African Region

DATA COLLECTION SURVEY ON URBAN SANITATION, SEWERAGE AND FAECAL SLUDGE MANAGEMENT IN AFRICA

FINAL REPORT

MARCH, 2022

JAPAN INTERNATIONAL COOPERATION AGENCY
YACHIYO ENGINEERING CO., LTD.
JAPAN ENVIRONMENTAL SANITATION CENTER

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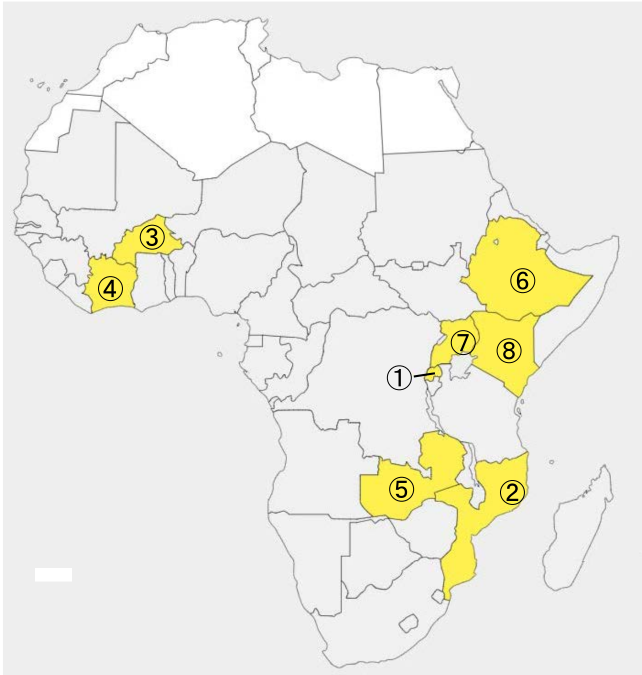
List of Abbreviations

AAWSA	Addis Ababa Water and Sewerage Authority
AFD	Agence Francaise de Developpement
AfDB	African Development Bank
AIAS	Administração de Infraestruturas de Abastecimento de Água e Saneamento
AURA	Water Regulatory Authority
BMGF	Bill and Melinda Gates Foundation
CWIS	City-wide Inclusive Sanitation
DFID	Department for International Development
COK	City of Kigali
DEWATS	Decentralized Wastewater Treatment Systems
DGA	Direction Générale de l'Assainissement, des Eaux Usées et Excrétas
EIB	European Investment Bank
EPA	Environmental Protection Authority
FSM	Faecal Sludge Management
FSTP	Faecal Sludge Treatment Plant
GIZ	Deutsche Gesellschaft fur Internationale Zusammenarbeit
GNI	Gross National Income
KCCA	Kampala Capital City Authority
KfW	Kreditanstalt für Wiederaufbau
LDC	Least Developed Country
LWSC	Lusaka Water and Sewerage Company
MAHRH	Ministère de l'Agriculture, des Ressources Hydrauliques, de l'Assainissement et de la Sécurité Alimentaire
MINASS	Ministry of Sanitation and Public Hygiene (Ministère de l'Assainissement et de la Salubrité Publique
MLGH	Ministry of Local Government and Housing
MININFRA	Ministry of Infrastructure
MoPHS	Ministry of Public Health and Sanitation
MSHRH	Ministry of Solidarity for Humanitarian Action and Reconstruction
MWDSEP	Ministry of Water Development, Sanitation, and Environmental Protection
MWE	Ministry of Water and Environment
MWSI	Ministry of Water, Sanitation and Irrigation
NCWSC	Nairobi City Water and Sewerage Company
NWSC	National Water & Sewerage Corporation
ONAD	Office National de l'Assainissement et du Drainage
ONEA	Office National de l'Eau et de l'Assainissement
PUA	Peri-Urban Area
REMA	Rwanda Environmental Management Authority
RHA	Rwanda Housing Authority
RURA	Rwanda Utilities Regulatory Authority
SDAD	Du Schéma Directeur de l'assainissement et du Drainage
SDGs	Sustainable Development Goals
SODECI	Société de Distribution d'Eau de Côte d'Ivoire
SSA	Sub-Saharan Africa
TICAD	Tokyo International Conference on African Development
UASB	Upflow Anaerobic Sludge Blanket
USAID	United States Agency for International Development
WASAC	Water and Sanitation Corporation
WASH	Water Sanitation Hygiene Program
WB	World Bank
WASREB	Water Services Regulatory Board
WSP	Water Services Providers
WWTP	Wastewater Treatment Plant
ZEMA	Zambia Environmental Management Agency

Location Map (Survey Countries / Cities)

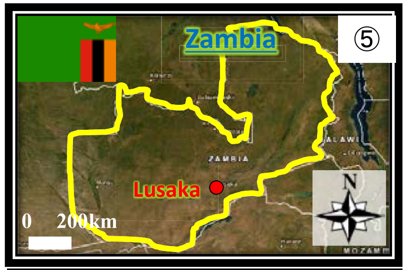


Population	4,574,000 (2020)
GNI per capita	800 USD

Population	31,260,000 (2019)
GNI per capita	460 USD

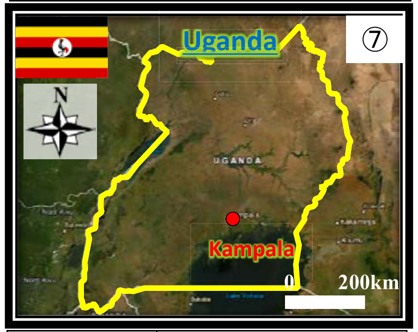
Population	20,900,000 (2020)
GNI per capita	770 USD

Population	26,380,000 (2020)
GNI per capita	2,280 USD

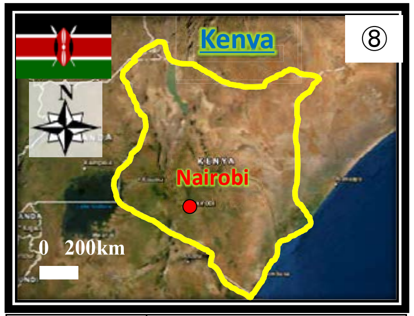


Population	1,838,000 (2020)
GNI per capita	1,160 USD

Population	114,960,000 (2020)
GNI per capita	890 USD



Population	45,740,000 (2020)
GNI per capita	800 USD



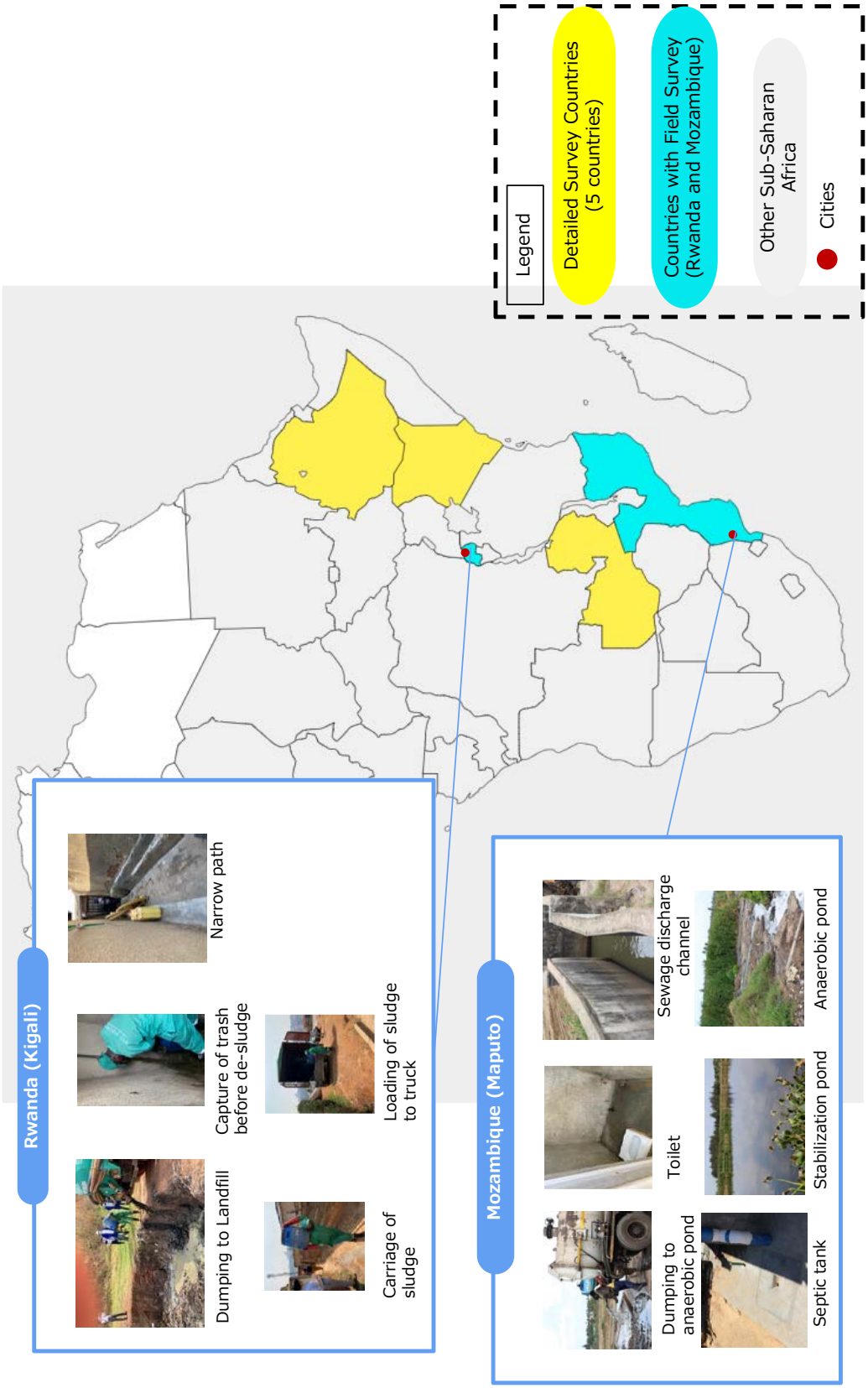
Population	53,770,000 (2020)
GNI per capita	1,840 USD

Legend

Source : Earthstar Geographics | Esri, HERE, Garmin | (c) Esri Japan、World Bank

Survey Countries (8 countries) · Other Sub-Saharan Africa · ● cities

Survey Photos
(Wastewater and Faecal Sludge Management in Rwanda and Mozambique)



SUMMARY

1. Objective of the Survey

The objectives of the Data Collection Survey on Urban Sanitation, Sewerage and Faecal Sludge Management in Africa (hereinafter referred to as the "Survey") are to understand the overall picture of wastewater and faecal sludge management in the Sub-Saharan Africa (hereinafter referred to as the "SSA") region, to confirm the necessity and direction of cooperation, and to clarify the concerns and preconditions for the cooperation.

Since the main donors in the sector such as the World Bank (WB) and the Bill and Melinda Gates Foundation (BMGF) propose the City-wide Inclusive Sanitation (CWIS) and emphasize on Faecal Sludge Management (FSM), the status of CWIS/FSM was particularly a concern in consideration of the fact that slum populations account for a majority of the urban population in SSA countries.

2. Target Area of the Survey

The Survey was conducted in three phases. In the first phase of the Survey, basic information on each country and city of the 49 SSA countries was collected including information on wastewater and faecal sludge management and urban sanitation. By reviewing the data collected in the first phase, 21 countries were selected considering the level of sewerage development and CWIS/FSM activities. By taking into account the concerns on cooperation potential on wastewater management sector and acceptability of the Survey, the following 8 countries/cities were selected as the Survey Countries for the second phase of the Survey (hereinafter indicated as the target countries in the second phase): Ethiopia (Addis Ababa), Kenya (Nairobi), Uganda (Kampala), Rwanda (Kigali), Cote d'Ivoire (Abidjan), Burkina Faso (Ouagadougou), Zambia (Lusaka) and Mozambique (Maputo).

In the second phase of the Survey, since various CWIS/FSM activities conducted by the WB, the African Development Bank (AfDB) and the BMGF were confirmed in the first phase, the components, current status and challenges of such activities were recognized by interviewing those institutions. Through the examination of effectiveness and work plan of the field survey, the following 5 countries/cities were selected as the Detailed Survey Countries for the third phase of the Survey (hereinafter indicated as the target countries for the third phase): Rwanda (Kigali), Mozambique (Maputo), Zambia (Lusaka), Cote d'Ivoire (Abidjan) and Kenya (Nairobi).

In the third phase of the Survey, field surveys were carried out in Rwanda (Kigali) and Mozambique (Maputo). However, due to the COVID-19 pandemic, on-line interviews were held with relevant institutions in Zambia (Lusaka), Cote d'Ivoire (Abidjan) and Kenya (Nairobi) for the collection and analysis of information. Based on the results of these surveys and on-line interviews, the directions of future cooperation on wastewater and faecal sludge management were examined, and the concerns and preconditions for future cooperation projects were compiled in the report.

3. Composition of Report

The background and objective of the Survey are described in Chapter 1. In addition, the concepts of "City-wide Inclusive Sanitation (CWIS)", "Faecal Sludge Management (FSM)", and "Sanitation Services Chain" are also explained.

Based on the results of literature surveys in 49 SSA countries, the availability of sewerage system and efforts for CWIS/FSM are mainly analyzed in Chapter 2.

In Chapter 3, the survey results of the 3 countries which were not selected as Detailed Survey Countries are described: Uganda (Kampala), Ethiopia (Addis Ababa) and Burkina Faso (Ouagadougou).

Chapter 4 explains the survey results of the 5 countries selected as Detailed Survey Countries in the third phase: Rwanda (Kigali), Mozambique (Maputo), Cote d'Ivoire (Abidjan), Zambia (Lusaka) and Kenya (Nairobi).

Chapter 5 points out the 14 issues listed below which all countries share and need to be taken into account when considering the wastewater and faecal sludge management as well as urban sanitation in SSA countries. The present situations were examined, and the measures against the identified issues and the matters to be considered for future cooperation were described.

The following are 14 common issues that all countries share and explained in Chapter 5:

5-1. On-Site Sanitation Facilities
5-2. Status of Sewerage System Development and Wastewater Treatment Technology
5-3. Standard of Wastewater Effluent
5-4. Water Pollution Issue
5-5. Urban and Slum Problem
5-6. Wastewater and Faecal Sludge Management in Slum Area
5-7. City-Wide Inclusive Sanitation (CWIS)
5-8. Faecal Sludge Management (FMS)
5-9. Social Marketing
5-10. Regulation of On-Site Sanitation
5-11. Faecal Sludge Treatment Technology
5-12. Institutional Framework for Wastewater and Faecal Sludge Management
5-13. Finance and Cost Recovery of Wastewater and Faecal Sludge Management
5-14. Master Plan

Chapter 6, the last chapter of the report, proposes the conceivable future cooperation areas for the wastewater and faecal sludge management in SSA countries with preconditions and the matters to be considered for such cooperation:

(1) Assistance for formulation of master plan
(2) Financial assistance and technical cooperation for wastewater and faecal sludge management with sewerage system
(3) Technical cooperation and financial assistance for enhancement of on-site sludge management (FSM)

CHAPTER 1 OUTLINE OF THE SURVEY

1.1 Background and Objective

1.1.1 Background

The African region has experienced a remarkable economic growth in accordance with abundant natural resources and rapid population growth. As for the Sub-Saharan Africa (hereinafter referred to as the "SSA") region, 33 of the 49 countries it consists of are identified as least developed countries (LDC) based on 2018 standard, and they are facing serious poverty problems. In some countries, rapid economic growth has led to urbanization. However, in those countries, the development of urban infrastructure has not kept pace, resulting in the formation of vast slum areas on the periphery of cities. In some capital cities, the slum population accounts for 70-80% of the urban population. Under these circumstances, effective sanitation and wastewater management is extremely difficult. Therefore, there are concerns that the wastewater and sludge may cause the deterioration of the sanitary environment in urban areas of SSA countries and hinder economic growth.

Japan is accelerating its efforts to contribute to the achievement of the Sustainable Development Goals (SDGs) by resolving issues in the water and sanitation sectors faced by developing countries. In addition, according to the "Africa Health and Wellbeing Initiative" announced at the 7th Tokyo International Conference on African Development (TICAD7) in August 2019, the dissemination of drinking water services and toilets are stipulated in Mt. Fuji-Shaped Healthcare in Africa. Thus, various supports are being provided to improve the urban sanitation environment, including health and healthcare. However, support for urban sanitation and wastewater management in SSA countries is limited.

1.1.2 Objective

The objectives of the Data Collection Survey on Urban Sanitation, Sewerage and Faecal Sludge Management in Africa (hereinafter referred to as the "Survey") are to understand the overall picture of wastewater and faecal sludge management in the SSA region through the information collection, to confirm the necessity and direction of cooperation, and to clarify the concerns and preconditions for the cooperation.

Figure 1-1 Target Area

1.1.3 Target Area

The target areas of the Survey are the 49 SSA countries and major cities in each country. The target countries of the Survey are shown in Figure 1-1.

1.2 Target Sector

1.2.1 Target Sector of the Survey

There are two types of wastewater/sludge generated by human activities: domestic wastewater/sludge generated by living activities and industrial wastewater/sludge generated by industrial activities such as industrial wastewater, agricultural wastewater, and livestock wastewater. The Survey mainly targets the management of domestic wastewater/sludge generated by living activities. Table 1-1

shows the types of wastewater/sludge from the domestic sources.

Table 1-1 Wastewater and Sludge from the Domestic Sources

Target	Contents		Description
Wastewater	Domestic	Black Water	Large and small human feces discharged from households, etc.
		Grey Water	Wastewater generated from kitchen, bath, laundry, etc. in daily life at home
	Commercial		Wastewater discharged by buildings other than detached houses, such as various commercial facilities, hotels, public offices, schools, hospitals, condominiums and apartments
	Tourism		Wastewater generated by tourism businesses and tourists at tourist sites
Sludge	Sewerage Sludge		Sludge generated at sewerage treatment plants
	On-site Sludge		Sludge generated during the treatment of the above sewerage at on-site sanitation facilities or non-collective sewerage treatment facilities

These wastewater and sludge, if released untreated, can cause waterborne diseases such as cholera and diarrhea, and worsen the sanitation environment for people. It also causes pollution of public water bodies (such as roadside ditches, stormwater drainages, rivers, lakes, and coastal areas) and the natural environment. Therefore, it is necessary to treat the wastewater and faecal sludge properly before discharging them. This is called “wastewater and faecal sludge management”.

Since sewage sludge is usually managed and treated as a part of the sewerage treatment process, it is appropriate to treat the management of sewage sludge as a part of wastewater management. Therefore, “faecal sludge management” in the Survey refers to the management of on-site sludge.

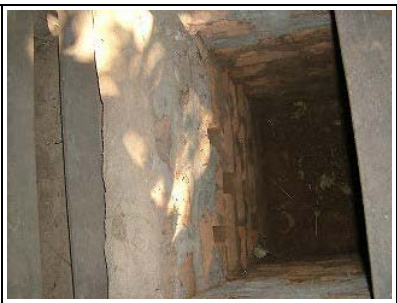
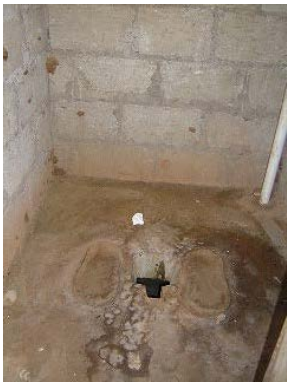
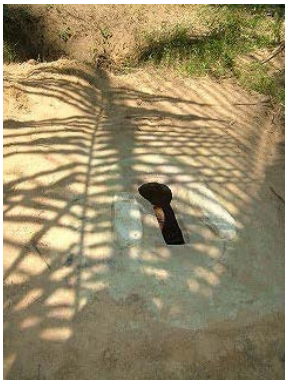
Besides, since the names and definitions of the classification of sewerage treatment system differ among countries, the classifications of sewerage treatment system are defined in the Survey as shown in Table 1-2.

Table 1-2 Classification and Definition of Wastewater Treatment System

Classification	Definition	Description
Collective System	Sewerage System	It is a system that collects wastewater in sewer pipes for discharge and treatment.
Non-collective System	Johkasou and its similar facilities	It is a system that stores wastewater at the generation place, treats it to a safe quality, and discharges it to surface water.
On-Site Sanitation Facility	Septic Tank	It is a facility that stores wastewater (mainly urine) at its generation source and discharges it after anaerobic treatment. If used properly, it can provide containment, separating urine from humans. The quality of the treated water is not safe for discharging into surface water, so it is often infiltrated underground through soak pits, but the risk of groundwater pollution remains.
	Pit Latrine (VIP Latrine, etc.)	It is a toilet that does not use water or use only a small amount of water, equips an upper slab and lined sides to provide a certain level of water tightness. There is no wastewater treatment function and it is intended for containment of urine away from humans. If the sides and bottom are not fully lined, there is a risk of groundwater pollution.
	Pit Latrine (excavated)	It is a latrine with unlined sides and bottom. There is no wastewater treatment function, and it is not a safe sanitation facility because of inadequate containment of urine away from humans with high risk of groundwater pollution.

* Johkasou: non-collective wastewater treatment systems in Japan

<Classification of On-Site Sanitation Facilities>

 	 	 
Septic Tank	Pit Latrine	Pit Latrine (excavated)

Source: provided by Uttar Pradesh provincial government in India and taken by the JST

1.2.2 Importance of Faecal Sludge Management (FSM) and City-wide Inclusive Sanitation (CWIS) for Sanitation and Wastewater Management in Developing Countries

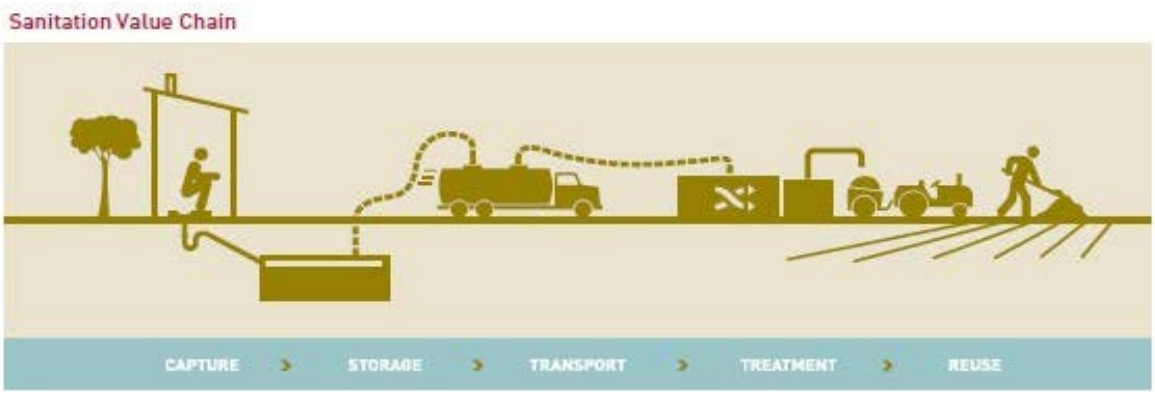
The conventional measures to improve the problems on sanitation and wastewater management in developing countries include the spread of basic sanitation facilities (safe toilets) and the development of wastewater treatment facilities such as sewerage systems. However, there is a growing view that this alone may not be enough to improve the sanitation and wastewater management problems in developing countries. Therefore, the importance of on-site sludge management (= Faecal Sludge Management (hereinafter referred to as the "FSM")) and City-wide Inclusive Sanitation (hereinafter referred to as the "CWIS") has been highlighted. In fact, both the FSM and the CWIS are exactly what Japan has been doing to improve sanitation and wastewater management problems in the country. Since the terms are unfamiliar, the concepts are presented below.

(1) Faecal Sludge Management (FSM)

MDG 7c (sanitation) of the Millennium Development Goals (MDGs) is replaced by SDG 6.2. The MDG 7c focusing on the development of toilets, and the installation of VIP pit latrines has been promoted in SSA countries. However, for on-site sanitation facilities, including pit latrines, and for enabling the use of sanitary latrines, the facilities must be accompanied by a series of sanitation services including proper sludge collection, transportation to sludge treatment facility and treatment. The absence of such sanitation services has been recognized as a hindrance to the spread of toilets, and as a result, SDG 6.2 emphasizes the importance of not only the installation of toilets, but also the accessibility to safe sanitation services. This series of sanitation services is called the "sanitation value chain" (referring to Figure 1-2), and the activities to establish this chain, in which the government, public corporations, private companies and residents work together, is called the Faecal Sludge Management (FSM)..

The term FSM was created to refer to the sludge management of pit latrines, which are common in urban areas in Africa. In addition, it is also used to refer to the management of sludge from septic

tanks, which are common in Asia, and from Johkasou and similar decentralized wastewater treatment facilities, which are used by households in Japan and mainly by commercial buildings not connected to sewerage systems in developing countries.



Source: Bill and Melinda Gates Foundation (BMGF)

Figure 1-2 Sanitation Value Chain

In Japan, the infrastructure and legal frameworks for the collection of faecal sludge from on-site facilities were established more than a half century ago after the development of technology for the sludge collection from night soil storage tanks or from Johkasous. This makes Japan a country that has truly practiced FSM. Meanwhile, there are few countries, including developed countries, that have established such a system. In developing countries such as the SSA countries, where the majority of the population is forced to rely on on-site facilities for sanitation, this issue needs to be addressed immediately, and the World Bank (WB) and other international organizations as well as the Bill and Melinda Gates Foundation (BMGF) have recently been putting special emphasis on this area.

(2) City-wide Inclusive Sanitation (CWIS)

There are many residents in developing countries who cannot benefit from sewerage services for several reasons including large slums even in urban areas, and financial constraints that limit the areas where sewerage services can be provided. To improve the condition of the people under such a poor sanitation environment, a wide range of solutions has been provided to ensure the access to safe and managed sanitation depending on the condition of each city, such as collective wastewater treatment, non-collective wastewater treatment, on-site sludge management and so on. The CWIS has been proposed and promoted by major donors and international organizations such as the WB and the BMGF as a paradigm shift in the sanitation sector. The CWIS focuses on the provision of services and creation of the service system rather than the infrastructure development. The FSM is a sanitation service mostly in demand and accessible to urban residents in developing countries who have difficulty in accessing sewerage services, such as people in slum and low-income areas. FSM is an essential component in the implementation of the CWIS strategy, which emphasizes the development of sanitation value chain.

In the “Position Paper on Water Environment Management Sector” (JICA, July 2018), one of the three pillars of the cooperation approach for developing countries is to “Promote the introduction of sewage treatment measures/technologies that combine collective (off-site) and non-collective (on-site) approaches”. This is based on the history of sewage management in Japan, which has promoted infrastructure and institutional development through the combination of sewerage, Johkasou and sludge treatment. The background of this approach is in line with CWIS in some respects even though the background is somewhat different from that of the WB and the BMGF.

1.3 Outline of the Survey

The Survey was conducted in three phases, and the final report was prepared in the last one. The work flow of the Survey is shown in Figure 1-3.

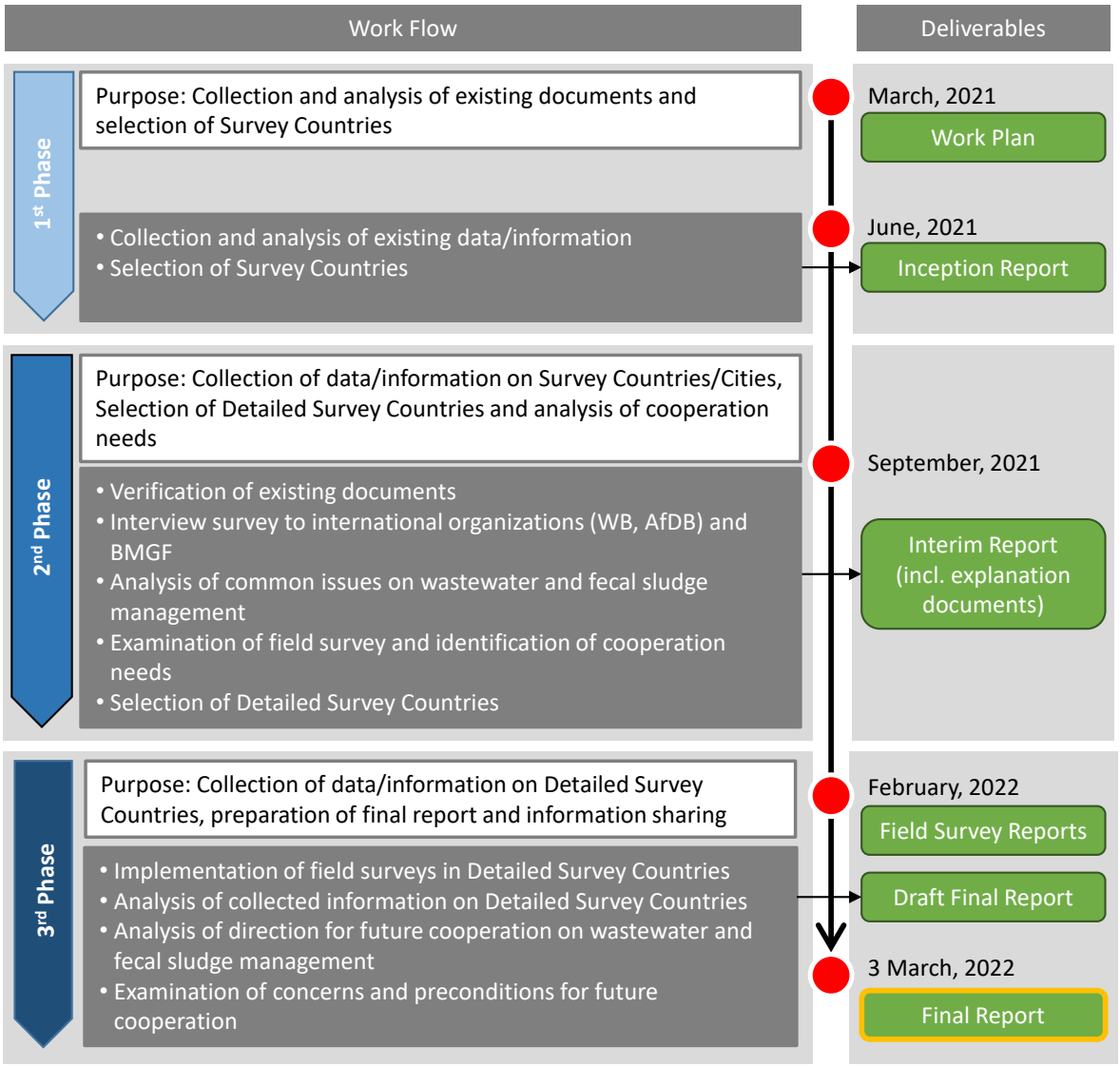


Figure 1-3 Work Flow of the Survey

In the first phase of the Survey, basic information on each country and city of the 49 SSA countries including information on wastewater and faecal sludge management and urban sanitation was collected by reviewing existing data (e.g. reports issued by JICA and other donors, website, etc.) as well as several reports of projects implemented by the WB and the African Development Bank (AfDB). After reviewing the data collected in the first phase, 21 countries were selected considering the level of sewerage development and CWIS/FSM activities. In accordance with a series of discussions with JICA, potential and concerns on cooperation on wastewater management sector, and acceptability of the field survey of each country were analyzed. As a result, the following 8 countries (8 cities) were selected as the Survey Countries for the second phase of the Survey (hereinafter indicated as the target countries in the second phase): Ethiopia (Addis Ababa), Kenya (Nairobi), Uganda (Kampala), Rwanda (Kigali), Cote d'Ivoire (Abidjan), Burkina Faso (Ouagadougou), Zambia (Lusaka) and Mozambique (Maputo).

In the second phase of the Survey, since various CWIS/FSM activities conducted by the WB, the

AfDB and the BMGF were confirmed in the first phase in those countries, the components, current status and challenges of those activities were recognized through interview surveys to those institutions. Through those works of the Survey, the common issues on wastewater and faecal sludge management in those countries were analyzed. Moreover, the effectiveness and work plan of the field survey as well as the assumed cooperation needs were examined. As a result, Detailed Survey Countries for the third phase of the Survey (hereinafter indicated as the target countries for the third phase) were examined. In accordance with the results of examination, the following countries and cities were selected as the Detailed Survey Countries: Rwanda (Kigali), Mozambique (Maputo), Zambia (Lusaka), Cote d'Ivoire (Abidjan) and Kenya (Nairobi).

In the third phase of the Survey, information on the situation of wastewater and faecal sludge management and urban sanitation in the Detailed Survey Countries and the situation of wastewater and faecal sludge management under the COVID-19 pandemic was collected, analyzed and organized through interviews with relevant organizations and field surveys. In addition, the information and issues collected up to the second phase of the Survey were shared with relevant organizations to confirm and update the contents of the collected information. Based on the results of these surveys, the directions of future cooperation on wastewater and faecal sludge management were discussed, and the concerns and preconditions for future cooperation projects were compiled.

1.4 Approach of the Survey

The approaches for the implementation of the Survey are as follows.

Approach 1: Strategy and Application of CWIS
Approach 2: Introduction of FSM and Establishment of Sanitation Value Chain
Approach 3: Necessity of Partnership with Other Donors in CWIS and FSM
Approach 4: Applicability of Japan's Experience for Improvement of Sanitation Issues in SSA Countries
Approach 5: Criteria for Selection of Survey Countries and Detailed Survey Countries
Approach 6: Examination of Cooperation Direction under COVID-19

1.4.1 Strategy and Application of CWIS

The WB, the AfDB and the BMGF have initiated the CWIS and FSM which are included in their projects for the support of sanitation improvement. Thus, the information on the project components and status of implementation and issues was collected through reviews of literature on wastewater and faecal sludge management and on-line interview surveys to those institutions. Based on the information, the strategy and applicability of the CWIS in a JICA project to support the sewerage and sanitation sectors were analyzed.

1.4.2 Introduction of FSM and Establishment of Sanitation Value Chain

The capital cities of SSA countries with significant concentration of commerce and industry are expected to gradually develop sewerage systems in their central areas. On the other hand, it will take a long time for the development of such facilities to extend to large areas of the city, and in the short to medium term, residents in large areas of the city and its surroundings will have to rely on on-site sanitation facilities such as pit latrines and septic tanks. Therefore, the importance of FSM is expected to increase in order to achieve the SDGs sanitation goals. However, the FSM is still in the stage of trial and error since it is a relatively new concept internationally.

According to the reports on the actual situation of FSM in SSA countries prepared by BMGF, a pioneer in CWIS and FSM, the issues shown in Table 1-3 were identified with regard to FSM particularly in SSA countries, which are not found in FSM in Japan.

Table 1-3 Particular Issues on FSM in SSA Countries

Issue	Description
Low Capacity of Governance	In Japan, FSM is properly carried out with proper regulation and supervision by the government, training and technical support provided by specialized organizations, and the trust between residents and the government. It is doubtful whether or not it is possible to conduct the same system in SSA countries where administrative capacity is low.
Structural Problems with On-Site Facilities	FSM in Japan is based on the assumption that toilet tanks and septic tanks are watertight. However, the pit latrine for the majority of on-site facilities in SSA countries is not watertight sufficiently, and some of its structures make sludge collection difficult, so FSM may not be fully effective.
Difficulties with Sludge Collection in Slum Areas	In the slum areas of SSA countries, roads and other infrastructure are inadequate. Thus, in many cases, vacuum trucks cannot even get close to pit latrine, and the FSM itself may not be viable.
Dumping of Waste at On-Site Facilities	In SSA countries, it is said that residents are often dumping waste in the pit latrines, which makes them fill up fast and hinders smooth FSM. The well coordination with solid waste management is needed.

In the Survey, keeping in mind the FSM system in Japan and the issues specific to FSM in SSA countries, FSM projects implemented with the supports of the WB, the AfDB and the BMGF were analyzed, and information on innovations and technologies developed in the field to solve problems specific to SSA countries was also collected for the analysis of cooperation direction on wastewater and faecal sludge management by JICA.

1.4.3 Necessity of Partnership with Other Donors in CWIS and FSM

In many SSA countries, urban sanitation and wastewater management projects have been implemented with the support of the WB and the AfDB, and in some countries, the BMGF has provided FSM support in collaboration with the WB and the AfDB. Especially in FSM, partnerships with the private sector for the construction of on-site facilities and collection and transportation of sludge, as well as with the central and municipal governments and public corporations are essential. The BMGF and international organizations are making efforts to build partnerships with them.

Therefore, it is importation to consider how to collaborate with the above partners when JICA provides the supports to this sector. In the Survey, the ways to establish the above partnerships for future JICA projects were examined.

1.4.4 Applicability of Japan's Experience for Improvement of Sanitation Issues in SSA Countries

Various types of approaches have been taken for improving sanitation in Japan: enhancement of administrative capacity of local governments by the National Institute of Public Health, sanitation guidance (door-to-door visits) by public health centers, training of sludge collection companies, improvement of their social status by local governments, and public awareness raising by residents' organizations (neighborhood associations).

The applicability of those Japanese experiences was examined for the support by JICA solely or in collaboration with other international institutions.

1.4.5 Criteria for Selection of Survey Countries and Detailed Survey Countries

The target countries for the second phase (Survey Countries) and the third phase (Detailed Survey Countries) of the Survey were selected based on the criteria shown in Table 1-4, considering the country/city's economy, population and wastewater/sludge management (developmental stage), in addition to the status of actual supports (JICA, other donors), and the potential for cooperation.

Table 1-4 Criteria for Selection of Survey Countries and Detailed Survey Countries

Phase	Country	Selection Criteria
2nd Phase	Survey Country	• Socio-economic conditions: economic conditions (GNI per capita), population of the capital city • Status of implementation of wastewater and sludge management: Status of CWIS/FSM initiatives, existence of sewerage system
3rd Phase	Detailed Survey Country	• Implementation of CWIS/FSM with support from the WB, AfDB, BMGF, etc. • Efforts for improvement of sewerage systems in slum areas • Existence of cooperation needs (development of sewerage systems and sludge treatment facilities, environmental regulations, on-site regulations, human resource development, etc.) • Countries (cities) where problems are emerging in wastewater treatment technologies and faecal sludge treatment technologies. • Availability of master plan reflecting CWIS/FSM • Economic situation of each country

1.4.6 Examination of Cooperation Direction under COVID-19

In the wastewater and faecal sludge management sector in SSA countries, many sanitation workers such as those working in the informal sludge collection companies, are extremely vulnerable to infectious diseases such as COVID-19. Therefore, the measures taken by the surveyed countries to control COVID-19 infection in the wastewater and sludge management sector were confirmed.

1.5 Implementation Structure and Schedule of the Survey

The implementation structure and schedule of the Survey are shown in Table 1-5 and Table 1-6 respectively.

Table 1-5 Implementation Structure

Name	Position
Kazushi HASHIMOTO	Team Leader / Wastewater Management Plan and Policy
Akira MORITA	Wastewater Management and Faecal Sludge Management
Yoshinosuke HAMADA	Facility Operation and Maintenance-1
Katsuyoshi SUDO	Public Health
Kazuhiro ISHIURA	Economic Analysis
Naoki UEHATA	Institutional and Financial Analysis
Takashi SAKAKIBARA	Facility Operation and Maintenance-2

Table 1-6 Implementation Schedule

Phase	Work Item	Feb.	Mar.			Apr.			May			Jun.		
			I	II	III	I	II	III	I	II	III	I	II	III
1st Phase	1) To collect and analyze existing data/information													
	2) To select the Survey Countries													
Note	Preparation and Submission of Inception Report													★

Phase	Work Item	May	Jun.			Jul.			Aug.			Sep.		
			I	II	III	I	II	III	I	II	III	I	II	III
2nd Phase	1) To confirm details of the projects implemented by the WB, the AfDB and the BMGF in the countries under survey													
	2) Based on the above, to prepare a questionnaire on wastewater and fecal sludge management in the Survey Countries													
	3) o conduct an on-line interview survey with the WB, the AfDB and the BMGF. The interview surveys were conducted based on a questionnaire.													
	4) In the interview survey, to confirm the support policy and status of other donors, and to identify the actual status of wastewater and fecal sludge management													
	5) To examine the cooperation needs of the Survey Countries													
	6) To prepare a summary of the results from the above													
	7) To select the Detailed Survey Countries for 3rd phase													
Note	Preparation and Submission of Interim Report													★
	Preparation for Field Survey													

Phase	Work Item	Sep.	Oct.			Nov.			Dec.			Jan.			Feb.			Mar.
			I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I
3rd Phase	Surveys																	
	1) Survey (Rwanda)																	
	2) Survey (Mozambique)																	
	3) Survey (Cote d'Ivoire)																	
	4) Survey (Zambia)																	
	5) Survey (Kenya)																	
Note	Preparation and Submission of country profiles (49 countries)																	★
	Preparation and Submission of Draft Final Report														★			
	Preparation and Submission of Final Report																	★
	Preparation for Field Survey																	

CHAPTER 2 COLLECTION AND ANALYSIS OF EXISTING DOCUMENTS (FIRST PHASE)

2.1 Collection and Analysis of Existing Documents in First Phase

In the first phase, basic information and information on wastewater and faecal sludge management and urban sanitation was collected for the 49 SSA countries. The information was collected from the reports of several projects implemented by the WB and the AfDB in addition to existing data (reports by JICA and other donors, internet information, etc.).

