Policy Brief Series 8

March 2021

WEPA

Toward the Establishment of Sustainable Faecal Sludge Management

– Lessons Learned from WEPA Partner Countries and Japan –

Author

Pham Ngoc Bao, Ph.D

Senior Water and Sanitation Specialist
Institute for Global Environmental Strategies (IGES)

IGES
Institute for Global Environmental Strategies

1 Background

Many Asian countries continue to experience rapid population growth, urbanization and changes in consumption patterns, which have led to a significant increase in water demand. Consequently, the amount of generated wastewater discharged into the environment is constantly growing. A considerable amount of wastewater in the region, particularly from developing countries, is not properly treated before being discharged. Estimates show that 85–89% of generated wastewater in Asia is discharged directly into water bodies untreated or only partially treated by simple on-site sanitation systems such as septic tanks (Bao and Kuyama, 2013), causing substantial levels of contamination in drinking water sources as well as inland and coastal ecosystems. Meanwhile, most urban residents in the region still predominantly rely on septic tanks for onsite sanitation to treat domestic wastewater before discharging into the nearby water environment. Reports show that around 95% of households in urban areas of Viet Nam have a septic tank, with respective figures for Thailand, Philippines and Indonesia of 87%, 83%, and 80% (UNICEF & WHO, 2019) (Figure 1). In this context, septic tanks play an important role as a basic sanitation facility for millions of the region's population. However, most tanks are often of non-standard design, improperly constructed, inaccessible for desludging, and are not regularly maintained or desludged. These are the main reasons affecting their poor performance, as well as the low-quality of effluent discharged into the environment. Therefore, it is considered that many septic tanks installed in the region are not fully achieving their intended purpose of providing effective onsite sanitation.

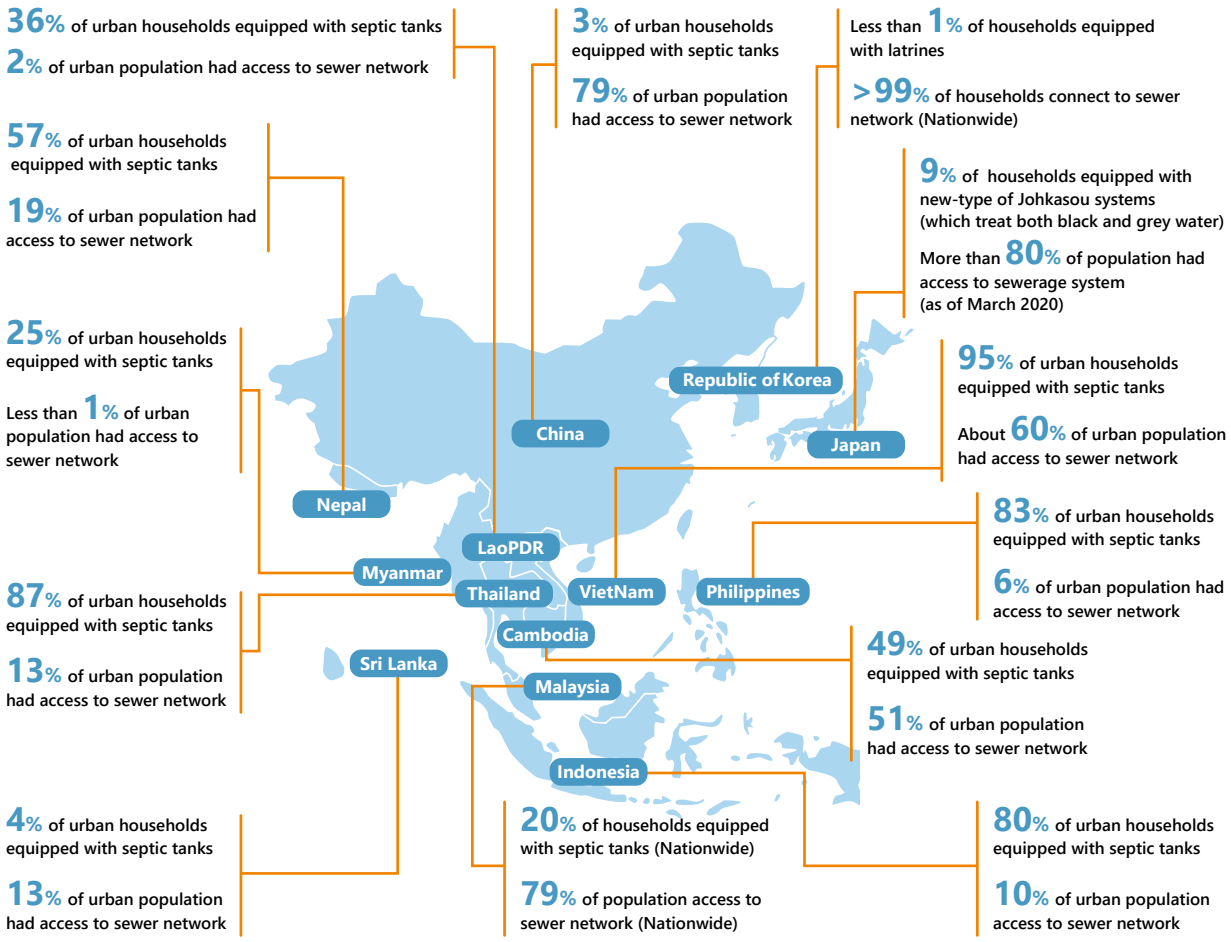

Figure 1. Septic tank and sewer network coverage in WEPA partner countries
(Source: WHO and UNICEF, 2019; Data for Japan (MOEJ, 2020); Data for Vietnam on sewer network coverage (World Bank, 2019))
Note: Water Environment Partnership in Asia (WEPA) is an initiative proposed by the Ministry of the Environment, Japan in 2003, with the aim of improving the water environment in Asia by strengthening water environmental governance. As of March 2021, the network comprised 13 country members: Cambodia, China, Indonesia, Japan, Lao PDR, Malaysia, Myanmar, Nepal, Philippines, Republic of Korea, Sri Lanka, Thailand, Viet Nam.

