

Republic of Kenya

**Collaboration Program
with the Private Sector
for Disseminating Japanese Technology
for
Ecological Sanitation System for
watershed management and
improving hygienic environment
in Non-urban Area**

Final Report

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LIXIL Corporation

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Chapter 1 Program Overview

This is the executive summary of the final report of “Collaboration Program with the Private Sector for disseminating Japanese Technology for Ecological Sanitation System for Watershed Management and Improving Hygienic Environment in Non-urban Area” in the Republic of Kenya. The program has been implemented by LIXIL Corporation (hereinafter as LIXIL) with the support of Japan International Cooperation Agency (JICA).

1.1 Background

Under the Kenya Vision 2030, the Republic of Kenya (hereinafter as Kenya) aims to improve sanitation environment as one of the priority areas for infrastructural development. The Millennium Development Goal’s Target 7 on the proportion of the population with sustainable access to safe drinking water and basic sanitation is still an unmet goal in Kenya. According to the World Bank, 21 million people still use unimproved sanitation and 5.6 million use open defecation.¹ While flush toilet penetration is around 50% in Nairobi and other urban areas, sewerage systems remain very rudimentary in non-urban areas. Consequently, water sources, including surrounding rivers and groundwater are polluted, causing increasing outbreaks of diseases such as typhoid and life-threatening diarrhea, which account for more than 17,000 death of young children under the age of five and for 234 million US dollar economic loss annually.²

To promote the provision of clean and comfortable sanitation environment in Kenya, LIXIL has proposed an ecological sanitation waterless toilet system, called Green Toilet System (GTS), and conducted a market survey in Kenya from December, 2012 to September, 2013. The survey showed that there is an urgent need to take countermeasures against inappropriate sewerage system in non-urban areas where residential zones are rapidly expanded. Therefore, with the support of JICA, LIXIL has implemented its project to promote its ecological sanitation waterless toilet system for the ever-increasing number of houses in Kenya’s urban city suburbs, with the goal of reducing inappropriate treatment of human waste and open defecation. LIXIL intends to use its expertise to improve people’s sanitation to remedy the country’s problem from a long term perspective.

¹ Water and Sanitation Programme, “Economic Impacts of Poor Sanitation in Africa (March 2012)”

² same as above

Business Plan

1. Target areas	Non-urban areas in the Republic of Kenya
2. System to be disseminated	Green Toilet System (GTS): Ecological waterless sanitation system which treats human waste safely for recycling without water.
3. Purpose	(1) To reduce environmental damages by treating human waste safely for recycling, and ensure environmental sustainability. (2) To increase agricultural productivity with organic fertilizer to be produced from the GTS. (3) To create employment through the GTS collection and composting processes as well as GTS production. (4) To promote women's participation in education and work
4. Business Policy	(1) In the LIXIL Mid-term strategy, its vision is to be the world's most valued, innovative and trusted living technology company. It aims to penetrate in Africa's market as potential and emerging market. (2) In align with the corporate philosophy 'contribute to improving people's comfort and lifestyles', LIXIL will fulfill its social responsibility in proving sanitation environment in Kenya.
5. Business Plan	(1) To sell GTS to tenement houses and others which use shared toilets in overpopulated areas in non-urban areas. (2) To collect and compost human waste from the GTS toilets, and sell GTS fertilizers to famers. (3) To transfer the system and technology on GTS from LIXIL to local institutions/organizations.
6. Implementation body	LIXIL is in charge of development, production and training of GTS Kenya Institute of Organic Farming (KIOF) assists in examination of safety and effectiveness of the GTS. LIXIL will involve relevant government agencies, including National Environmental Management Authority (NEMA) and Kenya Bureau of Standard (KBS) for building standard for GTS, as well as targeted county government offices for system development for GTS promotion.
7. Schedule	LIXIL's local corporation in Kenya to be established by February 2014. Local production to be started from June 2014.
8. Financial Plan	Total operation cost by 2020 is estimated as 2.2 billion JPY. ³ The initial investment cost is 50 million JPY. The initial investment will be recovered in 2.5 years.

1.2 Overview of the Technology to Be Disseminated

LIXIL's ecological waterless sanitation system, called Green Toilet System (GTS), is not a toilet facility itself, but the system that covers the cycle of safe defecation, storage, collection and fertilizer production, followed by the use of the fertilizer produced through the GTS in agriculture. GTS toilet has a simple solid-liquid separator which prevents odor from the storage tank without using water for the transportation of human waste, and treat it safely for recycling. Therefore it will not pollute ground water, rivers, lakes and other water resources. Instead of disposing of human waste, which contains phosphorus

³ 100 Japanese Yen (JPY)=0.87 US Dollars (USD)

and nitrogen as nutrients for plant growth, the system ferments and decomposes waste to recycle it as fertilizer. The system is expected to contribute to not only saving water usages, reducing environmental damages and improving sanitation for users, but also increasing agricultural productivity and generating incomes. Additionally, the system can be easily installed to the areas where there is no infrastructure on water and sewerage system, saving environment and cost without installing sewerage system.