2.2 Outline of CWIS and FSM in Sub-Saharan African Countries

The basic information on wastewater and faecal sludge management in the SSA cities is summarized in Table 2-1.

2.2.1 Current Status of CWIS

In the SSA countries, the collective wastewater treatment is limited to the capital city and a few other cities, and mostly non-collective on-site sanitation facilities (pit latrines, septic tanks, etc.) are utilized. The "access rate to improved sanitation facilities" in urban areas in SSA countries has increased from 66% in 2000 to 76% in 2017, while open defecation has also decreased from 10% to 6%. Compared to other regions, the improvement of accessibility is still limited. Moreover, the proportion of urban residents without access to sanitation remains large, because of the limited improvement of sanitation facilities and the large increase in urban population.

Among the SSA countries, the Republic of South Africa has the highest rate of sewerage system development at 86%, followed by the Republic of Zimbabwe at 76% and the Republic of Namibia at 66%, while only 13 countries have the development rate between 10% and 50%.

On the other hand, as for pit latrines, which are the main facilities for on-site sanitation, 18 countries have a usage rate of more than 50%, with the highest rate of 85% in the Republic of Botswana. For septic tanks, the Republic of Angola has the highest rate at 72%, followed by the Republic of Cape Verde at 51%, while 27 countries have the rates between 10% and 50%. This trend is even large in urban slum areas, peri-urban areas and rural areas.

2.2.2 Current Status of FSM

Information on sludge management was not readily available, and the information that could be obtained through desk research, including collection of existing data, was extremely limited.

In the SSA countries, the public (government institution or public corporation) collect the sludge in 3 countries, the private in 16 countries, and both in 5 countries. Only 3 countries have a registration system for sludge collection companies. Based on this situation, it is assumed that the private sector takes the lead in faecal sludge management.

With regard to sludge treatment, 2 types of areas were confirmed: one where sludge treatment facilities are established and treated like Senegal, and another where collected sludge is fed into the sewer system like Kenya.

Table 2-1 Current Status of Wastewater Management and FSM in SSA Countries

No.	Country	Status of Wastewater Management (% of population) (JMP;UNICEF 2017)			Status of Faecal Sludge Management	
		Pit Latrine	Septic Tank	Sewer Connection	Party for Sludge Collection	Application of Registration System
1	Republic of Angola	2	72	19	NA	NA
2	Republic of Uganda	59	7	2	Private	Applied
3	Kingdom of Eswatini	45	14	35	NA	NA
4	Federal Democratic Republic of Ethiopia	37	10	3	Public, Private	NA
5	State of Eritrea				NA	NA
6	Republic of Ghana	50	29	6	Private	NA
7	Republic of Cabo Verde	<1	51	36	NA	NA
8	Gabonese Republic	41		37	NA	NA
9	Republic of Cameroon	60	23	<1	Private	NA
10	Republic of The Gambia	48	28	4	NA	NA
11	Republic of Guinea	54	27	5	NA	NA
12	Republic of Guinea-Bissau	30	31	6	NA	NA
13	Republic of Kenya	47	12	20	Public, Private	Applied
14	Republic of Cote d'Ivoire	37	27	12	Private	NA
15	Union of Comoros	44	10	8	NA	NA
16	Republic of Congo	50	22	2	Private	NA
17	Democratic Republic of the Congo	43	12	<1	NA	NA
18	Democratic Republic of Sao Tome and Principe	33	4	17	NA	NA
19	Republic of Zambia	36	13	21	Private	NA
20	Republic of Sierra Leone	62	11	1	NA	NA
21	Republic of Djibouti				NA	NA
22	Republic of Zimbabwe	9	12	76	NA	NA
23	The Republic of the Sudan				Private	NA
24	Republic of Seychelles				NA	NA
25	Republic of Equatorial Guinea	63	7	12	NA	NA
26	Republic of Senegal	27	47	17	Public, Private	NA
27	Federal Republic of Somalia	57	8	22	NA	NA
28	United Republic of Tanzania	61	19	2	NA	NA
29	Republic of Chad	50	5	2	Private	NA
30	Central African Republic				Public	NA
31	Republic of Togo	38	41	<1	NA	NA
32	Federal Republic of Nigeria	32	32	16	Public, Private	NA
33	Republic of Namibia	6	<1	66	NA	NA
34	Republic of Niger	60	13	3	NA	NA
35	Burkina Faso	80	5	3	Private	Applied
36	Republic of Burundi	55	26	3	NA	NA
37	Republic of Benin	48	8	3	Private	NA
38	Republic of Botswana	85	6	2	Public, Private	NA
39	Republic of Madagascar	26	14	2	Private	NA
40	Republic of Malawi	35	15	8	Private	Not Applied
41	Republic of Mali	70	9	3	Private	NA
42	Republic of South Africa	8	2	86	Public (contract)	NA
43	The Republic of South Sudan	33	21	<1	NA	NA
44	Republic of Mozambique	39	20	3	Private	NA
45	Republic of Mauritius	47	4	49	NA	NA
46	Islamic Republic of Mauritania	55	24	5	Private	NA
47	Republic of Liberia	22	41	<1	NA	NA
48	Republic of Rwanda	81	2	6	Private	NA
49	Kingdom of Lesotho	82	4	3	Public (contract)	NA

2.2.3 Result of Analysis on Status of CWIS and FSM

The results of the analysis of the status of CWIS/FSM initiatives from the perspective of income level (GNI) are shown in Table 2-2.

CWIS/FSM initiatives are being implemented in SSA countries regardless of income level (GNI). In upper-middle income countries, sewer systems are being developed for wastewater treatment. On the other hand, on-site treatment is essential in the areas where wastewater treatment is not appropriate, such as slums and peri-urban areas. In addition, in low-income countries, there is an urgent needs to reduce the risk of waterborne diseases by improving sanitation in the living environment. This indicates that FSM efforts are also important from the perspective of public health. Therefore,

CWIS/FSM initiatives are expected to continue to be promoted in SSA countries regardless of income level.

Table 2-2 Status of CWIS/FSM Initiatives by GNI Level

Category	GNI per Capita (USD)	CWIS/FSM is established as national policy and is being implemented.	CWIS/FSM projects are being implemented in metropolitan cities with support of WB, AfDB and BMGF. It is unclear whether this has been established as national policy.	CWIS/FSM is being implemented as pilot project or in rural cities. It is unclear whether it has been established as national policy.	No information is available on CWIS/FSM.
High Income Country (>USD12,535)	16,870	Seychelles	Seychelles	Seychelles	**Seychelles**
High/Middle Income Country (USD4,046-12,535)	10,140	Mauritius	Mauritius	Mauritius	**Mauritius**
	7,660	Botswana	Botswana	Botswana	**Botswana**
	7,210	Gabon	Gabon	Gabon	**Gabon**
	7,050	Equatorial Guinea	Equatorial Guinea	Equatorial Guinea	**Equatorial Guinea**
	5,720	South Africa	**South Africa**	South Africa	South Africa
	5,250	Namibia	Namibia	Namibia	**Namibia**
Low/Middle Income Country (USD1,036-4,045)	3,850	Eswatini	**Eswatini**	Eswatini	Eswatini
	3,540	Djibouti	Djibouti	Djibouti	**Djibouti**
	3,420	Cabo Verde	Cabo Verde	Cabo Verde	**Cabo Verde**
	2,973	Angola	Angola	Angola	**Angola**
	2,130	Ghana	**Ghana**	Ghana	Ghana
	2,030	Nigeria	Nigeria	Nigeria	**Nigeria**
	1,890	Sao Tome and Principe	Sao Tome and Principe	Sao Tome and Principe	**Sao Tome and Principe**
	1,790	Zimbabwe	Zimbabwe	**Zimbabwe**	Zimbabwe
	1,750	**Kenya**	Kenya	Kenya	Kenya
	1,750	Republic of Congo	Republic of Congo	Republic of Congo	Republic of Congo
	1,660	Mauritania	Mauritania	Mauritania	**Mauritania**
	1,610	Cote d'Ivoire	Cote d'Ivoire	**Cote d'Ivoire**	Cote d'Ivoire
	1,500	Cameroon	Cameroon	Cameroon	**Cameroon**
	1,450	**Senegal**	Senegal	Senegal	Senegal
	1,450	**Zambia**	Zambia	Zambia	Zambia
	1,420	Comoros	Comoros	Comoros	**Comoros**
	1,390	**Lesotho**	Lesotho	Lesotho	Lesotho
	1,200	Benin	Benin	Benin	Benin
	1,090	South Sudan	South Sudan	South Sudan	**South Sudan**
Low Income Country (<USD1,036)	1,020	Tanzania	**Tanzania**	Tanzania	Tanzania
	950	Guinea	Guinea	**Guinea**	Guinea
	880	Mali	**Mali**	Mali	Mali
	850	Ethiopia	**Ethiopia**	Ethiopia	Ethiopia
	790	**Burkina Faso**	Burkina Faso	Burkina Faso	Burkina Faso
	780	Rwanda	**Rwanda**	Rwanda	Rwanda
	740	Eritrea	Eritrea	Eritrea	**Eritrea**
	710	Gambia	Gambia	Gambia	**Gambia**
	690	Togo	Togo	**Togo**	Togo
	670	Chad	Chad	Chad	**Chad**
	637	Guinea-Bissau	Guinea-Bissau	Guinea-Bissau	**Guinea-Bissau**
	620	Uganda	**Uganda**	Uganda	Uganda
	610	Liberia	Liberia	**Liberia**	Liberia
	590	Sudan	Sudan	Sudan	**Sudan**
	520	Madagascar	Madagascar	Madagascar	**Madagascar**
	520	Central African Republic	Central African Republic	Central African Republic	**Central African Republic**
	520	Democratic Republic of the Congo	Democratic Republic of the Congo	Democratic Republic of the Congo	**Democratic Republic of the Congo**
	490	Sierra Leone	Sierra Leone	**Sierra Leone**	Sierra Leone
	480	Mozambique	**Mozambique**	Mozambique	Mozambique
	380	Malawi	Malawi	**Malawi**	Malawi
	360	Niger	Niger	Niger	Niger
	280	Burundi	Burundi	Burundi	**Burundi**
	-	Somalia	Somalia	Somalia	Somalia
Remarks		Benin is categorized as "There is no sewer system even in metropolitan area."	Niger is categoried as "There is no sewer system even in metropolitan area."	Republic of Congo is categorized as "No information is available on accessibility of sewer system."	-

The results of the analysis regarding the status of CWIS/FSM initiatives based on population are shown in Table 2-3.

In the capital cities of SSA countries, the more populous the city, the more CWIS/FSM initiatives tend to be implemented. This is due to the need to ensure a living and sanitary environment in response to population growth and concentration of population in cities. It is assumed that FSM initiatives are being implemented in parallel with sewerage improvement. Since the trend of growth and concentration of population will continue in many capital cities, it is expected that the wastewater and sludge management in SSA countries is expected to be based on the concept of CWIS.

Table 2-3 Status of CWIS/FSM Initiatives by Population in Capital City

Population in Capital City (10,000)	CWIS/FSM is established as national policy and is being implemented.	CWIS/FSM projects are being implemented in metropolitan cities with support of WB, AfDB and BMGF. It is unclear whether this has been established as national policy.	CWIS/FSM is being implemented as pilot project or in rural cities. It is unclear whether it has been established as national policy.	No information is available on CWIS/FSM.	Remarks (other major cities)
727.4	Democratic Republic of the Congo	Democratic Republic of the Congo (K	Democratic Republic of the Congo	**Democratic Republic of the Congo (Kinshasa)**	Congo (Lubumbashi, Matadi)
675.9	Angola (Luanda)	Angola (Luanda)	Angola (Luanda)	**Angola (Luanda)**	-
439.7	**Republic of Kenya (Nairobi)**	Republic of Kenya (Nairobi)	Republic of Kenya (Nairobi)	Republic of Kenya (Nairobi)	Kenya (Mombasa, Kisumu)
436.5	Tanzania (Dodoma)	**Tanzania (Dodoma)**	Tanzania (Dodoma)	Tanzania (Dodoma)	Tanzania (Dar es Salaam)
327.3	Ethiopia (Addis Ababa)	**Ethiopia (Addis Ababa)**	Ethiopia (Addis Ababa)	Ethiopia (Addis Ababa)	-
276.6	Cameroon (Yaoundé)	Cameroon (Yaoundé)	Cameroon (Yaoundé)	**Cameroon (Yaoundé)**	Cameroon (Douala)
264.7	**Senegal (Dakar)**	Senegal (Dakar)	Senegal (Dakar)	Senegal (Dakar)	-
262.8	**Zambia (Lusaka)**	Zambia (Lusaka)	Zambia (Lusaka)	Zambia (Lusaka)	-
245.3	**Burkina Faso (Ouagadougou)**	Burkina Faso (Ouagadougou)	Burkina Faso (Ouagadougou)	Burkina Faso (Ouagadougou)	Burkina Faso (Bobo Dioulasso)
217.4	Togo (Lomé)	Togo (Lomé)	**Togo (Lomé)**	Togo (Lomé)	Togo (Sokodé)
207.0	Ghana (Accra)	**Ghana (Accra)**	Ghana (Accra)	Ghana (Accra)	-
181.0	Mali (Bamakɔ)	**Mali (Bamakɔ)**	Mali (Bamakɔ)	Mali (Bamakɔ)	-
176.3	Republic of South Africa (Pretoria)	**Republic of South Africa (Pretoria)**	Republic of South Africa (Pretoria)	Republic of South Africa (Pretoria)	Republic of South Africa (Durban)
168.1	Uganda (Kampala)	**Uganda (Kampala)**	Uganda (Kampala)	Uganda (Kampala)	-
166.1	Guinea (Conakry)	Guinea (Conakry)	**Guinea (Conakry)**	Guinea (Conakry)	-
165.0	Somalia (Mogadishu)	Somalia (Mogadishu)	Somalia (Mogadishu)	**Somalia (Mogadishu)**	-
148.5	Zimbabwe (Harare)	Zimbabwe (Harare)	**Zimbabwe (Harare)**	Zimbabwe (Harare)	Zimbabwe (Chitungwiza, Bulawayo)
141.1	Sudan (Khartoum)	Sudan (Khartoum)	Sudan (Khartoum)	**Sudan (Khartoum)**	-
137.3	Republic of Congo (Brazzaville)	Republic of Congo (Brazzaville)	**Republic of Congo (Brazzaville)**	Republic of Congo (Brazzaville)	Republic of Congo (Pointe-Noire)
127.4	Madagascar (Antananarivo)	Madagascar (Antananarivo)	Madagascar (Antananarivo)	**Madagascar (Antanànarìvo)**	-
108.0	Mozambique (Maputo)	**Mozambique (Maputo)**	Mozambique (Maputo)	Mozambique (Maputo)	-
105.6	Sierra Leone (Freetown)	Sierra Leone (Freetown)	**Sierra Leone (Freetown)**	Sierra Leone (Freetown)	Sierra Leone (Bo, Kenema, Makeni)
105.6	Malawi (Lilongwe)	Malawi (Lilongwe)	**Malawi (Lilongwe)**	Malawi (Lilongwe)	Malawi (Mzimba, Nkhata Bay)
102.2	Liberia (Monrovia)	Liberia (Monrovia)	**Liberia (Monrovia)**	Liberia (Monrovia)	-
97.8	Niger (Niamey)	**Niger (Niamey)**	Niger (Niamey)	Niger (Niamey)	-
95.8	Mauritania (Nouakchott)	Mauritania (Nouakchott)	Mauritania (Nouakchott)	**Mauritania (Nouakchott)**	-
95.1	Chad (N'Djamena)	Chad (N'Djamena)	Chad (N'Djamena)	**Chad (N'Djamena)**	-
89.6	Eritrea (Asmara)	Eritrea (Asmara)	Eritrea (Asmara)	**Eritrea (Asmara)**	-
85.9	Rwanda (Kigali)	**Rwanda (Kigali)**	Rwanda (Kigali)	Rwanda (Kigali)	-
70.4	Gabon (Libreville)	Gabon (Libreville)	Gabon (Libreville)	**Gabon (Libreville)**	-
62.3	Central African Republic (Bangui)	Central African Republic (Bangui)	Central African Republic (Bangui)	**Central African Republic (Bangui)**	-
49.7	Burundi (Bujumbura)	Burundi (Bujumbura)	Burundi (Bujumbura)	**Burundi (Bujumbura)**	-
47.5	Djibouti (Djibouti)	Djibouti (Djibouti)	Djibouti (Djibouti)	**Djibouti (Djibouti)**	-
38.8	Guinea-Bissau (Bissau)	Guinea-Bissau (Bissau)	Guinea-Bissau (Bissau)	**Guinea-Bissau (Bissau)**	-
33.1	**Lesotho (Maseru)**	Lesotho (Maseru)	Lesotho (Maseru)	Lesotho (Maseru)	-
32.6	Namibia (Windhoek)	Namibia (Windhoek)	Namibia (Windhoek)	**Namibia (Windhoek)**	-
26.4	**Benin (Porto-Novo)**	Benin (Porto-Novo)	Benin (Porto-Novo)	Benin (Porto-Novo)	Benin (Cotonou)
25.7	Equatorial Guinea (Malabo)	Equatorial Guinea (Malabo)	Equatorial Guinea (Malabo)	**Equatorial Guinea (Malabo)**	-
23.2	Botswana (Gaborone)	Botswana (Gaborone)	Botswana (Gaborone)	**Botswana (Gaborone)**	-
23.0	South Sudan (Juba)	South Sudan (Juba)	South Sudan (Juba)	**South Sudan (Juba)**	-
21.3	Côte d'Ivoire (Yamoussoukro)	Côte d'Ivoire (Yamoussoukro)	**Côte d'Ivoire (Yamoussoukro)**	Côte d'Ivoire (Yamoussoukro)	Côte d'Ivoire (Abidjan)
14.7	Mauritius (Port Louis)	Mauritius (Port Louis)	Mauritius (Port Louis)	**Mauritius (Port Louis)**	-
12.8	Cabo Verde (Praia)	Cabo Verde (Praia)	Cabo Verde (Praia)	**Cabo Verde (Praia)**	-
10.7	Nigeria (Abuja)	Nigeria (Abuja)	Nigeria (Abuja)	**Nigeria (Abuja)**	-
7.5	Comoros (Moroni)	Comoros (Moroni)	Comoros (Moroni)	**Comoros (Moroni)**	-
6.7	Sao Tome and Principe (São Tomé)	Sao Tome and Principe (São Tomé)	Sao Tome and Principe (São Tomé)	**Sao Tome and Principe (São Tomé)**	-
5.8	Eswatini (Mbabane)	**Eswatini (Mbabane)**	Eswatini (Mbabane)	Eswatini (Mbabane)	Eswatini (Manzini)
3.1	Gambia (Banjul)	Gambia (Banjul)	Gambia (Banjul)	**Gambia (Banjul)**	-
2.6	Seychelles (Victoria)	Seychelles (Victoria)	Seychelles (Victoria)	**Seychelles (Victoria)**	-
Remarks	Benin is categorized as "There is no sewer system even in metropolitan area."	Niger is categoried as "There is no sewer system even in metropolitan area."	Republic of Congo is categorized as "No information is available on accessibility of sewer system."	-	

2.3 Selection and Analysis of Survey Countries

Based on the information collected in the first phase of the Survey, and taking into account the fact that some countries lack information on wastewater and faecal sludge management, the countries to be surveyed in the second phase were examined from the viewpoints of (1) the status of sewerage system development and (2) the status of efforts related to CWIS/FSM.

As for the status of sewerage system development, it was assumed that as area in which more than 5% of the urban population is connected to the sewerage system is considered to have “some level of sewerage system development”. Table 2-4 shows the classifications used including the cases that are considered to be “working on CWIS/FSM”.

Table 2-4 Criteria for Selection of Survey Countries

- Accessibility to Sewer System

Classification	Description
Sewerage system in a certain level is developed in metropolitan area.	More than 5% of the urban population is connected to the sewerage system.
Sewerage system is available in only very limited parts of the city.	Less than 5% of the urban population is connected to the sewerage system.
There is no sewerage system even in metropolitan area.	No sewerage system is in place.

- Status of CWIS and FSM

Classification	Description
CWIS/FSM is established as national policy and is being implemented.	When activities to improve Faecal Sludge Management (FSM) by establishing a sanitation service chain from collection of on-site sludge (sludge generated from on-site facilities such as pit latrines, septic tanks, etc.) to sludge treatment. This includes the development of FSM strategies and master plans, but not mere research.
CWIS/FSM projects are being implemented in metropolitan cities with support of WB, AfDB and BMGF. It is unclear whether this has been established as national policy.	When activities related to the establishment of a sanitation service chain, from on-site sludge collection to sludge treatment, are being undertaken as part of a sewerage project. This does not apply to cases where construction of sludge treatment facilities is underway, but there is no effort to improve the sanitation service chain and no improvement in sludge collection is expected.
CWIS/FSM is being implemented as pilot project or in rural cities. It is unclear whether it has been established as national policy.	When part of a sanitation project to promote latrines and working on activities to establish a sanitation service chain from on-site sludge collection to sludge treatment.

The results of the study and analysis based on the above assumptions are shown in Table 2-5.

Table 2-5 Classification (Accessibility to Sewer and Status of CWIS/FSM)

Accessibility to Sewer System / Status of CWIS and FSM	Sewer system in a certain level is developed in metropolitan area.	Sewer system is available in only very limited parts of the city.	There is no sewer system even in metropolitan area.	No information is available on accessibility to sewer system.
CWIS/FSM is established as national policy and is being implemented.	**Kenya** **Zambia** Senegal	**Burkina Faso** Lesotho	Benin	
CWIS/FSM projects are being implemented in metropolitan cities with support of WB, AfDB and BMGF. It is unclear whether this has been established as national policy.	**Uganda** Eswatini **Ethiopia** Ghana Tanzania Republic of South Africa	Mali **Mozambique** **Rwanda**	Niger	
CWIS/FSM is being implemented as pilot project or in rural cities. It is unclear whether it has been established as national policy.	**Côte d'Ivoire** Zimbabwe	Guinea Sierra Leone Togo Malawi Liberia		Republic of Congo
No information is available on CWIS/FSM.	Angola Gabon Cameroon Djibouti Seychelles Equatorial Guinea Namibia Burundi Botswana Mauritius	Democratic Republic of the Congo Sudan Nigeria Mauritania	Chad Central African Republic	Eritrea Cabo Verde Gambia Guinea-Bissau Comoros Sao Tome and Principe Somalia Madagascar South Sudan

2.4 Summary of Survey Results in First Phase

Based on the results of the first phase of the Survey, 21 countries with some level of sewerage systems and efforts in CWIS/FSM were selected as candidates of Survey Countries for the second phase (countries of shaded areas in Table 2-5). The following 8 countries were selected from the candidate countries as Survey Countries for the second phase of the Survey by considering the interest of each country in supporting the sewerage sector and interest in the Survey: Ethiopia (Addis Ababa), Kenya (Nairobi), Uganda (Kampala), Rwanda (Kigali), Cote d'Ivoire (Abidjan), Burkina Faso (Ouagadougou), Zambia (Lusaka) and Mozambique (Maputo).

CHAPTER 3 DATA COLLECTION AND ANALYSIS OF SURVEY COUNTRIES (SECOND PHASE)

3.1 Survey Countries

The 8 Survey Countries selected for the second phase with their cities are as shown in Table 3-1.

Table 3-1 Survey Countries and Cities in Second Phase

Region	Country (City)
Eastern Africa	Ethiopia (Addis Ababa), Kenya (Nairobi), Uganda (Kampala), Rwanda (Kigali)
Western Africa	Cote d'Ivoire (Abidjan), Burkina Faso (Ouagadougou)
Southern Africa	Zambia (Lusaka), Mozambique (Maputo)

3.2 Methodology of Survey in Second Phase

3.2.1 Purpose and Approach

The purposes and approaches for the second phase of the Survey are as follows.

(1) Purpose of Survey

In the second phase of the Survey, the status of wastewater and faecal sludge management as well as urban sanitation in the target cities of the countries was surveyed and summarized. In addition, the effectiveness of the field survey, survey policy and the needs for cooperation in the field of wastewater and faecal sludge management were examined. Based on the above analysis, 5 countries, with 1 city form each country, were selected for the Detailed Survey Countries.

(2) Approach of Survey

Regarding the projects implemented by WB, AfDB and BMGF in the countries to be surveyed, interview surveys were carried out with those institutions to collect information on wastewater and faecal sludge in the countries, to examine cooperation needs and to select countries for detailed surveys in the next phase.

3.2.2 Methodology

In the second phase, the Survey was proceeded according to the following steps.

- The details of the projects implemented by WB, AfDB and BMGF in the Survey Countries were confirmed. In addition, information on wastewater and faecal sludge in the Survey Countries was confirmed.
- Based on the above information, a questionnaires on wastewater and faecal sludge management in the Survey Countries were prepared
- On-line interview surveys with WB, AfDB and BMGF were conducted based on the questionnaire.
- The support policy and status of other donors, and the actual status of wastewater and faecal sludge management were confirmed through the interview surveys.
- The cooperation needs in the Survey Countries were examined.
- A summary of the results of the above steps was prepared.
- Detailed Survey Countries for the third phase were selected.

3.2.3 Interview Survey with Donor

The results of the interviews with WB, AfDB and BMGF are shown below.

Table 3-2 Interview Survey Result with Donors

Country	Donor	Reason for Interview	PIC of Donor	Date of Interview
Uganda	AfDB	Supporting wastewater management in Kampala by Kampala Sanitation Program (2008, 2017)	Mr. M. Andrew Mbiro, AfDB Uganda Office	13 July, 2021
	BMGF	Supporting faecal sludge management in Kampala by Citywide Inclusive Sanitation (CWIS) Program - Phase II: Kampala Faecal Sludge Management (KFSM) Project on Improving Faecal Sludge Management for On-Site Sanitation in Kampala City (2019-2022)	Ms. Alyse Schrecongost, Senior Program Officer	30 July, 2021
Ethiopia	WB	Supporting wastewater management in Addis Ababa by Second Ethiopia Urban Water Supply and Sanitation Project (2017)	Mr. Antonio Manuel Rodriguez Serrano, Sr. Water and Sanitation Specialist, WB Mr. Yohannes Fisseham, Sr. Water Supply and Sanitation Specialist, WB Ethiopia Office	3 August, 2021
Kenya	AfDB	Supporting wastewater management in Nairobi by Nairobi Rivers Basin Rehabilitation and Restoration Program Sewerage Improvement Project (2018)	Ms. Emily Kilongi, AfDB Kenya Office Mr. Christopher Mutasa, AfDB Kenya Office	4 August, 2021
Cote d'Ivoire	WB	Supporting wastewater management in urban areas by Additional Financing for the Urban Water Supply and Sanitation Project (2019)	Mr. Jacques Touchard Adia, WB Cote D'Ivoire Office	Not conducted
Zambia	WB	Supporting wastewater management in Lusaka by Lusaka Sanitation Project (2015)	Ms. Ruth Kennedy-Walker (Water supply and sanitation specialist in the Water Global Practice at the WB HQs	14 July, 2021
	AfDB	Supporting wastewater management in Lusaka by Lusaka Sanitation Program (2015)	Mr. Herbert Chinokoro, Senior Water and Sanitation Specialist, AfDB Zambia Office	25 June, 2021
	BMGF	Supporting faecal sludge management in Lusaka by FSM Innovation Program	Ms. Alyse Schrecongost, Senior Program Officer	6 April, 2021
Burkina Faso	WB	Supporting wastewater management by Water Supply and Sanitation Program for Results (2018)	Mr. Ousmane Yida Yaya-Bocoum, WB Burkina Faso Office	18 June 2021
Mozambique	WB	Supporting wastewater management in Maputo and other cities by Mozambique Urban Sanitation Project (2019)	Ms. Odete Duarte Muximpua (Water supply and sanitation specialist at WB Maputo Office)	16 June, 2021
Rwanda	AfDB	Supporting wastewater management and faecal sludge management in Kigali and others by Maputo Sustainable Water Supply and Sanitation Program (2017)	M. Amandine Umukesha, AfDB Rwanda Office	No response to interview request

3.3 Outline of Survey Results in Second Phase

Among the 8 countries selected as Survey Countries for the second phase, the survey results of 3 countries (Uganda, Ethiopia and Burkina Faso) which were not selected as Detailed Survey Countries are as follows. Since the information in the second phase of the Survey is obtained from international organizations, etc., and not from the government or related organizations, it may contain information or analysis that is not acceptable to the countries.

3.3.1 Uganda

(1) Current Status of Wastewater and Faecal Sludge Management in Kampala City

1) Outline of Kampala City

The population of Kampala City is 1.7 million and the city center is surrounded by residential areas. The eastern part of the city faces Lake Victoria. It is an international lake and the source of water supply in the city, so the urgency of wastewater and faecal sludge management is high. On the other hand, the fact that there are 72 slums in which 60% of the city population live, and 48% of the houses are rented out (making it difficult for residents to modify the sanitation facilities by themselves) makes difficult the wastewater and faecal sludge management in the city.

2) Institutional Framework

In Uganda, the Ministry of Water and Environment (MWE) is in charge of policy and regulation, and the National Water Supply and Sewerage Corporation (NWSC) provides services based on a performance contract with MWE. There is no independent regulatory body. In Kampala City, the Kampala Capital City Authority (KCCA) is in charge of solid waste management and sanitation.

3) Sanitation Policy and Plan

The Kampala Capital City Strategic Plan (2020) targets to increase the percentage of sewerage connections in the central business district to 100% and the percentage of safe and controlled domestic sanitation facilities and safe sludge management to 80%.

4) Sanitation Facility

69% of citizens use pit latrines in the city. The dumping of waste in pit latrines by residents is one of the factors that hinder smooth sludge management in Africa. However, according to the BMGF, the Sato Pan, a plastic toilet bowl developed by Lixil, a Japanese company, helps to mitigate the dumping of waste in pit latrines.

5) Sewerage System

There are 2 wastewater treatment plants owned and operated by the NWSC in the city. Only 8% of the city population is connected to the sewerage system (2% of the residential population), and the majority of the population relies on on-site sanitation. According to the AfDB, increasing the connection ratio to the sewer is an issue, and financial support by the donors for the construction of tertiary sewer is expected. In addition, there is a plan to build the Nalukolongo WWTP & FSTP.

6) Wastewater Treatment Technology

There are 2 wastewater treatment plants in Kampala, the latest of which is the Bugolobi-Nakivubo WWTP (planned to be operational in April 2021) was built with the support of the AfDB. Its treatment process seems not to be the oxidation pond method, which is commonly observed in African countries, but trickling filter method or UASB/trickling filter method seem to be applied, according to appraisal report of the AfDB. The treatment process of the Lubigi WWTP seems to be the oxidation pond method.

7) FSM

With regard to on-site sludge management (FSM), a dedicated FSM department (the Directorate of Public Health and Environment) was established in the KCCA with the support of BMGF and other

organizations. The following activities have been carried out by the directorate:

- Social marketing to encourage residents to improve sanitation
- Strengthening the regulation of private companies such as sludge collection companies
- Building cooperative relationship with government agencies
- Building capacity of KCCA and private contractors
- Establishing and operating a call center to mediate between residents and private sludge collection companies

The above sludge management approach is also used, in whole or in part, in Senegal, Zambia and Mozambique, which are also working to improve FSM with support from BMGF and WSP (WB).

8) Faecal Sludge Treatment Facility and Treatment Technology

The amount of sludge collected in the city has increased due to the activation of the FSM. Therefore, in addition to the existing Lubigi WWTP & FSTP (covered sludge drying bed system with a treatment capacity of 400m^3/day), the NWSC will build 3 new WWTPs and FSTPs to increase the sludge treatment capacity to 1,600m^3/day.

(2) Issues of Wastewater and Faecal Sludge Management in Kampala City

1) Wastewater Management

- Residential sewerage connections are not promoted, and improvement of this situation is necessary. The reasons for the above issue are thought to be a lack of funds for laying tertiary sewer, high water and sewerage rates, and the high cost of connecting to public sewers. Thus, the comprehensive measures including rate structuring are thought to be necessary.
- There is a concern that the sewer pipelines laid before the AfDB project (L/A 2008) are deteriorating.
- Even though there is a plan to construct a new Nalukolongo WWTP & FSTP, according to the AfDB, the funding source has not been secured.

2) FSM

- On-site sludge management (FSM) is currently being actively promoted by KCCA with the support of donors such as BMGF, and is considered to have been successful to some extent. However, BMGF is concerned if KCCA would be able to handle the FSM sustainably after the completion of donor supports. In order to enhance the sustainability, it is considered necessary to increase the policy and financial involvement of the central government (NWE) by legislating FSM, and to expand the role of NWSC in FSM, which is currently limited to sludge treatment only, and to increase the technical involvement of NWSC.
- KCCA is making efforts to strengthen the regulation of sludge collection companies. However, according to BMGF, there are still issues in granting licenses.
- Although the sludge collection fee has been reduced as a part of KCCA's measures to strengthen FSM, it is still considered to be a heavy burden for the poor (especially the sludge collection charge with Gulper desludging equipment in slum areas, where sludge collection by vacuum trucks is difficult, is higher than that by vacuum trucks).
- The dumping of waste in the pit latrine interferes with the smooth sludge collection process and raises the cost of sludge collection.
- Manual desludging still being used and in such case, there is a risk of the extracted sludge being dumped on the ground or in the ditch. Moreover, there is a concern about the environmental impact of the sludge discharged into drainage channels, ground and waterways due to insufficient sludge treatment capacity. Thus, further strengthening of sludge management is necessary.

3.3.2 Ethiopia

(1) Current Status of Wastewater and Faecal Sludge Management in Addis Ababa City

1) Outline of Addis Ababa City

Addis Ababa, the capital city of Ethiopia, is a large city with population of 3.27 million (2019). The wastewater and faecal sludge management has not been properly implemented due to the rapid economic growth and concentration of population in urban areas, as well as the fact that 80% (2007) of the residents live in slums.

2) Institutional Framework

When it comes to urban sanitation, several institutions have responsibilities for their own sectors. At the national level, the Ministry of Urban Development and Housing, Ministry of Health, Ministry of Water, Irrigation and Electricity, Ministry of Environment, Forestry and Climate Change are the lead agencies.

In Addis Ababa, the Addis Ababa Water and Sewerage Authority (AAWSA), a public agency, is established with the responsibility of providing water supply and wastewater and faecal sludge treatment services in Addis Ababa.

3) Sanitation Policy and Plan

There is no specific policy for wastewater and faecal sludge management in Ethiopia. The Environmental Policy of Ethiopia (EPA, 1997), Health Policy of Ethiopia (Ministry of Health, 1993), and Urban Development Policy (1991), etc., indicate the necessary measures from different perspectives including the health, environment, water and urban development sectors. Meanwhile, the Integrated Urban Sanitation and Hygiene Strategy (IUSHS) was developed in 2017 with the support of the WB and others. This strategy aims to improve on-site sludge management (the goal is to develop FSM systems capable of safe transportation, treatment and recycling to 70% of total sludge generated nationwide by 2025), to improve existing latrines, to invest in decentralized WWTPs, to introduce wastewater reuse and to safely manage wastewater.

4) Sanitation Facility

In terms of improving public health, a number of initiatives have been implemented since the 2000s as the WASH program. In these efforts, the access rate to sanitation facilities such as toilets has been improved. However, the rate of access to sanitation facilities in urban areas remains low as it has not kept pace with the rapid population growth. In addition, since many pit latrines do not have slabs, improving them to reduce the impact on the surrounding environment is a issue.

Regarding the sanitation facilities in Addis Ababa, the WB reported in 2017 that flush toilet accounted for 26.42% (10% sewer connection and 16.42% septic tank), communal pit latrine for 50.06%, individual pit latrine for 18.26% and open defecation (field/forest) for 3.84%. Eradication of open defecation, proper collection of sludge, and transportation and treatment of wastewater are the key issues.

5) Sewerage System

Only Addis Ababa has a sewerage system in Ethiopia. The treatment capacity of the system is 60,500 m^3/day (under expansion to 90,000 m^3/day) and a sewer connection rate is 10% (2015).

The Wastewater Master Plan for Addis Ababa was formulated in 1993, and a revised version was

published in 2002. However, the plan does not reflect the current situation, since sanitary facilities have not been developed as planned and the population growth has exceeded the assumptions of the plan. Therefore, with the support of the WB and other donors, the revision of the Sanitation Master Plan to reflect the CWIS concept is currently under consideration.

6) Wastewater Treatment Technology

There are 2 wastewater treatment plants in Addis Ababa (Kotebe WWTP, Kality WWTP), and their treatment system appears to be an oxidation pond system.

7) FSM

AAWASA has 100 vacuum trucks, but half of them are out of service due to aging. In addition, private companies have only 50 vacuum trucks and provide sludge collection services only to commercial buildings and wealthy residents. Thus, the faecal sludge management in slum areas where most of the population lives is an issue.

8) Faecal Sludge Treatment Facility and Treatment Technology

The Kotebe WWTP was initially planned for on-site sludge treatment, and 20 sludge drying beds and 10 lagoons were constructed. However, some of the sludge drying beds were converted to stabilization ponds for sewage treatment in 2010. The sludge drying beds and lagoons of this facility treat 560m^3/day of sludge.

At Kaliti WWTP, the sludge lagoon and drying facility were constructed in 1999 with sludge treatment capacity of 110,000m^3/year.

9) Industrial Effluent Management

There are about 1,000 commercial buildings and factories in Addis Ababa. The management of industrial wastewater is an issue due to various problems including illegal connection of factories emitting hazardous substances to the sewerage system, and inappropriate wastewater treatment in commercial buildings not connected to the sewerage system.

(2) Issues of Wastewater and Faecal Sludge Management in Addis Ababa City

1) Wastewater Management

- Construction of facilities based on the master plan (construction of facilities that can accommodate the rapidly increasing urban population) and financing the construction
- Appropriate wastewater treatment in the slum areas (peri-urban areas)
- Measures to prevent environmental pollution caused by industrial wastewater

2) FSM

- Lack of sufficient equipment to provide sludge collection services
- Training and regulation of private sludge collection companies
- Proper treatment of the collected sludge
- Faecal sludge management by the AAWSA
- Management of shared latrines (periodic sludge collection)

3.3.3 Burkina Faso

(1) Current Status of Wastewater and Faecal Sludge Management in Ouagadougou City

1) Outline of Ouagadougou City

The population in Ouagadougou, the capital city of Burkina Faso, is approximately 2.5 million (2006) with a population growth rate of 4.0%. Because the topography of the city is flat, the construction cost of a gravity sewer system is high. The urban slum population ratio of the country is 57%, and that of Ouagadougou is assumed to be about the same. Since the city is located in a dry area (annual rainfall of 744mm), the barriers to sewerage system development are relatively high.

