

Status Analysis and Strategic Framework for Sanitation Management in Asia and Africa

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Abstract

Following rapid population increase and industrial development, the ever increasing environmental pollution and the sanitation-related problem associated are no longer regional or local but have become an issue requiring the globally dimensional concern and the provision of problem-solving alternative. Especially, since most of the problems resulted from the inappropriate sewerage and the lack of sewage treatment system are in the state of seriously occurring in economically underdeveloped regions, their significance is enormous. United Nations Environment Programme (UNEP) has been making efforts on establishing the technology selection methodology applicable in developing countries, through the accurate status investigation and analysis for the wastewater management state in Asian and African regions, and the sanitation management guideline utilizable by political leaders (PLs) or decision-makers (DMs). As part of this effort, Korea Institute of Water Environment (KIWE), together with the UNEP, selected China and Vietnam (in Asia) and Kenya and Ethiopia (in Africa) as subject countries of investigation and performed the on-site sanitation management investigation and analysis in this research. Results obtained from the on-site investigation were analyzed, and in order to be helpful on establishing strategy for the sanitation management in underdeveloped countries, the strategic framework (SF) has been made based on characterized results.

Keywords

Asia and Africa; Sanitation, Management; Strategic framework

INTRODUCTION

Currently, more than 2.4 billion people lack access to the adequate sanitation and are forced to dispose of their excreta in unimproved and unsanitary conditions. It has been reported that for the last three decades, the world population has been doubled to 6 billion, the world economy has been more than doubled, and the level of urbanization has been increased, especially in developing countries (UNEP, 2004a). According to the report of WHO and UNICEF (2000), the proportion of households in major cities connected to sewers in Asia and Africa are 45 % and 18 %, respectively. Several attempts have been made by countries in Asia and Africa regions to address the problems caused by improper sanitation management. However, as yet, no significant progress has been achieved. Because, the sanitation related problems in developing or underdeveloped countries are not simply the problem of sanitation or environment but the one which can be improved by supports of politics, economy, and technology as well as such immaterial elements as campaign or education (UNEP and K-water, 2006). When establishing strategy for the effective sanitation management in underdeveloped countries, based on these basic elements, the philosophical understanding of 'water as a recurring resource' should definitely be preceded. In general, the term 'sanitation' is understood as the services and facilities required in ensuring a healthy, user friendly, and convenient management of human wastes at the personal level, i.e., in and around the household (UNEP, 2004b). According to the Concise Oxford Dictionary, "sanitation" refers to all conditions that affect health, especially with regard to dirt and infection and specifically to the drainage and disposal of sewage and refuse from houses. In this report, the term 'sanitation' is defined as the

water originated from wastewater including domestic, industrial, and sewage. The purpose of this research is to develop guidelines for the sanitation management in Asia and Africa by assessing, reviewing, and analyzing the present situation of wastewater pollution for urban and rural areas and the existing sanitation management policies and strategies in these regions. It is expected that the new strategic framework for sanitation management in Asia and Africa is the first comprehensive solution on the overall sanitation management in developing and/or underdeveloped countries.

FIELD SURVEY AND ANALISYS

Selection of research areas

The subject areas of investigation were selected with emphases on such diverse characteristics as location, population, economy, and environmental characters and the regional representatives. China, along with India and Vietnam in the Asian region, needs effective and long-term plan and alternative provision for the potential environmental problems, due to abundant growth potential and fast economic development. Furthermore, in China, the security of nationwide investigation data and the technology proposition, corresponding to the specific purpose, are practically difficult, due to different regional climate, culture, population and economic structures, resulted from the large land area. In case of Vietnam, as a front runner among those southeastern countries showing the rapid economic growth, understanding of and approach toward the environmental problems and derivation of the solution alternative have the feature of becoming a model for the establishment of wastewater management guideline by other southeast regional countries. In addition, since most countries, in case of Africa, possess the outdated sanitation state (health environment) due to economic poverty, water shortage, and environmental pollution, Kenya and Ethiopia, located at the eastern and northern part, respectively, have become selected as subject countries of investigation.

