PODIWM

Policy Dialogue and Network Building of Multi-stakeholders on Integrated Decentralized Domestic Wastewater Management in ASEAN Countries

2018-2020

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Foreword

Securing to reach full implementation of the integrated water resources management is urgently required, as it is clearly shown in Sustainable Development Goals. Reduction of discharge of untreated wastewater into water bodies is one of the important targets, but Data suggests that achieving universal access to basic sanitation service by 2030 would require doubling the current annual rate of progress as United Nations announced. There could be several barriers and obstacles to be overcome in this field and current occasion.

This project, the Policy Dialogue and Network Building of Multi-stakeholders on Integrated Decentralized Domestic Wastewater Management in ASEAN Countries (PoDIWM) is a very timely subject. As the project title expressing a straightforward idea, Policy dialogue and network building in the stakeholders in this field is essential to share the knowledge appropriately and cooperate with each segment of administration in the government and local municipality, and agencies.

During the duration of this project, the world has been radically transformed by the impact of COVID-19. Although it may pose a threat to the project colleagues and affect the implementation of the project, it also reiterated the importance of sanitation of the living environment. We remain strongly committed to continuing to foster the diffusion of fact and knowledge, even on this difficult occasion.

I sincerely wish all delegates a successful and productive dialogue here where great ideas can take shape and become reality for the good of the regional environment and all its inhabitants.

Thank you,

Masahiro Osako, Dr.,
Director of the Center for Material Cycles and Waste Management Research
National Institute for Environmental Studies, Japan

Preface

Access to safe water and sanitation is indispensable to maintain a minimum standard of living. There is no exception to this principle, and no one should be left behind. In reality, unfortunately, many urban dwellers and farmers in the rural area still have limited access to safe water and sanitation in Southeast Asia.

The major source of water contamination in this region is the domestic wastewater from households and commercial buildings. Since the aquatic environment is harmed and the sanitation condition for habitants is deteriorating, improvement of the contaminated water flown into the environment is requisite for securing the sanitation and the hygiene.

The decentralized domestic wastewater management system is the sustainable and robust way of appropriate management of aqueous environments both in an urban and rural areas in Southeast Asia. It can contribute to improving the water environment quality when installed alone in individual residences or communities, and is expected to complement the centralized sewage management system. Decentralized systems are also attracting attention as a way to provide access to safe water to vulnerable populations.

The ASEAN-JAIF funded project, Policy Dialogue and Network Building of Multi-stakeholders on Integrated Decentralized Domestic Wastewater Management in ASEAN Countries (PoDIWM), has aimed to provide and share the technical and institutional knowledge and attempted to remove barriers to the adoption of decentralized systems in order to expand their applicability and feasibility in ASEAN regions.

Pandemics of infectious diseases have made our society being sanitized and clean to the extent we have not seen in our history. COVID-19 pandemics also drastically changed our social systems and the domestic wastewater management has been affected. On the other hand, domestic wastewater management shed light in providing opportunity to observe the virus in the drained wastewater which could contribute to the early detection of pandemics in the cities and communities. We are standing on the frontline to deliver the safety to community and society in terms of public health.

We are happily delivering the results of our project activities in this report. We hope that this report will further strengthen the collaboration among the project colleagues and will attract the potential stakeholders in the ASEAN region.

Regards,

Tomonori Ishigaki, Dr.,
Rieko Kubota, M.A.
Center for Material Cycles and Waste Management Research
National Institute for Environmental Studies, Japan

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Brief Summary of PoDIWM project

INTRODUCTION

In Asian developing countries, a major source of water contamination is the domestic wastewater from households and commercial buildings. Due to the contaminated water flown into the environment, the aquatic environment is harmed and the sanitation condition for habitants is also deteriorating.

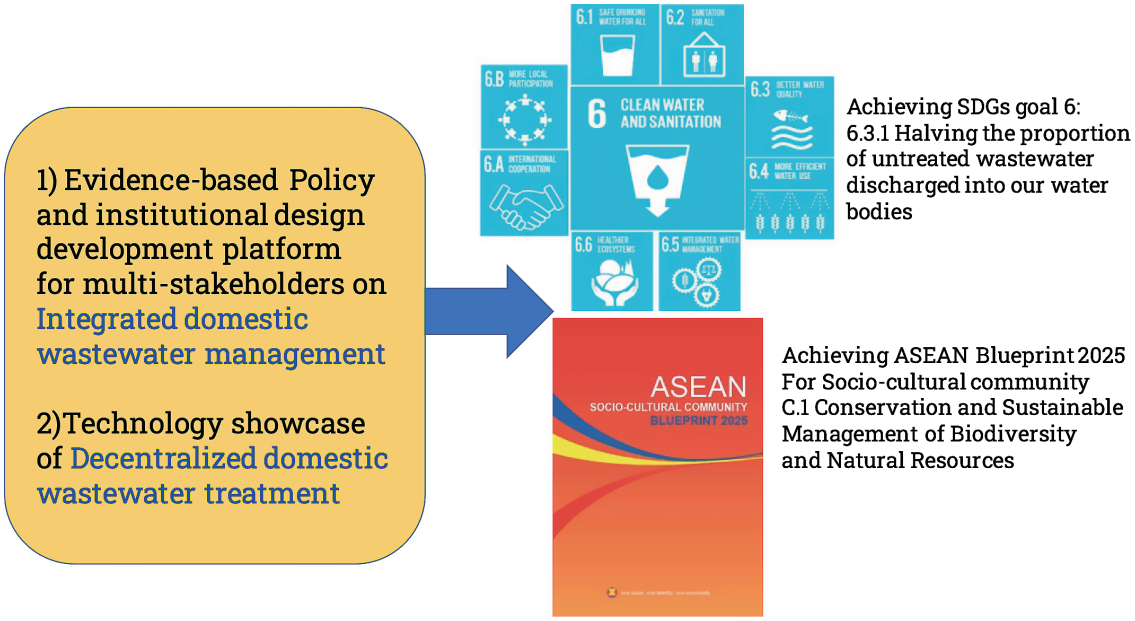
Most of the ASEAN countries establish the environmental standard for water quality and effluent standards for domestic wastewater already exist. However, compliance to the standards is difficult due to the lack of law enforcement to comply with the standard of domestic wastewater treatment, also an appropriate policy making and governance to execute the necessary policies and countermeasures to meet the water quality of effluent standard. On top of that, in many countries, wastewater issue is taken care by ministry of public works or such, and environmental issue is taken care by the ministry of environment or such. Such bureaucratic silos have been a factor for the lack of policy-making and its implementation. For the ASEAN countries to appropriately establish legislation and policies, possible policy and technological options should be well understood and well facilitated by relevant stakeholders.

Domestic wastewater treatment issue is regional issue in an aspect of water pollution of the environmental body including river and marine environment. The situation of current domestic wastewater treatment in AMSs is similar to each other though available policy, resource and technologies vary due to the difference in social and economic conditions. The problem and its causes can be addressed at the regional level by sharing the knowledge and practices of peer countries. Policy implementation can be promoted through the ASEAN framework in conjunction with the ASEAN Blueprints.

Site Visit in Kick-off Event, Indonesia (October 9, 2018)

OBJECTIVES AND METHODOLOGY

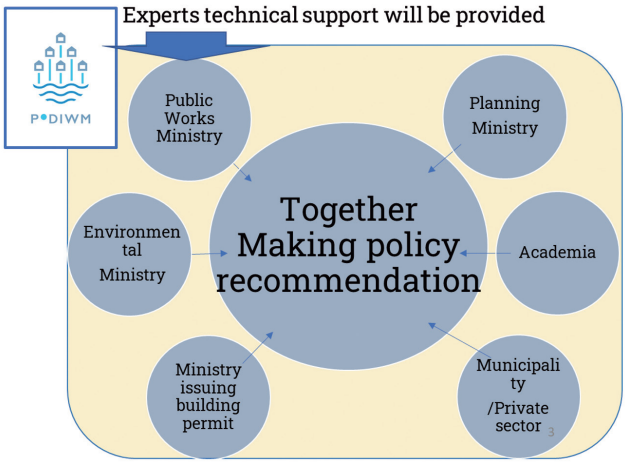
This project aims to serve as a policy and institutional design development platform for multi-stakeholders on integrated decentralized domestic wastewater management and technology showcase of decentralized domestic wastewater treatment in ASEAN countries.



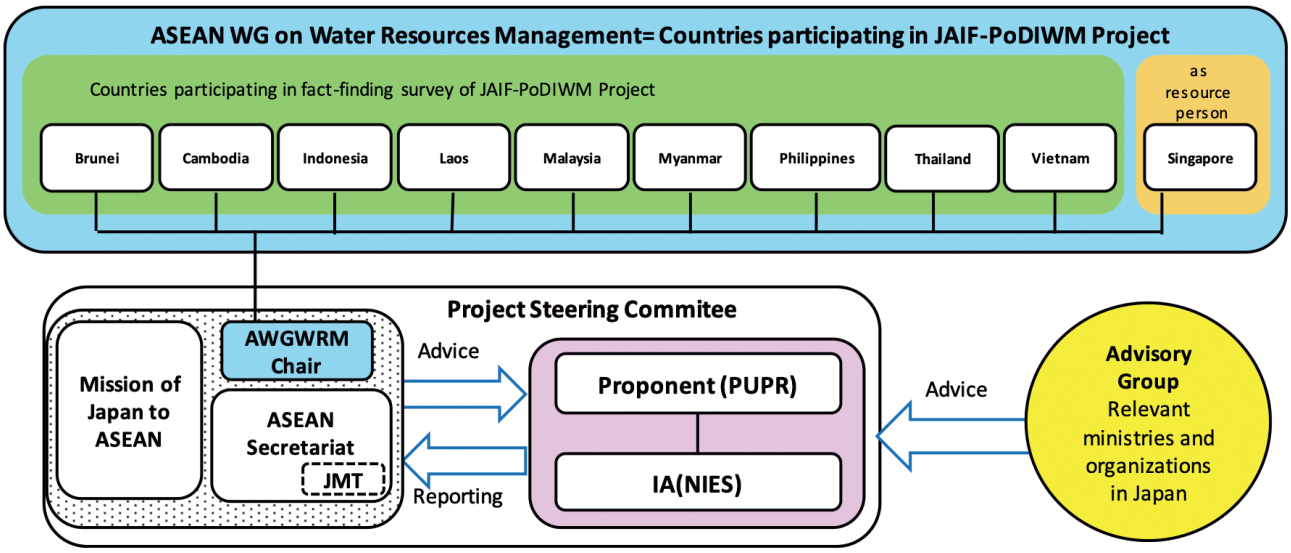
The project consisted of six main parts; namely, 1) Assessment of the status of legal policy systems and technology on domestic wastewater management in 9 AMSs*, 2) Fact-finding survey on legislation/policy/program/initiatives such as certification system about integrated decentralized domestic wastewater treatment in 9 AMSs, 3) Policy dialogues of AMSs on initiatives for integrated decentralized domestic wastewater treatment and its implementation, 4) Round-robin test of decentralized domestic wastewater treatment facilities manufactured to be tested in Indonesia, Thailand, and Japan 5) Capacity development training of multi-stakeholders for policy implementation, 6) Policy consultation in each 9 AMSs on domestic wastewater management including policies management, standardization, public and market initiatives for integrated decentralized domestic wastewater treatment. Depending on the conditions and priorities of each AMS, we shall tailor-made the preparation or policy draft, program action plan, strategy or draft grant proposal to donors as an outcome of the policy dialogue and policy consultation.

* As decentralized wastewater management is not applicable to Singapore anymore, Singapore was not involved in the Project though we have exchanged information and shared experiences.

This project also emphasizes the importance of networking and collaboration of multi-stakeholders relating to the domestic wastewater management. The project activity bridges the communication among the related stakeholders in one country and in interregional to discuss and make a “prioritized” policy to promote decentralized domestic wastewater management.



Directorate of Human Settlement, Ministry of Public Works and Housing (Kementerian PUPR), Indonesia will be the proponent of the project and National Institute for Environmental Studies (NIES), Japan, will be appointed as an Implementing agency. The officers from wastewater management related institutions, companies and relevant ministries at the national level will be the direct beneficiaries of the project and the communities that apply to the treatment will be indirect beneficiaries from reduced environmental pollution and health risk. Indonesia, as a proponent, is going to lead the regional policy dialogue as a chairperson.



·IA: Implementing Agency
·JMT: JAIF Management Team
·Project Steering Committee (PSC): (PUPR, Mission of Japan to ASEAN, GoJ, Environment Division of ASEAN Secretariat, AWGWRM Chair)
·Advisory Group: (Related Ministries of GoJ, Industrial Associations, donor's organization, academic experts)

JAIF PoDIWM Project Implementation Structure

FINDINGS OF COMMON ISSUES IN 9 AMSs

The trend of coverage of the management of domestic wastewater in each country showed the three groups of the development stage, such as (i) more than 50% of the population in national or at least in the urban is covered by the centralized treatment systems, but still being in the transition phase that requires the development of decentralized treatment system, (ii) more than 50% of the population in national or at least in urban is covered by the septic tank with proper management as their regulation but still need the development of current technology in urban and an expansion to the rural area for implementing the appropriate management of treatment technology, and (iii) more than 50% of the population in national are only able to access to the improperly managed treatment system or open defecation and need a strong effort to improve the situation. Besides the implementation of appropriate technology, the regional disparities in the country, and the lack of design of the total system including the sludge treatment are raised as common problems. It is necessary to legislate the sludge as well as the sediment or dredged mud or any other sludge-like materials. Some countries have also common problems to handle the gray water appropriately. Substantial regulation of the effluent standard and the combined treatment system for black water and gray water are recognized by all responded countries in this project.

Domestic wastewater management requires a comprehensive viewpoint of administration and governance and needed interdisciplinary cooperation. Intuitional and legal arrangements to collaborate with the several administrative departments are essential to moving forward the appropriate management of domestic wastewater in each country. Sectionalism is one of the strongest disabling factors on the moving forward the appropriate domestic wastewater management both in national and local government.

Lack of a sustainable financial mechanism for installation, operation, and maintenance of the decentralized wastewater treatment system is a common issue across the ASEAN member states. The same problem occurs in the centralized system, however, the public own system is easier to budget in contrast to the privately owned one. Incubation of public awareness with collaborative activity with the local residents is essential to strengthening the responsibility and cost-sharing sense. Appropriate tariff setting and fee collection systems that take into account compensation for socially vulnerable people are requisite. Involvement of the private sector including the scheme of public-private partnership will be a perspective measures for the successful implementation of the decentralized domestic wastewater treatment projects.

Financially and technically reasonable scheme for sludge management, including the removal from the individual plant, collection, transportation, treatment, recycle, and disposal, has not been established yet though it is an indispensable part of the sustainable management of domestic wastewater. Certification of operation and management service for the decentralized system is requisite for emphasizing the regulatory enforcement of sludge management.

Decision-makers in the central and local government urge the appropriate design and technology selection guidance of a decentralized domestic wastewater treatment system that suits the local legislation and condition of the community. It shall be useful for building permission and inspection that will be conducted by the certified engineer officers. The coverage of gray water becomes a common problem that should be solved following fecal management. The degree of urgency depends on the local history and condition, but it may affect the technology selection and budgeting either.

Domestic wastewater treatment system is the key infrastructure and utility and is requested to be resilient against natural disasters, climate change, and pandemics. It is necessary to provide the benefits and drawbacks of both the decentralized and centralized systems in this region.

Kick-off Meeting, Indonesia (October 9, 2018)

PSC Meeting, Philippines (May 27, 2019)

Events

Capacity Building Training

October 28 to November 1, 2019 Tsukuba, Japan

We have conducted the capacity building training for all the CTF members to visit Japan and learn from the Japanese technology and experience on decentralized domestic wastewater management. 54 CTF members plus some observers from the region have joined the one-week training. The lectures include the topics such as “Regulatory framework in sewerage sector”, “Introduction of Johkasou Act and its implementation in Japan”, “Determination and selection mechanism of suitable facilities in municipality level”, “Performance evaluation system for on-site treatment” among others and conducted a site visit to the Bio-Eco Laboratory where the treatment performance testing method is conducted.

Ibaraki Kasumigaura Environmental Science Center

October 30, 2019

Bio-Eco Engineering Research Laboratory Miho

October 30, 2019

Discussion

October 31, 2019
International Congress Center, Tsukuba, Japan

Discussing in mechanism of selecting Decentralized Wastewater Treatment Technology each country

About PoDIWM
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with Certificate after the schedule


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1st Policy Dialogue

January 19-22, 2020 Atlet Century Park Hotel, Jakarta, Indonesia

We have held the first regional policy dialogue in Jakarta, Indonesia from January 19 to 22, 2020. All the CTF members and some observers from AMSs, AWGWRM, ASEAN secretariat, Ministry of Environment Japan have participated. Interim reports of fact finding survey in nine countries have been introduced by the CTF members, and some common issues have been found. Based on such findings, we had a practical discussion, toward regional policy roadmap, by concretely identifying ideal visions, policy interventions, regional activities/programs and local characteristic for the six issues: 1) technological needs for decentralized domestic wastewater management, 2) policy coordination on domestic wastewater management, 3) master plan making for domestic wastewater management, 4) potential financial mechanism and fee collection, 5) policy implementation and capacity building at the local government level, and 6) standardization on treatment performance testing method for decentralized domestic wastewater management. The outputs of the discussion are shown as following figures.

DAY 1 : Country Presentation

DAY 2 : Group Discussion

Group 1 : Technological needs





Ideal vision [GD I]

Technological needs for decentralized domestic wastewater management

Potential policy interventions:

- ❑Legislation;
- ❑ Technology;
- ❑Public Awareness.
- ❑ Institutional Arrangement;
- ❑Promotion;
- ❑ Private Sector Partnership;

Enabling factors:

- ❑Incentives;
- ❑Budget;
- ❑Leadership;

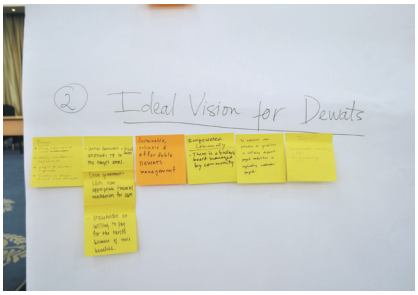
Disabling factors:

- ❑Lack of Technical staffs;
- ❑ Limited budget;
- ❑ Disaster Risk;
- ❑ Bad attitude;

Potential regional cooperation + local characteristics

Training, seminar, workshop, regional conference, forum, events study tour, Information sharing, expertise exchange, posters, website, award, ASEAN day of DEWATS

Group 2 : Policy coordination and master plan making



Ideal vision [GD 2]
Reliable wastewater treatment system that is accessible to everyone

Potential policy interventions:

-Institutional Framework, including regulation and enforcement☆☆
-Financial Mechanism ☆
-Awareness and education

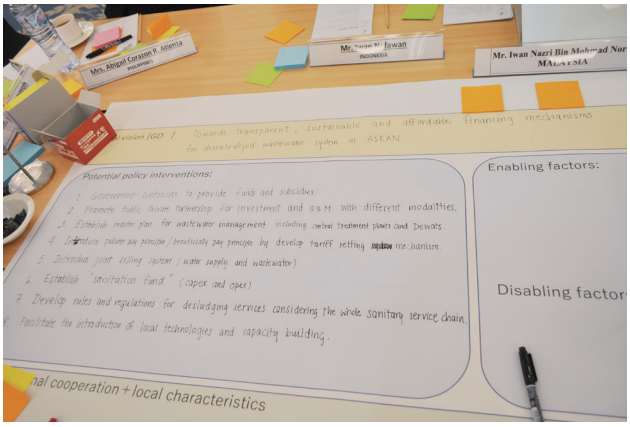
Enabling factors
-Strong support mechanism on cooperation between agencies
-Political will
-Reliable investment environ.
-Awareness, belonging action, environmental crisis, school curriculum, media
-variety and proper wastewater treatment
Disabling factors:
-Disagreement, lack of coordination between agencies, lack of enforcement
-Not enough budget
-Low awareness, Lack of infrastructure
-high cost, geographic problem on treatment systems

Potential regional cooperation＋local characteristics

A) Institutional setting
B) Local financial scheme
C) Human resource development
D) Investment

A) Human resource quality
B) Political and cultural difference
C) Different stakeholder involved
D) Existing infrastructure
E) Lack of budget

Group 3 : Financial mechanism and fee collection



Ideal vision [GD 3]: Towards transparent, sustainable and affordable financing mechanisms for decentralized wastewater system in ASEAN

Potential policy interventions:

1. Government continues to provide funds and subisidies for DEWATS
2. Promote PPP for investment and O&M with different modalities
3. Establish master plan for wastewater management including central treatment plants and DEWATS
4. Introduce Polluter Pay Principle/benieficiaries pay principle by developing tariff setting mechanism
5. Introduce joint billing system (such as water supply and wastewater)
6. Establish “sanitation fund” (capex and opex)
7. Develop rules and regulations for desludging services considering the whole sanitary service chain
8. Facilitate the introduction of local technologies and capacity building

Enabling factors:

1. Political wills from central and local government
2. Law and regulation on PPP including incentive policy to encourage private sector investment
3. Government directives
4. Collaboration among multi-stakeholders

Disabling factors:

1. Lack of public awareness
2. Low willingness to pay (consumer acceptance)
3. Lack of incentive and priority from government
4. Lack of investment viability

Potential regional cooperation + local characteristics
-Introduce SDG6 ASEAN city model projects
-Development of regional guideline for sustainable financing mechanisms in DEWATS project
-Establish regional platform for information and knowledge sharing on decentralized wastewater management

Group 4 : Policy implementation and capacity building





Ideal vision [GD 4]
Ensure the National Level Policy implementation through Multi Stakeholder Involvement at National and Local Level for Safely Managed Decentralized Domestic Wastewater.

