Cebu City

Pilot Survey for Disseminating SME's Technologies for Applicability of Dewatering Equipment for Septage Management of Cebu City

Summary Report

January, 2016

Japan International Cooperation Agency (JICA)

AMCON, INC.

1. BACKGROUND

Insufficient sewage treatment and disposal causes water quality to decline in urban areas, which negatively impacts human health, the economy, and the environment in the Philippines. The coverage rate of the public sewerage network in the Philippines is as low as 10%, and about 80% of households are thought to be using septic tanks. Septage, which is the sludge that accumulates in the septic tanks, is not extracted regularly and causes serious pollution to public water bodies and groundwater. As a result, approximately 10,000 people die from diarrhea annually and 18 people are affected by water-borne disease each day in the Philippines.

Although Local Governmental Units (LGUs) and Water Districts (WDs) are responsible for establishing treatment systems for domestic sewage and septage according to the Clean Water Act of 2004, this has been barely achieved at the moment and Cebu City, the second largest city in the Philippines, is no exception. In response to this situation, Department of Public Works and Highways (DPWH) developed National Sewerage and Septage Management Program (NSSMP) which selected 17 Highly Urbanized Cities (HUCs) that need urgent investments in their septage and sewerage management programs. Not only Cebu City, but also cities around Cebu such as Mandaue City and Lapu-Lapu City are included among these 17 priority cities.

Before the project starts, in Cebu City progress has been made towards the establishment of septage management. The establishment of septage management mechanisms and constructions of a septage treatment plant have been identified as top priority issues by the Solid Waste Management Board and a proposed city septage management ordinance was being discussed in the city assembly. However, due to a lack of technical and financial capability, septage management in Cebu City had not been effectively dealt with at that time.

On the other hand, Cebu City and Yokohama City signed the Memorandum of Understanding on Technical Cooperation for Sustainable Urban Development and agreed on cooperation in various fields to put this into practice. As part of this city partnership, Cebu City recognized that maintaining a hygienic environment in public water bodies, water quality conservation, and septage management are pressing environmental issues to be addressed. In this situation, Yokohama city considered that the dewatering equipment of AMCON, INC., which is headquartered in the city, would be contributing to tackle this problem.

Based on Cebu City's recognition of its environmental challenges and Yokohama City's recommendation to introduce dewatering equipment for septage management, AMCON, INC. has conducted a pilot run of the dewatering facility under the "Feasibility Survey and Pilot Project for Disseminating SME's Technologies to Developing Countries under the Governmental Commission on the Projects for ODA Overseas Economic Cooperation in FY 2012" supported by the Ministry of Foreign Affairs of Japan. The pilot study has confirmed the technical effectiveness and feasibility of this and laid the foundation for the further exploration for a longer term.

2. OUTLINE OF THE PILOT SURVEY FOR DISSEMINATING SME'S TECHNOLOGIES

(1) Purpose

In this Survey, the technical feasibility of AMCON's dewatering equipment was evaluated over a longer period and larger scale. In addition to this, institutional, administrative, and financial arrangements are also required for more proper septage management in Cebu City. Considering these aspects, the following items were studied in this Survey:

- The applicability of dewatering equipment for septage treatment
- Institutional frameworks and financial and organizational arrangements
- Capacity development for proper septage management
- Septage treatment plant model development

(2) Activities

■ Construction and operation of a septage treatment plant

- Build a pilot septage treatment plant utilizing the existing unused sewerage treatment plant.
- Prove the usability of the pilot septage treatment plant and effectiveness of the compost made from sludge cake by continuous operation of the plant.
- Provide instruction on operation and maintenance methods, and develop operation and maintenance manuals for the plant by reflecting on the results and lessons learned from the operation during the survey.
- Study the maintenance of septage collection trucks in the city by working with private septage collection companies.

■ Enhancement for septage management mechanisms

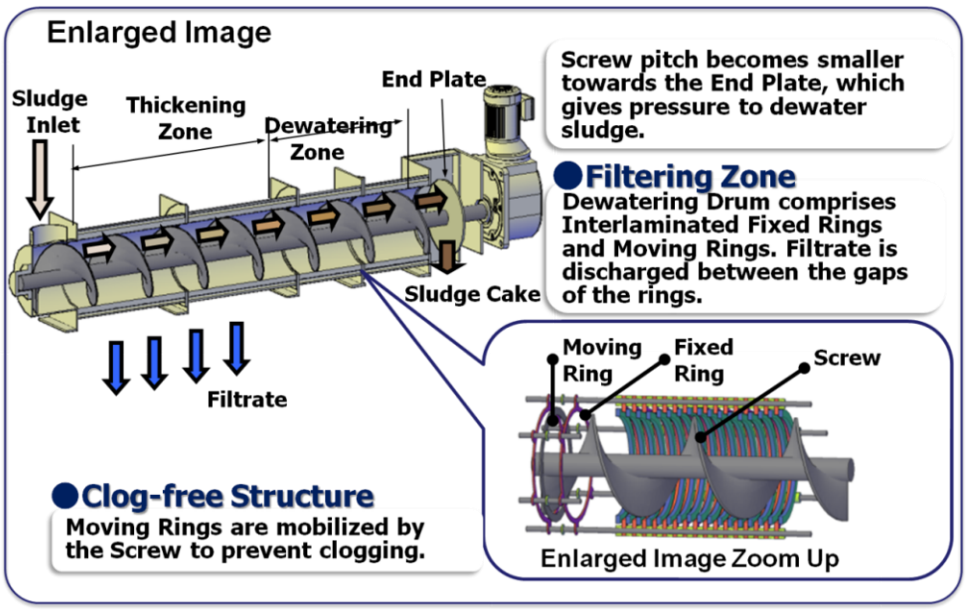
- Develop septic tanks inventories in several selected areas in the City and support the implementation of regular septic tank cleaning at residences and offices based on the inventories.
- Conduct training sessions in Japan for capacity development for the members of Cebu City.
- Propose and instruct the treatment charge collection system.

■ Information dissemination and awareness-raising activities

- Based on the lessons learned from the survey activities above, seminars are held for government agencies, surrounding municipalities, and the private sector.

(3) Information on the Products and Technologies to Be Provided

Volute is a type of proposed dewatering equipment for septage treatment in this project. This technology has various unique features and can offer many technological advantages, including providing a clog free solution for the dewatering process which other common technologies such as belt press and screw press types cannot provide. This is possible through the patented Volute Dewatering Press, which has unique cylinders structure as shown in the diagram below. With this unique structure, Volute can also provide various economic benefits such as lower electricity and water consumption than other dewatering devices, and environmental benefits such as less solid content leaking to the filtrate water. In addition to this, Volute has other advantages for instance sludge treatment without the use of a thickening tank, low burden for maintenance, correspondence from high sludge concentration to low sludge concentration, energy-saving (saving about 20% from other equipment), unattended operation, compact size, and lower costs.



These innovative features have made AMCON's Volute dewatering press widely accepted in various countries (2,689 Volute machines have been introduced in 63 countries as of December, 2015). In Japan, joint research conducted between AMCON and the Japan Sewage Works Agency verified its applicability to direct sludge dewatering from oxidation ditch tanks and entire unattended operation, and therefore it is recommended as suitable equipment for small-scale sewage treatment plants. At present, 1,100 machines have been introduced in municipalities in Japan. The feasibility study and pilot project conducted by the joint venture of AMCON and EXRI in 2013 also showed its effectiveness when it comes to the septage collected in Cebu City.

Considering the amount of septage generated in Cebu City of 80m^3/day (maximum), Volute

ES-303 was selected for this survey. Volute ES-303's capacity is 10m^3/hr and considered to be able to handle 80m^3/day. It is compact with a size of 3,605mm (L), 1,590mm (W), and 1,555mm (H) as shown below.

(4) Counterpart Organization

Cebu City Government

(5) Target Area and Beneficiaries

Cebu City and its citizens.

(6) Duration

About 25 months from January 2014 to January 2016

(7) Progress Schedule

			Activities	2014												2015											
				1-1			1-2			1-3			1-4			2-1			2-2			2-3			2-4		
				1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Socio Environmental Consideration	A		**Socio Environmental Survey**																								
		A1	Coordination with concerned agencies																								
		A2	Baseline survey and monitoring planning																								
		A3	Monitoring																								
		A4	Endline survey																								
Operation of Pilot Septage Treatment Plant	B		**Construction of Pilot Septage Treatment Plant**																								
		B1	Survey of existing condition																								
		B2	Facility planning and design																								
		B3	Coordination with concerned agencies																								
		B4	Construction management																								
	C		**Test Operation and Unveiling**																								
		C1	Test operation																								
		C2	Unveiling and operation start																								
	D		**Operation and Maintenance**																								
		D1	Operation and Maintenance Manual																								
		D2	Monitoring																								
		D3	Composting of sludge cake																								
Septage Management System Survey and Information Dissemination	E		**Septage Management System**																								
		E1	Current status of septage management in Cebu City																								
		E2	Coordination with concerned agencies on project component																								
		E3	Discussion Meeting with Cebu city																								
		E4	Septic tank inventory development																								
		E5	Japan study tour																								
		E6	Financial analysis and institutional arrangement																								
		E7	Recommendation for sustainable septage management planning																								
	F		**Information Dissemination**																								
		F1	Seminar for national and local governments																								
Varidation of outcome																											
Final Report																											
Final Report Submission																											▲

Activities in the Philippines Activities in Japan

(8) Manning Schedule

Role	Name	Organization	2014												2015												TOTAL	
			1-1			1-2			1-3			1-4			2-1			2-2			2-3			2-4					
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	PHL	JPN
Head	Kazuo KANEKO	AMCON																								0.13	0.13	
Project Manager	Seiji KIKUCHI	AMCON	0.20	0.27	0.20	0.13	0.23	0.27	0.07	0.33	0.30		0.30	0.30	0.30			0.20			0.27	0.13	0.23			0.27	3.70	0.30
Market Research	Yuichi HIROSE	AMCON																			0.13					0.17	0.30	
Equipment Maintenance	Yukinobu SANO	AMCON						0.13																	0.13		0.26	
Project Manager	Yusuke SUZUKI	AMCON	0.20	0.27	0.20	0.40		0.27	0.07	0.30			0.30		0.30			0.20			0.13	0.33	0.13		0.03	0.40	3.23	0.30
Design and Installment	Yosuke HAMADA	AMCON	0.20	0.03	0.07	0.40				0.33																	1.03	
Chief Advisor	Junya KIKUHARA	EXRI		0.23		0.13		0.17			0.30		0.20					0.20			0.30		0.17	0.25	0.05		1.40	0.70
Septage Management Advisor	Ryo HIRAGA	EXRI	0.20	0.03	0.03	0.13		0.200			0.330					0.23		0.23			0.20		0.23			0.20	2.03	0.00
Policy Advisor	Masato OHNO	EXRI		0.233				0.133													0.20		0.10	0.10		0.20	0.77	0.20
Coorinator	Toru SHIMAKAGE	EXRI		0.23																							0.23	0.00
Technical Advisor	Taiji TSURUTANI	EXRI	0.20	0.27		0.33	0.27	0.20					0.10		0.23			0.20			0.20		0.17			0.20	2.27	0.15
Septage Management Advisor	Nao TAKEUCHI	EXRI	0.20	0.03	0.20	0.40	0.47	0.33				0.23	0.50		0.33	0.23		0.23			0.20		0.23			0.20	3.30	0.55
Capacity Development	Makoto YAMASHITA	EXRI		0.17									0.05														0.17	0.05
																											AMCON Total	8.65	0.6
																											EXRI Total	10.17	1.7
																											Total		21.07

