Indonesia

Hygiene Improvement through Utilization of Ecological Sanitation Waterless Toilets Preparatory Survey for BOP Business Promotion English Summary

September 2015

Japan International Cooperation Agency

(JICA)

LIXIL Corporation

i-Incubate Co., Ltd.

OS
CR (1)
15-087

Table of Contents

Abbreviations

BMW	Bacteria, Mineral, Water
BOP	Base of Pyramid
CLTS	Community-Led Total Sanitation
EHRA	Environmental Health Risk Assessment
IDR	Indonesia Rupiah
IPAL	Instalasi Pengolahan Air Limbah)
IPLT	Instalasi Pengolahan Lumpur Tinja
MDG	Millennium Development Goals
PPL	Penyuluh Pertanian Lapangan
SANIMAS	Sanitasi Masyarakat
TPA	Final Disposal Site
UDDT	Urine-Diverting Dry Toilet
WSP	Water and Sanitation Program

1 Overview of the Study

1.1 Background and Objectives of the Study

1.1.1 Background of the Study

According to the MDG assessment done by UNICEF and WHO, 2.4 billion people or 28% of the global population still lack access to improved sanitation facilities in 2015[1], which causes 3,000 of children under the age of 5 years old (mostly under 2 years old) die every day due to waterborne diseases[2]. Improving access to sanitation is a key to overcome development challenges including high child mortality rate, unstable food security and poor health care. In Indonesia, sewerage and sanitation coverage is still low and 6 million ton of urine and feces are discharged to river or canal without proper treatment. Hence Indonesia is keen to improve sanitation system of the country, given the fact that 780 children under the age of five die every week due to typhus and diarrhea.

International organizations, non-governmental organizations and foundations have been proactively involving activities to improve sanitation in developing countries. For example, aiming to eradicate the practice of open defecation, World Bank and Bill Gates Foundation implemented Total Sanitation and Sanitation Marketing programs in 29 municipalities in East Java through Water and Sanitation Program (WSP) from 2007 to 2010. The Foundation also announced to disburse 42 million dollars in new sanitation grants globally that aim to spur innovations in the capture and storage of waste, as well as its processing into reusable energy, fertilizer and fresh water. The idea behind this initiative is to push forward the low-flush and cost-less toilet in contrast to the current prevailing practice which requires a large amount of water to flush human excreta. While the flush toilet contributed to save hundreds of thousands of lives in the past 200 years, it imposes burden on environment as the system requires large amount of relatively clean water to let wastes ran in a sewer pipe smoothly. This is not an effective way of treating wastes anymore considering the environmental impact and the cost incurred for the construction of sewerage system and treatment facility. On the other hand, ecological sanitation system (ecosan) studied in the Study allows to converting human excreta into nutrients to be returned to the soil and is expected to serve the needs of Base of Pyramid (BOP) who live in the populated area without access to proper toiled connected to sewerage system.

JICA Study Team (the Study Team) is composed of two private companies, namely LIXIL Group (LIXIL) and i-Incubate Co., Ltd (i-Incubate). Under the corporate principle, “Link to Good Living,”

[1] P5, 25 Years Progress on Sanitation and Drinking Water – 2015 Update and MDG Assessment, UNICEF and WHO

[2] http://sanitationdrive2015.org/resources-2/fast-facts/

LIXIL strives to contribute to improving people's comfort and lifestyles and to creating sustainable society by providing innovative products and services. One of the company's initiative to materialize this principle includes the technical and market study for ecosan toilet in Vietnam that seeks to recycle urine and dung. This project has been implemented since 2010 with the close cooperation with Hanoi Architectural University. Under this JICA Study, the Team attempted to develop business strategy for the ecosan market in Indonesia by utilizing the experience and knowledge gained from the project in Vietnam. In parallel to the JICA Study, LIXIL has also been conducting feasibility study for ecosan in Kenya since March 2013. Through these projects and initiatives, LIXIL is committed to promote its ecosan toilet or a "recycle-type waterless toilet" tailor-made to meet the individual country's needs and circumstances.

1.1.2 Objectives of the Study

The Study aims to achieve the following two objectives in light of LIXIL's ecological sanitation system called Green Toilet System (GTS).

(1) Development of prototype for GTS which serves the needs of BOP; and
(2) Development of business model to promote GTS in Indonesia

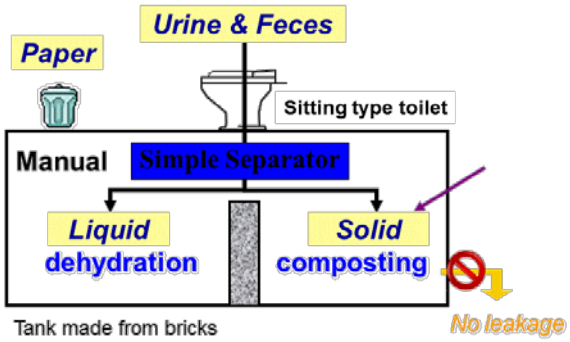
The value chain set for the business model (2) above includes developing/constructing and distributing the toilet which meets the needs of local people and communities (Access), collecting and treating human excreta in environmentally-friendly manner (Collection and Treatment) and reuse of the treated human wastes for agriculture and energy (Reuse). The Team attempted to explore the technical feasibility for each step of the value chain and build the possible business model for GTS.

Figure 1-1 Value chain of Green Toilet System

1.1.3 LIXIL's Green Toilet System

LIXIL's GTS aims to dehydrate and decompose human excreta within a tank installed underneath a toilet. Being not flushed, volume of wastes will be kept minimum. It also allows initial treatment of human excreta done in the toilet on the spot, resulting in more effective second treatment without causing adverse effect to ground water, river, lake and ocean. As urine and feces will be decomposed

by bacteria, unusual odor will disappear and by-product generated from the decomposition process can be utilized for agricultural activities. Valuable components of fertilizer such as phosphorus, nitrogen and potash will also be recovered from urine.



GTS is considered to be ideal for island-states like Indonesia where it is difficult to build adequate infrastructure, because the system dose not require high upfront cost for the construction of sewerage pipe and treatment facility and can be installed in individual houses. GTS also meets the objective of "Universal Access", the policy to enhance the access to proper sanitation and clean water, and the scheme to advance organic agriculture, which have been promulgated by President Joko Widodo.

1.2 Methodology of the Study

1.2.1 Methodology of the Study

Figure below shows how the Study was carried out.