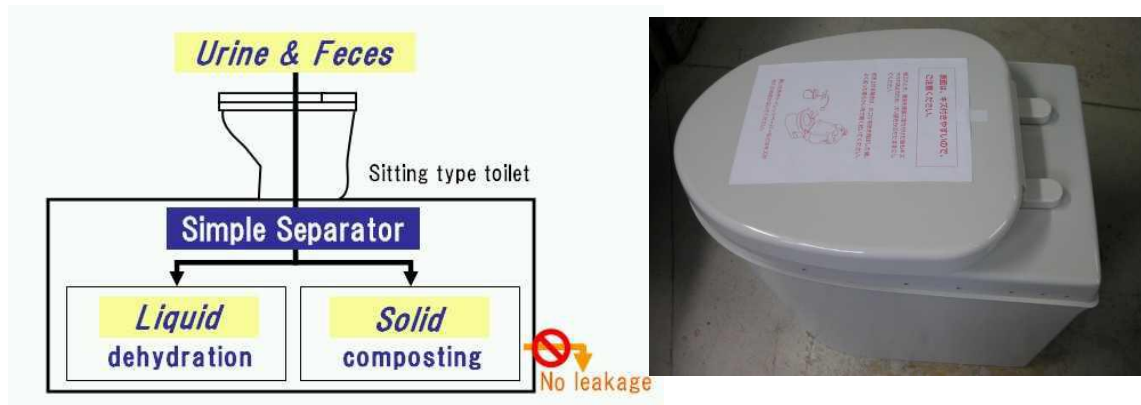


Figure 1-1 Concept and Image of GTS

1.3 Project Overview

- (1) Project Period: January 2014 to March, 2016
- (2) Objectives:
 - i. To develop GTS including the system and training program to meet the needs of African market.
 - ii. To promote people's understandings on the need of GTS through various events, such as project site's visits and demonstration seminars.
 - iii. To identify necessary standards and certificates for GTS and establish a cooperative framework with relevant local organizations.

(3) Implementation Framework

LIXIL was in charge of product development (to customize the product for Kenyan market), training management (to develop and implement programs of demonstration, seminars, and training in Japan), and sales development (to identify markets and targets) with the support of OSA Japan as coordination and standard advisor which conducted the feasibility study for GTS before. As counterpart's organizations, Nairobi City County and NEMA endorsed the project and the Department of Environment in Nakuru County also agreed to collaborate with the project team for a monitoring test in Naivasha. Saidia Furaha, Kenyan NGO, and KIOF have jointly implemented the monitoring tests with the project team.

(4) Implementation Process

Process	Main Activity
1 st fieldwork	<p><u>Preparation for a monitoring test and mobilization of cooperation</u></p> <ul style="list-style-type: none"> • Select a project site for the monitoring test in collaboration with a local NGO. • Produce GTS toilet facility for trial with local materials and those imported from Japan. • Secure cooperation from Nairobi City County. • Interview with local developers.
2 nd fieldwork	<p><u>Implementation of the 1st monitoring test</u></p> <ul style="list-style-type: none"> • Re-select and develop a project site in the school owned by local NGO, Saidia Furaha. • Hold a workshop for monitors and kick-off the 1st monitoring test. • Start an agricultural test for GTS compost.
3 rd fieldwork	<p><u>Revision of the business system based on the results of the 1st monitoring test</u></p> <ul style="list-style-type: none"> • Organize a workshop with the monitors of the 1st monitoring test. • Take a NEMA's examination for system development • Conduct market research on waterless toilets and organic fertilizer • Kick-off the collaboration with KIOF
4 th fieldwork	<p><u>Data analysis on the 1st demonstration test and implementation of the 2nd monitoring test</u></p> <ul style="list-style-type: none"> • Analyze the results of the 1st demonstration test and develop upgraded toilets. • Start the 2nd monitoring test at KIOF <p><u>Market research on waterless toilets and organic fertilizer</u></p> <ul style="list-style-type: none"> • Identify one of the potential markets that is staff housing in large plantation companies.
5 th fieldwork	<p><u>Modification of the toilets and compost based on the 2nd test results (1)</u></p> <ul style="list-style-type: none"> • Improve transportation function of the toilets. • Conduct a compost comparative test for agricultural products. <p><u>Preparation for a large-scale demonstration for commercialization (1)</u></p> <ul style="list-style-type: none"> • Select a project site for a large-scale demonstration for the feasibility study for the business plan
6 th fieldwork	<p><u>Modification of the toilets and compost based on the 2nd test results (2)</u></p> <ul style="list-style-type: none"> • Develop an improved models of the toilets and their building. • Standardize a composting process in according to the KIOF's guideline. • Conduct a comparative test of liquid fertilizer and compost <p><u>Preparation for a large-scale demonstration for commercialization (2)</u></p> <ul style="list-style-type: none"> • Identify partners for the demonstration and the necessary permit and licenses to conduct the demonstration. • Implement a site visit tour at KIOF for the monitors and select monitoring farmers for compost produced by the GTS. <p><u>Full-scale market research (1)</u></p> <ul style="list-style-type: none"> • Identify potential markets for toilets. • Interview farmers and clarify various farmers' needs by farming size.
7 th fieldwork	<p><u>Localized business model development based on the 2nd test</u></p> <ul style="list-style-type: none"> • Develop a main product for Kenyan market which was modified based on the demonstration. • Confirm the safety of GTS composts produced in align with the KIOF guideline <p><u>Preparation for a large-scale demonstration for commercialization (3)</u></p> <ul style="list-style-type: none"> • Secure the cooperation on the demonstration from Nakuru County. • Conduct a workshop for compost monitors. • Finalize the large-scale demonstration plan <p><u>Full-scale market research (2)</u></p> <ul style="list-style-type: none"> • Conduct market study on tenement users for toilets and human waste compost.