One of the biggest concerns currently facing many Asian countries, particularly WEPA partner countries is the inappropriate management of faecal sludge (also referred to as "septage") generated from septic tanks, due to the lack of viable business models. To date, most urban areas have heavily relied on informal, 'on-call' faecal sludge emptying and collection services, which are sometimes provided by unregulated private companies with low desludging service quality. Perhaps the most problematic aspect of this system is the illegal dumping, carried out by such desludging companies, of human waste into nearby rivers or canals (Figure 2). This has resulted due to reasons such limited treatment facilities and capacity, cost and/or time savings related to long-distance transport of sludge from households to faecal sludge treatment plants, plant availability, and obligatory sludge disposal fees at treatment plants. Thus, this faecal sludge is sometimes illegally dumped in several WEPA countries. As a result, most of the urban human waste is not safely collected, managed or treated before being released into the environment, contaminating both groundwater and surface water, spreading high levels of pathogens into the urban water environment and transmitting fecal-associated infections.

Figure 2. Illegal dumping of faecal sludge into receiving water bodies

Box 1. What is faecal sludge?

Faecal sludge (FS) often refers to the partially treated matter, which was stored in and pumped out of a septic tank or other on-site/decentralized sanitation facility (e.g., cesspool, pit latrine, ventilated pit latrine, dry or double-vault latrine). It is raw or partially digested, a slurry or semisolid, which contains three major components: scum, effluent and sludge. Faecal sludge management includes the process of storage, collection, transport, treatment and safe end-use or disposal of FS. FS is highly variable in viscosity, quantity, and concentration, depending on local contexts. (Rohilla et al., 2017)

The ongoing COVID-19 pandemic has further underscored the need to ensure access to safe and reliable water and wastewater services for all, to minimize the risks of microbial infection as well as to protect human health during infectious disease outbreaks. However, this ultimate goal will remain far out of reach if current faecal sludge management practices are not appropriately addressed, which requires appropriate business models so that it can operate sustainably. The current situation, if unresolved, also potentially threatens the ability of many WEPA countries to achieve the related targets under the Sustainable Development Goals by 2030 – particularly target/indicator 6.2.1 (increase the proportion of population using safely managed sanitation services) and target/indicator 6.3.1 (increase the proportion of wastewater safely treated). Therefore, there is a high need to introduce appropriate business models that offer holistic solutions, i.e., that consider the entire sanitation service chain, from proper septic tank design, to capture/storage, emptying, collection and transport, treatment and safe treatment/reuse/disposal of treated faecal sludge (Figure 3).

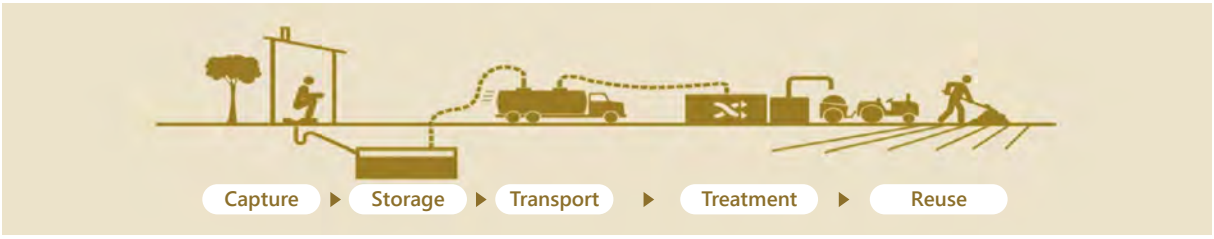

Figure 3. Safely managed sanitation system providing protection from exposure to hazards across the sanitation service chain (Source: Rohilla et al., 2017)

This Policy Brief has been developed with the aim of: (i) investigating the existing situation and challenges on faecal sludge management in WEPA countries; (ii) identifying enabling factors for introducing and implementing appropriate business models for sustainable faecal sludge management, through selected case studies in WEPA countries; and (iii) initiating discussions on how lessons learned from Japan's experiences in using Johkasou systems for human waste and faecal sludge management can be introduced to improve the situation in WEPA partner countries.

2 Situational analysis of faecal sludge management in WEPA countries

Increasing access to improved sanitation is not only a regional (Asian) but also a global priority. As well as the health benefits, improved sanitation has significant economic benefits. For example, the return on 1 USD spent on water and sanitation improvements in low-income countries is 5 to 46 USD, depending on the intervention (Hutton et al., 2007). Many countries in Asia have made certain progress towards the Millennium Development Goals (MDGs) and have increased access to improved sanitation facilities over the last two decades. However, providing adequate access to sanitation facilities in itself does not ensure such facilities will operate properly or as intended if the issue of effective faecal sludge management is ignored. Consequently, improper management of this faecal sludge in many Asian countries has resulted in significant impacts on human and environmental health in this region.

Challenges faced by WEPA countries in effective faecal sludge management

Based on our observations and a number of intensive on-site investigations into current faecal sludge management in WEPA countries, the following common challenges have been identified.