Activities in the Philippines

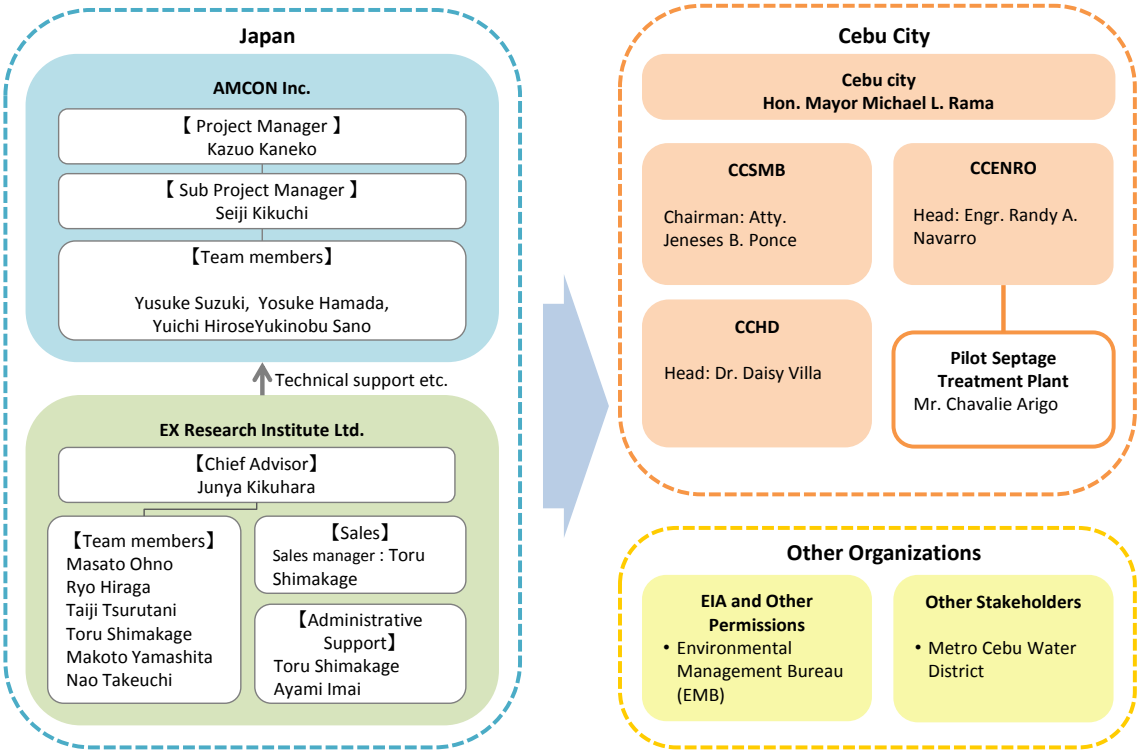
Activities in Japan

(9) Implementation System

This project was implemented under the cooperation of both Japan and the Philippines. On Japanese side AMCON, INC. led the project with technical and administrative support provided by EX Research Institute Ltd. At the beginning of this project, the Department of Public Services (DPS) of Cebu City Government was responsible for septage management issues, and therefore the Japanese side worked together with DPS.

However, in July 2014, Cebu City passed the Septage Management Ordinance and the Cebu City Environmental and Natural Resources Office (CCENRO) was established as a department that deals with septage management. Engr. Randy A Navarro, the former DPS vice head was appointed as head of CCENRO. In addition, the Cebu City Septage Management Board (CCSMB) was created and Atty. Jeneses Ponce was appointed as its chairman. Since then, this project has been mainly implemented with CCSMB and CCENRO. In June 2014, the pilot septage treatment plant was built and began operating. Mr. Chavalie Arigo was appointed manager of the pilot septage treatment plant, and therefore direct capacity development for the operation of the plant was mainly conducted for this manager and the operators who work under him. Cebu City Health Department was also involved in the implementation of the septic tank inventory development.

Further, communications was maintained and information was collected from the Environmental Management Bureau regarding EIA and other environmental permission, as well as with Metro Cebu Water District (MCWD) regarding septage management issues. The implementation structure is shown below.



3. ACHIEVEMENT OF THE SURVEY

(1) Outputs and Outcomes of the Survey

1) Construction and Operation of a Septage Treatment Plant

a) Construction of the Pilot Septage Treatment Plant

Construction was carried out and completed over the schedule below of a pilot septage treatment plant, including the installation of septage intake tanks and sludge dewatering equipment, at the existing sewerage treatment plant within Cebu City.

Construction start date	Construction details
March 3, 2014	Treatment plant disassembly work, anti-seismic test
March 10, 2014	Construction of the septage intake tank
April 5, 2014	Dewatering equipment installation work, plumbing, and hard wiring
April 10, 2014	Start of a trial run for the dewatering equipment
June 16, 2014	Paving work
August 18, 2014	Construction work on the lagoon sluice section

Photo: Scenes from the installation of the dewatering equipment

b) Operation of the Pilot Septage Treatment Plant

From its subsequent operation, 34,000m^3 of septage has been treated from its cumulative 3,400 hours of operation thus far. This amount of septage would have been discharged directly into the environment without this project, therefore it could be said that this pilot survey contributed to reducing pollution in Cebu City. The pictures below show the lagoon and treated water of the pilot septage treatment plant in March and September 2015. The water in the lagoon and effluent is clear.

Photo: Lagoon and discharge from the pilot septage treatment plant
(Left: March 2015, Right: Septemeber 2015)

The table below shows the water quality monitoring results. The BOD values for the discharged water remained below the effluent standard of 100mg/L of BOD, or else slightly above this, except for the values from January 2015. The reason why the measured BOD and COD values in January are much higher than the effluent standard is because human waste from the portable toilets at the Sinulog Festival was dumped directly into the lagoon. Also, the change of the supervisor of the pilot septage treatment plant in June and the CCENRO head in September affected the flocculation management of the dewatering equipment and presumably affected the effluent BOD values in July and September, which are slightly higher than the effluent standard.

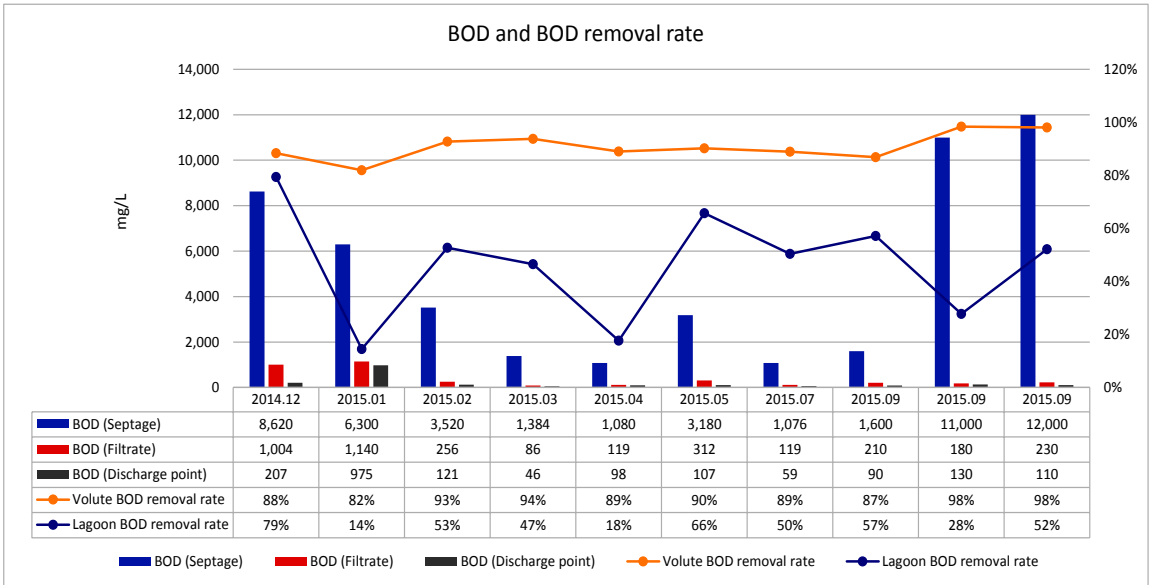
		2015							
		1	**2**	**3**	**4***	**7***	**9/15***	**9/18***	**9/20***
Septage	**TS**	3,830	2,332	3,160	12,500	27,060	14,800	42,600	40,400
	SS	450	850	263	11,040	26,860	11,869	38,000	34,100
	BOD	6,300	3,520	1,384	2,600	3,900	1,600	11,000	12,000
	COD	20,899	29,810	10,598	4,000	6,400	4,700	9,400	10,000
Filtrate	**TS**	5,524	3,030	3,486	140	340	4,800	1,500	1,800
	SS	400	1	1	40	320	620	80	120
	BOD	1,140	256	86	240	280	210	180	230
	COD	2,432	385	120	68	50	120	81	81
Sludge cake	**W/C (%)**	73.88	65.21	75.29	77	79.7	76.6	71.2	70.3
Discharge water**	**BOD**	975	121	46	70	110	90	130	110
	COD	1,176	202	73	53	79	79	89	80

*Monitoring values from April to September 2015 are analyzed in Japan. The COD values are lower than BOD because the analysis method for COD is different in Japan.

** The premise of the pilot septage treatment plant is classified to Class SC according to Administrative Order No. 35 1990. The effluent standard of COD is 200mg/L and BOD is 100mg/L.

The graph below shows the transition in the BOD removal rate of both the dewatering equipment and the lagoon. The BOD removal rate of the dewatering equipment hovered around 85 to 98%, while the BOD removal rate of the lagoon fluctuated and fell to less than 20% on occasions. This indicates that the dewatering equipment is effective in directly treating septage, though it takes time for the water quality of the lagoon to recover once it has been polluted. The fact that non-septage material was dumped in the lagoon during its pilot operation is believed to have affected the results in terms of the instability of the BOD removal rate for the lagoon as shown in the pictures below. Therefore, improvement measures were proposed that include thorough gate management, such as prohibiting the intermixing of raw night soil and industrial effluent, as well as enhancing aeration of the lagoon and constructing an artificial wetland.

Considering the fact that the effluent BOD level have hovered around the standard value of 100mg/L, this made it clear that if lagoon improvements, flocculation control, and gate management could be properly performed, then the effluent standards could be attained.



	2014.12	2015.01	2015.02	2015.03	2015.04	2015.05	2015.07	2015.09	2015.09	2015.09
BOD (Septage)	8,620	6,300	3,520	1,384	1,080	3,180	1,076	1,600	11,000	12,000
BOD (Filtrate)	1,004	1,140	256	86	119	312	119	210	180	230
BOD (Discharge point)	207	975	121	46	98	107	59	90	130	110
Volute BOD removal rate	88%	82%	93%	94%	89%	90%	89%	87%	98%	98%
Lagoon BOD removal rate	79%	14%	53%	47%	18%	66%	50%	57%	28%	52%

Fig: BOD and BOD removal rate of the dewatering equipment and lagoon

Sep 22, 2014

Oct 21, 2014 (After ketchup was dumped)

Jan 16, 2015

Feb 2, 2015 (After night soil was dumped)