Potential policy interventions:
1. INCENTIVES AND DISINCENTIVES
Provide Strong Ordinances (Includes The Disincentives Measures) and ensure its implementation
Providing incentives to the LGU that has good performance (Through Financial And/Or Professionals Support)
Provide Incentives to the household that applying Standardized Septic Tank and got the Septic Tank Desludged.
2. Institutional Framework
Create Institutional Structure that enable conveyance of the policy until the LGU Level
The Decentralized DWM Services Chain should be managed by an institution/operating unit
The Scheduled Desludging by the Operator Units should be managed by the operator units and regulated
3. Policy to provide database
Ensure every LGU has database of the treatment technology applied on every houses
The database of the treatment technology should be managed by institution and included in Policy
4. Financial Mechanism Policy/ Payment Upon Service Rendered
5. Prepare Policy that embody the strategic masterplan in managing decentralized domestic Wastewater Management including the Capacity Development
6. Standard within the Decentralized Wastewater Management
Ensure the Standard Implemented and Monitored
Policy for Standard required for the treated biosolid from FSTP or STP
Develop Guideline and Standard for water Reuse and biosolid based on application

Enabling factors:
Political will in supporting decentralized domestic wastewater management
Commitment of the national and regional (provincial) to allocate budget in implementing decentralized DWM
Improve tariff collection mechanism (confidence building for the investor)
Woman taking the lead in promoting safely managed hygiene and sanitation
Disabling factors:
Political Intervention (Unstable political system)
Budget Allocation not based on the needs but more to the common amount
Non-sustainable Tariff, and collection Mechanism
Lack of Data on Decentralized Domestic Wastewater Management

Potential regional cooperation + local characteristics
Coordination between local stakeholder for determination of the service charges
Different units in LGU in Managing Decentralized DWM
Lack of Current Act or Legislation on Sewerage System
Implementation of Data Privacy Act (Philippines)
Privatisation Issue and Unsuccessful initiatives (Thailand)
Level of Community Awareness on Needs of Scheduled Desludging
Existence of Traditional or Primitive System - not Standard /unregulated

Group 5 : Standardization





Ideal vision [GD 5]

To assure performance of decentralized domestic WWT products be accessible according to the harmonized testing protocols in ASEAN member states.

Potential policy interventions:
Prioritizing DDWWT and FSM as “Key /integral Parts” in achieving SDG6
-harmonization of parameters and analytical methods
-formulation of evaluation committee in each AMSs
-Establishment of certification and endorsement system
-inspection of the product in operational stage
-Public awareness raising
-Capacity development (both end-users and local government)
-Manufacturers registration

Enabling factors:
-Commitment on SDG by government
-Regional market needs
-Public awareness
-Deterioration of public health and environment
-Implementation of SDGs for green cities in AMSs
Disabling factors:
Lack of fund
Difficulty of multi-ministries coordination.
No Standard procedure(SOP) for inspection and building permission.
Lacked capacity for setting standard testing bodies.
Increasing CAPEX of the tested products.

Potential regional cooperation＋local characteristics
-Institutionalization of DEWATS regional platform into ASEAN ministerial committee AWGWWM task group
-Developing regional platform exchanging experience and legal enhancement of local/national professionals
-Training, workshop
-Guideline for establishment of certification and endorsement systems
-Consideration applicability of DEWATS in coastal zones and/or flood-proned areas, riverside communities

Output papers on the discussion of the break out groups of participants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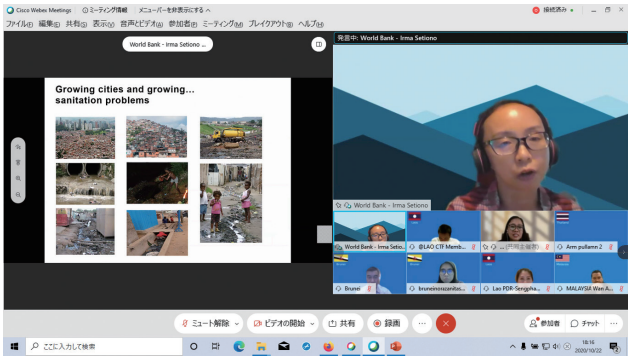
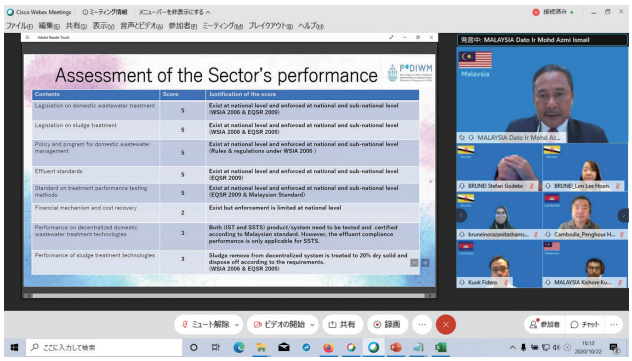
2nd Policy Dialogue

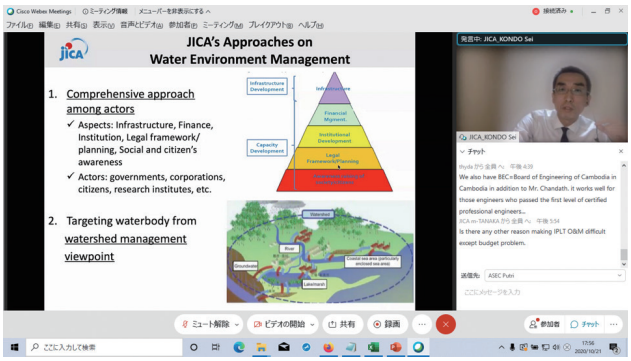
October 21, 22, and 27, 2020 Online

OVERALL

We have held the second regional policy dialogue on October 21, 22, and 27, 2020. Through the policy dialogue, the participants agreed on the necessity to develop a policy roadmap for the introduction, dissemination, and establishment of appropriate domestic wastewater management in the ASEAN region, and confirmed that the network of stakeholders is mutually committed to resolving common regional issues and will continue to work closely with the ASEAN Secretariat to strengthen the activity in this field.



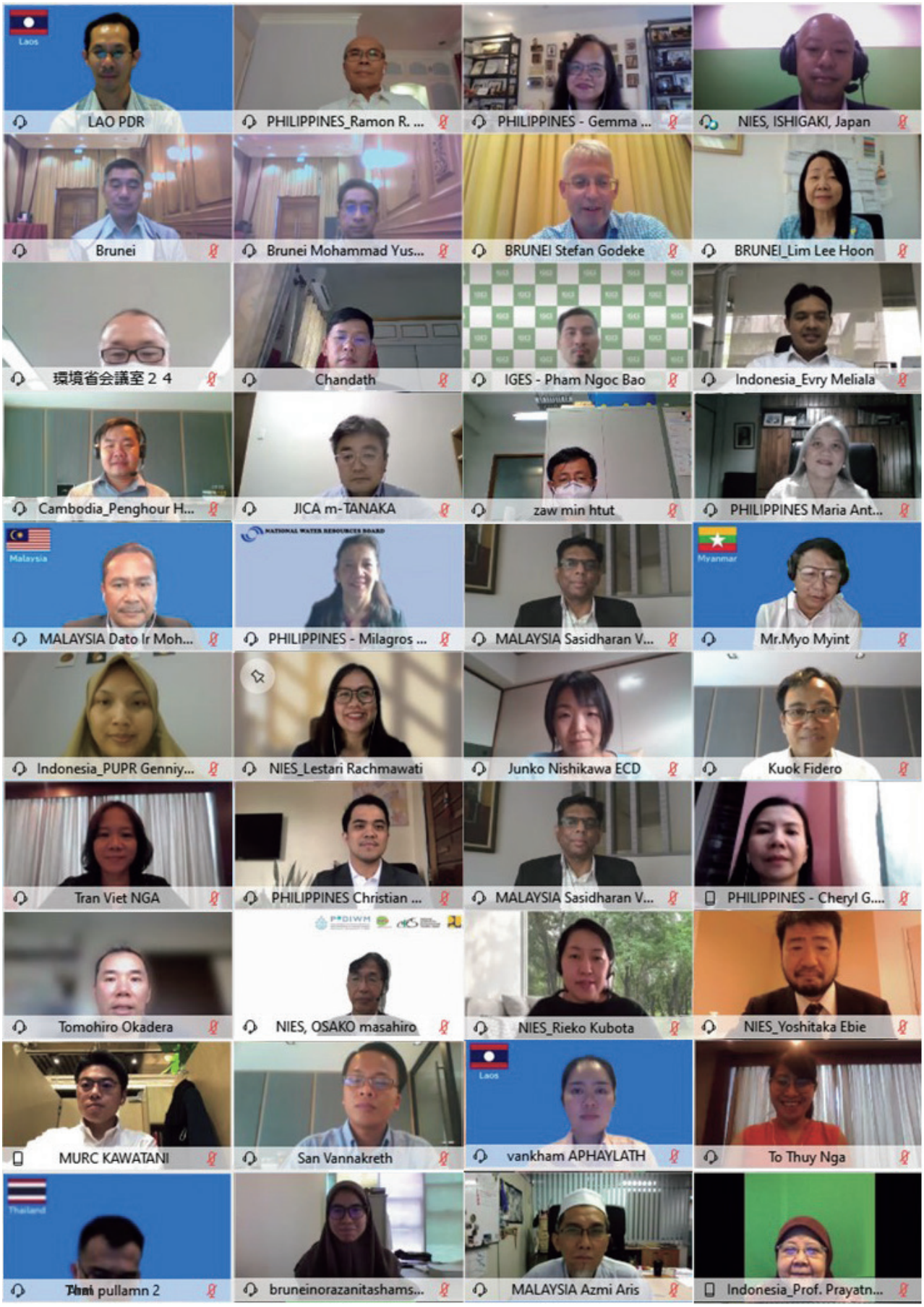




PARTICIPANTS AND COUNTRIES

All country task force members in Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Thailand, and Vietnam.

Guest speakers and experts from the Ministry of Public Works and Housing, Indonesia (Co-representative of the project), ASEAN Working Group on Waste Resource Management, Ministry of the Environment, Japan, World Bank, Japan International Cooperation Agency, and Institute for Global Environmental Strategies, Japan.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NIES, ISHIGAKI, Japan
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Brunei Mohammad Yus...
BRUNEI Stefan Godeke
BRUNEI_Lim Lee Hoon
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Indonesia_Evry Meliala
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Junko Nishikawa ECD
Kuok Fidero
Tran Viet NGA
PHILIPPINES Christian ...
MALAYSIA Sasidharan V...
PHILIPPINES - Cheryl G....
Tomohiro Okadera
NIES, OSAKO masahiro
NIES_Rieko Kubota
NIES_Yoshitaka Ebie
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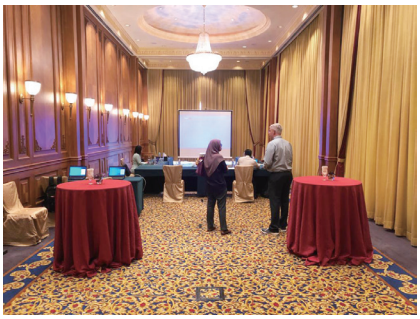
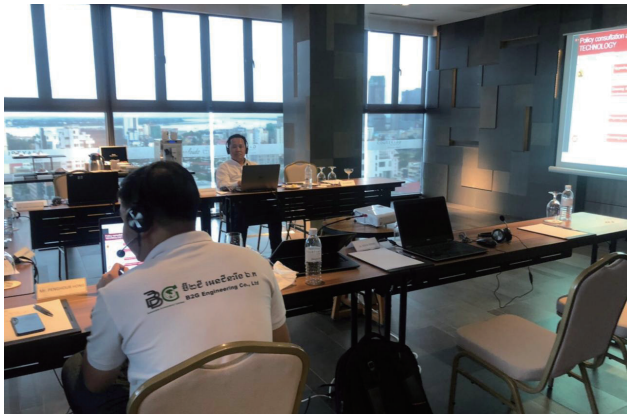


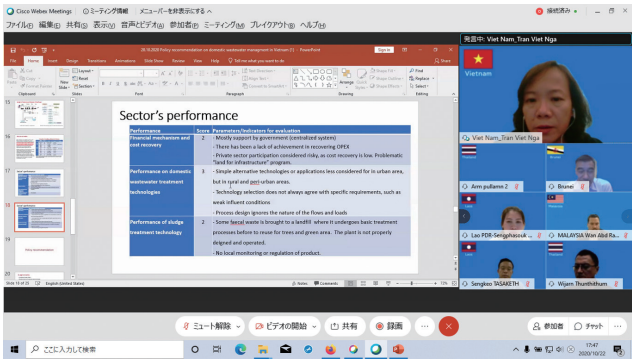
DETAILED REPORT OF THE POLICY DIALOGUE AND PERSPECTIVES

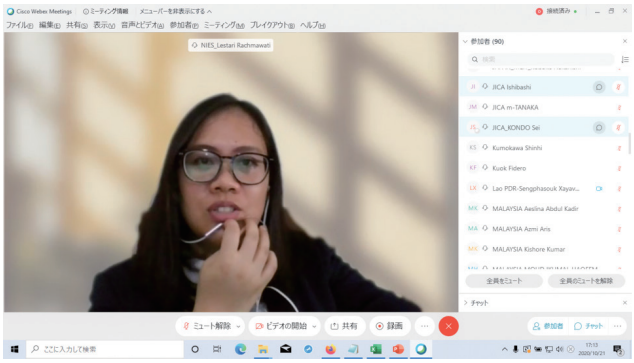
Based on the results of a fact-finding survey in the project countries regarding the legislation, budget securing, and technological feasibility for domestic wastewater management, the participants identified areas in need of improvement and resource investment. Besides, policy recommendations were made to achieve long-term goals (e.g., strengthening the connection to sanitary wastewater treatment) in relation to the Goal 6: Ensure access to water and sanitation for all in Sustainable Development Goals.

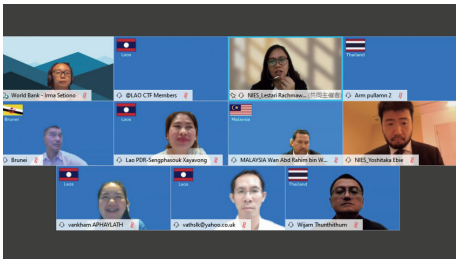
The progress and results of discussions in each country encouraged the participants to agree on the necessity of a common regional format for the introduction, dissemination, and establishment of decentralized wastewater treatment systems at the ASEAN regional level, and will continue to work closely with the ASEAN Secretariat.

At the end of the dialogue, we have agreed to collaborate continuously to contribute and support the improvement of domestic wastewater treatment technologies, systems, and institutions in the ASEAN region through the network of the regional experts that have been developed in the project. We have also agreed with the implementation of the next phase of JAIF-PoDIWM project or other relating research activities as responsible stakeholders for water resource management and pollution control in the Asian region.







PoDIWM Secretariat in Japan

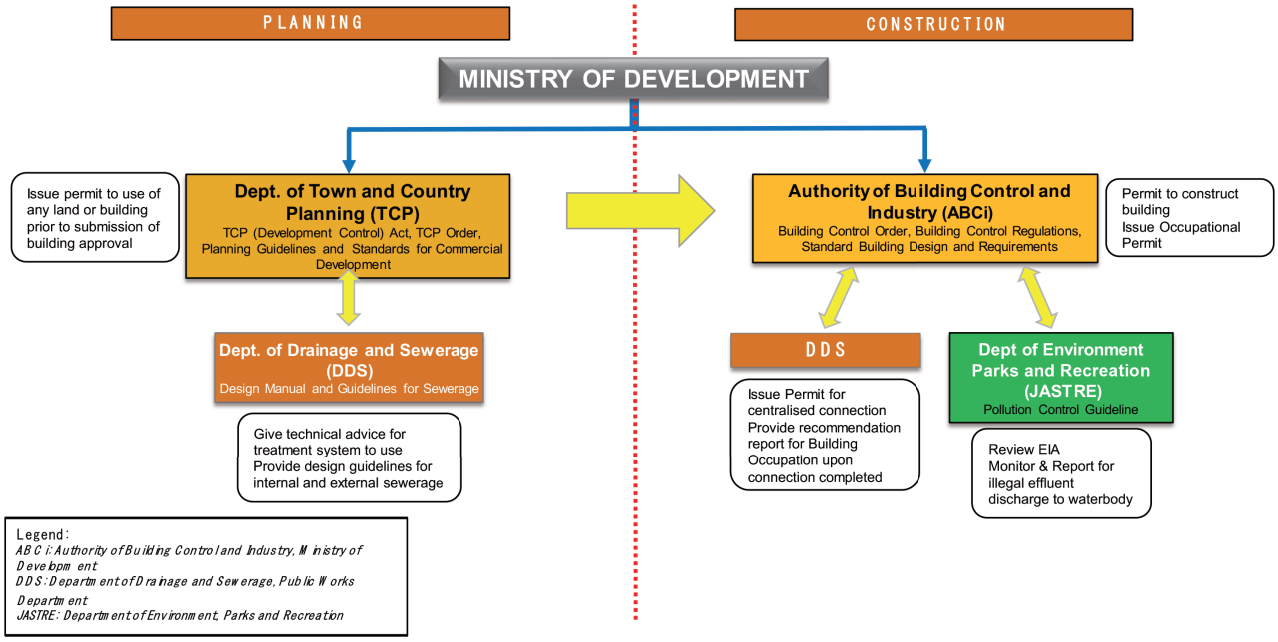
Country Reports

Brunei Darussalam

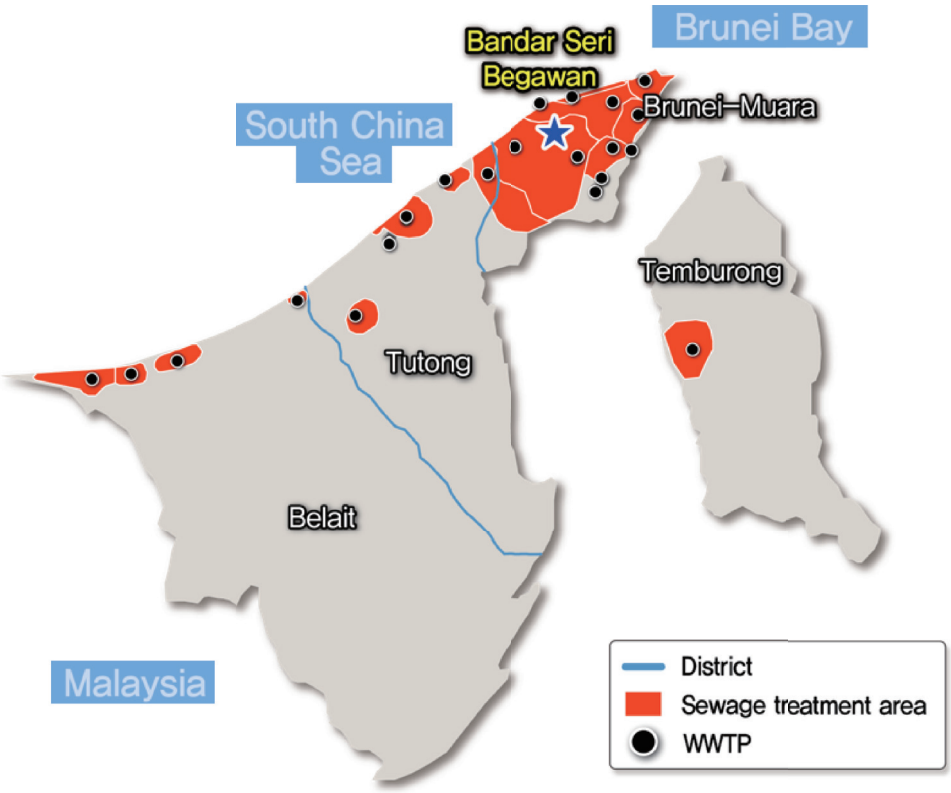
CURRENT SITUATION ON DOMESTIC WASTEWATER MANAGEMENT

The management and upgrading of national sewerage systems, including sewerage development construction as well as the monitoring of effluent water quality discharge from sewerage treatment plants are important aspects in this regard. Department of Drainage and Sewerage (DDS) of Public Works Department, Ministry of Development (MOD) has a supporting role of providing sewage tanker services for cleaning and desludging of sanitary pipelines and manholes, and laboratory testing of effluent samples.