Institutional framework for faecal sludge management throughout the entire sanitation service chain

Establishing an appropriate institutional framework based on local socio-economic, climatic and environmental contexts that embrace existing sanitation infrastructures, institutions and planning procedures is considered a key part of successful sludge management. This framework must be supported by strong commitment and political will from both national and local governments. It should be considered an enabling environment to facilitate different government and non-governmental agencies and private sector organizations to work together and achieve sustainable sanitation, i.e., sustainable faecal sludge management. However, such management is not prioritized by either national and/or local governments as part of overall sanitation plans in many WEPA countries. In addition, the roles and responsibilities of relevant governmental agencies, ministries and other stakeholders (e.g., utility managers, private sector companies, customers, community-based organizations, sanitation associations) related to faecal sludge management across the sanitation service chain are not clearly defined, and sometimes overlap or leave gaps. This has resulted in a lack of accountability, poor communication, coordination and planning, delayed construction, as well as disagreements between stakeholders in the event of issues.

Guidelines on standard design of septic tanks and faecal sludge management

Some WEPA countries lack guidelines on national standards for the design and construction of septic tanks. Meanwhile, in the other countries, where national standards for design exist, but practically many installed septic tanks in urban areas have not been designed and constructed according to appropriate standards. In addition, only a few countries have established a Guideline or regulations for faecal sludge management and regular desludging (e.g., Malaysia). Even in such cases, however, detailed and practical guidelines on faecal sludge management for local governments that take into account local contexts is absent. Moreover, responsibilities for faecal sludge emptying and disposal is often left to householders, property owners and the informal private sector. Consequently, most households have either never desludged their tanks or have no knowledge of their latest desludging. In actuality, households tend to only make contact with desludging services upon the occurrence of a blocked septic tank. For example, World Bank reported that up to 75% of

septic tanks in Vietnam and 66% in Indonesia have never been emptied (World Bank, 2015).

Regulations on regular inspections, desludging and maintenance of on-site sanitation facilities

Currently, most WEPA countries have yet to establish, or have established but only very weakly enforce guidelines or regulations on regular desludging of faecal sludge from septic tanks either by manual or mechanical means; exceptions are Japan, Republic of Korea, Malaysia.

According to a recent published report from World Bank (2016), in Indonesia for instance, since the 1990s over 150 faecal sludge treatment plants have been constructed and entered into operation. However, of these less than 10% are still operating, of which operations are further degraded due to both ineffective emptying services and lack of demand from households. Thus, insufficient amount of faecal sludge is transported to plants for treatment.

Malaysia is another example, which had historically suffered due to weak capacity at the local government level for managing both water and sewerage services. In 1993, therefore, the government nationalized the sewerage service and transferred the wastewater assets to the federal government. Services were thereafter provided through a single, private concessionaire, Indah Water Konsortium (IWK). From 1993 to 2008, IWK built sewers, developed desludging services, constructed faecal sludge and wastewater treatment facilities across the country, and, together with the regulatory agency, established clear policy guidelines and standard operating procedures for developers and wastewater operators. The provision of sewerage services was regulated and licensed by one regulatory body, Suruhanjaya Perkhidmatan Air Negara (SPAN), which included faecal sludge extraction, transportation, and treatment and disposal. Desludging services for individual septic tanks within IWK's concession areas were scheduled and undertaken on a three-year cycle by IWK. Efforts have also been made to raise awareness among households of the importance of this practice.

Recently, Haiphong city of Vietnam, and Manila city of Philippines (through Manila Water Company) also introduced regulations on regular desludging, with 4-5 years interval in case of Haiphong and 5-7 years in case of Manila. In other countries, faecal sludge is often emptied and collected by private companies (e.g., Indonesia, Lao) due to the limited capacity both in terms of human resources and equipment (e.g., vacuum trucks) of state companies.

Lack of understanding on effective faecal sludge treatment technologies

Given that wastewater and faecal sludge characteristics vary widely from city to city and country to country

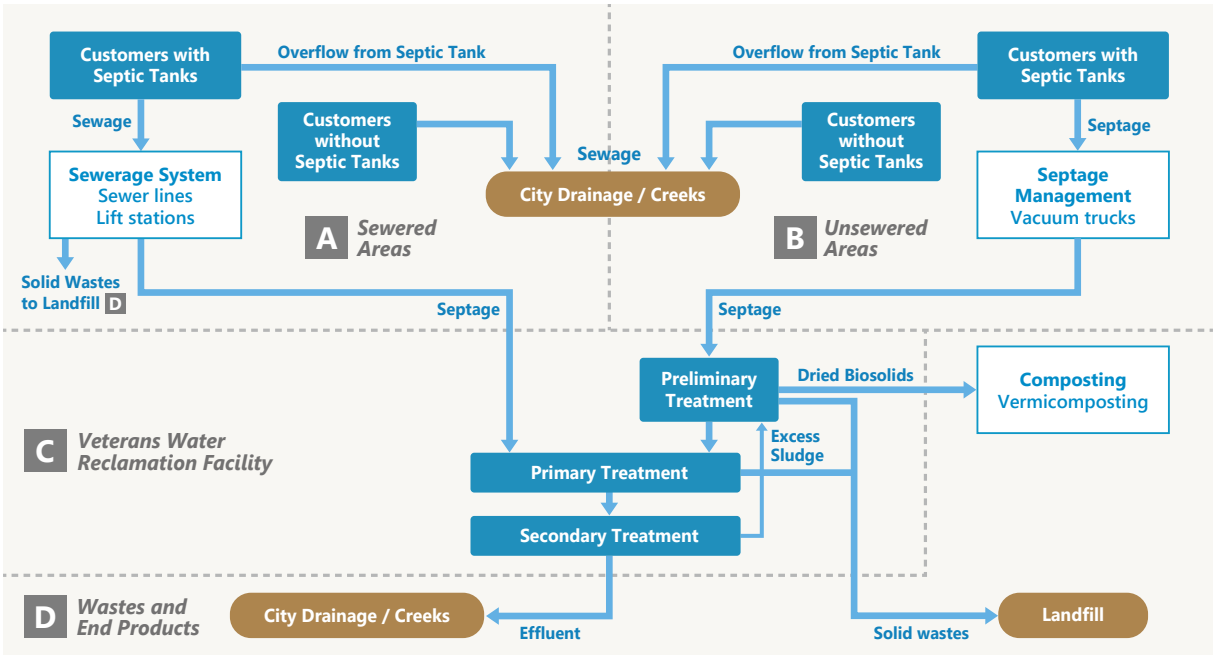

Figure 4. Selection of appropriate technology at Veterans Water Reclamation Facility (The Philippines) for combined sewage and faecal sludge treatment. (With daily treatment capacity: 2,400 m³ of sewage, 240 m³ of faecal sludge)