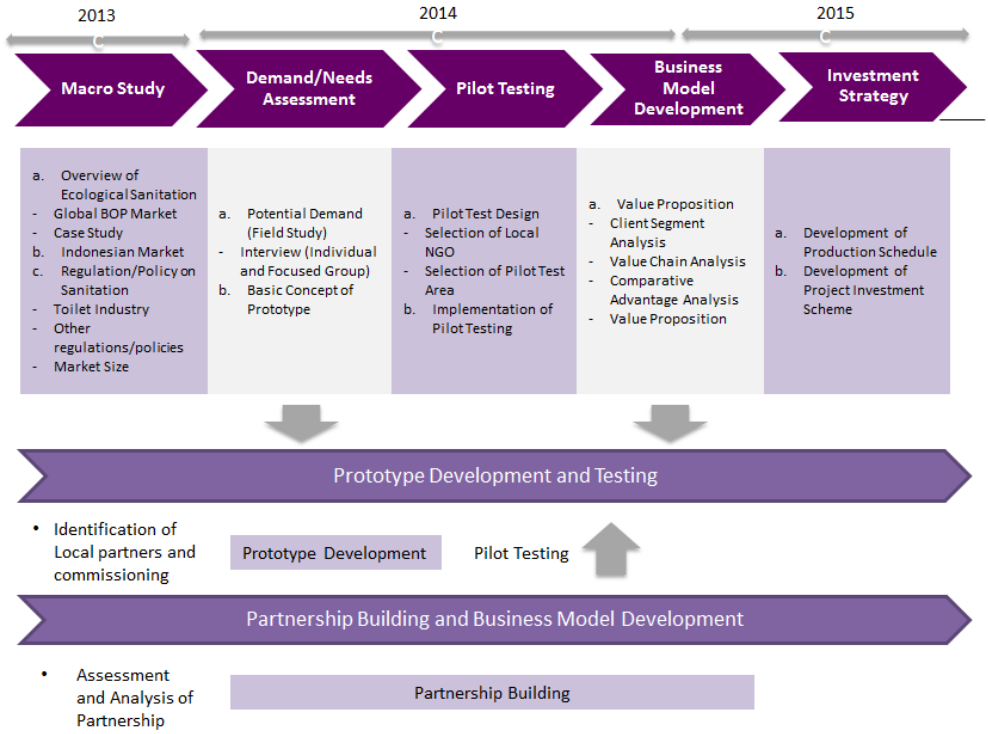


Figure 1-2 Methodology of the Study

1.2.2 Selection of Pilot Area

In selecting the area to implement the pilot study, the following two points were considered at first, that is village/region where (1) water is scares and (2) organic agriculture is widely accepted and local population does not have negative impression toward the reuse of human excreta as fertilizer or people already recognized that the application of increased volume of chemical fertilizer cause damage to the soil in the longer term. However, it was agreed later that priority shall be given to the point (2) above since the challenge of installation of GTS lies with the treatment and reuse of human wastes. Hence it was decided to look for the area where the organic agriculture has already been accepted.

Based on the above said observation, the Study Team interviewed Institut Teknologi Bandung (ITB), Universitas Surabaya (UBAYA), Sekolah Tinggi Teknik Surabaya (STTS), provincial environmental authorities and NGOs. All the interviewees advised that organic fertilizer is widely used and utilization of animal excreta is accepted in East Java, hence, the Team explored the possibility to carry out the pilot in Regency of Lumajang, Batu or Malang.

Meetings and interviews were conducted for several times with each Regency but authorities of Batu and Malang were inundated with the ongoing projects with other aid agencies, which made them difficult to collaborate with the Study Team. Therefore, it was decided to conduct the pilot in Lumajang Regency which expressed keen interests in installation of GTS and promotion of organic agriculture.

（Source）
http://id.wikipedia.org/wiki/Kabupaten_Lumajang

（Source）
http://lumajangkab.go.id/petakab2011.php

Lumajang Regency is divided into 21 districts. It has an area of 1,709.90 square kilometers and the population of 1,012,121. According to Environmental Health Risk Assessment (EHRA), various

types of toilets have been used such as squat type (62.67%), sitting type (11.72 %), pit latrine (3.71%) and others (21.9%).

EHRA also indicates that, in the Regency, the different kinds of methods are applied for the treatment of feces, including septic tank (50.43%), pit latrine (23.1%), discharging to river/lake/ocean (10.86%), and others such as sewerage pipe, drain and paddy field/soil (15.6%). 90% of the septic tanks currently used is not managed properly which causes the untreated feces submerged to soil. This raises the concern within the local authority who is keen to find a solution to the sanitary issues including the introduction of recycle-waterless toilet.

1.2.3 Selection of the Pilot Residence

In selecting the location (residence or village) where the prototype GTS is installed, the Study Team requested the Regency's Department of Public Work Cipta Karya to nominate five villages based on the selection criteria prepared by the Team. As a result, Tompokersan, Blukon, Boreng, Kepuharjo and Merekan were short-listed by the Regency and the Team collected and analyzed data to finalize the selection process as shown in the table below.

Table 1-1 Results of Data Analysis for Five Villages in Lumajang

	Selection Criteria	Standard	Scoring System	Lumajang Regency				
				Tompokersan	Blukon	Boreng	Kepuharjo	Merakan
Macro /Economic	Population	>2000	x<2000=1x>5000 =3 2000>x<5000 = 2	3	2	3	3	1
	Average Income	>Minimum regional fee	x<100=1 x>150=3 100>x<150=2	3	2	2	2	1
	Easy access (transportation) from Surabaya	4 hour	x<2=3 2>x<4=2 x>4=1	2	2	2	2	2
	Do most of the people in pilot area have agricultural activities/house gardening?	> 40%	x<20%=1 20%>x<40%=2 x>40%=3	2	3	1	2	2
Sanitation Status	Do people have toilet?	40%	x<40%=1 40%>x<75%=2 x>75%=3	3	2	2	3	1
	How is the overall situation of toilet use/sanitation?	Good	Good=1 Mad=2 Bad=3	2	3	3	2	1
	Is there any ground or river pollution from the toilet?	No pollution	yes=3 no=0	3	3	3	3	0
	Is the sanitation status of the site representing the wider region/city?	> 70%	x<50%=1 50%>x<75%=2 x>75%=3	3	3	3	3	1
Micro Condition	The local government show interest or commitment to improve sanitation system?	yes	yes=3 no=0	3	3	3	3	3
	The people would be willing to use EcoSan prototype?	yes	yes=3 no=0	3	3	3	3	3
	The people would be willing to use the compost for their agricultural activities?	yes	yes=3 no=0 need education=1	3	3	3	1	1
Technical	The availability of the toilet space	More than 2x2 square meter	availble=3 not=0	3	3	3	0	3
	Availability of the fermentation area	For composing feces, at least 1x1 square meter outside space is needed	availble=3 not=0	3	3	3	0	3
	Location of a well	Toilet needs to be at least 3m distant from the well	x>3m=3 1>x<3=2 x<1=1	3	3	2	0	0
User status	Do the candidate household have the agriculture activities/house gardening?	yes	yes=3 no=0	3	3	3	0	3
	Do the candidate household use compost / willing to use compost?	yes	yes=3 no=0	3	3	3	3	3
	Environmental consciousness	high	high=3 med=2 low=1	2	2	1	2	1
			TOTAL	47	46	43	32	29

Based on the results of data analysis, the Team, in close collaboration with the Regency's Department of Public Work Cipta Karya, interviewed individual households who were interested in installing and using GTS in Tompokersan, Blukon and Boreng where scored high points. It was then decided to carry out the pilot at the residence of Mr. Skirno in Tompokersan who is also a Leader of Agriculture Association of the village.

