WORLDWIDE ACCESS TO SANITATION SERVICES

Mitsugu Saito
Technical Manager, Overseas Environmental Cooperation Center, Tokyo, Japan

Yasumoto Magara
Professor of Engineering, Hokkaido University, Sapporo, Japan

Keywords: Appropriate technology, Community participation, Fecal-oral transmission, Open defecation, Primary health care, Resource recovery, VISION21.

Contents

Summary

By WHO estimation in 2000, 2.4 billion people worldwide still do not have appropriate sanitation. To solve the problem, significant amounts of sanitation facilities must be provided. The VISION21 initiative aims at halving the number of people without access to hygienic sanitation by 2015 and this will mean delivering the facilities for 384 000 people every day.

Appropriate technology offers some possibilities to solve the problem since every country has a different climate, an individual social system and indigenous cultural background. As against the conventional options, which are normally expensive, energy intensive and hi-tech, appropriate options are relatively cheap, community based and robust.

Sanitation technologies are roughly divided into two categories—wet systems and dry systems. The principal advantages of wet systems are; 1) protection from vector insects, 2) protection from odor, 3) combined handling with cleaning water. The advantages of dry system are; 1) water saving, 2) the possibility of resource recovery.

For implementation of sanitation facilities, community participation is essential. With attractive benefits, people’s motivation or willingness to pay is extensively boosted. A facilitator or animator can play a key role to motivate, organize and educate people. A community often needs external help, either technically or financially. Keys to success in sanitation promotion are to give people appropriate information on hygiene, technical knowledge, and confidence in their capability.

Human beings cannot avoidexcretion. Hygiene and sanitation are therefore a right and an obligation for all. Above all, ceaseless efforts have to be made until sanitation services become available in every corner of the world.

1. Introduction

The World Health Organisation (WHO) estimates that 2.4 billion people worldwide do not yet have any acceptable means of sanitation, and 1.1 billion people do not have an improved water supply. For those who are threatened by the health risks, United Nations (UN) and other organizations have launched several programs and action plans which protect and promote health for the world population. One of major turning points came in 1976, at the UN Conference on Human Settlements (Habitat) in Vancouver. The Conference impressed on the many governmental delegations that the improvement of water supply and sanitation services in poor countries was the key emergent task for all people. Habitat then recommended establishment of realistic targets and programs to provide water and sanitation for unserved urban and rural people.

Two years later, the International Conference on Primary Health Care was held in Alma-Ata, USSR. This conference called for urgent and effective action to develop and implement primary health care throughout the world. The Declaration of Alma-Ata adopted during the Conference aimed at attaining an acceptable level of health for all the people of the world by the year 2000, and included adequate supply of safe water and basic sanitation as essential elements, as well as nutrition, immunization, etc. (see *Primary Health Care: The Key to Health for All*).

From 1981, five years after the Conference in Vancouver, the International Drinking Water Supply and Sanitation Decade (IDWSSD) was launched targeting “safe water supply and sanitation for all.” Unfortunately, due to obstacles such as population growth, regional conflicts, poverty, water pollution, etc., the target was not achieved. On the positive side, the policies of the Decade Plan, the principles of equity and community participation, contributed to redirect the previous perception of international cooperation, "charity from rich to poor."

In 1990, the Water Supply and Sanitation Collaborative Council (WSSCC) was established in order to maintain the momentum of the IDWSSD. The mission of the WSSCC is to accelerate the achievement of sustainable water, sanitation and waste management services for all people, with special attention to the unserved poor. WSSCC builds bridges between professional associations and international NGOs, covering many aspects, e.g. technical, regional, tactical, networking, etc.

VISION21 was launched by the WSSCC at the Second World Water Forum and Ministerial Conference in the Hague in March 2000. VISION21 is based on the "Water for People" initiative and aims at halving the number of people without access to hygienic sanitation facilities and adequate quantities of affordable and safe water. This will mean delivering improved water services to almost 280 000 people every day for the next 15 years, and improved sanitation facilities for around 384 000 per day. The ultimate goal to achieve universal access to hygiene, sanitation and water services was set at 2025 (see *Constraints to Improving Water and Sanitation Services*).