(e.g., due to food habits, onsite sanitation facilities and cleaning practices), the selection of appropriate technological options must take into account local contexts, including land availability, power and cost requirements, availability of skills, knowledge and materials, and potential impacts on surrounding local environments. It is therefore important to establish (via the government) detailed guidelines to enable informed choices for faecal sludge treatment technologies. Such guidelines should be made available to local governments to help them identify appropriate solutions for their city or province. However, most of the countries lack such guidelines until now, except for a few countries or cities (e.g., Indonesia, Manila city), which have recently made great efforts to introduce them.

Lack of effective business models for faecal sludge emptying, collection and transport, treatment and final disposal

Depending on local circumstances, each city is expected to develop its own business model for faecal sludge management, by considering the overall sanitation service chain. Figure 5 shows an example of an existing business model for faecal sludge management in Denpasar city, Indonesia, in which household sludge is emptied and collected mainly by private companies. A small part of this collected sludge is transported to Suwung Faecal Sludge (Septage) Treatment Plant (designed capacity: 400 m^3/day; actual operating capacity: about 200-300 m^3/day), located within the Suwung Wastewater Treatment Plant. Similarly to Bandung, private companies are required to pay treatment fees to UPT PAL (local government company in charge of wastewater and faecal sludge management) for disposal of the collected sludge at the treatment plant. Unfortunately, governmental control has not been sufficiently effective as these are cases of private or individual faecal sludge emptying providers illegally dumping collected sludge from households into the open environment (e.g., rivers and lakes) or manholes to avoid paying treatment fee. One of the challenges facing UPT PAL to raise capacity and performance of the plant is the lack of investment budget. While a wastewater fee is separately collected by UPT PAL, and

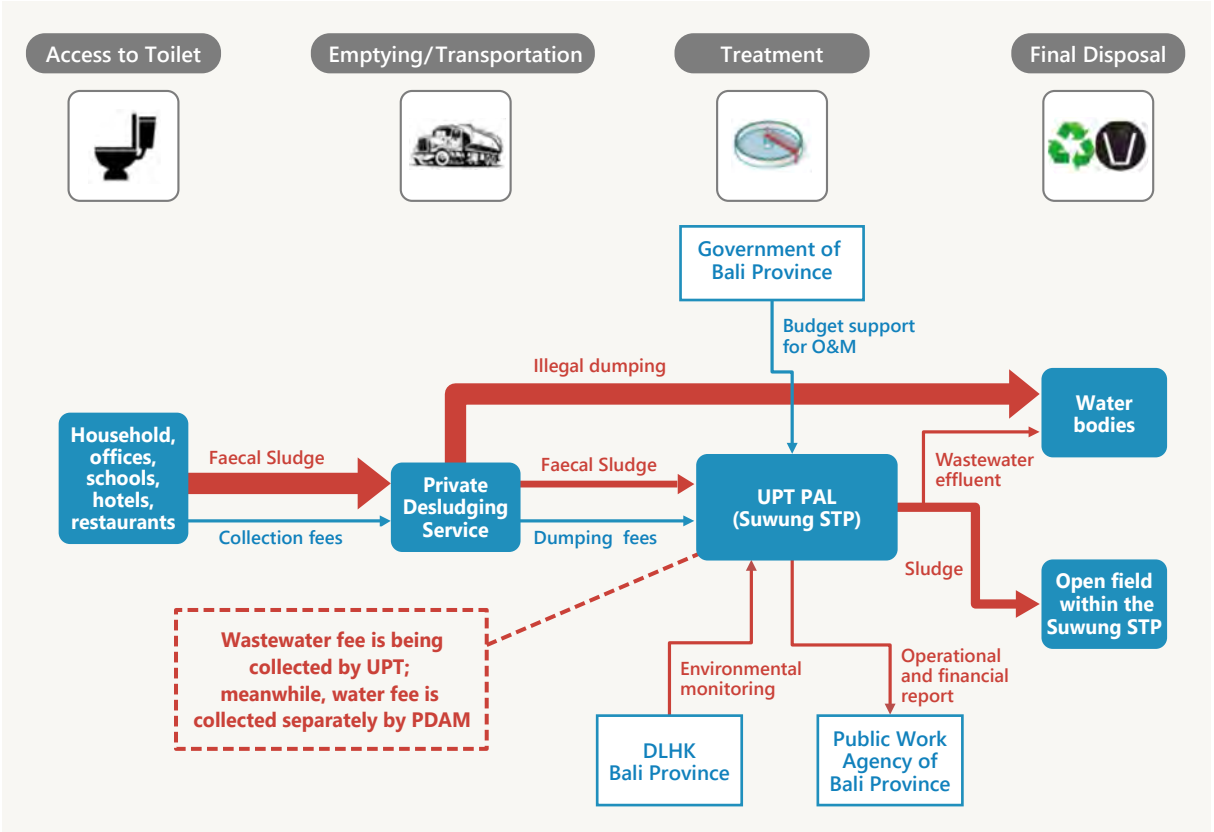

Figure 5. Existing business model for faecal sludge management in Denpasar, Indonesia (Bao, 2019b)

a water fee is collected by PDAM; consequently, less than half of the relevant households have historically paid the wastewater fee/bill. The main payers appear to be hotels, restaurants, offices, and the like, based on the authors' interview with UPT PAL in 2019 (Bao, 2019a).