Table 1. Research areas in Asia and Africa

Regions	Nations	Research Area	
		Urban	Rural
Asia	China	Nanjing & Shenyang City	Hunan province
	Vietnam	Hanoi & Haiphong City	-
Africa	Kenya	Meru	Eldoret Twon
	Ethiopia	Addis Ababa	Godar Town

Results from status investigation

Asian Region

China is assessed as a country possessing the potential weakness of sanitation management failure due to vast territory, disproportionate water resources, large population and rapid economic growth. Most developed cities are formed in coastal regions, and the circumstances for the own environmental infrastructure establishment has become facilitated, resulted from the rapidly increased governmental financial support since 1980s, and the environment-related construction has become active accordingly (Based on the 10th 5-year plan, the total of \$84.33 billion, corresponding to 1.3 % of GDP, is planned invested and \$32.53 billion among these is expected to be invested on the water supply and drainage related water treatment facilities and their associated projects). As a result, the sanitation management system, developed centering around such big cities as Beijing and Shanghai, is in the state of very well established. However, resulting from the not properly formed specialty manpower for the operation and management, compared to the very rapidly constructed wastewater treatment plant, the treatment plant has been shown many cases of

not normally operated, and in case of agricultural areas, it has been shown the significantly poor condition compared to downtown areas, and thus much of policy support and alternative for the financial security for the sanitation improvement have been needed.

In case of Vietnam with abundant precipitation and well developed lakes, even though the sewer-line system for the purpose of excluding rainwater was developed early, the establishment of new sanitation management infrastructure is currently needed due to the problems resulted from the deterioration of existing sewer-lines. Furthermore, the lake pollution by wastewater resulted from the lack of appropriate wastewater treatment plant and its subsequently associated sanitation problem are emerging at the significant level. Although some big cities are planning for concrete maintenance and new establishment for the sewer-line area, expanding large amounts of capital, technology and specialty manpower is needed. The development of technology and infrastructure related to sanitation in Vietnam is considered requiring the construction of wastewater treatment plant and the new establishment/repair of sewer-lines, centering around the downtown area.

African Region

Although the sanitation related infrastructure status in Kenya is somewhat good compared to other African countries, most agricultural regions, except for some big cities, are in the state of lacking sanitation facilities. In addition, slums have been formed adjacent to downtown recently, becoming a new problem, so the appropriate countermeasures for these regions are needed as well.

In case of Ethiopia with relatively abundant water resources, the sanitation related status was shown not that much different from Kenya. Facilities for the fundamental sanitation management, including personal sanitation, were absolutely short, and the sanitation infrastructure status was shown with a big gap between urban and rural areas. Being more serious, above all, is that in addition to the shortage of financial support, technology and specialty manpower to overcome this situation, understanding of the accurate current status and provision of the alternative are originally troublesome, due to the difficulty of obtaining those related data, compared to Kenya. Results from the investigation of the sanitation management status for these countries are summarized in Figure 1.