Feb 28, 2015

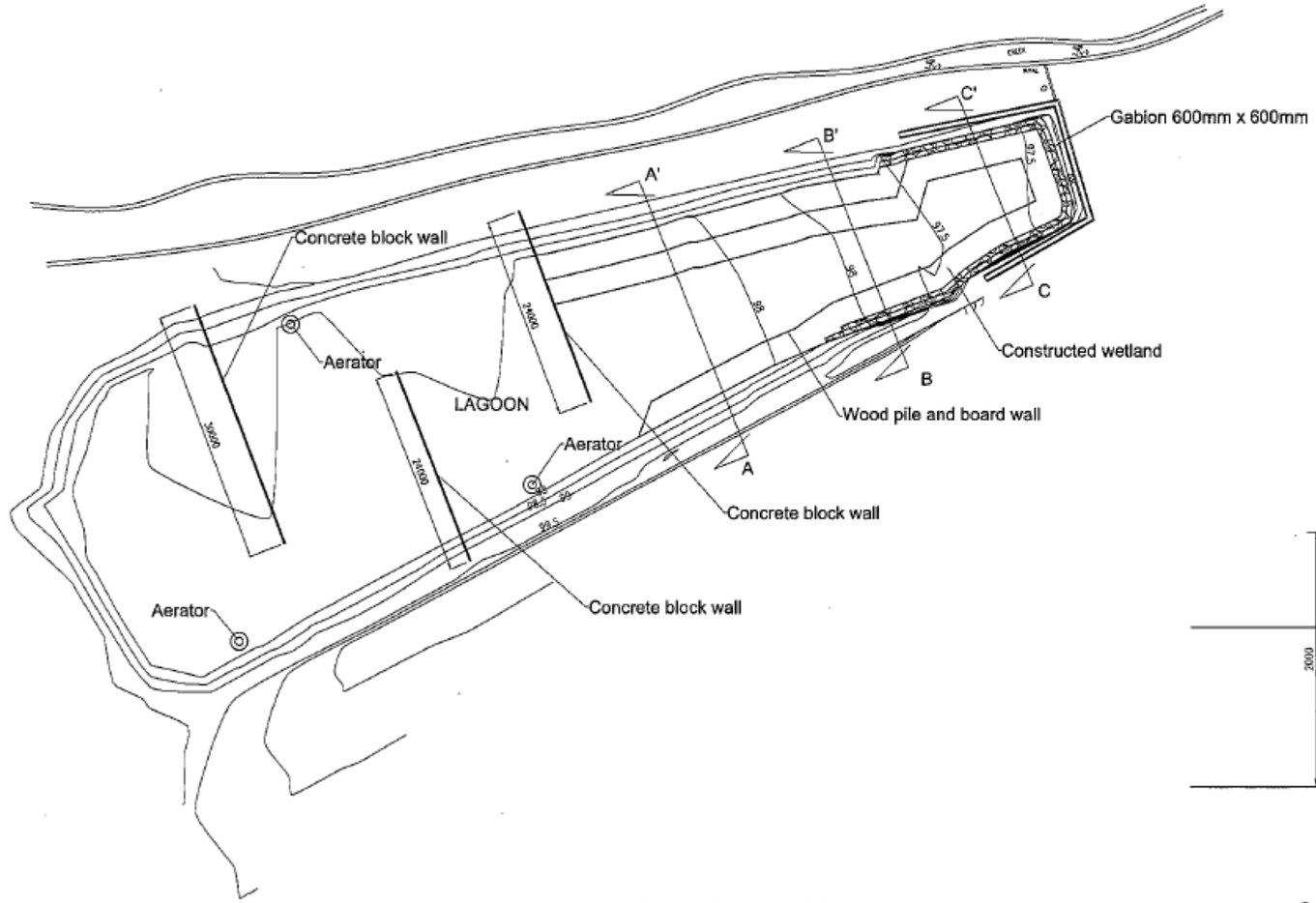
Mar 05, 2015

Apr 13, 2015

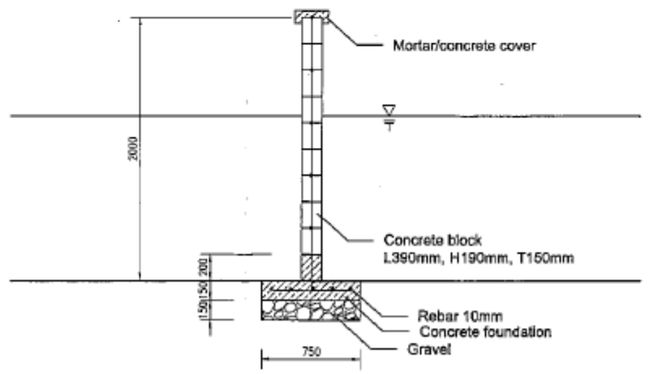
Jul 20, 2015 (After STP manager is changed)

Sep 14, 2015

Item	Amount
Concrete block wall	Height: 2m Total length: 78m
Aerator	2 units

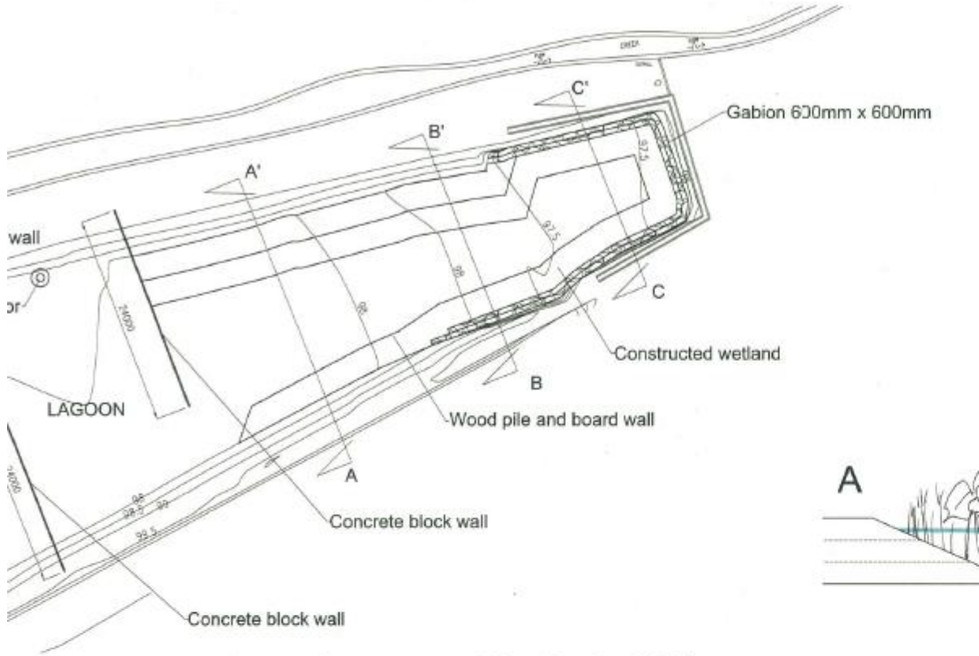


Lagoon Improvement Plan (Scale=1/300)



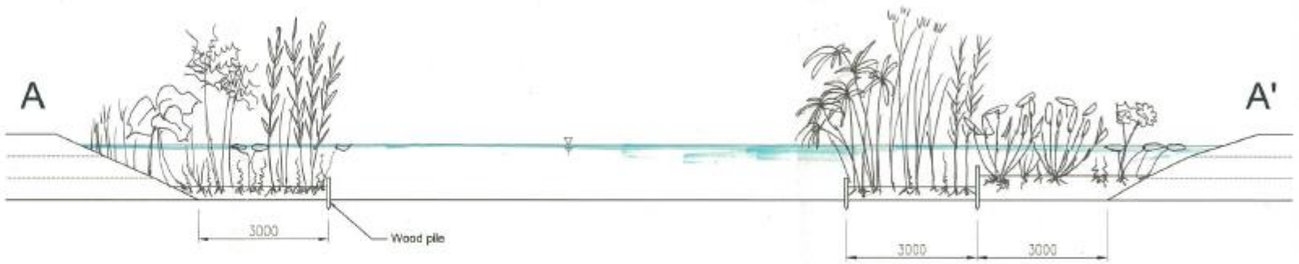
Concrete block wall section (scale=1/20)

Fig: Proposed lagoon improvement plan -1

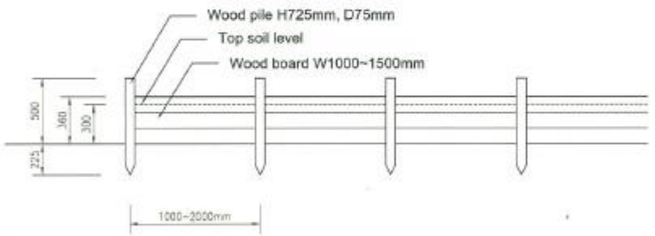


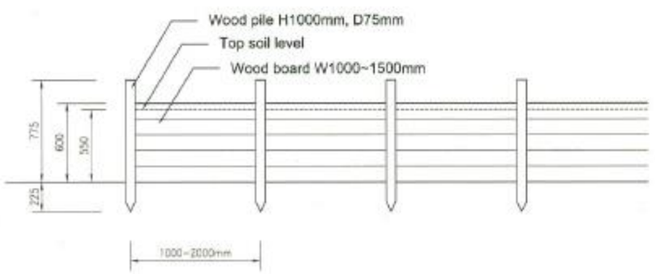
Lagoon Improvement Plan (Scale=1/300)

Item	Amount
Gabion 600mm x 600mm	Total length: 120m
Wood pile (D: 75mm, H: 725mm)	500
Wood pile (D: 75mm, H: 1000mm)	48
Wood board (H: 600mm, W: 1000-2000mm)	48m
Wood board (H: 360mm, W: 1000-2000mm)	500m

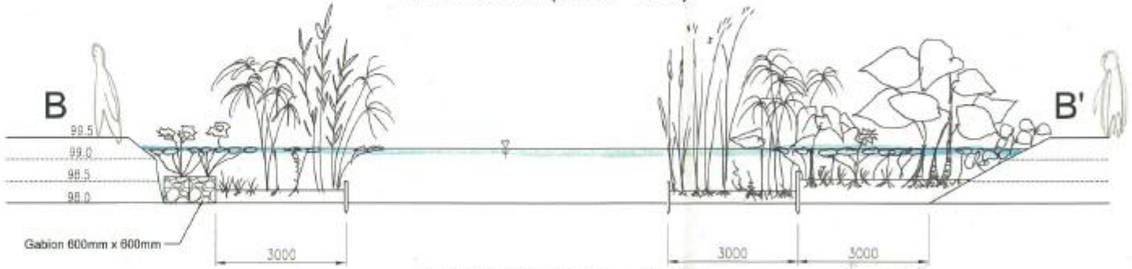


A-A' Section (Scale=1/60)

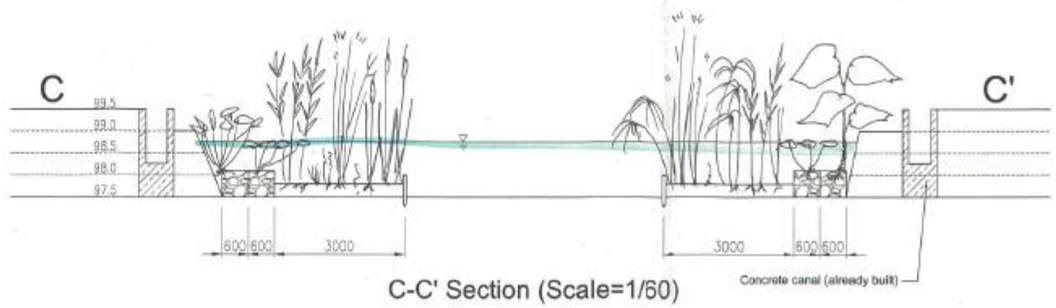




Detail section of constructed wetland (scale=1/20)



B-B' Section (Scale=1/60)



C-C' Section (Scale=1/60)

Fig: Proposed lagoon improvement plan -2

Other than the fluctuations in the water quality in the lagoon, several other issues arose during the pilot operation. The first is an issue with the cleaning water for the dewatering equipment. Since tap water's pressure was not sufficient enough a well was dug to supply water, but since this water contains salt it caused the machinery to rust. Thereafter, a deep well was dug out, but the water from this deep well also contains salt, and so the aforementioned issue has not been resolved.

Photo: Dewatering press become rusty and after providing protection (Aug, 2014)

Photo: Deep well and its water (July, 2015)

The second issue involves the perpetual clogging of the sludge feed pump. A pump with different specifications to what was initially planned was supplied, and solids that were larger than expected were found within the septage. As a result of these, the pump from the vacuum truck to the septage intake tank became clogged. A screen for the septage intake tank designed to remove these solids was proposed to Cebu City as a way to handle this, but the specifications of the tank that was installed differed from the proposed specifications. Therefore, it was recommended to Cebu City that a screen made by AMCON be installed and that two locally-sourced blowers be installed. As of December 2015, the screen made by AMCON was installed and blowers are planned to be installed by Cebu City.