2) Institutional Framework

The General Directorate for Wastewater Sanitation and Human Excreta (DGAEUE) of the Ministry of Agriculture, Water and Fisheries (MSHRH) is responsible for sanitation policy and regulation, while the National Office for Water and Sanitation (ONEA) is responsible for the provision of urban water supply and sewerage sanitation services under a three-year performance contract with the government. According to the WB, the ONEA has made impressive achievements in urban water supply (access to safe water in urban areas increased from 37% in 1990 to 91% in 2016), despite financial vulnerabilities, although it has faced the challenges in sanitation (access to improved sanitation in urban areas is 38%).

3) Sanitation Policy and Plan

The ONEA has been working on not only wastewater management but also the FSM as a part of its sanitation strategy since 1996, the earliest among the western African countries. In addition, it has adopted a sanitation surcharge system that collects fees from a wide range of water customers regardless of their connection to the sewerage system to finance sanitation improvements for the poor. As a result, Burkina Faso is considered a country where the CWIS is practiced to some extent.

4) Sanitation Facility

73% of population in Ouagadougou use pit latrines and 15% use septic tank. According to the 2010 census, 80% of the population in the city used the unimproved (old) pit latrine. Since the old pit latrine is not hygienic and not suitable for the smooth FSM, replacing it with an improved one is important.

5) Sewerage System

The access rate to the sewerage network in Ouagadougou city is less than 2%. The main facilities connecting to the sewerage system are commercial facilities and factories in the city center.

6) Wastewater Treatment Technology

The Ouagadougou city has 1 wastewater treatment plant (Kossodo WWTP with 5,400m^3/day) with an oxidation pond system. It is reported that it has a problem of overloading due to the inflow of factory effluent.

7) FSM

Burkina Faso is the oldest country in West Africa (1996) that has been working on not only wastewater management but also the FSM as a part of its sanitation strategy. It is reported that the ONEA is engaged in various activities and supports not only sewerage but also faecal sludge

management. It provides support to households for the improvement of on-site sanitation facilities, and trains the builders and sludge collection companies on each phase of sanitation service chain for the treatment, disposal and reuse of sludge.

8) Faecal Sludge Treatment Facility and Treatment Technology

There are 3 sludge treatment plants (built in the 2010s) operated by ONEA in Ouagadougou with the treatment process of sun-dried sludge bed system. The existing sludge treatment plants are overloaded due to increase in volume of incoming sludge, which in turn is caused by the start of private sludge collection companies. Thus, it is planned to construct a fourth sludge treatment plant.

(2) Issues of Wastewater and Faecal Sludge Management in Ouagadougou City

1) Wastewater Management

- It is reported that existing wastewater treatment plants are overloaded in terms of quality (not volume) of incoming wastewater due to the inflow of factory effluent. Thus, strict regulation of industrial wastewater is needed.

2) FSM

- Although there are legal systems, regulations and standards related to the wastewater and faecal sludge management in Burkina Faso, it is reported that they are not actually enforced. Thus, the regulations need to be strengthened.
- Since the existing faecal sludge treatment plants are overloaded, the sludge collection companies are inevitably dumping the sludge in an open area. This may reduce the outputs of the FSM, so it is necessary to enhance the sludge treatment capacity. In addition, the cause of the overload may be a technical problem specific to the treatment of sludge from pit latrine containing a lot of residuals such as waste. Thus, it is necessary to find out the causes and examine the solution.

3.4 Summary of Survey Results in Second Phase: Selection of Detailed Survey Countries

3.4.1 Summary of Survey Results in Second Phase

The Survey is required to collect basic information on wastewater and faecal sludge management in the cities in the SSA region, and to examine the direction of future cooperation according to the size and economic level of the cities and the stage of development of their sewage and faecal sludge management systems.

Most of metropolitan cities of most SSA countries have sewerage systems regardless of the income level of the countries. However, in “LDC and low income countries” and “LDC or low income countries”, which make up the majority of SSA countries, the sewerage coverage even in metropolitan cities is limited to the central business district, and only 2-10% of the urban population (commercial customers and the wealthy) is covered by sewers.

In the cities of Nairobi in Kenya and Abidjan in Cote d'Ivoire, which belong to the “low and middle income countries”, the sewerage coverage rate exceeds 40%, and some of the general population is connected to the sewerage system. In Nairobi and Abidjan, however, the ratio of slum population to the urban population is high and similar to that of the capital cities of other SSA countries, and sewage and sludge management for slum residents is an issue. While some countries have succeeded in providing water supply to a wide range of people, including those in slum areas, regardless of the economic level of the country, it is generally considered difficult to develop sewerage systems in slum areas. There are exceptional cases where sewerage systems have been introduced to slum areas on a trial basis, such as the sewerage system in Lusaka City (Zambia) using the condominial method,

and the sewerage system in Nairobi City using the Output Based Aid scheme.

Since all the 8 cities of the second phase of the Survey have a large proportion of urban slum population, it is important to implement the CWIS to provide the wastewater and faecal sludge management services to low-income groups including those in slum areas. Since most of these people depend on on-site sanitation facilities such as pit latrines, the enhancement of the FSM of on-site sanitation facilities was identified as an essential component of CWIS.

Some cities have been somewhat successful in achieving CWIS/FSM with the assistance of the WB, the AfDB and the BMGF, and others have started to work on CWIS/FSM. Both the WB and the AfDB rely on the BMGF for their know-how in establishing the sanitation service chain in CWIS/FSM.

It also became clear that the specific methods of CWIS/FSM, especially the regulatory systems, include those similar to the regulatory system for on-site sanitation in Japan.

The wastewater and faecal sludge treatment technologies used in the 8 cities surveyed (such as stabilization ponds and sun-dried beds) are rudimentary compared to Japan's advanced technologies, and it was clear that there is a large technology gap.

Based on these survey results, it is considered that the CWIS/FSM should be incorporated in some form into the future support for the wastewater and faecal sludge management in SSA countries. In addition, Japan's on-site regulatory system may contribute to the realization of CWIS/FSM. However, it might be not only financially but also politically difficult to realize the sewerage system improvement that requires huge amount of money, without addressing the issue of the poor sanitation environment of low-income groups such as slum areas, because it is difficult to reach a consensus among the public and donor communities on its investment priority. Therefore, the possibility to support the improvement of wastewater and faecal sludge management with JICA cooperation in the SSA countries through the improvement of sanitary conditions in slum areas causing the mitigation of the political and financial barriers and the promotion of the development of sewerage system should be considered.

3.4.2 Selection of Detailed Survey Countries and Cities

For the selection of Detailed Survey Countries, the following policies were applied.

Policy-1: The priority was given to the countries where CWIS/FSM was being implemented with the support of WB, AfDB, BMGF, etc. and results were being achieved (score: 2). In particular, the target countries/cities of the BMGF were more prioritized (score: 3). The countries that have started to implement CWIS/FSM but do not seem to have achieved sufficient results were also to be considered as it was believed that lessons can be learned about what hinders the realization of CWIS/FSM (score: 1).

Policy-2: The priority was given to the countries/cities that were experimenting with sewerage systems in slums, as this might be helpful for future sewerage support in SSA region (score: 1).

Policy-3: The countries that were considered to have financial cooperation needs for the development of sewerage systems and sludge treatment facilities, as well as possible cooperation needs in soft aspects such as environmental regulations, on-site regulations, and capacity development, were considered (score: 1).

Policy-4: The priority was given to the countries/cities with emerging problems in wastewater treatment and faecal sludge treatment from the perspective of seeking the possibility of future cooperation (score: 1).

Policy-5: The countries with master plans that reflect the CWIS/FSM were considered (score: 1),

as it was considered that the master plans will enable the analysis of financial cooperation or will be a reference for the formulation of a master plan supported by JICA in the future.

Policy-6: Among eight countries, at least one country was selected from each of the three categories of "LCC and low income country", "LCC or low income country" and "low/middle income country".

Table 3-3 Selection of Detailed Survey Countries and Cities

Country	Score / Income Level	Approach to CWIS/FSM	Slum Area and Sewerage	WWT/Sludge Treatment Issue	Financial/ Technical Cooperation Needs	CWIS Master Plan	Total Score
		・Priority Country of BMGF (3 points) ・CWIS/FSM execution (2 points) ・CWIS/FSM trial/no achievement (1 point)	Trial of sewerage in slum area (1 point)	Outstanding issue on WWT/ Sludge Treatment (1 point)	Needs assumed (1 point)	MP with CWIS concept (1 point)	
Uganda	LCC and low income country	3			1		4
Ethiopia	LCC and low income country	1			1	1 (under preparation)	3
Kenya	Low/Middle income country	2	1	1 (Nakuru)	1		5
Cote d'Ivoire	Low/Middle income country	1			1	1 (obtained)	3
Zambia	LCC or low income country	3	1	1	1	1 (prepared, not obtained)	7
Burkina Faso	LCC and low income country	1		1		1 (draft obtained)	3
Mozambique	LCC and low income country	2		1	1		4
Rwanda	LCC and low income country	1		1	1		3

Based on the above results, it was decided to exclude Uganda, where wastewater and faecal sludge management is not a priority sector for JICA. In addition, considering the impacts and restrictions caused by the COVID-19 pandemic and the regional balance, the following 5 countries were selected as Detailed Survey Countries: Rwanda, Mozambique, Zambia, Cote d'Ivoire and Kenya.

CHAPTER 4 DATA COLLECTION AND ANALYSIS OF DETAILED SURVEY COUNTRIES (THIRD PHASE)

The overview of the results of the detailed survey conducted in 5 countries (5 cities) is described in this chapter.

The field surveys were carried out in Kigali of Rwanda and Maputo of Mozambique. However, in Abidjan of Cote d'Ivoire, Lusaka of Zambia, and Nairobi of Kenya, the field surveys could not be conducted due to COVID-19. Therefore, on-line meetings were held for those 3 countries. As a result, it was difficult to confirm the cooperation needs since the actual situation and sites were not observed. The outline of the survey results shown in this chapter was all shared with the Detailed Survey Countries.

4.1 Kigali, Rwanda

4.1.1 Current Status of Wastewater and Faecal Sludge Management in Kigali City

(1) Outline of Kigali City

The population of Kigali, the capital of Rwanda, which has been growing rapidly in recent years, is 1.13 million (2012). The city is endowed with hills and undulating terrain. The central business district (CBD) with modern buildings and various government agencies are located on the hill in the western part of the city. Embassies and luxury residential areas are located on the hills in the central and northern part of the city. But informal settlements extend from the slopes of those hills to the lowlands. The population in informal settlements accounts for 78% of the city's population (2015), making wastewater and sludge management in Kigali challenging.

(2) Institutional Framework

The institutional framework for wastewater and sludge management in Rwandan consists of various organizations. The Ministry of Infrastructure (MININFRA) is in charge of policies and plans, while the Water and Sanitation Corporation (WASAC) is in charge of service provision. The Rwanda Utility Regulatory Authority (RURA) is in charge of public utility regulation, and the Rwanda Environment Management Authority (REMA) is in charge of environmental regulation. In addition, the Rwanda Housing Authority (RHA) is involved from the perspective of housing development. Regarding the management of wastewater and sludge in Kigali City, the City of Kigali (COK) is involved from the perspectives of city planning, upgrading of informal settlements, building permits, etc.

(3) Sanitation Policy and Plan

One of the five goals of the Rwanda National Sanitation Policy (2015) is to “develop safe, well-regulated and affordable off-site sanitation services for densely populated areas.” However, “off-site sanitation” in the plan here is a broad concept that includes not only sewerage but also on-site sludge management (collection and treatment). The targets of the said policy are shown in Table 4-1.

Table 4-1 Targets of Rwanda National Sanitation Policy (2015)

Item	2015	16/17	17/18	18/19	19/20	29/30
Ratio of Urban Population connected to Sewerage	2	2	2	15	20	35
Ratio of Population accessible to Safe Sludge Treatment Services	N/A	10	30	50	70	10

(4) Sanitation Facility

The sanitary facilities of the residents of Kigali City are characterized by a large proportion of pit

latrine with 85.2% representing pit latrine with solid slab and 3.6% representing pit latrine without slab, and flush toilets (septic tanks) accounts for 9.3% (2016 AICV5). Pit latrine fills up in about 7 years, and in rural areas where the space is large, another pit is dug and used when it is full. But in urban areas where the space is limited, it is difficult to do so. Therefore, sludge needs to be removed from the pits in urban areas for sustainable use, and this requires faecal sludge management (FSM) service chain from sludge collection, transportation to treatment and reuse.
In order to prevent groundwater pollution, new installation of conventional pit latrine without concrete or brick lining is prohibited; however, a lot of such pit latrines especially in informal settlements remains, and due to its structure, desludging work by vacuum tanker is difficult (pit may collapse). Disposal of trash into pit latrine also hinders desludging and treatment (PIT VIDURA takes more than two hours to remove the trash from pit latrine, before using a vacuum pump for sludge removal).

(5) Sewerage System

The first public sewer system in the country, currently in the project pipeline with the support of the AfDB and the European Investment Bank (EIB), will cover the central business district (CBD) in western Kigali, and most of CBD's commercial buildings and surrounding houses are expected to be connected to the sewers. The population covered by the sewerage system will be 120,000, which is equivalent to about 10% of the population of Kigali City. The project is currently in the final stages of bid evaluation. WASAC has subsequent plans for other sewerage system in the Gasabo District (F/S implemented) and Kicukiro District (F/S planned) in the central part of the city.

WASAC has restructured its organization to put the new public sewerage system into service by establishing the Division of Sewerage Operations under the Directorate of Urban Water and Sewerage. The division will have three units (operation, maintenance, and sewer works), and in addition to the head of each unit, three engineers and four operators will be assigned.

The Rwanda Housing Authority and the City of Kigali are promoting housing land development. In addition to self-development, they support housing land development by private developers. As a result, there are already 30 housing estates in Kigali City and the number is expected to increase in the future. Regarding the wastewater treatment of the estates, the developers are obliged to install a semi-centralized wastewater treatment system instead of installing septic tanks in individual houses. But some of them are not properly operated or maintained, making their improvement a challenge. In addition, the same challenge is faced by about 300 commercial buildings in Kigali City that have middle to large-scale decentralized wastewater plants.

(6) Wastewater Treatment Technology

The Nyabugogo WWTP (12,000 m^3/day), which is currently under the bid evaluation stage, is planned to apply the activated sludge with maturation pond method. Since it will be the country's first full-scale sewage treatment plant, the O&M know-how of the sewage treatment plant is supposed to be transferred from the contractor to WASAC during the two-year O&M period under DBO (design, build and operate) contract. However, WASAC is worried about the maintenance and inspection of the sewers.

Most of the treatment processes of semi-centralized/decentralized sewage treatment facilities installed in estates and commercial buildings are activated sludge methods.

(7) Wastewater and Faecal Sludge Management in Slum Area

In informal settlements, wastewater and sludge management such as installation of sewers and sludge collection by vacuum tankers faces difficulties due to lack of access roads. Recently, upgrading of informal settlements that includes construction and improvement of roads has been conducted under

1st and 2nd phases of the Urban Development Project financed by the WB. As a result, the road network is upgraded, and an increased number of dwellings now have access to vacuum tankers. One private sludge collection operator developed mechanical emptying method that does not use vacuum tankers and has been enhancing its service provision in informal settlements.

(8) FSM

Concerning urban sanitation improvement in Kigali, related institutions have common understanding that sewerage and management of sludge from pit latrines and septic tanks (faecal sludge management – FSM) should be promoted together. RURA established a series of regulations related to on-site sanitation in 2016 such as licensing of companies that construct on-site sanitation facilities, provide sludge collection service and provide operation and maintenance service on decentralized wastewater treatment systems. These regulations are similar to those of Japan.

There are six sludge collection operators licensed by RURA in Rwanda, and the number of vacuum tankers that they operate is very small, less than 15 in total. It is assumed that only Kigali would require 40 to 50 tankers. One of the factors preventing private companies' entry into sludge collection business is lack of financial support by the government for procurement of vacuum tankers and spare parts. PIT VIDURA, one of the six licensed companies, is extending its sludge collection service in informal settlements where conventional vacuum tankers have difficulty to access, with support from Bill and Melinda Gates Foundation (BMGF) and Water for People (an international NGO). However, only two desludging services per day is currently provided by PIT VIDURA in the informal settlements, and the number is obviously too small considering the number of households in such areas that is over 100,000.

It was found that a new FSM guideline is under development by a working group which is led by RURA and includes WASAC, with assistance of BMGF, based on a recognition that existing regulations are insufficient for improvement of FSM. New regulations on FSM are supposed to be established based on the guideline by June 2022.

The new guideline makes FSM in informal settlements as well as operation and maintenance of wastewater treatment systems attached to estates and commercial buildings the responsibility of WASAC, under which service provision are delegated to private sludge collection operators and operation and maintenance companies. Levying sanitation tax on top of water tariffs to cover the service provision is also considered.

(9) Faecal Sludge Treatment Facility and Treatment Technology

Currently there is no faecal sludge treatment plant (FSTP) in Kigali, and sludge collected from on-site sanitation facilities is disposed of untreated in the ponds in Nduba landfill site, requiring urgent establishment of FSTPs. A new FSTP (with a capacity of 600m^3/day and a treatment process with Imhoff tank, solid-liquid separation and drying bed) is planned to be constructed in Masaka and it seems that negotiations to secure necessary finance are underway. For efficient FSM operation, the Masaka FSTP will not enough and one or two more FSTPs would be necessary, considering the distance between the informal settlements in western part of the city, which is the major source of faecal sludge, and Masaka FSTP.

4.1.2 Issues of Wastewater and Faecal Sludge Management in Kigali City

(1) Wastewater Management

- Smooth implementation of the sewerage system development which is in the project pipeline in the Central Business District.

- Strengthening of the capacity for operation and maintenance of the sewerage system including sewer management (maintenance and inspection of the sewers)
- Improvement of the operation and maintenance of the semi-centralized/decentralized wastewater treatment systems installed in housing estates and commercial buildings

(2) FSM

- Establishment of the faecal sludge management service chain from the improvement of the sanitary system to collection and transport of sludge to treatment of sludge and reuse
- Urgent development of sludge treatment capacity in Kigali City
- Promotion of the entry of the private operators into the desludging service provision in areas that includes informal settlements, together with their capacity development.

4.1.3 Cooperation Needs on Wastewater and Faecal Sludge Management in Kigali City

During the field survey, the following support needs were identified by the relevant organizations in Rwandan:

- Transfer of know-how on wastewater management in terms of operation and maintenance of sewerage system as well as O&M and monitoring of semi-centralized/decentralized wastewater treatment system
- Support for construction of the sludge treatment facilities

In addition, it was observed that the sizes of the vacuum tankers being used by the desludging operator in Kigali City are large (10t and 20t) and have difficulties in entering into informal settlements in addition to consuming a large amount of fuel (accounting for half of the operational expenditure of the desludging operation), which make the desludging operations inefficient. There is a possibility that introduction of middle-sized vacuum tankers which are prevalent in Japan would improve the efficiency of the desludging operations in Kigali City including informal settlements.

4.2 Maputo, Mozambique

4.2.1 Current Status of Wastewater and Faecal Sludge Management in Maputo City

(1) Outline of Maputo City

The population of Maputo, the capital of Mozambique, is 1.2 million (Maputo Metropolitan Area: 1.8 million). The city center, where office buildings, hotels, public administration offices and houses of high-income households are located in orderly manner is called 'Cement City' which is located in the southern part of the city. The peri-urban areas, where many informal residents live in un-orderly manner, are located in the northern part of the city. There are pockets of areas with low-income residents in the city center too. According to WB, 80% of Maputo populations live in slum areas. There is no sewerage system in peri-urban areas and all residents relay on on-site sanitation systems. Therefore, the management of the sludge accumulated in the on-site sanitation system (Faecal Sludge Management or FSM) is an urgent issue.

The topography of Maputo City, particularly the southern city center area, is characterized by a coastal terrace. The elevation of land increases steeply at an area a few hundred meters inside from the coast line where port facilities exist and, and the elevation at some points within a few hundred meters from the coast line reaches 70m. The high-rise buildings and government offices in the city center are located both on the terrace and below the terrace, and many residential houses are located on the terrace. In Baixa area, a busy downtown area in Maputo City located in the low-lying area below the terrace, frequent flooding has occurred recently, and it is sometimes attributed to the effects of global warming. Accordingly, under the WB financed Maputo Urban Transformation Project (2020), counter measures against the flooding are being taken. Furthermore, the wastewater generated in this area is currently collected together with storm water by the sewer and discharged to Maputo Bay without proper treatment, causing the pollution of Maputo Bay water. Necessary counter measures must be taken against this problem.

(2) Institutional Framework

Direcção Nacional de Abastecimento de Água e Saneamento (DNAAS) under MOPHRH is in charge of policy on wastewater and sludge management in Mozambique.

The local governments are in charge of provision of sanitation and sewerage services. But, since the local governments are financially weak and lack the capacity to mobilize resources and build the infrastructures, Administração de Infra-estruturas de Água e Saneamento (AIAS) is in charge of the asset management. AIAS builds sewerage systems and sludge treatment facilities, signs contract with the municipalities that operate these facilities and collect the tariffs, and then pay a counter value to AIAS.

When the local governments introduce or revise their sanitation tariffs, the approval of Autoridade Reguladora de Água (AURA) is required. AURA confirms if the proposed tariff matches the quality of the service. The decrees for the provision of sanitation services are to be established by the local governments. The role of AURA is to prepare guidelines for the local governments.

(3) Sanitation Policy

The "National Urban Water Supply and Sanitation Strategy 2011-2025 (2011)" outlines the Mozambican Government's policy on sewage and sludge management. The strategy aims to achieve a universal access to urban sanitation by 2025. The strategy focuses on rehabilitation and upgrading of existing sewerage systems and improvements of on-site sanitation facilities (transition from pit latrines to septic tanks, improvement of pit latrines in slums), and strengthening FSM business by encouraging the entry of private companies in relation to the latter. Furthermore, it indicates the

setting and collection of sanitation tax to make the provision of sanitation services financially sustainable.

In Maputo City, the implementation of measures in line with this strategy is progressing steadily with the support of the WB and others, albeit little by little.

(4) Sanitation Facility

In Maputo City, 9% of population is covered by sewerage systems, 35% uses septic tanks, 55% uses pit latrines, and 1% has no facilities or practicing open defecation (BMGF 2017).

In peri-urban areas where middle- and high-income residents live, septic tanks are used and desludging services are provided by vacuum tanker operators. The majority of the inhabitants belong to low-income households, and they often share one traditional pit latrine with several families. These pit latrines are public health hazards and removal of sludge by vacuum tankers are difficult. Therefore, the City of Maputo recognizes that making transition from traditional pit latrines to improved ones and septic tanks is important. Under such circumstances, a pilot project including the demolition of traditional pit latrines and construction of communal toilets (sanitary blocks) equipped with a septic tank and a water supply tank was implemented in the Nhlamankulo peri-urban district with the support of WSP; the pilot project involved the users for their operation and maintenance. As the scheme seems to be functioning well, the City of Maputo intends to promote its replication in other peri-urban areas by securing funds.

(5) Sewerage System

The areas north of the trunk sewer (red color) are peri-urban areas where sewerage system does not exist.

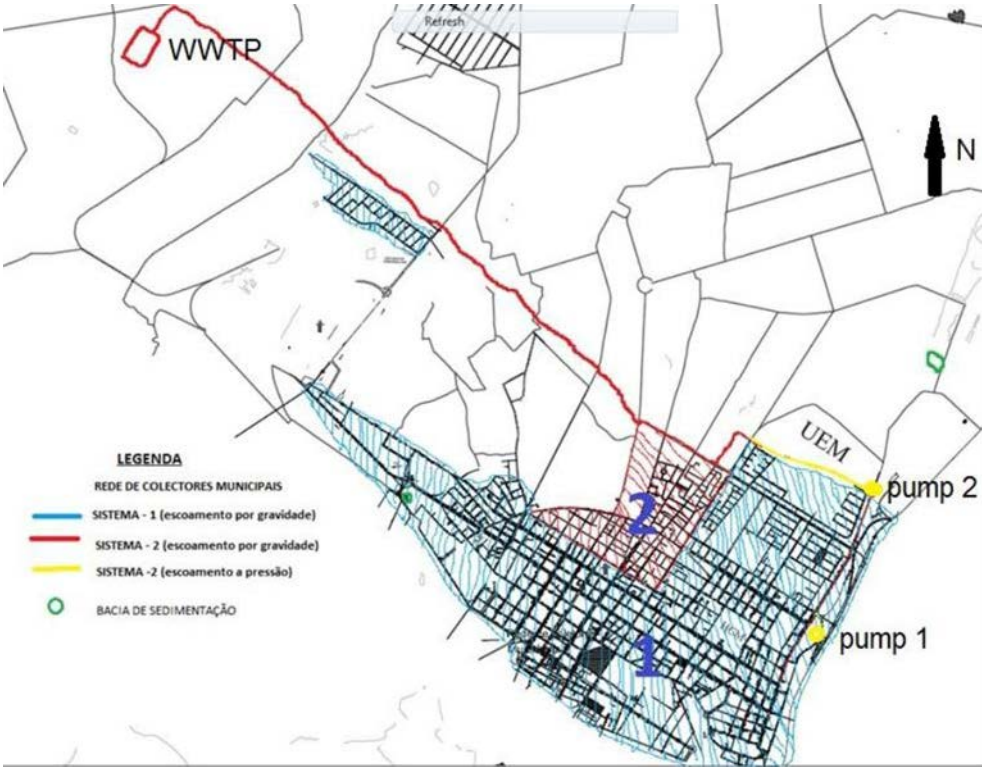


Figure 4-1 Sewerage Systems in Maputo City

As shown in Figure 4-1, the current sewerage systems in Maputo City are as follows:

- Blue Color: System 1
  It is a combined sewer, and discharges wastewater to Maputo Bay without proper treatment. The population it serves is 76,645.
- Red Color: System 2
  It is a separate sewer, and wastewater is treated by Infulene WWTP. The population it serves is 38,298.
- Yellow Color: System 2
  It is part of System 2, and it is supposed to discharge wastewater treated by Infulene WWTP to Maputo Bay. However, the two pumps required for this have not been operating since 2008, and it has been discharging the waste water without proper treatment since then. The population it serves is 21,258.

On the terrace of the southern area of Maputo City, a separate sewer system built in 1980s serves the residential area (System 2). In the low-lying area below the terrace, a combined sewer system built in 1940s by Portuguese serves the downtown area (System 1). Wastewater collected by the combined sewer system is discharged to Maputo Bay without proper treatment. This poses a threat to wastewater management, but no counter measures have been taken. Infulene WWTP is currently treating all wastewater from the area covered by System 2 except that from the southeast part of the city center because the two pumping stations, which are supposed to pump-up the wastewater from this area to the trunk sewer, have not been operational since 2008, and as a result it is discharged to Maputo Bay without proper treatment. These two pumping stations are to be rehabilitated under the WB financed Mozambique Urban Sanitation Project (2019).

The wastewater of System 2 is treated by Infulene WWTP, as mentioned above. However, the Infulene WWTP is currently not functioning properly due to the lack of maintenance and subsequent loss of treatment capacity. Therefore, it is to be upgraded under the above-mentioned WB financed Mozambique Urban Sanitation Project (2019).

A Master Plan for Sanitation and Drainage in Maputo Metropolitan Area (PLANO DIRECTOR DE SANEAMENTO E DRENAGEM DA ÁREA METROPOLITANA DE MAPUTO) was formulated in 2017. As for the System 1 in the low-lying area, the transformation of the existing combined sewer system to a separate sewer system, connecting to the trunk sewer by uplifting the collected wastewater by a newly built pumping station, was proposed as a measure to prevent the discharge of wastewater to Maputo Bay without proper treatment. The Survey Team considers that such proposal is difficult from the following two viewpoints:

- Transforming the existing combined sewer system to a separate sewer system is considered almost difficult even in Tokyo, Japan, due to presence of numerous underground utilities that make it complicated to construct a new sewer under the roads. In the highly urbanized Baixa area, as many underground utilities as in Tokyo must exist under the roads.
- Lifting huge volume of wastewater 30 to 40m by pumps requires considerable cost for energy and operation and maintenance of the pumps.

An alternative measure would be the introduction of high-performance decentralized wastewater treatment systems such as Johkasou in Japan in the office buildings and condominiums that are most likely discharging large volume of wastewater, thereby reducing volume wastewater discharged to Maputo Bay without proper treatment. The measure requires not only technology but also establishment of an operation and maintenance system.

In an interview with officials of Maputo Municipal Council (MMC), they stated that MMC does not have enough capacity to urge all the commercial buildings and condominiums individually to install a high-performance decentralized wastewater treatment systems in their premises, emphasizing that wastewater should be treated in the sewerage system as the master plan proposed.

(6) Wastewater Treatment Technology

Infulene WWTP, the only one WWTP in Maputo City, treats the wastewater from the city and Matola City as well as the on-site sludge collected and transported from all Maputo Metropolitan Area. Its wastewater treatment capacity is 48,000m^3/day, and treatment method is anaerobic pond-stabilization pond method. The sludge from the anaerobic pond is treated by sun-drying bed. Currently, it is operating at 15-20% of the full capacity, because of the stoppage of the inflow of the wastewater from a part of the System 2 area due to non-functional two pumping stations. The wastewater needs to be uplifted to the trunk sewer by the pumps. Substantial volume (500 m^3/day) of the onsite sludge collected and transported to Infulene WWTP is currently directly discharged to the anaerobic pond and treated. The sludge accumulated in the anaerobic pond has not been managed for many years resulting in a huge accumulation of sludge in both the anaerobic pond and stabilization pond, the latter would not have occurred if the sludge in the anaerobic pond had been properly managed. The fact that the effluent water quality does not meet the national effluent standard confirms that the WWTP is not functional. Under the WB financed Mozambique Urban Sanitation Project (2019), a full scale rehabilitation work is in progress including the replacement of the inflow facility (wastewater) and receiving facility (on-site sludge), dredging and expansion of the anaerobic ponds and stabilization ponds, and the replacement of the sludge drying beds. Assignment and training of the O&M staffs and securing the O$M budget by introducing wastewater/sanitation charge are also included in the Project.

It was aware that the anaerobic pond-stabilization pond wastewater treatment method, which uses the natural method and commands large land area, is widely used in African countries because it is believed that it has such merits like relatively easy O&M since this treatment method does not involve many mechanical parts nor require much electricity. But, if the sludge accumulated in the anaerobic pond is not properly managed, then it may accumulate also in the stabilization pond and the treatment performance deteriorate and lead to the abandonment of the WWTP in about 10 years. Particularly, in case of the WWTP which treats not only wastewater but also on-site sludge as is the case of Infulene WWTP, frequent removal of the sludge from the anaerobic ponds is required. According to the rough calculation by the Survey Team, Infulene WWTP requires emptying and sun-drying of the anaerobic ponds once every 4 months. As for the method for sludge management of the anaerobic pond, not only the method of emptying and sun-drying, but methods of installing thickener with sludge scraper, or desludging by using submersible portable pump, among others, shall be considered.

(7) FSM

Operators who collect and transport sludge from on-site sanitation facilities need a license from the City of Maputo, and currently 40 operators are licensed with 72 vacuum trucks in total. The desludging service industry mainly for septic tanks seems to be very active, but emptying of pit latrines is still conducted by informal workers who burry the collected sludge in a pit dug nearby.

The WB has been working on to develop a FSM business model for low-income peri-urban areas through WSP. The following issues concerning sludge management of on-site sanitation facilities in the peri-urban areas were raised by the Maputo City officials interviewed:

- Since the sludge of pit latrines is very hard and difficult to remove by a vacuum tanker, the provision of desludging service by local micro enterprises was promoted by providing them with necessary equipment (manual pumps, etc.). But the business was not profitable due to difficulty of desludging works and limited payment ability of the residents. As a result, the companies turned their services to middle- and high-income households.
- Coordination between primary operators that collect sludge and carry it to the transfer station, and the secondary operators that transport the sludge from there to the treatment plant is not functioning well. This resulted in a situation that collected sludge was not transported to the

treatment plant in a timely manner. For this reason, the service should cover the whole chain from desludging to transport and disposal.

The City of Maputo is promoting transition from pit latrines to septic tanks in order to make it easier for desludging operators to collect sludge by vacuum trucks. However, a system that makes residents in peri-urban areas easily accessible to emptying services seems yet to be established due to the fact that some residents stated in an interview that they do not know how to contact the service providers.

(8) Faecal Sludge Treatment Facility and Treatment Technology

The collected sludge in Maputo is transported to Infulene WWTP by vacuum tracks and discharged into the anaerobic pond. Operators need to pay a dumping fee for the disposal. The sludge put into the anaerobic pond is treated together with the sewage (anaerobic pond to facultative pond).

Effluent from Infulene WWTP is discharged into a nearby river and used to irrigate agricultural farms. In the on-going WB project, it is planned to reuse sludge generated from wastewater treatment as fuel (bio-fuel) and fertilizer.

In addition, the Sanitation and Drainage Master Plan for the Maputo Metropolitan Area proposes construction of 2 faecal sludge treatment plants. The Infulene WWTP is not sufficient for faecal sludge treatment, and construction of additional treatment plants is important also from the viewpoint of reducing sludge transportation cost. However, there is no prospect of securing funds for it so far.

4.2.2 Issues of Wastewater and Faecal Sludge Management in Maputo City

(1) Wastewater Management

- Out of two sewerage system, System 1 (combined sewer system) is discharging wastewater to Maputo Bay without proper treatment, resulting in the pollution of the bay. Some counter measures need to be taken.

(2) FSM

- With the support of WSP (WB) and keeping pace with the extension of water supply system, Maputo City Government is promoting the transition from pit latrines to septic tanks in peri-urban areas. In parallel, it is urgently needed to establish a system in which households can easily access to the desludging service providers.
- Currently, Infulene WWTP is the only facility treating collected sludge from on-site sanitation systems. While inflow volume of wastewater is limited, relatively larger volume ($500m^3$/day) of on-site sludge is being treated, thereby creating heavy loads on the wastewater treatment process. Further, high transportation cost from the sludge collection points to Infulene WWTP makes the tariff for desludging unaffordable for residents, particularly for those living in peri-urban areas. Construction of new sludge treatment facilities is desirable in order to reduce the transportation cost and make desludging service affordable for those users.

(3) Both Wastewater Management and FSM

- Sewerage tariff has not been collected in Maputo City, but the introduction of sanitation surcharge is envisaged in the near future. Starting collection of the sanitation surcharge as early as possible is desirable. We understand that the rate of sanitation surcharge is 15% of the water bill, which may need to be increased to finance the improvement of the provision of sanitation services.

4.2.3 Cooperation Needs on Wastewater and Faecal Sludge Management in Maputo City

- It would be good to support the capacity development of Mozambican officials working in related organizations through training on the wastewater management and sludge management including Japan's on-site sludge management system (combination of training in Japan and training in Mozambique).
- It would be good to support for construction of new sludge treatment facilities.

4.3 Abidjan, Cote d'Ivoire

4.3.1 Current Status of Wastewater and Faecal Sludge Management in Abidjan City

(1) Outline of Abidjan City

Cote D'Ivoire had achieved splendid annual GDP growth rate of 8% after the independence (1960), called 'Miracle of Ivoire', but it fell sharply during the civil war (2002-2011), and is now in the process of recovery. Although many high-rise buildings exist in the business district of Abidjan, a substantial portion of the population lives in slum areas.

According to the 2014 general population and housing census, the City of Abidjan had approximately 4.7 million inhabitants. The City of Abidjan currently has 10 communes (Abobo, Adjamé, Attécoubé, Cocody, Koumassi, Marcory, Plateau, Port-Bouët, Treichville and Yopougon) and 4 sub-prefectures (Anyama, Bingerville, Brofodoumé and Songon). The informal settlements are spread over all the communes and sub-prefectures of the city. In the City of Abidjan alone, there are currently more than 132 informal settlements covering a total area of more than 5,000 hectares with more than 1.2 million inhabitants, i.e. 25.5% of the city's population.

Accordingly, both the overall improvement of urban sanitation and the improvement sanitation in slum areas are the issues.

(2) Institutional Framework

The Directorate of Urban Sanitation and Drainage (DAUD) under the Directorate General of Sanitation and Salubrity (DGAS) of the Ministry of Sanitation and Salubrity (MINASS), established in 2018, is responsible for policies on sewage and sludge management in Côte d'Ivoire. The main roles of DAUD are to implement and supervise the legal and regulatory framework for sewage and drainage, to coordinate with relevant institutions, and to provide supports to local authorities.

The National Office of Sanitation and Drainage (ONAD) was established in 2011 with the aim of ensuring the access to sewage and drainage facilities for all. ONAD implements the development and maintenance of sanitation facilities in collaboration with the MINASS (technical field) and the Ministry of Budget and Portfolio (financial field) based on a five-year performance contract.

The operation and maintenance of sewerage facilities in Abidjan is carried out by SODECI, a private operator, based on a contract with the government (Affermage Contract) under the monitoring and control of ONAD. However, the contract was terminated in October 2018, and discussions are on-going to extend the contract. As of now, both parties have not reached an agreement for the extension of the contract.

Collection and transport of the sludge from on-site sanitation facilities are conducted not by SODECI but by other private companies under a contract with ONAD.

In reality, District autonome d'Abidjan (DAA) is involved in various activities on the wastewater and sludge management. But the transfer of authority from central government to local government has not progressed well. Accordingly, DAA does not have legal authority on many sanitation issues.

(3) Sanitation Policy

Lettre de Politique Sectorielle (Assainissement et Drainage), formulated in 2016, prioritizes the development of infrastructure such as sewerage system as well as the development of on-site sanitation, emphasizing the importance of coordination among governmental agencies, private sector operators and local governments.

(4) Sanitation Facility

58% of the population in Abidjan relay on on-site sanitation. Majority of them may be septic tanks, but, in slum areas, pit latrines may also be used widely.

(5) Sewerage System

In order to improve the pollution of lagoons in the Abidjan City, a sewerage system has been developed since 1970s, and a sewerage system, which collects the wastewater from the northern, central and southern areas and discharges it to the Atlantic Ocean, after pretreatment, through ocean outfall, was established in 1990s. However, the wastewater from the western area continues to be discharged to the lagoon without treatment and it needs to be addressed (the current situation of the Abidjan sewerage system is shown in Attachment 1).

42% of the Abidjan population are connected to the sewerage system, indicating that the population in the slums and low income areas may be not connected to the sewerage system.
In the year 2000, JICA prepared a feasibility study that proposed a plan in which the wastewater in the western area is intercepted and transferred to the sewerage system in the central area. But the plan has not been realized.

Schema Directeur d'Assainissement et de Drainage du District d'Abidjan (SDAD) was prepared in 2018 with the assistance of AFD, French Development Agency, and it proposes the increase of the rate of the population connected to the sewerage system to 75%.

SDAD proposes to divide Abidjan into 5 sewerage zones and to develop sewerage system (sewer networks and wastewater treatment plant) in each zone (the 5 sewerage zones proposed are shown in Attachment 2). As for the western area, a new sewerage system (STEP Vridi Gada), which differs from that of the JICA feasibility study proposal, is proposed.

(6) Wastewater Treatment Technology

The existing sewerage system in Abidjan is an ocean outfall system which includes pretreatment (removal of screen residues, etc.) but does not include full-fledged sewage treatment.

The descriptions of the sewage treatment method of the 7 WWTPs (5 WWTPs for 5 sewerage zones, STEP 60,000 logements and STEP PK24) proposed by SDAD are shown in Table 4-2.

Table 4-2 Outline of Planned WWTPs

WWTP	Daily Sewage Volume (m^3)	Sewage Treatment Method
STEP Adjahui	519,000	Prétraitement + Décantation primaire + Emissaire long dans l'océan
STEP Vridi Gada	220,000	Prétraitement + Décantation primaire + Emissaire long dans l'océan
STEP de Vitré 2	43,000	Prétraitement + Décantation primaire + Emissaire long dans l'océan
STEP Cocody Bingerville	143,000	Boues activées moyenne charge
STEP Anyama	123,000	Boues activées faible charge
STEP 60,000 logements	24,000	Boues activées faible charge
STEP PK24	5,300	Boues activées faible charge

Source: AFD 'Actualisation du Schema Directeur d'Assainissement et de Drainage du District d'Abidjan MISSION D – ETABLISSEMENT DU SCHEMA DIRECTEUR RAPPORT DE SYNTHESE''3 STATIONS D'EPURATION DES EAUX USEES' (P.16-20)

As shown above, the treatment method for WWTPs for STEP Adjahui and STEP Vridi Gada, which covers the most densely populated area of Abidjan, was supposed to be the ocean outfall, the same as that of the existing system.