1.2.4 Methodology, Items and Period of the Study

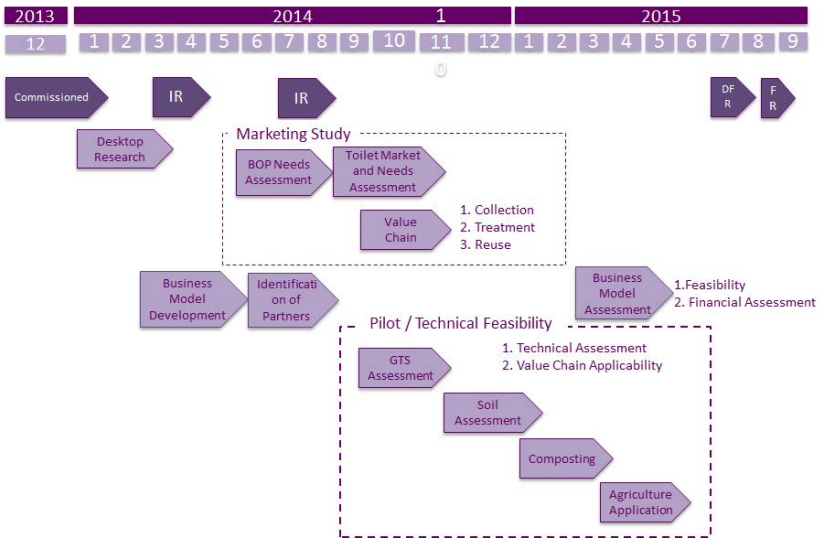


Figure 1-3 Study Plan and Schedule

The Study was carried out from December 2014 to June 2015. Following desktop research on macro economics and overview of the global market for the waterless toilet, demand survey (needs assessment and market research in Indonesia), pilot testing and technical verification were conducted during the field study. Based on the results of field study, the Study Team attempted to develop a business model for GTS including risk and profitability analysis.

Table 1-2 Research Items and Methodology

Research Item		Methodology
Macro, Investment and Business Climate		
Indonesia	Policy, regulation and laws on sanitation	Literature and interview
	Policy, regulation and laws on sewerage system and environment	
	Policy, regulation and laws on agriculture (organic fertilizer)	
Lumajang	Population and demography	Literature and interview
	Income and income distribution	
Market Needs and Demands (Lumajang)		
	Access to toilet, type of toilets available (availability of connection to sewerage pipe) and price	Field study and interview

	Culture and lifestyle (level of acceptance of human excreta)	Field Study and focus interview
	Level of comfort of current toilet	Field Study and focus interview
	Demand for replacement, willingness to pay	Field Study and focus interview
Development of Business Model		
	Type of ecological sanitation available in the global market	Literature and interview
	Risk analysis	
Value Chain for Recyle Waterless Toilet (Lumajang)		
	Collection (methodology, frequency and price)	Field study and interview
	Treatment	Field study and interview
	Organic fertilizer (brand, Price, amount, type of crops)	Field study and focus interview
	Organic fertilizer (recycled product), especially demand for human wastes oriented product)	Field study and focus interview
	Regulation and certification for organic fertilizer	Literature and interview
	Cost and risk analysis for sales, collection, treatment recycle	Interview and cost benefit analysis
Development Effectiveness and Parameter		
	Analysis on BOP and level of access to toilet	Literature and interview
	Collection of baseline data for development parameters	Literature

2 Results of the Study

2.1 Conclusion

2.1.1 Feasibility of the Project

Based on the results of field study, it was concluded that it is not commercially viable for a private entity alone to implement the Project without any financial or institutional assistance from public entities or aid agencies. Furthermore, it was proved that further study may be necessary to find out which part within the value chain, LIXIL or local government would take the lead and what kind of arrangement would be sought to realize Public-Private Partnership (PPP). Demand survey for GTS and by-products (liquid fertilizer and compost) would also need to be carried out.

To this end, LIXIL is currently discussing with Lumajang Regency to conduct rather large-scale pilot testing in view of the following parameters.

(1) Providing 100 households with GTS;
(2) Producing 200 ton of compost and 60 ton of Bacteria, Mineral and Water (BMW) per year;
(3) Providing compost and BMW to farmers for free; and
(4) Conducting agricultural test and analysis for the crops applied compost and BMW

2.1.2 Basis for the Business Decision

In accordance with the LIXIL's initial plan, the company sought the business model where LIXIL was responsible for the development and sales of GTS, while the human wastes would be collected and treated by utilizing the existing local system. However, the results of field research indicated that there was no such existing mechanism for collection, treatment and reuse and local government as well as private entities had few experience or knowledge about the management of value chain of ecological sanitation (ecosan) system. In general, installation of ecosan or GTS is not commercially viable unless the profit from collection and reuse is assured, it was hence concluded that LIXIL has to involve in every step of value chain in order to make the business profitable.

However, it should be noted that there is little precedent where one single private company is responsible for the whole value chain of ecosan. In view of this, it was agreed to conduct large-scale study and pilot testing in order to help LIXIL to have sufficient data and information for them to make business decision. As Lumajang Regency is aware of that LIXIL has to bear all the risks associated with the implementation of entire value chain. It is being discussed how the LIXIL's

innovative technology, GTS, can be adopted in the Regency's master plan.

Business model was reviewed in light of technical and economic feasibility and the possibility of realization of PPP. Results of review are provided blow.

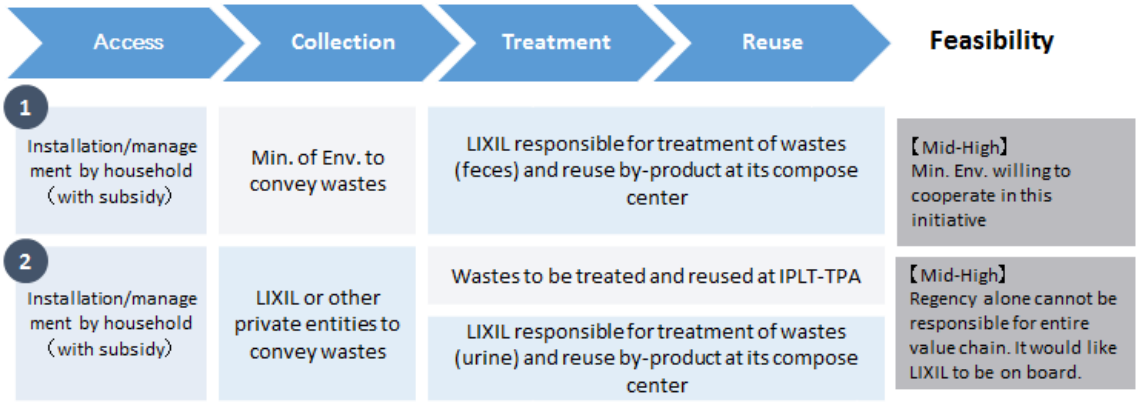


Figure 2-1 Business Model

(1) Technical Review

Technical feasibility has been reviewed not only for design of GTS but also the entire value chain, namely, collection, treatment and reuse. Firstly, design was reviewed and improved to meet the local needs throughout the Study. Possibility of mass production is also under discussion. For collection, the Study Team found out that the quality service is locally available. Contrary, it was concluded that it is technically unfeasible for Lumajang Regency to treat and reuse human excreta due to limited capacity. Although LIXIL is able to safely treat waste with its own technology, it was agreed to carry out large-scale pilot project to obtain more detail data which allows the company to make business decision.