Financing and incentive mechanisms for cost recovery

The lack of financing and incentive mechanisms for cost recovery is one of the major reasons why many countries have failed to establish effective models for faecal sludge management that include emptying, collection and transport, treatment and final disposal/reuse. There is no "one size fits all" financial model proven to work in all situations, and in reality, service delivery models need to be periodically revisited and modified based on changes in legal, environmental and economic conditions, as well as responsibilities. Various financial models have been proposed. An extensive list of possible configurations, stakeholders, stakeholder responsibility and types of financial transfers can be found in the study by Tilley & Dodane (2014). Regardless of the sludge management program/system chosen, however, it needs to be premised on being funded by user fees to make it sustainable. Such fee can be added to monthly water bills or charged as special municipal environment fees or pay-as-you-use. Fees should also cover at least the basic operational costs of the service, including human costs, costs for vehicles and fuel, and costs for treatment, operation and maintenance of faecal sludge treatment facilities. The related faecal sludge management program can be fully or partially sustained by the tariffs and potential revenue from selling treatment residuals as fertilizers, provided they are correctly produced and satisfy national quality standard for reuse.

Social and commercial marketing, and public awareness raising campaigns for customers and relevant stakeholders

Effective social and commercial marketing, as well as public awareness raising activities (e.g., through pamphlets, education programs, regular community meetings) on the need and importance of periodically desludging septic tanks should be carried out when regular desludging services are first introduced, as well as periodically thereafter over the whole cycle (e.g., 2-3 years or 3-5 years), depending on the characteristics of each locality, and of the septic tanks.

3 Business models for sustainable faecal sludge management

a. Concept of business models for sanitation service chain, including from sludge emptying, collection and transport to treatment and final disposal/reuse

The concept, "business model" is often used to describe how a business or service model is structured, financed, institutionally arranged and managed to enable quality services to be delivered to customers. According to Otoo and Drechsel (2018), business models can consist of four core elements that describe a firm: (i) Value proposition, which distinguishes it from other competitors through the products and services it offers to meet customer needs; (ii) Customer segment(s) the firm is targeting, the channels it uses to deliver its value proposition and the customer relationship strategy; (iii) Infrastructure comprising the key activities, resources and partnership network that are necessary to create value for the customer; and (iv) Financial aspects (costs and revenues), which ultimately determine a firm's ability to capture value from its activities and break even or earn profit. Business models can be introduced at different stages of the sanitation service chain, including one for faecal sludge emptying, collection and transport, one for operating the faecal sludge treatment plants, and one for reuse or final safe disposal of the treated sludge.

b. Enabling factors for introducing and implementing sustainable business models for faecal sludge management

In order to ensure successful introduction and implementation of business models for sustainable faecal sludge management, a number of enabling factors need to be considered, as discussed via case studies from selected WEPA countries in the following section.

Business model for faecal sludge management in the Philippines

The economics of any fecal sludge management program can be partially or fully sustained by successful collection of tariffs from customers and potential returned value from the sale of treatment residuals as fertilizers for farmers. Dumaguete City of Philippines is a good example. Here the tariff is 2 pesos (0.05 USD) per cubic meter of water consumed. Households use an average of 15 cubic meters a month, resulting in a monthly fee of 30 pesos (0.60 USD), which is perceived as affordable. Maynilad Water and Manila Water have a 20% tariff added to the monthly water bill to cover both faecal sludge and sewerage management. In San Fernando City of Philippines, however, where the district water service only serves 25% of the residents, a fee is collected along with the property tax, with each building owner paying equivalent fees. Of the various systems, the Dumaguete system of a step-based fee according to water consumption appears to be the most equitable, as poorer people who consume less water pay less for sanitation services. This system also encourages water conservation, since reducing water consumption directly impacts on the fees charged (Robbins et al., 2012).

Business model for faecal sludge management in Nonthaburi municipality of Thailand

Thailand has about 162 faecal sludge treatment facilities across the country, which generally make use of the anaerobic process. For example, Nonthaburi city's plant uses anaerobic digesters as the main treatment technology, and the treated sludge is used as a soil supplement. The existing business model for faecal sludge management in Nonthaburi city is described in Figure 6.

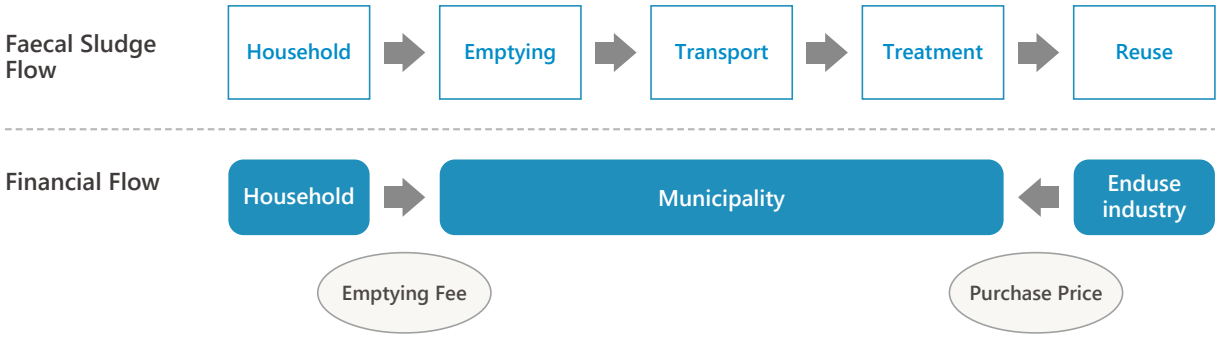

Figure 6. Existing business model for faecal sludge management in Nonthaburi city, Thailand
(Source: Bao et al., 2020)