Photo: Septage receiving tank temporarily placed to remove solids in septage and removed solids

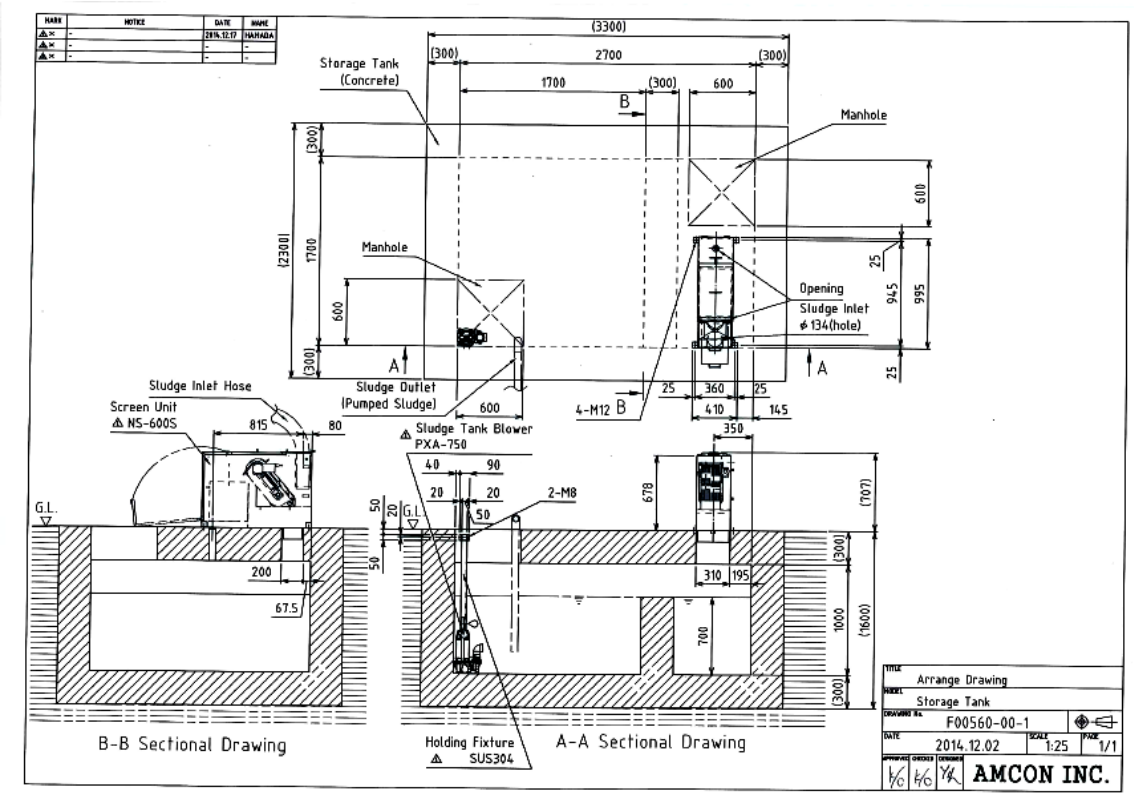
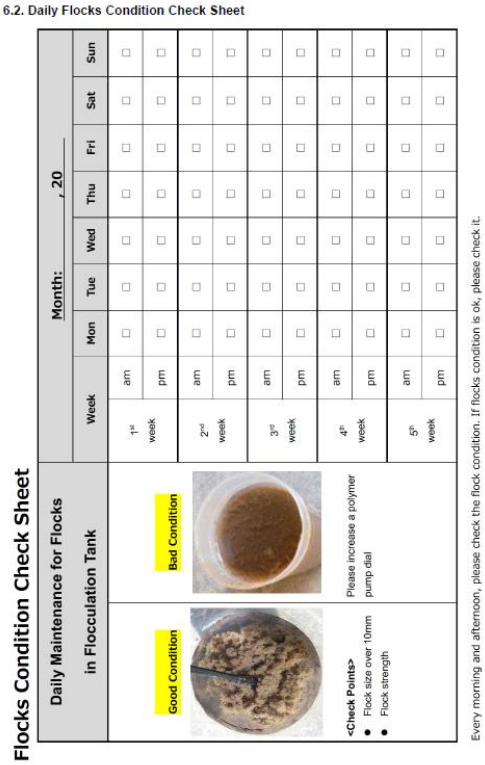


Fig: Drawing of the proposed septage receiving tank

The third issue is related to the operation and maintenance structure for the pilot septage treatment plant. In July 2014 CCENRO was established and the head was appointed, followed by the appointment of the plant supervisor. Also, the budget for the personnel costs for the six equipment operators for FY2015 was secured. However, the plant supervisor was replaced in July 2015 and the CCENRO head resigned in October 2015. Furthermore, many of the operators are short-term employees, so the most of the initial members were replaced. The transference of work in relation to these replacements was not handled adequately, resulting in a state of affairs in which many issues were arising for the plant's operation. Also, a form for recording the operating status was included

within the first edition manual, but they tend to fall behind on these records. In this way, right before the end of the pilot survey a problem for the facility operating structure arose.

In response to this, intensive training sessions were held for the newly appointed personnel, including new CCENRO head, the new plant supervisor, and new equipment operators in November and December 2015. In addition to this, the final edition of the operation manual was prepared and handed over to CCENRO. The final operation manual includes daily, weekly, and monthly operation management check sheets for two years for flocculation control, lagoon water checks, and odor checks that were recognized as challenges during the project period.



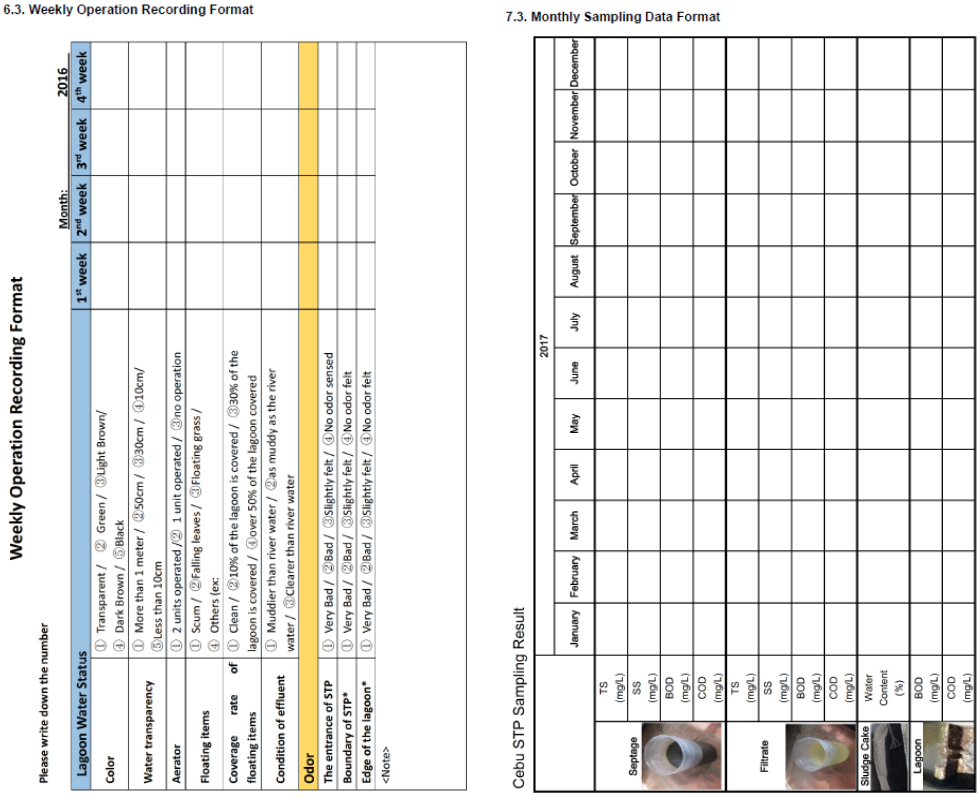


Fig: The Final-edition Operation & Maintenance Manual (Excerpt)

c) Composting of Sludge Cake

Initially, it was planned to use farm managed by Cebu City to compost sludge cake. However, they are no longer able to accept this sludge cake due to the insufficient lot size and the fact that the roadway there is frequently cut off due to flooding. Therefore, Cebu City suggested two proposed sites for composting, but given the weak facilities at both sites and the lack of access roads to allow the trucks transporting the sludge cake, we were unable to secure a composting site for the sludge cake.

Therefore, a constituent analysis was performed on the sludge cake, with the results indicating that they were 1.2% nitrogen, 0.93% phosphorous, and 8.2% potassium, meaning their net NPK is 10.33%. According to the composting test conducted by Japan Sewage Works Agency, it is known that net nitrogen reduction rate through composting is around 65%. Based on that, net NPK value after composting would be 3.8% that can attain the Philippines compost net NPK standard. While the feasibility of composting this could not be proven in this pilot study, if this can be properly composted then it could reach the level where it can be used as fertilizer.

2) Enhancement of Septage Management Mechanisms

a) Study on the Current Status of Septage Management in Cebu City

A study on the current status of septage management was carried out by visiting roughly 1,600 households in Cebu City. The study on the current status of septage management revealed that roughly 10% of the residents in urban barangays within Cebu City do not have septic tanks, and that even of those with septic tanks are less than 50% of them have had it de-sludged within the past five years. Based on this study, it was estimated that the amount of septage that can be collected within Cebu City's urban barangays is 150m^3/day. This can be handled via the current planned facility capacity of 200m^3/day.

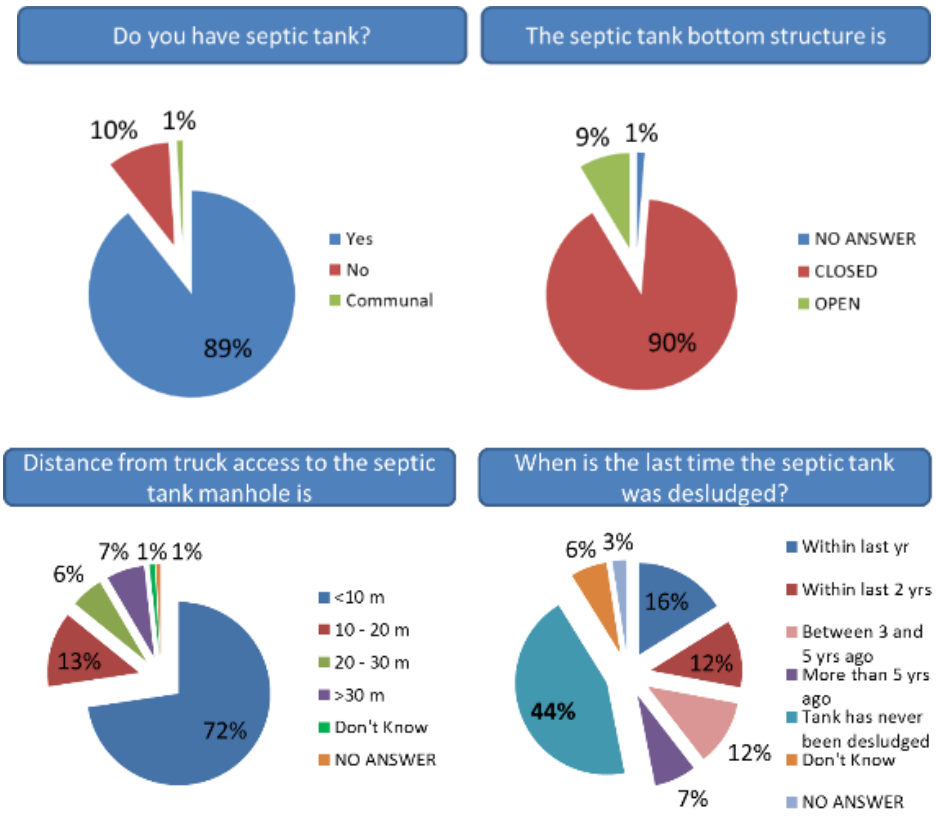


Fig: Results of the study on the current status of septage management (excerpt)

b) Septic Tank Inventory Development

A pilot septic tank study was carried out in Barangay Zapatera, which is one of the urban barangays in Cebu City. This study revealed that Cebu City has detailed health information inventories for each individual household in every Barangay. It came to light that these were collected from a health study on all of the children in the city conducted by CCHD (Operation Timban) and the health surveys for renewing business permits. Therefore, it is decided to add the septic tank related simple

four questions such as: (1) whether or not there are septic tanks, (2) the year they were installed, (3) the type of septic tank, and (4) whether they can be accessed by vacuum trucks. We proposed a system for collecting base data on septic tank inventories that included a division of roles between CCHD and CCENRO of Cebu City.