(2) Economic Review

If GTS is installed at 1000 households, within 9 years from the initial installation, LIXIL would acquire the revenue of 80,000 US dollars. This analysis was arrived based on the assumption that the market price of GTS is set at 180 US dollars out of which 100 US dollars of initial cost per unit would be incurred. Thus, it is not commercially viable for LIXIL to simply sell GTS alone without considering any additional revenue stream within the value chain. It is necessary to build a comprehensive business strategy which covers value chain as a whole from sales of GTS to reuse of human excreta as a compost and liquid

fertilizer[3].

If LIXIL manages whole value chain, the company would acquire the revenue of 1.25 million yen from collection and treatment separately. In terms of cost, the company needs to bear around 40 million yen for collection and treatment respectively and 2.15 million yen for reuse (conveyance, etc). However, if all of the by-product such as compost and liquid fertilizer is sold at the market price, LIXIL could receive 6.375 million yen per annum and the company could expect the gross profit of 8.25 million yen (13% of margin). Even only with liquid fertilizer, it would bring LIXIL the revenue of 3.97 million yen per annum (9% of margin). Based on these cost benefit analysis, it was concluded that the project would be profitable as long as LIXIL is on board for entire value chain.

(3) Public-Private Partnership (PPP)

Challenge associated with the project lies with the possibility of partnering with local government, Lumajang Regency. It is under the responsibility of Regency for emptying waste from septic tank for proper treatment, however, few local governments in Indonesia, let alone Lumajang, manages this practice adequately, leading to the fact that untreated excreta has been discharged to nearby water body directly. It is important to follow the development of future sanitation policy in Indonesia nationally and locally so that LIXIL is able to commit and come up with feasible business strategy. It is especially important to take into account legal risk (whether or nor LIXIL would be licensed to implement collection and treatment of waste) and local government risk (to what extent Lumajang Regency is ready to bear risks associated with the implementation and financial obligation). The Study Team has yet to come to agreement on this point with the Regency to date, which requires continued discussion with the local government.

2.1.3 Initial Business Model and Evaluation

In terms of evaluating the business model, the Study Team reviewed how the user can be involved with each step within the value chain based on the analysis on the global ecological sanitation model. It was concluded that the three models are widely accepted as shown below.

[3] Assuming that liquid fertilizer shall be sold at IDR7,500/L (584,000L in total) and compost at IDR1,000/kg (2,173 ton in total). Both targeting 1000 households.

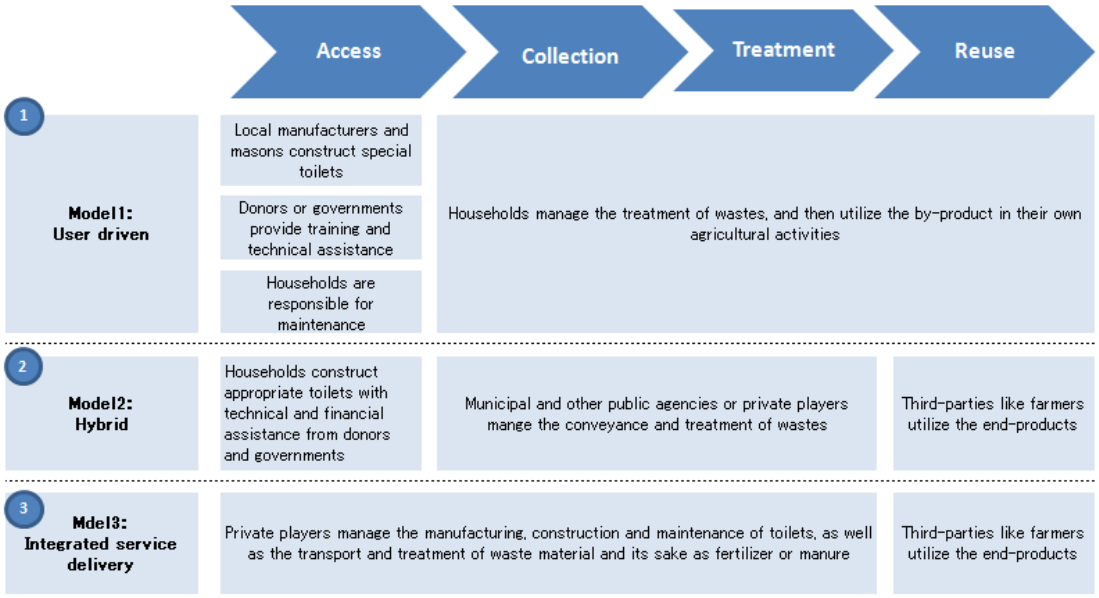


Figure 2-2 Overview of Global Ecological Sanitation

For Model 1 “User-driven Model”, donors or governments assist households with procuring Urine Diverting Dry Toilets (UDDT) with pits or vaults for collecting urine and dehydrating feces, mainly in rural and peri-urban areas. They rely on users to empty vaults and utilize the wastes in their agricultural activities. These programs are heavily dependent on subsidies, limiting long-term sustainability. High cost of toilets also discourages users from constructing toilets or repairing existing ones. Users often use toilets incorrectly (e.g. forgetting put ash) hampering the re-use.

As to Model 2 “Hybrid Model”, municipalities or donors assist households, mainly in peri-urban and urban areas, with procuring urine and feces separating toilets that have waste collection vaults. Donor organizations/municipalities then set up internal teams, local enterprises or community associations to collect and treat wastes. Assisting factors of this model include that users are not required to handle or re-use the waste and users, community and government are integrated into design and implementation of the project, enhancing sustainability.

On the other hand, UDDT toilets are not seen as aspirational and many households default on collection fees, and models still rely heavily on subsidies. This model also faces logistical and human resources constraints for collecting wastes and distributing fertilizers and lacks in scale to produce electricity, biogas and fertilizers.

Lastly regarding on Model 3 “Integrated Service Delivery”, private companies provide households

with toilets or access to public or share toilets, mainly in peri-urban and urban areas. They monitor the collection process, treat wastes and produce by-product for reuse and sale.

Assisting factors for this model is that strong product and end-to-use service livery leads to minimal requirement of handling from users. Pay-per-use system also supports affordability and reduce burden on users and franchisees. However, it lacks ability to produce by-product at scale and low demand from farmers limits revenue from re-use. As shared toilets are used by various users, ensuring proper usage of toilets is a challenge. Significant logistical and human resources are needed for collecting wastes. In addition, as is the case for other models discussed, cultural acceptance for application of human excreta oriented fertilizer onto crops would be low.

Based on the analysis on global ecological sanitation model and needs assessment conducted in Lumajang, the business model for LIXIL's GTS is developed as delineated below.