The service area of Nonthaburi City Municipality is 38.90 km^2, which provides collection and transportation services within its boundaries. This municipality is a key player in faecal sludge collection, transportation and treatment services. The service consists of four trucks (3 m^3 trucks: 2; 6 m^3 trucks: 2). It has been found that in dense urban areas such as Nonthaburi City Municipality, service distances are lower than in remote areas, which is also affected by the location of the faecal sludge treatment plant. The service, due to its reliability, appropriate service fee and efficient contact channels, has resulted in a high level of customer satisfaction. The sludge treatment plant uses anaerobic digestion with sand drying bed, with a maximum capacity of 40 m^3/day and current capacity of 30 m^3/day. Both anaerobic digestion and sand drying bed together with covered lagoon use the gravity flow configuration to release faecal sludge to the next operation unit, which entails little equipment required except a harrow and screen grid/ basket to remove garbage at appropriate stages (Bao et al., 2020).

Dried sludge from the faecal sludge treatment plant is sold directly, given away to customers, mixed with organic waste to produce fertilizer, applied to plantations, or applied in the reuse market. The Nonthaburi City Municipality sells approximately 72 tons of dried sludge to gardeners annually, and the liquid component is normally used for plant watering. The municipality stores liquid effluent in a pond for plant watering within the organization. In terms of the reuse activity, the major reuse market is agriculture. Dried sludge is sold to vegetable gardeners at around 3,000 Baht/ton (100 USD/ton), according to the results of an interview at the plant, carried out by the author in 2019 (Bao et al., 2020).

Figure 7. Nonthaburi city faecal sludge treatment plan and fertilizer produced as final product

Business model for faecal sludge management in Denpasar, Indonesia

As mentioned earlier, Figure 5 shows an example business model for faecal sludge management in Denpasar, which failed to address the issues of illegal dumping of collected sludge and involved low rates of collected wastewater and low sludge management fees. In order to address these challenges, a collaboration was formed between a research group from the Institute for Global Environmental Strategies (IGES) and the Institute of Technology of Bandung. Its aim was to conduct insightful investigations into the problems and hold discussions with various stakeholders in Denpasar to identify appropriate solutions as well as propose an appropriate business model for faecal sludge emptying, collection and transport, treatment and reuse (Figure 8). As a result, a scheduled desludging program was proposed to create demand from customers, an incentivised discharge model was suggested to address the issue of illegal dumping, and a sanitation fee mechanism was proposed to cover the operation and maintenance

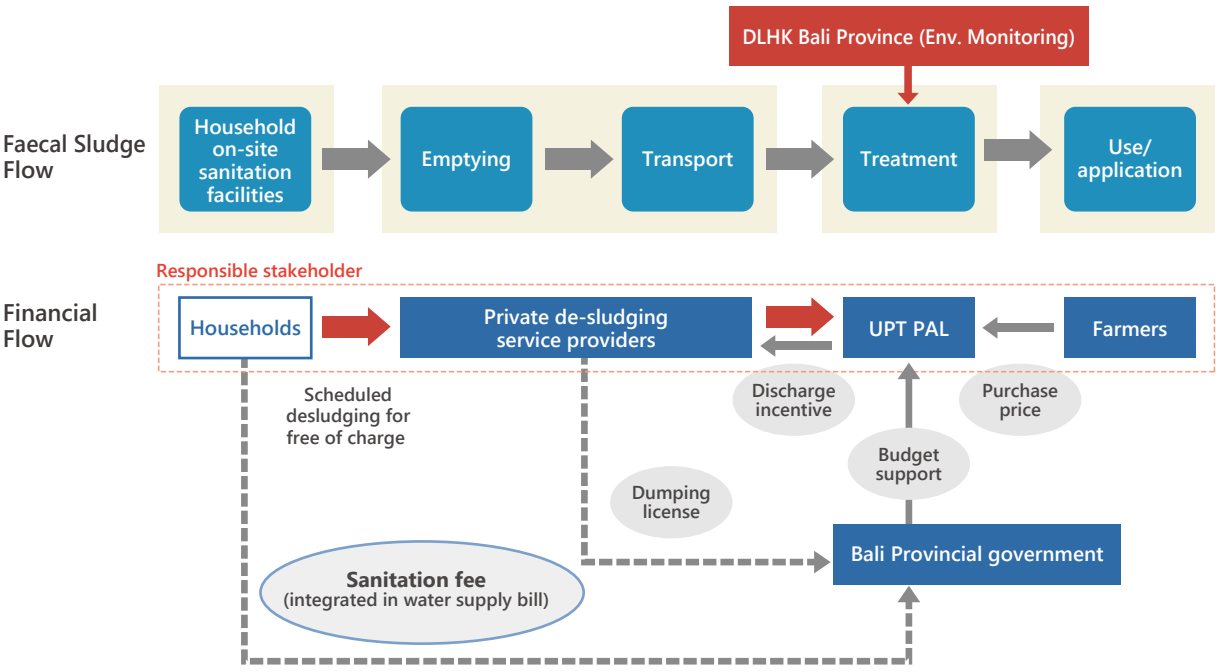

Figure 8. Example of incentivized discharge model proposed for faecal sludge emptying, collection and transport, treatment and reuse in Denpasar city of Indonesia (Bao, 2019b)

costs of the faecal sludge treatment plant. It was also recommended to incorporate the sanitation fee into the water supply bill in order to improve the rate of collection of wastewater and sludge fees (Bao, 2019b).

A similar idea has been successfully introduced and implemented recently by Haiphong Sewerage and Drainage Company (SADCO) in Haiphong city of Vietnam, where a 20% of tariff has been added to monthly water bills to cover both faecal sludge and sewage treatment costs.