But, according to ONAD explanation, all the WWTPs should conduct the secondary treatment, considering the possible marine pollution caused by the untreated sewage.

(7) FSM

Various efforts have been made for the improvement of the on-site sanitation facilities and the quality of sludge collection services in Abidjan.

For the improvement of on-site sanitation facilities, the Sanitation Service Delivery (SSD) Project funded by the USAID was carried out from 2014 to 2021 with the participation of the ONAD as the counterpart, besides the Abidjan City Council and the Housing Department of the Ministry of Construction. The components of the project included the campaigns for public awareness raising to promote the installation of clean toilets in low-income settlements including slum areas, and the promotion of the installation of septic tanks and improved pit latrines. The project also provides training to small-scale toilet builders on maintenance and installation.

To improve the quality of sludge collection services, various efforts are being made by ONAD, including the establishment of an association of sludge collection companies, a license system for the companies, the provision of training to the companies, and a loan system for the companies to purchase equipment and spare parts. According to the ONAD, 34 sludge collection companies were licensed and 113 vacuum trucks were in operation as of 2020. The collected sludge is delivered to three unloading stations in the city (Abobo, Yopougon, and Treichville) and unloaded into the sewerage system.

As stated above, several efforts to develop Sanitation Service Chain for Faecal Sludge Management (FSM) have been implemented. Under SSD, a call center, which is still operational, was created in ONAD in order to connect the customers and the desludging operators and to improve the efficiency of provision of desludging services.

However, a regular sludge collection system (residents' obligation to remove sludge with regular intervals) has not been introduced, and sludge collection fees have not been regulated. Basically, when a septic tank is full, the residents ask the sludge collection company to collect the sludge, and the sludge collection fee is decided by negotiation. According to a member of the desludging operators association, this causes some poor people who cannot afford the fee to remove the sludge by themselves or by hiring informal operators to remove it manually, and dispose it to the rainwater drainage nearby.

(8) Faecal Sludge Treatment Facility and Treatment Technology

Currently, the collected faecal sludge from Abidjan is being discharged to the sewer and disposed to the ocean (the sludge from the central area) and to the lagoon (the sludge from the western area). Accordingly, there is no sludge treatment facility.

SDAD proposes to treat the collected faecal sludge in 5 WWTPs, and a sludge treatment facility (capacity of 300m^3 per day) is being built in Anyama area, north of Abidjan, with a fund provided by the Islamic Development Bank. The information on sludge treatment method is yet to be confirmed.

(9) Regulation for Decentralized Wastewater Treatment Plants of Commercial Buildings

The building permit for large building is the responsibility of the Ministry of Construction, and the one for medium sized building is the responsibility of commune government. The permission process includes checking the wastewater treatment system to be connected to the building. It seems that the permit is given based on the documents only and there is no on-site inspection.

CIAPOL monitors the effluent water quality of industrial wastewater, but CIAPOL does not monitor the effluent water quality of the decentralized wastewater treatment plant of commercial buildings. It is unclear which agency is responsible for the monitoring of the performance of the decentralized wastewater treatment systems of the commercial buildings.

(10) Sewerage Finance (Sanitation Service Charge)

The sanitation service charge in Cote D'Ivoire is basically based on the concept that the cost of the sewerage system is covered by the charges collected from the residents. In order to collect the sanitation service charge broadly, sanitation surcharge system is in place in which not only those who are connected to the sewer but also those who are not connected to the sewer shall pay certain amount. The sanitation service charge is linked to water service charge and is set for three categories of customers: (1) customers who are connected to the sewerage system, (2) customers who live in areas with sewerage system but are not connected to it, and (3) customers who live in areas without sewerage system. The sanitation service charge is mainly composed of two portions: the one paid to SODECI for operation and maintenance, and another paid to the Treasury and used for the development of the sewerage network (Contribution de Development Assainissement, CDA).

However, the current sanitation service charge in Abidjan is extremely low. Comparing the ratio of sewerage charges against water charges, the rate is about 11% in Côte d'Ivoire, while in other African countries it ranges from 15% to 75% (Mozambique: 15%, Zambia: 32.5%, Uganda and Kenya (Nairobi): 75%, etc.). One of the reasons that the rate of sanitation service charge in Abidjan is extremely low may be that the pre-treated wastewater is currently discharged into to the ocean, and since full-fledged WWTP is not yet in place, there is no need to pay large amount for WWTP. However, since ONAD is planning to develop new 5 WWTPs with secondary treatment, which are much more expensive than the current system in both CAPEX and OPEX, it is assumed that sanitation service charge will need to be increased sharply in the future.

(11) Financial Resource Mobilization (Donor Assistances, etc.)

The current situation of financial resource mobilization for wastewater and sludge management in Abidjan is summarized, based on the results of the data collection by the local consultant, ONAD's presentation to the Survey Team (Attachment 3), and the results of the interviews with Ministry of Construction (in charge of STEP 60,000 Logements) and Ministry of Industries (in charge of STEP PK 24) in Attachment 4. Out of 7 WWTPs proposed in SDAD, private sector financing is envisaged for STEP 60,000 Logements and STEP PK 24, and the financial resources for all 5 WWTPs and 5 public sewerage systems are yet to be mobilized.

4.3.2 Issues of Wastewater and Faecal Sludge Management in Abidjan City

(1) Wastewater Management

- Implementation of SDAD
- Development of the sewerage system in western area is particularly important in order to prevent further pollution of Ebrie Lagoon
- Increase the sanitation charge in order to finance the CAPEX and OPEX of the WWTPs with secondary treatment

(2) FSM

- Strengthening regulations on FSM toward the introduction of regular desludging system

(3) Regulating decentralized wastewater management systems of commercial buildings not connected to the sewerage system

- Strengthening the monitoring of decentralized wastewater management systems of commercial buildings

As for the above (2) and (3), the institutional frameworks for the on-site sanitation and wastewater management in Japan could be used a reference, with necessary modifications. Thus, the following documents related to these issues were provided to DGASS, ONAD and DAA as the reference materials by the Survey Team:

- ✓ Institutional Frameworks for On-site Sanitation Management Systems (ADBI Development Case Study No. 2021-1 (June))
- ✓ Night Soil Treatment and Decentralized Wastewater Treatment System in Japan (Pamphlet prepared by the Ministry of Environment, Japan) which can be downloaded from the following link (https://www.env.go.jp/recycle/jokaso/basic/pamph/pdf/wts_full.pdf)

4.4 Lusaka, Zambia

4.4.1 Current Status of Wastewater and Faecal Sludge Management in Lusaka City

(1) Outline of Lusaka City

The population of Lusaka Province is 2.3 million (of which 1.7 million reside in Lusaka City), 70% of which live in the peri-urban area (WB). 10-15% of the population is connected to the sewers, 40-45% use septic tanks, 43% use pit latrine (KfW)[1]. 90% (about 1.5 million people) of the population in the peri-urban area use pit latrine (WB)[1].

Poor people using pit latrine were forced to pay high fees for poor desludging services, but improper sludge management was the cause of repeated cholera outbreaks in slams. Due to concerns about groundwater pollution caused by pit latrine (60% of Lusaka's water supply depends on groundwater as a source), the Zambian Government and Lusaka City have been promoting the CWIS that involves sanitation improvement in slams.

In order to support this initiative, the Lusaka Sanitation Program (LSP), assisted by the WB, the AfDB, the EIB and KfW of Germany, has been underway since 2015 (total funding amount of USD 300 million). The implementing agency is LWSC. LSP includes both on-site and off-site sanitation components such as renewal of wastewater treatment plants, expansion / upgrade of sewage pipelines, construction of on-site sanitation facilities (toilet), construction of faecal sludge treatment plants (FSTP), enhancement of faecal sludge management (FSM) services, etc.

(2) Institutional Framework

The ministry responsible for urban sanitation is the Ministry of Water Development and Sanitation (MWDS). Under the ministry, the National Water Supply and Sanitation Council (NWASCO), a water and sanitation service regulator, permits the operation of 11 commercial utilities nationwide. The Lusaka Water and Sanitation Company (LWSC) is responsible for provision of sanitation services (sewerage, on-site sanitation facilities, FSM) in Lusaka City.

(3) Sanitation Policy, Law and Regulation

The National Water Policy of 1997 stipulates that (1) regulation and service provision are separated, (2) local governments (LAs) are responsible for service provision, and (3) local governments can delegate service provision to commercial utilities (CUs). Based on this policy, the Water Supply and Sanitation Act, also enacted in 1997, stipulates the establishment of NWASCO as a regulatory body and the requirements for licensing of CUs by NWASCO.

After that, most LAs invested themselves to establish CUs and chose to delegate the provision of water supply and sanitation services to CUs, and currently 11 CUs are licensed by NWASCO and operate in 10 provinces (LWSC in Lusaka Province). In addition, LAs can establish its own ordinances (By-laws) to support the provision of services by CUs. In this way, a system was established in which CUs provide services under the regulations of NWASCO.

1) Promotion of CWIS

In 2016, the then Minister of Water Development, Sanitation and Environmental Protection and the Minister of Local Government and Housing issued a review directive to NWASCO so that CUs would also provide services related to on-site sanitation. The background is as follows:

[1] Although percentages of population using pit latrine are inconsistent between KfW and World Bank, both data are indicated.

- There was an urgent need of improving on-site sanitation as a countermeasure against outbreak of water-borne diseases such as cholera.
- Although the 1997 Water Supply and Sanitation Act stipulates that CUs should provide overall sanitation services (off-site and on-site), CUs' services had been limited to water supply and sewerage at that time.

In response to the directive, NWASCO developed the Regulatory Framework of Urban On-site Sanitation and FSM and extended NWASCO's own licensing authority to on-site sanitation and FSM. In addition, NWASCO reviewed the license conditions for CUs in December 2018, and added services related to on-site sanitation and FSM to the CUs' responsibilities.

In fact, in the Lusaka Sanitation Program (LSP) supported by 4 donors (WB, AfDB, EIB and KfW), guidelines and standards for on-site sanitation and FSM services targeting the poor have been developed for Lusaka in advance. Based on these, NWASCO formulates standards for the whole country.

Actually the BMGF appreciates LWSC's effort to extend urban sanitation services in unsewered areas in a short time after their mandate was expanded to on-site sanitation and FSM in 2018.

NWASCO is making the following efforts to expand CWIS in the cities other than Lusaka.

- Completed GIS mapping of on-site sanitation facilities, which is the basis for CUs to develop FSM business models in 4 cities (2 cities in Copperbelt Province and 2 in Eastern Province).
- Urging CUs other than LWSC to establish FSM Unit.

2) Development Status of Regulations and Guidelines by NWASCO for Promotion of CWIS

NWASCO is currently formulating the Code of Practice on On-site Sanitation. It establishes technical standards for on-site sanitation facilities used in Zambia and service provision standards for FSM. According to NWASCO, it is almost 90% complete, leaving behind the technical drawings. It will be finalized with the approval of the Zambia Standards Organization (ZSB).

On the other hand, NWASCO is also in the process of formulating Statutory Instruments (SIs) to ensure the enforcement of the Code of Practice. In addition to the Code of Practice, various standards established by the LSP and being enforced by by-laws are useful, so it is also meaningful to apply the regulations of the City of Lusaka nationwide by SIs.

(4) Sanitation Facility

The Lusaka City places great importance to the dissemination of pit latrine that does not contaminate groundwater and facilitates desludging, and has set structural standards. Based on this, LWSC has developed a standard design and is promoting it.

The standard design was developed with the support of the WB and AfDB in LSP for improved pit latrine for domestic use (see Figure 4-2), and LWSC is promoting it by subsidizing part of construction costs.

Source: LWSC & WB, Lessons Learned Onsite Sanitation and Fecal Sludge Management from the Lusaka, 2021

Figure 4-2 Standard Design of Improved Pit Latrine

1) Design of Improved Pit Latrine

The design was led by LWSC. Aiming for human centered design from the beginning, LWSC staff visited the community to understand the needs of users and reflected them in the design. On the other hand, for LWSC, it is important in designing not to contaminate groundwater and to make it easy to desludge in consideration of FSM business (assuming desludging is made every 2 to 2.5 years).

At the final stage of design, it was confirmed with the participation of Lusaka City Council (LCC) executives and community leaders. The LCC officially included it in the building guidelines.

2) Promotion of Improved Pit Latrine

LWSC provides subsidies making use of the funds of the WB Project. To ensure that the household has ownership, the superstructure that the household is interested in is borne by the household (the average burden is USD 120), and LWSC will assist in the construction of the underground structure.

As the WB Project ends in October 2022, securing subsidy resources after that is an issue (LWSC is proposing to the WB to extend the Project until 2024). If the number of toilets with this design increases and the importance of the design is recognized by the residents, the subsidies can be gradually reduced and eventually the entire cost can be borne by the residents.
* In the WB Project, the number of household toilet construction subsidies has been reduced from the initial 10,000 to 3,500.

(5) Sewerage System

The LWSC's sewer network (480km) covers about 30% of the city area and has 33,000 connections, treating wastewater generated by population of about 300,000.

(6) Wastewater Treatment Technology

As shown in Table 4-3, LWSC has two wastewater treatment plants (Manchinchi WWTP and Chunga WWTP, of which Manchinchi WWTP has a polishing pond, Garden Pond) and four stabilization ponds.

Table 4-3 Outline of WWTPs and Stabilization Pond

Plant	Plant type	Capacity (m^3/d)
Chelston	Stabilization Pond	2,700
Matero	Stabilization Pond	7,100
Chunga	Trickling Filter	9,100
Kaunda Square	Stabilization Pond	3,600
Manchinchi	Trickling Filter	36,000
Garden	Stabilization Pond	
Ngwerere	Stabilization Pond	8,350

Of these, Manchinchi WWTP (including Garden Pond) and Chunga WWTP adopt the trickling filter method, but they are not currently functioning. In addition, sludge accumulation is remarkable in the sludge drying beds and the lagoon where sludge is deposited in the rainy season. According to LWSC, the reasons why Manchinchi WWTP became dysfunctional are as follows. Chunga WWTP is in almost the same situation (sludge accumulation due to overload).

- The facilities were very old (constructed in 1950s-1970s), and almost no rehabilitation has been done after the construction.
- The sewage collection area and the number of houses have increased significantly from the original plan, and pit latrine sludge has also been received, resulting in a significant overload condition, sludge accumulation and loss of treatment function (currently sewage is only pre-treated by a screen and then bypassing Manchinchi WWTP and flowing into Garden Pond).

The treatment function of the Garden Pond is also lost due to the accumulation of sludge. This is because Manchinchi WWTP is not functioning, and everything that should have been removed there has flowed into the Garden Pond, resulting in a much higher amount of sludge than expected.

However, with the support of the Millennium Challenge Corporation (MCC), one dredger (which functions like a floating pump) was purchased, and sludge was partially removed (2012 and 2013). It is said that the Ngwerere Pond is kept in good condition by utilizing the dredger.

1) Improvement of Wastewater Treatment Facilities

In LSP, with the support of EIB and KfW, the two existing WWTPs will be upgraded as follows:

- Manchinchi WWTP and Garden Pond (36,000m^3/day of treatment capacity) will be closed and new Ngwerere WWTP (70,000m^3/day) will be established in the same site of Ngwerere Pond.
- Chunga WWTP (9,100m^3/day) will be upgraded on the same site (26,000m^3/day).

Both WWTP are currently in the process of functional design and preparation of bidding documents. In the first quarter of 2022, a design and build contractor will be selected and construction will start, with construction completion scheduled for 2024 (construction period of 2 years).

The existing Manchinchi WWTP and Chunga WWTP adopts trickling filter as a treatment method at the F/S stage. However, since the emission standards for nitrogen and phosphorus (15 mg/l and 6 mg/l, respectively) set by ZEMA cannot be met with the trickling filter method, it was decided that the standard activated sludge method would be applied instead at the functional design stage. Excess sludge will be treated on sludge drying beds.

2) Improvement of Operation and Maintenance of Sewage Treatment Facility

The standard activated sludge method will be introduced in the WWTPs to be upgraded, and LWSC assured that operation and maintenance of the method would not be a problem because it has a track record of having operated the Chawama sewage treatment plant (Kafue County) that uses the same technology since around 2008.

For stabilization ponds other than WWTP, sludge will be removed by using the dredger to maintain their function.

(7) FSM

In response to the expansion of the scope of LWSC's operation (with the addition of on-site sanitation and FSM services) in December 2018, the FSM Unit was established in the Peri-Urban Department in August 2019. Currently, 6 full-time staff (in charge of business and technical matters) are employed.

In October 2019, LWSC changed its name form Lusaka Water and Sewerage Company to Lusaka Water and Sanitation Company.

In the LSP, LWSC is promoting construction of on-site sanitation facilities (toilet) and FSTP as well as strengthening FSM services focusing on the poor.

(8) Challenges and Efforts for Improvement on FSM Service Provision in Peri-Urban (Slum) Area

1) Status of Sludge Collection Service

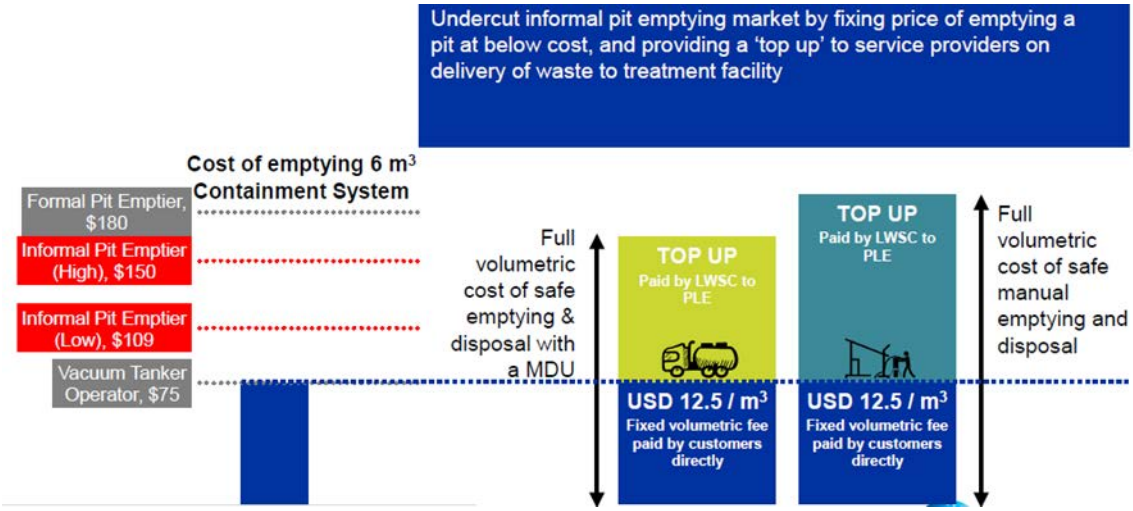
For septic tanks, there has been a market for desludging, and private companies provide such service by vacuum tankers. As of 2019, the number of vacuum tankers is 54 (operated by about 15 companies).

Pit latrine is predominant in the peri-urban area and they are usually emptied by informal individual service providers due to factors such as difficulty in access by vacuum tankers (cannot desludge unless target facility is within 30m from the paved road) and hard sludge that is difficult to be removed by machines due to the dry toilet. Illegal dumping of the collected sludge around the area by the informal service providers has become a problem.

2) Improvement of FSM Service Provision in Peri-Urban (Slum) Area

With the support of the WB and AfDB in LSP, LWSC has developed a FSM business model based on performance-based contracts with the aim of providing formal services by private companies instead of informal individual-based services. The outline is as follows:

- LWSC has signed a performance-based contract with 6 private companies and they started service provision in May 2020. LWSC subsidizes part of the emptying cost (Top up part in Figure 4-3).



Source: LWSC & WB, Lessons Learned Onsite Sanitation and Fecal Sludge Management from the Lusaka, 2021

Figure 4-3 Conceptual Diagram of LWSC's FSM Service Provision

- LWSC promoted improved pit latrine to stimulate demand for emptying, and at the same time secured service providers. Training on desludging was conducted for the six contracted companies.
- The breakdown of the 6 companies is 2 community-based Water Trusts and 4 private companies. The target areas for service provision are all peri-urban areas.
- Performance indicators are the amount of sludge that is safely transported to the treatment plant in a month. Monthly LWSC sets a target value and measures performance based on it.
- The desludging fee is 150 kwacha (about USD 8.3) per 1 m3 of sludge and it is paid by the residents to the company, and the transportation and dumping cost to the sludge treatment plant is paid by LWSC to the company according to the performance (Top up part). The top up amount is 190-290 kwacha / m3 equivalent to 10.5-16 US dollars.
- Service marketing is made using billboards, TV, radio, etc. and direct sales to community members. Each company also conducts marketing activities.
- LWSC is preparing a standard work procedure (SOP) for the FSM business model based on this activity.

LWSC's efforts are characterized by clarifying that septic tank is emptied by a vacuum tanker and pit latrine is emptied manually. LWSC sought an appropriate method for emptying the pit latrine according to the situation in the peri-urban area (use of a vacuum tanker, use of a movable pump, improvement of tools for manual removal, etc.), and finally LWSC concluded that manual desludging, filling the buckets with removed sludge and transporting them by light truck was the most suitable way.

Source: BMGF, FSM INNOVATION - Approaches to FSM in Peri-Urban Areas: A Case Study in the City of Lusaka, 2017

Service provision has demonstrated good results so far, but the performance-based contract is until August 2022. In the same year, the Projects of WB and AfDB are expected to complete and the funds for subsidies are exhausted accordingly. LWSC is considering how to secure funds for further development of the activity.

(9) Faecal Sludge Treatment Facility and Treatment Technology

1) Current Status of Sludge Treatment Facility

Manchinchi WWTP is currently the only treatment facility of sludge collected from on-site sanitation facilities (septic tanks, pit latrines) in Lusaka (Two other FSTPs were constructed in Kanyama and Chazanga with the support of WSUP. However, they are not currently in operation due to its proximity to water source for one and operational problem for the other.). Sludge treatment in Manchinchi WWTP is as follows:

- There are two inlets, one for the septic tank sludge (septage) carried by the vacuum tanker (decanting point) and the other for the pit latrine sludge (which is put in a bucket and carried by truck). Both are transported by pipe from the inlet to the sewage treatment plant.
- The daily receiving volume varies from day to day, but the septage is about 80 to 100 m^3 and the pit latrine sludge is about 50 m^3.
- At the sewage treatment plant, sludge is pretreated with a screen and then dried on a drying bed (deposited in the lagoon during the rainy season). Dry sludge is used for agriculture as a soil conditioner.

2) Improvement of Sludge Treatment Facility

In the LSP, the following 2 FSTPs are constructed with the support of the WB and AfDB:

- Manchinchi FSTP (constructed on the premises of Manchinchi WWTP): WB support, scheduled to be completed in October 2022.
- Matero FSTP (constructed on the site of Matero Pond): AfDB support, scheduled to be completed in January 2022.

The treatment methods applied for both FSTPs are as follows:

- Septic tank sludge (septage): Receiving facility (screen) ⇒ Solid-liquid separation with thickening tank ⇒ (sludge) Two bio-digesters (series) ⇒ Sludge drying bed
- Pit latrine sludge: Receiving facility (screen / grit removal) ⇒ 2 Bio-digesters (series) ⇒ Sludge drying bed
- In Manchinchi FSTP, the effluent from the solid-liquid separation process is piped to Ngwerere WWTP for treatment. The effluent of Matero FSTP is treated in the adjacent Matero Pond.
- Dried sludge is used for agriculture as soil conditioner.

3) Improvement of Operation and Maintenance of Faecal Sludge Treatment Facilities

According to LWSC, skills required for operation and maintenance of newly constructed and upgraded FSTPs is not new for LWSC because its staff at the existing Manchinchi WWTP and Matero Pond is familiar with the operation and maintenance of the facilities so they can take care of the new plants without problem.

Currently, in Manchinchi WWTP, sludge is deposited in the lagoon because it cannot be dried in the rainy season. In order to avoid such operations, both FSTPs will have a covered drying beds so that sludge can be dried even in the rainy season.

(10) Measures against Floods in Lusaka

1) Situation of Flooding and Influence in Lusaka City

- Floods occur almost every year during the rainy season. Peri-urban areas such as the Kanyama and Chawama are the most affected.
- Floods are one of the causes of cholera outbreaks, but public health issues are complex as follows:
  - ✓ The city area of Lusaka has expanded, and the expansion of the sewer network has not caught up.
  - ✓ Therefore, many residents use pit latrine, causing groundwater pollution by escherichia coli and nitrate nitrogen.
  - ✓ In the peri-urban area, many residents rely on shallow wells for drinking water and are affected by groundwater pollution.
  - ✓ Only 55% of the waste generated in the city is collected, and the rest is illegally dumped in the neighborhood, causing blockage of drainage channels.
  - ✓ Cholera became a pandemic from 2017 to 2018, and as a drastic solution, improvement of FSM centered on the promotion of lined pit latrine was proposed.

2) Organizational System for Flood Control in Lusaka City

- LAs (LCC in the case of Lusaka) is primarily in charge of flood control. LAs will mainly take medium- to long-term preventive measures.
- In the event of a serious flood, the Disaster Management and Mitigation Unit under the Vice President's Office will provide emergency measures and support for the victims.
- At LCC, the Department of Public Health is in charge of sensitization activities for residents, and the Department of Engineering Service is in charge of construction and rehabilitation of drainage channels.

3) Causes of Floods in Lusaka City

- Drainage facilities such as drainage channels are not sufficiently developed in flood-prone areas.
- In these areas, unplanned building construction has added to the difficulty of drainage.
- Blockage of drainage channel due to illegal dumping of garbage. The cause is that the residents throw it away in the neighborhood to avoid paying the waste collection fee. The collectors are

not well managed, and there are cases where they are dumped collected waste on the way without being transported to the disposal site.
- Decrease in water catchment area due to development.

4) Measures against Floods by Lusaka City

Insufficient waste management (particularly illegal dumping of waste by residents and collectors) is the main cause of floods, and LCC is working to improve waste management through the Solid Waste Management Improvement Plan 2020-2025. The main actions are:
- Sensitization and environmental / hygiene education for residents to prevent illegal dumping
- Strengthening monitoring to prevent illegal dumping by collectors

In addition, the city has partially started the upgrading of slums and is also working on the proper management of development plans in the city area.

4.4.2 Issues of Wastewater and Faecal Sludge Management in Lusaka City

LWSC indicated the following as issues with need for support:
- Continuation of activities to promote improved household pit latrine, which have been conducted with the support of the WB and AfDB.
- Additional construction of FSTPs. Although two FSTPs are being constructed with the support of the WB and AfDB, it is necessary to establish other FSTPs in a zone that cannot be covered by the two FSTPs under construction (initially four FSTPs were planned, but finally reduced to two).
- Continuation and expansion of the provision of FSM services in the peri-urban area based on the performance-based contract. It has demonstrated good results, and is expected to continue even after the WB project is completed.

In addition, LWSC indicated the following as medium- to long-term needs
- In order to check the technical and cost adequacy of the septage collection service by a private company, LWSC intends to own one or two vacuum tankers of its own and provide the service itself.
- Installation of units to maximize reuse of treated wastewater from FSTP and dried sludge.
- The sewer network expansions that are covered by the support of the WB and AfDB are part of those planned in the Master Plan, and some of them have been cut due to lack of funds. Support is needed for the remaining part.

4.5 Nairobi, Kenya

4.5.1 Current Status of Wastewater and Faecal Sludge Management in Nairobi City

(1) Outline of Nairobi City

The Nairobi City, the capital city of Kenya, is a center of East African region, such as the existence of headquarters of international organizations, and its population is growing rapidly. The population of Nairobi City is 4.397 million according to the 2019 Population Census, and the percentage of slum population accounts for 40%. In Kenya, sewerage systems are being developed in Nairobi and other major cities, and the connection to sewerage systems by the residents is promoted, especially in Nairobi.

The sanitary condition in slum areas is still a major challenge. However, the efforts for the improvement of sewerage connection in slum area have been made through the output-based aid (OBA) system and condominial sewerage system. The city water and sewerage corporation is also working for the improvement of on-site sludge management (FSM). The wastewater is regulated by the National Environment Management Authority (NEMA). Industrial wastewater, which accounts for about 20% of the total wastewater, is connected to the sewerage system for treatment after the pre-treatment carried out to meet the effluent standards.

(2) Institutional Framework

The Ministry of Water, Sanitation and Irrigation (MWSI) and the Ministry of Health and Sanitation (MoPHS) are in charge of formulation and implementation of policies for wastewater and faecal sludge management in Kenya. The MWSI is responsible for policies on water supply and sanitation, and MoPHS is for the environment and public health.

The sewerage facilities in Nairobi City are constructed by the Athi Water Works Development Agency (AWWDA) and operated and maintained by the Nairobi City Water Supply and Sewerage Corporation (NCWSC) under a license issued by the Water Services Regulatory Board (WASREB). However, according to the Gazette Notice No. 4574 on Water Act 2016 issued in July 2020, it was determined that the mandate for the operation and maintenance of Dandora WWTP and Kariobangi WWTP would be transferred from NCWSC to AWWDA. In response, AWWDA is preparing a "Strategy for Transforming Management of AWWDA National Public Water Supply and Sewerage System" to strengthen its role. The AWWDA is considering to change of role allocation so that the AWWDA will be responsible for the operation and maintenance of WWTP, and the NCWSC will be responsible for the maintenance and management of sewer networks. In addition, as an independent regulatory body, WASREB has the authority to issue the business license for operation and maintenance of WWTPs as well as to set and revise the water and sewerage tariff rates.

The service for on-site sludge collection is provided both by NCWSC and by licensed private sludge collection companies.

(3) Sanitation Policy

The fundamental law on the management and use of water resources is the Water Act, which was revised in 2016 in line with the revised Constitution on decentralization. This led to the reorganization of the relevant institutions in the sanitation sector and the establishment of the current implementation framework for water supply, sewerage management and faecal sludge management.

As a policy related to wastewater and faecal sludge management, the National Environmental Sanitation and Hygiene Policy 2016-2030 was formulated with the support of the WB and as a revision of the National Environmental Sanitation and Hygiene Policy developed in 2007. The policy

aims to ensure universal access to improved sanitation facilities and a clean and healthy environment for all by 2030 with 8 strategies to achieve the said goal. As measures to implement the strategies, the followings are described, and the construction of wastewater treatment facilities and the promotion of on-site sanitation are emphasized: the development of wastewater and faecal sludge treatment facilities, the realization of appropriate treatment, the formulation of installation standards and regulations for the installation of on-site sanitation facilities, the regulation of private sludge collection companies, the provision of standards for sludge collection methods, and the establishment of a business license system.

(4) Sanitation Facility

The percentage of on-site facilities (VIP latrine, septic tank, cesspool, etc.) in the slum and pre-urban areas not connected to the sewerage system is 51.3%, and open defecation is 0.7%. Most of the on-site facilities are simple pit latrines from an economic point of view, and the percentage of improved latrine such as VIP is not high. Therefore, there is a need for upgrading to improved pit latrines to reduce the impact on the living environment, as well as to develop ablution blocks connected to the sewerage systems.

(5) Sewerage System

The access rate to water supply is 81% and that to sewerage is 48% in Nairobi City. The capacity for wastewater treatment is 192,000 m^3/day (expansion of 20,000 m^3/day is under construction). The target population is 2.1 million, which accounts for about half of the population. In addition, the AfDB provides the fund for a project to expand the sewerage system to increase the number of beneficiaries with sewer connection to 3.1 million or 70% of the population by 2023. According to the AfDB, the residents in the city are highly willing to connect to the sewerage system. Moreover, the WB states that 130,000 slum residents in Nairobi City achieved to connect to the sewerage system through the OBA. Regarding the maintenance of sewer networks, the following issues were pointed out; there are about 1,000 cases of blocked pipes per month, and the limited number of staffs are assigned for the O&M of wastewater treatment plants.

(6) Sewerage System in Slum Area

A unique methods to sewerage connections are applied in slum areas of Nairobi City.

The first method is the OBA provided by the WB. The normal sewer system is installed in the culvert only under the public roads. However, this method achieves the house connection as an integrated project. According to the post evaluation report of the WB in 2019, the number of people connected in the slum areas was 137,243, and the number of connections was 7,260 against the target of 8,013, of which 3,122 connections were considered sustainable and used continuously for 3 months. The total cost of the project was USD 4.2 million. In the case of Nairobi City, the OBA is applied to the water connection as well.

The second method is the individual house connection using the private land and applying the small diameter pipes and shallow burial, as well as the installation of ablution blocks under the project supported by the AfDB. In the former method, sewerage culverts are buried in private land as necessary, and the diameter of the pipes is reduced to 6 inches (about 150mm) from the usual 250-300mm, and shallow burial is used to reduce the construction period and cost. This method is also called condominial sewerage and has already been adopted in Brazil and other countries. This method has a weakness since it is prone to blockage of the sewer, but measures are being taken such as providing openings for inspection and educating residents. The NCWSC stated that it is too early to judge the applicability of condominial system because it was only introduced 2 years ago.

(7) Wastewater Treatment Technology

capacity is currently under expansion to 180,000 m^3/day with the support of AfDB (to be completed in 2022). The treatment system of the Kariobangi WWTP (32,000 m^3/day) is a trickling filter system. The Kariobangi WWTP is currently under the rehabilitation with the support of AfDB.

(8) FSM

The sludge collection services in Nairobi City are provided by NCWSC and private sludge collection companies licensed by NCWSC. The collected sludge is discharged into designated unloading points (2 locations) that are connected to the sewerage system.

There are about 150 licensed private companies with a total of about 200 vacuum trucks. NCWSC also provides sludge collection services with one 7m3 vacuum truck and 3 staff, and the desludging charge is Ksh5,000 (about USD 5).

Depending on the capacity of the vacuum truck, the private sludge collection companies need to pay a permit application fee to the NCWSC: Ksh20,000 (about USD 20) for 2m^3 or less, Ksh40,000 (about USD 40) for 2-7m^3, and Ksh60,000 (about USD 60) for 7m^3 or more. According to the NCWSC, the number of private companies is on the rise in accordance with an increase in the number of customers led by population growth in the city. The sludge collection charge is decided between the user and the company, which is not regulated by the government.

According to the NCWSC, the private sludge collection companies provide the collect services even in slum areas as long as there is demand and they can earn a charge. According to the AWWDA, in the back of the slum where vacuum trucks cannot enter, sludge storage tanks are set up along the road for the residents, and the residents bring the sludge to the tanks.

Both AWWDA and NCWSC have been requested to improve the FSM so that they are working on the preparation of improvement plans.

(9) Faecal Sludge Treatment Facility and Treatment Technology

Since sewer networks are well developed in Nairobi City, the collected sludge is discharged into 2 designated sewage pipes for integrated treatment with sewerage. Therefore, there is no faecal sludge treatment facility.

(10) Sewerage Finance

All customers connected to the sewerage system are charged with 75% of their water bill as a sewerage tariff.

Even though the construction of wastewater treatment plant is the responsibility under the AWWDA, the repayment of loan for the above construction is obliged by the NCWSC. According to the NCWSC, since such a repayment is a financial burden on it, the NCWSC is planning to propose to WASREB a revision of the water tariff rate.

4.5.2 Issues of Wastewater and Faecal Sludge Management in Nairobi City

(1) Wastewater Management

- Proper wastewater treatment in slum/peri-urban areas
- Proper operation and maintenance of wastewater treatment plants
- Proper maintenance of sewer networks (measures for leakage)

- Measures to prevent environmental pollution caused by industrial wastewater

(2) FSM

- Proper disposal of collected sludge
- Implementation of faecal sludge management by the NCWSC
- Rehabilitation of pit latrines from which sludge is not properly collected

CHAPTER 5 COMMON ISSUES ON WASTEWATER AND FAECAL SLUDGE MANAGEMENT IN SUB-SAHARAN AFRICAN COUNTRIES

When conducting information collection and study in sectors such as water supply and transportation, where there is a general understanding across countries and regions about the development goals of the sector and the measures to achieve them, it would be possible to recognize the progress of development and issues from the overall frameworks (such as the policies, institutional framework (legal system, administrative organization), financial system, and plans or master plans) and the technical details. For example, in the case of water supply projects, the development goal is to deliver safe water to as many people as possible, and there is a general understanding that the way to achieve this is to strengthen the technical, institutional and financial capabilities of the organizations in charge of water supply projects.

However, it was considered in the Survey that the wastewater and faecal sludge management in Africa is a field where there is not a general understanding of the development goals and the measures to achieve them. Different goals may be set including preventing water pollution in public water bodies, eliminating waterborne infectious diseases such as diarrhea by improving sanitation, or improving the living environment by taking measures against bad odors, and the measures required will vary depending on the set goals.

Therefore, in the Survey, the information on the actual situations, issues and measures of wastewater and faecal sludge management in each target country was first collected and examined as much as possible. Through this activity, the perspective for working on the wastewater and faecal sludge management in Africa was recognized. For example, the percentage of usage of pit latrine as on-site sanitation facility is high even in the urban areas in Africa. The faecal sludge management for pit latrine may require technologies and approaches different from that widely used in the urban areas of Asian countries. In addition, since African urban population is dominated by people living in slum areas, the expansion of sewerage systems is difficult, and the wastewater and faecal sludge management is more difficult. It was observed that the institutional frameworks and financial systems to tackle such challenges are being devised in some SSA countries.

Based on such perspective as the above, the common issues on wastewater and faecal sludge management in SSA countries are analyzed by the following subjects:

5-1 On-Site Sanitation Facilities
5-2 Status of Sewerage System Development and Wastewater Treatment Technology
5-3 Standard of Wastewater Effluent
5-4 Water Pollution Issue
5-5 Urban and Slum Problem
5-6 Wastewater and Faecal Sludge Management in Slum Area
5-7 City-Wide Inclusive Sanitation (CWIS)
5-8 Faecal Sludge Management (FMS)
5-9 Social Marketing
5-10 Regulation of On-Site Sanitation
5-11 Faecal Sludge Treatment Technology
5-12 Institutional Framework for Wastewater and Faecal Sludge Management
5-13 Finance and Cost Recovery of Wastewater and Faecal Sludge Management
5-14 Master Plan

It is considered that the above approach is consistent with the basic idea of CWIS led by the WB and the BMGF, which is to analyze the needs first, to widely examine applicable methods according to the needs and not impose a specific method (e.g., sewerage), and to seek comprehensive solutions not only from technological aspect but also from legal, institutional and financial aspects.

5.1 On-Site Sanitation Facilities

5.1.1 Perspective of Survey

As the measures for wastewater and sludge management may differ depending on the on-site sanitation facilities used by the residents, on-site sanitation facilities are investigated.

5.1.2 Findings from Literature Review and Interview Survey

(1) Status of on-site sanitation facilities

All the target countries in the second phase have sewerage systems in their respective capitals, but the areas where such systems are in place is limited, and households that are not connected to sewerage systems have on-site sanitation facilities.

In most cases, on-site sanitation facilities consist of pit latrines installed outdoors or septic tanks installed indoors, and pit latrines account for the majority with the exception of Abidjan City (Cote d'Ivoire).

The majority of residents, especially in slum areas, seem to use pit latrine. There are various types of pit latrines, including very simple latrines (unlined excavation), and improved pit latrines in which the pit is sealed with a lining.

There are also pit latrines that are used jointly by several households, in addition to the individual latrines that are maintained by each household.

Pit latrines were not originally designed for desludging. In rural areas, when the pit is full, a new pit can be dug elsewhere, but in urban areas, this is not possible, so desludging is necessary.

In the case of pit latrines, the upper part of the toilet pit is open, and garbage may be easily dumped into it, which is an obstacle to sludge management.