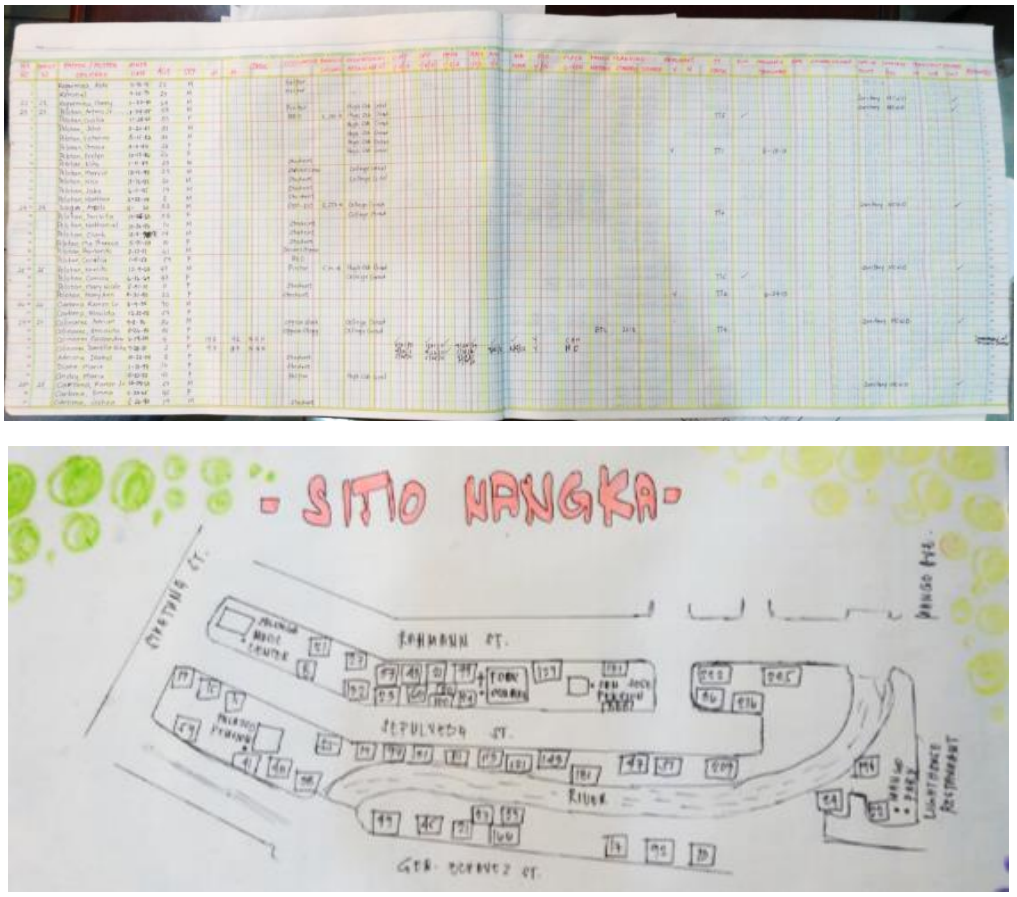


Photo: Health information for individual households maintained by each barangay

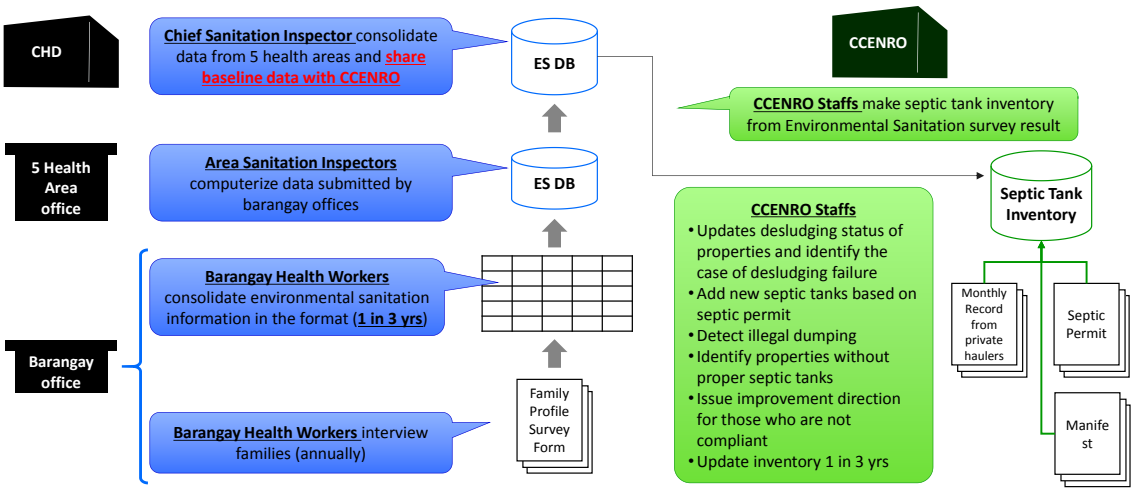


Fig: Proposed system on how to organize septic tank inventory data

Afterwards, a simple Excel form for organizing these inventories was prepared, and instruction was given to CCENRO staff members on how to organize the inventory data. So far, data on 23 barangays has been organized.

Fig: A scene from the instruction on organizing the inventories given to Cebu City staff members

Inventory Format of Septic Tank Information (Example)

ID	Name	Address	Tel. No.	Sitio	No. of Users	Type of Septic Tank
1	[redacted]	851-L Mabapo St. Mambaling Cebu City	[redacted]	Mabapo	7	Proper septic tank
2	[redacted]	851-L Mabapo St. Mambaling Cebu City	[redacted]	Mabapo	3	Proper septic tank
3	[redacted]	819-L Mabapo St. Mambaling Cebu City	[redacted]	Mabapo	5	Proper septic tank
4	[redacted]	819-L Mabapo St. Mambaling Cebu City	[redacted]	Mabapo	5	Proper septic tank
5	[redacted]	819-L Mabapo St. Mambaling Cebu City	[redacted]	Mabapo	5	Proper septic tank
6	[redacted]	851-L Mabapo St. Mambaling Cebu City	[redacted]	Mabapo	N/D	Proper septic tank
7	[redacted]	851-L Mabapo St. Mambaling Cebu City	[redacted]	Mabapo	6	Proper septic tank
8	[redacted]	851-L Mabapo St. Mambaling Cebu City	[redacted]	Mabapo	4	Proper septic tank
9	[redacted]	851-L Mabapo St. Mambaling Cebu City	[redacted]	Mabapo	N/D	N/D
10	[redacted]	851-L Mabapo St. Mambaling Cebu City	[redacted]	Mabapo	1	No facility
11	[redacted]	851-L Mabapo St. Mambaling Cebu City	[redacted]	Mabapo	3	Proper septic tank
12	[redacted]	851-L Mabapo St. Mambaling Cebu City	[redacted]	Mabapo	3	Proper septic tank
13	[redacted]	851-L Mabapo St. Mambaling Cebu City	[redacted]	Mabapo	3	N/D
14	[redacted]	Teves Compound Mambaling Cebu City	[redacted]	Teves Compound	2	Proper septic tank
15	[redacted]	Teves Compound Mambaling Cebu City	[redacted]	Teves Compound	6	Proper septic tank
16	[redacted]	Teves Compound Mambaling Cebu City	[redacted]	Teves Compound	5	Proper septic tank
17	[redacted]	Teves Compound Mambaling Cebu City	[redacted]	Teves Compound	6	N/D
18	[redacted]	Teves Compound Mambaling Cebu City	[redacted]	Teves Compound	5	Proper septic tank
19	[redacted]	Teves Compound Mambaling Cebu City	[redacted]	Teves Compound	6	No facility
20	[redacted]	Teves Compound Mambaling Cebu City	[redacted]	Teves Compound	4	Proper septic tank
21	[redacted]	Teves Compound Mambaling Cebu City	[redacted]	Teves Compound	8	Proper septic tank
22	[redacted]	Teves Compound Mambaling Cebu City	[redacted]	Teves Compound	5	Proper septic tank
23	[redacted]	Teves Compound Mambaling Cebu City	[redacted]	Teves Compound	6	Proper septic tank
24	[redacted]	Teves Compound Mambaling Cebu City	[redacted]	Teves Compound	5	Proper septic tank
25	[redacted]	Teves Compound Mambaling Cebu City	[redacted]	Teves Compound	3	Proper septic tank
26	[redacted]	Teves Compound Mambaling Cebu City	[redacted]	Teves Compound	3	Proper septic tank
27	[redacted]	Sitio Bayabas Mambaling Cebu City	[redacted]	Bayabas	7	N/D
28	[redacted]	Sitio Bayabas Mambaling Cebu City	[redacted]	Bayabas	5	Proper septic tank
29	[redacted]	Sitio Bayabas Mambaling Cebu City	[redacted]	Bayabas	5	Cess pool
30	[redacted]	Sitio Bayabas Mambaling Cebu City	[redacted]	Bayabas	3	Proper septic tank
31	[redacted]	Sitio Bayabas Mambaling Cebu City	[redacted]	Bayabas	3	Proper septic tank
32	[redacted]	Sitio Bayabas Mambaling Cebu City	[redacted]	Bayabas	4	Proper septic tank
33	[redacted]	Sitio Bayabas Mambaling Cebu City	[redacted]	Bayabas	6	Proper septic tank
34	[redacted]	Sitio Bayabas Mambaling Cebu City	[redacted]	Bayabas	5	Proper septic tank
35	[redacted]	Sitio Bayabas Mambaling Cebu City	[redacted]	Bayabas	6	Proper septic tank
36	[redacted]	Sitio Bayabas Mambaling Cebu City	[redacted]	Bayabas	10	Proper septic tank

Fig: Inventory in which data has been inputted -1

(the blacked out section contains personal information)

			Registered day				Type of septic tank	Accessibility
			Barangay name				Proper septic tank	Yes
Sitio	No. of Users	Type of Septic Tank	Construction year	Last time de-sludged	Access		Cess pool	No
Mabapo	7	Proper septic tank	1995	2005	Yes		No facility	N/D
Mabapo	3	Proper septic tank	2010	Never de-sludged	No		N/D	N/A
Mabapo	5	Proper septic tank	1990	Never de-sludged	No			
Mabapo	5	Proper septic tank	2010	2014	No			
Mabapo	5	Proper septic tank	1995	2014	No			
Mabapo	N/D	Proper septic tank	1990	2002	Yes			
Mabapo	6	Proper septic tank	1995	2001	Yes			
Mabapo	4	Proper septic tank	N/D	N/D	N/D			
Mabapo	N/D	N/D	1995	2006	N/D			
Mabapo	1	No facility	N/A	N/A	N/A			
Mabapo	3	Proper septic tank	1990	2005	Yes			
Mabapo	3	Proper septic tank	1998	2004	Yes			
Mabapo	3	N/D	1988	2012	Yes			
es Compound	2	Proper septic tank	1999	2001	Yes			
es Compound	6	Proper septic tank	1991	2013	Yes			
es Compound	5	Proper septic tank	1992	2005	Yes			
es Compound	6	N/D	1990	2001	Yes			
es Compound	5	Proper septic tank	2015	N/D	Yes			
es Compound	6	No facility	N/D	N/D	N/D			
es Compound	4	Proper septic tank	2012	N/D	No			
es Compound	8	Proper septic tank	2009	Never de-sludged	Yes			
es Compound	5	Proper septic tank	1980	2009	Yes			
es Compound	6	Proper septic tank	2010	Never de-sludged	Yes			
es Compound	5	Proper septic tank	2014	Never de-sludged	Yes			
es Compound	3	Proper septic tank	2015	Never de-sludged	Yes			
es Compound	3	Proper septic tank	2009	2013	Yes			
Bayabas	7	N/D	1986	Never de-sludged	Yes			
Bayabas	5	Proper septic tank	N/D	N/D	N/D			
Bayabas	5	Cess pool	1996	N/D	Yes			
Bayabas	3	Proper septic tank	1994	2001	Yes			
Bayabas	3	Proper septic tank	1992	2003	Yes			
Bayabas	4	Proper septic tank	N/D	N/D	Yes			
Bayabas	6	Proper septic tank	2013	Never de-sludged	Yes			
Bayabas	5	Proper septic tank	1989	2009	Yes			
Bayabas	6	Proper septic tank	2005	N/D	N/D			
Bayabas	10	Proper septic tank	1990	2015	N/D			

Inventory in which data has been inputted -2

Cebu City formulated septage management regulations via a system of collecting fees from private haulers using a manifest as records for septic hauling. But since the residents carry out de-sludging on a voluntary basis, and the amount of septage hauled fell by half owing to the fees charged to the private haulers, we proposed a systematic method for collecting septage that is based on the septic tank inventories to Cebu City.