4 Lessons learned from Japanese experience in managing faecal sludge from Johkasou systems

a. A brief history of night-soil (or faecal sludge) treatment and management in Japan

Japan has a long history and rich experience in managing night soil, or faecal sludge, since the Edo Era (1603 to 1868), in which farmers and residents in towns often constructed large night soil storage tanks, in so doing acting as suppliers of fertilizer for agricultural products. During the period of rapid economic growth starting in the late 1950s, due to the rapid urbanization and increasing use of chemical fertilizer, the traditional night soil recycling systems went into disuse and night soil turned from being regarded as 'fertilizer' to 'waste', resulting in serious environmental, social and health problems. To cope with these issues, the Government of Japan launched a subsidy program in the 1960s to promote the construction of night soil treatment facilities for households, namely "Tandoku-shori Johkasou", which only used to treat black water from toilets. In the 1980s, a new type of small-scale Johkasou known as 'Gappei-shori Johkasou' (referred to as Johkasou thereafter) was developed, which can be used for treating both black and gray water, while new installations of the blackwater-handling Tandoku-shori Johkasou were prohibited from 2001. The new small-scale Johkasou spread rapidly in suburban and rural areas that were not suited to constructing sewerage systems, which has resulted in a marked improvement in the water environment and water recycling in Japan (MOEJ, 2018).

As of March 2020, approximately 92% of Japan's total population has access to adequate sewage treatment services, which includes 9% of population using new-type of effective Johkasou system (MOEJ, 2020).

b. Lessons learned from Japan for other WEPA countries to improve faecal sludge management

Qualification and performance testing systems for on-site sanitation facilities

Differing from other countries, in Japan, all onsite sanitation facilities introduced have to be appropriately certified (Johkasou), especially for newly built houses or buildings that have no access to city- or prefecture-based sewerage systems. As part of the building permit process, a municipal construction surveyor is required to check the installed facilities (Johkasou), which must be standardized through use of a performance testing system to ensure sufficient performance during operations (Hashimoto, 2019). Unfortunately, this standardization process for on-site sanitation facilities, particularly for household users, had not yet been introduced in most other WEPA countries as of the time of this report.

Introduction of effective scheduled desludging programs

In order to ensure onsite sanitation systems such as septic tanks perform and function appropriately, they need to be desludged at certain time intervals (e.g., 3 to 5 years depending on country). In practice, however, households only use emptying services upon the occurrence of issues with their septic tank (e.g., blockage, bad odor), thus septic tanks are usually used despite being full of accumulated sludge and scum, which reduces their functionality and performance. This practice, if continued, can result in insufficient input amounts of faecal sludge for treatment at plants, forcing plant closure, as has occurred in Indonesia. Thus, in order to address this issue, Japan introduced a scheduled desludging program for Johkasou systems as a legal obligation for users, which obligates such be carried out at least once a year, managed by a municipality-certified desludging company.

Sound financing mechanism for operation and maintenance costs

In Japan, as part of its sanitation policy, a sound financing mechanism has been established to support

investment, operation and maintenance costs. In 1987, the Government of Japan introduced the National Subsidy Program to help accelerate installation of the new type of Johkasou, which treats both black and gray water, and conversion of the old-type Johkasou. A number of specific measures and subsidy schemes from the government and municipalities have been implemented, such as the Johkasou Installation Project (for private installations) and Johkasou Municipal Installation Project (for municipal installations) (MOEJ, 2021).

Establishment of training, examination and qualification systems for sludge service providers

Desludging services in most WEPA countries are currently provided by either public companies and/or private companies (formal or informal), which are sometimes not government certified. As a result, their performance is relatively poor, operations do not adhere to any standards, and the sludge collected is often illegally dumped or discharged into lakes, rivers, and sewage systems in order to save on fuel and discharge costs at designated dumping sites.

In order to address such issues, an official training, examination and qualification system was established in Japan for desludging business/workers and operators, desludging technicians and vendors engaged in the desludging business, to ensure service quality can be maintained and controlled by the government. Associated costs related to training and examination are covered by trainees themselves or the companies hiring them.

Selection of appropriate technological solutions for faecal sludge treatment considering local contexts

Japan has over 60 years of experience in developing and operating night soil and sludge treatment facilities, and over 1,000 sludge treatment facilities have been constructed and operate across the country (Hashimoto, 2019). Like other Asian countries, Japan is also challenged with securing the necessary land for constructing sanitary landfills and for dumping sludge from Johkasou systems and other centralized wastewater treatment plants. Consequently, compact systems for composting as a valuable fertilizer for agriculture or incinerating the sludge have been widely developed and constructed across the country. In 1997, the Government of Japan revised its subsidy policy for night soil and/or sludge treatment facilities through the introduction of a subsidy to eligible facilities, which also included resource recycling facilities. While sludge treatment technologies might be costly and may not be suitable in several WEPA countries, Japan's wealth of experience in technological processes such as solid-liquid separation, treatment of supernatant (wastewater) and safe disposal of dewatered sludge could be shared with other WEPA countries for their future consideration.

5 Policy recommendations

While great progress has been made in the Asian region to increase the ratio of household access to improved sanitation facilities such as septic tanks, sanitation does not just concern the toilets themselves. It also involves the broader sanitation service chain, including the management and treatment of effluent as well as faecal sludge from sanitation facilities, particularly from septic tanks, and the need to ensure it satisfies national standards before being discharged or disposed of into nearby water bodies or receiving sites. In order to address the current challenges of faecal sludge management faced by WEPA countries, the following points should be taken into account:

- Need for strong political will and commitment, from both national and local governments, to achieve impact and create positive changes and improvements in faecal sludge management. Consequently, appropriate local budgets should be allocated for faecal sludge management activities.
- Clarification of roles and responsibilities of each stakeholder group regarding faecal sludge management across the sanitation service chain, to improve coordination, planning and smooth implementation.
- Development of standard designs for septic tanks as well as detailed guidelines for faecal sludge management based on country contexts, in order to guide and facilitate local governments in implementing faecal sludge treatment and management.
- Improved capacity of local governments, to enable monitoring and enforcement of faecal

sludge disposal, as well as establishment of regular desludging programs, by cities, supported by a GIS-based database system on household sanitation (e.g., toilet availability, size and shape of septic tanks, number of chambers, last emptying, accessibility of septic tank), and which requires periodic emptying of all household-level septic tanks, in order to improve public demand for related services.