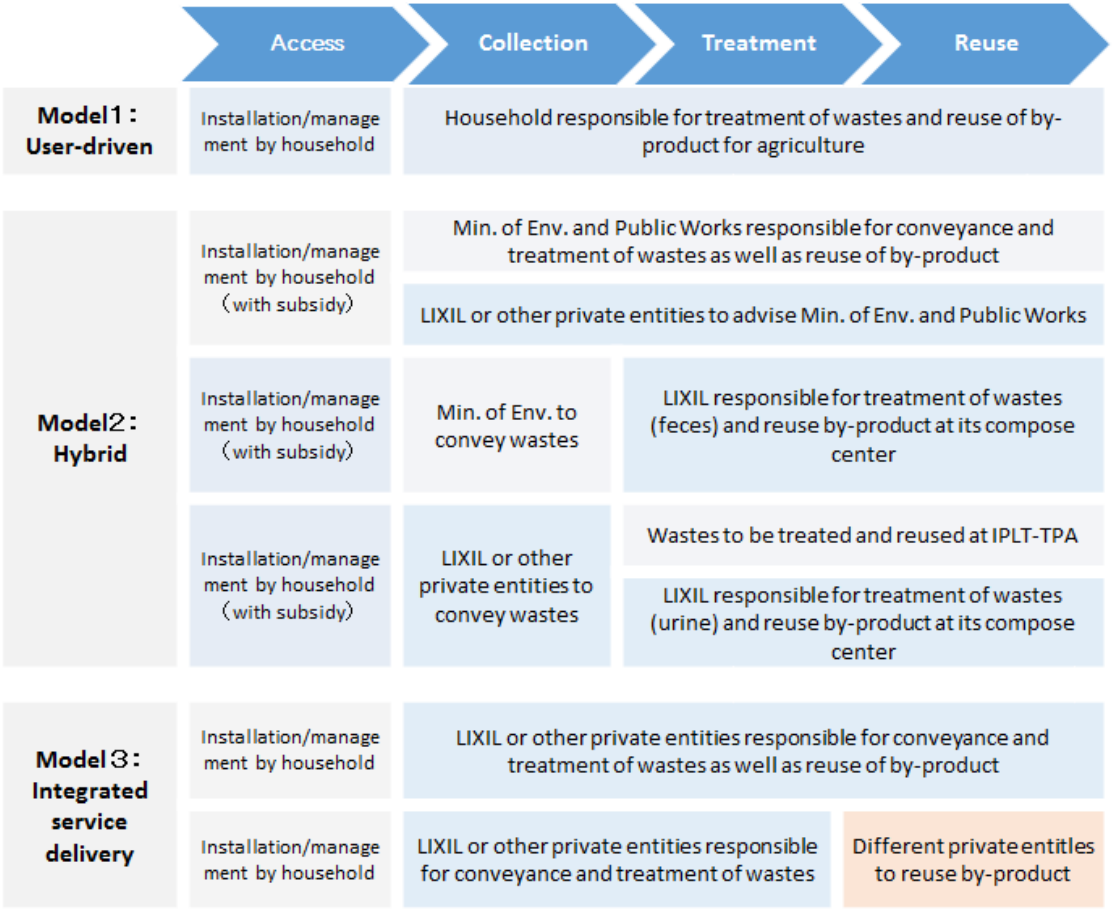


Figure 2-3 Business Model Explored

In building an appropriate business model for GTS, the Study Team evaluated demands for ecological sanitation in Lumajang and analyzed appropriate value chain to accommodate the local needs. Summary of evaluations is provided below.

2.1.4 Project Evaluation (1) Target Users and Demands

As to the current sanitation practice, 57.7% of total population of Lumajang (50,278 households) uses squat or sitting toilet, 6.7 % for pit, 9.7% for share toilet and 25.8% for open defecation.

In the meantime, the Study Team conducted focused interview with 9 farmers including Mr. Skirno who accepted to install the pilot of GTS at his residence and all of them responded that they were not satisfied with the present toilet installed in their homes due to its odor, uncleanness and lack of comfort. Although each respondent showed interests in GTS, they were not ready for the immediate replacement with the existing one which has been used for more than 10 years unless the new house is built or the current house is renovated. Assuming, out of 1% of middle-high income families who

builds a new house, 50% are to install GTS, it will take 9 years to cover 1000 households. It was also found out from the interview that most of the respondents would invest more in education or foods than in renovation of house.

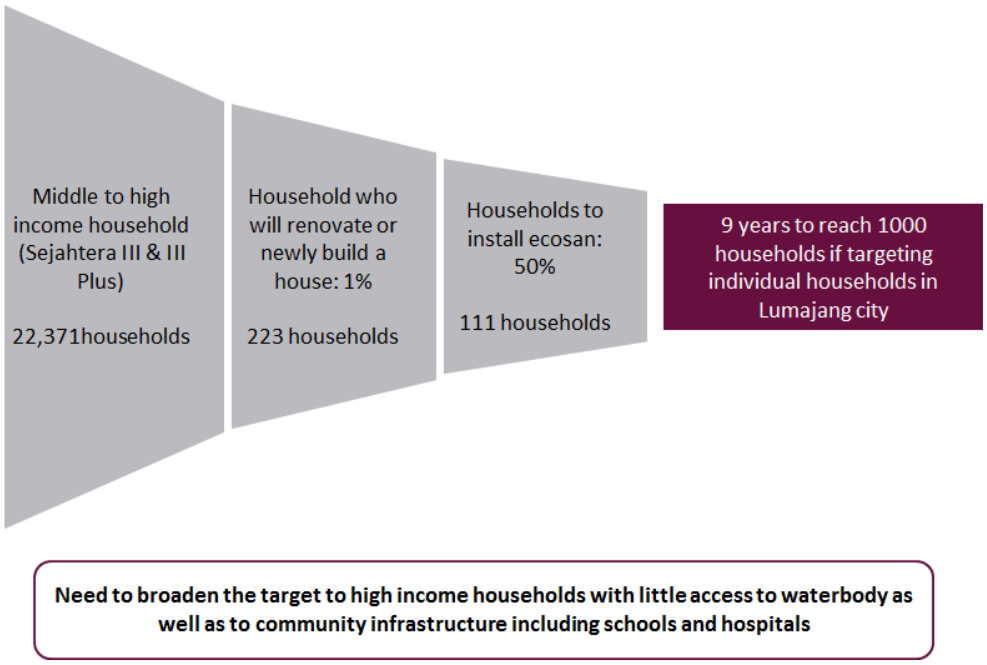


Figure 2-4 9 years to reach 1000 households

Thus, LIXIL would need to approach schools or community facilities to cover larger targets as well as targeting high-income families who have difficulty in accessing water sources.

Demands for GTS also depend on prices imposed for collection service. Being unable to develop a business model for treatment and reuse, the Study Team was not able to conduct in-depth needs assessment for entire value chain. In understanding the demands, it is necessary to carry out large-scale pilot by scaling up the target to public sector within Lumajang city as well as households outside of the city. More concretely, it is inevitable to explore the public sector's willingness to pay for collection, treatment and reuse and demand survey among middle-high income population.