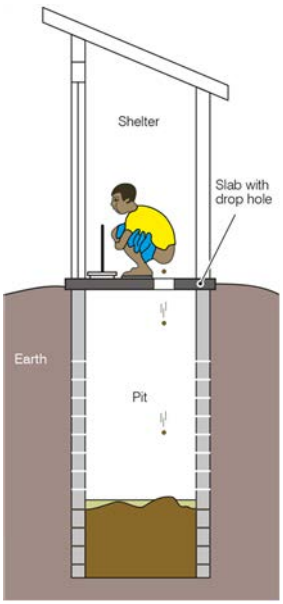


Figure 5-1 Structure of Pit Latrines

Although septic tanks, which can be flushed, are better for sanitation than pit latrines, pit latrines are still more common in sub-Saharan Africa. This may be because the water tariffs in sub-Saharan African countries are higher than in Asian countries. Water flushing significantly increases water

consumption and increases the water tariff burden on households. This would be an obstacle to the spread of sewerage systems.

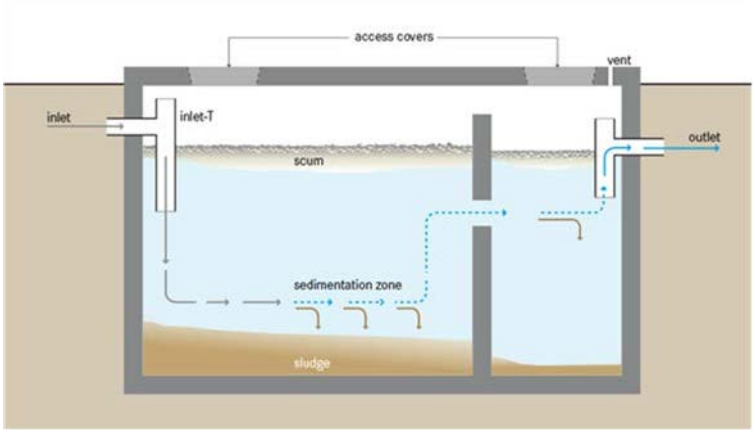


Figure 5-2 Structure of Septic Tanks

Table 5-1 Status of On-Site Sanitation Facilities in the Detailed Survey Countries

Capital City /Country	Sewer Coverage	Septic Tank	Pit Latrine	Open Defecation	Information Source
Maputo (Mozambique)	9%	35%	55%	1%	BMGF
Kigali (Rwanda)	0%	9.3%	88.8%	1.9%	EICV5
Kampala (Uganda)	8% (resident 2%)	28%	69%	1%	KCCA
Addis Ababa (Ethiopia)	10%	16.26%	68.32%	3.84%	WB
Ouagadougou (Burkina Faso)	<2%	15%	73%	N/A	ONEA
Lusaka (Zambia)	10-15%	40-45%	43%	N/A	KfW
Nairobi (Kenya)	48%	51.3%		0.7%	AfDB
Abidjan (Cote d'Ivoire)	42%	45%	13%	0%	SDAD

(2) Issues

As for pit latrine, there are still many pit latrine that are not clearly classified into improved pit latrine (VIP pit latrine) or other types. In the case of unlined pit latrines, when a vacuum truck is used to remove the sludge, the wall of the pit at the bottom of the latrine collapses due to the suction of the sludge, and the latrine itself is damaged. Therefore, there is no choice but manually remove the sludge. In addition to the lack of proper sludge management, there are concerns about the deterioration of the sanitary environment due to the flow of foul water from the pit into the surrounding rivers, groundwater, and other living environments.

In order to tackle FSM in the future, the first important task is to convert unlined pit latrines to improved pit latrines or septic tanks.

5.1.3 Findings through Detailed Survey

(1) Implementation Status of On-Site Sanitation Facility Improvement

1) Maputo City (Mozambique)

With the support of WSP, Maputo City tried a pilot project of the FSM business model for desludging from pit latrines, transporting, and dumping in peri-urban area from 2014 to 2016, but was not successful. Therefore, while continuing to improve sanitation in the peri-urban area with the support of WSP, it is promoting the transition from pit latrines to septic tanks to facilitate desludging by vacuum trucks.

The survey team visited individual household toilets and shared multi-household toilets (Sanitary Block) constructed through this initiative, and confirmed that low-income people actually have access to flush toilets with septic tanks.

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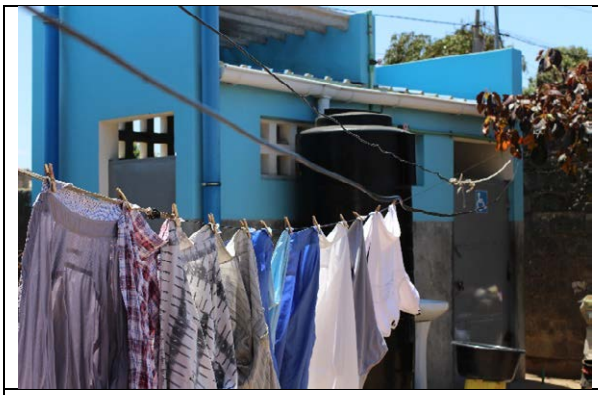
<tr><td>  </td><td>  </td></tr>
<tr><td>Exterior view of toilets (left entrance is a general toilet, right entrance is a toilet for the disabled, and the center is a rainwater tank and hand washing area)</td><td>Interior of general toilet</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Inside of toilet for the disabled</td><td>Septic tank</td></tr>
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Figure 5-3 Toilet shared by Multiple Households

2) Lusaka City (Zambia)

The Lusaka Water Supply and Sanitation Corporation (LWSC) has developed a standard design for an improved pit latrine for households (see figure below) and is partially subsidizing its construction costs under a project supported by the WB and AfDB under the Lusaka Sanitation Program, which is being implemented with the support of four donors.

Resource: LWSC & WB, Lessons Learned Onsite Sanitation and Fecal Sludge Management from the Lusaka, 2021

Figure 5-4 Standard Design of Improved Pit Latrine

The improved pit latrine shown in the above figure is a double pit that is designed to prevent groundwater contamination. The first pit is watertight and separated from the toilets, human waste can be stored, separated into solid and liquid, and treated anaerobically. In addition, the supernatant liquid flows into the second pit and is filtered on the sides and then is discharged out of the system. The pit is connected to the toilet by a thin pipe, which prevents the dumping of solids into the pit, which would make desludging difficult.

The construction costs are subsidized for underground structures, while the costs for sheds of toilets, which households are interested in more, are covered for by households (average USD 120) so that households can take ownership. The LWSC is aiming to gradually reduce the subsidy to the full cost of the project in the future as the number of toilets of this design increases and the need for the project becomes more widespread among the residents, but for the time being, it is necessary to secure the resources for the subsidy in some way. The WB and AfDB projects will be completed in 2022, and the LWSC are proposing to the WB to extend the project until 2024.

The standard design of the improved pit latrine was developed by the LWSC. From the beginning, LWSC has been visiting communities to understand their needs and reflect them in the design, aiming for human centered design. On the other hand, for LWSC, it is important that the design prevents the pollution of the groundwater and makes the removal of the sludge easy in consideration of the FSM business (desludging every 2 to 2.5 years is assumed).

3) Abidjan City (Cote d'Ivoire)

For the improvement of on-site facilities, the USAID implemented the Sanitation Service Delivery (SSD) Project (2014-21021). The counterpart was the National Sewerage and Drainage Corporation (ONAD), but the Abidjan City Government and the Housing Department of the Ministry of Construction were also participating. With the support of the National Sewerage and Drainage Corporation (ONAD) (with the participation of the government of Abidjan and the Housing Department of the Ministry of Construction), the SSD Project was raising awareness among the poor in slum areas and other areas about the need for clean toilets, and was promoting the installation of septic tanks and improvement of pit latrines. The project also provided training to small-scale toilet builders on maintenance and installation.

(2) Donors' Financial Support for Improvement of On-Site Sanitation Facilities

In both Mozambique and Zambia, the WB and other donors are providing financial support for upgrading pit latrines and converting them to septic tanks. Regarding the donors' support for the construction of household toilets, which is normally considered to be borne by the beneficiaries, the WB said that each household should bear the cost of the superstructure (building) of the toilets since they will benefit from it, but the donors are justified in bearing the cost of the substructure (tank part) that will contribute to reducing the impact on the surrounding environment.

5.1.4 Measures to be taken, Matters to be considered to Realize the Cooperation

In general, pit latrine is not easy to desludge, so it is desirable to convert it to a septic tank. The improved pit latrine developed by LWSC, which is easy to desludge, may be one of the solutions. In any case, it is important for on-site sludge management to make on-site sanitation facilities capable of desludging, and JICA should encourage and support such efforts in the target countries.

For the above reasons, it is necessary to consider the following for future cooperation:

- It is necessary to continue to collect information on measures to improve on-site sanitation facilities (e.g., LWSC) that are being implemented in SSA countries.
- If there are currently no septic tank or pit latrine experts in Japan, it is necessary to train such experts or find and appoint non-Japanese personnel with such expertise.

- The reality is that even in Japan, there is a lack of progress in the transition from the Johkasou (black water treatment) to the Johkasou (black water + grey water treatment) and there is a government subsidy system to promote such transitions. But many developing countries in SSA do not have the financial resources for such subsidies. In light of this, it is necessary to provide financial support for part of the improvement and conversion costs, as is being done by international organizations such as the WB.

5.2 Status of Sewerage System Development and Wastewater Treatment Technology

5.2.1 Perspective of Survey

Although sewerage system is an important infrastructure for urban wastewater management, since its development requires huge financial resources and long time, the status of sewerage system development and wastewater treatment technology may co-relate to the level of economic development.

5.2.2 Findings from Literature Review and Interview Survey

(1) Status of Sewerage System Development

All eight (8) cities under the second phase of the Survey, have a sewerage system. According to the information obtained by the survey team, the coverage ratio of the sewerage system is as shown in Table 5-2.

Table 5-2 Ratio of Sewer Connection by City

Country	Country Classification by Income Level	City	Ratio of Sewer Connection	Information Source
Mozambique	Low-Income LDC	Maputo	9%	BMGF
Rwanda	Low-Income LDC	Kigali	0% (After the completion of the on-going AfDB financed project: 10.6% (target))	WASAC
Uganda	Low-Income LDC	Kampala	8% (Residential: 2%)	BMGF
Ethiopia	Low-Income LDC	Addis Ababa	10%	WB
Burkina Faso	Low-Income LDC	Ougadougou	Less than 2%	ONEA
Zambia	LDC or Low-Income	Lusaka	10-15%	KfW
Kenya	Lower- Middle- Income Countries	Nairobi	48% (After the completion of the on-going AfDB financed project: 70% (target))	AfDB
Cote d'Ivoire	Lower- Middle- Income Countries	Abidjan	42%	AFD M/P

In two lower- middle- income countries, Nairobi (Kenya) and Abidjan (Cote d'Ivoire), the ratio of sewer connection is above 40%. On the other hand, in remaining six (6) countries which belong to 'Low-Income LDCs' and 'LDC or Low-Income', the ratio of sewer connection is around 10% or below and the sewerage system is limited to the business districts and the high-income residential areas in the center of the city. In Nairobi, Kenya, sewerage system spreads to the general residential areas and it is reported that some of the slum residents are also connected to the sewerage system with the support of Output-Based Aid, which commands attention.

(2) Sewage Treatment Technology

The situation of sewage treatment in the 8 cities under the second phase is as shown in Table 5-3.

Table 5-3 Situation of Sewage Treatment by City

Country	City	Situation of Sewage Treatment	Information Source
Mozambique	Maputo	Out of two (2) sewerage systems, one is discharging to the ocean bay without treatment. Influene WWTP's capacity is 48,000 m^3/day. Sludge accumulates in the stabilization pond. A plan to build a new WWTP next to it exists. Pollution of Maputo Bay is an issue.	WB
Rwanda	Kigali	There is a small WWTP in a housing estate (under rehabilitation). Nyabugogo WWTP (activated sludge. Capacity: 12,000 m^3/day) is under construction in a business district. Strengthening the wastewater management is the issue.	AfDB NWSC

Country	City	Situation of Sewage Treatment	Information Source
Uganda	Kampala	There are two (2) WWTPs. Ratio of sewer connection is 8%. Bulogobi-NakivuboWWTP (Trickling Filters, Capacity: 45,000 m^3/day. Started operation: April, 2021) Lubigi WWTP (stabilization pond) Future plan for two (2) WWTP/STP (Nalkolongo, etc.) exists. Increase of the connection, replacement of the aged sewers, are the issues.	AfDB NWSC
Ethiopia	Addis Ababa	There are two (2) WWTPs (Kotebe & Kality. Stabilization pond. Capacity: 60,000 m^3/day (expansion; 90,000 m^3/day)). Ratio of sewer connection: 10%. Growing population, slum area, management of industrial wastewater, are the issues.	WB
Burkina Faso	Ougadougou	There is one WWTP (Kossodo. Stabilizatio pond. Capacity: 5,400 m^3/day.）. Management of industrial wastewater and increase of the ratio of sewer connection, are the issues.	WB
Zambia	Lusaka	There are seven (7) WWTPs (Trickling Filters: 2 Stabilization pond:5. Total capacity: 67,000 m^3/day). Ratio of connection: 10-15%. Improvement of water quality, strengthening monitoring, are the issues.	WB, AfDB, BMGF,
Kenya	Nairobi	There are two (2) WWTPs (Dandora & Kariobangi. Stabilization pond & Trickling Filter. Total capacity: 192,000 m^3/day (expansion; 20,000 m^3/day)). The collected on-site sludge is disposed into the sewers. Slum area, maintenance of sewers, management of industrial wastewater, are the issues.	AfDB
Cote d'Ivoire	Abidjan	No WWTP (Ocean outfall). Ratio of sewer connection: 42%. Implementation of Master Plan (2019), pollution of lagoon caused by the untreated wastewater in the western Abidjan, are the issues.	WB, AFD, JICA

The following are the technical summaries of sewage treatment processes used in SSA countries.

1. Stabilization Ponds

Oxygen generated by photosynthesis of algae is used for sewage purification, and a combination of anaerobic pond, facultative pond, and maturation pond is common. In anaerobic pond, settled sludge is oxidized and decomposed. In facultative pond (including surface aeration) and maturation pond, organic matters are oxidized and decomposed. Because the capacity is large, it is resistant to load fluctuations and nitrogen can be removed. There are many cases of combining with interceptor sewers. It has features such as low cost and easy operation and maintenance. Sludge removal is carried out every few years.

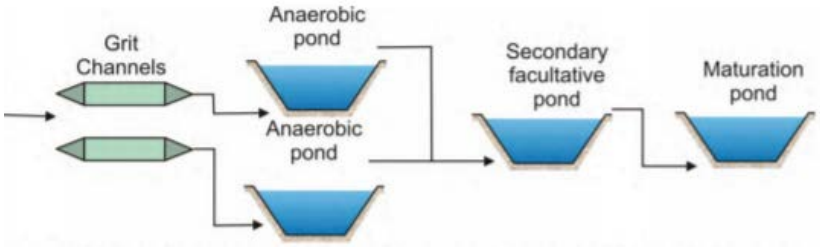


Figure 5-5 Flow Example of Stabilization Ponds

The capacity of the main ponds is designed as follows:

- Anaerobic pond: retention time of 3-5 days, water depths of 2-4 m
- Facultative and Maturation ponds: 14-30 days, and water depths of 1-2 m.

The required area for the stabilization ponds is about 10 m^2 for 1 m^3 sewage per day, which is said to be 20 times that of the conventional activated sludge method.

The problems of the stabilization ponds include (1) restrictions on land use (required land area and land price), (2) greenhouse effects caused by methane gas generated in the anaerobic ponds (which are said to be 24 times that of CO2), and (3) requiring human power to periodical removal of sludge.

2. Trickling Filters

It is a type of biological membrane method in which sewage is sprayed on the surface of a circular pond filled with crushed stones, and oxygen in the air is supplied to the biological layer formed on the stones. The system generally consists of primary clarifier, trickling filter and secondary clarifier. There are examples of combining with an activated sludge tank. Historically the technology was developed as an alternative to the stabilization ponds. Its installation area is 1/10 of the stabilization ponds, the electricity consumption is about 1/2 of the activated sludge method, thus it is characterized by the point that maintenance is easy.

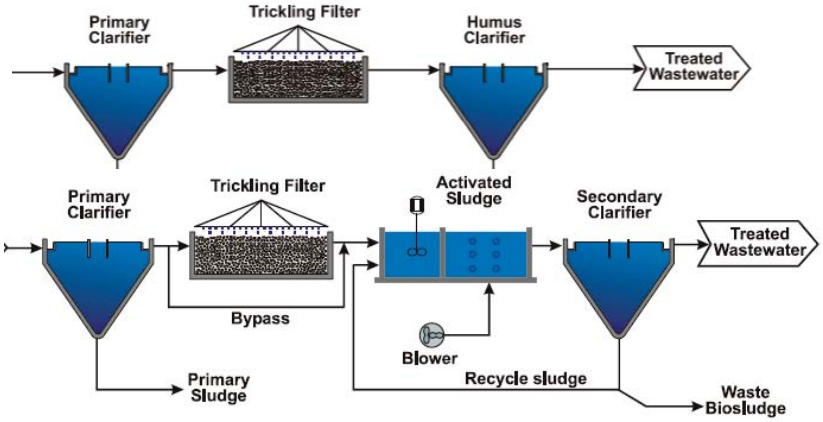


Figure 5-6 Flow Example of Trickling Filter Method

The capacity of the main units is designed as follows:

- Primary clarifier: retention time of 2 hours
- Trickling filter: load per filter area of 14 m^3/m^2/day (high-speed method)
- Secondary clarifier: retention time of 2 hours

Although it has a proven track record as an alternative technology to the stabilization ponds, it is desirable to develop efficient filter materials and post-treatment technology.

3. Standard Activated Sludge Method

It is a type of floating organism methods in which sewage is mixed with activated sludge by aeration stirring in a reactor, and the sludge is settled and separated in the secondary clarifier thereby obtaining supernatant treated water. A portion of the settled sludge is sent back to the reactor and the rest is discharged as excess sludge. The method corresponding to the nitrogen and phosphorus removal has also been put in practical use. It is possible to adjust the volume of bacteria and concentration of dissolved oxygen in the reactor.

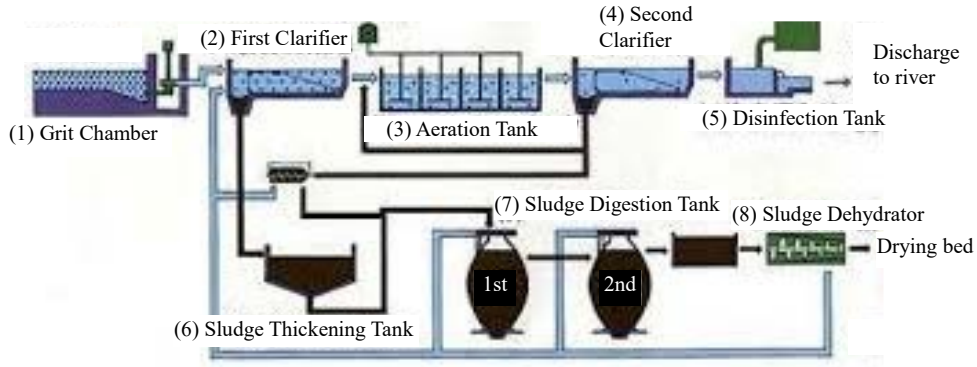


Figure 5-7 Flow Example of Activated Sludge Method

The capacity of the reactor is designed as follows:

- Retention time: 6-8 hours
- BOD load: 0.3-0.8 kg/m^3/ day
- BOD sludge load: 0.4 kg /kg-SS/ day

The installation area is about 0.5m^2/1m^3 of sewage/day.

The problems of the activated sludge method are (1) power consumption is large at 0.3 kwh / 1 m^3 of sewage, (2) large volume of excess sludge generation, and (3) advanced operation and maintenance technology is required. In the future, if the operation and maintenance system is established and the management capacity is enhanced, the technology is expected to be widely applied.

5.2.3 Findings through Detailed Survey

The ratio of sewer connection is increasing slowly in many cities. The following are considered as the factors restricting the progress of the sewer connection in SSA countries:

- High percentage of the slum population
- Low per person water usage volume. (In order for a household to connect to the sewer, conversion to the flush toilet is a prerequisite, which will increase the water usage. (In India, it is said that the water usage volume: 125l/day/person is the minimum requirement for the sewer connection.)
- Difficulty in the financial resource mobilization.

The information obtained during the detailed survey in Kigali City (Rwanda), Maputo City

(Mozambique) and Abidjan City (Cote d'Ivoire) is as follows. As for the mobilization of financial resources for the sewerage system development, the survey team considers that, since many countries have no choice other than relying on the donor assistance, the roles of the donors would be an important factor. Since major donors such as the WB and the AfDB are putting emphasis on the CWIS concept, whether the country is working on the Faecal Sludge Management (FSM) or not would be a factor on which donors make a decision. From this viewpoint, all the five (5) countries in the third phase of the Survey are working on the FSM improvement. This will work in favor for these countries.

(1) Kigali City (Rwanda)

In Kigali City, the percentage of the slum population is as high as 78%. Slum areas spread all over the city. Business districts are on the hill tops and slums are on the slopes of the hills. Such topographic condition of the city would make the development of sewerage system in the city challenging. The average water consumption volume per person is very small (57l/m^3/person/month) and it would also be an obstacle. The reasons for the small water consumption are considered as (1) majority of toilets are pit latrines which does not use water, and (2) the water tariff is too expensive discouraging the water use. Now, the very first sewerage system in the country is being built with the assistance of AfDB. Its major customers may be commercial users on the hill tops, and not the residential users.

Kigali City is implementing Informal Settlement Upgrading supported by the WB financed 'Urban Development Project' (2016), which made the FSM services by vacuum trucks accessible to a part of the slum residents. Nevertheless, since not all residents are accessible though the newly built road, an area-wide sewerage system development would not be possible even in the upgraded settlements in the near future.

(2) Maputo City (Mozambique)

Maputo's slum population accounts for 86% of the total and the sewerage coverage rate is 9%. The majority of the population that can physically be connected to sewers is believed to already have been connected. In the southern part of Maputo City, called the Cement City, office buildings, hotels, government offices, and high-end residential areas are lined up in an orderly manner, and sewers are installed. In the peri-urban districts located on the northern side of the city, there are many informal residents living disorderly, and there is no sewerage. Looking at the map, a part of the peri-urban districts in the north also appears to have a readjusted land, but they still do not seem to be suitable for the installation sewers.

Maputo is focusing on improving the existing dysfunctional sewerage system in the southern part of the city.

The wastewater treatment plant in Maputo applies an anaerobic pond-stabilized pond system, and an integrated treatment of sludge that discharge into the anaerobic pond. The sludge (septic tank) is dumped directly in the anaerobic pond without pretreatment. Since no sludge removal from the pond has been conducted for long time, the pond has turned into a land with the accumulated sludge and it was obvious that a planned service was not performed.


Sewage inflow channel


Sewage inlet bar screen


Anaerobic pond


Anaerobic pond under dredging


Stabilization pond


Stabilization pond


Discharge of sludge into anaerobic pond


Discharge of sludge into anaerobic pond

Figure 5-8 Situation of Existing Facilities in Infulene WWTP, Maputo, Mozambique

The method of directly discharging on-site sludge into the anaerobic pond for treating sewage is problematic as explained below.

Since solid loads are added when sludge is put into the anaerobic pond, it is necessary to remove the sludge periodically. However, no sludge removal has been conducted and the facility does not have any operation manual.

For an anaerobic pond for sewage, it is common to drain the water and dredge the sludge after long-term use. With regard to this facility, since on-site sludge is put into the pond in this facility, periodic removal of sludge is necessary. In design, installation of a concentration tank (separation tank) dedicated to sludge and efficient solid-liquid separation followed by discharge of separated effluent into the anaerobic pond is desirable.

As described above, before sludge is discharged into the integrated treatment in the sewage treatment facility for treatment process, a pretreatment operation such as solid-liquid separation (separation tank, thickening tank, etc.) should be performed to reduce solids and organic matter loads. Furthermore, in the case where the trickling filter method or the activated sludge method is adopted, primary clarifier is usually provided, and pretreatment is also necessary to feed the sludge into it. In addition, in case of discharging sludge into sewage pipe, the input ratio of sludge to the amount of sewage based on the solids and organic matter loads of sludge as well as measures to prevent blockage of the pipe should be considered.

(3) Abidjan City (Cote d'Ivoire)

The ratio of sewer connection in Abidjan City is as high as 42%. It seems that the business districts in the central area and the high-income residential areas in the eastern area are already connected to the sewerage system. The percentage of the slum population in the city is 25% and, according to a local consultant survey report, the slums are scattered all over the city. If that is the case, there may be a room to expand the sewerage system to all over the city avoiding the scattered slum areas. Furthermore, the survey team was informed that new housing estates are being developed in the suburban areas. There may be possibilities for the development of sewerage systems targeting these new housing estates.

5.2.4 Measures to be taken, Matters to be considered to Realize the Cooperation

Even in many Low-Income LDCs in SSA, there exist sewerage systems in their business districts. It shows that sewerage system is a necessary infrastructure for commercial users, regardless of the income level. In SSA countries, the measures for wastewater and sludge management are determined not by the level of the economic development but by the type of users. As the results of the recent economic growth, there are certain percentage of commercial users and middle- or high-income residents who seek for the sewer connection in SSA countries. For the ordinary citizens, the initial target is to convert their toilet to the flush toilet by the use of a septic tank. Once it is done and their income level goes up, they may start thinking about the sewer connection. On the other hand, due to the same economic growth, a large number of rural population have migrated to the urban area, resulting in the increase of the slum population. Many of the slum residents use pit latrines. Since the sewerage system development in the slum area is difficult, excluding a few exceptions, the demands for the on-site sludge management (FSM) have increased. This is the current situation of urban sanitation in SSA countries identified through the Survey.

Generally speaking, the development of sewerage system in the slum area is difficult. But, there is an example of realizing sewer connections for a population of 130,000 in slum areas in Nairobi, Kenya, by using Output-Based Aid (OBA) method, under which subsidies were provided to cover the cost of house connections for the slum residents by the Global Partnership on Output-Based Aid GPOBA. The GPOBA is established in the WB in 2003, and it has become the Global Partnership for Results-Based Approaches (GPRBA) since 2019. The member countries are Australia, Netherlands, IFC, SIDA, and DFID, but Japan (JICA) is not a member. Another example is the introduction of condominial sewer system, which was developed and is widely used in Latin American countries to connect the slum residents to the sewer, in parts of the slum areas in Lusaka, Zambia and Nairobi, Kenya.

In Asia, too, there is an example of realizing sewer connections in the low-income area in Colombo, Sri Lanka, by the support of GPOBA, in which the sewer connections to the WWTP financed by SIDA was supported by GPOBA. The Output-Based Aid (OBA) methods are widely used in other sectors such as electricity and water supply, in order to solve the issue of the last mile connectivity.

According to the above, it is necessary to consider the following for future cooperation:

- Pros and Cons of introducing the OBA method into the JICA's infrastructure operations including the possibility of JICA's joining GPRBA shall be considered.
- Pro and Cons of introducing the condominial sewer system into JICA's support for the sewerage system development shall be considered. There is a possibility that, in some of the JICA financed sewerage projects in Latin America, the condominial sewer system has already been applied. If that is the case, conducting a systematic review of such cases is recommendable.

5.3 Standard of Wastewater Effluent

5.3.1 Perspective of Survey

It is necessary to survey the effluent standards applicable to sewage treatment plants and on-site sludge treatment facilities in each count.

5.3.2 Findings from Literature Review and Interview Survey

Table 5-4 shows main items of the effluent standards (standards applied to wastewater treatment plants and faecal sludge treatment plants) in each country.

Many countries use 50 mg/L for BOD and 50 mg/L for SS. The standards of Total Coliforms are different by country. In many countries, the standard value for each item is stricter than the national effluent standard of Water Pollution Prevention Act of Japan.

In Japan, however, most of prefectures set the effluent standards stricter than the national standards, which are applicable to each water area and business classification. As a reference, the standard of Tokyo Metropolitan Government is shown in the table.

In SSA countries, the effluent standards of each country are looser than the standards in Tokyo, Japan. In SSA countries, the effluent standards of each country are set as standard values, which are commensurate with the prevailing sewage treatment technology in each country, such as the wastewater stabilization pond technology.

Table 5-4 Effluent Standards in Each Country

Item / Country	pH	BOD (mg/L)	SS (mg/L)	T-N (mg/L)	T-P (mg/L)	Total Coliform (CFU or MPN/100mL)
Mozambique	6.0-9.0	COD 150	60	15	10	
Burkina Faso	6.4-10.5	50	20	50	5	2,000
Rwanda	5.0-9.0	50	50	30	5	400
Zambia	6.0-9.0	50	100	50	6	25,000
Uganda	5.0-8.5	50	50	10	5	400
Ethiopia	6.5-8.5	-	-	-	-	Nil
Kenya	6.5-8.5	30	30	-	-	30
Cote d'Ivoire	5.5-8.5	100	50	50	-	-
Reference: Japanese effluent standards for specified workplaces under Water Pollution Act	5.8-8.6	Daily average 120	200	120	16	Daily average 300,000
Reference: Effluent standards for sludge treatment plants (newly constructed) in Tokyo	5.8-8.6	20	40	20	2	Daily average 300,000

Source: Effluent standards in each country

5.4 Water Pollution Issues

5.4.1 Perspective of Survey

In many countries, public awareness of the issue of pollution of public water bodies triggers their serious effort for the wastewater management such as the development of sewerage systems.

5.4.2 Findings from Literature Survey and Interview Survey

There is a limitation of literature survey for obtaining the information on the existence of the issue of pollution of public water bodies in each country. The survey team obtained such information through the interviews with multilateral development banks on the water pollution issues which are argued in the following four (4) countries.

Table 5-5 Pollution of Public Water Bodies

Country	Water pollution issues
Cote D'Ivoire	Pollution of Ébrié Lagoon in Abidjan City
Burkina Faso	Industrial pollution caused by leather industries and gold mines
Uganda	Pollution of Lake Victoria, an international water and source of drinking water for Kampala City
Kenya	Pollution of Lake Nakuru and the rivers near Nairobi City

Pollution of street drains caused by the illegal disposal of sludge from pit latrines/septic tanks by manual desludging workers is the pollution issue the most often reported.

5.5 Cities and Slums

5.5.1 Perspective of Survey

In Sub-Saharan African countries, infrastructure development cannot keep up with rapid urbanization due to economic development. Therefore, there are slum areas and the provision of such services as electricity, transportation, water and sanitation in the slum area is a big issue.

Nowadays, electricity and potable water services are provided to the much of slum populations, but regarding the sewerage and faecal sludge management, it is difficult to support slum residents by the usual measures such as the sewerage system development. Therefore, other measures are required, and it is necessary to clarify the actual situation of slum in SSA countries and to collect information on how the government or municipalities are dealing with the slum areas in their urban planning.

The following is the UNHABITAT's definition of 'slum'. If the living condition of a resident meets one of the following five (5) definitions, he/she is counted as a 'resident in the slum'. The slum resident is not equal to an illegal resident. Even if he/she is a formal resident, if he/she lives in an endurable house, if he/she is forced to live in a room with more than three (3) people together, he/she does not have an easy access to safe water or adequate sanitation, he/she is a 'resident in slum'. On the contrary, even if he/she lives in a durable house, if he/she lives in unplanned settlement and there is a risk of forced evictions, he/she is a 'resident in slum'. Even if not all the residents are 'resident in slum', but if majority of the residents are 'resident in slum', the whole area is classified as a 'slum area', and the introduction of sewerage system in such area would be difficult.

[UNHABITAT's definition of 'slum']

Slums: Some Definitions
UN-HABITAT defines a slum household as a group of individuals living under the same roof in an urban area who lack one or more of the following:
1. Durable housing of a permanent nature that protects against extreme climate conditions.
2. Sufficient living space which means not more than three people sharing the same room.
3. Easy access to safe water in sufficient amounts at an affordable price.
4. Access to adequate sanitation in the form of a private or public toilet shared by a reasonable number of people.
5. Security of tenure that prevents forced evictions.

(deleted)
Approximately one-fifth of slum households live in extremely poor conditions, lacking more than three basic shelter needs.
(source)
https://mirror.unhabitat.org/documents/media_centre/sowcr2006/SOWCR%205.pdf#:~:text=UN-HABITAT%20defines%20a%20slum%20household%20as%20a%20group,more%20than%20three%20people%20sharing%20the%20same%20room.

5.5.2 Findings from Literature Review and Interview Survey

Table 5-6 shows the WB data on the slum population ratios in urban areas nationwide in 8 surveyed countries, and the figures obtained by JICA survey team on the slum population ratios in 8 surveyed cities.

Except for Nairobi and Abidjan, the slum population is very high at 60–80%.

It may be wondered whether these high slum population ratios reflect a temporary situation or permanent one. According to the 2010 City Profile (UN-HABITAT), slum population ratio of Maputo in Mozambique is 70%, and according to the WB's Maputo Urban Transformation Project (2020), it is 86%, so slums population ratio is not decreased.

In Abidjan in Cote d'Ivoire, the slum population ratio in the city has increased from 13.8% (1988) to current 25% of the population.

Table 5-6 Slum Population Ratio in Detailed Survey Countries and Cities

Item / Country	Urban slum population ratio in countries (%)	Survey cities	Slum population ratio in survey cities (%)
Mozambique	77	Maputo	86
Burkina Faso	57	Ouagadougou	NA
Rwanda	42	Kigali	78
Zambia	55	Lusaka	70
Uganda	48	Kampala	60
Ethiopia	64	Addis Ababa	80
Kenya	47	Nairobi	40
Cote d'Ivoire	60	Abidjan	25

Source: Homepage of WB and articles on sanitation in each country

5.5.3 Findings through Detailed Survey

Due to COVID-19, JICA survey team could confirm the slum situation of only two cities, Kigali in Rwanda and Maputo in Mozambique.

(1) Current Situation of Slums in Kigali, Rwanda

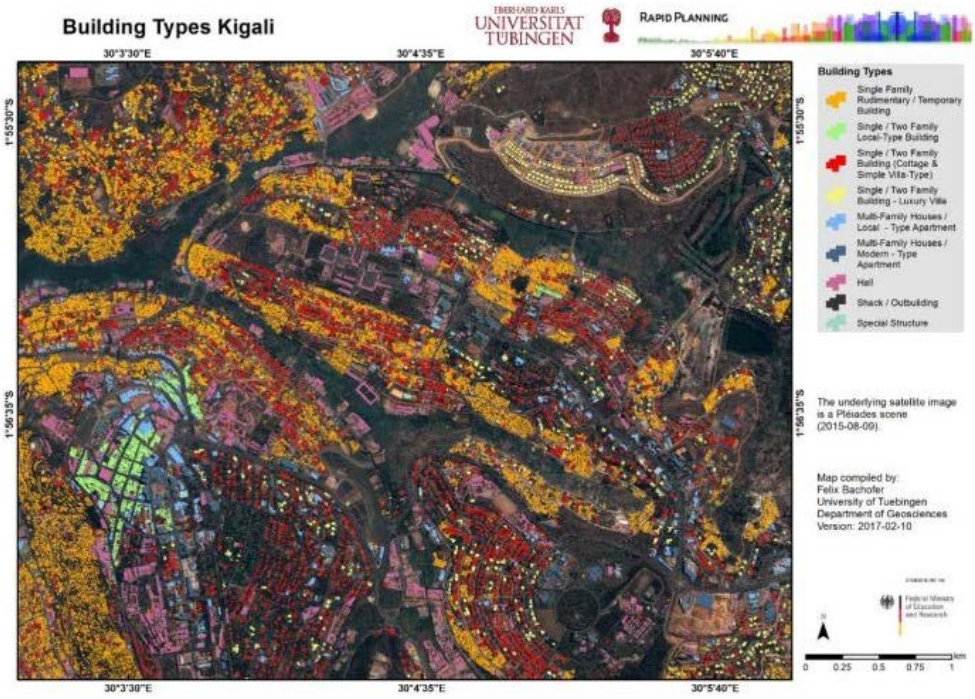
The current situation of slums in Kigali, Rwanda is shown in the photographs obtained during the field survey. These photographs has been attached to the PPT document "Presentation to JICA Survey Team -Informal Settlement Upgrading" (hereinafter referred to as "City of Kigali (CoK) PPT") prepared by CoK, when JICA Survey Team visited CoK.

Figure 5-9 shows the skyscrapers of the CBD on the hill on the west side of the city. There are the slums on the slopes of the hills. In addition, the houses on the slope of the hill in front of the camera are also slums.

Source：CoK PPT

Figure 5-9 Central Business District on Hill and Slums on Slopes (Kigali City)

Figure 5-10 shows an aerial photograph of the types of houses in Kigali City. CBD is blue, green, and purple dots on the left side of the picture. The orange dots are "poor provisional houses", which means slums. The slums are spread throughout the city, and even in the neighboring areas next to CBD.

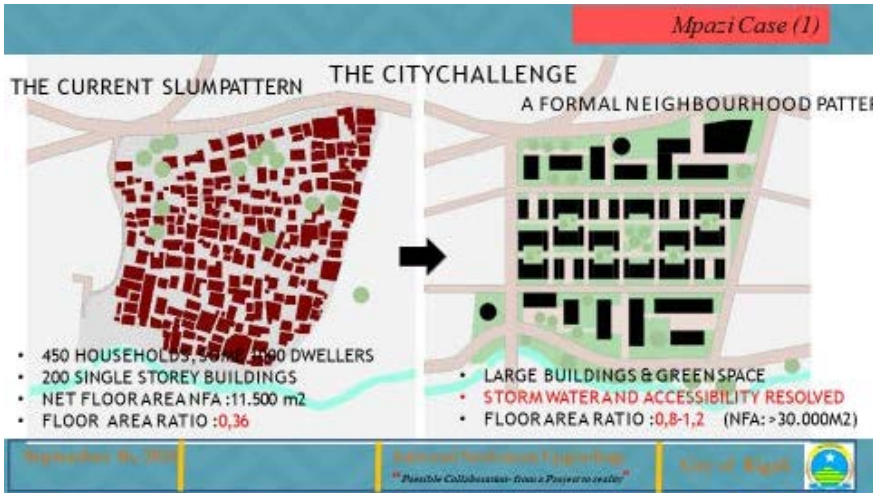


Source: Eberhard Karls Universitat Tubingen Manual Working with geospatial data in Kigali (CoK)

Figure 5-10 Spread of Slums in Kigali City

The current slum pattern is shown on the left side in Figure 5-11, and CoK wants to transform it to the pattern on the right side. In the current pattern, there are few roads inside the slums. It causes not only the disconnection of slums from the outside world but also the disconnection among neighbors, and it prevents the slum residents to enjoy the same normal life and to engage in the productive activities as normal citizens do.

From the viewpoint of wastewater and sludge management, it may be easily imagine that it would be difficult not only to build the sewerage system but also for vacuum cars to access the sanitary facilities of individual residents.



Source: CoK PPT

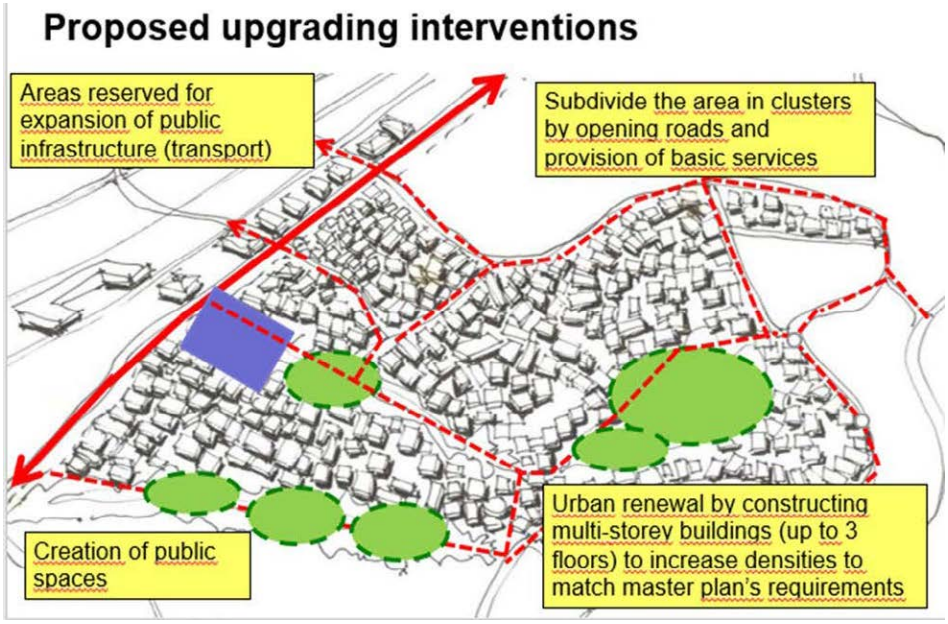
Figure 5-11 Concept of Slum

Figure 5-12 shows the concept of the improvement plan (Upgrading) of the slums in Kigali City under Urban Development Project (1st: 2016) by the WB. Under this slum upgrading project, in Biryogo, Agatare, Rwampara areas (total area: 86 ha, total population: 18,914) in Nyarugenge

District, which is the oldest slum areas in Kigali City, road: 9.3 km, foot path: 6.3 km, storm water drainage: 2.51 km, replacement of water tank: one place and street lights: 196 places, were built. The infrastructures costed USD 10 million which was financed by the WB and the cost for the compensation for involuntary resettlement, although it was contained to be minimum, costed about USD 4 million, which was borne by the Government of Rwanda.