- Establishment of appropriate business models with sound financing mechanisms for effective faecal sludge management that account for local contexts, for each city/province, which also clarify roles and responsibilities for all relevant stakeholders, and cover registration of all households, registered private contractors, introduction of regular desludging service systems, and monitoring plans for safe faecal sludge disposal and reuse, if available.
- Provision of advocacy, capacity building and awareness raising campaigns by local governments that target relevant local residents and stakeholders regarding the need for periodic desludging of septic tanks and proper management of collected faecal sludge.
- Introduction of official standard procedures for training, examination and qualification, to improve capacity as well as practical skills for desludging workers, technicians and service providers engaged in the faecal sludge management business. This will help raise service quality as well as enable effective control over water pollution.

Acknowledgement

The author would like to express his sincere gratitude to Dr. Yoshitaka Ebie of the National Institute for Environmental Studies for kindly providing valuable comments and suggestions to improve the quality of this Policy Brief.

References

ADB (2016). Sanitation and Sustainable Development in Japan. Mandaluyong City, Philippines: Asian Development Bank, 2016.

Bao et al. (2020). Final Report: A Case Study in Thailand. A Commission Report prepared by Institute for Global Environmental Strategies (IGES), in collaboration with Naturally Acceptable and Technological Sustainable (NATS) - Asian Institute of Technology (AIT), Bangkok, Thailand. Under a project entitled: "Policy Dialogue and Network Building of Multi-stakeholders on Integrated Decentralised Domestic Wastewater Management in ASEAN Countries" – November 2020.

Bao (2019a). Direct interview with UPT PAL in 2019.

Bao (2019b). Situational Analysis and Business Model Assessment for Septage Management in the Urban Areas of Indonesia – Final Synthesis Report (Commission Report). Prepared by Institute for Global Environmental Strategies (IGES), in collaboration with Ganeca Environmental Services (Indonesia).

Bao, P.N., and Kuyama, T. (2013). Decentralized domestic wastewater management in Asia – Challenges and Opportunities. Policy Brief Series No. 1. Published by WEPA-MOEJ. Accessed on 24th March. 2021.Available on http://www.wepa-db.net/pdf/1403policy_brief/WEPA_PB1_2013.pdf

Hashimoto, K. (2019). Institutional Mechanisms for Sustainable Sanitation: Lessons from Japan for Other Asian Countries. ADBI Working Paper Series. Published by Asian Development Bank Institute.

Hutton, G., Haller, L., Bartram, J. (2007). Global Cost-benefit Analysis of Water Supply and Sanitation Interventions. Journal of Water and Health 5(4), p.481-502.

MOEJ (2018). Night Soil Treatment and Decentralized Wastewater Treatment Systems in Japan. Ministry of the Environment, Japan. Accessed on 24th March. Available on: https://www.env.go.jp/recycle/jokaso/basic/pamph/pdf/wts_full.pdf

MOEJ (2020). Status of population access to the sewage treatment by the end of FY2029 – Ministry of the Environment, Japan (in Japanese). Accessed on 22nd March 2021. Available on: https://www.env.go.jp/press/108379.html

Otoo, M., Drechsel, P. (2018). Resource Recovery from Waste: Business Models for Energy, Nutrient and Water Reuse in Low- and Middle-Income Countries. Edited by Miriam Otoo and Pay Drechsel. New York, NY: Routledge, 2018.

Robbins, D., Strande, L. and Doczi, J. (2012). Opportunities in Fecal Sludge Management for Cities in Developing Countries: Experiences from the Philippines. North Carolina: RTI International. Accessed on 24th March 2021. Available on: https://www.ircwash.org/resources/opportunities-fecal-sludge-management-cities-developing-countries-experiences-philippines

Rohilla, S.K., Luthra, B., Bhatnagar, A., Matto, M., and Bhonde, U. (2017). Septage Management: A Practitioner's Guide, Centre for Science and Environment, New Delhi.

Tilley, E., and Dodane, P.H. (2014). Financial Transfers and Responsibility in Faecal Sludge Management Chains. In Chapter 13 of "Faecal Sludge Management Systems Approach for Implementation and Operation" Edited by Linda Linda Strande Mariska Ronteltap, Damir Brdjanovic. Published by IWA Publishing 2014.

UNICEF & WHO (2019). Progress on household drinking water, sanitation and hygiene 2000-2017. Special Focus on Inequalities. New York: United Nations Children's Fund (UNICEF) and World Health Organization, 2019. Accessed on 24th March 2021. Available on: https://www.who.int/water_sanitation_health/publications/jmp-2019-full-report.pdf

World Bank (2015). Improving On-site Sanitation and Connections to Sewers in Southeast Asia- Insights from Indonesia and Vietnam. Published by Water and Sanitation Program – World Bank. Accessed on 24th March 2021. Available on: https://www.wsp.org/sites/wsp/files/publications/WSP-Improving-On-site-Sanitation-Connections-to-Sewers-Southeast-Asia.pdf

World Bank (2016). Septage Management Pilots and Capacity Building in Indonesia: Synthesis Report. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/24721 License: CC BY 3.0 IGO.

World Bank (2019). "Vietnam: Toward a Safe, Clean, and Resilient Water System." World Bank, Washington, DC.