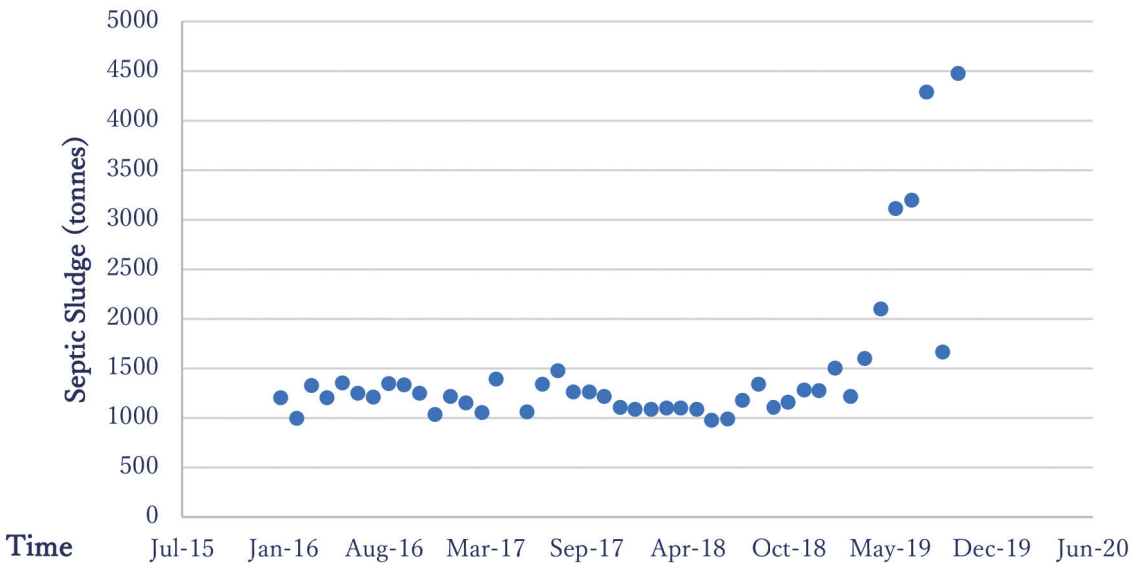
In order for Brunei Darussalam to have a sustainable water treatment system, DDS has taken the initiative to develop the Design Manual and Guidelines for Sewerage which describe essential references and guide to Qualified Persons (i.e. engineers and architects) and designers responsible for the design of wastewater system. The manual provides a standardized basis for planning, design and construction. This is merely to ensure that the wastewater system is functional and should also comply with central government requirements.



Building Approval Process for residential, commercial and industrial development



Improved sanitation coverage of the Population:
59% centralized sewerage system (major townships & National Housing Schemes)
34% with septic tanks (sub-urban & rural areas)



Sludge received at Sungai Paku Landfill between 2016 and 2019.

Sludge deposited to landfill contains the sludge from centralized wastewater operation as well as from decentralized operation (septic tanks). Judging from the estimated sludge from centralized systems, the sludge from the decentralized system would be lower than predicted from the regular interval (once in every 5 years) of desludging. It indicated that desludging of septic tanks is not performed at regular intervals but more infrequently around once every ten years.

ASSESSMENT OF THE SECTOR'S PERFORMANCE

- **Legislation on domestic wastewater and sludge treatment**
  - · To share/link with other Government Agencies such as Town and Country Planning Order, 2015, Environmental Protection and Management Order, 2016, Pollution Control Guidelines for Industrial Development 2003, Minor Offences Act, 2013
  - · To publish Design Manual and Guidelines for sewerage
  - · To enact the Sewerage Act

- **Policy and program for domestic wastewater management**
  5 years National Development Plan
  Annual recurrent budget

- **Effluent standards**
  DDS and JASTRE guidelines for the required monitoring value (BOD5; 20 mg/l and TSS; 30 mg/l) for decentralized domestic wastewater treatment is higher than that in Japan.

- **Standard on treatment performance testing methods**
  Standard and Guidelines on performance testing methods are in place.

- **Financial mechanism and cost recovery**
  Fully funded by Brunei government (centralized)
  Installation and maintenance for Septic tank borne by house owners.

- **Performance on domestic wastewater treatment technologies**
  Performance of centralized STP is based on analyses.
  Monitoring of septic tank has been started in 2019.

POLICY RECOMMENDATIONS

- **Institutional arrangement and legal framework**
  59% of the population uses a centralized sewerage system. For Brunei's Kampong Ayer settlement (around 13k person based on 2018 statistics) And 34% of people in Brunei are served with septic tanks, especially in suburban and rural areas. Since certain regions in Brunei are quite remote, not all of Brunei's population will have access to centralized wastewater treatment in the future. Implementation of appropriate management of the decentralized system is requisite. For instance, the septic tank should be desludged regularly, and deposited into the Sg Paku landfill.



- **Technology**

It is planned to develop the Strengthening the monitoring and maintenance section in sewerage act and implementing concrete regulation in sewerage act to spell out and provide details with regards to the monitoring and maintenance procedure of septic tanks.

It is proposed to improve the monitoring and desludging plan of septic tanks from currently less than once every 5 years to once every 2 years. Key monitoring parameters should be BOD5, TSS, COD and TS.

Based on the results of the monitoring, septic tank effluent limits, frequency of desludging and maintenance, guidelines and regulations need to be updated and referred to in the sewerage act.

The promotion of R&D is important in order to improve septic tank treatment and design e.g. prefabricated septic tanks which can limit ammonium, phosphate and nitrate emissions. The involvement of R&D in this regard can also include the usage of treatment ponds for phytoremediation, such as the utilization of specific plants for wastewater treatment.

Septic tank database shall be created and maintained, for planning and enforcement.

It is recommended to continue the planned maintenance and upgrade of centralized domestic wastewater treatment plants as part of the National Development Plan.

It is recommended to promote more regular desludging of septic tanks in order to improve the performance of septic tanks and to avoid discharge of septic tank effluent, which has little treatment, into the environment such as Sungai Brunei.

It is also recommended to continue monitoring and maintenance of septic tank especially those discharge directly to the water source such as rivers etc. in combination with finalizing the Drainage and Sewerage Act.

- **Finance**

Currently, the septic tank owners bear 100 % of the cost for desludging and monitoring of septic tanks.

Currently important initiatives as part of the National Development Plan, the sewerage network is being upgraded, which includes repairs of sewerage pipelines.

As part of the policy recommendation, private-public partnerships (PPP) for long-term continued maintenance of STP to maintain optimum performance should be considered. The Brunei government encourages the connection to the centralized system. In the future, a connection fee to the centralized system shall be considered.

- **Public awareness and participation**

JASTRE shall assist in the preparation of guidebooks for the public on the importance of water quality, the linkage between septic tank maintenance and improving water quality and the environment, and our role for a sustainable future.

Efforts shall be put on community outreach programmes in all four districts of Brunei to raise public awareness and participation.

Kingdom of Cambodia

CURRENT SITUATION ON DOMESTIC WASTEWATER MANAGEMENT

Improvement of wastewater management policy was taken by the Sub-decree 235 in 2017. However, improvement of the enforcement system of Sub-decree 235 is one of the ongoing challenges so far. Building Code has existed though it is not designed to meet the wastewater quality criteria of Sub-decree 235.

Domestic wastewater management has not been implemented appropriately for various reasons such as institutional, economic, social and technical issues.

(1) Issues for implementing decentralized domestic wastewater management

- Needs in building a system to evaluate and secure the ability of the decentralized domestic wastewater treatment facility (e.g. Performance evaluation test for Johkasou in Japan)
- Insufficient system to ensure the capability of contractor
- Insufficient system for maintenance and inspection of decentralized domestic wastewater treatment facility
- Lack of removal of sludge and proper disposal (e.g. O&M inspection, Authorization for Removal of sludge
- Lack of management of graywater
- Residents' awareness of water environment and wastewater management etc.

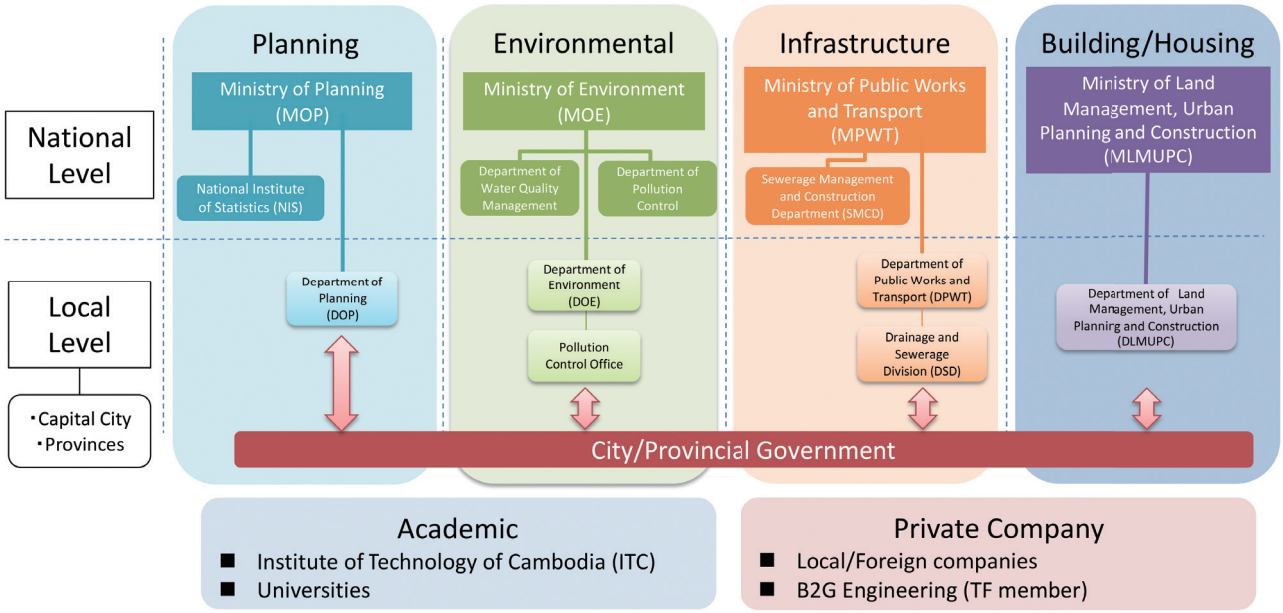
(2) Background to being a barrier for implementing decentralized domestic wastewater management

- Inadequate discussion, lack of sharing recognition about area segmentation between sewage and decentralized system, or certification system of effluent, because of overlapping jurisdiction of multiple ministries (jurisdiction of Infrastructure development or water environment).
- Shortage of information about the performance of the distributed domestic wastewater management facility because many facilities are to be constructed on site.
- There is no legal provision nor mechanism of facilities for sewage management.
- Lack of residents' awareness about wastewater management, motivation to pay the service fee

(3) Information necessary for solving the problem

- Facilitating knowledge sharing of mutual information on distributed wastewater management system among stakeholders
- Promotion of understanding of systems related to decentralized domestic wastewater facilities and educational methods that can secure domestic wastewater management

Current Administrative structure for decentralized wastewater management in Cambodia is shown in following diagram.



The WHO/UNICEF Joint Monitoring Programme reported the low coverage of the population using improved sanitation facilities as shown in the table below. Besides, ADB revealed that most of household septic tank are the unsealed base (e.g. more than 90% in the surrounding area of Tonle Sap Lake).

Year	National			Rural			Urban		
	Proportion of population using improved sanitation facilities (excluding shared)			Proportion of population using improved sanitation facilities (excluding shared)			Proportion of population using improved sanitation facilities (excluding shared)		
	Latrines and other	Septic tanks	Sewer connections	Latrines and other	Septic tanks	Sewer connections	Latrines and other	Septic tanks	Sewer connections
2000	1%	5%	7%	1%	1%	2%	1%	19%	29%
2015	0%	38%	11%	0%	36%	3%	0%	44%	44%

Source: ANNEX 4 National sanitation estimates, Progress on Drinking Water, Sanitation and Hygiene 2017, Update and SDG Baselines, WHO, UNICEF

ASSESSMENT OF THE SECTOR'S PERFORMANCE

- **Institutional effectiveness**
  - Sub-decree 235 shows the responsibilities and roles of each related organizations. But it is not monitored for proper enforcement of regulations by each institution.
  - Harmonizing between environmental policy and construction policy may not be taking place. For example, building permit regulated by construction law which is not considered wastewater treatment performance
  - Information sharing scheme from central government to municipal government and regulation monitoring system does not exist.

- **Policy and Legal framework**
  - Sub-decree 235 ensures the public health and water environment. Sludge management is regulated in sub-decree on solid waste management (1999).
  - Building permit based on the construction law regulated the requested capacity regarding the building size. But it does not consider harmonizing with sub-decree 235 based on the environmental law.
  - Wastewater monitoring is conducted by MOE. However, monitoring is limited in industrial wastewater and doesn't cover the domestic wastewater.
  - Building codes exists, while regulation for maintenance or emptying is not stipulated.

- **Public awareness and participation**
  - Each community manages decentralized wastewater properly in the limited area such as the developed area in the city.
  - There are opportunities for all citizens to learn about the need for wastewater treatment. E.g.) Results from the survey of willingness to pay which MPWT has conducted in 2018.
  - Building codes exists, while regulation for maintenance or emptying is not stipulated.

- **Technologies**

  Wastewater
  - Decentralized wastewater treatment facilities are latrine and anaerobic septic tanks. Aerobic treatment facility has been installed in the industrial sector. There is no regulation stipulated the requirement for effluent from facilities that meet the criteria of BOD.
  - There is no mechanism to collect the information about the population ratio who use the improved facility.
  - State-sponsored training courses for engineers of construction or O&M have not been introduced.

  Sludge
  - There is no sludge treatment facility in Phnom Penh. "National Fecal Sludge Management Guidelines for Rural Households" regulated how to treat the fecal sludge in the rural area.
  - Administration deals with illegal sludge damping strictly using penalty mechanism.

- **Resource recovery and reuse**
  - Project utilizing treated fecal sludge to fertilizer has been conducted in Siem Reap.
  - "National Fecal Sludge Management Guidelines for Rural Households" shows technical requests when treated fecal sludge is converted to fertilizer.

- **Technical expertise**
  - · Some cities and central government conduct the technical training for their staff in charge of wastewater treatment but the training opportunity is still very limited.
  - · Wastewater treatment experts from research institutions organize technical workshops for domestic stakeholders, but it is not nationwide and regularly.

- **Private sector involvement**
  - · Private sector like constructors install septic tanks as a decentralized wastewater treatment facility.
  - · EPC or O&M company for wastewater management exists in Cambodia but they concern mainly industrial aerobic treatment facilities. Open pond system for graywater treatment is partially installed in Diamond island, Phnom Penh.
  - · Private sector can transport and empty sludge from wastewater treatment facilities nationwide.

POLICY RECOMMENDATIONS

- **Needs for Political Will and Institutional Reform**

  Through several taskforce meetings conducted during the PoDIWM project duration, needs for political will was identified as follows:
  - · To fully implement of Sub-Degree 235, more Prakas (detailed decision in implementation of sub-decrees) should be prepared. Making good use of the existing law of Sub-decree 235, it is important to clarify the role of the institution.
  - · For the monitoring system, to build the network between central government and local government.
  - · For the awareness raising, getting involved with the citizens in wastewater management, government should enhance understanding the necessity of the pipe connection from the household, fee of collection, maintenance and treatment.
  - · Capacity building for every level of stakeholders as policy maker, technical engineers, operators, users and citizens is important.
  - · For financial scheme, Subsidies, PPP or clean environment fund (polluter-pay basic) could be the option to stimulate private investment.

- **Enabling Environment for Integrated Decentralized Domestic Wastewater and Sludge Management**

  "Sub-Decree No. 235 on the management of drainage system and wastewater treatment system (2017)" is a key regulation for Cambodia, which was established by MOE, MPWT and MOI. It aims to define the clear role of each ministry, the delegation of operations to local governments, streamlining and ensuring the safety of processing systems, promoting public understanding and public participation, and promoting investment in development donors and the private sector.

- **Disabling Environment for Integrated Decentralized Domestic Wastewater and Sludge Management**

  As disabling factors, several challenges were identified.
  - · Increasing pollution load by population expanding and industrialization
  - · Septic tank is still mainly used in Cambodia
  - · In Phnom Penh city, introducing centralized sewage system is a priority issue.
  - · Lack of capacity in technical human resource and capital resource.
  - · Lack of awareness of the importance of wastewater management and sludge management

· Lack of financial resources for R&D in wastewater domain

- **Selection of Appropriate Wastewater Treatment Technologies for Cambodia**
  In Cambodia, the selection of appropriate wastewater treatment technologies must be difficult since the lack of technical human resources. Need a program to train engineers.

- **Selection of Appropriate Sludge Treatment Technologies for Cambodia**
  Sludge waste from factory wastewater treatment and product manufacturing processes is considered as hazardous waste in "Sub-Decree on Solid Waste Management (1999)". According to JICA study (2016), most of the septage collected by vacuum cars from the households is illegally dumped in the drainage channels or wetlands. Since there is not enough land in cities to landfill and dispose of sludge, it is necessary to design an appropriate system for the construction of sludge treatment plants.

- **Business Models and Financing Mechanisms for Cost Recovery at Different Phases**
  PPP/PFI scheme could be an option for involving private investment. MOP negotiates with the MEF in formulating national plans. National plan compiled by MOP submitted to MEF then MEF has a role in allocating the budget.

- **Capacity Development and Awareness Raising Programs for Policy Makers**
  International donors (JICA, AFD, and ADB, etc.) have respectively conducted events or seminars to mainstream the awareness of wastewater and sanitation benefits in cooperating with MPWT. "Advocacy for Sanitation in Phnom Penh (2017)" supported by AFD was organized to involve all stakeholders and potential decision-makers, is one of the outstanding activities for an advocacy argumentation and campaign.

Republic of Indonesia

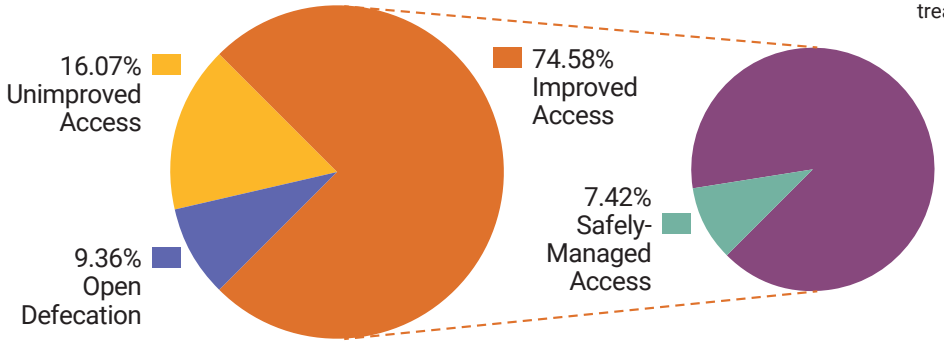
CURRENT SITUATION ON DOMESTIC WASTEWATER MANAGEMENT

One of the government's efforts to increase the sanitation access was putting the sanitation issue as one of the targets in RPJMN (National Medium Term Development Plan) 2010-2014 which focused on removing Open Defecation practice until 2014. In the next term, the Indonesian government has issued the policy to continually improve sanitation conditions through RPJMN 2015-2019 as stipulated in Presidential Regulation no. 2 of 2015. In this policy, the government aims to increase public access to proper sanitation to be 100% by 2019, or also called universal access. This target has also been stated in the Ministry of Public Work and Housing (Kementerian PUPR) regulations No. 13.1 / PRT / M / 2015 related to the strategic plan of the Kementerian PUPR 2015 - 2019 where the strategy to achieve this target is an increase in population health insurance for proper sanitation, domestic wastewater and environmental drainage waste to 100% at the basic needs.

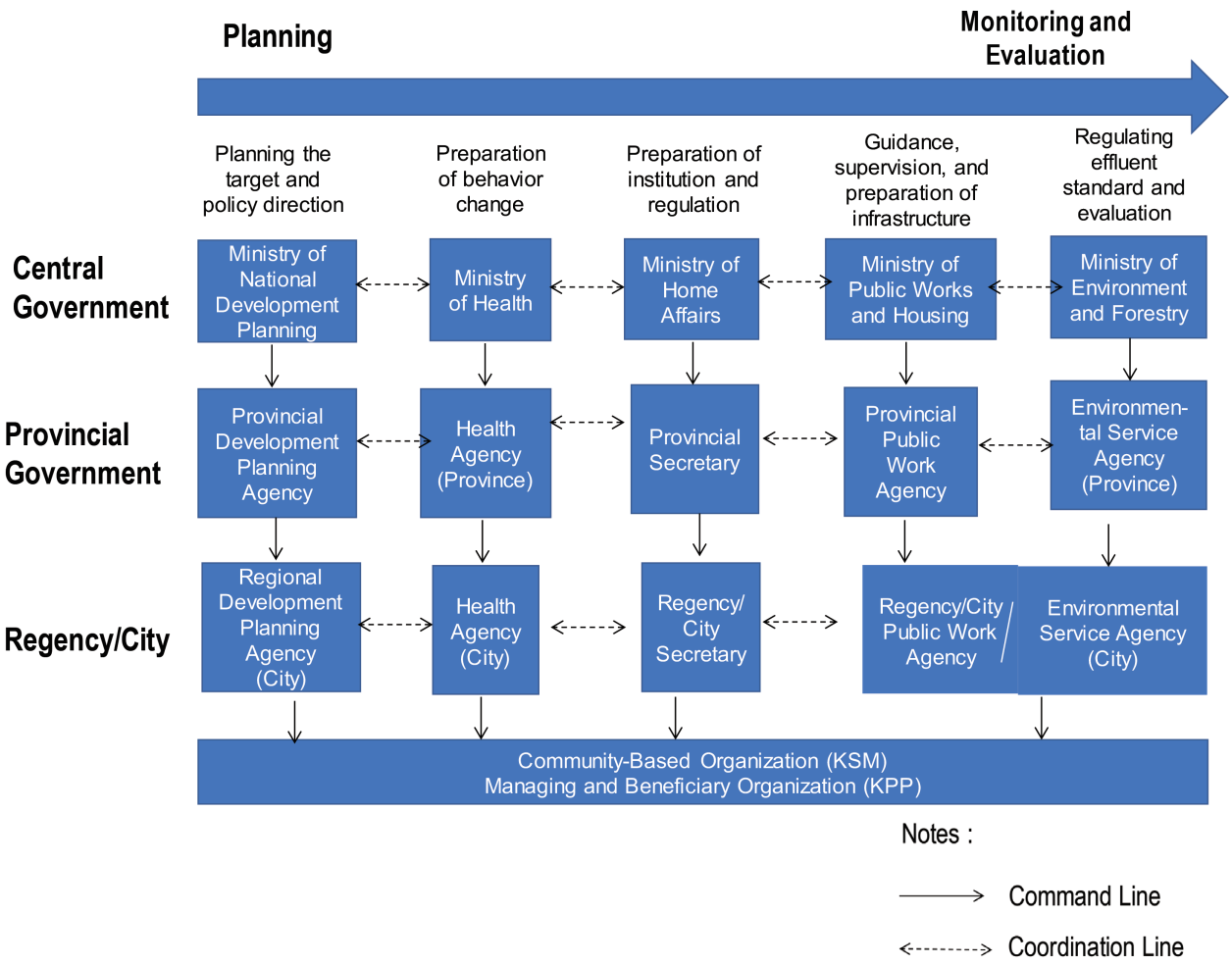
To fulfill this universal access goal, PUPR targets this achievement to be 85% of decent access and 15% of basic access. Therefore, the government continues to make efforts to achieve this target so that the quality of the environment, especially community sanitation can be improved.