The already completed site of the slum upgrading was visited in the Survey and observed many new houses were being constructed along the new 7m road inside the slum. This slum upgrading was considered to be effective for the transformation of the slum.

From the viewpoint of wastewater and sludge management, sludge collection by vacuum cars became possible for the houses along the newly constructed road and the houses within 20-30 m distance from the road. However, it was also observed that there are still many houses that vacuum cars could not access. The sludge dumped in a newly built storm water drainage channel in the slum was observed. The practice of manual desludging by the residents themselves or by the informal desludging operators seemed to be continuing. The introduction of the sewerage system in this area was considered impossible since the situation even after the slum upgrading was still far from the situation in which most of the residents were physically able to connect to the sewer pipes which was the prerequisite for the area wide development of the sewerage system.



Source: CoK PPT

Figure 5-12 Concept of Informal Settlement Upgrading

(2) Current Situation of Slums in Maputo, Mozambique

The population of Maputo in Mozambique is about 1.2 million (1.8 million in the Maputo metropolitan area including the surrounding area). The southern part of the city is called Cement City, which is the center of the city where office buildings, hotels, government offices, and luxury residential areas are located.

However, there are peri-urban areas, where the slum residents live, in the north side of the city. There are some cases that wealthy people live in peri-urban area, but most of the residents are slum residents. According to the WB, 80% of Maputo's population is slum population.

There is no sewerage in peri-urban areas (north of the sewer line shown in red), where 80% of the residents of Maputo live, and the residents rely on on-site sanitation. It makes Faecal Sludge

Management (FSM) an important issue.

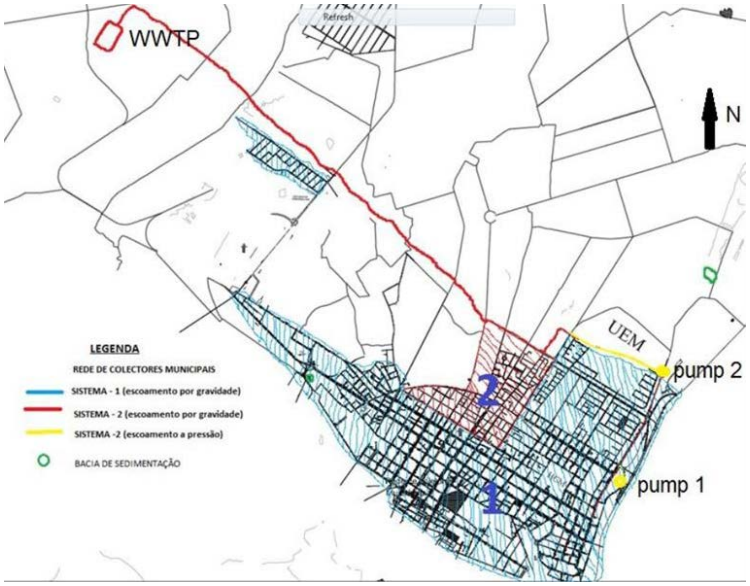


Figure 5-13 Concept of Sewer System in Maputo

5.5.4 Measures to be taken, Matters to be considered to Realize the Cooperation

In SSA countries, it is essential to grasp the situation of the slum area, since more than half of the total urban population live in the slum area and the measures for the wastewater and sludge management is different between the non-slum area and the slum area. However, obtaining such information is not easy. In Kigali City (Rwanda), since the upgrading of unplanned settlement was being implemented under the Rwanda Urban Development Project financed by the WB, the information on the current situation of the slum area was provided from the staffs in charge of the upgrading. It is highly probable that the similar projects are being implemented in another countries by the assistance of the WB or other donors (it was found that, in Abidjan, Cote d'Ivoire, the similar project is being supported by the AFD together with the WB).

According to the above information, it is necessary to consider the following for future cooperation:

- It is necessary to collect information on the slum upgrading project in order to know how the measures for the wastewater and sludge management would change before and after the slum upgrading. More concretely, will the development of sewerage system become possible? Will only the FSM become possible but not the sewerage system?
- Collaboration with the slum upgrading project supported by other donor would be needed.

5.6 Wastewater and Sludge Management in Slums

5.6.1 Perspective of Survey

In large cities of Sub-Saharan Africa which are dominated by slum residents, poor wastewater and sludge management in slums leads to deterioration of sanitation and water environment of the entire city, posing a risk of offsetting the results of improving wastewater and sludge management such as construction of water supply and sewerage infrastructure outside the slum area. Therefore, it is important to understand the status of sanitation services provision including wastewater and sludge management in slums of the target cities and identify good practices.

5.6.2 Findings from Literature Review and Interview Survey

(1) Current Status of Wastewater and Sludge Management - Sewerage

1) Conventional Sewerage is not suitable for slums.

Conventional sewerage system is considered unsuitable for slums for the following reasons.

- Many of the slum residents do not have land rights (informal settlements) and are considered temporary occupants. Therefore, they are not incorporated into urban or public service plans, including sewerage.
- Due to the dense housing and narrow and disorderly passages, installation works of sewer pipes is technically difficult.
- Construction and maintenance costs will be higher for the same reasons. As a result, sewer connection fees and sewerage charges become expensive, exceeding the amount that residents can pay.

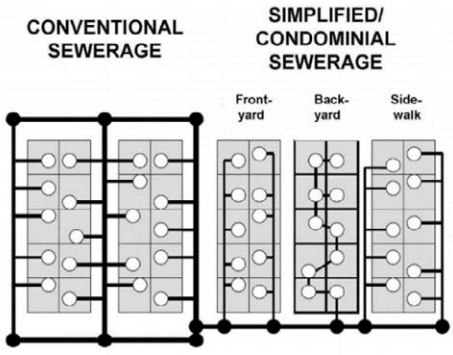
2) The introduction of Simplified (Condominial) sewerage has been sought in some cities, but it is limited.

To reduce the risk of groundwater contamination from pit latrines, or for reasons such as the desire for sewerage services from high-income residents even if they are living in slums, Lusaka implemented a pilot project to introduce a Condominial sewerage in slums (Kalingalinga Project supported by WSP). In Nairobi, introduction of Simplified sewerage in slums is planned in the AfDB supported Nairobi Rivers Basin and Restoration Program Sewerage Improvement Project Phase II.

【Reference】Simplified (Condominial) Sewerage

1. Features

In comparison with ordinary sewerage, construction costs can be reduced (50 to 80% reduction from normal sewerage) because of (1) using a small diameter pipe, (2) in shallow soil, (3) a loose slope, (4) laying pipes at a shorter distance by passing through the premises of a private house, etc., (5) by being able to flexibly lay and expand pipes according to the situation in the area. It was introduced in Brazil in the 1980s and disseminated to Latin American countries, South Africa, Pakistan, etc.



2. Simplified Sewerage and Condominial Sewerage

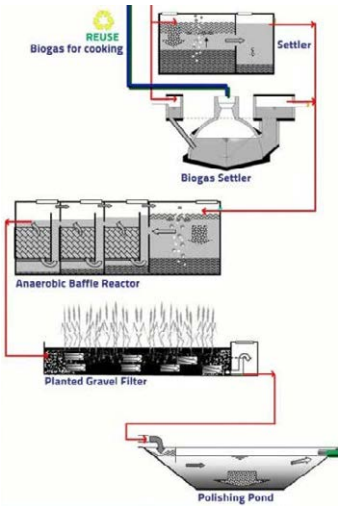
It is technically the same thing. Condominial Sewerage is a form in which residents participate in planning, implementation, operation and maintenance in the installation area.

3. Maintenance

Compared to ordinary sewerage, repair of pipes and elimination of clogging are required at a higher frequency.

In addition, according to the person in charge of the Lusaka Sanitation Program in AfDB says that the maintenance work itself is easier than a normal sewer pipe with a deep depth because the depth of pipe laying is shallow.

4. Treatment of sewage



Typically, the Simplified (Condominial) Sewerage is connected to a main sewer pipe, and sewage is treated in a sewage treatment plant. But there is also a method of treating sewage installing a small decentralized wastewater treatment system (DEWATS) in the neighboring area. The WB's original plan for the Lusaka Sanitation Project was to install DEWATS in each district to connect them to Condominial Sewerage (excluded from the components due to a review of the plan).

*DEWATS (Decentralized Wastewater Treatment System): As an alternative to centralized treatment in conventional sewage treatment plants that require high construction costs and advanced operation and maintenance technology, DEWATS is conceived as a system with (1) low construction costs, (2) no need for chemicals and electricity, (3) easy maintenance and management, and (4) the use of resources such as biogas, and its introduction is progressing in Sub-Saharan Africa. It usually consists of a sedimentation tank, an anaerobic treatment tank, and an aerobic treatment tank with vegetated gravel filters.

3) Sewer connection for slum residents by Output Based Aid.

According to the WB website, 137,243 residents of the Nairobi slums have obtained sewer connections through the Nairobi Sanitation Project of the WB-backed Global Partnership on Output-Based Aid (GPOBA).

(2) Current Status of Wastewater and Sludge Management - On-Site Sanitation Facilities and Faecal Sludge Management (FSM)

As noted in 5.6.2.(1), residents are forced to rely on on-site sanitation facilities in slums where sewerage service is limited. Pit latrine constitutes the majority among on-site sanitation facilities, most of which are with traditional structures that are not lined. When a pit becomes full, the pit needs to be covered with soil and another pit is dug or it is emptied by removing the sludge. In the slum where houses are dense, the former is often difficult, and the appropriate management of faecal sludge including pit emptying, transportation and treatment of sludge inevitably becomes a challenge. The present situation of the faecal sludge management in slums is as follows.

1) Residents are forced to rely on unsanitary and expensive informal services

In each city, pit-emptying services by vacuum tankers are provided by the Water and Sewerage Corporation or private contractors, but their targets are mainly middle- and high-income areas. The reasons why it is difficult to provide the service in slums are as follows:

- Pits are often not accessible by vacuum tankers in slums with dense housing, disorderly and narrow streets.
- It is difficult to remove sludge from pit latrine by vacuum tankers.

- ✓ The pit is not lined, so the pit collapses due to mechanical desludging.
- ✓ Garbage is often thrown away in pits, and it is necessary to separate the garbage from sludge (In Kigali City (Rwanda), before removing sludge with vacuum tankers or vacuum pumps, garbage fishing using a special tool was carried out, and it took more than two hours. Therefore, one team was able to empty only two pit latrines per day).

- The sludge removal fee by vacuum tanker becomes expensive due to the following factors, exceeding the amount that can be paid by many residents.
  - ✓ Increased work costs due to difficulties (requirement of long stretching of suction hoses that increases workload, and additional work to soften hard sludge, etc.)
  - ✓ The cost of transportation to the treatment plant is high (in Kigali City (Rwanda), the vacuum car was large (20 tons and 10 tons), and half of the sludge collection cost was fuel).

2) Informal services involve the following problems

- Manual emptying of pits does not give due consideration to the health and safety of workers, and the work is unsanitary, adversely affecting the surrounding environment. Although it is a necessary service, there are cases where workers are discriminated because they are socially repelled.
- The removed sludge is not properly treated and dumped in neighboring vacant lots, gutter, garbage dumps, etc., leading to deterioration of the environment and an increase in the health risk of residents.

3) Despite the poor service mentioned above, sludge removal fees are expensive

Whereas the informal service reportedly charges USD 7-13 as desludging fee in Maputo, there are reports of USD 80 in Lusaka, suggesting that it is a high payment for low-income people in slums.

5.6.3 Findings through Detailed Survey

(1) Introduction of Sewerage in Slums

1) Introduction of Condominial Sewerage in Slum in Lusaka City

As a case study of sewerage introduction in slums that are generally considered difficult, the Survey Team studied a case of the Condominial Sewerage in Lusaka City, Zambia (Kalingalinga Project supported by WSP).

The project was planned to involve (1) Water supply improvement (increase water supply in order to enable the introduction of water-borne sanitation) in the peri-urban area near the center of Lusaka City, (2) Obtaining consent of the community to install the sewers, participate in the installation work and maintain the system after installation through sanitation marketing, (3) Installation of sewage pipes, and 4) Each household will construct toilets and connect to sewage pipes. It was assumed that the 48,000 people would be benefitted over three phases. It is reportedly progressing to the middle of the second phase, but the number of connected units so far is unknown. The remaining phase will be implemented as soon as the funding becomes available.

According to the Lusaka Water and Sewerage Corporation (LWSC), the operation and maintenance of the installed system is good. However, LWSC does not have a plan to replicate the system in other peri-urban areas because the Kalingalinga area has been chosen for the project due to its special circumstances that there are sewer mains running nearby and a water supply source that should be protected. LWSC's strategy for other peri-urban areas is rather with lower cost solution by promoting improved pit latrines and enhancing FSM services.

2) Case Study of Sewerage Improvement in Nairobi

In the City of Nairobi, a unique measure for sewerage connections in slums is adopted.

- It is the Output-Based Aid (OBA) by the WB. This scheme regards the connection to the house as an integral part of the project while the usual sewerage project involves laying of sewer pipes only under the public road. According to the WB's Ex-post Assessment Report (2019), 137,243 people were benefitted in the slum areas with 7,260 connections compared to the target of 8,013, of which 3,122 were deemed sustainable after three months of continuous use. The cost was USD 4.2 million. In the case of Nairobi City, the same OBA scheme is also applied to water connections.
- AfDB adopts such measures as flexible door-to-door connections utilizing private lands, small diameter pipes, shallow burial of sewers, and installation of communal toilets. As for the former, sewage pipes are buried in private lands as necessary, the diameter is reduced to 6 inches (about 150 mm) from normal diameter of 250 to 300 mm, and the construction period and cost are reduced by shallow burial. This system is called Condominial Sewerage that has already been adopted in Brazil, etc. This technology has a weak point that blockage of the pipe tends to occur, but measures such as provision of an opening for inspection and sensitization of residents are carried out. The NCWSC says that the Condominial method was only introduced two years ago, and it is too early to determine its success or failure.

(2) Provision of Sludge Collection Service in Slums

1) Maputo City

Maputo is urging the transition from pit latrines to septic tanks that are easy to collect the sludge by a vacuum tanker so that sludge collectors can provide service. Some residents who switched from pit latrine to septic tanks in the slum area know that regular sludge removal from septic tanks is necessary, but some say they do not know how to contact desludging operators. Therefore, a system to ensure that slum residents can make use of the desludging service is considered unestablished.

2) Lusaka City

LWSC has developed a sludge collection scheme based on the performance-based contract to improve the provision of FSM services in peri-urban areas. LWSC signed contracts with six private companies that started service provision in May 2020. LWSC is able to provide low-cost services to low-income people by subsidizing part of the sludge collection cost (for details, see 5.8.3.(4)).

In this effort, it is unique that desludging method is clearly differentiated between the septic tank with a vacuum tanker and the pit latrine with manual emptying. The LWSC sought various desludging methods for pit latrine according to the situation in peri-urban areas (use of vacuum tankers, use of movable pumps, improvement of tools for manual emptying, etc.), but as a result, it was concluded that the optimal way was to empty the pit manually and pack the removed sludge in buckets for transporting them by light trucks.

3) Kigali City

Under the WB's second Urban Development Project, the City of Kigali is upgrading slums, and as a part of the Project, roads in the slums are being developed. As a result, residents not far from the road have been able to use vacuum tankers for desludging. Pit Vidura, a private desludging company, developed a method to provide mechanized sludge collection service without vacuum tankers and focuses on desludging services for pit latrines in slums.
In a slum in Kigali City, the Survey Team observed Pit Vidura's removal work of pit latrine sludge, and it was confirmed that pit latrine sludge contains a lot of solid matters, that is considered as one

of the characteristics of the pit latrine sludge. Technical issues associated with this include:

- In order to prevent the hose from being blocked by solid matters, it is necessary to remove them before suction work with a vacuum car or vacuum pump, which increases the cost of sludge collection work.
- Solid matters and sand tend to accumulate within the vacuum tanker and cause deterioration of the tank, so it is desirable for the tankers to wear a damper that makes it easy to discharge them.
- There is a limitation to the removal of solids and sand at the pretreatment stage in sludge treatment facilities, and contamination of solids in the treatment process is inevitable. Therefore, it is necessary to be careful when selecting the treatment process because they may cause breakdown of frequently used machinery such as pumps.

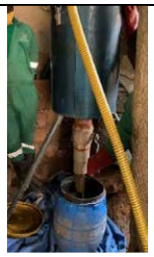
The outline of the desludging work is as follows. It is considered that the fishing before the desludging work and transportation of buckets containing the removed sludge is very heavy labor.

Observation of sludge removal work from a pit latrine in Kigali City
The target pit latrine is in a house in the back of an alley about 50 meters away from the paved road through a narrow path (see photo below). The vacuum tanker's hose does not seem to reach it.



<Desludging Procedure>
Pit latrine of the target house has not been emptied for seven years. During the time, the sludge at the bottom has hardened and it is difficult to remove it. In this work, it is explained that the upper 3 meters of fluid sedimentary sludge containing moisture can be removed. In addition, it is explained that removal of the sludge by a machine of the desludging operator is limited to a depth of 6 meters.

(1) Garbage fishing: First, use a hooked iron bar to extract solids in the pit. Do essential work to ensure that hoses and pumps do not clog with the solids. It takes 2 to 3 hours with this work alone.
(2) Sludge removal by the pump: It is a diesel-motored pump that can operate even in places where there is no electricity.
(3) The removed sludge is enclosed from the cylinder into buckets.
(4) The buckets are transported by workers carrying them on the shoulder, and loaded onto a truck parked by the side of the road. The amount of sludge removed in this work is about 30 buckets.
(5) Sludge loaded onto truck is transported to a sludge dumping site adjacent to Nduba Landfill. Since it is inefficient to carry and dump buckets, in the future it is being considered to transfer it to a vacuum car and transport it to the dumping site.
(6) It takes 4 to 5 hours to complete desludging.

 Garbage fishing	 Garbage fishing	 Sludge is enclosed from the cylinder into the bucket
 Diesel pump	 Insert the hose into the pit and pull out the sludge	 Cylinder
 Carrying a bucket in a narrow alley	 Load the bucket into the truck	

5.6.4 Measures to be taken, Matters to be considered to Realize the Cooperation

Regarding wastewater and sludge management in slums, there are cases in which sewer connection is attempted using special methods such as Output Based-Aid and Condominial method in Lusaka City and Nairobi City. Since they are not methods that can be applied to everywhere, it is generally considered that sewerage development in slum areas is not easy, and sanitation improvement in slum areas are mainly strengthened through Faecal Sludge Management (FSM) of on-site sanitation facilities. On-site sludge management in slums also faces many issues such as presence of large numbers of pit latrines that make desludging difficult, many places that are difficult to have access by vacuum tankers, and desludging fees are high and may exceed the payment capacity of slum residents. The challenge is how to overcome these problems in line with the actual conditions of slums in each individual city.

In this survey, LWSC in Lusaka City (Zambia) seemed to be a little ahead of the others in dealing with these issues, but overall, it is still considered to be in the stage of trial and error.

According to the above, it is necessary to consider the following for future cooperation.

- It is necessary to collect further information on wastewater and sludge management in Zambia (Lusaka City), especially in slum area, including a field survey.
- It is necessary to collect information on preceding cases other than Zambia (Kampala, Dakar, etc.).

5.7 City-wide Inclusive Sanitation (CWIS)

5.7.1 Perspective of Survey

In the urban area in which more than half of the population belongs to the slum population or low income population, the residents who can use the sewerage system are the minority. It is not sustainable economically, financially nor politically, to implement a sewerage project, which requires huge financial resources and poses heavy financial burdens, for the people who belong to the minority. On the other hand, the slum population or low income population, who needs to rely on the on-site sanitation facilities are required to pay large amount of money for the low quality desludging services provided by informal sector, such situation had been left unsolved without the intervention by the public sector in many SSA countries until the recent time. Nobody gains from such situation. The concept of CWIS was conceived in order to change such situation and to create a win-win situation for all the city residents. This survey studies how far this CWIS concept is taking root in SSA countries.

5.7.2 Findings from Literature Review and Interview Survey

According to the literatures provided by the WB or the BMGF, the concept of the CWIS is to select the most appropriate technology, which fits the best to the actual situation, among various measures including both the centralized solutions and the on-site solutions, and, by doing so, to fulfil the demands of all the city residents. Under the CWIS, the most important element is to improve the various sanitation services related to the on-site sanitation, in order to fulfil the demands of the slum population and low income population who inevitably rely on the on-site sanitation. Therefore, the improvement of the FSM is the pillar of CWIS.

Both the WB and AfDB used to include not only the development of sewerage system but also the construction of faecal sludge treatment facilities in their project scope. When considered necessary, they used to include the installation of toilets (VIP latrines) for low income populations including slum population, too. But, even if the toilets and the faecal sludge treatment facilities are developed, the on-site sanitation would not improve without improvement of the sludge collection and transport services which connects both ends. It is only the recent time that the importance of establishing the flow of series of services from the construction of the toilets, collection, transportation, treatment and reuse of the faecal sludge, and of the intervention by the public sector (central government, local government, regulatory agency, public utility for water and sewerage) in this regard, is recognized.

BMGF has been taking leadership role in this move. BMGF is currently strengthening its support for CWIS in SSA and South Asia. In SSA, the BGF is focusing on the following three (3) countries.

Table 5-7 BMGF's CWIS Support Focus Countries (SSA)

BMGF's CWIS Support Focus Countries
Senegal
Zambia
Uganda

The staffs of the WB resident mission in Zambia and Uganda, whom the survey team interviewed expressed their views that BMGF has the superior know-how for establishing the sanitation service chain which is essential for the realization of CWIS and is playing a supplemental role for the sanitation assistance by the WB and AfDB.

The WB creates 'CWIS Team' in its Water Global Practice. (The Task Team Leader is Mr. Martin Gambrill, Lead Water and Sanitation Specialist. AfDB is also adopting the CWIS concept in its sanitation assistance.

The sanitation projects in 8 SSA countries, which were selected as the target countries for the second

phase, the appraisal report of which mentions about the adoption of the CWIS concept (support of the sanitation service chain is included in the project scope) are as shown in the following table.

Table 5-8 WB/AfDB Financed Project including CWIS Concept

MDBs	Countries	Project with CWIS Concept
WB	Cote d'Ivoire	Additional Financing for the Urban Water Supply and Sanitation Project (2019)
WB	Zambia	Lusaka Sanitation Project (2015)
AfDB	Zambia	Lusaka Sanitation Program (2015)
WB	Mozambique	Mozambique Urban Sanitation Project (2019)
WB	Burkina Faso	Water Supply and Sanitation Program for Results (2018)
WB	Ethiopia	Consolidated Water Supply, Sanitation, and Hygiene Account Project (2019)

5.7.3 Findings through Detailed Survey

In order for the CWIS concept to take root in each SSA country, it is necessary not only for the government to adopt the CWIS concept in their sanitation policy paper or sanitation strategy paper but also for their sanitation service utilities to include the job related to the CWIS concept in their operation.

In all the 5 countries for the detailed survey (Rwanda, Mozambique, Zambia, Cote d'Ivoire and Kenya), not only the sewerage system development but also the strengthening of the on-site sanitation management by the public sector is mentioned in their sanitation policy/strategy paper, reflecting the CWIS concept.

Table 5-9 CWIS Concept in Sanitation Policy/Strategy Paper

Country	CWIS Concept in Sanitation Policy/Strategy Paper
Rwanda	Develop the safe and well regulated sanitation services affordable for the residents.
Mozambique	Improvement of on-site sanitation (transition to the septic tank, improvement of pit latrine in slums) is prioritized. Strengthening the faecal sludge management business (FSM) by promoting the private sector participation is required.
Zambia	National regulatory agency makes provision of on-site sanitation services as a condition for licensing the water and sanitation utility.
Cote d'Ivoire	Importance of coordination among government agencies, private operators and local governments for on-site sanitation is highlighted.
Kenya	Establishment of the standards and rules for the installation of on-site sanitation facilities, the regulations for private desludging operators and the standards for desludging works and the license system related on-site sanitation.

How the sanitation service utilities include the job related to the CWIS concept into their operation, in another words, the actions taken for establishing the sanitation service chain for the faecal sludge management, varies country by country (utility by utility). More or less, some action is being taken by all the utilities in these countries. It seems that the most advanced in this regard among 5 countries is LWSC (Zambia) supported by the BMGF.

In other 2 countries focused by the BMGF, Uganda (Kampala City) and Senegal (Dakar City), which were excluded from the Detailed Survey Countries, it is reported that their sanitation service utilities are conducting the operations reflecting the CWIS concept. It was considered in the Survey that it is desirable to collect information on their activities in these countries which will be useful for JICA to consider on the introduction of the CWIS concept in its sanitation assistance.

Table 5-10 Sanitation Service Utility's Operation reflecting CWIS Concept

Country	Sanitation Service Utility	Operation reflecting the CWIS Concept
Rwanda	WASAC	License system for the desludging operator was introduced by RURA (regulatory agency). WASAC participates in the working group hosted by RURA for drafting the new guidelines for faecal sludge management (FSM), in which the strengthening of the role of WASAC in FSM is considered.
Mozambique	Maputo City Council	License system for the desludging operator is in place. The City Council, in collaboration with WSP (WB), conducted a pilot project for creating a business model for FSM in slum areas. The conversion from pit latrine to septic tank is being promoted by the City Council.
Zambia	LWSC	LWSC expanded its operation to on-site sanitation and FSM. LWSC created the FSM Unit inside the company by the support of BMGF. LWSC created the structural standard for the improved pit latrine which makes the desludging works easier. LWSC entered into the performance based contract with six (&) private companies to provide the desludging services in slum areas. LWSC is developing the sludge treatment facilities,
Cote d'Ivoire	ONAD	By the USAID support, ONAD conducts such activities as training of the septic tank builders in slum areas, creating license system for the desludging operators, training of the desludging operators, helping the establishment of the Association of Desludging Operators and holding regular meetings between ONAD and the Association, creating the financing system for the desludging operator's purchase of vacuum tankers, establishing Call Center in ONAD and developing the sludge treatment facilities.
Kenya	NCWSC AWWDA	Connection of the slum residents to the sewerage system using output-based aid (OBA) and/or condominial sewerage system was piloted. NCWSC provide licenses to private desludging operators. NCWSC and AWWDA is preparing for the improvement plan of FSM.

5.7.4 Measures to be taken, Matters to be considered to Realize the Cooperation

According to the survey team's understanding, under the current situation prevailing in SSA countries in which the ratio of the slum population in the urban population is high and most of them do not have the access to the appropriate sanitation services, the CWIS is equal to enabling the provision of the wastewater and FSM services to the slum areas. The survey team considers that the CWIS concept reflects precisely the current situation in SSA countries.

Through the detailed survey, it was confirmed that all the targeted countries for the detailed survey not only have reflected the CWIS concept in their sanitation policy, strategy but also have made or making the sanitation service utilities include the activities related to the on-site sanitation management in their operations. We can assume that there are other SSA countries doing the similar. It may be possible to conclude that the CWIS concept is taking root in SSA countries to some extent.

According to the above, it is necessary to consider the following for future cooperation.

- Adoption of the CWIS concept may make the dialogue with the SSA country and the collaboration with other donors smoother.
- It may be necessary to strengthen the collaboration with Bill & Melinda Gates Foundation (BMGF), since both the WB and AfDB admits the superior know-how of BMGF in reflecting the CWIS concept in the wastewater and FSM administration in developing countries.

5.8 On-Site Sludge Management (FSM)

5.8.1 Perspective of Survey

In the cities of Sub-Saharan African countries, where the majority of the population is dependent on on-site sanitation facilities, it is essential to improve FSM services in order to realize CWIS in which all residents can enjoy appropriate sanitation services.

In order to improve the service, comprehensive measures such as (1) development of regulations and systems to ensure provision of adequate services, (2) establishment of a service provision system by fostering and strengthening private companies, (3) raising of residents' awareness of using the adequate services, and (4) financial measures to enable low-income people to use the services will be necessary.

Therefore, it is important to identify good practices by understanding specific initiatives and measures taken in the target cities.

5.8.2 Findings from Literature Review and Interviews Survey

(1) Development of Regulations and Systems to ensure Adequate Services

1) Standards for On-Site Sanitation Facilities

The following efforts have been made to promote the installation of on-site sanitation facilities that facilitate sludge removal, such as linings of pit latrine.

i) Maputo

Maputo City has established installation and structural standards of pit latrines by by-laws. However, the standards are not enforced and monitored sufficiently by the City.

ii) Lusaka

Lusaka City has set standards for the construction of pit latrine, and the LWSC is urging residents to build a pit latrine that meets them. The City is supposed to enforce and monitor the standards, but its implementation status is unknown.

iii) Kampala

KCCA has developed the Minimum Standards for Onsite Sanitation Technology Options in Kampala as a standard for installing on-site sanitation facilities, but its implementation status is unknown.

2) Standards for desludging

As far as the survey has been conducted, only Maputo City has defined the timing of sludge removal (when the sludge reaches a certain height), the removal and treatment methods of sludge by a by-law.

3) Regulation of FSM Services

The utilization of private enterprises in FSM services is mainstream in each target city. In order to secure appropriate service provision by private businesses, Initiatives such as the registration and permission systems of operators, and contracts and agreements that define the service level are observed. Specific examples are as follows.

i) Maputo

Maputo City regulates sludge removal and transportation services by vacuum tankers.

The City has set a service level and signed contracts with private companies to provide services in slums where existing service provision has been insufficient.

There seems to be no crackdown on informal services, but it needs to be checked.

ii) Lusaka

Permission from ZEMA is required for sludge removal and transportation services by vacuum tankers.

With the support of the WB project, LWSC signed a Performance-Based Contract with private companies to provide services for slums with agreed service level.

There seems to be no crackdown on informal services, but it needs to be checked.

iii) Kampala

For regulating desludging operators in Kampala, KCCA issues permits for operating sludge collection to private companies, and concludes a Service Level Agreement (SLA) in which the respective roles of KCCA and the companies as well as requirements and monitoring are agreed. In addition, private companies need to obtain permission from NEMA for sludge transportation.

Informal sludge removal is prohibited, but the actual situation is unknown.

4) Establishment of Service Provision System by fostering and strengthening Private Companies

Due to the absence of or limited FSM service provision in slums, residents are forced to rely on informal services. In order to overcome the situation, efforts have been made to foster the private businesses to make them capable of providing appropriate services. Specific examples are as follows.

i) Maputo

Maputo City provided training, operation manuals and necessary equipment to private contractors that the City contracted.

ii) Lusaka

LWSC provided training for private companies that it contracted. In the contracting process, LWSC encouraged the companies to employ informal workers who had already worked in target areas, aiming a win-win in terms of improving the working environment for the workers and facilitating service provision using the workers' knowledge about the target areas.

iii) Kampala

The KCCA is responsible for encouraging private operators to provide sludge collection services in slums and, if necessary, fostering such operators.

5) Raising of Residents' Awareness of using Appropriate Services

In order to introduce formal services, it is necessary to make residents understand that informal desludging services worsen the surrounding environment and increase health risks, and to encourage them to use hygienic services, although they are expensive. Specific examples of initiatives include:

i) Maputo

Through a campaign involving community leaders by the Maputo City, residents were able to understand the public health problems caused by improper sludge treatment and that appropriate services are clean. As a result, residents have come to seek appropriate desludging service.

ii) Lusaka

With the support of the AfDB, the LWSC uses a social marketing firm to reach out to communities for encouraging not only adequate sludge removal but also appropriate toilet construction and raising of sanitation awareness.

iii) Kampala

KCCA recognizes the importance of FSM and is responsible for improving on-site sanitation facilities that are difficult to be emptied, and for persuading residents to use desludging service provided by authorized operators.

6) Financial Measures to enable Low-Income People to use the Services

Measures have been taken to reduce the amount paid by low-income people for desludging service in a manner in which the city or water and sewerage companies cover a portion of the cost of FSM service provision by private operators in slums. Specific examples are as follows.

i) Maputo

Maputo City bears the transportation from the relay station to the sludge treatment facility if the sludge is collected in slums. In addition, private businesses are waived from payment of the tipping fee in case they deliver the sludge by themselves to the treatment facilities.

The City planned to start collection of sanitation and wastewater charge in 2021, and "sludge treatment" is stipulated as one of the targets that are covered by the revenue, but it is unclear whether it will be used to reduce sludge removal fees for low-income people.

ii) Lusaka

In the Performance Based Contract with private operators, the amount paid by the user for desludging service is kept low to a certain amount, and the cost exceeding it is paid by LWSC to the operators according to their performance.

5.8.3 Findings through Detailed Survey

(1) Improvement of On-Site Sanitation Facilities

Improving on-site sanitation facilities (pit latrines, septic tanks) to be safe for users and easy to remove sludge should be considered in the first place for on-site sludge management (FSM), and various attempts are being made in the target countries of the detailed survey. The following attempts have been made as described in detail in 5.1.3. In Mozambique and Zambia, WB and other donors provide financial support for covering part of the costs required for residents to improve (build or remodel) on-site sanitation facilities.

(2) Development of Regulations and Systems to ensure Good Service Provision

Concerning on-site sanitation and on-site wastewater management, private operators actually provide services such as construction of on-site facilities, sludge collection and transportation from on-site facilities, and maintenance and inspection of on-site wastewater treatment plants. Ensuring quality of the service provision is an issue. In order to ensure it, all the five countries that are targets of the

detailed survey, have strengthened measures. The measures include introduction of permission and registration systems for the service providers, establishment of guidelines on the service provision and conducting training for the private operators. The details are described in 5.10.3. below.

(3) Status of Sludge Collection Service by Private Operators

1) Kigali City, Rwanda

Through the field survey, it was found that there were six desludging operators licensed by the regulatory agency RURA. However, the number of vacuum tankers owned by the six operators was significantly insufficient with a total of 15 or less, and only one company named PIT VIDURA provides mechanical desludging service using vacuum pumps and other equipment in slums where vacuum tankers cannot enter. One of the obstacles to new entry of desludging operators is that there is no government support for the cost of purchasing vacuum tankers and spare parts, making the initial investment burden very large.

2) Maputo City

Companies that collect and transport sludge from on-site sanitation facilities require the permission of the Maputo City. Currently 40 companies with a total of 72 vacuum tankers are authorized. It can be said that the sludge collection industry mainly focusing on septic tanks is very active.

3) Lusaka City

Private companies provide sludge removal services from septic tanks using vacuum tankers. As of 2019, there were 54 vacuum tankers owned by about 15 companies.

4) Abidjan City

According to ONAD, as of 2020, 34 desludging operators with a total of 113 vacuum tankers had permits.

5) Nairobi City

150 desludging operators are authorized by the NCWSC with 200 vacuum tankers. New entry of operators into the desludging business is increasing.

(4) Establishment of Service Provision System by fostering and strengthening Private Companies

Even if private desludging operators are present, it is not easy to make them provide sludge collection services to residents of slums. In Mozambique and Zambia, attempts have been made to build a business model for on-site sludge management (FSM) in slums with support of the WSP (WB) and AfDB. It was found that the attempt have been successful in Zambia to some extent.

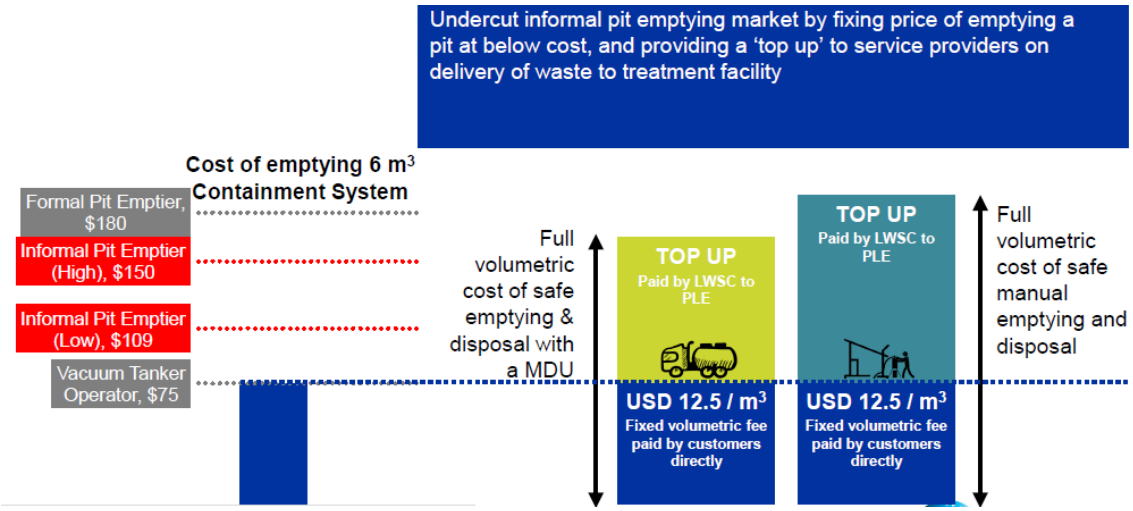
1) Maputo City

The WB has worked developing a FSM business model for low-income people in the peri-urban areas through WSP from early on. Specifically, it provided training and necessary equipment (manual pumps, etc.) to eight existing waste service providers and urged them to provide sludge collection services in a peri-urban area where service provision by vacuum tankers was difficult. According to the Maputo City, the service providers have changed their service target from the peri-urban residents to middle and high income persons because it was not a profitable business due to the difficulty of work and the low payment capacity of slum residents.

2) Lusaka City

With the support of the WB and AfDB in LSPs, LWSC has built an FSM business model based on the performance-based contract with the aim of providing formal services by private companies instead of informal, individual-based services. Subsidies reduce the amount paid by low-income residents, and the amount paid to operators increases according to their performance. It can be said that LWSC deals with the challenge faced by Maputo City which is "It is not a profitable business due to the low payment capacity of residents" by applying subsidies. The outline is as follows.

LWSC started service provision in May 2020 by concluding performance-based contracts with 6 private companies. LWSC subsidizes a part of desludging cost as "TOP UP" part in the figure below.



Source: LWSC & WB, Lessons Learned On-Site Sanitary and Fecal Sludge Management from the Lusaka, 2021

Figure 5-14 Conceptual Diagram of LWSC's FSM Service Provision

LWSC has established the foundations for the FSM business by promoting improved pit latrine to stimulate demand for desludging, and at the same time securing service providers. It provided training on sludge collection with the six participating companies.

The six companies consist of two community-based Water Trust organizations and four private companies. All peri-urban areas in Lusaka are eligible for the service provision.

The performance indicator is the volume of sludge that is desludged and safely transported to the treatment plant in a month. The LWSC set the target value for each contractor on monthly basis and measures contractor's performance based on it.

The desludging fee is 150 Kwacha (approximately USD 8.3) per m^3 of sludge, and LWSC pays transportation and dumping expenses (Top up portion) to the companies (190-290 Kwacha/m^3, equivalent to USD 10.5-16).

Marketing of the services to the public is based on the use of billboards, TV, radio, etc. as well as direct advertising to community members. In addition, each company is also advertising its service.