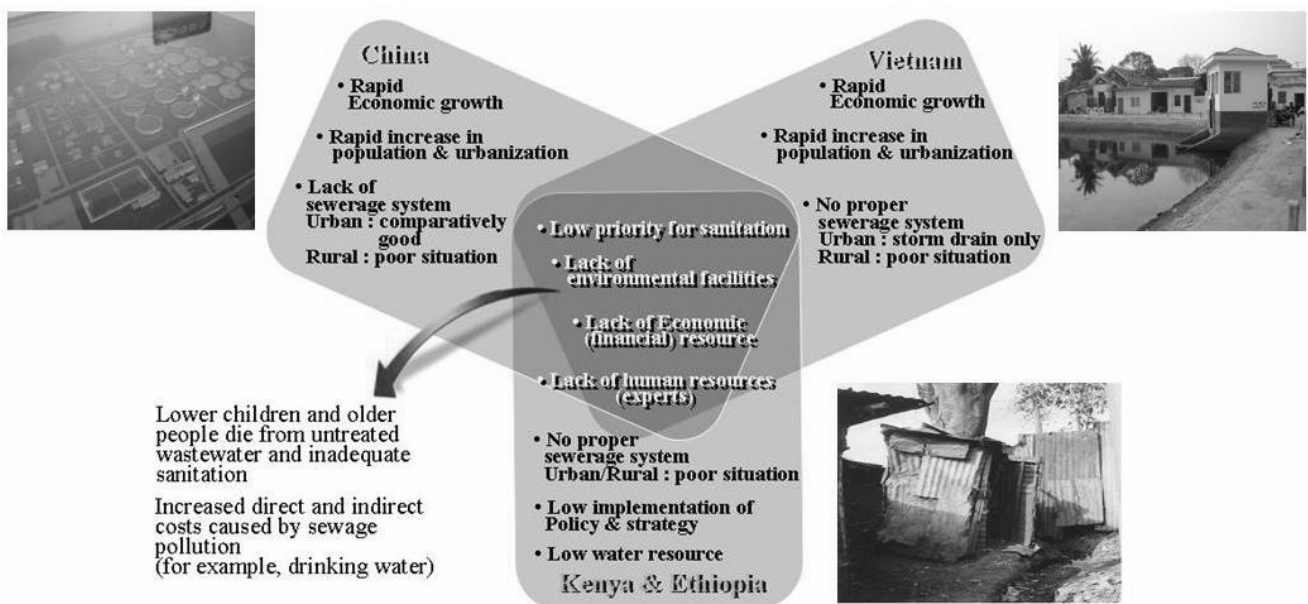


Figure 1. Summary of the sanitation management status in studied countries

RESULTS AND DISCUSSION

In general, the sewerage system can be effectively established when the demand of residents, the economic power of nation and local autonomous entity, and the national policy support are run parallel. Economic power and living standard of respective country, especially, can become dominant factors affecting the developmental stage for its sewerage system. Beginning and end for the sanitation management can be largely divided from the “concept of personal or small-scale regional sanitation management” starting from each individuals to the “public health” or the “concept of integrated environmental management”, corresponding to public society and nation. In the long run, the sanitation management must be perceived as the problem of understanding and managing the overall water recycling process but not as the problem simply limited to the sewerage.

Strategic framework (SF) for the sanitation management

Just like the environmental infrastructure consists of diverse material/immaterial factors, the establishment of sanitation management also requires for the factors to consider, from such diverse areas as policy, economy, society, and culture, beyond the environmental area. Since the relationship between these factors to consider is very complicated, it gives difficulty to PL or DM, especially in case the underdeveloped country intends to introduce policy or technology for the sanitation management. For the strategy establishment reasonable for the sanitation management, this report proposes the strategic framework (SF), as shown in Figure 2.

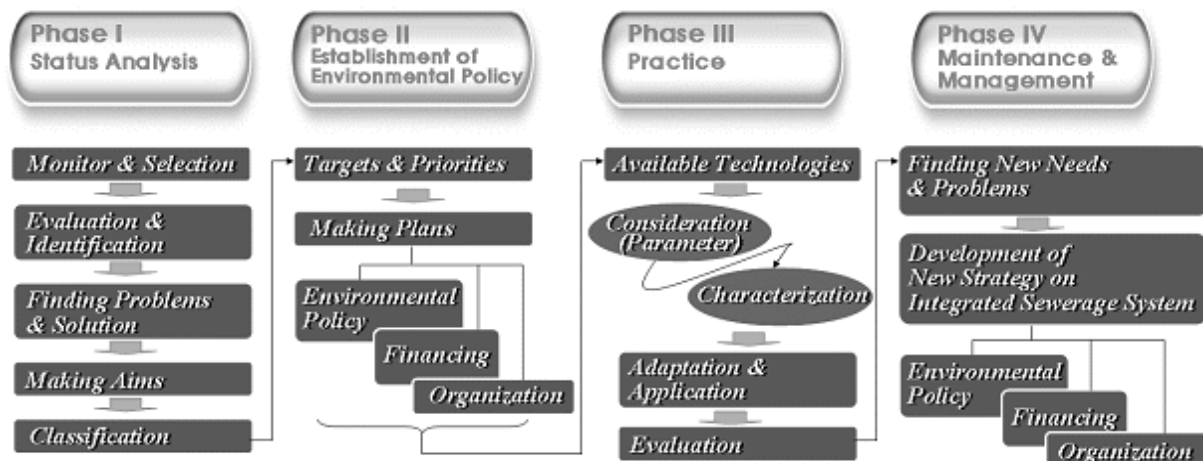
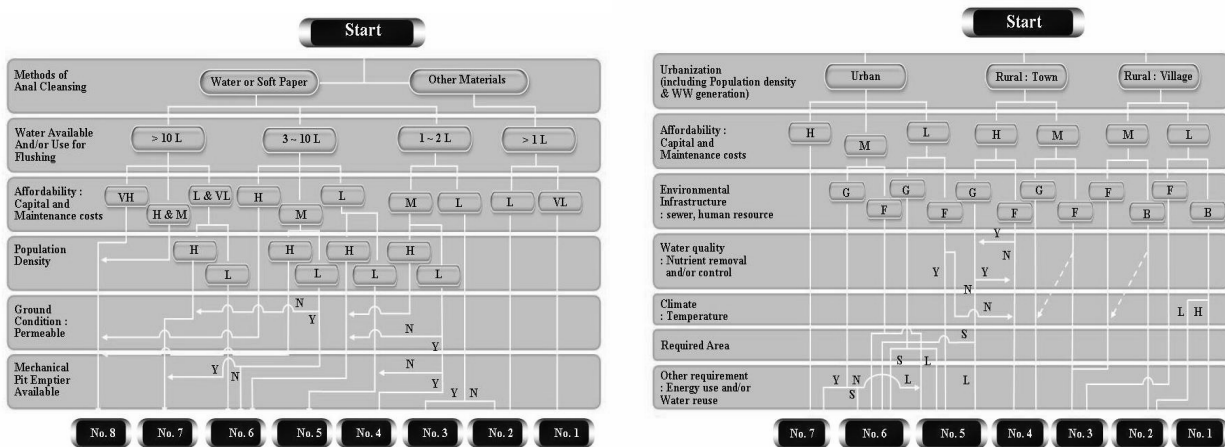