Septic Tank to be De-sludged

Inventory Format of Septic Tank Information (Example)

							Registered day		
							Barangay name		
ID	Name	Address	Tel. No.	Sitio	No. of Users	Type of Septic Tank	Construction year	Last time de-sludged	Access
1	[redacted]	851-L Mabapo St. Mambaling Cebu City	[redacted]	Mabapo	7	Proper septic tank	1995	2005	Yes
2		851-L Mabapo St. Mambaling Cebu City		Mabapo	3	Proper septic tank	2010	Never de-sludged	No
3		819-L Mabapo St. Mambaling Cebu City		Mabapo	5	Proper septic tank	1990	Never de-sludged	No
4		819-L Mabapo St. Mambaling Cebu City		Mabapo	5	Proper septic tank	2010	2014	No
5		819-L Mabapo St. Mambaling Cebu City		Mabapo	5	Proper septic tank	1995	2014	No
6		851-L Mabapo St. Mambaling Cebu City		Mabapo	N/D	Proper septic tank	1990	2002	Yes
7		851-L Mabapo St. Mambaling Cebu City		Mabapo	6	Proper septic tank	1995	2001	Yes
8		851-L Mabapo St. Mambaling Cebu City		Mabapo	4	Proper septic tank	N/D	N/D	N/D
9		851-L Mabapo St. Mambaling Cebu City		Mabapo	N/D	N/D	1995	2006	N/D
10		851-L Mabapo St. Mambaling Cebu City		Mabapo	1	No facility	N/A	N/A	N/A
11		851-L Mabapo St. Mambaling Cebu City		Mabapo	3	Proper septic tank	1990	2005	Yes
12		851-L Mabapo St. Mambaling Cebu City		Mabapo	3	Proper septic tank	1998	2004	Yes
13		851-L Mabapo St. Mambaling Cebu City		Mabapo	3	N/D	1988	2012	Yes
14		Teves Compound Mambaling Cebu City		Teves Compound	2	Proper septic tank	1999	2001	Yes
15		Teves Compound Mambaling Cebu City		Teves Compound	6	Proper septic tank	1991	2013	Yes
16		Teves Compound Mambaling Cebu City		Teves Compound	5	Proper septic tank	1992	2005	Yes

Target septic tanks for hauling in Brgy xxx: properties with less than 10 users → Less than 10 → Only proper septic tank → More than 5 years ago → yes

Target septic tanks for hauling in Brgy xxx: properties with more than 10 users → More than 10 → Only proper septic tank → Between 3-5 years ago → yes

->Make a list of septic tanks for de-sludging

Septic Tank to be Reconstructed

Inventory Format of Septic Tank Information (Example)

							Registered day		
							Barangay name		
ID	Name	Address	Tel. No.	Sitio	No. of Users	Type of Septic Tank	Construction year	Last time de-sludged	Access
1	[redacted]	851-L Mabapo St. Mambaling Cebu City	[redacted]	Mabapo	7	Proper septic tank	1995	2005	Yes
2		851-L Mabapo St. Mambaling Cebu City		Mabapo	3	Proper septic tank	2010	Never de-sludged	No
3		819-L Mabapo St. Mambaling Cebu City		Mabapo	5	Proper septic tank	1990	Never de-sludged	No
4		819-L Mabapo St. Mambaling Cebu City		Mabapo	5	Proper septic tank	2010	2014	No
5		819-L Mabapo St. Mambaling Cebu City		Mabapo	5	Proper septic tank	1995	2014	No
6		851-L Mabapo St. Mambaling Cebu City		Mabapo	N/D	Proper septic tank	1990	2002	Yes
7		851-L Mabapo St. Mambaling Cebu City		Mabapo	6	Proper septic tank	1995	2001	Yes
8		851-L Mabapo St. Mambaling Cebu City		Mabapo	4	Proper septic tank	N/D	N/D	N/D
9		851-L Mabapo St. Mambaling Cebu City		Mabapo	N/D	N/D	1995	2006	N/D
10		851-L Mabapo St. Mambaling Cebu City		Mabapo	1	No facility	N/A	N/A	N/A
11		851-L Mabapo St. Mambaling Cebu City		Mabapo	3	Proper septic tank	1990	2005	Yes
12		851-L Mabapo St. Mambaling Cebu City		Mabapo	3	Proper septic tank	1998	2004	Yes
13		851-L Mabapo St. Mambaling Cebu City		Mabapo	3	N/D	1988	2012	Yes
14		Teves Compound Mambaling Cebu City		Teves Compound	2	Proper septic tank	1999	2001	Yes
15		Teves Compound Mambaling Cebu City		Teves Compound	6	Proper septic tank	1991	2013	Yes
16		Teves Compound Mambaling Cebu City		Teves Compound	5	Proper septic tank	1992	2005	Yes

Septic tanks that should be reconstructed in Brgy xxx: properties → Only proper septic tank → More than 25 years ago → yes

→ Cess pool & No facility → yes

->Make a list of septic tanks for reconstruction

Fig: Method for identifying septic tanks to be de-sludged using septic tank inventories and preparing lists

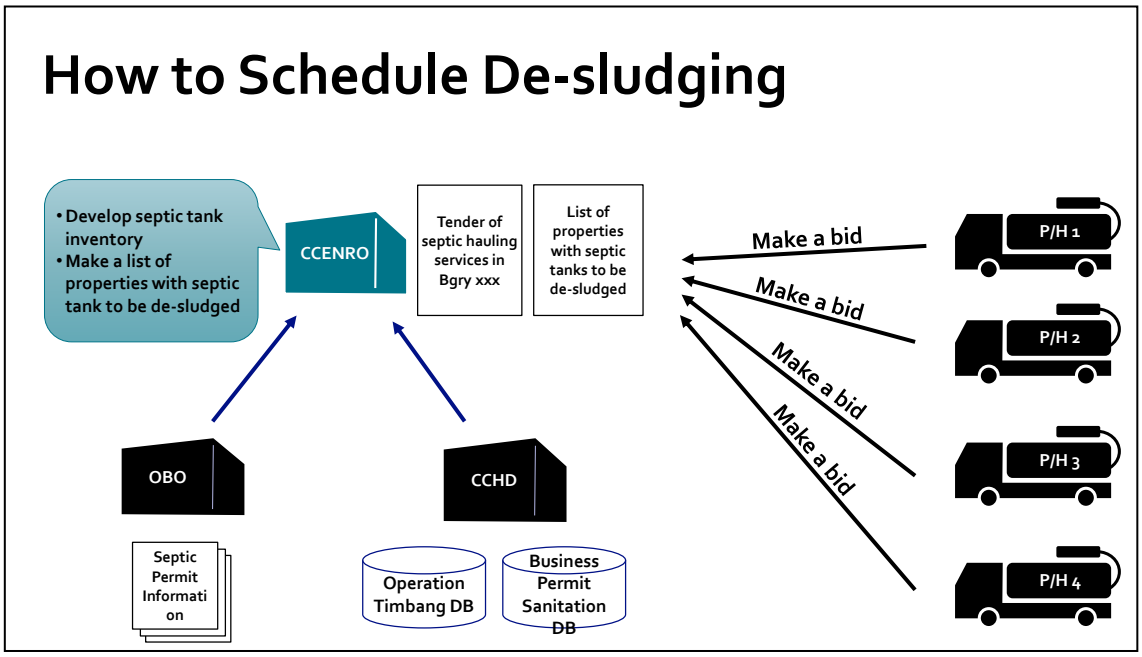


Fig: Tender system for private haulers based on the list of septic tanks to be de-sludged

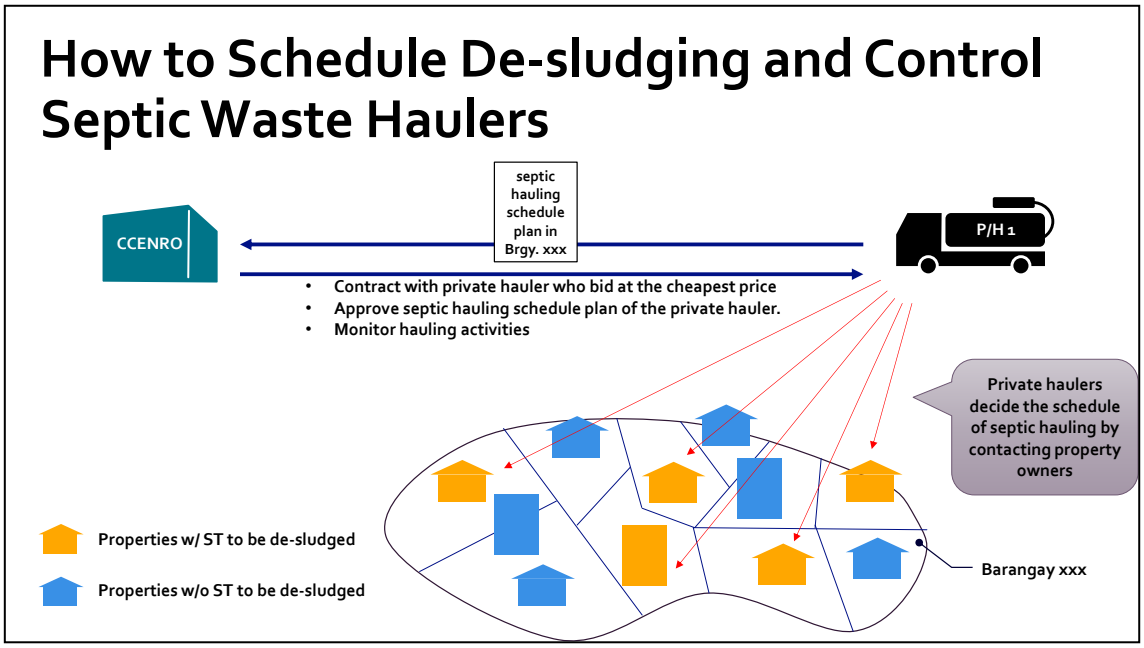


Fig: Method for managing private haulers based on the list of septic tanks to be de-sludged

c) Study Tour Program on Septage Management in Japan

Training was carried out in Japan in November 2014 in order for the counterparts to obtain useful knowledge and expertise regarding the issues posing challenges for the creation of a septage management system in Cebu City. The participants were Janeses B. Ponce, the Chairman of CCSMB,

Randy A. Navarro, the head of CCENRO, Daisy Villa, the head of CCHD, and Chavalie Arigo, the Plant Supervisor of the pilot septage treatment plant. The sites that they visited and toured and the contents of the lectures they heard are below.

Sites visited / toured	**Contents**
Yokohama City	・ History of waste and Johkasou sludge management administration in Yokohama City ・ Courtesy call on the Yokohama City International Technical Cooperation Division
Japan Education Center of Environmental Sanitation	・ History of night soil treatment in Japan ・ Japan's Johkasou sludge management system ・ Sludge collection, hauling, and treatment ・ Fee collection system ・ Trends surrounding inventory organization, legally-mandated tests, and de-sludging in Japan
Ebina Municipal Beautification Center	・ Johkasou sludge management system through broadly-based administrative associations ・ Onsite tours of de-sludging operations
Cleaning Facility Association of Kouza	・ Visit to a night soil treatment facility ・ Night soil treatment arrangement through broadly-based administrative associations ・ Johkasou sludge and night soil collection and hauling status ・ Fee collection system
AMCON equipment purchasers in Sodegaura City	・ Daily tasks related to operation ・ Daily tasks related to maintenance

d) Financial Analysis and Recommendation

Through this pilot project it was learned that improvements must be made for both hard and soft dimensions, including improving the treatment facilities and enhancing the septage management structure. Conditions have been set for each of three stages: (1) Present conditions, (2) Short-term feasible improvements, and (3) Comprehensive improvements and financial analyses have been performed according to these three conditions. Improvements details that should be carried out in the future have been organized together through the setting of the conditions as shown below.

Item	(1) Present conditions	(2) Feasible improvements	(3) Comprehensive improvements
Population	650,000		
No. of households	131,174		
Collection area	Urban barangays in Cebu City		
Operating hours	1,800 hours/year	1,800 hours/year	7,000 hours/year
Septage intake volume	60m^3/day	60m^3/day	200m^3/day
Amount of sludge cake generated	720t/year	720t/year	2,800t/year

Water supply	MCWD	MCWD	MCWD
Collection plan	No	No	Yes
Lagoon improvements	No	Yes	Yes
Compost facility	No	Yes	Yes
Intake tank	No	Yes	Yes
No. of sludge cake trucks	1	2	2
OPEX (pesos/year)	7,700,000	11,000,000*1	58,000,000*2
CAPEX (pesos)		23,000,000*3	23,000,000

*1: Includes maintenance costs such as for lagoon improvements, compost facilities, intake tanks, trucks, and more.
*2: In addition to the above, includes administrative costs such as septage collection costs, septic tank inventory management, and more.
*3: Includes lagoon improvements, compost facility construction, intake tank construction, and sludge cake transport vehicle purchases in with CAPEX.