Based on this activity, LWSC is developing a standard operating procedure (SOP) as an FSM business model.

(5) Reduction of Sludge Collection Cost

The biggest obstacle for on-site sludge management (FSM) is the high cost of sludge collection and

transportation using vacuum tankers. Collection and transportation of household septic tank sludge costs more than USD 200 in Japan whereas in developing countries in Asia it costs around USD 50. It is said that the sludge collection and transportation cost of Africa are generally higher than in Asia. If USD 50 must be paid at once, it would be a significant burden for ordinary households in developing countries. Particularly for low-income people such as those living slums, it would be prohibitively expensive. The challenge is how to reduce this to a level that is affordable for such households.

In Dakar, Senegal, it is reported that with the support of the BMGF, new entry of operators to the desludging business has been promoted and call centers have been established to reduce sludge collection and transportation fees by 20%. It can be a promising solution for the issue to switch from the demand correspondence (on-call) sludge collection system which is common in majority of countries to the planned sludge collection system like the periodic sludge collection system of the septic tank in Japan. Introducing monthly payment plan system of desludging fees instead of pay-all-at-once could be another solution but currently no countries apply such system.

The situation in Zambia and Cote d'Ivoire on this issue is as follows.

1) Zambia

Based on the FSM business model with the performance-based contract (see 5.8.3.(4)), LWSC subsidizes part of the sludge collection costs for slum residents in Lusaka City.

2) Cote d'Ivoire

Under the SSD project supported by the USAID, a call center was established in ONAD and it is still active. However, the periodic sludge collection system (the obligation of residents to desludge their on-site sanitation facilities and the rule of its frequency) has not been introduced and the sludge collection fee is not regulated. Current practice is that when the septic tank is full, the residents ask desludging operator to collect sludge, and the sludge collection fee is negotiated between users and operators based on the distance from the collection location to the unloading station. Some poor people who are not capable of paying the sludge collection fee by vacuum tankers seem to remove sludge manually by themselves or by contracting informal service providers and dump the sludge into storm water drainage near their homes.

5.8.4 Measures to be taken, Matters to be considered to Realize the Cooperation

On-site sludge management (FSM) is the most important means for realizing CWIS in light of the current state of urban sanitation in SSA countries. In the Detailed Survey, it was found that at least those target countries are working, either totally or partly, on the improvement of on-site sanitation facilities, the development of regulations and systems to ensure good service provision, the establishment of a service provision system by fostering and strengthening private companies and reducing sludge collection costs. However, it was also found that the extent to which each country has achieved differs a lot among them.

In order to increase efficiency of the FSM and enhance the environmental improvement effect, it is desirable for each country to introduce a periodic sludge collection system such as one that introduced in Japan. But it has also become clear that no countries have done it or even approached to do it. In order to oblige users of the periodic desludging, it is necessary to meet a condition in which sufficient desludging service provision should be possible. It is thought that each country is still far from meeting the condition.
According to the above, it is necessary to consider the following for future cooperation.

- There is an excellent FSM system in Japan, but it is necessary to carefully examine whether it conforms to the current situation of SSA countries. If there are more suitable FSM implementation models (such as the call center system supported by the BMGF in Dakar and Kampala), and if they are judged to be appropriate in light of the current situation of each country, it is advised to flexibly incorporate them into JICA's cooperation.

5.9 Social Marketing

5.9.1 Perspective of Survey

In order to realize CWIS, it is important to raise awareness of population regarding environmental and public health problems caused by insufficient wastewater and sludge management. In this context, social marketing can be done to urge people to: (1) build appropriate on-site sanitation facilities, (2) connect to sewers in areas where sewerage is maintained, and (3) promote the conversion of using informal pit emptying service into the use of hygienic regular FSM services.

It is useful for Japan's sanitation cooperation to understand what resources international aid agencies and NGOs are using to conduct such awareness raising and social marketing for target residents.

5.9.2 Findings from Literature Review and Interview Survey

In the following projects, awareness raising and social marketing for residents are carried out.

(1) Maputo: FSM pilot project in peri-urban area (supported by WSP)

- Contents of awareness raising and social marketing
  - ✓ Importance of FSM for Public Health
  - ✓ Role of local small companies that provide FSM services
- Resources used: Local NGO, Mozambique Small Service Providers Association (AMMEPS)

(2) Lusaka: FSM Improvement Project in peri-urban areas (supported by WSUP)

- Contents of awareness raising and social marketing
  - ✓ Improving public health with proper FSM services
  - ✓ City regulations (informal FMS services are illegal)
  - ✓ Details of the new FSM service provision
- Resources for used: WSUP local staff

(3) Lusaka: Lusaka Sanitation Program (supported by AfDB)

- Contents of awareness raising and social marketing
  - ✓ Health and environmental risks posed by inadequate sanitation
  - ✓ Importance of sewer connection
  - ✓ Need to improve the FSM
- Resources used: Local sanitation marketing firm*
  *The company is a JV with a UK company and a local company. The UK company brings experts with experience in Asia (Indonesia, Thailand, Bangla, India, etc.) to strengthen the capabilities of local companies and tries to enable local companies to perform sanitation marketing even after the project ends.

(4) Kampala: Citywide Community Mobilization in the Sanitation Improvement Program / Kampala FSM Program (supported by BMGF, DfID, GIZ and WFP)

- Contents of awareness raising and social marketing
  - ✓ Importance of safe and hygienic desludging
  - ✓ Importance of improving toilets (allowing sludge to be easily removed)
  - ✓ Importance of keeping toilets hygienic
- Resources used: Unknown. Active involvement of community leaders is noted.

5.9.3 Findings through Detailed Survey

(1) Maputo City

Maputo City is promoting the conversion of pit latrines into septic tanks in its effort of sanitation improvement in peri-urban areas with the support of WSP, and is working for the construction of individual household toilets and multi-family toilets, both with septic tanks, subsidizing part of construction cost.

Concerning the construction of individual household toilets, it is conducted in collaboration with WSP and a local civil society organization (CSO) called Residents Association of Chamanculo C District. Therefore, it is assumed that the CSO raised awareness of the target families about importance of converting pit latrines into septic tanks, bearing a part of construction cost, and operation and maintenance of the facility after the construction.

(2) Lusaka City

In Lusaka, in the process of developing a design for improved pit latrine, LWSC has visited the community to understand the needs of users and reflected it in the design with the aim of making a human-centered one. In addition, community leaders have also participated in finalizing the design, suggesting that LWSC has continued dialogue with the community from the beginning of the process with the promotion of the newly designed pit latrines in the community in mind.

5.10 Regulation for Improvement of On-Site Sanitation Management

5.10.1 Perspective of Survey

The regulations on on-site sanitation/wastewater management in Japan, in Johkasou Act (On-Site Sanitation System Act), Waste Management and Public Cleansing Act, Building Standard Act, etc. are considered to be the most advanced in the world. The Johkasou Act (1983) was enacted to regulate all the steps such as, manufacturing, installation, collection and transportation of the sludge, maintenance, human resource development, performance monitoring by the third party, of the Johkasou, the standard on-site wastewater treatment system in Japan with high treatment performance comparable to the modern WWTP. Although some articles may not be applicable for the on-site systems such as pit latrine and septic tanks prevailing in developing countries, the articles on construction/installation, collection and transportation of the sludge, sludge treatment, human resource development, would be applicable for such low-tech on-site systems.

Actually, it was found that, in many of the eight (8) countries targeted for the survey, the registration system (license system in Japan) is being established as the first step of the improvement of the on-site system management.

Furthermore, in some countries, the effluent standards for the large on-site system of commercial users such as hotels, office buildings, shopping malls, etc. are tightened and the advanced decentralized wastewater treatment systems similar to Johkasou in Japan, are being introduced by commercial users. The regulatory system in Japan established by Johkasou Act would be a useful reference for regulating such systems.

The following table summarizes the challenges of the on-site systems which are common in Japan and in developing countries and Japan's responses to these challenges item by item.

Table 5-11 Challenges in On-Site System Management

Challenges	Japan's Response
Improper design of the on-site systems	Structural standards, Government approval, Performance testing system of the on-site systems
Lack of monitoring of compliance with the building standards of the on- site system	Building confirmation by the building officials of a local government
Poor installation of the on-site systems	Registration system for the Installation Business Certification and Examination system for the Installation Workers
Improper management of the sludge generated by the on-site systems by their owners or users	Enactment of the On-site System Act (Johkasou Act). Regular desludging obligation.
Unregulated De-sludging Operators working in the difficult conditions	Approval system of the desludging vendors
Improper treatment/disposal of the on-site sludge	Development of the sludge treatment facilities nationwide
Improper operation and maintenance of the on-site systems	Enactment of the On-site System Act (Johkasou Act). Owner's legal obligation of O&M. Owner's obligation of deploying a Technical Supervisor for a large on-site system (≧501PE). Registration system for the O&M vendors.
Lack of human resources for the maintenance work	Training system, Certification and Examination system for the O&M technicians.
Lack of awareness on the on-site systems among the system owners and local governments	Establishment of the training institution for the professionals in the business related to the on-site systems
Lack of accountability	Legal inspection
Poor operation and maintenance of the large size on-site systems of the commercial users	Monitoring under Water Pollution Control Law (compliance to the effluent standard, measurement, report and inspection)

5.10.2 Findings from Literature Review and Interview Survey

The survey team obtained the detailed regulations on the on-site system in Rwanda enacted in 2016

and found that the regulations cover many items which are included in Japan's regulations on the on-site system.

5.10.3 Findings through Detailed Survey

All the five (5) countries for the detailed survey are working for the improvement of faecal sludge management (FSM). Although the situation of establishment of the regulations for the purpose varies country by country, all five (5) countries have already introduced license/registration system for the desludging operators. It is because it is essential for the government to grasp the desludging operators who actually provide the services, in order to improve FSM. But it is also found that, although the regulation is important, it is not enough to improve FSM if the administrative organization which administer the regulation is not in place. In Zambia and Kenya, Water and Sewerage (Sanitation) Company (public utility) has included FSM in their scope of business. In Rwanda, similar reform is under consideration.

(1) Rwanda

Rwanda Utilities Regulatory Authority (RURA) enacted series of regulations on on-site sanitation in 2016 which includes the permit system on the construction business, desludging business, operation and maintenance business of the on-site systems, which are similar to the regulations on the on-site system in Japan.

Around 2016 when the series of the regulations on on-site sanitation were enacted, however, a few numbers of research papers appeared which pointed out that the faecal sludge management is not properly conducted in the slum areas of Kigali City where 78% of city population lives. Although the development of regulations is the first step for the on-site system management, it is not enough and further improvement such as reforming the administrative organization needs to accompany.

Based on such understanding, related agencies such as WASAC have established a working group and are preparing new FSM guidelines with the support of the BMGF and under the leadership of RURA. Based on the new guideline, new regulations on FSM are scheduled to be enacted by June 2022. Under the new guideline, the WASAC is responsible for the management of on-site systems including the faecal sludge management of all the residents including those who live in slum areas and the operation and maintenance of the decentralized wastewater treatment systems in the estates and commercial buildings. Under the WASAC's supervision, the private desludging operators and the operation and maintenance vendors will to the job. It is also considered to introduce such system as the associated costs will be recovered by incorporating them in WASAC's water bill.

(2) Mozambique

In Maputo City, Mozambique, the desludging industries look active. Furthermore, conversion from pit latrine to septic tanks of the slum residents is also in progress. But, when the Survey Team interviewed a slum resident who has recently converted her pit latrine to a septic tank, it was mentioned that, although she was told that septic tank needs to be desludged regularly, she does not know how to contact the desludging operator. It seemed that a system which ensures access to desludging service to all slum residents has not been established yet.

In Mozambique, each municipal council is to enact the ordinances required for the provision of the sewerage and FSM services in the city. Autoridade Reguladora de Água (AURA) has a role to prepare guidelines for the purpose and to guide the municipalities. The AURA is planning to prepare the following guidelines and expressed interest in Japan's on-site sanitation management system. The following materials were provided to AURA through the Survey:

- KPIs on the on-site sanitation

- Guidelines for faecal sludge management (FSM)
- Guidelines for the private sector participation in the on-site sanitation
- Guidelines for securing the hygiene and safety of the sanitation workers
- Effluent standards for the sludge treatment and the related matters such as the sampling method

(3) Cote d'Ivoire

Under the USAID Project, ONAD conducts such activities as training of the septic tank builders in slum areas, creating license system for the desludging operators, training of the desludging operators, helping the establishment of the Association of Desludging Operators and holding regular meetings between ONAD and the Association, creating the bank financing system for the desludging operator's purchase of vacuum tankers and establishing Call Center in ONAD in order to connect the customers and the desludging operators.

On the other hand, it was found that the regular desludging system (obligating the residents to desludge his/her on-site system, establishing the rule on the required frequencies) has not been introduced and the desludging fee is not regulated. The residents ask the desludging operators to do the job, when his/her on-site system is full of sludge. The desludging fee is subject to negotiation between the residents and the desludging operators taking into consideration the distance between the place of collection and the unloading station.

(4) Zambia

In Zambia, under the Lusaka Sanitation Program (LSP) which was supported by four (4) donors (WB, AfDB, EIB and KfW), the guidelines and standards on the on-site sanitation and on the provision of the FSM services for low-income residents were prepared. Based on the achievement of LSP, National Water and Sanitation Council (NWASCO) prepared 'Regulatory framework of urban on-site sanitation and FSM' for all the water utilities (CUs) nationwide and expanded its own mandate of licensing into the area of on-site sanitation and FSM. NWASCO reviewed its conditions for licensing CUs and added the service provision for on-site sanitation and FSM as the responsibilities of CUs.

NWASCO is currently preparing for the Code of Practice on On-site Sanitation which is aimed at establishing the technical standards on the on-site sanitation facilities in Zambia and the standards for the provision of the FSM services. According to NWASCO, the documents are 90% complete except the technical drawings and will be finalized after obtaining the approval of Zambia Bureau of Standards (ZSB). On the other hand, NWASCO is also preparing for Statutory Instrument: SI in order to ensure the enforcement of the Code of Practice so that the guidelines and standards prepared under LSP and enforced in Lusaka City by the municipal ordinance will be applied nationwide.

5.10.4 Measures to be taken, Matters to be considered to Realize the Cooperation

Since the substantial portion of the on-site sanitation services (manufacturing, construction and installation of the on-site sanitation facilities, collection and transportation of the sludge and maintenance of the decentralized wastewater treatment plants) is conducted by the private companies, it is essential to regulate them properly. The regulatory framework on the on-site system established in Japan regulates the private companies at each steps of the on-site system in detail, which can be a model for developing countries. Actually, among the countries for the detailed survey, there are countries which have established the similar regulatory framework as in Japan. But the performance of such countries is not necessarily good. The regulations would not work without accompanying the reform of the administrative organization which actually enforce the regulations or the development of the necessary infrastructures.

According to the above, it is necessary to consider the following for future cooperation.

- It is necessary to develop the measures and opportunities to explain the regulatory framework of Japan's on-site system in the manner easily understandable to the audiences in developing countries including SSA countries.
- It is necessary to have a flexibility to introduce the regulatory framework which is different from the one in Japan, if it is considered appropriate.

5.11 Sludge Treatment Technology

5.11.1 Perspective of Survey

In 8 cities surveyed in the second phase, majority of residents rely on on-site sanitation facilities such as pit latrines and septic tanks for the storage and treatment of toilet wastewater, and sludge treatment facilities for treating the collected sludge will be required.

5.11.2 Findings from Literature Review and Interview Survey

Construction of facilities for an appropriate treatment of sludge has started just recently in each country, and the treatment capacity is still insufficient.

(1) Status of On-Site Sludge Treatment

The current state of sludge treatment (disposal) in eight cities is summarized as follows.

Table 5-12 Current Status of Sludge Treatment (Disposal) in 8 Cities

Country	City	Sludge Treatment (Disposal) Method	Information Source
Mozambique	Maputo	Put into the anaerobic pond of the sewage treatment plant (oxidation pond method).	World Bank appraisal document
Rwanda	Kigali	Dumped on landfill site. There is a plan to construct a new sludge treatment facility.	Interview with WASAC in the field survey
Uganda	Kampala	Treated with covered sun sludge drying bed. There is a plan to construct three new sludge treatment facilities.	AfDB appraisal document
Ethiopia	Addis Ababa	Treated with two sludge drying beds (attached to sewage treatment plant).	World Bank appraisal document
Burkina Faso	Ouagadougou	Treated with three sludge drying beds. There is a plan to construct a new sludge treatment facility.	World Bank appraisal document
Zambia	Lusaka	Put into the sewage treatment plant (trickling filter method).	World Bank appraisal document
Kenya	Nairobi	Put into the sewage pipes and treated with sewage.	AfDB appraisal document
Cote d'Ivoire	Abidjan	Put into the sewage pipes and release into the sea with sewage (sludge generated from the western part of the city is discharged untreated into the lagoon along with sewage)	JICA FS (2000)

Maputo, Mozambique
Directly discharged into the anaerobic pond of the sewage treatment plant (Photo by the Survey Team)

Dumped at Landfill site in Kigali, Rwanda
(Photo by the Survey Team)

Decanting point within the Wastewater treatment plant in Lusaka, Zambia

Figure 5-15 Sludge Discharge at Wastewater Treatment Plants

In Ouagadougou, the National Waterworks and Sewage Corporation (ONEA) worked with the city government and private desludging operators to strengthen on-site sludge management (FSM) and build three faecal sludge treatment facilities in the 2010s. However, since the amount of sludge delivered to the facilities exceeded the treatment capacity, it is necessary to build a new facility. A similar situation is seen in Kampala.

There are also cases where on-site sludge is discharged into wastewater treatment plants (Maputo and Lusaka) and cases where sludge is put into sewage pipes (Nairobi and Abidjan). It is considered that both methods are without problem if they are conducted properly.

Technical considerations for integrated treatment of on-site sludge with sewage

In addition to treating faecal sludge in treatment facilities that are designated to the purpose, there is a method of an integrated treatment of sludge by effectively utilizing sewage treatment plants. In the integrated treatment, there are two ways to feed the sludge to the sewage treatment process: one is to discharge the sludge directly into the sewage treatment plant, and the other is to pre-treat the sludge in a designated facility (with grit removal, screen, storage tank and input pump) and discharge effluent to sewers or send it directly to sewage treatment plant. In the former case, it is necessary to secure space for receiving sludge transporting vehicles and sludge receiving unit within the sewage treatment facility. Although the former case is reasonable, necessary facilities for integrated treatment should be incorporated to the planning of sewage treatment facility from the outset, because there are restrictions on the capacity, space, sludge input destination, etc. of the sewage treatment facility if they are considered at the later stage. In the integrated treatment, since nitrogen-rich sludge is added in the sewage treatment, the nitrogen ratio to BOD (C / N ratio) decreases, so it is necessary to pay attention to the sludge input ratio to the sewage amount. An example of the flow of integrated treatment is shown in the figure below.

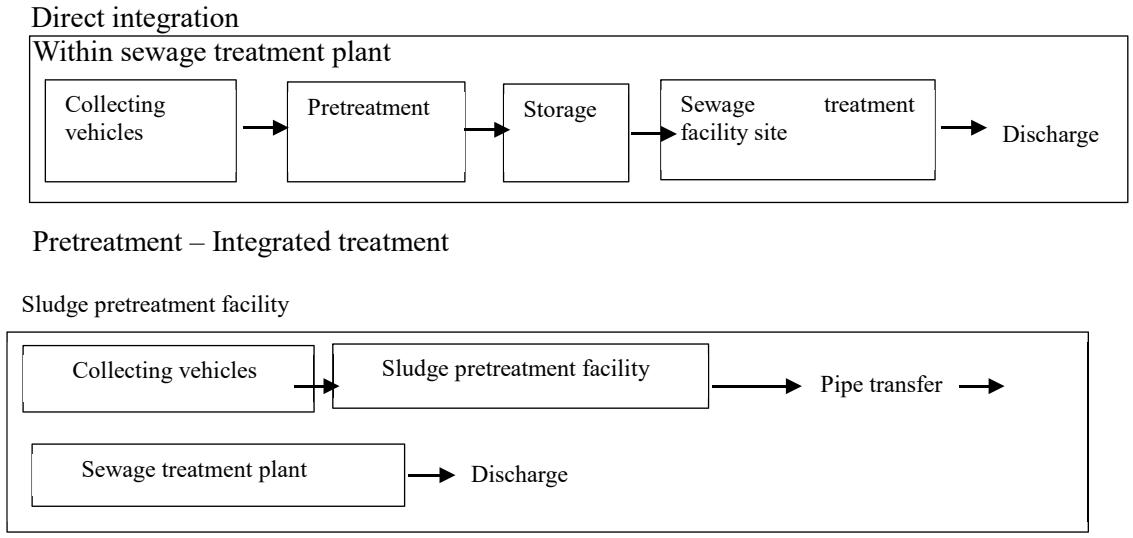
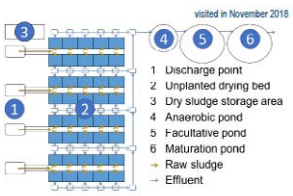
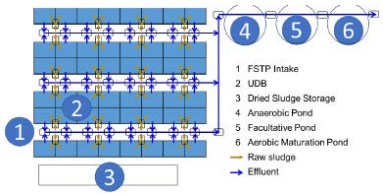
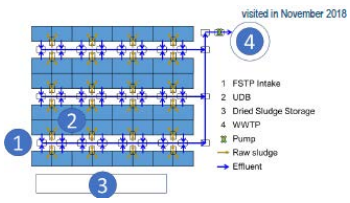


Figure 5-16 Examples of Integrated Treatment of Sludge with Wastewater

(2) Appropriateness of Sludge Treatment Technology

Among the 8 cities surveyed, 3 cities (Ouagadougou, Kampala, and Addis Ababa) have designated sludge treatment facilities. The treatment methods applied to them are considered to be sludge drying beds. Concerning the three on-site sludge treatment facilities in Ouagadougou (drying bed system), a report "Scoping Study: Faecal Sludge Treatment plants in South-South-Asia sub-Africa" that Swiss research institute EAWAG developed together with the BMGF provides a schematic drawings of the facilities.

Table 5-13 Schematic Drawings of On-Site Sludge Treatment Facilities in Ouagadougou (EAWAG)

location	Sourgoubila Burkina Faso	Zagtouli, Burkina Faso	Kossodo, Burkina Faso
Start of operation	2016	2014	2014
Treatment capacity	133m^3/day	125m^3/day	125m^3/day
Operating agency	ONEA	ONEA	ONEA
Treatment flow			
Technical details, etc.	Drying bed - Anaerobic pond - Oxidization pond - Maturation pond Load per filter area: 0.7m^3/m^2/day, 30 days of drying Tipping fee: USD 0.6/m^3	Drying bed - Anaerobic pond - Oxidization pond - Maturation pond Load per filter area: 1m^3/m^2/day, 30 days of drying Tipping fee: USD 0.6/m^3	Drying bed - wastewater treatment Load per filter area: 0.9m^3/m^2, 30 days of drying Tipping fee: USD 0.6/m^3
Problems, etc.	Basic design Clogging of the filtering bed High load on filter	Same as left	Same as left
Points needed to check	Actual treatment volume Configuration of pretreatment Generation of odors and pests Dried sludge with solids Replacement of sand, understructure for water collection Management of oxidation pond Staff training	Actual treatment volume Configuration of pretreatment Generation of odors and pests Dried sludge with solids Replacement of sand, understructure for water collection Management of oxidation pond Staff training	Treatment unit for separated effluent Actual treatment volume Configuration of pretreatment Generation of odors and pests Dried sludge with solids Replacement of sand, understructure for water collection Management of oxidation pond Staff training

Looking at the schematic drawings of the three existing sludge treatment facilities in Burkina Faso, it seems that the collected on-site sludge is directly discharged into the drying beds, and that pretreatment, solid-liquid separation and drying are performed simultaneously on the drying filter bed. Possible reasons for adopting such a method are as follows.

- Since 73% of Burkina Faso's on-site sanitation facilities are pit latrines, the proportion of pit latrine sludge is considered to consist high proportion of the sludge discharged to the facilities. Since pit latrine is located outside of the house, contamination of the pits with sand adhering to the foot and shoes easily occurs. In addition, foreign matters such as garbage are often dumped into pit because the toilet structure is for dropping. According to the analysis of contaminants content in sludge surveyed in Dakar, Senegal, degradable organic substance was 43%, sand was 25%, grit was 11%, plastic was 12%, fiber was 2.5%, plant seed was 3% and bone and wood fragments were 1%. The ratio of inorganic and no degradable contaminants accounted for nearly 50%. Although it is necessary to efficiently remove these contaminants, it can be seen that it is difficult to remove contaminants with normal pretreatment operations (sand removal by gravitational sedimentation, screen). (Source: Faecal Sludge Management, IWA Publishing, 2014)
- As a hygienic measure against pathogens, it is desirable to digest the sludge once. But when sludge with insufficient pretreatment is put into the digestion tank, it takes time and effort to remove scum and sand generated in the tank.

- The drying filter bed (sand) is easy to clog, and it takes time and effort to replace it, but it can be performed in a relatively open work environment.

In this method, it is thought that contaminants such as plastic pieces remain in the dried sludge. Therefore, it is necessary to confirm the actual condition of hand sorting.

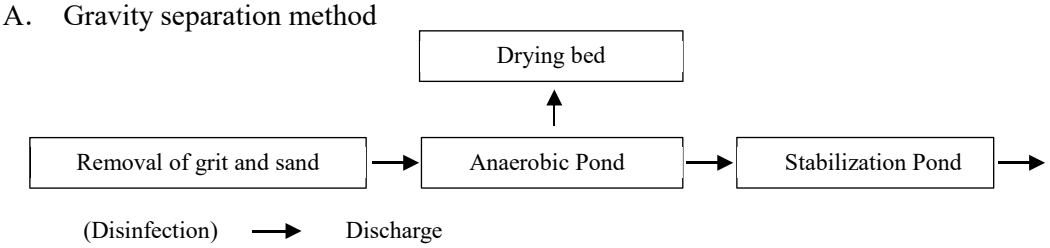
(3) Basic Approach to Design of On-Site Sludge Treatment Facility

In the box below, the basic idea in the design of the on-site sludge treatment facility is described. In addition, pit latrine sludge may not be applicable depending on the sludge properties because it contains a large amount of sand and contaminants as described above. For example, if the sludge is with low fluidity, after manually removing contaminants from the pit, sludge can be sucked by a vacuum tanker. Another method is to inject the sludge directly into the drying bed, omitting the pretreatment and solid-liquid separation steps.

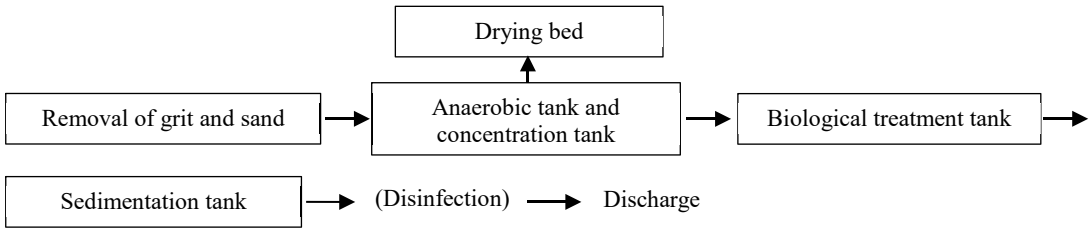
[Features of Sludge and Treatment Methods]
"Sludge" targeted here is sludge removed from septic tanks that is a mixture of sedimentary sludge and scum. In the septic tanks, solids and soluble organic matter are digested and decomposed, producing digestive sludge and scum. For this reason, the properties of the sludge have characteristics such as a small soluble organic matter, a large number of insoluble solids, and high potentiality of solid-liquid separation. Therefore, as a basis of sludge treatment, solid liquid separation such as concentrated separation and mechanical separation should be done in the preceding stage, followed by treatment of separated effluent mainly for removing organic matter in the latter stage. Almost the same treatment is carried out in the treatment of Johkasou sludge in Japan.

A flow example combining solid-liquid separation and separated effluent treatment of sludge is shown in the figure below.

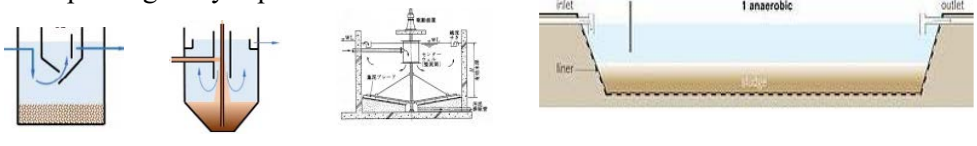
A. Gravity separation method



OR

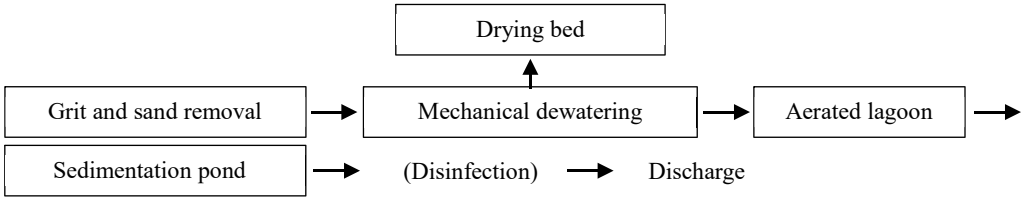


Example of gravity separation method



Inhoff tank　　Hopper type with scraping machine　　Pond type (anaerobic pond)

B. Mechanical separation method



Centrifuge [Sludge treatment operation]

Screw Press [Sludge treatment operation]

Belt Press [Sludge treatment operation]

Rotary Press [Sludge treatment operation]

[Sludge treatment operation]

(1) Pretreatment

Grit chamber and screens are used to remove soil, sand and contaminants in the loading sludge to prevent troubles in equipment and water tanks. Since it is easy to become unsanitary work, protective measures for workers are necessary. Mechanization of the process is possible.

(2) Solid-liquid separation

For a gravity sedimentation separation, those methods such as anaerobic ponds, anaerobic digestion tanks, storage tanks and concentration tanks are applied. The tank capacity is planned considering the fluctuation adjustment of the inflow volume. If the mud collection function is not equipped like an anaerobic pond, human power work is required for the extraction of the sedimentation sludge. For a mechanical separation, centrifugal dehydrator, screw press, etc. are applied. Usually, a polymer flocculant is added for sludge aggregation. The advantage of the mechanical separation is that dehydrated sludge with about 80% moisture is obtained, making it easy to dry in the sun.

(3) Treatment of separated effluent

The treatment methods of separated effluent are largely divided into a natural purification method with a stabilization pond and an artificial biological treatment method. Though algae management is necessary for the stabilization pond, the nitrogen removal effect can be expected. In the biological treatment method, in addition to the trickling filter and the activated sludge methods, there are two methods, biological membrane method and carrier activated sludge method. As a characteristic of the separated effluent, the BOD / N ratio is as low as 1-2 with respect to the raw sewage of 3-5, and in biological treatment, when managing bacteria and removing nitrogen, it is necessary to devise adjustment of BOD / N balance.

[Recycling of residue sludge]

The method which has proven in reusing sludge as the resource is a method of applying dried sludge in farmland as fertilizer. On-site sludge is characterized by high safety compared to sewage sludge because there is almost no chance of mixing harmful substances. However, since there is a possibility of accumulation of harmful substances due to bioconcentration action in the sludge treatment process, the establishment of a standard for components for utilizing as fertilizer and periodic analysis are required, and the introduction of a system corresponding to the Japan Fertilizer Control Law will be effective. As for the drying method, a drying bed method and a machine drying method are used, and the drying bed method is advantageous in terms of maintenance cost, but there are restrictions such as land space and location considering odor. In the machine drying method, heat treatment such as kiln method is common, but maintenance costs such as odor countermeasures and corrosion prevention measures of generated gas increase.

5.11.3 Findings through Detailed Survey

(1) Pretreatment

At the three existing sludge treatment facilities in Ouagadougou, pit latrine sludge seems to be directly put into the drying beds. In Maputo, sludge removed from septic tanks is discharged directly into the anaerobic pond, and only a simple screen is used in other examples. In such pretreatment operations, residue remains in the dried sludge, and there is a concern of soil contamination by metal fragments and vinyl at the time of applying it in farmlands. In the case of direct sun drying treatment, this point could not be confirmed, but in fact, there is a high possibility that hand selection has been performed to some extent during the scraping of dried sludge. As a method for efficient sorting of contaminants, the introduction of a vibrating sieve machine should be considered. But development of a simple sieving device that can be performed manually is desired.

The standard pretreatment method used for sludge treatment in Japan is a combination of automatic fine eye screen (1 to 2 mm) and screw press. The reason for this is that an ultrafiltration film is used in the biological treatment process, and it is an indispensable device for membrane protection. In addition, in order to perform fine eye screen processing, it is necessary to maintain auxiliary equipment such as fine sand removal, introduction of a fine crusher, and relay tank arrangement. It is difficult to apply the pretreatment method in Japan as explained above to treatment of sludge from pit latrine and septic tank.

In Nairobi and Abidjan, sludge is injected to sewer pipes. If the injection is conducted without pretreatment, there is a concern of environmental outflow of contaminants in the interceptor type, so it is desirable to inject the sludge after pretreatment.

(2) Planning of New Sludge Treatment Facilities

New sludge treatment facilities are planned in Rwanda, Mozambique and Zambia. According to these planning documents, the applied common flow is as shown below.

- Receiving of sludge: coarse screen and gravity solid-liquid separation (concentration tank)
- Separated effluent: Anaerobic tank (multi-chamber type) - Natural purification system (artificial wetland) -Discharge into sewers
- Separated sludge: Drying bed

It is obvious that method that does not require energy is adopted. DEWATS is the basis of the methods, and there are cases in Asia as well.

A gravity separation method is used for the solid-liquid separation of sludge, but if a sludge dehydrator is introduced, the drying bed can be made compact. Pit latrine sludge has a limitation in pretreatment, and it is difficult to apply mechanical dehydration to it.

The anaerobic tank adopts a multi-chamber type, which can be considered as an improved version of the conventional septic tank. Artificial wetlands require the labor of vegetation management, but the removal of nitrogen and phosphorus can be expected. When sewerage is introduced in these planning facilities in the future, it is possible to inject the separated effluent of the anaerobic tank into sewers.

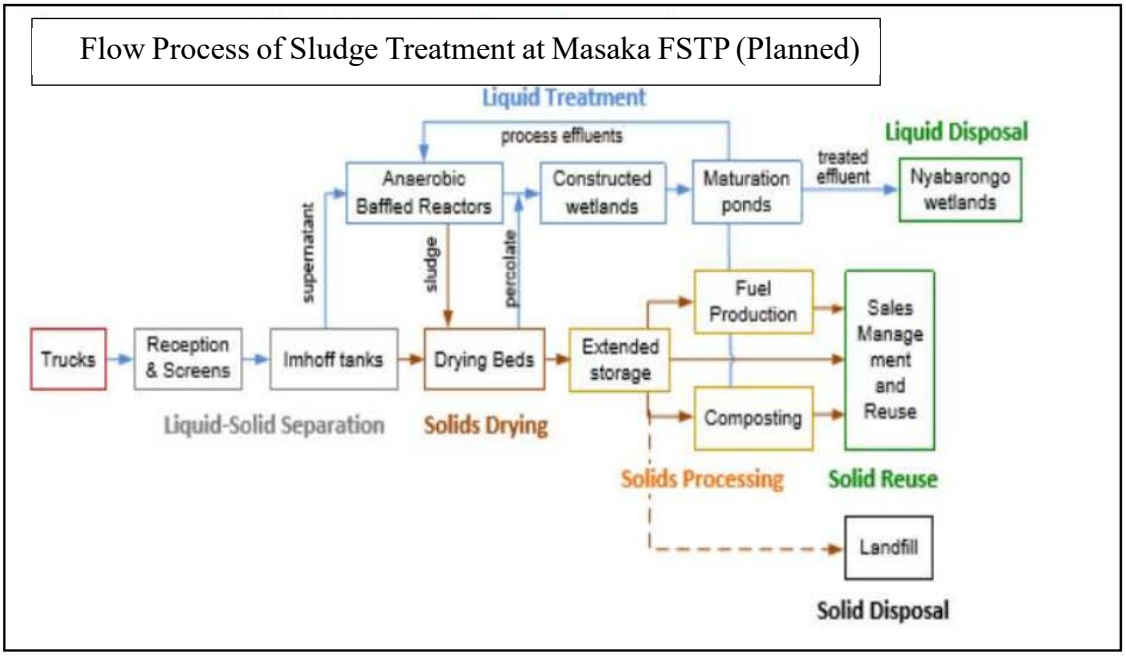


Figure 5-17 Planned flow of Masaka FSTP, Rwanda

- Septic tank sludge: Receiving facility (Screen) ⇒Solid-liquid separation in thickening tank⇒Two Bio-digesters (in series) ⇒Drying bed
- Pit latrine sludge: Receiving facility (Screen and grit removal) ⇒Two Bio-digesters (in series)⇒ Drying bed
- For Manchinchi FSTP, separated effluent is transported to Ngwerere WTP by pipe and treated. For Matero FSTP, separate effluent is treated in adjacent Matero Pond.
- Dried sludge is used in agriculture as a soil conditioner.

Figure 5-18 Flow of FSTPs to be Updated and Newly Constructed in Zambia

Sedimentation pond ⇒ Drying bed
⇒ Anaerobic Pond ⇒ Planted horizontal filter

Figure 5-19 Flow of Planned FSTP in Marracuene, Mozambique

(3) Applicability of Japanese sludge treatment technology

- Cyclone type sand removal tank

The unit is installed next to the input slope. Sand is separated by the gravity cyclone effect and removed from the hatch attached to the lower part of the tank. (Shape similar to exhaust gas cyclone)

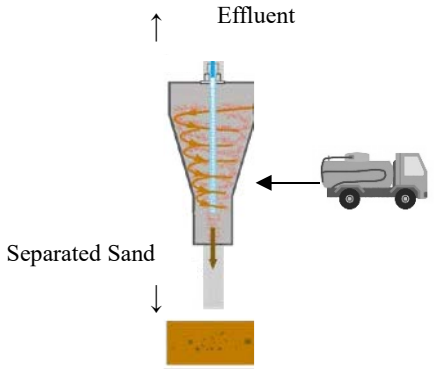


Figure 5-20 Sedimentation Tank

- Simple pretreatment machine

It is used for small-scale sludge treatment facilities and industrial wastewater treatment, and is called an immersion type rotating screen. It may be applied to the pretreatment of septic tank sludge.

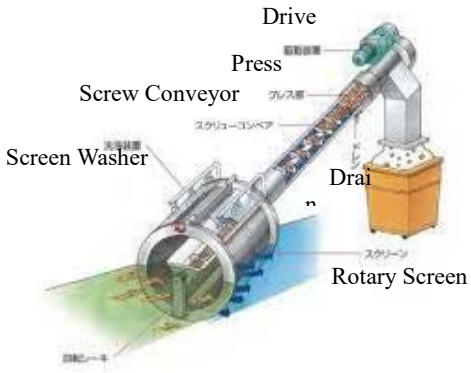


Figure 5-21 Simple Pretreatment Machine

- Vacuum tanker deodorizer

Device attached to vehicle that burns and adsorbs the odor of exhaust gas discharged from the vacuum device during suction.

Figure 5-22 Vacuum Tanker Deodorizer

- High-efficiency sludge dehydrator

This model has higher energy-saving and dewatering performance than conventional dehydrator.

Screw Press　　Belt Press　　Rotary Press

Figure 5-23 High-Efficiency Sludge Dehydrator

- Training for engineers

In Japan, there is a training course on the on-site sludge treatment for the engineers to acquire basic knowledge in all aspects of laws, regulations, systems, and technologies. Certification is provided to the trainee who completed the training course.

Figure 5-24 Training for Engineers

5.12 Institutional Framework for Wastewater and Faecal Sludge Management

5.12.1 Perspective of Survey

The reasons for the delay of wastewater and faecal sludge management in the developing countries, especially in on-site sanitation, are the involvement of various public and private organizations, and the fragmentation of the public organizations. In addition, since on-site sanitation tends to be considered as a private matter, the governments have not been actively involved in the improvement of on-site sanitation. From those points of view, the organizational structure leading to the smooth promotion of CWIS is examined after confirming the implementation structure of on-site sanitation in each of the target cities.