Based on Central Agency of Statistics (BPS) 2018, Indonesia already had improved access to about 75% of decent access, 16% of basic access, and 9.4% of no access for wastewater treatment, as can be seen in the following figure.

Present situation of domestic wastewater treatment both in urban and rural areas



Current administrative structure for decentralized wastewater management in Indonesia is shown in the following diagram.



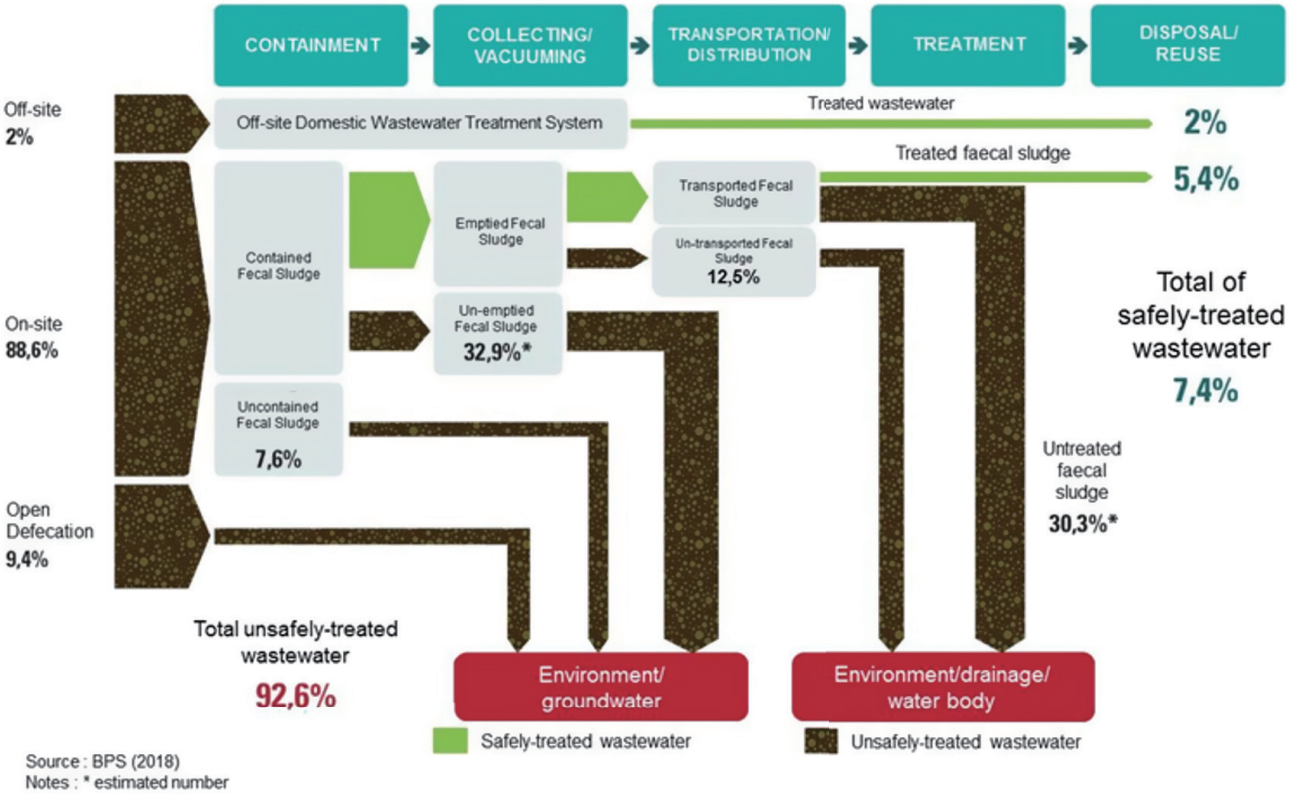
Ministry of National Development Planning, Sanitation sub directorate:
To prepare materials for study, coordination and policy formulation of national development planning, national development strategy, policy direction, as well as the development of the regulatory framework, institutional and financing in the sanitation sector, and to coordinate with other stakeholders such as financing in the sanitation sector.
Ministry of Public Works and Settlement, Domestic Wastewater Management Sub-Directorate:
To prepare policy formulation and implementation on the development of wastewater treatment system. To prepare technical guidance and supervision of wastewater treatment system development.
Ministry of Public Works and Settlement, Research Institute for Human Settlements, PUSKIM:
To implement research, development, technology transfer, and disseminate. To prepare Intellectual Right Properties. To do technical advice such as test, study, inspection and certification.
Ministry of Environment and Forestry, Domestic Wastewater Pollution Control Sub-Directorate:
To prepare materials on policy formulation and implementation in the domestic waste pollution control sector. To prepare materials on the formulation of norms, standards, procedures, and criteria in the domestic waste pollution control sector. To supervise or implement any matter related to domestic waste pollution control in the local.
Ministry of Health, Water and Basic Sanitation Health Sub-Directorate:
To formulate and implement the regulation on water and basic sanitation. To prepare material for technical guidance and partnership, monitoring, evaluation, monitoring and reporting.
Ministry of Home Affairs, Drinking Water, Wastewater, and Sanitation Sub-Directorate:
To formulate and implement the regulation on drinking water, wastewater, and sanitation. To Preparing material for general building management, technical guidance and supervision.

The urban daily water consumption per capita is ranging from 90 liters/day to 190 liters/day. Assuming average consumption of 120 liters/day and 80% of the water becomes wastewater, the wastewater production per capita would be 96 liters/day. Concerning the high urban population in Indonesia, the volume of wastewater is high and would be harmful to the environment and human health if not safely treated.

By the end of 2018, Indonesia has reached 2% of off-site treatment system, 88.6% of on-site wastewater treatment system, and the rest was still open defecation. Off-site treatment system is considered to be safely-treated wastewater, while on-site system still needs to look further into the detailed management itself.

In the on-site wastewater treatment system, only 5.4% of the total wastewater treatment safely-treated, considering proper containment, desludging system, and appropriate transported septage system. The fact is, 7.6% was simply uncontained, 32.9% was contained but does not desludged, 12.5% un-transported fecal sludge, and 30.3% has been desludged but then dumped into river/drainage.

In total, 16.1% of the population in Indonesia has unimproved access and 9.4% of people (almost 25 million people) still do open defecation practice.



In terms of sludge treatment, public septage treatment has been built in 281 regencies/cities out of a total 514 regencies/cities in Indonesia. 103 facilities are already operated though the rest are still not operated yet, due to lack of sludge input. Scheduled desludging service is promoted by connecting the septic tank control and septage management.

ASSESSMENT OF THE SECTOR'S PERFORMANCE

- **Legislation on domestic wastewater treatment:**
  National regulation exists and is enforced at the sub-national level.

- **Legislation on sludge treatment:**
  Legislation of sludge management exists and has been applied in city/regency scale, but the legislation of sludge treatment is not included yet.

- **Policy and program for domestic wastewater management:**
  Establishment of National Working Group – "POKJA" to consider domestic wastewater policies and programs until regency/city level.

- **Effluent standards:**
  National regulation exists and enforced at the sub-national level. However, the monitoring system has not been implemented widely in all cities.

- **Standard on treatment performance testing methods:**
  Treatment performance method was already established and recently being upgraded, further processed to be a national standard.

- **Financial mechanism and cost recovery:**
  Financial mechanism and cost recovery is under each local government's policy.

POLICY RECOMMENDATIONS

- **Development of national level law governing wastewater**
  The Central Government is rapidly developing the national wastewater sector regulatory framework and target to improve the sector performance; however, the implementation is still facing challenges. There is a need to develop national level law governing wastewater because the current regulation is at the ministerial level.

- **Local Government Difficulties to comply with the Required Effluent Standard**
  After the Central Government issued the new and strict regulation of effluent standard, local Government needs to update technologies, increase the O&M budget, increase the number of skilled human resources, and provide reliable WWTP operation and maintenance procedures.

- **Development of Services Provision Performance Monitoring**
  Local governments face difficulties in providing safely managed wastewater services to follow the existing performance monitoring evaluation scheme. Moreover, the reporting mechanism is outdated, and as a result, not all Local Government reports are the most recent/updated/sent back to the Central Government.

- **Updating procedure for building permit**
  Building permit system requires to submit the design of the wastewater treatment/ containment system. For office or commercial buildings, the wastewater treatment plant is monitored effectively. However, for households with an onsite system, the monitoring mechanism before the issuance is still ineffective; hence, some households construct their septic tank not following the standard.

- **Implementation of management of greywater in on-site system**
  Most households use septic tanks that do not follow the standard design criteria which only treats blackwater, meanwhile the graywater is directly discharged to the water body.

- **Development of a national policy on fecal sludge service**
  Promotion of fecal sludge treatment including regularly desludging is essential. Separation between operator and regulator, and budget allocation for sludge management is indispensable. There is a risk of contamination of the water body and groundwater due to illegal sludge dumping. Utilization of the treated water and solids still low since there is no specific guidance on resource recovery.

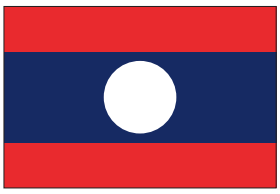
- **Development of scheme on various fecal sludge desludging fees**
  There is technical guidance from the ministry regarding the tariff, but is not yet on the regulatory level; therefore, tariff levels and tariff structures vary at local government level. The tariff mechanisms should suit to recover the O&M Cost.

- **Development of uniform monitoring and evaluation mechanism for domestic wastewater**
  Monitoring implementation for household-scale is hindered due to: interlevel miscoordination, no uniform monitoring mechanism, and limited budget. As a result, mostly only city-scale WWTPs and selected residential-scale WWTPs are checked by the Local Governments.

- **Management of knowledge in the sanitation field**
  There is a demand for knowledge management for the community-based wastewater management. It is expected to clear up the confusion because the community will know where to consult about the technical aspect of wastewater treatment systems and to increase more in-depth knowledge about sanitation. Knowledge management to share and increase awareness in the wastewater sector, currently available for operators, regulators, and service providers.

- **Development of private sector participation model**
  Policy on private sector participation can cover community-based service provision, service providers, and private sector investment in wastewater sector development. Public sector involvement model should be considered in policy making to promote efficiency and create the conditions for accountability and effective service provision at local government level.

Lao People's Democratic Republic



CURRENT SITUATION ON DOMESTIC WASTEWATER MANAGEMENT

Domestic wastewater generation in Vientiane capital has been increased by urban area population increasing.
Criteria for water quality of wastewater discharge per type of building has been regulated by Environmental Protection Law (EPL).
Decentralized system has been introduced in 25 areas in Laos. It is introduced to high-density housing area in some provinces or residential areas that use drainage channels connected to Hong in Vientiane city.
Decentralized system will be introduced to Bokeo Province, Bolikhamxay Province, Khammouane Province, Luang Namtha Province.
Japanese firm is applying to JICA for the budget to introduce Kind Integrated Digestion Strand (KIDS). When it is decided to introduce KIDS, it will be installed beside the cafeteria on the university campus. (National University of Laos)
Government of Vientiane capital has scheduled to monitor the water quality of effluent, river and drainage in Vientiane city.

Challenges to be considered to improve wastewater management:

Master plan to install centralized wastewater treatment in central Vientiane city has been made by the donor of Hungary. However total plan for other areas including sub-urban area of Vientiane city and the decentralized system is not yet made.
Building code for decentralized wastewater treatment facility has been regulated by the Ministry of Public Works and Transportation (MPWT), but its regulation is not designed to meet the criteria of EPL.
DPWT of Vientiane capital has been recognized to improve immediately the regulation for decentralized wastewater treatment facility. Thus, the core-challenge of central and local governments are making the policy roadmap to improve the decentralized wastewater treatment.

Organization Chart of Seleted Gournment Agencies

Prime minister

- **Ministry of Public Works and Transport**
  - Department of Water Supply
  - Department of Housing and Urban Planning
- **Ministry of Natural Resource and Environmental**
  - Department of Water Resources
  - Department of Pollution Control
  - Lao National Mekong Committee Secretariat
  - Natural Resources and Environment Research Institute
  - Natural Resources and Environment Data and Information Center
- **Ministry of Health**
  - Department of Hygiene and Health Promotion
  - Water Supply (Nam Saat) and Environmental Hygiene Center
- **Minisitry of Agriculture and Forestry**
  - Integrated Watershed Management Unit (IWMU)
  - Department of Irrigation (DoI)
  - Department of Livestock and Fisheries (DLF)
- **Ministry of Planning and Investment**
  - Department of Planning
  - Department of Inspection

Organization Chart of Selected Government Agency related to water resource,wastewater and sanitation.

- **MPWT:** the Ministry of Public Works and Transport, supervised nationwide wastewater treatment service.
- **MONRE:** the Ministry of Natural Resources and Environment, supervised waterbody and water environment.
- **DPWT:** the Department of Public Works and Transport of each province, issues the building permit of the decentralized domestic wastewater treatment facility.
- **DONRE:** the Department of Natural Resources and Environment of each province, do the water inspection.
- **DHHP:** the Department of Health and Hygiene Promotion regulates the wastewater discharge in the outside area of the city.
- **UDAAs:** the Urban Development Administrative Authorities have gradually been established in Vientiane Capital and four secondary towns (Luang Prabang, Thakhek, Savannakhet and Pakse) to improve urban management. VCOMS, Vientiane City Office for Management and Services being named to a public service organization in UDAA of Vientiane Capital is in charge of acceptance the desludging company or O&M of the sludge treatment plant.

Current legal situation in Laos:

"Environmental Protection Law (EPL) "stipulates water quality standards and responsibilities for decentralized domestic wastewater.
"New Agreement on Building Management No.2241" stipulates building standards.
"Agreement of Management Septic Tank Emptying Service" stipulates sludge treatment management system.

Major stakeholders of domestic wastewater treatment are shown below. The role sharing of gray water O&M has not been decided.

Basic major stakeholders in Laos for wastewater management

Management type	Budget	Planning	Implementation	O&M (Service)
Centralized (tentative)	Foreign Fund: MPI/ MPWT/ Vientiane Capital	MPWT: Nationwide DPWT: citywide	DPWT	Public company
Decentralized	Civil	DPWTs issue the building permit for the city area over 400 m^2 Office PWTs issue the building permit for area below 400 m^2	Civil (constructor)	Shown in the table below

Basic major stakeholders in Laos for Decentralized O&M

Type of wastewater	Containment	Emptying	Transport	Treatment
Blackwater (feces, flush)	USER	Private company Accepted by UDAAs (VCOMS is in charge in Vientiane Capital.)	Private company	Building permit issued by DPWT, Water monitoring conducted by DONRE
Graywater (kitchen, shower etc.)	USER	No one control	No one control	Building permit issued by DPWT, Water monitoring conducted by DONRE

ASSESSMENT OF THE SECTOR'S PERFORMANCE

• Institutional effectiveness

· The role and responsibility of the wastewater are clarified by Environmental protection law. Civil also have the responsibility of the polluter pay principle.
· MONRE and MPWT and MoI co-operate in the modification of EPL etc.
· However, responsibility for graywater management is not enough. Also, continued cooperation scheme of each organization is lack.

• Policy and Legal framework

· Environmental protection law defines the polluter pay principle being imposed on citizens in that article. And environmental standards are regulated as sub-decree of EPL. This is a very important driver.
· However the facilities regulated by this latest regulation cannot secure the quality of discharged water as defined in EPL. For this reason, regulations concerning facilities that can guarantee the quality of discharged water that satisfies the standard value are required.

- **Public awareness and participation**
  - According to a past questionnaire survey to study the willingness to pay for drainage water purification and domestic wastewater management, civil living near drainage showed a high willingness to pay for the water treatment. However the fee amount for wastewater treatment is only 4,000 Kip (equally 0.45USD) per month.
  - Education for the neediness of wastewater treatment in schools or workplaces is highly needed.

- **Technologies**
  - Most households in the city area use septic tank or latrines and households in rural area use latrines or communal latrines.
  - F/S of high-performance decentralized wastewater treatment system has been done in limited buildings in Phongsaly province.
  - F/S to improve the decentralized system that contains aerobic treatment tank with media will be conducted in Lao University supported by JICA.
  - Framework for assessment of decentralized wastewater treatment facility is lacking.

- **Private sector involvement**
  - Sludge was collected by the private sector in Vientiane city and sludge treatment plant operation will be done by the public company.
  - NGO BORDA has been done coaching service for municipal government staff or private sector.
  - High-performance decentralized wastewater treatment system was controlled by an engineering private company.
  - Scheme to drive investment for decentralized wastewater treatment facilities like fee collection and local bond is lacking.

POLICY RECOMMENDATIONS AND CONCLUSIONS

- **Needs for Political Will and Institutional Reform**

  Although the regulations have been enacted for discharge standards for domestic wastewater and the officials of each ministry have been described, coordination between ministries is insufficient. Needs for Political Will are as follows:
  - Ministries are working independently and their roles are not separated clearly.
  - It is necessary to upgrade of “decentralized wastewater facility standard” to satisfy the water quality criteria.
  - We should take measures for graywater as a priority. Because gray water is not treated at all while black water is controlled to some extent.
  - Capacity building is needed to develop the capacity to run the system of domestic wastewater management.
  - It is necessary to clarify the role of O&M in centralized wastewater treatment facilities and do the capacity development of its implementers.
  - Establish the financing scheme for the installation of domestic wastewater treatment facilities that can meet the effluent standard.

- **Enabling Environment for Integrated Decentralized Domestic Wastewater and Sludge Management**

  The Vientiane city's domestic wastewater (graywater and overflow of the septic tank or pit latrine) flows out into the drainage called ”Hong”. Citizens require the administration to improve the living environment around this drainage channel. It is still considered to hardly introduce the decentralized wastewater treatment facilities that meet effluent standards due to budget constraints.

Surround the drainage channel will be enabling environment for integrated decentralized domestic wastewater management but it may be needed to consider with the collaboration of centralized project of Hungarian project. As the direction of collaboration, methods for cascaded installation of facilities that is as follows.

· Introducing a decentralized sewage treatment facility to each location and changing it to a pump station in accordance with the introduction of sewage

· Promoting the decentralized wastewater treatment facilities that can also treat gray water in the area where the installation time of sewage is the latest

- **Selection of Appropriate Wastewater Treatment Technologies**

  In Vientiane city, the centralized sewage system takes feasibility study has been carried out. Japanese firm also carried out the technical feasibility study. The facility certification system to satisfy the water quality criteria should be developed accompanying with the regulated performance testing method.

- **Selection of Appropriate Sludge Treatment Technologies for Targeted Country**

  Wetland method in KM21 treatment plant will be the model case nationwide. It is expected to promote the methods for cost recovery and technology in the country.

- **Business Models and Financing Mechanisms for Cost Recovery at Different Phases**

  Local bonds have not been issued for the wastewater sector and are not listed as targets for PFI projects in Laos.

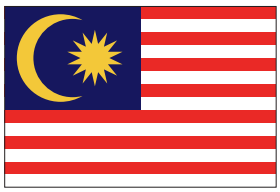
  However, according to the interview for MPI in June 2019, it has expanded the scope of PPP projects in Laos since 2019. There is room for consideration of financing mechanisms utilizing private funds.

  Establishing the stable fee collection system from community and household is essential to operate the system sustainably by enhancement of public awareness and participation.

- **Capacity Development and Awareness Raising Programs for Policy Makers**

  Capacity development may be highly recommended policy proposal. Installation of decentralized wastewater treatment facility continues to be mainstream of wastewater treatment method. But the measures ensuring the performance of treatment are not enough. Capacity development training is necessary to realize the system design that includes Performance test and effluent standard expansion.