Simultaneously, VISION21 emphasizes the importance of developing the options in concordance with regional needs and resources. This indicates the use of appropriate technology—the technology applicable and affordable for countries in every stage of development.

The World Summit on Sustainable Development held in Johannesburg in 2002 included 2015 targets to halve the unserved people in its Plan for Implementation. Today, world people are obliged to contribute to eradicating poor health and improving living conditions.

Worldwide coverage of sanitation services in 2000 was 86% and 38%, for urban and rural communities, respectively. In order to meet the 2015 target, sanitation facilities for 2.2 billion people must be provided. Since higher population growth is expected in urban areas during this period, the number of people who need improved sanitation is almost the same in urban and rural areas.

2. Historical review of human excreta handling

Water-based sanitation facilities—understood today as sanitation itself—were developed in the middle of the nineteenth century. Prior to this, sanitation practice differed between regions and hierarchies, and the archaeological remains date back several thousand years. Public buildings in the Greco-Roman Era were already equipped with public latrines, and cities had a storm drain infrastructure. Similar findings have been identified in many part of the world, e.g. Babylonia, Palestine, Indus, etc. Despite this, it is probable that the majority of people then defecated on streets, in fields, and/or along rivers.

Until the end of the Middle Ages, there were no significant developments in sanitation facilities. Open defecation and bedpan defecation were still the principal ways for ordinary people, and consequently, epidemic diseases prevailed periodically over many cities in concordance with population growth.

The nineteenth century was a turning era in terms of sanitary systems. The first water closet was connected to water and wastewater lines in the 1850s in London. Earth closets and dry toilets with urine/feces separation also appeared in this period, but these non-water systems eventually disappeared and the water closet was propagated throughout the world.

Although the collection of storm drainage dates back to ancient time, it had long been discharged directly to streams, and the untreated sewage resulted in the accumulation of sludge and development of offensive odors. Following behind the development of the sanitation apparatus by several decades, wastewater treatment technologies were developed, primarily physical and chemical treatment followed later by biological treatment (trickling filter system in the 1890s and activated sludge system in the 1910s). With the combination of sanitation apparatus, sewerage network, and wastewater treatment, the hygiene sanitation system was complete, but imbalance between these three facilities led to environmental pollution. Today new approaches are emerging to review current water-based sanitation systems toward more sustainable options.

3. Objectives of sanitation services

Sanitation itself is not the purpose but one useful tool for better life. Sanitation takes essential part of integrated system of disease prevention, pollution control, and resource recovery. Among them, the prevention from infectious diseases is the main motive of sanitation. To cut off the infection chain of diseases, three countermeasures to be taken are sanitation, hygiene and environmental development.

Many infectious diseases are caused by gastro-intestinal viruses, bacteria, protozoa, or helminthes. Fecal-oral transmission is the principal route for diseases that originate from human excreta, but there are a few exceptions (see Table 1). Vectors, water, and/or a part of the human body transmit the pathogens that the infected person defecates, and they find a new host through the mouth by eating, drinking, or sucking fingers. Toilets or latrines act as a primary barrier, as shown in Figure 1. Pit latrines; for example, are said to reduce diarrhea by 36% or more when they are used properly; while hand washing with soap and water accounts for another 35% or more.

Transmission Route	**Disease**
Fecal-oral	*Poliomyelitis*, *Hepatitis* A, Dysentery, Cholera, *Salmonellosis*,
	Amoebiasis, *Giardiasis*, Roundworm, Tapeworm,
	Pinworm, Whipworm, Hookworm, etc.
Urinal-oral	Typhoid Fever
Fecal-dermal	*Shistosomiasis* (*S. mansoni*, *S. japonicum*)
Urinal-dermal	*Shistosomiasis* (*S. haematobium*)

Table 1. Excreta related infectious diseases

Human excreta are also environmental hazards. Unlike domestic or industrial wastewater, human excreta contains few chemical contaminants—the main concerns are organic matter and nutrients. Due to population growth, environmental stress as a result of untreated human excreta has been very severe. In particular, eutrophication in stagnant water bodies is major threat to aquatic ecosystems.