Based on this, a comparison was performed on a case in which fees are collected from private haulers and a case where these are added to water charges.

Collection options	(1) Present conditions	(2) Short-term improvements	(3) Comprehensive improvements
Collected from private haulers (OPEX ÷septage intake volume)	425.15 pesos/m^3	587.19 pesos/m^3	N/A
Collected from water charges (OPEX ÷ No. of households)	58.34 pesos/year	80.58 pesos/year	439.55 pesos/year

The option of collecting fees from private haulers imposes higher financial burden to private haulers and therefore it is highly possible to lead de-sludging fee to hike. At present the de-sludging fee citizens pay is 2,500 – 3,000 pesos for one time de-sludging. Assuming the de-sludging volume is $3m^3$ for average households, private haulers would have to pay 1,300 pesos with (1) and about 1,800 pesos with (2) out of 2,500 -3,000 pesos. This would significantly impact their financial situation, and lead to circumstances where substantial rate hikes in the de-sludging fees are unavoidable. What is more, with options (1) and (2) systematic collection would not be carried out, the amount of septage de-sludged would remain as low as less than 50% because the residents de-sludge their septic tanks at voluntary base and therefore annual revenue will decline.

Conversely, in the case where the fees are added to the water charges, even with "(3) Comprehensive improvements" the price per household only goes up to 440 pesos/year (36 pesos/month). Assuming that the average household's water consumption is $24m^3$, this can be handled by water charge increases of 1.5 pesos/m^3.

3) Information Dissemination and Awareness-Raising Activities

On June 24, 2014, central government officials, Cebu City officials, administrative officials concerned with septage management from surrounding municipalities and HUCs, other people involved in the septage industry on the private sector side, and more were invited for the holding of an unveiling ceremony for the pilot septage treatment facility. At the event, speeches were given by the Mayor of Cebu City and the Assistant Director of the JICA Philippines Office. Close to 100 people participated in the unveiling ceremony, with awareness-raising activities carried out for the participants that were designed to improve their understanding of the characteristics of the dewatering equipment and their operating mechanisms.

Photo: Scenes of awareness-raising activities at the unveiling ceremony

Further, on December 10, 2015 a facility turnover ceremony together with a seminar to present the results of this pilot survey were held. Participants included Cebu City officials, DPWH, MCWD, and local media as well as a personnel member from the OECD Green Growth Study Team who happened to be in Cebu for their own study. In the seminar, presentations on AMCON's dewatering machine and the results of this pilot survey were carried out. In the presentation the effectiveness of the septage treatment model using AMCON's dewatering machine system was described together with the achievements and challenges of this pilot project. In addition, collaboration between MCWD and Cebu City in the septage management implementation was strongly emphasized based on the financial analysis result of this survey.

Photo: Scenes of turnover ceremony and presentation in the seminar

The septage treatment plant model (shown below) studied in this survey was presented. This can offer a solution for LGUs and WDs who look for inexpensive yet workable technology to treat septage. As our result of survey it was estimated that CAPEX of this model septage treatment plant with capacity of 200m^3/day is 80 million pesos, which is less than about two thirds of CAPEX of fully mechanized septage treatment plant. It was also calculated that the septage treatment and disposal cost of this model plant is about 300 pesos/m^3, which is about two thirds of average cost of 450 pesos/m^3/day.

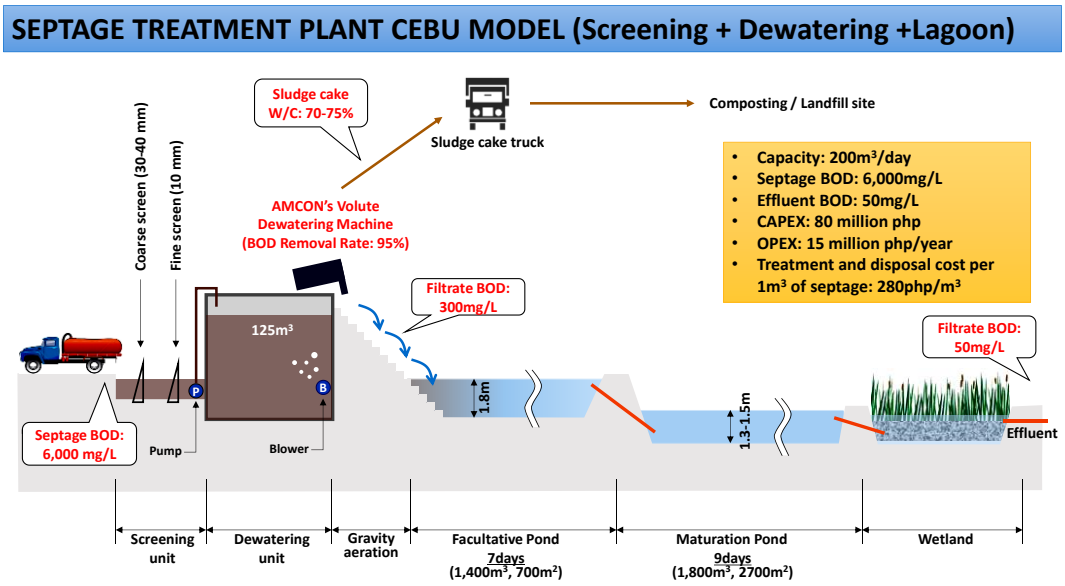


Fig: Septage treatment plant model using AMCON'sVolute + facultative and maturation pond

In addition to this, other septage treatment models using AMCON's Volute dewatering equipment combined with a sequence batch reactor (SBR) and aerated pond were developed as shown below. A table comparing different factors according to these technological options was also prepared.

SEPTAGE TREATMENT PLANT CEBU MODEL (Screening + Dewatering +Activated Sludge)

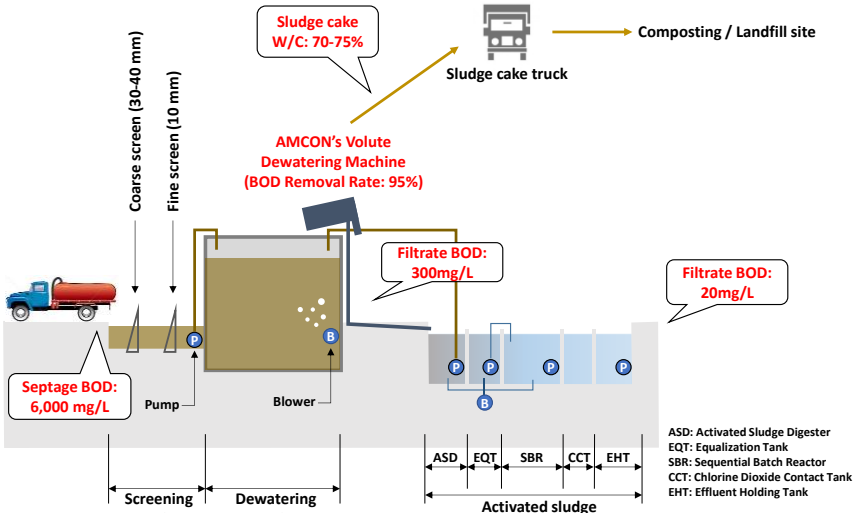


Fig. Septage treatment plant model using AMCON's Volute + combined with SBR

SEPTAGE TREATMENT PLANT CEBU MODEL (Screening + Dewatering +Aerated Pond)

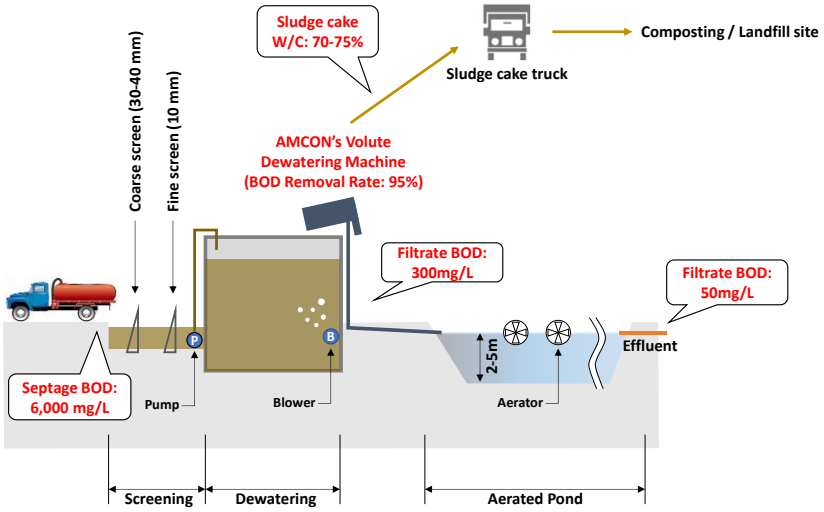


Fig. Septage treatment plant model using AMCON's Volute + aerated pond

Table. Comparisons of different Volute septage treatment plant models

Technological options	Land	Electricity	CAPEX	O&M difficulty	OPEX
Waste stabilization pond	Large	Low	Low	Easy	Low
Volute + Lagoon	Relatively large	Relatively low	Relatively low	Relatively easy	Relatively low
Volute + Aerated pond	Moderate	Moderate	Moderate	Moderate	Moderate
Volute + SBR	Small	High	High	Difficult	High

(2) Self-reliant and Continual Activities to be Conducted by the Counterpart Organization

1) Agreement among the Stakeholders concerning the Septage Management Leader

At this point in time, there has been different opinions between MCWD, MCDCB, and Cebu City regarding who will serve as the septage management leader in Cebu. MCWD has an F/S that was conducted via the Philippine Water Revolving Fund in 2008, and MCDCB recommends building a septage treatment plant as part of the sewage sub-roadmap of the Mega Cebu Roadmap. Cebu City played a leading role in guiding this survey, and a result of the financial analysis shows that collecting the septage collection and treatment costs by adding them to the water charges is the most sustainable option.

Moreover, the head of CCENRO who had previously received technical guidance, resigned and the Plant Supervisor who took part in study program in Japan, was replaced. What is more, the operators at the treatment plant are short-term employees. Owing to these factors, it can be said that a personnel structure that could ensure the sustainable operation of the plant is not fully established. In addition, despite the fact that Cebu City was urged to acquire CNC and obtain discharge permit that were necessary for the project, the city failed to handle this. Further, since the treatment plant cannot use water supplied from MCWD, a problem arose in which fresh water for cleaning the dewatering equipment could not be secured. As things currently stand, Cebu City could not be said to have adequate capabilities when it comes to the sustainable operation of this sort of pilot septage treatment plant.

At the same time, data has steadily been collected for the development of the septic tank inventory that was performed through this pilot survey and this can be used as invaluable initial data for systematically promoting septage management in the future. Moreover, it was learned that the data needed for the septic tank inventory can be collected efficiently over a short period of time by using Cebu City health surveys.

In light of the above, it is recommended that MCDCB, MCWD, and Cebu City will work together to make progress with planning and implementation for the sake of sustainable septage management. But before doing this, they must first reach an agreement on who will take the lead with respect to septic tank management regulations, septage collection and the management of private haulers, treatment plant operation, and fee collection, as well as the sort of implementation structure and budgetary allocations that will be used for this. Presumably, the most efficient and sustainable approach would be to have Cebu City handle the regulatory areas, and have MCWD perform the collection and hauling, build and operate the treatment plant, and collect the fees. These aforementioned regulatory areas include administrative guidance related to septic tank de-sludging and improving septic tanks that are not in legal compliance. In doing so, some of the collected fees would conceivably be distributed to Cebu City to provide it with the budget for this.

Either way, a master plan and implementation plan for comprehensive septage management will be needed when it comes to the independent operation of the treatment plant, systematic septage collection, and the establishment of a fee collection structure to support these after the end of this demonstration project. This must be based on coordination and agreement related to the division of roles among the local stakeholders.