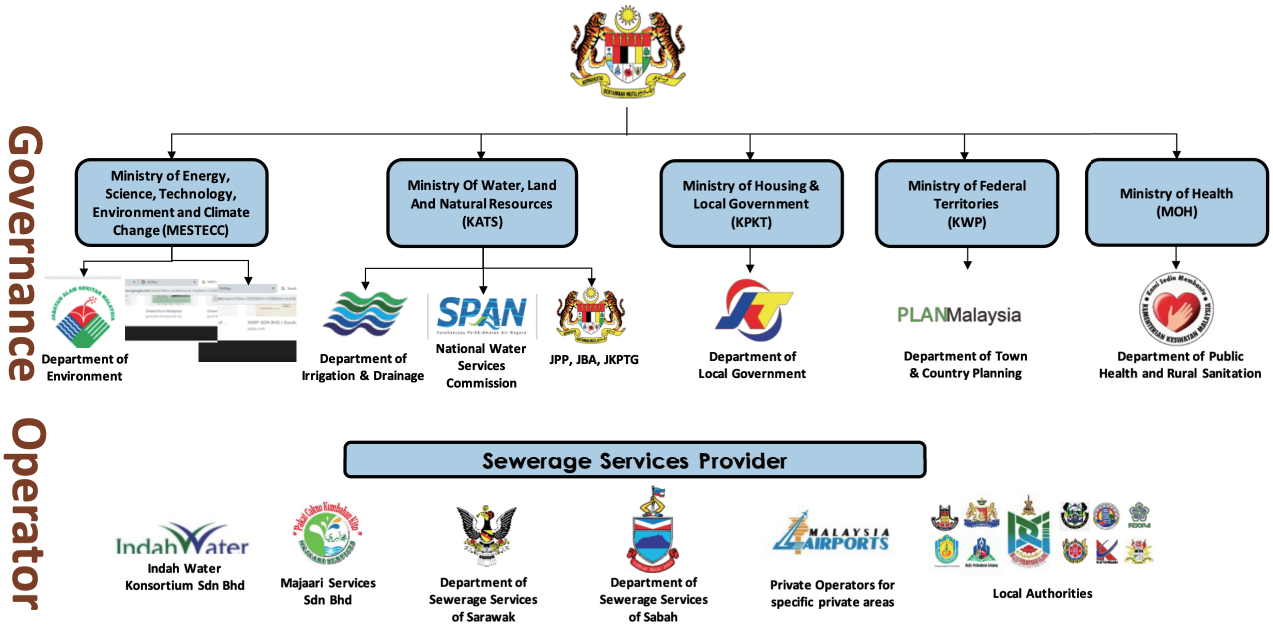
Malaysia



CURRENT SITUATION ON DOMESTIC WASTEWATER MANAGEMENT

The need for improvement in the sewerage systems became stronger in the 1980s after the Environmental Quality Regulations were enacted in 1979. Technological advancements included the introduction of full secondary treatment via mechanized sewage treatment plants (STPs). There are various types of mechanized STPs ranging from the conventional activated sludge to extended aeration, rotating biological contactors and trickling filters. Mechanized STPs capable of providing full secondary treatment are far superior to the other systems. These mechanized plants greatly improved treatment performance, reducing BOD from 200-400 mg/l to 10-30 mg/l.

The evolution of treatment processes from primitive to primary and then to secondary systems was mainly due to the development of technologies in the sewerage industry. The evolution has also involved the movement from non-mechanical systems to more mechanical and automated systems. New and improved equipment has also been continuously introduced due to technological advancements. Over time, this has increased the expectations regarding environmental standards and the skill level in the design, construction and operations of new sewerage works.



Organization Chart of Selected Government Agency

Ministry of Water, Land and Natural Resources (KATS):
KATS is responsible for Water, Land and Natural Resources Management such as Water and wastewater management from source to end use, Irrigation and drainage management, and Sewerage Services
National Water Services Commission under KATS:
To implement and enforce the water supply and sewerage services laws and to consider and recommend reforms to the water supply and sewerage services laws. To ensure the national development goals pertaining to coverage, supply and access to water supply and sewerage services are achieved. To formulate and implement a plan to ensure all reasonable demands for sewerage services are satisfied and in consultation with the relevant authorities.
Sewerage Services Department under KATS:
To promote the smooth implementation of suitable and modern sewerage system throughout the country according to the stipulated standards. To ensure the successful and satisfactory implementation of privatization projects.
Department of Environment under Ministry of Energy, Science, Technology, Environment & Climate Change (MESTECC, currently MOSTI):
To manage the industries discharging sewage, industrial effluent and leachate are required to comply with the following relevant discharge limits as stipulated in their respective regulations. To manage the Sewage discharge standards, Industrial effluent discharge limits.
Indah Water Konsortium owned by Ministry of Finance (Incorporated):
To provide scheduled operation and maintenance of public sewers, network pumping stations and public STPs. To provide corrective and preventive maintenance of public sewers, STPs and sludge treatment facilities to meet the regulatory requirements. To perform scheduled desludging services for septic tanks on government premises and demand desludging for septic tank users.

Meanwhile, the centralized wastewater treatment system known as STP was identified in the sewerage catchment study to cater for sewerage catchment area. It is costly to build and operate especially in areas where population densities are low and dispersed household conditions. On top of that, the decentralized domestic wastewater treatment system is worldwide usage. The sewerage system in Malaysia comprises a mix of centralized system and decentralized systems.

Sewerage Facilities	2016		2017	
	Quantity	Population Equivalent (PE)	Quantity	Population Equivalent (PE)
Public Sewage Treatment Plant (a+b)	6753 r	24,808,450 r	6871	25,258,155
a.Multipoint Plant	6660'	16,983,923 r	6,770	17,125,895
b.Regional Plant	93	7,824,527	101	8,132,260
Private Sewage Treatment Plant	3338	3,009,095	3,603	3,373,471
Communal Septic Tank	4386	532,076	4,359	531,127
Individual Septic Tank	1,343,439	6,859,823	1,354,986	6,934,008
pour flush latrine	1,154,592	5,772,960	1,171,555	5,857,775
Network Pumping Station	1,117	n.a.	1,183	n.a.
Length of Sewer Network	19,409r	n.a.	20,100	n.a.

Multi-point Plant: STPs to cater for sporadic and scattered development by different developers
Regional Plant: STPs identified in the sewerage catchment study to cater for a sewerage catchment area.

ASSESSMENT OF THE SECTOR'S PERFORMANCE

- **Legislation and Policy Frameworks**

  National guidelines are nationwide standardization of sewerage infrastructure requirements. It is an established system to ensure sewage treatment plants are designed and built to the required quality to meet health and safety as well as environmental and operational requirements.

- **Technical and Technological Aspects**

The current technologies used for decentralized wastewater treatment system are individual septic tank (IST) and small sewage treatment system (SSTS). The IST is for 5 to 30 PE (1.125-6.750 m³/day). According to Malaysia Sewerage Industry Guidelines Volume 5, the IST is regarded as temporary treatment system. The product must be approved by SPAN and complying with the determined effluent standard. Desludging activities must be provided by the registered desludging contractor.

As for SSTS, it is designed for 31 to 149 PE (6.975-33.525 m³/day). The usage of SSTS is limited to the development with lower population size when compared to STP. The treatment principles of SSTS are the same as septic tank with additional aeration process at the second tank for removal of BOD and same as sewage treatment plant but only have critical function to provide partial treatment. Besides, SSTS only involves low energy and technology application.

- **Sludge Treatment/Processing**

Sludge treatment involved both non-mechanised and mechanised systems. Non-mechanised processes are geobags, sludge lagoon and drying bed while mechanised processes are belt press, centrifuge decanter and filter press.

- **Financial Aspects**

Water Services Industry Act offers a resolution to critical issues for the sewerage industry such as billings & collection, refusal for individual septic tank, desludging service and maintenance of small sewage treatment plants. The sewerage services financial performance is only confined to IWK and MAJAARI as other operators does not charge their customers nor have a clear segregation of costs for the provision of the sewerage services.

- **Social-Economic Aspects**

Commercial viability ultimately depended on consumer willingness to pay, and the non-payment of tariffs. The federal government apparently accepted the survey results despite the previous reluctance of state governments to finance sewerage improvements through higher charges for fear of public opposition. The initial tariff structure met with opposition from household customers whom the government hoped to cross-subsidize. More crucially, commercial/industrial customers rejected the substantial tariff increases needed to cross subsidize households. Subsequent rejections of revised tariff rates suggest that fundamental opposition to the 'user pays' principle remained.

POLICY RECOMMENDATIONS

- **Institutional arrangement and legal framework**

· National Physical Plan proposed to improve the efficiency of wastewater treatment by implementing modern technologies and sustainable environmentally friendly approach to provide treated effluent, especially for sensitivity area.

· Strengthening Regulatory Framework to improve effective implementation and enforcement of the acts.

· Gazettement of National Sewerage Catchment Plan based on permanent framework to develop local sewerage development plan and to address matters pertaining to sewerage planning.

· Guidelines-Mechanism of property connection to improve the implementation of connection between decentralized and centralized systems.

· To appoint the facility licensee in accordance with WSIA to oversee sewerage asset planning and development with more effectively in terms of resource optimisation and financial sustainability.

- To enhance capacity building for effective decentralized wastewater management through the introduction of structured training and certification program for desludging services operators.
- To treat all sludge/septage at a public sludge acceptance center approved by the regulator before final disposal or reuse.
- SPAN and Desludging Service Operators to establish cooperation and collaboration with Local Authorities/Municipalities to mandate septic tank desludging as a requirement for renewal of business licenses for commercial premises.

- **Technology**
  - To adopt the Product certification process for decentralized wastewater treatment system/septic tanks.
  - To improve the standard and guidelines and prioritize the use of technology for decentralized wastewater system according to the environmentally sensitive area and/or water catchment area.
  - To implement the technical specification for resource recovery (bio-solids and bio-effluent).
  - To impose use of advanced septic tank or decentralized wastewater system for new development (<150PE) in water catchment areas.
  - To expand the availability of more comprehensive and complete database to ease desludging services operations such as on-site real time capture of actual field data, records of desludging activities, disposal of sludge and services rendered.
  - To explore the usage of sustainable technology such as constructed or riparian wetland system for treatment and polishing of effluent discharge from the decentralized system in prioritized existing development areas.

- **Finance**
  - OPEX will be influenced by tariff setting. Revise New tariff setting as the current sewerage charges is too low and not sustainable. Implementation of a sustainable tariff for desludging services upon approval of the revised tariff by the government.
  - Investment of sewerage for CAPEX is significantly developer driven but government plays a role in terms of environmental friendly and sustainable approach.
  - Joint billing of water and sewerage is already implemented in Labuan (2016) and Terengganu (2020). Implement in other states progressively.
  - Government to allocate fund for investment for interceptor system or/and constructed wetland for existing sensitive and/or water catchment areas served by the decentralized systems
  - The implementation of the revised tariff, desludging rules and joint billing will enforce the responsibility of home owners to ensure their septic tank is desludged. It will be suggested that the home owner will have options of payment method (installment/one-off) according to their affordability.
  - PPP to be encouraged for the sustainable business model to promote reclamation and reuse of effluent and recycling of biosolids.

- **Public awareness and participation**
  - To establish advocacy and rewards programs on sewerage services operator, for example, “Desludge and Win” Contest.
  - To promote public health and sanitation in a neighborhood emphasizing the importance to be connected to the centralized system or choose a better IST technology to be installed.
  - To create an appropriate scheduled desludging notices and reminders for the owner by utilizing the appropriate technology available.

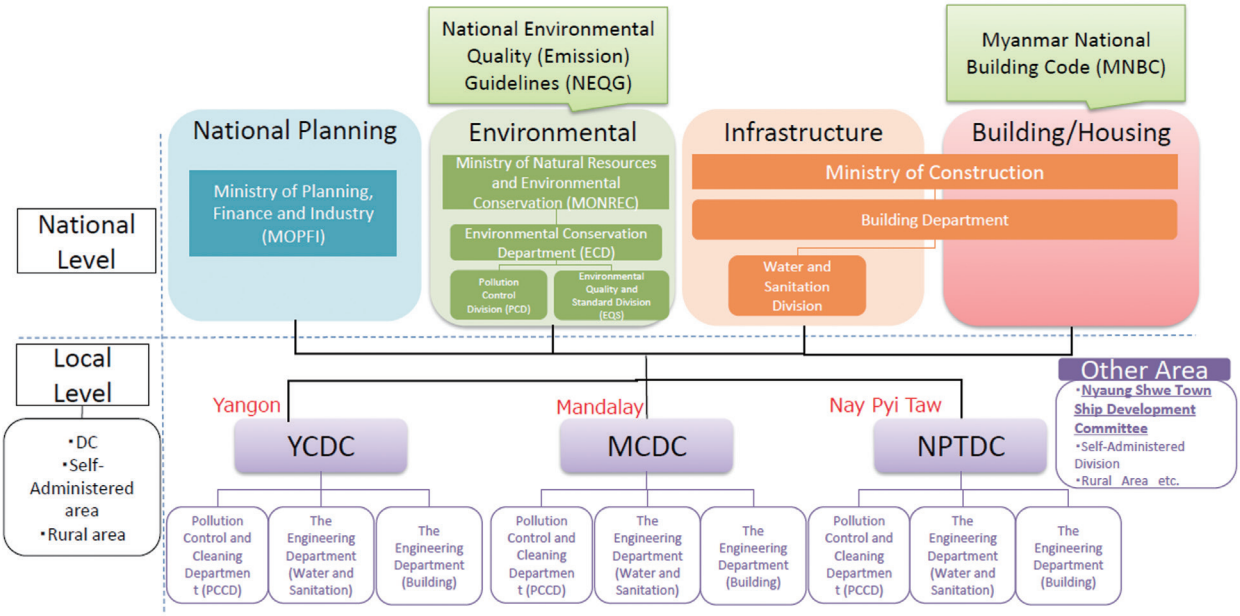
Republic of the Union of Myanmar

CURRENT SITUATION ON DOMESTIC WASTEWATER MANAGEMENT

Technology upgrading and installation of wastewater treatment facility are actively in Yangon. There are projects like development of wastewater treatment master plan and expansion of centralized wastewater treatment system by 2027.
Touring spot like Inle Lake has been going to install the high-performance facility like Johkasou. However, households in other urban area and rural area still use pit latrine or septic tank. Septic tank or pit latrine with slab are the most popular facility as an improved sanitation facility.

	Flush/pour flush to:					
	Piped sewer system	Septic tank	Ventilated Improved pit latrine	Pit Latrine with slab	Composting toilet	Total
State/Region						
Kachin	0.0	31.6	5.7	53.9	0.9	92.10
Kayah	0.0	4.8	0.4	74.3	1.7	81.20
Kayin	0.0	2.2	1.2	69.4	0.7	73.50
Chin	0.0	0.3	5.6	76.8	4.2	86.90
Mon	0.0	2.9	12.9	75.0	0.4	91.20
Rakhine	0.0	1.0	1.6	41.6	3.9	48.10
Shan(North)	0.0	16.0	3.6	42.8	6.0	68.40
Shan(East)	0.0	71.0	0.4	20.6	0.1	92.10
Shan(South)	0.3	11.7	5.0	68.1	0.6	85.70
Ayeyarwaddy	0.0	3.7	0.9	77.1	1.4	83.10
Bago(East)	0.2	9.6	0.8	69.3	0.0	79.90
Bago(West)	0.0	0.6	1.3	85.8	0.8	88.50
Magwe	0.0	7.0	4.3	71.5	1.3	84.10
Mandalay	0.0	17.5	8.5	65.0	0.0	91.00
Sagaing	0.0	2.1	1.5	86.8	0.5	90.90
Tanintharyai	0.0	20.7	6.4	55.3	1.9	84.30
Yangon	7.3	38.8	0.9	46.7	0.2	93.90
Area						
Urban	**3.6**	**32.3**	**4.8**	**53.5**	**0.3**	**94.50**
Rural	**0.0**	**6.0**	**3.1**	**69.8**	**1.4**	**80.30**

Miltiple Indicator Cluster survey(DOH)(2009-2010)



Administrative Structure for Decentralized Wastewater Treatment Facility

Department of Meteorology and Hydrology: Water Assessment of major rivers Data Collection and analysis
Directorate of Water Resources and Improvement of River Systems:
Ensuring sage navigation on rivers and creeks; protecting the river systems for the beneficial utilization of the public, monitoring of water quality river training, river dredging, navigation, river bank protection and river water quality monitoring
Irrigation and Water Utilization Management Department:
Provision of irrigation water to farmland, and monitoring of water quality irrigation water supply, construction, operation and maintenance of irrigation dams and flood protection embankments, agriculture water quality monitoring, and Pump irrigation and rural water supply
Forest Department: Reforestation and Conservation of Forests
Environmental Conservation Department: National Environmental Conservation related activities
Department of Hydroelectric Power: Hydropower Generation
Department of Health: Environmental Health, Water quality assessment and control, monitoring water quality
Department of Human Settlement and Housing Development: Domestic water supply
City Development Committees: City water supply and sanitation, water conservation and protection works
Myanmar Engineering Society: Water resources management related activities, especially consultation
Technology University: Training and Research
Township Level: Organizing water needs, conservancy needs

CHALLENGES TO BE CONSIDERED TO IMPROVE WASTEWATER MANAGEMENT

Wastewater regulation on national level has been still developed and not yet implemented.
Waste management act on national level has just been implemented and wastewater and water quality management on national level regulation will be implemented.
High-performance treatment facility is going to be installed in some areas by the private companies like hotel, but O&M of facility is one of challenges to keep the treatment performance.
O&M training for high-performance treatment facility like Johkasou has been introduced in YCDC by Japanese private company through JICA's technical support.
MWEP (Myanmar Water Engineering & Products Co., Ltd.) has been conducting the training course for municipal government staff.

ASSESSMENT OF THE SECTOR'S PERFORMANCE

- **Institutional effectiveness**
  Lack of organizational structures for wastewater management in rural areas, responsibility for graywater management, and Active cooperation scheme for various stakeholders

- **Policy and Legal framework**
  Lack of wastewater effluent discharge standards as law, regulations for monitoring system for domestic wastewater, and regulations for O&M

- **Public awareness and participation**
  Lack of community-led or government-initiated wastewater management system for decentralized wastewater facilities, and willingness for recycling and reuse of the treated wastewater

- **Technologies**
  Wastewater
  Lack of treatment efficiency, affordability of citizens, and knowledge for management of wastewater facilities
  Sludge
  Lack of appropriate and enough sludge treatment technology, and private sector who can provide sludge emptying service

- **Resource recovery and reuse**
  Lack of willingness to reuse and recycling of the treated wastewater, and market demand

- **Technical expertise**
  Lack of coordination between the university and government, and certification system for the skilled engineer or operator

- **Private sector involvement**
  Lack of O&M service provider for the decentralized system, and Applied case of PFI scheme for wastewater management

POLICY RECOMMENDATIONS AND CONCLUSIONS

- **Needs for Political Will and Institutional Reform**
  - Establishment of environmental standards and monitoring system and laboratory (by ECD).
  - Education for the citizens about the environment is expected in the future. It would be helpful that sharing measures what kind of education and how to explain the importance of wastewater management (by YCDC).
  - Development of research level from academic research to the working level and to expand technical personnel (by MTU).
  - Importance of increase of data by pilot local study and survey, clarifying the role of multi stakeholders, designing master plan through nationwide, awareness raising of civil, and low-cost technology (by MOC).
  - Wastewater penetration to the groundwater from the septic tank is one of a challenge to solve (by NPTDC).

To ensure the treatment performance of decentralized wastewater facilities, it is considered that inspection for installed facilities by local administration shall be more strictly and formulate the inspection methodology and decision standards.

- **Enabling Environment for Integrated Decentralized Domestic Wastewater and Sludge Management**
  Residential land development is progressing in Mandalay City and the suburbs of Yangon, and the need for sewage treatment facilities is increasing. Appropriate sludge treatment as a part of waste management should be considered at both national and local government level.

- **Disabling Environment for Integrated Decentralized Domestic Wastewater and Sludge Management**
  It is possible to discuss the maintenance and management of septic tanks and the introduction of the septic tank law in cities such as Yangon, but it is difficult to set countrywide standards in the current domestic situation. Strengthen Regulations and policy framework on the maintenance and management of septic tanks necessary. It is needed to legalize wastewater discharge standard then introduce the monitoring system, which is highly important to control water quality. Subsequently, it is necessary to establish technical standards for realizing wastewater discharge regulations.

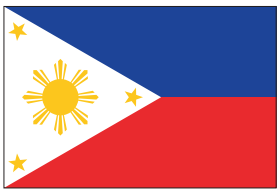
- **Selection of Appropriate Wastewater Treatment Technologies**
  Decentralized system including Johkasou have been installed in Yangon and other cities but these are limited to some advanced buildings or facilities. Maintenance and inspection of those wastewater treatment facilities will be done by the trained maintenance team of DAIGO-Sangyo from Japan and the team of engineers trained from Osaka city, Hiyoshi Co., Ltd., and HORIBA Co., Ltd. Certification system for products and engineers is requisite accompanying with the education/training.

- **Selection of Appropriate Sludge Treatment Technologies**
  In the current state of Myanmar, several sludge treatment methods are taken. In the future, it is considered desirable to select sludge treatment technology according to the local status, but two major methods can be considered roughly.
  As Nay Pyi Taw DC and Yangon CDC chose, one of the choices is that the sludge extracted from the septic tank and latrine is put into the terminal treatment plant and treated. Another choice is as Mandalay CDC chose; oxidation pond method will be the one choice.

- **Business Models and Financing Mechanisms for Cost Recovery at Different Phases**
  For the financing mechanism utilizing private funds such as PPP/PFI scheme, November 2018, a project bank (Project Bank) was established by the Ministry of Planning and Finance (MOPF) and issued. The scope of the project bank would be expanded for the wastewater sector.
  Private finance schemes is not very much popular, but there is room for consideration to use such scheme for wastewater treatment facilities.
  To establish a stable fee collection system, public awareness raising is indispensable.

- **Capacity Development and Awareness Raising Programs for Policy Makers**
  Capacity development program is one of the important activities for Myanmar. Although various wastewater treatment technologies come from China, Korea, Japan, Europe, etc. to Myanmar, it has not been possible that the local government staff could not estimate exactly how much will contribute to its performance and the solution of wastewater treatment problems. It is extremely important to evaluate these technologies and proceed with the optimal technology introduction.