Sanitation, on the other hand, also has a positive aspect, that of resource recovery. Human and animal excreta have long been used as fertilizer or energy sources. Industrialization and modernization have produced more efficient and effective alternatives by exploiting limited resources. Today, the importance of sustainability is eventually recognized and human excreta have been revived as a recyclable resource (as long as humankind survives). Sanitation technologies enable use of this resource with minimum risk, and contribute to sustainable development.

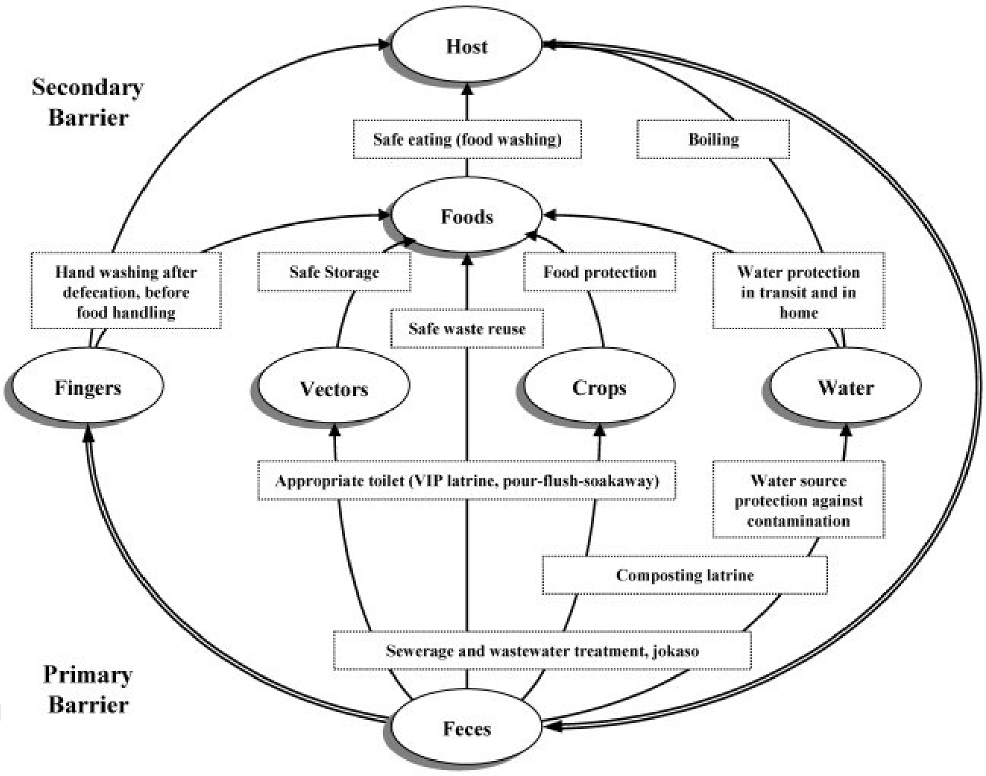

Figure 1. Infection chain of fecal-oral diseases

4. Appropriate technology on sanitation service

Today, piped sewerage and wastewater treatment plant are regarded as ultimate and ideal ways to handle human excreta and wastewater. But the countries where the system was invented and spread are located in regions with a temperate climate, and the system is not always suitable for arid or tropical climates. Every country has a different climate, an individual social system, and indigenous cultural background, so the appropriateness must be evaluated comprehensively. Over the years, many technical options have been developed to suit a variety of needs. These local applications are not yet well recognized because of their limitations, and they are often considered as inferior or makeshift options.

4.1. Recognition of appropriate technology

This perception is gradually changing in the field of international cooperation and regional development. People are coming to understand that these local applications are often very suitable in particular regions for particular purposes. As against conventional options, which are normally expensive, energy intensive and hi-tech, the local options are relatively cheap, community based and robust. These options are, therefore, known as "appropriate technology" and several organizations are now evaluating, classifying and developing them.

