usually gloomy affairs. But last May at Wye Island near Washington DC, 75 experts from 20 countries met for four days to consider the world's ecological fate, and chose to look on the sunnier side of the planet's future.

"As we consider the contours of a brighter and sustainable future, its features become clearer," the group stated. "World population is stabilized before it doubles again, and the erosion of the planet's renewable resource base—the forests, fisheries, agricultural lands, wildlife, and biological diversity—is halted. Societies pursue management practices that stress reliance on the 'income' from these renewable resources, not a depletion of the planet's capital. Enlarging this income requires sophisticated management and more intensive use of prime farm and forest lands and fisheries, as well as the application of new technologies to improve agricultural yields, control pests and spoilage, and exploit new opportunities such as aquaculture, hydroponics, and salt-tolerant crops."

"Human activity," the experts agreed, "becomes more 'closed' in the ecological sense, so that it does not impair the functioning of natural systems. Manufacturing processes produce less waste, and what waste is produced is reused in other processes. Advanced technologies are widely applied to achieve high efficiencies in the use of energy and in its production from solar, biomass, and other renewable sources. Broadly-based economic growth proceeds in ways that lessen the gap between rich and poor both within and among countries, and the door is increasingly opened to artistic and cultural pursuits in a world where the hard labor of survival is lessened."

Too utopian? Maybe. But the sponsors of the conference, a new environmental "think tank" in Washington DC, called the World Resources Institute, had purposefully named the conference "The Global Possible: Resources, Development and the New Century." And those who attended the conference showed surprising unanimity and optimism.

To be sure, such a scenario cannot come about without the exercise of great political will, the experts added. "Realizing this future will require impressive international cooperation among governments, and larger roles for those outside government, given the burdens that governments now face," the conference reported.