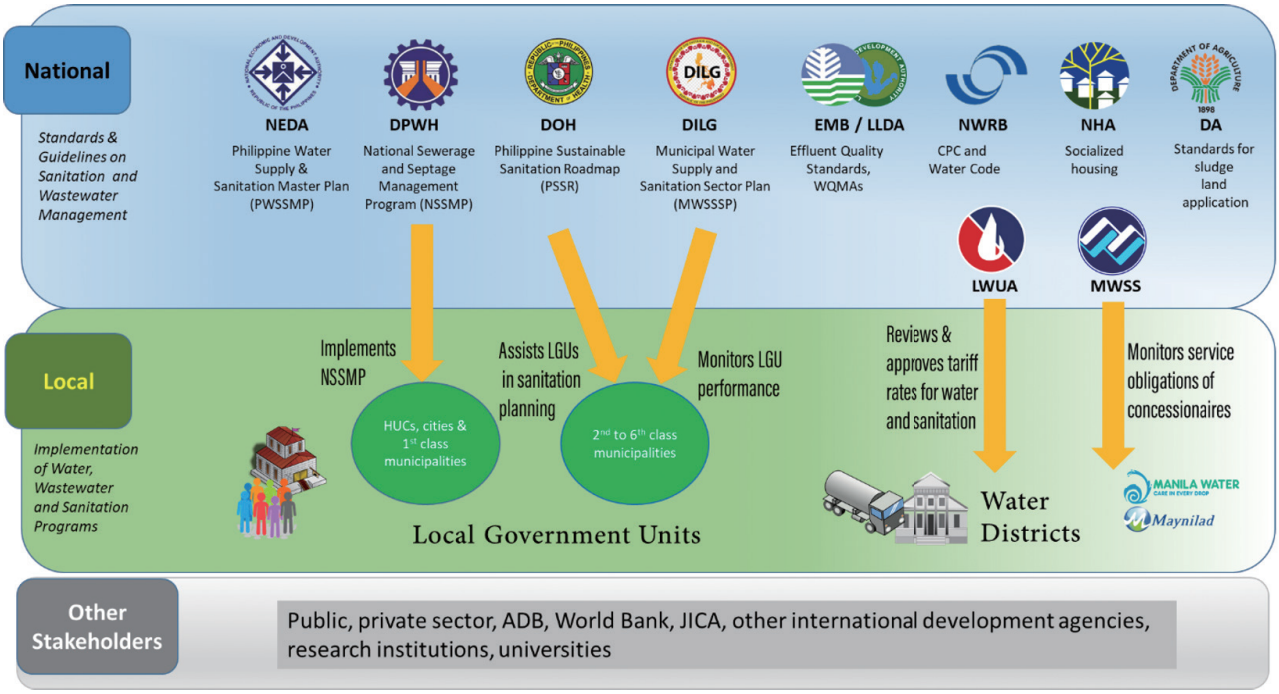
Republic of the Philippines



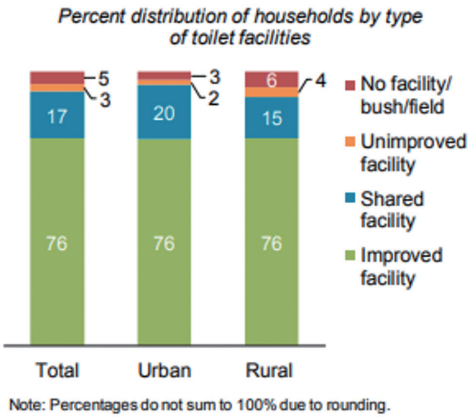
CURRENT SITUATION ON DOMESTIC WASTEWATER MANAGEMENT

Much of the surface water in most large urban centers in the Philippines comprises rivers that pose a public health risk due to levels of coliform bacteria such as in all rivers in Manila. Many beaches in Manila Bay, especially those along the eastern side, also have levels of bacteria that imposes a significant health risk to those using the bay for transport, fishing, or bathing. As per reports, 95% of the wastewater from urban households flows into groundwater, public canals, drainage systems, rivers, and other water bodies, either directly, or after only receiving minor treatment in poorly designed or maintained septic tanks. Effluents from domestic wastewater usually find its way to street drainage systems or seep through the ground. The lack of proper domestic wastewater treatment greatly impacts the quality of groundwater, surface waters and coastal and marine waters. Improperly treated domestic wastewater discharges can also cause waterborne diseases such as diarrhea, cholera and dysentery. Based on 2005 data, sanitation-related economic losses in the Philippines amount to P78 billion annually.

There are challenges in implementing a wide-scale sanitation improvement in the Philippines because sanitation programs are expensive. However, there have been efforts in recent years to promote improved sanitation from which best practices can be built upon and replicated. One such effort is the privatization of the Metropolitan Waterworks and Sewerage Systems of its water supply and sanitation services. For some local government units, decentralized domestic wastewater management system is the alternative approach due to its low funding and technical requirement compared to centralized systems. Decentralized wastewater management is defined as collection, treatment and reuse of wastewater at or near its source of generation. Decentralized system is a client-centered approach that aims at introducing and designing the most appropriate combination of wastewater treatment technologies based on the needs of clients, considering their objectives, local conditions and financial means. It recognizes that one of the shortcomings of centralized systems is that they often leave users without any control over the provision of the service. Economic, environmental and social aspects such as affordability, functionality, reliability and financial and environmental soundness are further enabling sustainability of the decentralized system.



Domestic wastewater management has many stakeholders from different national and local government agencies which had a mandate to implement policies relating to sewerage and sewage. The legal framework for domestic wastewater management in the Philippines is provided by the various national laws described further within this report. Central and local governments have launched numerous programs to improve the sanitation sector in the Philippines. National Sewerage and Sanitation Program by the Department of Public Works and Highways and The National Sewage and Septage Management Program (NSSMP) to provide financial support and technical assistance to local governments to catalyze the development of new projects are two key programs. Alongside, local governments partner with water districts and/or private partners in planning sanitation projects.



Despite the efforts, both urban and rural Philippines face challenges in sanitation. In Metro Manila, only about 15% of the households have access to fully piped sewerage. The remainder relies on septic tanks or pit latrines. In rural areas, the priority concern is the lack of potable water, which is generally prioritized over sanitation. This is further compounded with the lack of drainage infrastructure and electrification in rural areas, which impact the type of interventions in the development of sanitation systems. Thus, rural communities should first meet the basic sanitation requirements of installing toilet in their homes, proper design of latrines or preventing open defecation.

For most of Metro Manila and other urban centers in the Philippines, around 80% of households have installed septic tanks as a source of primary treatment for domestic wastewater. Through the adoption of affordable strategies utilizing combined systems and storm overflow interceptors, the concessionaires are accelerating coverage and are currently targeting full coverage by the end of the concession period. Currently, sewerage and sanitation services are being provided to over 13 million people of the national capital region, through over 50 sewerage treatment facilities and five septage

treatment facilities. Common sewage and septage treatment technologies used include Anaerobic Baffled Reactor, anaerobic digestion in treatment lagoons, chemical conditioning and dewatering with lagoon or activated sludge treatment, chemical stabilization with hydrated lime and effluent treatment with lagoons, anaerobic digestion and composting with municipal solid waste, waste stabilization ponds and engineered reed bed.

ASSESSMENT OF THE SECTOR'S PERFORMANCE

The national government, local governments and water districts of the Philippines contribute significantly to drive the country's sanitation sector through planning and setting goals (ex. Water Supply and Sanitation Master Plan), rationally allocating resources (ex. Unified Financing Framework), providing subsidies, setting standards, etc. However, limited resources, weak law enforcement, poor coordination, inadequate capacity, low awareness and other factors still slow down the sector's development. Against this backdrop, the performance of available domestic wastewater treatment technologies is assessed through a series of site specific and technology-option specific criteria. Effluent standards are important in such performance evaluation. The same standard applies to treated wastewater from a centralized septage treatment facility and from a decentralized wastewater treatment system. Outcomes of performance evaluation of some existing system is further discussed in the report. Apart from that, the performance can be assessed through the sector's contribution to the reuse of wastewater, biogas recovery. Generated sludge is treated and processed for reuse in corn, sugarcane and mango farms as soil conditioners in lahar-affected areas in Tarlac and Pampanga. Between 2006 and 2008, approximately 49,000 m^3 of biosolids were applied. The volume of biosolids delivered to these nutrient-poor areas has tremendously helped in improving the soil fertility of these once barren areas.

Financing and cost-recovery of the decentralized system are achieved by several means. Subsidies and grants are important features in most of the financing mechanisms since they provide viability gap funding. Subsidies and grants may come from the national government and from the local government. An example of a national government subsidy is the one granted through its NSSMP which provides 50% subsidy to the local government that has been approved and passed its application for subsidy. Meanwhile, some water districts are looking into the private sector as a potential partner in its sanitation projects. Cost-recovery is usually achieved through fixed fees, users' fee included in water bills, real estate tax or business permit and user's fee for private sector owners of septage facilities.
Donors provided the initial funding to jumpstart the conduct feasibility studies of several sanitation projects in the Philippines. These grants came from USAID, ADB, World Bank, and GTZ, to name a few. Private initiatives are also encouraged thru partnership with the local government so that the operations of the treatment facility complies with the existing ordinance in the city or municipality.

The results from the fact-findings indicated that centralized and decentralized wastewater treatment technologies can be complementary solutions in achieving the sustainable development goals in wastewater and sanitation. However, there are gaps in implementing decentralized wastewater treatment technologies because of the lack of implementing rules and guidelines from the national/ local government, lack of toolkits to aid local implementers in their decision-making, and lack of financing and cost recovery mechanisms for decentralized systems.

POLICY RECOMMENDATIONS

Short term

- **Revisions to the Septic Tank Design and Construction Guidelines by the DOH and strict implementation of the guidelines**
  The Department of Health (DOH) has finalized the revisions to Chapter 17 of the Sanitation Code that pertains to the standards and guidelines for sewage and septage facilities. This includes an updated standards/guidelines for the septic tank design, construction and maintenance for new installations. However, these standards should also incorporate guidelines in upgrading existing septic tanks to be compliant with the new standards.

- **Building a Strong Partnership Network**
  Multi-sector partnership and network of public agencies), private sector, academic groups, service providers, professional associations and other related groups and institutions, for collaborating on knowledge sharing and improvement, funding, improved services, business opportunities, research and innovation, peer learning, and stakeholder engagement. Linkages with industries, trade and farmer associations should be explored and strengthened for optimum reuse of wastewater and biosolids.
  Necessary platforms can be established such as periodic conferences, workshops, summits, meetings, events, and other regular interaction among various stakeholders and partners for knowledge sharing, peer-learning, information dissemination.

- **Guidelines for the Selection of Appropriate Wastewater Management and Treatment Technologies**
  Many available wastewater technologies in the market today would immensely help the local implementers to have selection guidelines on how to select the type of wastewater treatment technology well-suited to the quality and quantity of wastewater generated onsite. The selection tool for ASEAN decision-makers are provided by this PoDIWM project, and it will be useful for easier buy-in of the technology by the local executives.

Middle term

- **Hybrid solution for the implementation of decentralized system**
  Since having a centralized sewage/septage management systems is investment intensive, local governments may choose to initiate the implementation of the decentralized system in selected priority areas such as highly-densed areas with high traffic and/or narrow roads, communities near bodies of water, subdivisions and other housing projects, etc. This hybrid solution is more cost-effective than implementing a sewerage system for the entire urban area. Having several decentralized systems installed may also lead to savings on the number of trips for the vacuum trucks to collect the septage and to dispose of in a centralized treatment plant.

- **Drafting of Specific Guidelines for decentralized system implementation and monitoring process from the different agencies (DOH, DILG, DENR, LWUA, LLDA, PRRP)**
  The guidelines can include specifications the design, installation, construction, inspection, approval and monitoring guidelines for the decentralized system. Existing guidelines are only applicable for septic tanks.

Long term

- **Integrated Centralized and Decentralized Wastewater Systems**

  Capital intensive projects take time due to the resources required. If the hybrid strategy is chosen by the local government as the appropriate solution for their locality, the centralized sewage/septage management system may be integrated with the existing system, thereby increasing the capacity of the local government in managing and treating domestic wastewater.

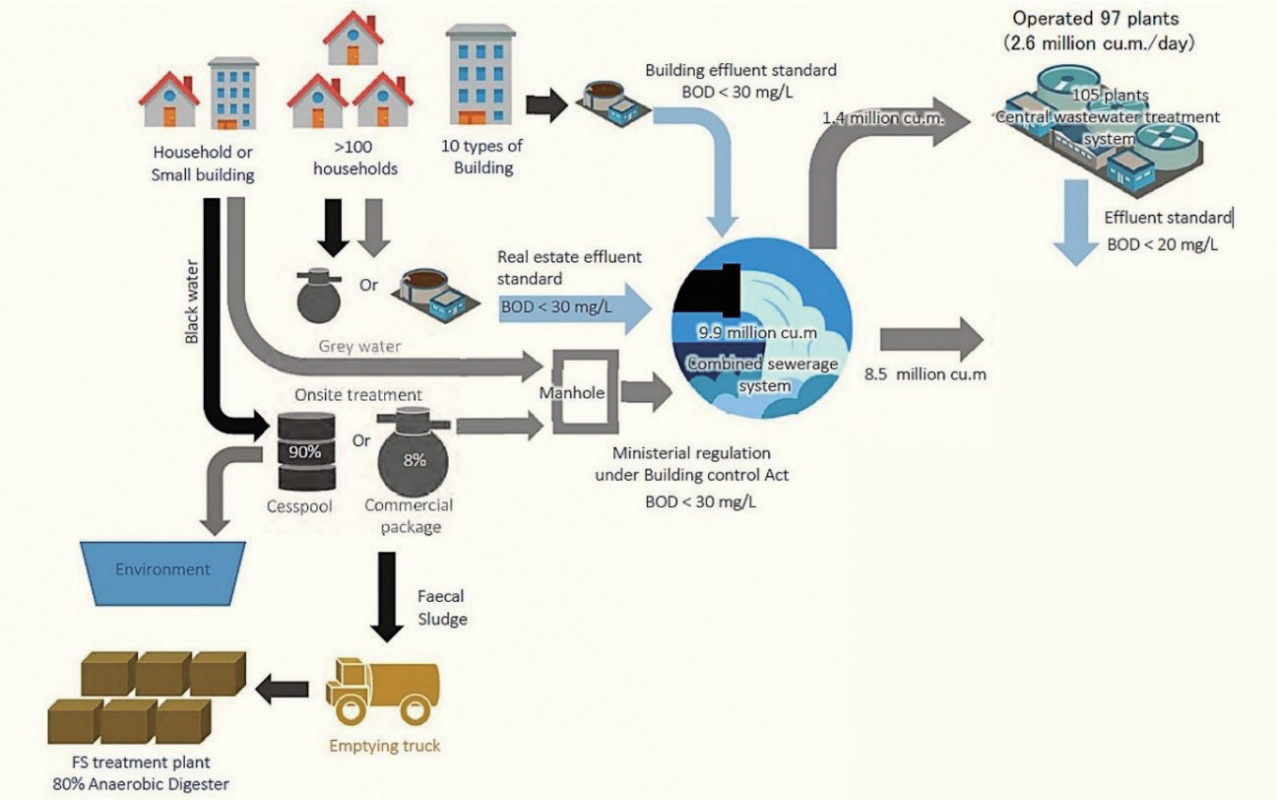
- **Enhanced Business Models and Financing Mechanism for Cost Recovery at Different Phases in the Sanitation Service Chain**

  In the existing business model for septage management in the Philippines, procurement of vacuum trucks is part of the capital investment. However, there is an option for encouraging private sector participation in the emptying and transport phase, by licensing and certifying private trucking operators. Thus, collection and transport of septage will be more frequent – every three years, for example – rather than the existing five to seven years desludging cycle. These private trucking operators will be paid on the volume of septage that they bring to the septage treatment plant.

Kingdom of Thailand

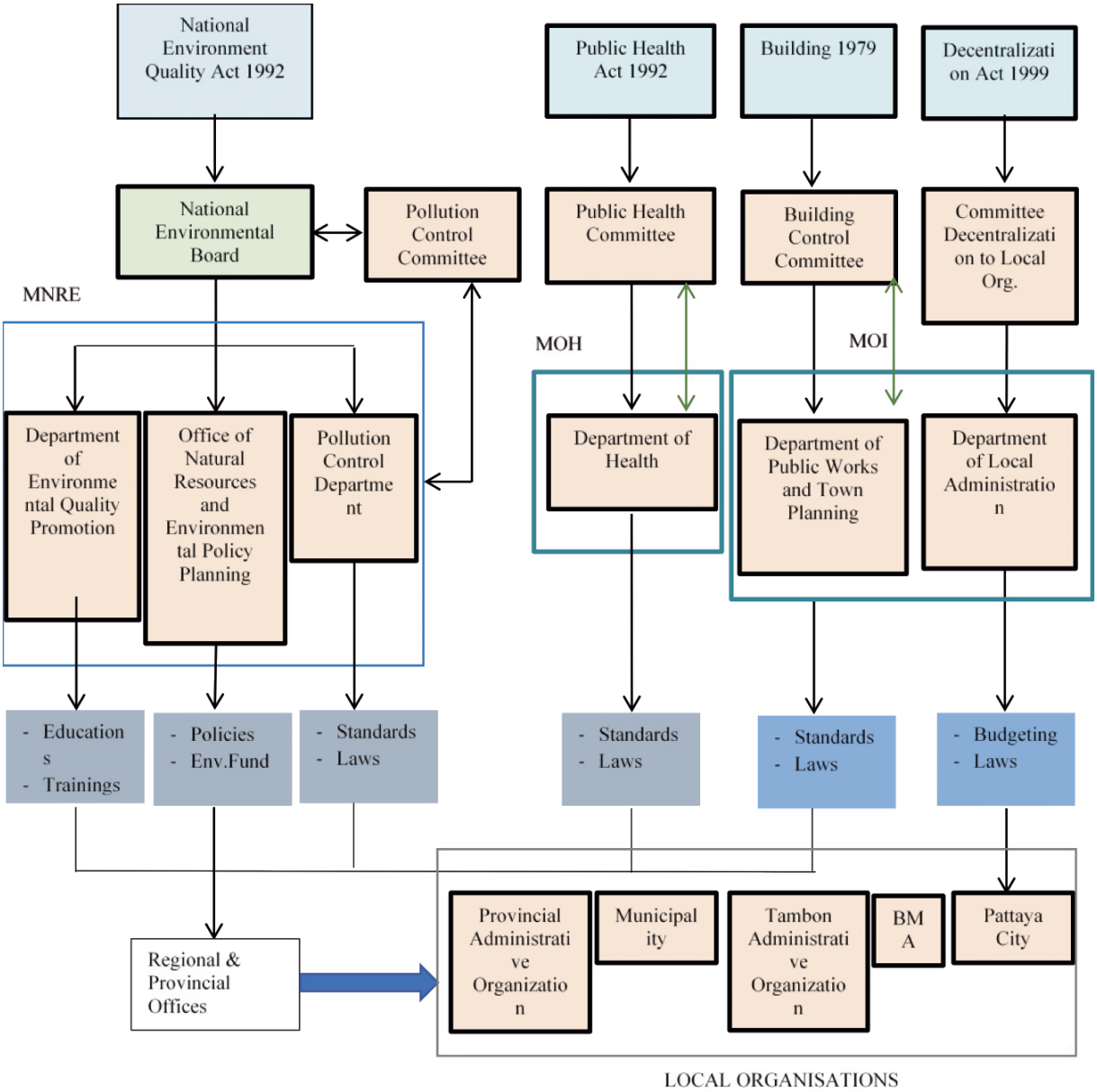
CURRENT SITUATION ON DOMESTIC WASTEWATER MANAGEMENT

Over the last two decades, Thailand has achieved remarkable improvement in access to improved sanitation. By 2017, 99.8 percent of all households in the country had access to improved sanitation. According to SDGs 6 indicator, Thailand is on the upward trend in terms of clean water and sanitation percentage and rating. Globally, Thailand is positioned 12th in terms of SDG 6's value and indicator criteria such as population using at least basic sanitation services, which are improved sanitation facilities. Although there has been an overall improvement in sanitation, due to the lack of proper access to domestic and septage/sludge treatment facilities, lack of funds, absence of performance testing standards, coordination among relevant ministries and effective local government administration, the country still faces major drawbacks in addressing the issues.



Current Situation of Domestic Wastewater Management in Thailand

Combination of both on-site, decentralized (cluster) and centralized wastewater treatment facilities is a typical form of domestic wastewater treatment. It is estimated that only about 26-27% of domestic wastewater is being properly treated in Thailand. Approximately, 90% of the total generated wastewater daily is graywater of which 73% of it passes through the drainage canal and gets disposed into the receiving water. The only treatment it gets is sedimentation and some microbial degradation in the drainage canal. The remaining 27% of graywater together with the 8% of the total 0.98 million m³ of blackwater produced daily from commercial septic tanks are being treated at the wastewater treatment plants. However, the status of the black water infiltrating into the ground from the cesspool which contributes nearly 90% of the black water remains unknown together with the environmental and health impacts in the region. These onsite systems of commercial septic tanks and cesspool are served by legal and illegal trucks for sludge collection of which only a very small percentage are safely treated in the existing faucal sludge treatment plants, while the rest are illegally dumped into the receiving water bodies posing serious environmental and health impacts.