As for appropriate technology, "now" is a key word to consider. If advanced sanitation systems are applied to low-income regions with anticipation of future development, the available financial and human resources may prove inadequate for installation and maintenance. The system must be affordable. This does not mean that only the present status should be considered—plans can be made for stepwise upgrading. In terms of benefit sharing, a "some for all" policy based on the principle of equity can reduce the degree of inequity at every point of the time-axis, i.e. in a succession of "nows".

Another characteristic of appropriate technology is its local oriented approach. As climate, society and/or culture differ between countries, so does the possible outcome. Of course, science and technology regard these boundary conditions, too, but appropriate technology does it much more effectively. So-called donor countries, which have a high technology level, are unevenly located over the world, and there is no guarantee that systems developed in these countries can have universal application.

Appropriate technology should therefore pursue integration. Science and technology have, through the process of advancement, differentiated into various domains. On the other hand, appropriate technology resembles traditional techniques, before differentiation was very significant. This indicates the importance of integration of applications that are now variously divided.

4.2. Extent of appropriateness

The notion of appropriate technology helps improvement of traditional methods rather than departing from them, and it widens the range of available choices. By keeping things on a small scale, various techniques become possible options. For example; nomads in the desert may practice hygienic open defecation with no risk nor hazard, and, conversely, urban sewerage may cause water pollution unless a wastewater treatment facility is in operation. One important note is that to evaluate safety, vocational hygiene must also be considered. Usually, appropriate technology is labor intensive, and hygiene for the person in charge must be carefully considered.

Appropriate technology is, as mentioned above, simple in hardware, but rather complicated in software. In other words, it is not a foolproof system but one that the beneficiaries need to understand very well. This promotes community participation, with emphasis on user-friendly technologies, and eventually encourages a sense of ownership.

As for integration, an example of a sanitary field is expressed in Figure 2. Conventionally, this field is classified by function (vertically), but by recombining interdisciplinarily (horizontally), a more sustainable approach will be developed.

Classified by Purpose (New Approach)	Classified by Function (Conventional Approach)			
	Waterworks	Sewerage	Solid Waste	Other Related Field
Health	Drinking water	Sanitation	Composting	Hygiene, Food supply
Amenity	Domestic water	Domestic wastewater	Household waste	Housing
Business	Industrial water	Industrial wastewater	Industrial waste	Vocational health
Flood Control	Dam	Storm drain	Road sweeping	Forestation
Pollution Control	-----	Wastewater treatment	Incineration, Sanitary landfill	Environmental remediation
Resource	Rainwater harvesting	Wastewater reuse	Recycle	Natural energy

Figure 2. Example of new approach for integration

5. Classification of sanitation facilities

Sanitation facilities have several grades (see Figure 3) and they have their own advantages and disadvantages. They consist of apparatus, collection/release and treatment. Apparatus, or defecation site, whether concealed or open, can always be defined in any type of facility. Then, collection/release or treatment may also be added by its configuration (see Table 2). Water is one of the most important materials for sanitation. It has many functions; excreta transportation, anal cleansing, water seal, hand-washing, etc. On the other hand, methods without water also exist, e.g. dehydration and composting, which sterilize and reduce volume by removing water. Typical images of various sanitation systems are drawn in Figure 4. There are seat riser and squatting plate variations in every type, but the difference does not affect the sanitary system.

-
-
-

Bibliography

Chorus I., Ringelbond U., Schlag G. and Schmoll O. (2000). *Water, Sanitation & Health, Resolving Conflicts between Drinking-Water Demands and Pressure from Society's Waste*, 440 pp. London: IWA Publishing. [This is the proceedings of an international conference held in Bad Elster, Germany on 24-28 November 1998].

Howard G. (1999). *On-site Sanitation and Groundwater: the Art of Balancing Unknown Risks?*, Waterlines 17.4, On-site Sanitation and Groundwater Quality, pp.2-5. London: Intermediate Technology Publications Ltd. [This article looks at the concerns on possible risks of on-site sanitation and goes on to point to some possible ways forward].