2.1.5 Project Evaluation (2) Development of Value Chain

The Study Team reviewed the every component of steps comprising of value chain of GTS as follows.

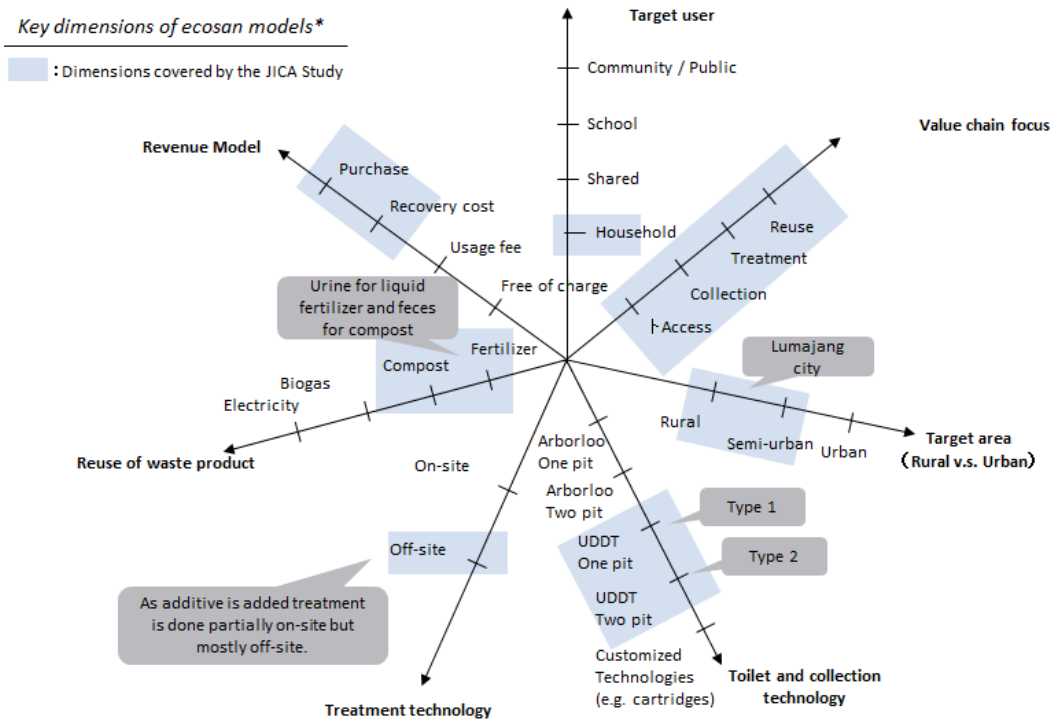


Figure 2-5 Component of each step of value chain

(1) Toilet and Collection Technology

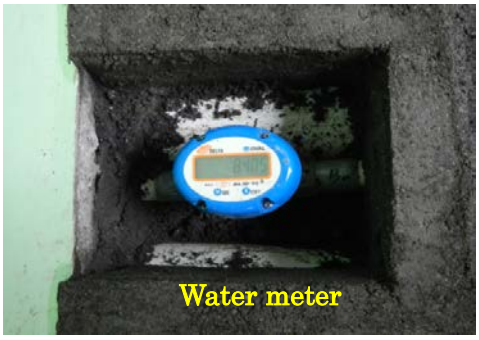
GTS has been installed in Lumajang after careful pre-study on the applicability and local environment. The product was continued to be improved as the Team obtained further data on exterior, function, odor and treated wastes during the Study.

Toilet was designed taking into account local practice (e.g. a large amount of water is needed for flush) and treatment process of wastes was also amended in view of local needs. For example, although direct dehydration treatment was planned at the beginning, it was decided to put additive to accelerate the drying process as it was turned out that the amount of water needed on the spot is larger than initially anticipated. Because of this amendment, however, treatment process for urine underneath the toilet was much simplified, leading to the reduction of development cost of GTS. Feces were preliminary fermented underneath the toilet and possibility of applying bio-additive was explored. As to flushing water, the integrated biological and filtration system was invented.

It was a local company that designed and built the exterior of GTS. In future, cooperation with LIXIL's affiliated local company, American Standard Asia Pacific, will be sought, with

locally available resources and technique. It was also found out that auxiliary equipment except for toilet itself is locally available hence it was concluded that commercialization of GTS in Indonesia is viable.

Pilot testing was conducted in view of two aspects; (1) adoptability of toilet and (2) treatment of wastes. User's Guide for GTS was prepared and measurement device to monitor humidity, amount of water, etc. was installed. Periodic questionnaire and regular measurement of total amount of water, odor, pH and humidity were carried out. The Study Team requested UBAYA to conduct in-depth analysis on the said collected data.



Results of data showed that the inside of GTS has been cleaned once every week and well managed during six-month pilot. There was no ammonia gas detected inside and results of questionnaire indicated that users felt no odor and user experience was similar to the one with regular flush toilet. Although negligible amount of ammonia gas was detected inside the urine storage tank, no such gas caught in the feces storage tank as odor was evolved to outside by fan.

Regarding treatment of wastes, urine, feces and water were separated and sent to individual storage tank for further treatment. Based on the analysis of treated wastes conducted by UBAYA, while treatment method needs to be improved to enhance quality of by-product, it was confirmed that urine and feces treated during the Study is qualified for the application to the soil.

For urine, in order to make it qualify as fertilizer, introduction of BMW (Bacteria, Mineral, Water) Technology was considered. Because fertilizer content in urine is lower than that of chemical fertilizer or condensed liquid fertilizer, it was explored to produce BMW from urine, which is rich in mineral and humus. BMW technology is widely accepted in Japan and while animal manure or wastewater can be treated by this method safely, treated water

called BMW activated water has positive impact on the production crops and reduction of odor and insects. Under the Study, BMW activated water was produced from urine and studied its effect toward crops.

(2) Collection of Waste

Supposedly, it is local government that is responsible for collecting wastes from pit but during the Study it was learned that the frequency of pit emptying by the public entity is very low. It was also understood from the interview with farmers that there is no such system to utilize collected human excreta as fertilizer. There was a great demand for collecting or selling wastes among urban population as they do not engage in agricultural activities. On the other hand, it took a while to get farmers in rural areas to understand? the value of human excreta, however, once farmers realized the benefit, they responded that pit emptying service would not be necessary as they were ready to do so by themselves for their agricultural purpose.

Lumajang Regency in fact outsources pit empting service to two local private entities. Thus it is possible for LIXIL to delegate the task of collecting wastes to them. To this end, however, further discussion with Regency on subsidy and license is required.

(3) Treatment of Waste

Wastes stored in LIXIL's GTS are partially treated on-site by applying locally-available additives. There would also be no regulatory implications on treating wastes in Indonesia.