In the turnover ceremony and seminar held on December 10 2015 where MCWD also attended, the importance of the collaboration between stakeholders mentioned above is strongly emphasized. JICA survey team introduced the person in charge of septage management of MCWD to CCSMB Chairman Atty. Ponce, and it is desirable that further communication between MCWD and Cebu City will be held for the future implementation of septage management in Cebu.

2) Challenges for Each Septage Management Component

Aside from the agreement between stakeholders concerning the septage management leader, specific challenges for each individual component that were recognized in this demonstration project are listed below.

Septage management components	**Challenges**
Septic tank management	▪ Thus far, septic tank inventories have been organized for 15 barangays, but these must be organized for the remaining barangays. ▪ Coordination and agreement between stakeholders are needed regarding the use of the collected data in the septage management plans.
Collection and hauling structure	▪ Understanding, coordination, and agreement between the stakeholders are needed when it comes to septage collection and hauling plans, the executing agency for the private hauler commissioning system, and its management methods based on the septic tank inventories proposed through this demonstration project.
Establishment of the treatment plant	▪ ECC (or CNC) based on the Philippines Environmental Impact Assessment System and discharge permit should be obtained. ▪ The septage intake tank must be suitably installed (installation of a screen and in-tank blower). ▪ The compost facilities must be installed so as to ensure that there are access roads for trucks that are of the appropriate size leading to it. ▪ Lagoon improvements must be made in order to comply with effluent standards. ▪ Fresh water for cleaning the machinery must be ensured.
Treatment plant operating structure	▪ The gate must be managed so that only domestic septage is taken in. ▪ A structure of personnel with a technical background must be established for the operation of the septage treatment plant.

Septage management components	Challenges
Structure for securing financial resources	▪ There must be coordination and agreement between stakeholders regarding the fee collection structure for applying fees to water charges. ▪ The division of roles between stakeholders must be determined for the septage management components, and agreement on the budgetary allocations must be reached on the basis of this.

On December 10, 2015 after the seminar, JICA, CCENRO, CCSMB, and AMCON discussed and agreed that the necessary actions should be taken for the following issues and a Memorandum of Understanding was to be signed soon.

- Fresh water use for washing the equipment
- Installation of the screen and blowers
- Expansion or construction of an adequate composting facility
- Lagoon improvements
- Reviews of the water tariff and taxes in the form of budget resources
- Collaboration with MCWD and MCDCB

4. FUTURE PROSPECTS

(1) Impact and Effect on the Concerned Development Issues through Business Development of the Products and Technologies in the Surveyed Country

When this project's contribution is considered from the perspective of resolving the problem of the contamination of public water bodies and groundwater due to insufficient septage management, the claim could be made that building the treatment plant has provided a place where the septage that had previously been discharged into the environment can now be taken in. During the project period, a cumulative total of 34,000m^3 of septage was treated, which has prevented the contamination of public water bodies and groundwater over the short-term.

(2) Lessons Learned and Recommendations through the Survey

This survey has mainly focused on verifying the applicability of AMCON's Volute dewatering equipment to treat septage through building and operating the pilot septage treatment plant, as well as conducting capacity development for the enhancement of septage management mechanisms.

However, in order to establish a more sustainable septage management system in Cebu, the lessons learned and recommendations can be made in line with the septage management components: 1) technological components, 2) managerial components, and 3) financial components, as shown below.

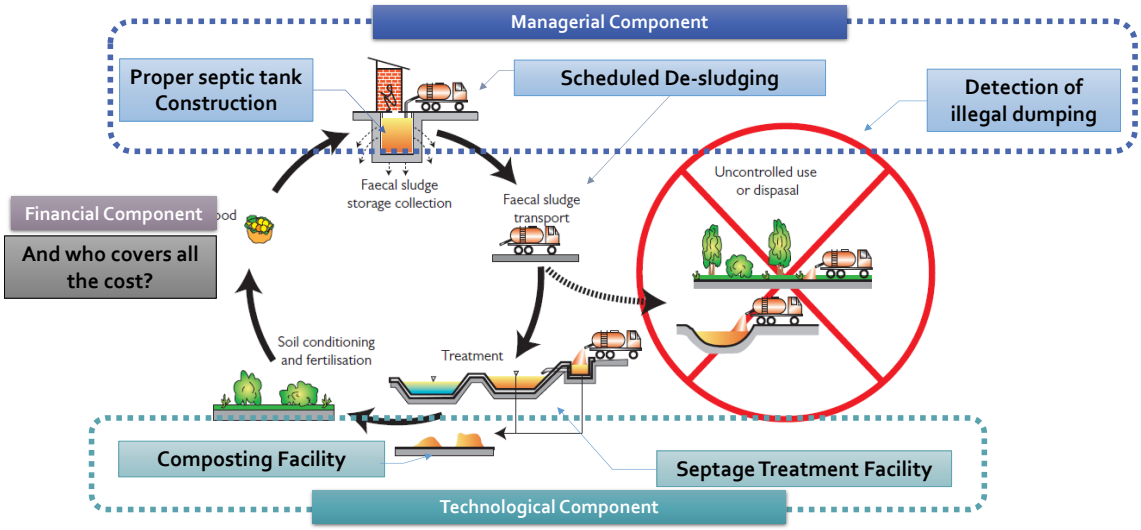


Fig. Septage Management Components

(Edited from source: A Rapid Assessment of Septage Management in Asia[1])

1) Lessons Learned and Recommendations for Technological Aspects

The pilot septage treatment plant was built, operated, and treated 34,000 m^3 of septage that was generated in Cebu during the project period. Through our survey, the following points were identified as lessons learned and recommendations for the sustainable operation of the plant in the future and the establishment of a composting facility.

- The BOD levels of the septage brought to the pilot septage treatment plant varies from 3,000 – 20,000mg/L, and sometimes contains large foreign matter that clogs the pumps. Therefore, it is recommended that post & pre-treatment units be installed. The solution can be the lagoon improvements proposed here and the installation of a septage receiving unit that has a screen and a tank with blowers.
- Use fresh water for washing dewatering equipment as soon as possible, otherwise it will become damaged and become unusable within three years.
- Accept only domestic septage. Industrial waste water should not be treated in the pilot septage treatment plant, but by the onsite treatment system.
- Properly carry out daily, weekly, and monthly monitoring according to the operation manual.

[1] AECOM International Development, Inc. and the Department of Water and Sanitation in Developing Countries (Sandec) at the Swiss Federal Institute of Aquatic Science and Technology (Eawag), 2010. A Rapid Assessment of Septage management in Asia: Policies and Practices in India, Indonesia, Malaysia, the Philippines, Sri Lanka, Thailand, and Vietnam (Available at: http://pdf.usaid.gov/pdf_docs/Pnads118.pdf) [Accessed on January 20, 2016]

- When designing the composting facility, hire an experienced consultant who has expertise in the composting process and necessary facilities.

2) Lessons Learned and Recommendations for Managerial Aspects

The septic tank inventory started being developed during the project and continuous efforts are being made by CCENRO. This data can be the foundation for the future septage management planning. Based on this achievement, the following points can be made as lessons learned and recommendations for managerial issues.

- The septic tank inventory developed in the project can be used as initial data for detecting septic tanks to be re-built and de-sludged as well as areas that need new septic tanks built.
- The septic tank inventory can make scheduled de-sludging possible.
- The list of septic tanks to be de-sludged can be utilized for a system for commissioning private haulers to perform the de-sludging work and preventing illegal dumping by regular reporting from the private haulers.
- An appropriate septage de-sludging planning and commissioning system for private haulers would protect them from losing their market.
- In the commissioning and permitting process for private haulers, the hauling equipment must be upgraded to meet the sanitary standards.
- Local Government Units are good at gathering on-the-ground data that can serve as the basis for the septic tank inventory. Therefore, it is recommended that septage program implementers cooperate with them for the development of the septic tank inventory.

3) Lessons Learned and Recommendations for Financial Aspects

The financial and cost analysis conducted in this survey showed several key points for the future septage management in terms of who will bear the cost. The following points should be noted for reviews of the fee collection system in the future.

- Charging the septage treatment fee to private haulers imposes a higher financial burden on private haulers. This is highly likely to lead to increases in the de-sludging fees that citizens pay, which can disincentivize private haulers from carrying septage to the treatment plant, and therefore illegal dumping could presumably occur.
- Putting additional fees on water tariffs follows the PPP (Polluter Pays Principle) and is a more efficient way to collect fees. However, this is unfair to those who do not have septic tanks, but rather have water connections, because they cannot receive the service. Therefore communal septic tanks must be constructed for those who lack them.

In light of all the lessons learned and recommendations above, cooperation and collaboration for the implementation of the septage program between MCWD and Cebu City is necessary. Based on the survey results, the following shows the recommendations for the roles and responsibilities to be divided up between MCWD and Cebu City/other LGUs.

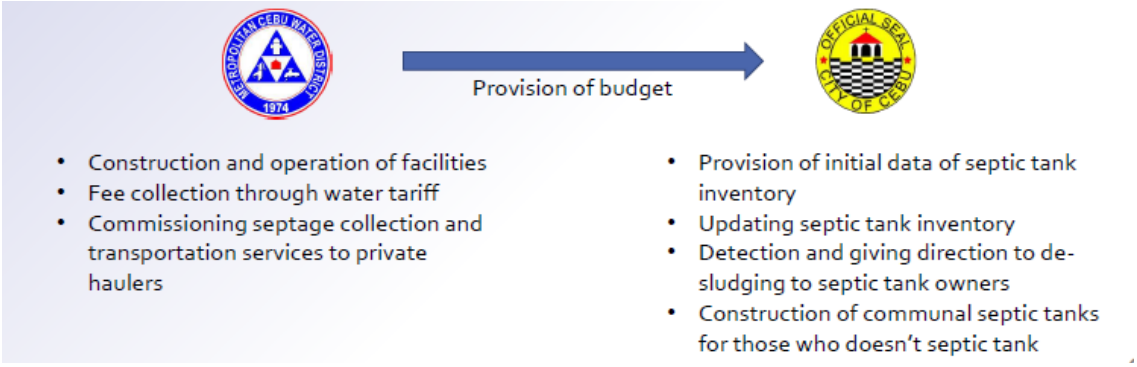


Fig. Recommended roles and responsibilities between MCWD and Cebu City

On the whole, when it comes to water administration in the Philippines, both LGUs and WDs exist as implementers at the local level. Therefore, the importance of platforms in which various different stakeholders, including LGUs, WDs, congressional officials, and NGOs can hold discussions was recognized for the establishment of independent, sustainable septage management structures in the Philippines.

ATTACHMENT-1: OUTLINE OF THE SURVEY

Republic of the Philippines

Verification Survey with the Private Sector for Disseminating Japanese technologies for Applicability of Dewatering Equipment for Septage Management of Cebu City, AMCON INC. Yokohama, Japan

Concerned Development Issues in the Philippines

- Sewerage system has not been established in Cebu City and sludge generated in septic tanks are not treated and dumped inappropriately, causing a serious environmental problem.
- Affordable and environmentally sound septage treatment facility was needed in Cebu City.

Implemented Activities in the Survey

- Verification of the applicability of the dewatering machine through long-run operation.
- Capacity development for the sustained operation of the machine and the establishment of comprehensive septage management system.
- Hosting a seminar for other LGUs and other concerned parties to disseminate the product in the Philippines.

Proposed Products/Technologies

Volute Dewatering Machine

- Separate septage into sludge cake and filtrate. Filtrate is discharged into environment after appropriate treatment. Sludge cake is compostable.
- Patented with the following features
  - ✓ Clog-free and low running cost
  - ✓ Easy to operate and maintenance. Only needs simple training.

Impact on the Concerned Development Issues in the Philippines

- Establishment of septage management structure in the Cebu City Government.
- Construction of a model septage treatment facility utilizing the existing sewage treatment facility.
- Effective use of sludge cake

Expected Outputs and Outcomes of the Survey

- Private companies in the Cebu region, DPWH, and other LGUs around Cebu City show their interests in the product.
- Maynilad Water Services Inc purchased three volute dewatering machines in 2013.
- Four units were sold to private companies in 2014.
- One unit is being out to contract with Baguio City's wastewater treatment plant.
- Two units are proposed for two sewage treatment plant of Manila Water. Order is expected to be made for one unit in 2016.