Kalbermatten J. M., Julius D. S. and Gunnerson C. G. (1980). *Appropriate Technology for Water Supply and Sanitation, 1-A, A Supply of Technical and Economic Options*, 40 pp. Washington: Transport, Water and Telecommunications Department. The World Bank. [This reports the broad technical, economic, health, and social findings of the research and discusses the aspects of program planning necessary for their implementation].

Pickford J. (1995). *Low-cost Sanitation, A survey of practical experience*, 167pp. London: Intermediate Technology Publications Ltd. [This book is a guide to what has been learned about providing sanitation coverage for both rural and urban low-income communities].

Tchobanoglous G. and Burton F. L. (1991). *Wastewater Engineering, Treatment, Disposal and Reuse, Third edition*, 1334 pp. New York: McGrawhill, Inc. [This is a comprehensive textbook widely used in collages and universities and by practicing engineers in both the public and the private sectors].

WHO Commission on Health and Environment (1992). *Our Planet, our Health: Report of the WHO Commission on Health and Environment*, 381pp. Geneva: World Health Organization. [This report was prepared for the Earth Summit in order to deepen the comprehension of sustainable development from the viewpoint of Health].

Winblad U. and Kalama W. (1985). *Sanitation without Water*, 161pp. London: Macmillan Education Ltd. [This book has been prepared to meet increasing demands for practical information on how to design, build and operate better latrines].

Biographical Sketches

Mitsugu Saito is Technical Manager at Overseas Environmental Cooperation Center, Japan. He was born in 1959 in Sapporo, Japan; grew up and was educated there. He was admitted to the Architectural Engineering Department, Hokkaido University in 1978 and graduated from it with his graduate thesis on thermal environment. He continued his study at Graduate School of Environmental Science. For his research on thermal waste recovery systems from industrial cooling water, he was conferred a master degree of environmental science from Hokkaido University in 1984. He then worked for a construction company; Obayashi Corporation, from 1984 to 1997, as a mechanical engineer on building service works. In the meantime, he was dispatched to Thailand from 1990 to 1995. He was dedicated to many construction and renovation projects (mainly hi-tech factories). His responsibilities covered air-conditioning, plumbing, water and wastewater treatment, utility supply, and pollution control. From 1997, he enrolled to Japan Overseas Cooperation Volunteers (JOCV), part of the framework of Japan International Cooperation Agency (JICA). He spent two years in Morocco as an urbanist of the municipality of Fès. He was assigned to "Service Nettoiement et Parc Municipal" with responsibility for research and planning of solid waste management system. In 1999, he returned to Japan and resumed his study in Hokkaido University as a PhD student at the Environmental Risk Engineering Laboratory, School of Engineering. He obtained a PhD in 2003 for his dissertation titled "Appropriate technology of domestic wastewater management for low-income urban communities."

Yasumoto Magara is Professor of Engineering at Hokkaido University, where he has been on faculty since 1997. He was admitted to Hokkaido University in 1960 and received the degree of Bachelor of Engineering in Sanitary Engineering in 1964 and Master of Engineering in 1966. After working for the same university for 4 years, he moved to National Institute of Public Health in 1970. He served as a Director of the Institute from 1984 for the Department of Sanitary Engineering, then the Department of Water Supply Engineering. In the meantime, he also obtained a Ph.D. in Engineering from Hokkaido University in 1979 and was conferred an Honorary Doctoral Degree in Engineering from Chiangmai University in 1994. Since 1964, his research subjects have been in environmental engineering and have included advanced water purification for drinking water, control of hazardous chemicals in drinking water, management and treatment of domestic waste including human excreta, management of ambient water quality, and mechanisms of biological wastewater treatment system performance. He has also been the member of governmental deliberation councils of several ministries and agencies including Ministry of Health and Welfare, Ministry of Education, Environmental Agency, and National Land Agency. Meanwhile he performs international activities with JICA (Japan International Cooperation Agency) and World Health Organization. As for academic fields, he plays a pivotal role in many associations and societies, and has been Chairman of Japan Society on Water Environment.
Professor Magara has written and edited books on analysis and assessment of drinking water. He has been the author or co-author of more than 100 research articles.