Figure 2. Strategic framework for the establishment of environmental infrastructure

The SF is largely performed through 4 stages (Phase I – Phase IV), which is also the stage (process) of establishing and driving the sanitation management strategy as well as the process of establishing the environmental infrastructure, previously mentioned, from the different viewpoint. Phase I, as the status analysis step, is the stage collecting, assessing and analyzing the scattered related data, followed by identification, and then classification based on long-/short-term specific goal and purpose, through the individual problem perception and the groping of solution alternative. Phase II, as the step for performing the materialization work (selecting items, species, areas, etc.) based on target and priority for those classified alternatives, is the stage establishing the long-/short-term plan to go over to the concrete execution stage for environmental policy, financial support capability, organizational composition, etc. of the respective region or country. These kinds of long-/short-term plans are materialized mainly in the form of environmental policy. In Phase III, as the stage for establishing the concrete execution alternative, based on long-/short-term plan, etc., established in Phase II, the selection of optimal technology, above all, becomes the important key item. There exist innumerable many environmental improvement technologies for the sanitation management.

The policy and decision makers, therefore, should be able to select the optimal technology group applicable, through the deep consideration about economy, society, culture, etc., among them, of the respective region and the assessment for technological characters and affecting factors. In Phase IV, as the maintenance/management stage, new problem is perceived through the assessment for a certain period by introducing/applying the optimal technology selected in Phase III, and through the pre-execution process (covering from Phase I to Phase II), the strategy for such new areas as the organizational re-composition for environmental policy, financial security, and maintenance/management are established. The Phase III stage selecting the applicable technology, especially, is very important as the one providing the guide capable of more reasonably selecting the technology satisfying both present level and future demand. In order for the reasonable selection of technology appropriate for the respective region or country, the decision-tree (DT) referable by PL and DM is proposed in this report. The DT is largely divided into regions with the sewer-line unsupplied and already installed, as the sanitation technology related item mainly associated with the wastewater treatment, and this is ultimately in a close relationship with the smooth supply and use of water as well. The PL or DM related to the sanitation management would be able to establish the optimal sanitation management related technology and infrastructure applicable in the respective region, by employing the DT.



a) DT I for on-site treatment facilities b) DT II for conventional wastewater treatment process
 Figure 3. Decision trees for applicable treatment technologies

Table 1. Classification of the wastewater treatment technologies for DT I and DT II

Class	Applicable technologies	
	DT I	DT II
No.1	Simple pit toilet	1 st treatment
No.2	Ventilated pit toilet	Soil trench (Natural treatment system)
No.3	Composting toilet	Lagoon (Natural treatment system)
No.4	Pour-flush toilet	Conventional activated sludge
No.5	Aqua-privy	Biological nutrient removal (BNR) process (Type of continuous flow)
No.6	Septic tank	BNR process (Type of batch)
No.7	Cesspits	Advanced wastewater treatment process (including MBR, AOP process)
No.8	Sewerage	