Regulatory Framework of Decentralized Domestic Wastewater and Fecal Sludge Management

Related stakeholders of the decentralized domestic wastewater sector

Ministry	Department
Institutions at National Level	
Ministry of Interior (Metropolitan Wastewater Management Authority – State Enterprise under MOI)	Water Quality Control Department
Ministry of Natural Resources and Environment	Pollution Control Department (Water Quality Management Bureau–Under PCD)
	Office of Natural Resources and Environment Policy and Planning (ONEP)
	Department of Environment Quality Promotion – (Environmental Research and Training Center)
	Department of Administration
Ministry of Public Health	Department of Health
Institution at sub-National Level	
Local Government Agencies	Public Health and Sanitation Divisions
	Civil Engineering Divisions
	Public Health and Environmental Bureaus
Bangkok Metropolitan Administration	Drainage and sewerage Department
	Solid Waste, Hazardous Waste and Night Soil Management
	Environment Department
	The BMA Budget Department
Private sector	Private service providers for faecal sludge emptying and transport, Companies, involved in providing design, construction and operation for the wastewater treatment plants
International Organization	Japan International Cooperation Agency, Institute for Global Environmental Strategies, Bremen Overseas Research and Development Association (BORDA), The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Danish International Development Agency (DANIDA), etc.

ASSESSMENT OF THE SECTOR'S PERFORMANCE

- **Institutional Framework and Policy Coordination**

  Policy influence is required to establish standards for wastewater and faecal sludge management as well as to streamline the tariff collection process. Coordination among and within government forces is currently feeble due to overlapping institutional roles which should be resolved soon along with the capacity building of the institutions. Apart from institutional improvements, it is important to raise awareness among the public to ensure their fullest cooperation in implementing sanitation-related legislations and practices.

  Wastewater treatment plants are operated at the low incoming influent concentration. Treatment plants still can accommodate the fecal sludge to meet the organic content requirement, however, organic content requirement shall be evaluated prior to undergoing the co-treatment. This could compensate some proportion of the raw fecal sludge going into the open environment while complementing the organic requirement for the treatment plants to effectively remove the nutrients

from wastewater. This requires the coordination among the departments coupled with the awareness of the authorities to consider the fecal sludge as the resource rather than the burden.

- **Technology**

A growing number of the decentralized wastewater treatment facilities are being constructed across the country. Installation, operation and maintenance of decentralized systems often require more awareness, involvement, and participation from local users than centralized ones. The decision to implement a decentralized solution to wastewater treatment needs is usually made or discussed at the local level, and local stakeholders are usually more proactive when considering these systems. Decentralized wastewater systems showed a competitive cost structure, simpler technology, and limited additional costs, while high efficiency could be achieved with good O&M. Locally reclaimed water was largely (30–100%) used for landscape irrigation of green areas, while in centralized systems less than 5% of the effluent was recycled. Modification of the guideline on the anaerobic digestor to recover the greenhouse gas from digesters or flaring the gas prior to releasing into the environment.

Regarding fecal sludge or septage treatment plants in Thailand, unfortunately, there are about 162 fecal sludge treatment facilities in Thailand. In the case of Nonthaburi fecal sludge treatment plant, anaerobic digester is the major treatment technology. The treated sludge is used as a soil amendment. There is no provision as of now to accommodate the sludge from the decentralized domestic wastewater plant and sewerage plant. For the septage treatment plant, there are no guidelines and standards.

About 90 % of households hold leaching nature containment types (cesspools) contributing to the groundwater pollution. The cesspool upgrade shall be the priority agenda. The upgrade shall be the sealing the bottom of cesspool. For the new households or the communities, it shall be mandatory to have a proper septic tank while focusing on the enforcement and monitoring.

- **Finance**

On December 4, 2006, National Environment Board agreed to collect wastewater management fee in accordance with the polluters pay principle and depending on the type of the wastewater treatment systems.

The type of treatment systems and per cubic meter of fees to be charged in presented below:

1. Stabilization Pond 2 – 4 baht per cubic meter,
2. Aerated Lagoon (AL) 3 - 5 baht per cubic meter,
3. Activated Sludge systems (AS) 3-5 baht per

At present, only about 17 local administrative organizations have adopted the user fee for wastewater collection. This has resulted in the lack of funds to operate and maintain the treatment plants.

ONEP provides the funding for the wastewater treatment plant investment, however, most of the local organizations do not meet the documentation based on ONEP's template. In other words, the local authorities are not capable of preparing documentation and do not seek any technical consultation thus could not secure the fund.

Hence for wastewater and faecal sludge management to be sustainable, it is necessary to charge the treatment fee to the users. The different schemes like the surcharge on the water bill, property tad or income can be experimented.

Apart from the cost recovery, the Thailand providing both wastewater and faecal sludge emptying and transport service could face the dual investment and management for wastewater and faecal sludge treatment plant. This could escalate the amount of tariff to be charged to the user in order

to sustain both systems. For the existing schemes, possibility of accommodating the FS into the existing wastewater treatment plant shall be explored. While for the growing urban area, different wastewater management scheme shall be explored decentralized without septic tanks or septic tanks with soak pits and the faecal sludge treatment plants.

- **Private sector involvement**
  Private sector is limited to the contract-based service for the operation of the wastewater treatment plant. Though Thai government has been advocating the public-private partnership in wastewater management, it is yet to come into practice. Tongthawil Service Co. is an example that a fecal sludge treatment business is profitable with the treatment fee.

POLICY RECOMMENDATIONS

There is no clear zoning for the centralized and decentralized wastewater treatment systems. However, the recent approach is to employ centralized scheme if the water consumption volume in any area more than 2000 m³/day. Cities need to do a citywide sanitation planning to define the zones for centralized, decentralized and onsite sanitation systems while introducing technologies targeted to urban poor and low GHG emission.

Local government should develop a local action plan and appropriate legislation for cost recovery mechanism and bring it into practice. The decentralized system should be prioritized considering its cost, effluent quality produced and operation and maintenance cost arrangements. If needed, a central unit or Ministry should be in charge of the integrated wastewater management approach including fecal sludge management and shall develop an institutional framework to map local governments to manage sanitation at their localities with clear roles, ownership and coordination required. Government shall develop programs to capacitate local government to operate and maintain wastewater-related utilities and shall drive the community to involve in wastewater management by launching awareness campaigns regarding regular maintenance of onsite sanitation system.

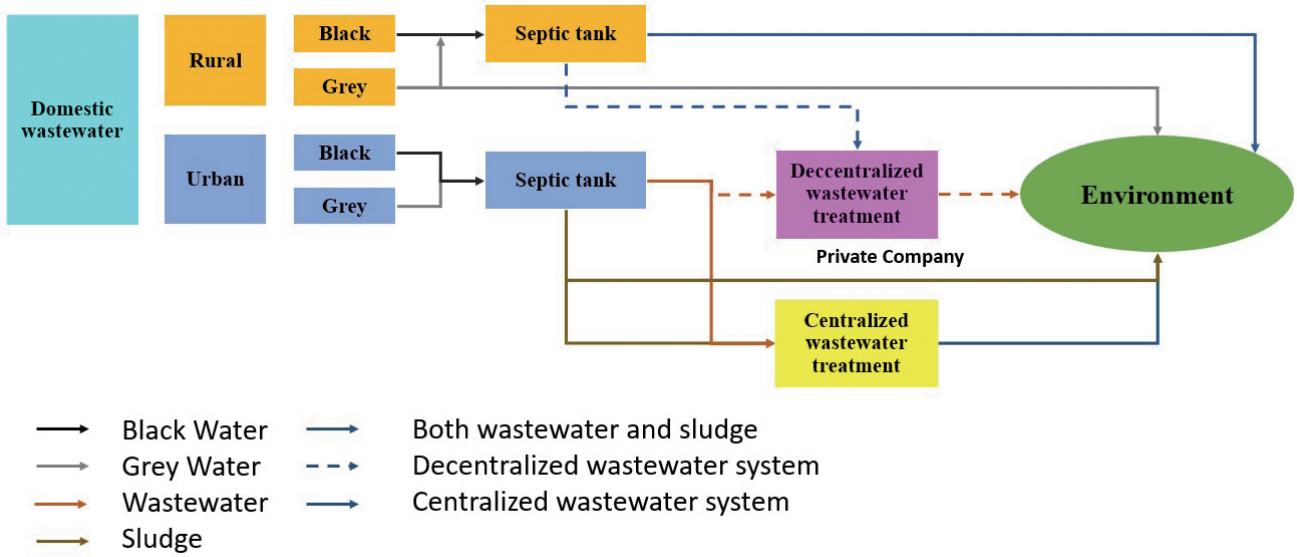
· Needs for political will and institutional reform
· Enabling environment for integrated decentralized domestic wastewater and sludge management
· Disabling environment for integrated decentralized domestic wastewater and sludge management
· Selection of appropriate sludge treatment technologies for Thailand
· Business models and financial mechanisms for cost recovery at different phases
· Capacity development and awareness raising programs for policy makers



Socialist Republic of Vietnam

CURRENT SITUATION ON DOMESTIC WASTEWATER MANAGEMENT

Vietnam has been successful in improving sanitation facilities, providing more than 90% of the population with the improved drinking water source and improved sanitation facilities. Despite the notable improvements, significant challenges still remain for Vietnam in terms of achieving SDGs 6. In ensuring availability and sustainable management of water and sanitation for all, it is important to reach communities which have no access to centralized facilities. In doing so, decentralized wastewater treatment systems play a major role.

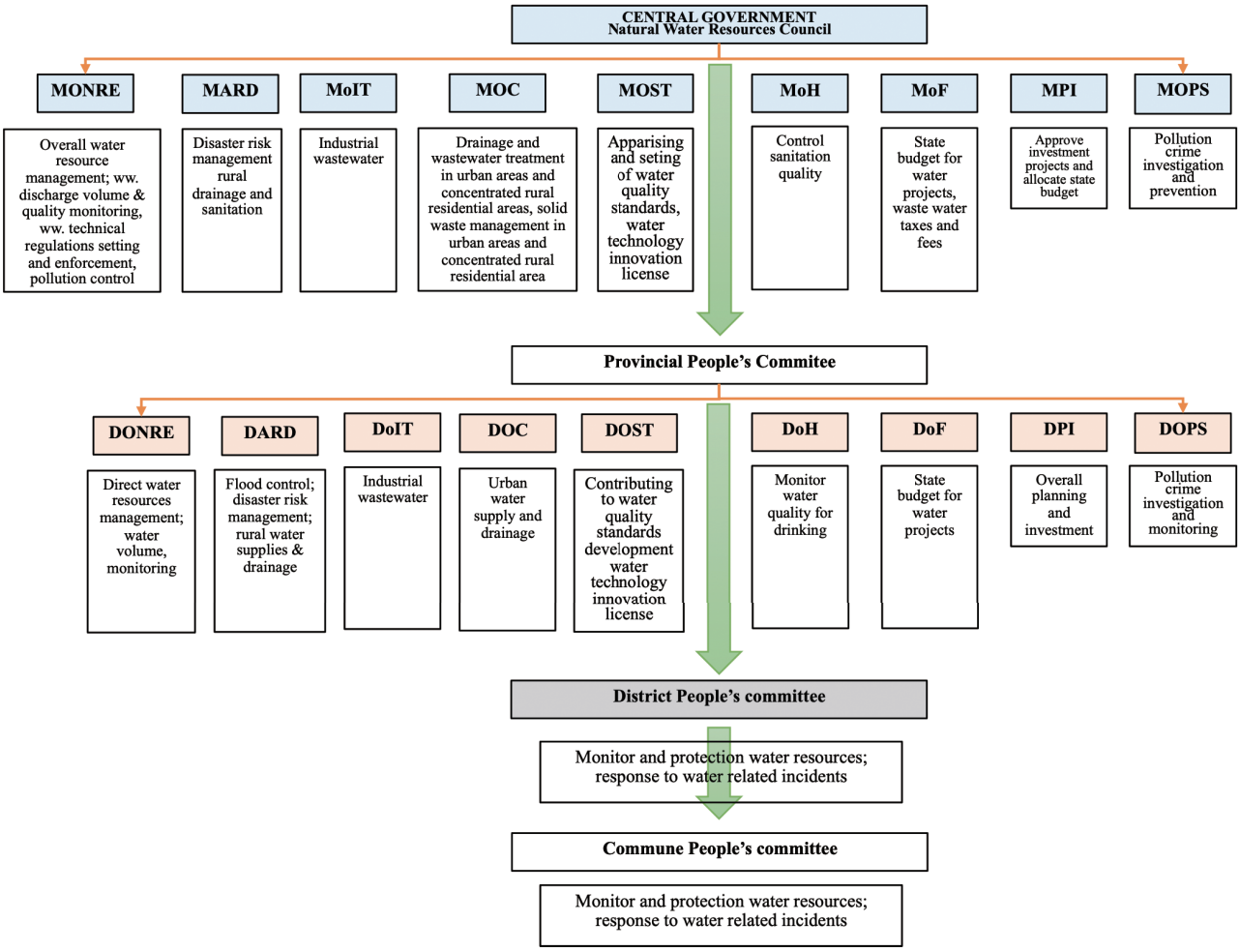


Wastewater and sewage sludge management flowchart in Vietnam

The most common collection network type is the combined type, which primarily functioned as the stormwater pipeline, receiving 90% of generated wastewater. Recently, separate collecting system has been introduced in newly developed areas. Even if there exists a massive demand for urban domestic wastewater management, the number of urban centers which have been equipped with sewerage treatment plants is still low, around 35 plants in big cities with a total design capacity of approximately 12-13% of the total need of treatment. Approximately 50% of the rural households had a typical hygiene latrine in comparison with the rate of 60% which was targeted in national rural sanitation coverage. The sanitation coverage in rural areas is still low because the main focus now is on the provision of drinking water.

Approximately 90% of urban households have septic tanks receiving domestic wastewater, in most cases only from toilets. Graywater from the kitchen and drainage is mostly disposed of directly to

open drains. Accumulated septic tank sludge, septage or fecal sludge is pumped out periodically for treatment and disposal. Against this backdrop, decentralized system for domestic, industrial and institutional wastewater treatment are being continuously enforced through legislation.



The roles of national and local governments towards sanitation in Vietnam

There is a strong regulatory framework related to wastewater management in Vietnam. These regulations focus on wastewater and fecal sludge management, decentralized domestic wastewater treatment by hotels, offices, schools, research facility, department stores, supermarkets, markets, restaurants, production facilities, condominiums and residential buildings, allowable effluent concentrations, etc. While a comprehensive legal framework has been set up and is periodically updated, detailed technical guidance, and local regulations adaptive to specific contexts are still lacking. Significant overlaps and gaps remain as well due to the lack of sufficient synchronization between agencies.

ASSESSMENT OF THE SECTOR'S PERFORMANCE

- **Institutional Framework and Policy Coordination**

A strong legal and institutional framework, access to funding, ownership of local authorities, the public's demand, awareness, feedback and commitment and such are key in this regard. Meanwhile, affordability, functionality, reliability, financial soundness and environmental soundness ensure the sustainability of decentralized system. On the other hand, lack of priority by local government, slow implementation, lack of information, education, communication and awareness, poor city development practices and limited capacity push back the improvement.

In order to overcome the barriers and achieve sustainability in the sanitation sector, the committed and willing involvement of national and local governments as well as all other stakeholders including the public is essential. While the sanitation sector is being driven by a strong legislative framework, well-defined roles and responsibilities have to be set for all stakeholders, to improve coordination and reduce conflicts. In some cases, their implementation is delayed by the slow progress of other stakeholders such as line-ministries, which is a situation that requires immediate improvement.

In order to achieve the quality of service, strict standards should be set for wastewater and sludge management. Even though the wastewater sector has set standards, sludge treatment and its performance evaluation have not been well standardized. Regulations and standards set should be strongly enforced to make sure all stakeholders comply with them. Monitoring practices should be improved, and random inspections should be increased followed by penalties for those who violate regulations and standards.

- **Technology**

The performance of decentralized system depends on numerous factors from design through operation and maintenance. Local conditions of respective applications are considered in the design stage to ensure optimum performance. Simple and reliable technologies such as simplified (separate) sewer system, anaerobic baffled reactor, anaerobic filter, horizontal planted gravel filter and aerated ponds adopted in the decentralized system significantly eliminate technical difficulties. Regular monitoring of influent and effluent quality and treatment plant condition is also carried out. Effluent quality is compared with effluent standards established by several regulations to check compliance. In addition to wastewater treatment, sludge treatment and reuse are also being carried out. For example, more than 200,000 septic tanks in Hai Phong are managed through the GIS system and fecal sludge is collected every three or five years. However, unlike for wastewater, there are no established standards to evaluate the performance of sludge treatment facilities and this issue is currently in the discussion stage.

- **Finance**

One major factor contributing to the smooth operation of sanitation systems is cost recovery. Tariffs is a significant part of cost recovery. The tariff system for the decentralized system is not as well defined as that of the centralized system. For the centralized wastewater system, wastewater tariffs are defined as 10-20% of the water tariff in most cases. Collected wastewater tariff is used to contribute to covering the operation and maintenance costs. On the contrary, decentralized wastewater treatment systems do not employ an effective and sustainable financial model.

The fact that decentralized system involving a large number of stakeholders could diversify funds leading to financial sustainability. Some of the funding agencies for currently running Vietnamese decentralized system are ADB, BORDA, IMV, Animals Asia Foundation, MARD-Vietnam, local and provincial governments and private owners. Studies which conducted economic analyses on the

wastewater sector have concluded that it is worthwhile to invest in the sewerage and wastewater infrastructure in Vietnam. Efficient management of received investments is also as important as attracting them. The studies also recommend that efforts should be made to recover the full or close-to-full cost within three to five years of commencing operation of the infrastructure through user fees.

POLICY RECOMMENDATIONS

- **Legal and policy recommendations**
  - · Commitment towards SDG6.3
  - · Should be driven by the resource recovery and reuse
  - · Formulation of laws/regulations
    - For Septage management
    - For On-site system and Off-site management
  - · Improvement of laws/regulation for
    - For Environmental Water Quality Standard (Receiving water environment) QCVN 08, 09, 10/BTNMT for ambient water quality
    - Regulation of Effluent Water Quality QCVN 14, 40/BTNMT for wastewater quality
  - · Develop with regulators understanding of appropriate compliance:
    - e.g. use of composite sampling, percentile compliance, phased introduction of consent
    - Reporting requirements
    - Penalties for non-compliance
    - Establish monitoring and basic standards for the re-use of sludge

- **Technology**

  Since the decentralized system is a promising technology to ensure sanitation for all, national and local guidelines have to be established as soon as possible. The guidelines should cover all aspects of planning, building, operating and maintaining not just plants, but also sludge/septage collection, and transportation. For continuous improvement of the sanitation sector, research and development activities should also be pioneered through research institutions, universities and relevant agencies.
  - · Specific treatment process (technology) to meet the effluent water quality standards is requested, and the performance of specific treatment process (technology) should be evaluated and examined.
    - For improvement of system performance and efficiency
  - · Formulation of Design and O&M manual
    - For enhancing the selection of appropriate technology (Design guideline) considering the level of treatment required as well as BOD of influent wastewater
    - For treating wastewater safely and steadily
  - · Innovation of technology
    - Acceleration of the efficiency of wastewater treatment and management
    - Impact on the existing systems

- **Planning and coordination**
  - · Closely coordinate at the central level between MOC, MOST and MONRE on developing management mechanisms, policies and technologies for decentralized wastewater treatment solutions.
  - · Role and coordination of central/local government and private sector for planning, design, construction, O&M, assessment, etc.
  - · Zonation for the centralized and decentralized scheme-short-term focus must be on decentralized

scheme, long-term plan for transitioning to centralized scheme.

· Zonation of the areas for the different schemes with FSM, Decentralized scheme and Centralized scheme - considering population density while paying particular attention to underlying aquifers.

- **Management models**

· Need a single body to manage the network and treatment of wastewater

Have resource/skills available for M&E, service and network.

Have operational understanding of process.

Establish sampling regime and capability for wastewater characterization and compliance monitoring.

· Appropriate model for O&M service provider company

BIWASE model: manage all water/wastewater/solid waste in Binh Duong City and sub-urban areas

Public participation

- **Financial mechanisms**

Necessary measures have to be taken to incentivize private sector participation in the sanitation sector and to encourage PPP. While there are successful programs conducted by the private sector, scaling up and diversification of private sector participation, particularly in smaller and remote water schemes, are being challenged.

· Efficiency of existing financial resources

· Mobilizing additional and innovative forms of domestic and international finance

Enhancement of public-private partnership

Policy and financial incentives for the private investor

· Establishment of construction and O&M cost sharing principles

· Sound business model considering long term income and expenditures

· Appropriate model for O&M service provider company

· Tariff Collection

Protection for poverty

Requirement to raise the tariff to fully cover wastewater conveyance, treatment and by-product handling.

Provide a roadmap for the required increase in tariff

· Policy shall seek political commitment to enforce the user tariff scheme to cover O&M cost of the treatment plants

- **Effective fecal sludge management**

· Formalize management of fecal sludge

Desludging regulations

Define ultimate disposal of sludge - landfill or reuse

If reuse define treatment stage to achieve required standards

For example: Co-composting with green waste

· Promotion of septage management and sewage works

Centralized wastewater treatment plant

· Other by-products safe disposal

Screenings, grit and grease to be disposed to landfill

Septic waste to undergo aerobic treatment as a minimum

Target wastewater treatment standards for liquors

Sludge to blend with sludge from wastewater treatment plants

Obligate reporting of mass & composition of materials collected (including septic sludge)

Activity Reports

Round-Robin Test

Report on Round-Robin Test on Harmonized Performance Testing Method for Decentralized Domestic Wastewater Treatment Facilities

Introduction

The major pollutants in most of the water bodies come from the domestic wastewater. Most of the ASEAN countries have already established the effluent standard. However, compliance to the standard is difficult due to the lack of governance to appropriately execute the necessary countermeasures to meet the effluent standard.