5.12.2 Findings from Literature Review and Interview Survey

- The wastewater and faecal sludge management is based on the provision of sewerage or FSM services to residents and fee collection from them. Apart from the line ministries in charge of policy and planning and the service providers under those ministries (which provide services by themselves or delegate the provision of services to private companies), it has become clear that there are many SSA countries that have established a regulatory body which ensures the quality of services and the appropriateness of service fee.
- The independent regulatory body is established in 4 countries (Zambia, Kenya, Rwanda and Mozambique) among 8 Survey Countries targeted in the second phase.
- The service providers for the wastewater and faecal sludge management under the supervision of line ministries and/or local governments are the water and sewerage corporation or sewerage corporation in most countries.
- In addition to the designated duties, the practical roles among the line ministries, regulatory bodies and service providers shall also be clarified, especially from the perspective of CWIS and FSM.
- The major roles of regulatory bodies include the following (in case of NWASCO, Zambia):
  - ✓ Issuance of business licenses to water and sewerage corporation/private operators
  - ✓ Establishment of service levels and technical standards for services
  - ✓ Formulation of guidelines including fee setting for service provision
  - ✓ Approval of fees
  - ✓ Establishment of regulations, benchmarks and monitoring systems for service delivery
  - ✓ Performance monitoring of water and sewerage corporation/private operators
  - ✓ Compilation of on-site and off-site service delivery rates and reporting to the government (SDG monitoring)

The mandates of relevant institutions in each city are described below.

(1) Maputo

- Sewerage Services
  - ✓ Policy and Planning Body: Ministry of Public Works, Housing and Water Resources (MOPHRH) / National Directorate of Water Supply and Sanitation (DNAAS)
  - ✓ Regulatory Body: AURA
  - ✓ Service Provider: Maputo city government
- FSM Services
  - ✓ Policy and Planning Body: Maputo city government
  - ✓ Regulatory Body: AURA
  - ✓ Service Provider: Maputo city government and private operators

(2) Lusaka

- Sewerage Services
  - ✓ Policy and Planning Body: Ministry of Water Development and Sanitation (MWDS)
  - ✓ Regulatory Body: NWASCO
  - ✓ Service Provider: LWSA
- FSM Services
  - ✓ Policy and Planning Body: Ministry of Water Development and Sanitation (MWDS)
  - ✓ Regulatory Body: NWASCO and Lusaka city government (City government takes the lead in regulation, and based on that, NWASCO is considering national level regulation.)
  - ✓ Supervisory Body: Lusaka city government
  - ✓ Service Provider: LWSA and private operators

(3) Nairobi (both Sewerage and FSM)

- ✓ Policy and Planning Body: Ministry of Water, Sanitation and Irrigation (MWSI)
- ✓ Regulatory Body: WASREB
- ✓ Service Provider: NCWSC (sewerage), NCWSC and private operators (FSM)

(4) Kampala

- Sewerage Services
  - ✓ Policy and Planning Body: Ministry of Water and Environment (MWE)
  - ✓ Service Provider: NWSC
- FSM Services
  - ✓ Policy and Planning Body: MWE (nominal), KCCA (practical)
  - ✓ Service Provider: KCCA and private operators, and NWSC for sludge treatment only

(5) Kigali (both Sewerage and FSM)

- ✓ Policy and Planning Body: Ministry of Infrastructure (MININFRA)
- ✓ Regulatory Body: RURA
- ✓ Service Provider: WASAC (sewerage), private operators (FSM)

(6) Addis Ababa (both Sewerage and FSM)

- ✓ Policy and Planning Body: collaboration among Ministry of Water, Irrigation and Electricity (MoWIE), Ministry of Works, Urban Development and Housing Construction, and Ministry of Health (MoH)
- ✓ Service Provider: AAWSA (sewerage), AAWSA and private operators (FSM)

(7) Ouagadougou (both Sewerage and FSM)

- ✓ Policy and Planning Body: Ministry of Agriculture, Water and Fisheries (MAHRH)
- ✓ Service Provider: ONEA (sewerage), ONEA and private operators (FSM)

(8) Abidjan (both Sewerage and FSM)

- ✓ Policy and Planning Body: Ministry of Sanitation and Public Hygiene (MINASS)
- ✓ Service Provider: National Sanitation and Drainage Agency (ONAD) / SODECI (sewerage), ONAD and private operators (FSM)

5.12.3 Findings through Detailed Survey

In all 5 countries targeted in the third phase of the Survey, the line ministries responsible for policy and planning were recognized to be in charge of on-site sanitation as well as sewerage.

It was also revealed that all of the sewerage service providers in 5 countries either currently provide or are planning to provide FSM services as well as sewerage services, namely the water and sewerage corporation (Zambia, Kenya and Rwanda), the sewerage corporation (Cote d'Ivoire) and the city government (Maputo in Mozambique). It can be said that on-site sanitation has become a "public matter" in those countries.

The 4 among 5 countries have established independent regulatory body, which approves sewerage tariffs, establishes standards for on-site facilities and services, issues business licenses, develops guidelines for FSM services, and establishes other frameworks to enable service providers to deliver not only sewerage services but also FSM services.

The following are the summary of the findings in the third phase of the Survey on the organizational structure for wastewater and faecal sludge management in each country.

(1) Rwanda

Through the field survey, the following 4 ministries and/or institutions are considered to be the main bodies in the wastewater and faecal sludge management. The Rwanda Housing Authority (RHA) is involved since the housing development is active in Kigali city. The City of Kigali (COK) is involved from the perspectives of city planning, upgrading of informal settlements, building permits, etc.

Table 5-14 Main Ministries and Institutions for Wastewater and Faecal Sludge Management

Institution	Functions
MININFRA	It is responsible for policies, guidelines, strategies and monitoring of the water sector (including sewage and faecal sludge).
WASAC	It is responsible for the implementation of water supply, sewerage and sanitation projects in urban areas, including the capital city of Kigali. In addition to the public sewerage system, it is also responsible for the operation and maintenance of community plant-type semi-intensive sewage treatment facilities at seven estates in Kigali.
RURA	It directly belongs to the President. It regulates the water-related services provided by the WASAC and/or private companies and promotes the public-private partnership (PPP). The water and sewerage tariffs for WASAC shall be approved by RURA. RURA also plays a central role in the development of regulatory framework of on-site sludge management. It is currently working on drafting Guidelines for Faecal Sludge Management to strengthen the role of WASAC in on-site sludge management (FSM).
REMA	It is responsible for environmental regulations.

(2) Mozambique

Through the field survey, the roles of the Agency for Water Sanitation and Infrastructure (Administração de Infraestruturas de Abastecimento de Água e Saneamento, AIAS) and the Water Regulatory Authority (Autoridade Reguladora de Água, AURA) were clarified.

1) AIAS

The local governments are in charge of provision of sanitation and sewerage services. But, since the local governments are financially weak and lack the capacity to mobilize resources and build the infrastructures, AIAS is in charge of the asset management.

AIAS builds sewerage systems and sludge treatment facilities, and signs contract with the municipalities that operate these facilities, collect the tariffs and pay a counter value to AIAS.

2) AURA

When the local governments introduce or revise their sanitation tariffs, the approval of AURA is required. AURA confirms if the proposed tariff matches the quality of the service. The decrees for the provision of sanitation services are to be established by the local governments. The role of AURA is to prepare guidelines for the local governments.

(3) Zambia

Through a series of hearings, the following points were clarified.

1) Establishment of CWIS Promotion System led by NWASCO

In 2016, the Minister of Water Development, Sanitation and Environmental Protection and the Minister of Local Administration and Housing issued a directive for NWASCO to consider that CUs should provide services related to on-site sanitation as a countermeasure to the outbreak of waterborne diseases such as cholera. In response to the directive, NWASCO developed the regulatory framework of urban on-site sanitation and FSM and extended its own licensing authority to on-site sanitation and on-site sludge management (FSM).

In accordance with the above, NWASCO reviewed the license conditions for CUs in December 2018, and service delivery for on-site sanitation and FSM was added to the responsibilities of CUs. In practice, under the Lusaka Sanitation Program (LSP) supported by 4 donors (WB, AfDB, EIB and KfW), the guidelines and standards for on-site sanitation and FSM services targeting the poor were developed, and the NWASCO formulated the standards applied to other areas by referring to the guidelines and standards prepared in the LSP. In addition, NWASCO encourages CUs other than LWSC to establish FSM units. Through those activities, a system to promote CWIS nationwide has been established in Zambia with NWASCO playing a central role.

2) Development of Implementation Framework of FSM by LWSC

Following the expansion of its mandate in December 2018 (adding on-site sanitation and FSM services to the existing water and wastewater services), LWSC established the FSM Unit in the Peri-urban Department in August 2019. Six full-time staff members (business and technical) are currently assigned to the unit.

In October 2019, “Sewerage” in the company name (Lusaka Water and Sewerage Company) was changed to “Sanitation”. In the LSP, it has been promoting the development of on-site sanitation facilities (toilets) focused on the poor, the construction of FSTPs and the enhancement of FSM services.

(4) Cote d'Ivoire

The Directorate of Urban Sanitation and Drainage (DAUD) under the Directorate General of Sanitation and Salubrity (DGAS) of the Ministry of Sanitation and Salubrity (MINASS), established in 2018, is responsible for policies on sewage and sludge management in Côte d'Ivoire. The main roles of DAUD are to implement and supervise the legal and regulatory framework for sewage and drainage, to coordinate with relevant institutions, and to provide supports to local authorities.

The National Office of Sanitation and Drainage (ONAD) was established in 2011 with the aim of ensuring the access to sewage and drainage facilities for all. ONAD implements the development and maintenance of sanitation facilities in collaboration with the MINASS (technical field) and the Ministry of Budget and Portfolio (financial field) based on a five-year performance contract.

The operation and maintenance of sewerage facilities in Abidjan is carried out by SODECI, a private operator, based on a contract with the government (Affermage Contract) under the monitoring and control of ONAD. However, the contract was terminated in October 2018, and discussions are underway to extend the contract. As of now, both parties have not reached an agreement for the extension of the contract.

To improve the quality of sludge collection services, various efforts are being made by ONAD, including the establishment of an association of sludge collection companies, a license system for the companies, the provision of training to the companies, and a loan system for the companies to purchase equipment and spare parts, and the establishment and operation of call center.

5.12.4 Measures to be taken, Matters to be considered to Realize the Cooperation

The feature of organizational structure for wastewater and faecal sludge management in many SSA countries is that the water and sewerage corporation handles both water supply and sewerage (in Japan, water supply and sewerage are handled by separate corporations), as well as on-site sludge management (FSM). In Japan, on-site sludge management is carried out by the sanitation bureau (in the Ministry of the Environment), which is different from the sewerage bureau (in the Ministry of Land, Infrastructure, Transport and Tourism). Thus, the organizational structure in the SSA countries is considered to be a more integrated structure than that in Japan.

In many SSA countries, a regulatory body, which is apart from the line ministry, plays a role in ensuring the balance of interests between the service provider and the customers (residents) (an appropriate balance between rates and services). This is also an organizational structure which is not found in Japan. In order to provide appropriate services to all residents under the situation where funds are limited and the gap between the rich and the poor is great, such an organizational structure was formed and developed with the support of the WB and other institutions. Moreover, it was also recognized that all regulatory bodies in each country are focusing on the improvement of on-site sludge management (FSM) services and the development of regulations for this purpose.

According to the above, it is necessary to consider the following for future cooperation:

- It is necessary to actively collect information on how the organizational structure in water, wastewater and on-site sludge management sectors in SSA countries has been developed, especially on the roles and practices of regulatory bodies.
- It is necessary to enhance the contacts with regulatory bodies for the formation and implementation of water, wastewater and on-site sludge management projects.

5.13 Finance and Cost Recovery of Wastewater and Faecal Sludge Management

5.13.1 Perspective of Survey

The operation and maintenance of sewerage systems and sludge treatment facilities is carried out by local governments in Japan. There are several financial supports from the central government to local governments, such as the subsidy system from the central government to local governments, the local allocation tax system which transfers a certain portion of the national tax to local governments, and local bonds issued by local governments. However, in many SSA countries, both the central government and local governments are financially weak, and financial support is considered to be difficult even though the strengthening of local autonomy is claimed but is not accompanied by the transfer of financial resources. Thus, it is necessary to find out the situation of the finances and cost recovery of wastewater and faecal sludge management.

5.13.2 Findings from Literature Review and Interview Survey

(1) Public Corporation System (Water Supply and Sewerage)

In many SSA countries, water and sewerage corporations established by the central or local government generally operate sewerage systems and sludge treatment facilities with the supports from foreign donors such as the WB and the AfDB. The source of funds for their works is the water and sewerage tariff paid by residents, commercial customers and other users. In some SSA countries (e.g. Senegal), the public-private partnership (PPP) is also applied to entrust the operation of water supply facilities to water majors which have financial capacity. However, such cases are rare for sewerage and sludge treatment, which are dependent on donor support.

(2) Sanitation Surcharge System

In most of the 8 countries surveyed in the second phase, water and sewerage corporations established by the central government or local governments operate water supply and sewerage facilities, and collect sewerage tariff along with water tariff. There are 2 main methods of cost recovery for wastewater and faecal sludge management.

Method 1: Sewerage tariff is collected from customers who are connected to the sewerage system. In most cases, the sewerage tariff is a certain percentage of the water tariff or a per-unit fee, depending on the amount of water usage. This is the method used for sewerage tariff in Japan.

Method-2: A certain percentage of the water tariff is collected as a Sanitation Surcharge from all customers of water service, regardless of whether they are connected to the sewerage system. The construction of sewerage system requires a huge investment and long period, so that not all residents can be connected to the sewerage system immediately. If the operation of the sewerage system is funded only by the sewerage tariff paid by the limited number of residents who are already connected to the sewerage system, the sewerage system will not be smoothly developed. On the other hand, the improvement of the water environment will benefit those who are not connected to the sewerage system to some extent. Therefore, if the cost for wastewater management can be collected widely from all residents through the Sanitation Surcharge, the financial resources for sewerage improvement will be expanded, leading the shortening of time for the residents to connect to the sewerage systems.

Sanitation Surcharge is a method which is not found in Japan. It has been introduced in 4 of the 8 countries surveyed (Mozambique, Burkina Faso, Zambia and Cote d'Ivoire). In Asian countries, the Environmental Charge introduced in Manila, the Philippines, is also considered to be a type of Sanitation Surcharge.

The above 2 methods can be used together. For example, in Mozambique, there is no sewerage tariff and 15% of the water tariff is collected as Sanitation Surcharge regardless of whether the customer is connected to the sewerage system or not. In Zambia, 30% of the water tariff is collected as a sewerage tariff from customers connected to the sewerage system, and 2.5% of the water tariff is collected as Sanitation Surcharge from all water customers regardless of their connection to the sewerage system.

The following is a summary of the tariff system and cost recovery for wastewater and faecal sludge management in each country.

- Mozambique (Maputo)
  - ✓ The sewerage tariff is not applied, but it is decided to introduce the Sanitation Surcharge from 2021.
  - ✓ The Sanitation Surcharge will be used to cover the cost of operation and maintenance of sewage treatment plants and sludge disposal, but not the cost of sludge collection by private operators.

- Burkina Faso (Ouagadougou)
  - ✓ The residents connected to the sewerage system pay FCFA 60/m^3 and those not connected to the sewerage system (using on-site facilities) pay FCFA 21/m^3 as Sanitation Surcharge.
  - ✓ The Sanitation Surcharge is used to cover the cost of pit latrine materials provided to residents by the ONEA, but is not used to cover the cost of sludge collection by private operators.

- Rwanda (Kigali)
  - ✓ Since there is no public sewerage system, WASAC collects only water tariff.
  - ✓ According to the Draft Guidelines for Faecal Sludge Management for Rwanda recently prepared by RURA, the WASAC will use private sludge collection companies and private maintenance companies for wastewater and faecal sludge management at on-site sanitation facilities and semi-intensive/decentralized wastewater treatment facilities in the estates and commercial buildings. The costs of sludge management and maintenance of semi-intensive/decentralized wastewater treatment facilities are to be recovered by adding it to the water tariff called as Sanitation Tax.

- Zambia (Lusaka)
  - ✓ The sewerage tariff is 30% of the water tariff.
  - ✓ Regardless of the connection to the sewerage system, 2.5% of the water tariff is collected separately as Sanitation Surcharge.
  - ✓ The collected Sanitation Surcharge is managed by the Sanitation Fund of NWASCO, and its use is prioritized for the improvement of sewerage facilities in low-income areas served by the LWSC, but not for the cost of sludge collection by private operators.

- Uganda (Kampala)
  - ✓ The residents connected to the sewerage system pay 75% of water tariff, while commercial and industrial customers pay 100% of water tariff to the NWSC as sewerage tariff.

- Ethiopia (Addis Ababa)
  - ✓ As of year 2000, only connection fees were collected and no sewerage tariff was collected. It has not been confirmed whether or not sewerage tariff has been collected since then.

- Kenya (Nairobi)
  - ✓ For all customers connected to the sewerage system, NCWSC collects 75% of water tariff as sewerage tariff.

- Cote d'Ivoire (Abidjan)
  - ✓ The City of Abidjan uses a combination of sewerage tariff and Sanitation Surcharge. It has the following features:
    - Target customers: (1) customers who connect to the sewerage system, (2) customers who live in areas where the sewerage system exists but not connect to the sewerage system, and (3) customers who live in areas where the sewerage system does not exist.
    - Tariff structure: (1) private operator (SODECI) portion (sewerage fee) and (2) government portion (Sanitation Surcharge).

(3) Water Tariff for Resident

The average amount paid for water by the general population in the target countries is about USD 14.1/month in a case of water usage of 20m^3/month, which is higher than in that Indonesia (Jakarta: USD 8-9/month) and the Philippines (Manila: USD 6/month). Those in Uganda and Burkina Faso are particularly high.

In addition, this payment does not include the amount paid by households using on-site sanitation facilities to private sludge collection companies.

Table 5-15 Payment for Water by Household in Each Survey Country

Country (Capital City)	Charge for Water Use with 20m^3		
	Water	Sewerage / Sanitation	Total (USD/20m^3)
Maputo (Mozambique)	USD 9.4	USD 1.4	USD 10.8
Ouagadougou (Burkina Faso)	USD 18.1	USD 2.2	USD 20.3
Kigali (Rwanda)	USD 12.5	NA	USD 12.5
Lusaka (Zambia)	USD 6.3	USD 2.0	USD 8.3
Kampala (Uganda)	USD 19.7	USD 14.8	USD 34.5
Addis Ababa (Ethiopia)*	USD 1.36	NA	USD 1.36
Nairobi (Kenya)	USD 8.9	USD 6.7	USD 15.1
Abidjan (Cote d'Ivoire)	USD 8.9	USD 1.2	USD 10.1
Manila (The Philippines)	USD 5.3	USD 1.0	USD 6.0

* The status of sewerage fee collection in Ethiopia is unknown.

(4) Sludge Collection Charge

The sludge collection charges are a significant burden for users of on-site sanitation facilities. In many cases, sludge collection operations are carried out by private companies or the informal sector, and the charges are not regulated. The table below shows the rates of sludge collection charges in the target countries confirmed by the literature survey.

Table 5-16 Sludge Collection Charge in Each Survey Country

Country	Sludge Collection Charge (resident)	
	Vacuum Truck	Manual Desludging
Mozambique	USD 30 - 80 (average: USD 53)	USD 7 - 13 (pit latrine) USD 30 - 70 (septic tank)
Burkina Faso	USD 50 (average)	
Rwanda	Vacuum Truck: USD 80 (10t vehicle) USD 90 (20t vehicle) Vacuum pump + cylinder: USD 40 - 80/unit	-
Zambia	USD 100 (USD 12 - 13/m^3)	USD 80
Uganda	Vacuum Truck: USD 10 - 25 (USD 5/m^3) Vacutag: USD 80 - 200 (USD 40/m^3)	
Ethiopia*	USD 9.3 - 36	
Kenya	USD 37 - 46	
Cote d'Ivoire	USD 110	USD 55

5.13.3 Findings through Detailed Survey

(1) Subsidy for Development of Sewerage System

In the 5 countries surveyed in the third phase of the Survey, no subsidy system for sewerage system development could be confirmed. In Cote d'Ivoire, the Sanitation Surcharge covers 70% of the cost of O&M work done by private operators, and the national treasury covers 30%, but the Sanitation Surcharge is used to finance the repayment of loans from donors for the sewerage facilities of the government.

The reasons for the absence of subsidy system for sewer maintenance can be considered as follows:

- The central and local governments of each country are financially weak and do not have the financial resources for subsidy.
- The sewerage systems are developed only in some cities, such as the capital city, and the benefiting population is limited, so it is not possible to justify taxation.

(2) Sanitation Surcharge

The 3 of 5 countries (Zambia, Mozambique and Cote d'Ivoire) have adopted the Sanitation Surcharge system. The details of the system vary, but it is common among them that they collect a certain type of sanitation fee from all water customers, including those who are not connected to the sewerage system.

The reasons for the adoption of the Sanitation Surcharge system can be considered as follows:

- Sanitation improvements, such as sewerage, require a large investment, so the base of fee collection needs to be expanded.
- Each country is engaged in on-site sanitation improvement as well as sewerage. The water and sewerage public corporations which are the service providers need to secure the resources to pay for such improvement.

Regarding the use of the Sanitation Surcharge, the use of the funds is specified in its regulations in Mozambique, and the funds can be used for the development and renewal of sewerage and sludge treatment facilities. In Zambia, the funds can be used for a wide range of sanitation-related purposes such as sewerage and on-site sludge management (FSM). In Cote d'Ivoire, the funds can be used for the development of a sewerage network.

(3) Sludge Collection Charge

Even in countries with Sanitation Surcharge, residents who rely on on-site sanitation facilities such as pit latrines and septic tanks need to pay sludge collection charges to sludge collectors in addition to the Sanitation Surcharge paid to water and sewerage corporations. In other words, the introduction of Sanitation Surcharge has not practically led to the improvement of on-site sludge management (FSM).

This is a major difference from the Environmental Charge in Manila (Philippines). In Manila, 20% of the water tariff is collected as Environmental Charge to cover the cost of sewerage development and on-site sludge management (FSM). The residents can receive free sludge collection service every 6-7 years if they pay the Environmental Charge. Why do not the SSA countries have the same system as Manila?

In order to cover the cost of sludge collection by the Sanitation Surcharge, the service provider must have a system in place to ensure that sludge collection services are provided. In Manila, 2 private operators (Manila Water Company Inc. and Maynilad Water Services Inc.), based on concession agreements with the city government, have established such a system by developing on-site sludge

treatment capacity ahead of the sewage system and organizing sludge collectors. However, in SSA countries, such a system has not yet been established. In order to ensure fairness in the cost burden between sewerage users and on-site sanitation users, it is necessary to establish a system for on-site sludge management (FSM) and to establish a system that can reliably provide sludge collection services to the residents.

5.13.4 Measures to be taken, Matters to be considered to Realize the Cooperation

The finance and cost recovery (tariff system) of wastewater and faecal sludge management in SSA countries is basically based on the principle of using water and sewerage tariff revenues to cover both investment and O&M costs, reflecting the fact that both central and local governments do not have the financial capacity to subsidize water and sewerage projects and on-site sludge management in SSA countries. The Sanitation Surcharge system has been introduced in several countries in order to expand the funding base for the costs of wastewater and faecal sludge management. It is important to note that this is completely different from the financial system for wastewater and faecal sludge management in Japan, where government subsidies and local allocation taxes can be used as financial resources in addition to sewerage tariff.

However, the Sanitation Surcharge currently in place in some SSA countries does not cover the cost of sludge collection and transportation, which is borne by many urban residents including slum areas. Thus, it does not contribute to the expansion of FSM services necessary to realize CWIS in SSA countries. For the examination of the tariff system for wastewater and faecal sludge management in SSA countries, the income disparity shall be considered in the tariff system since there are many low-income residents. However, the sewerage tariff system and charge for faecal sludge management do not take income disparity into consideration, so there is a concern that the tariff system in Japan may not be useful as a reference in SSA countries.

It is considered that Manila (Philippines) case can be a reference to SSA countries where most of customers live in slum areas, since, in Manila, water supply, sewerage and faecal sludge management are handled by sole privatized entity without relying on government subsidy and recover the required costs by project revenue. The Environmental Charge introduced in Manila is a tariff system including the charge for on-site sludge management, and allowing slum residents to enjoy sludge collection services at low cost.

According to the above, it is necessary to consider the following for future cooperation:

- The systems of sewerage tariff and sludge collection charge in Japan may not be useful as a reference when examining the tariff system for wastewater and faecal sludge management in SSA countries.
- It is necessary to train and appoint personnel who understand the tariff system for wastewater and faecal sludge management in Manila.

5.14 Master Plans

5.14.1 Perspective of Survey

Although the sewer coverage is still low in many countries, all countries have sewerage systems and it is presumed that master plans for sewerage system development have been prepared, but an issue of how to reflect the CWIS concept in the master plans is to be considered.

5.14.2 Findings from Literature Review and Interview Survey

As examples of master plans that are said to reflect the CWIS concept in addition to sewerage development, the Lusaka City Sanitation Master Plan, Abidjan City Sewage and Storm water Master Plan and Ouagadougou City Zoning Plan and FSM Master Plan may be mentioned.

In Ethiopia, there is an existing master plan, but with the support of donors such as the WB, a revision of the wastewater master plan (Sanitation Master Plan) to reflect the CWIS concept is under development.

5.14.3 Findings through Detailed Survey

In Maputo, Mozambique, the "Maputo Metropolitan Area Sanitation and Drainage Master Plan" has been developed, but only the WB project for upgrading treatment facilities is scheduled for implementation.

In Lusaka, Zambia, the "Lusaka Sanitation Master Plan" was developed in 2011, and other donors (WB, AfDB, EIB, KfW) have been requested to support the development of facilities based on the master plan and are implementing it.

The following two points should be taken into consideration when developing master plans for urban wastewater and sludge management in SSA countries.

(1) Need for Proper Understanding of the Location of Slum Areas

Since the methods of wastewater and sludge management are completely different between slum areas (sometimes called peri-urban areas, informal settlements, unplanned settlements, etc., but they are synonymous) and non-slum areas (planned settlements), and it is basically difficult to develop sewerage systems in slum areas, it is necessary to correctly identify the location of slum areas.

In SSA countries, where the ratio of slum population to urban population is more than 50% in many countries, it is considered that governments correctly identify slum areas in accordance with the definition of slums set by UNHABITAT. However, in other regions such as Asia, governments may underestimate slum areas due to political considerations, etc., it should be carefully checked. In fact, there is a case where the city government of the capital of a Southeast Asian country claimed that the slum population ratio in the city was 15%, but the WB and the United Nations claimed that the slum population ratio in the city was 40%.

It is also important not to predict that the slum population ratio in the target city will decrease in the future without solid evidence. In fact, even in Kigali, Rwanda, where economic growth has been remarkable, the slum population ratio has been increasing in recent years.

(2) On-site Sludge Management (FSM)

In the FSM, facilities such as sludge treatment facilities need to be developed, but what is more important is to regulate the services to be provided appropriately by private service providers, to

sensitize residents to accept such services, and to establish a system for the government to do so.

Since most of the service providers for construction and installation of on-site sanitation facilities and sludge collection operations are private service providers, this is considered to be synonymous with the idea of carrying out administrative reform regarding wastewater and sludge management. Therefore, most of the master plans for wastewater and sludge management reflecting the CWIS are expected to be administrative reform plans, which will be different from the conventional master plans focusing on facility development.

5.14.4 Measures to be taken, Matters to be considered to Realize the Cooperation

The formulation of a master plan for wastewater and sludge management in SSA countries is a new challenge because of the lack of useful precedents, such as how to reflect in the master plan the existence of slums that do not decrease with economic growth, how to incorporate non-quantitative factors such as institutional reforms and regulatory enhancements needed to improve on-site sludge management into the master plan, this will be a trial-and-error process, as precedents will not be useful.

According to the above, it is necessary to consider the following for future cooperation:

- It is necessary to accumulate know-how by preparing a master plan jointly with other donors such as the WB who are ahead of this field.

CHAPTER 6 DIRECTION AND MATTERS TO BE CONSIDERED FOR COOPERATION ON WASTEWATER AND FAECAL SLUDGE MANAGEMENT IN SUB-SAHARAN AFRICAN COUNTRIES

6.1 Assistance for Formulation of Master Plan

In many African countries, in addition to developing sewerage systems, the strategies to promote the CWIS have been adopted to ensure the access to adequate sanitation services for slum population, who constitute a large proportion of the urban population, by strengthening on-site sludge management (FSM). From this viewpoint, it is necessary that the sanitation master plan should incorporate the concept of CWIS, aiming at not only the development of sewerage system but also the comprehensive improvement of urban sanitation. In the areas where the development of sewerage system is difficult, it is a realistic approach to start improving sanitation by strengthening FSM as the initial step.

The components of CWIS include the development of sewerage facilities and/or FSM, but simply adding a plan for the improvement of on-site sludge treatment facilities does not make it CWIS. If many of the existing on-site sanitation facilities have no lining, which makes efficient sludge collection by vacuum tankers difficult, an action plan is needed for their improvement. If the policies, institutions, organizations and finances (tariff system) are not in place to make on-site sludge collection and transportation services accessible to all residents, including slum residents, an action plan to improve them shall also be included in the sanitation master plan. This can be considered as an administrative reform for wastewater and faecal sludge management.

It is considered that international organizations and other donors are still in the process of trial and error regarding the methodology for preparing such sanitation master plans. As precedents, there are sanitation master plans prepared by MCC (US) for Lusaka (Zambia) and AFD (France) for Abidjan (Cote d'Ivoire) and Ouagadougou (Burkina Faso). JICA can consider firstly analyzing those master plans. In addition, Addis Ababa (Ethiopia) is in the process of formulating a sanitation master plan with the concept of CWIS with the support of the WB. It would be effective for JICA to participate in the preparation process in some way.

It is considered that JICA will initiate the support for the preparation of master plans with the concept of CWIS. However, there are various challenges that have never been experienced in Japan, such as the large number of pit latrines, the high percentage of slum population, and the absence or weakness of such financial systems as government investment budget, government subsidy or local allocation tax system, which are special features of urban sanitation in SSA countries. Thus, it is recommended to collaborate with other donors such as the BMGF, which has experience in supporting CWIS in Africa.

6.2 Wastewater and Faecal Sludge Management with Sewerage System

6.2.1 Construction and Rehabilitation of Wastewater Treatment Plants and Sewer Networks (ODA Loan and Grant Aid Project)

In SSA countries, including Low-Income and LDCs, there is a need for financial cooperation for the construction and rehabilitation of sewerage systems because there are a certain percentage of commercial users and middle- and high-income groups in capital cities that require sewerage connections due to recent economic development.

Until recently, it has been difficult for countries and donor communities, such as the WB, to reach a consensus on the appropriateness and the priority on investing in sewerage systems that require large

investment but benefit only a small number of citizens, while keeping the majority of the population (the slum residents) without adequate sanitation services. However, as countries work on the CWIS and slum residents receive a certain level of sanitation services, the political hurdle for the development of sewerage systems is expected to decrease.

When JICA provides support to sewerage systems in SSA countries, the following matters shall be considered:

- Financial support for sewerage systems, particularly in Low-Income LDCs, shall be conditional on the target country's commitment to CWIS, or shall be combined with support for strengthening FSM in slums to realize the CWIS. In this case, co-cooperation with BMGF and other institutions is desirable.
- In Low-Income LDCs in particular, a project shall be integrated with sewerage and faecal sludge management, and not solely with sewerage.
- In the case of supporting wastewater treatment plant, many of the wastewater treatment processes currently used in many African countries involve rudimentary technologies that are not used in Japan, such as stabilization ponds. Therefore, if the cooperation of Japan's ODA requires the application of technologies currently used in Japan, the opportunity for financial cooperation will be limited.
- In the construction of wastewater treatment plants and faecal sludge treatment plants, it is a common practice to implement them under a Design, Build and Operate contract with 2 to 3 years O&M, during which operational know-how is transferred to the executing agency, such as the water and sewerage corporation.

6.2.2 Proper Operation and Maintenance of Wastewater Treatment Plant and Improvement of Tariff Collection and Finance (Technical Cooperation Project)

In many SSA countries, water and sewerage corporations are engaged in both water supply and sewerage projects, as well as faecal sludge management such as on-site sludge treatment. However, compared to the water supply sector, the sewerage and faecal sludge management sector is often weaker in terms of human resources. Therefore, it is necessary to improve institutional capacity including the enhancement of personnel. In this field, the needs of cooperation by JICA can be considered.

The matters that need to be considered in implementing a JICA technical cooperation project are as follows:

- Regarding the O&M of wastewater treatment plants in SSA countries as described above, the contractor is responsible for O&M for 2-3 years after the completion of the facility under a Design, Build and Operate contract, and during that period, it is a common practice to transfer the operational know-how to the executing agency, such as the water and sewerage corporation. Since this practice is considered effective for the transfer of technology, it is necessary to coordinate between the JICA T/A and the Design, Build and Operate contract. Although not an SSA country, the "Sewerage Construction Project in Kurdistan Region" in Iraq is a Japan's ODA loan project being implemented under a Build and Operate contract. In this project, the contractor performs O&M for 2 years after construction, and during this time, the staff of the executing agency is tentatively assigned to the contractor for technology transfer.
- The technology transfer is practiced in the project for the construction of wastewater treatment plants through Design, Build and Operate contract or Build and Operate contract. However, such projects do not cover the technology transfer for O&M of sewerage networks. Thus, a JICA cooperation project can provide the transfer of technology for O&M of sewerage networks.
- In SSA countries, the implementing agencies for sewerage (water supply and sewerage corporations) are often also in charge of on-site sludge management (FSM). Therefore, the technical cooperation projects shall cover the FSM as well as sewerage.

- The improvement of tariff collection and financial condition is important for the wastewater and faecal sludge management; therefore, the JICA cooperation should take an approach that considers this. However, the tariff systems in SSA countries are significantly different from that in Japan. The tariff systems in SSA countries are developed in consideration of the financial weakness of the central and local governments and slum population dominating the population in urban areas. The JICA experts who will be assigned shall have sufficient knowledge on the finance for wastewater and faecal sludge management in the developing countries, such as expert who engaged in the water and sewerage management in Manila. It may be desirable for JICA to train such Japanese personnel.
- In many SSA countries, the regulatory body has the authority to approve the tariff for wastewater and faecal sludge management. Thus, the regulatory body shall be involved in JICA's technical cooperation projects.

6.3 Strengthening Faecal Sludge Management (Enhancement of Capacity for Decentralized Wastewater and Faecal Sludge Management)

6.3.1 Improvement of On-Site Sanitation Facilities (Technical Cooperation Project/ Expert Dispatch)

In many SSA countries, pit latrines are commonly used as on-site sanitation facilities, even in urban areas, especially in slum areas. However, the sludge collection from pit latrines is not easily practiced. Therefore, it is desirable to convert them to septic tanks to improve the on-site sludge management. In Zambia, the LWSC developed an improved pit latrine with easy sludge collection, which could be adopted by other SSA countries. Since developing on-site sanitation facilities that make the sludge collection easy is important for on-site sludge management, JICA shall encourage and support such efforts in the target countries with the following considerations:

- On-site sanitation facilities commonly used in SSA countries are pit latrines and septic tanks, for which no Japanese technologies are available; therefore, it may not be possible to secure Japanese experts with the relevant knowledge to provide guidance on their improvement in SSA countries. However, even if there are no such experts in Japan at present, it is desirable for JICA to train such experts in order to provide support for FSM improvement in developing countries in the future. In the meantime, it is necessary to promote the participation of foreign experts in JICA's technical cooperation through networks such as the BMGF.
- Considering the Japanese experiences of transition from Tandoku-shori Johkasou system (black water treatment) to Johkasou system (black water + grey water treatment) that did not progress well, that residents cannot expected to install and improve on-site sanitation facilities by themselves in the absence of financial support (subsidies). In consideration of the application of subsidy system in Japan to promote the above transition, it is necessary for JICA to examine the financial cooperation for the structural improvement of on-site facilities.

6.3.2 Promotion and Proper Implementation of Faecal Sludge Management (FSM) (including Slum Areas) (Technical Cooperation Project and Financial Assistance)

In order to achieve CWIS, it is necessary to strengthen on-site sludge management (FSM), because many urban residents in SSA countries depend on on-site sanitation such as septic tanks and pit latrines. The FSM is mainly carried out by private sludge collection companies in SSA countries. Therefore, the main issues to be addressed are the development of regulations and systems to ensure quality services, the establishment of service delivery system by training and strengthening private sludge collection companies, and the reduction of sludge collection costs.

The matters to be considered by JICA in the improvement of FSM in SSA countries are as follows:

- Although the agencies such as the water and sewerage corporations or sewerage corporations are responsible for implementing FSM in SSA countries, the regulatory bodies are often responsible for the development of regulatory frameworks necessary for FSM improvement. Thus, it is necessary to involve the regulatory bodies in the technical cooperation.
- It is important to explain the FSM system in Japan, such as the regular sludge collection system from Johkasou. The FSM system in Japan, in which Johkasou is used as standard on-site wastewater treatment facility, cannot be applied to residential customers (general public and slum residents) in SSA countries, but it can be applied to commercial customers such as office buildings, and there is a need for it.
- On the other hand, the FSM system that BMGF and other institutions are currently trying to establish in SSA countries includes elements different from those of FSM system in Japan (for example, call center facilitating contact between customers and sludge collection companies). Therefore, for the implementation of technical cooperation project by JICA, it is necessary to consider not only the Japanese FSM system but also the FSM system that BMGF is planning to establish, and have the flexibility to adopt the one that is more suitable to the current situation in the SSA countries.
- In order to avoid confusion in the target countries, technical cooperation projects on FSM shall be implemented in collaboration with other donors such as BMGF by sharing the common purposes, and with enough coordination, in the preparation stage, on the targeted populations and the method to be used.
- In many SSA countries, private sludge collection companies are already active to some extent, and they procure and operate their own equipment. Therefore, it is necessary to carefully examine the necessity of providing equipment so that it does not hinder competition among private companies. In addition, it is necessary to establish a maintenance and repair system and a parts supply system for vacuum tankers made in Japan.

6.3.3 Construction of Faecal Sludge Treatment Facilities and Enhancement of Capacity for Operation and Maintenance (Financial Assistance and Technical Cooperation Projects)

The faecal sludge treatment facilities together with the sludge collectors are the main elements of on-site sludge management (FSM). Since there is an overwhelming shortage of such facilities in SSA countries, there is a need for JICA to provide financial support and to carry out technical cooperation projects.

The matters to be considered by JICA in the development of faecal sludge treatment facilities in SSA countries are as follows:

- The financial assistance for the construction of faecal sludge treatment facilities shall be conditional on the target country's commitment to CWIS, or shall be combined with support for strengthening sludge collection in slums, etc., to encourage the target city's commitment to CWIS.
- The sludge treatment processes currently used in many SSA countries are rudimentary technologies that are not used in Japan, such as sun-drying bed systems and stabilization ponds. This is not only because of the low cost and easy O&M, but also because sludge from pit latrine, which often contains a lot of impurities, is not suitable for mechanical treatment. Therefore, if the financial cooperation of Japan's ODA must be based on the technology currently used in Japan, the opportunity for financial cooperation will be limited.
- It is necessary to train Japanese experts who can design sludge treatment facilities not used in Japan, such as sun-drying bed systems and stabilization ponds, and can provide guidance on operation and maintenance.
- The scale of faecal sludge treatment facilities is smaller than that of wastewater treatment plants. If Japanese technology is not used, the construction may be done by local contractors with Japanese fund.

- As in the case of financial support for wastewater treatment plants, it is desirable that the contract should be a Design, Build and Operate or Build and Operate contract, and the contractor should operate and maintain the plant for a certain period after construction, during which time the technology shall be transferred to the implementing agency. If it is difficult to adopt such a contract scheme, a technical cooperation project by JICA will be necessary.