Technological alternative for underdeveloped countries

Recently, there has been the actual circumstance of much concern being paid to the establishment of sanitation infrastructure, appropriate for the underdeveloped country. The environmentally developed countries, when proposing the technology appropriate for this region, tend to assess the technology capable of gaining big efficiency in the respective region, but with small effort and concern, as the “appropriate technology”. For example, to assert construction of the latest style of sewer-line system and super-advanced wastewater treatment plant for the remote and secluded mountainous place of underdeveloped country, with the unsecured waterworks facility, would be inappropriate. The typical characteristics of the streams of household wastewater clearly reveal that urine contributes about 87 % of nitrogen, 50 % of phosphor, and 54 % potassium to the domestic wastewater, whereas grey water, despite its very large volume compared to urine, contributes only about 3 % of nitrogen, 10 % of phosphor, and 34 % potassium (Larsen and Gujer, 1996; Esrey et al., 2000). On the contrary, feces, which is 10 times smaller in volume than urine, contains high organics and pathogens. For the region with sewer-line uninstalled in the underdeveloped country, such alternatives/methods as collecting feces and urine after separated and utilizing the natural treatment facility in region easy for the land use could be good examples.

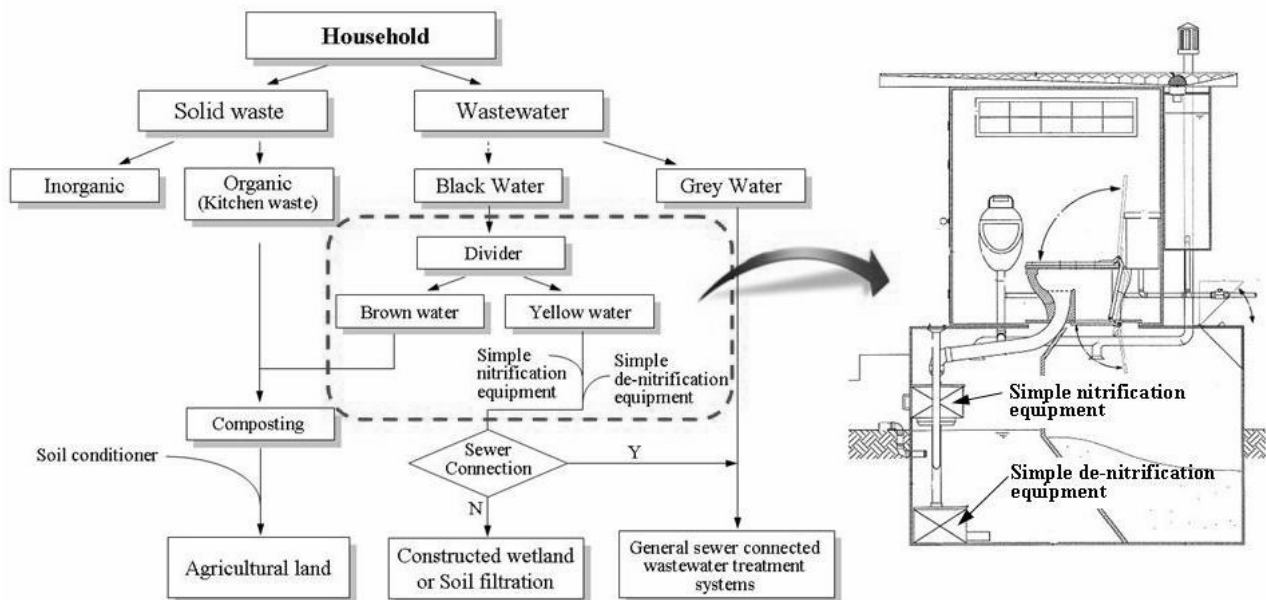


Figure 4. Improvement on the on-site treatment facilities in underdeveloped country

CONCLUSIONS

Based on these above results, the applicable technologies, with consideration of national income level and environmental circumstance, can be summarized. Among those subject countries of investigation in this research, for countries in the African region, construction and supply of the on-site treatment facilities are considered necessary with priority. In case of the Asian region, although there exists more or less difference depending on variations in the economic strength, for Vietnam lacking the fundamental environmental infrastructure, the establishment of such basic environmental systems as sewer-line, including the on-site treatment facilities, and wastewater treatment plant construction are considered to be needed. In comparison, the downtown area may maintain, as it stands, the direction of present infrastructure establishment associated with the sanitation, while the consideration of rural community should no longer be delayed, in China.

The importance of selecting the optimal technology appropriate for the respective region or country, when establishing the infrastructure related to the existing sanitation, has recently been emphasized, centering around the environmentally developed countries. The increasing trend of this concern is considered to be further accelerated, related to the concept of environmentally friendly, future-oriented, and sustainable development.

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