One way to solve the issue is to promote installing the performance certified decentralized wastewater treatment facilities for domestic wastewater. Most of the households only set up the simple septic tank which is rarely cleaned or desludged. Being aware of the urgency to lessen the damage by domestic wastewater, some countries in ASEAN have started considering an establishment of the standardization of treatment performance testing method for domestic wastewater facilities.

In the last few years, the import/export of the wastewater tanks is increasing within the ASEAN region. Having recognized the similarity of the use condition of the tanks and rapid increase in population in the ASEAN region, respective countries would have great merit with the harmonized testing method.

Round-robin test

To foster a better understanding of the performance test and certification system in the ASEAN region, the round-robin test on the performance testing method was conducted in three countries; Indonesia, Thailand, and Japan.

In this round-robin test, the draft of the Indonesian testing method was used as a basis of the harmonized testing method to find which part could be common and which part would be unique in each country.

Three identical test products which are made in Indonesia were purchased and installed at the testing bodies in each country.

Brief specification of the test product

BJ-1 (PT. Daiki Axis Indonesia)

- Main components: Sedimentation/separation chamber, anaerobic contact media chamber, moving bed chamber (aerobic), sedimentation chamber, and disinfectant chamber
- Capacity: 1 m³/day
- Total volume: 1.73 m³
- Blower: 60 L/min

	Testing body	Set-up
Indonesia	PDAM Bandung and PUSPERKIM	
Thailand	AIT Test Center	
Japan	NIES and BCJ	

Set-up of the test product in each country.

Harmonization of the performance testing method

In this project, it was found that not all the procedure could be the same in three countries. For example, due to the constraints of the equipment for wastewater feeding in each testing body, the details of the wastewater inflow pattern could not be the same in the three countries. However, the principal feature of the inflow pattern such as the peak factor and the peak shape could be the same. Because the inflow pattern has a great impact on the treatment performance in small-scale wastewater treatment facilities, the harmonization of this part of the testing method would be very important.

BOD and nitrogen concentration of the influent wastewater was adjusted to the standard concentration using additives like methanol, glucose, or feces, and the way of the adjustment was also different in the three countries. Development of an easy but precise way to adjust concentration might be a key to establish a harmonized testing method. As an alternative, evaluation based on the removal rate would be worth to be considered.

Water quality items in the effluent standard and analytical methods are not identical in each country. These parts should be unique in each country, however, the same testing method could be applied for the performance evaluation of test products.

Future development

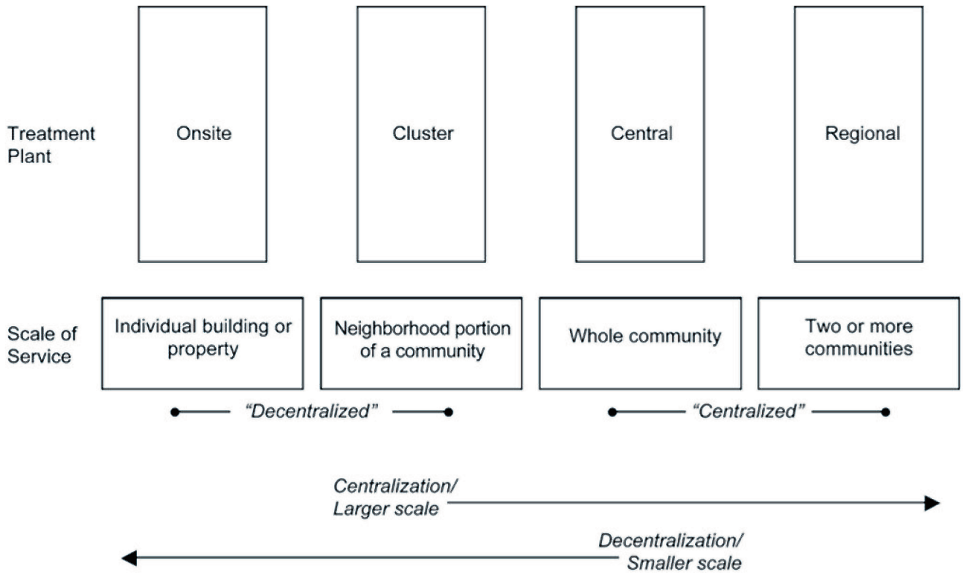
We still have a long way to go before we have the regional mutual recognition with one harmonized testing method in the ASEAN region. It is so important to exchange the professional views and ideas on the establishment and operation of the testing method within ASEAN member states.

It is also necessary to set up the testing bodies by public bodies either at the central government or provincial government level to maintain a fairness of the test. Further study and establishment of an appropriate framework of the organization and operational rules should be discussed. Hopefully, the testing body would be an international organization in ASEAN.

Technology Selection Guideline

Development of Sustainable Decentralized Domestic Wastewater Treatment Technology Selection Tools for ASEAN Countries

When choosing and installing a wastewater treatment system, several selection criteria applied, including the type of system, wastewater characteristics and extent of treatment, human health considerations, level of management and oversight required, and the effluent standards to be met. We have prepared the guideline for the selection of decentralized domestic wastewater technology to cater to the needs of the local government officials who are usually responsible for selecting the decentralized domestic wastewater technologies in infrastructure development for sanitation.
Today there is a wide variety of decentralized systems developed for residential, industrial, and commercial use. They can be scaled to meet individual homes' needs, or for clustered treatment to meet individual houses' needs, or for clustered treatment to meet the needs of several residential housing units or commercial facilities. Following figure represents the scaling of decentralized and centralized capacities.



A decentralized or semi-centralized system offers the following advantages:

1. Less cost required; in terms of investment costs and operation and maintenance costs.
2. Better protection of water resources, in case of failure small damage (risk minimization)
3. Better adjustment to the individual grade of pollution
4. Flexible (expandable) and adaptable to changing frame conditions, population, tourism, industries
5. Provide tailor-made solutions for environmentally sensitive areas, can be implemented in the modular principle
6. Can better fit into the landscape
7. Re-use of treated wastewater and nutrients (Nitrogen and Phosphorus) is easier to manage

The main drawbacks of decentralized wastewater management are:

1. Potential lower treatment efficiency (esp. Nitrogen and Phosphorus)
2. Need for education and correct usage
3. Require qualified personal for operating and maintenance
4. Insufficient monitoring might occur
5. Legal frameworks and institutional settings are more complex

Domestic wastewater contains undesirable and potentially unsafe chemical and biological contaminants generated from specific processes in residential, commercial, and industrial processes. While introducing contaminants makes up a relatively small fraction of the total wastewater composition, they can still be present in large amounts to endanger public health and environmental integrity (Trotta et al., 2002). Domestic wastewater typically has lower pollutant loads than commercial and industrial wastewater. Regardless, many potential pollutants can be present in domestic sewage due to various domestically available chemicals that can easily dispose of the toilet, sink, or drain.
Despite the large number of potential pollutants present in domestic wastewater, its general chemical and biological composition have been well characterized. Domestic wastewater consists of two main components: graywater and blackwater. Blackwater is any wastewater that has come into contact with humans. Graywater is defined as untreated wastewater that has not come into contact with human waste. Sources of graywater include wastewater from bathtubs, showers, bathroom washbasins, washing machines, and laundry tubs. Graywater is typically 30 - 50 % of the total wastewater flow generated in indoor residential use.

Any decision in favor of a specific technical option in the early planning phase will strongly influence both investment and operating costs. To provide cost-effective and sustainable decentralized wastewater treatment plant should take a holistic approach in selecting the treatment technology.
Selection of alternatives for new or upgrade decentralized wastewater treatment plant relies on considering the economic and non-economic criteria. However, this approach's challenge lies in often difficulty considering appropriately essential factors that are not readily quantifiable.

Economic criteria includes the parameters on initial investment cost, operational and maintenance cost. As for non-economic criteria, technical criteria includes the parameters on land space requirement, construction difficulty, operator technical skill, ability to handle the flow/quality variation. Environmental criteria includes the parameters on nitrogen removal, BOD removal, energy type. Social related criteria includes the air pollution.

During the development of the plan, the planners would have the main selection to be the primary consideration in selecting treatment technology. Several factors usually comprise the planners' primary consideration while designing wastewater treatment technology, such as land availability, capital cost, operational and maintenance cost, and technical skill requirement. Additionally, the primary criteria

are also supported by other supporting technical criteria that will ease the planners to lower down the technology options.

To consider the treatment capacity, decentralized wastewater treatment technology can be flexible and adaptable to site conditions, population type, and type of wastewater characteristics. The wastewater management system can vary based on the house site condition. Additionally, several treatment technologies are not always suitable for smaller treatment capacity, as it might be too expensive if applied for single or ten houses. In this guideline, the treatment technology will be classified into three treatment capacity types.

The wastewater treatment selection represented in the following matrices is prepared to combine the treatment capacity and planner's consideration in selecting wastewater treatment technology.

Decentralized Wastewater Treatment Technology Selection Tool for 5 – 50 PE

Selection Criteria	Parameters	Wastewater Treatment Technology Options (5 – 50 PE)		
		Septic Tank	Anaerobic Filter	Packaged Aerated Wastewater Treatment Plant (PAWTP)
Critical Criteria	Land space requirement (m2/PE)	Medium	Medium	Small/ Medium
	Capital Cost (US$ /PE)	Fair	Medium	High
	Operational & Maintenance Cost (US$ /PE)	Medium	Medium	High
	Technical Operator Skill	Fair Level	Medium Level	High Level
Supporting Criteria	Ability to Handle Flow Variation	Good	Good	Fair
	Ability to handle influent quality variation	Poor	Poor	Good
	Ease of construction	Easy	Easy	Easy
	Ease of Operation	Fair	Fair	Medium
	Energy Type	Natural	Natural	E/M
	Nitrogen Removal	Low	Low	Good
	Removal of organic matter			Good
	Air Pollution	Gases (CO2, Methane)	Gases (CO2, Methane)	-

Decentralized Wastewater Treatment Technology Selection Tool for 50 -500 PE

Selection Criteria	Parameters	Wastewater Treatment Technology Options 50 – 500 PE			
		Rotating Biological Contactor (RBC)	Anaerobic Filter	Anaerobic Baffled Reactor	Packaged Aerated Wastewater Treatment Plant (PAWTP)
Design Primary Criteria	Land space requirement (m2/PE)	Small - Medium	Medium	Medium	Small/ Medium
	Capital Cost(US$ /PE)	High	Medium	Fair	High
	Operational & Maintenance Cost (US$ /PE)	Medium	Medium	Medium	High
	Technical Operator Skill	High Level	Medium Level	Medium Level	High Level
Supporting Criteria	Ability to Handle Flow Variation	Good	Good	Good	Fair
	Ability to handle influent quality variation	Fair	Poor	Good	Good
	Ease of construction	Very Easy	Easy	Easy	Easy
	Ease of Operation	Medium	Fair	Fair	Medium
	Energy Type	E/M	Natural	Natural	E/M
	Nitrogen Removal	Good	Low	Low	Good
	Removal of organic matter	Good	Good	Fair	Good
	Air Pollution	odor	Gases (CO2, methane)	Gases (CO2, methane)	VOCs

Decentralized Wastewater Treatment Technology Selection Tool for 500 – 10,000 PE

Selection Criteria	Parameters	Decentralized Wastewater Treatment Technology Options 500 – 10,000 PE								
		Activated Sludge	Rotating Biological Contactor (RBC)	Trickling Filter	Anaerobic Filter	Anaerobic Reactor	Aerated Lagoon	Constructed Wetland	Waste Stabilization Pond	Packaged Aerated Wastewater Treatment Plant (PAWTP)
Primary Criteria	Land space requirement (m2/PE)	Small/ Medium	Small - Medium	Small - Medium	Medium	Medium	Large	Large	Large	Small/ Medium
	Capital Cost (US$ /PE)	High Ccw (EU) = 3038 $\cdot PE^{-0.349*}$ Ce (EU) = 63117$\cdot PE^{-0.612*}$ 29.42 (USD/PE) – 98.92 (USD/PE)**	High	Medium Ccw = 69853$\cdot PE^{-0.996}$ Ce = 96716$\cdot PE^{-0.9989}$	Medium	Fair	Medium	Low	Medium	High
	Operational & Maintenance Cost (US$ /PE)	Medium/High	Medium	Medium	Medium	Medium	Medium	Low	Low	Medium/High
	Technical Operator Skill	Moderate Level	Moderate Level	Moderate Level	Lower Level	Lower Level	Lower Level	Lower Level	Lower Level	Moderate Level
Supporting Criteria	Ability to Handle Flow Variation	Fair	Good	Good	Good	Good	Good	Good	Good	Fair
	Ability to handle influent quality variation	Good	Fair	Fair	Poor	Good	Good	Fair	Good	Good
	Ease of construction	Easy	Very Easy	Easy	Easy	Easy	Very Easy	Very Easy	Very Easy	Easy
	Ease of Operation	Medium	Medium	Medium	Fair	Fair	Fair	Fair	Fair	Medium
	Energy Type	E/M	E/M	E/M	Natural	Natural	E/M	Only For Pumping	Natural	E/M
	Nitrogen Removal	Good	Good	Partly	Low	Low	Partly	Partly	Partly	Good
	BOD Removal	Good	Good	Good	Good	Good	Good	Fair	Good	Good
	Air Pollution	VOCs	Odor	Odor	Gases (CO_2, Methane)	Gases (CO_2, Methane)	VOCs	Odor	Odor	VOCs

Regional Policy Recommendation

Regional Policy Recommendation on Domestic Wastewater Management

Regional "ONE VISION" in each Policy Domains of Integrated Domestic Wastewater Management

Based on the sub-thematic group discussion held during the 1st Regional Policy Dialogue in January 2020, participated by the Country Task Force team members as representatives of the respective countries, the following regional vision, policy interventions, regional context and potential regional programs were identified.

• Technological development for decentralized domestic wastewater treatment systems

Vision: Fulfill technological needs for decentralized domestic wastewater treatment systems for integrated domestic wastewater management

Policy interventions:

· Appropriate legislation and institutional arrangements (including Private-public partnership) for identifying and supporting the needs of technology for decentralized domestic wastewater management are identified to be necessary at both national and local government level.

· Availability of the appropriate technology that is suitable for the local context in the ASEAN countries is essential factor.

· Public awareness must promote the usage of appropriate technology.

• Policy coordination on domestic wastewater management master plan

Vision: Reliable wastewater treatment system that is accessible to everyone

Policy interventions:

· Institutional framework including regulation and its enforcement are identified to be a key factor.

· To build financial mechanism such as national government subsidies system for local government,

appropriate fee collection system on user's fee, and the private and public partnership framework to enable the investment of the private sector in this issue.

· Awareness and education to the residents are also important to ensure the accessibility to sanitation and clean water in their community.

• Potential financial mechanism and fee collection

Vision: Towards transparent, sustainable and affordable financing mechanisms for decentralized domestic wastewa ter system in ASEAN

Policy interventions:

The following policy measures are identified to realize the above vision.

· Government continues to provide funds and subsidies for decentralized domestic wastewater treatment system
· Promote Public-Private Partnership (PPP) for investment and the operation and maintenance (O&M) with different modalities
· Establish a master plan for wastewater management including central treatment plants and decentralized domestic wastewater treatment system
· Introduce Polluter Pay Principle/beneficiaries pay principle by developing tariff setting mechanism
· Introduce joint billing system (such as water supply and wastewater)
· Establish “sanitation fund” (capex and opex)
· Develop rules and regulations for desludging services considering the whole sanitary service chain
· Facilitate the introduction of local technologies and capacity building

• Policy implementation and capacity building at the local government level

Vision: Ensure the National Level Policy implementation through Multi Stakeholder Involvement at National and Local Level for Safely Managed Domestic Wastewater

Policy interventions:

· Providing strong ordinances (Includes Disincentives Measures) and ensuring its implementation is important both on incentives and disincentives.
· Providing incentives to the local government that has good performance of services (through financial and/or professionals support).
· Providing incentives to the household that applying Standardized Septic Tank and got the Septic Tank Desludged is enhanced to increase an awareness.
· Creation of institutional structure enables conveyance of the policy not only at the national level but also at the local government level.
· The Decentralized domestic wastewater management services chain should be managed by an institution/operating unit and the scheduled desludging by the operator units should be managed by the operator units and regulated.
· To ensure every local government has a database of the treatment technology applied to every household.
· The database of the treatment technology should be managed by institutions and included in the policy. On financial policy measures, payment upon service rendered is the way to gain more understanding by the users of the domestic wastewater treatment system.
· Implementation of Data Privacy Act (Philippines), Privatisation Issue and Unsuccessful initiatives (Thailand), Level of Community Awareness on Needs of Scheduled Desludging, Existence of Traditional or Primitive System - not Standard /unregulated.

- **Standardization on treatment performance testing method for decentralized domestic wastewater management**

Vision: Be accessible to reliable products of decentralized domestic wastewater treatment technology by the harmonized testing protocols in ASEAN member states

Policy Interventions:

Followings have been identified as important policy interventions.

· Prioritizing decentralized domestic wastewater treatment and fecal sludge management as "Key/ integral Parts" in achieving SDG6
· Harmonization of effluent standard parameters and analytical methods
· Establishment of certification and endorsement system for the products
· Public awareness raising
· Capacity development (both end-users and local government)
· Manufacturers registration and inspection of the product in the operational stage

Hub Function for Continuous Networking of the Regional Stakeholders on Domestic Wastewater Management

Continuous networking of the stakeholders on domestic wastewater management in ASEAN region is proposed to establish inheriting the multi-stakeholder's network from the PoDIWM project are proposed. It will enhance the data collection and knowledge and information sharing on the credible and updated timely wastewater and sanitation data in ASEAN, which will inform policy-makers as a basis of evidence-based decision-making in respective countries and to provide numerous social, economic and environmental benefits in both public and private sectors. This network will be consulted of the National Focal Points plus the Focal Points especially working on the issue of wastewater management in respective countries. The sub-working group will be a platform to consult among the ASEAN Member States and interested Development Partners which are interested in supporting the Member States in this issue, to enhance the management of the domestic wastewater including septage more safely and appropriately. The group will also report back to the AWGWRM main body the updated status of upcoming projects, regional activities, etc. and to seek for according to the advice on issues related to domestic wastewater. The sustainable hub function will be organized thorough the certain platform which shall be developed in the upcoming phase of the project.

Roadmap for Appropriate Domestic Wastewater Management in ASEAN Region

1. Supporting the Appropriate legal and policy framework on domestic wastewater management	Relevant target by 2030
To develop concrete National legislation system on building permission, effluent/environment standards,	Overall SDG 6
To prioritize decentralized domestic wastewater treatment and fecal sludge management as key factor in achieving SDG 6	Overall SDG 6
To enforce to design the domestic wastewater management system as a part of master plan of urban development	6.b.1
To make proper zoning of decentralized and centralized management	
To develop the local regulation on black water, fecal sludge, and graywater	
To prepare the advocacy and rewards for local government	
To support the framework that keeps the integrated the multi-stakeholder governance approach going, including the coordination with national and Local gov.	Overall SDG 6
To develop regulations for desludging services considering the whole sanitary service chain	6.3.1
2. Helping to improve the financial obstacles	
To mobilize the budget into sanitation field	6.a.1
To enhance the PPP scheme, that also legalize the existing informal service provider	6.b.1
To show clear Incentives of local government by clear indication of PSC and VFM	
To Introduce beneficiaries pay principle by developing tariff setting mechanism	6.b.1
3. Identifying and supporting technological needs for decentralized domestic wastewater management	
To establish the monitoring system with transparent information sharing.	6.b.1
To harmonize effluent standard parameters and analytical methods	
To publish the manual of design and O&M for domestic wastewater treatment systems	6.3.1
To prescribe performance standards of the decentralized treatment systems and engineers	6.3.1
To establish the certification and endorsement system for the treatment system	
To establish manufacturers registration and inspection of the product in operational stage	
To increase number of technical staffs to adapt the appropriate technology	
To built public and centralized sludge treatment center	6.3.1
To fix and upgrade the old existing systems	6.3.1
To develop the locally adaptable technology and its database and/or showcase	6.b.1
4. Supporting social inclusion and public awareness	
To prepare welfare tariff system and house development policy to support vulnerable people	6.2.1
To promote the knowledge sharing and expertise exchange for local practitioner to understand the appropriate domestic wastewater management	6.3.1
To disseminate the community for appropriate management of the plant and the fee collection	6.b.1

Testimonial

The ASEAN Member States are experiencing high and fast urbanization, increasing our major cities' load, including our water condition. The provision of sustainable urban water and wastewater management is essential to support safer, inclusive, and resilient human settlements. Decentralized wastewater management is widely known as a tool for providing safe wastewater management, bridging the gap between onsite systems and conventional centralized systems.

The implementation of Policy dialogue and network building of multi-stakeholders on integrated decentralized domestic wastewater management in ASEAN countries (PoDIWM) Project allows us to exchange challenges and solutions in managing wastewater to provide clean and safe water sanitation in AMSs. I want to emphasize that multi-stakeholders collaboration in managing decentralized wastewater management is a fundamental tool in implementing the project. I hope the project can further strengthen the water and sanitation collaboration among the ASEAN Member States in the future.

Even though, during the implementation of this project, we are facing a Covid-19 pandemic. I appreciate the implementation team's adaptability and commitment to implementing the project. Allow me to express the appreciation for all the ASEAN Member States that already collaborate and contribute during the PoDIWM Project implementation. Moreover, I would sincerely address my gratitude to the National Institute of Environmental Studies - Japan, the ASEAN Secretariat, and the Directorate of Sanitation, Directorate General of Human Settlements, Ministry of Public Works and Housing for implementing this project smoothly.

Regards,

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