(4) Utilization for Agricultural Activities (Liquid Fertilizer and Compost)

While the objective of the Study was to produce compost from feces and liquid fertilizer from urine, one of the challenges imposed was to change local people's behavior, namely, willingness to use and eat product grown by such organic fertilizer made of human excreta. Although fertilizers produced from cow or goat's manure are widely accepted, interviewees showed some hesitance to apply that of made of human wastes onto edible crops.

While the amount of compost and liquid fertilizer produced during the Study was not sufficient enough to prove the effects onto growth of agricultural crops, the results of pilot testing shows that by mixing several types of existing fertilizer with urine and BMW activate water, the volume and quality of crops are improved. In order to carry out further analysis, it was agreed to implement the pilot in larger scale, including the assessment of soil.

2.2 Business Model

2.2.1 Business Model Identified through the Study

As shown in figure below, the feasibility and the possible service provider of each step of value chain was analyzed during the Study. The Study Team discussed with Lumajang Regency about the results of analysis and it was agreed to pursue Model 2: Hybrid Model as the most attainable option.

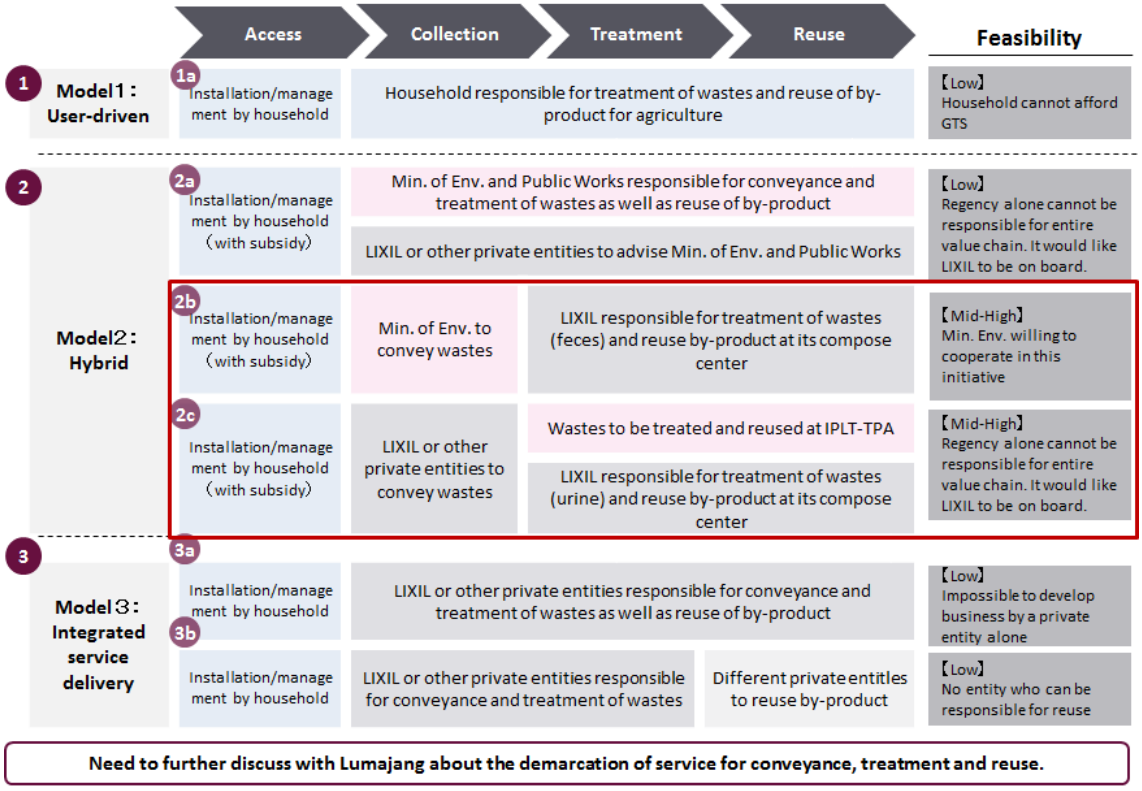


Figure 2-6 Business Model

Furthermore, the Team discussed with the Department of Public Works of the Regency how the roles of conveyance, treatment and reuse can be demarcated between LIXIL and the Department of Environment. As shown in the concept of Model 2b below, awareness-raising about and promotion of the GTS will be done by local sanitarians hired by the Regency. Human excreta piled up underneath the system will be emptied and conveyed to s temporary storage house operated by Ministry of Environment (MOE). MOE's garbage truck will then collect and transfer wastes from storage to a compost center build by LIXI in a final disposal site (TPA) located 16km away from Lumajang. By-product (compost and liquid fertilizer) produced at LIXIL's compost center will be distributed to farmers through agriculture adviser called PPL.

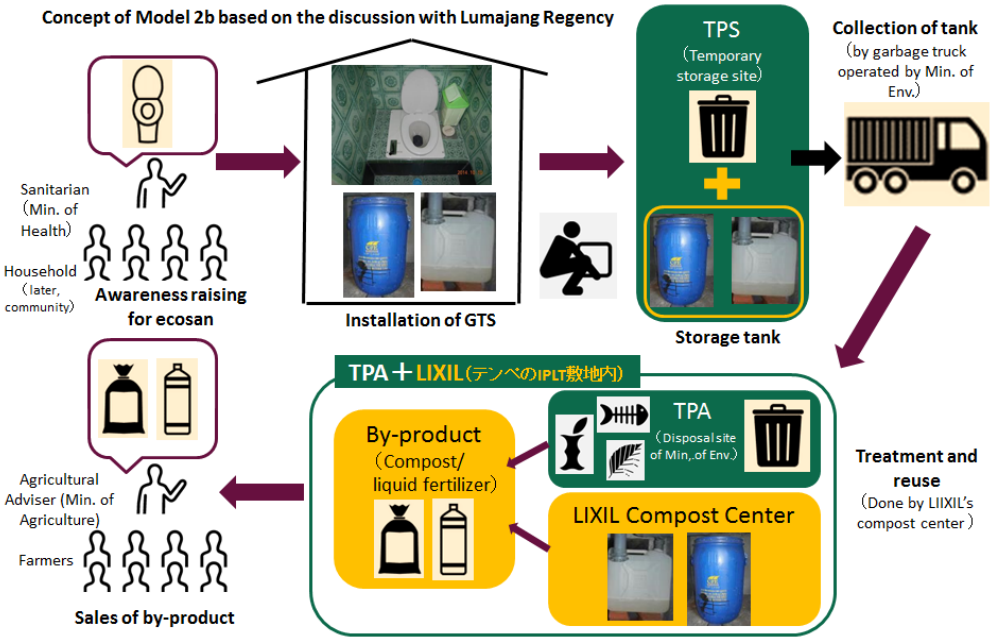


Figure 2-7 Expected Business Model

2.2.2 Challenges and Responses

The greatest challenge in distributing GTS is how to expand to ensure the scale-merit. As discussed in the foregoing section, it would require longer period of time to reach profitable line of business if GTS is sold only to individual households in Lumajang Regency. Thus, it is inevitable to come up with the strategy to cultivate the broader market including public infrastructure (schools and hospitals) while meeting the needs of households simultaneously. Challenges, opportunities and responses for each step of value chain are provided in figure below.

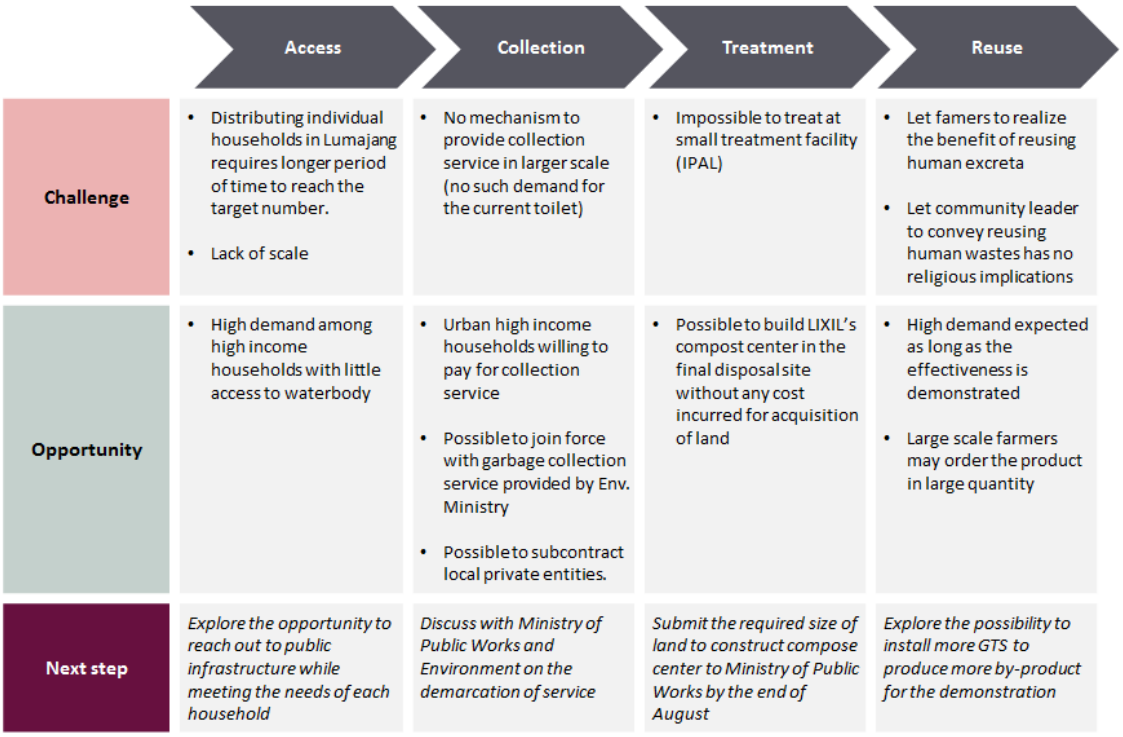


Figure 2-8 Challenges, Opportunities and Responses for Each Step of Value Chain

Another issue includes how to raise awareness on the benefit of reusing waste product, in other words, how to establish a market for human-excreta-oriented organic fertilizer among local people. As explained previously, psychological hesitance toward such fertilizer is likely to be seen widely. Results of interviews showed that liquid fertilizer is likely to be well received as it is much easier to splay onto soil

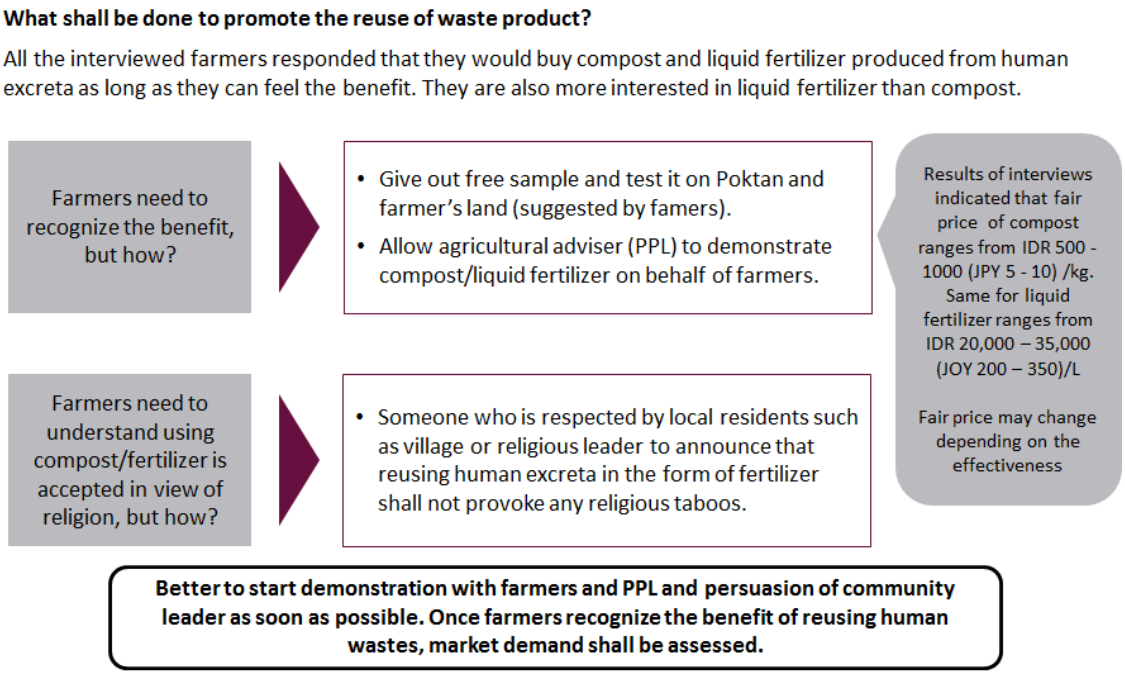


Figure 2-9 Challenges and Responses for Promoting Reuse of Waste Product

2.2.3 Next Step

In order to explore the business opportunity for GTS, there are two issues remain to be considered, firstly how to ensure the scale-merit and secondly how to raise awareness about the benefit of reuse of human excreta among local farmers. The Study Team will continue to seek the possibility with Lumajang Regency in carrying out mid-large scale pilot testing to further conduct needs assessment and accumulate knowledge and experience in light of collection of wastes from households as well as production of compost and liquid fertilizer at the compost center. In the proposed pilot, produced fertilizers will be distributed to farmers in the vicinity of Lumajang for free so that the Team can study usability and demands for such organic fertilizer without imposing any financial burden on the side of farmers.

Results of the above said pilot testing will allow to precisely calculate the feasible scale of business (assumed for 1000 households at the time of writing of this report) and internal rate of return (assumed at 13%), enabling the Study Team to make final business decision including plans for cap-ex, investment, stuffing, finance, business expansion.

As mentioned in the foregoing section, the level of commitment of Lumajang Regency is a key to the realization of GTS business in Indonesia. LIXIL will continue to promote the benefit and effectiveness of GTS locally and nationally and explore the opportunity for engaging in

Public-Private Partnership not only with Lumajang Regency but also with the concerned central government agencies.

Contents for Figure and Table