Chapter 2 Development Needs and Market Opportunity on Sanitation

2.1 Development Needs on Water and Sanitation

In Kenya, 80% of its land is arid or semi-arid with limited water resources. 17.3 million, out of the population of 46.7 million, lack access to safe water, and 32.7 million lack access to improved sanitation⁴. As shown in the following figures, urban drinking water trends deteriorated in 2015 compared to 1990. It is thought to be due to overpopulation, lack of water resource as well as lack of sewerage system which can protect precious water resources from pollution. Regarding sanitation trend, while there are improvements both in urban and rural areas, access to improved facility is still limited to 30% of the population.

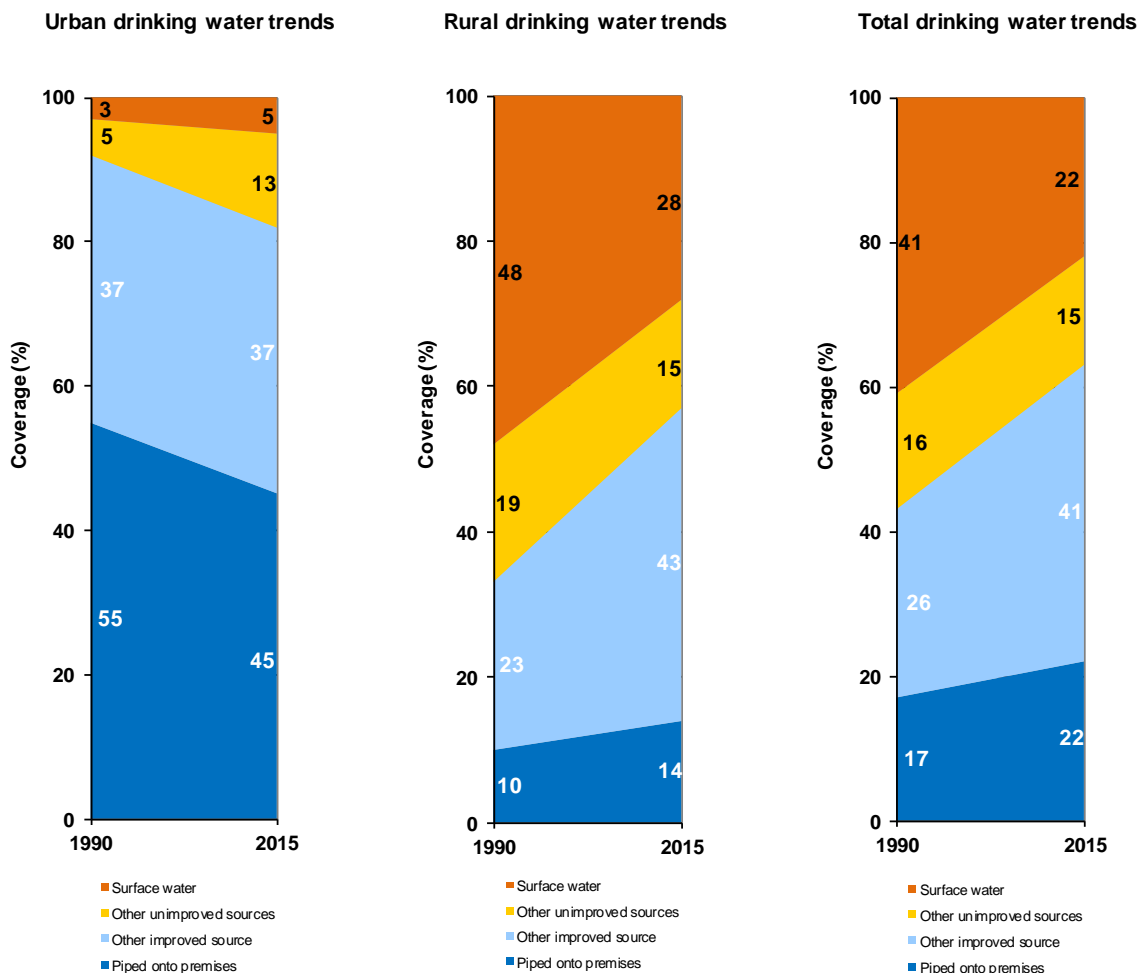


Figure 2-1 Access to Safe Water in Kenya

(Source: UNICEF and WHO, Progress on Drinking Water and Sanitation 2015 Update)

⁴ Source: Water.org, <http://water.org/country/kenya/>, accessed on 17 December, 2015

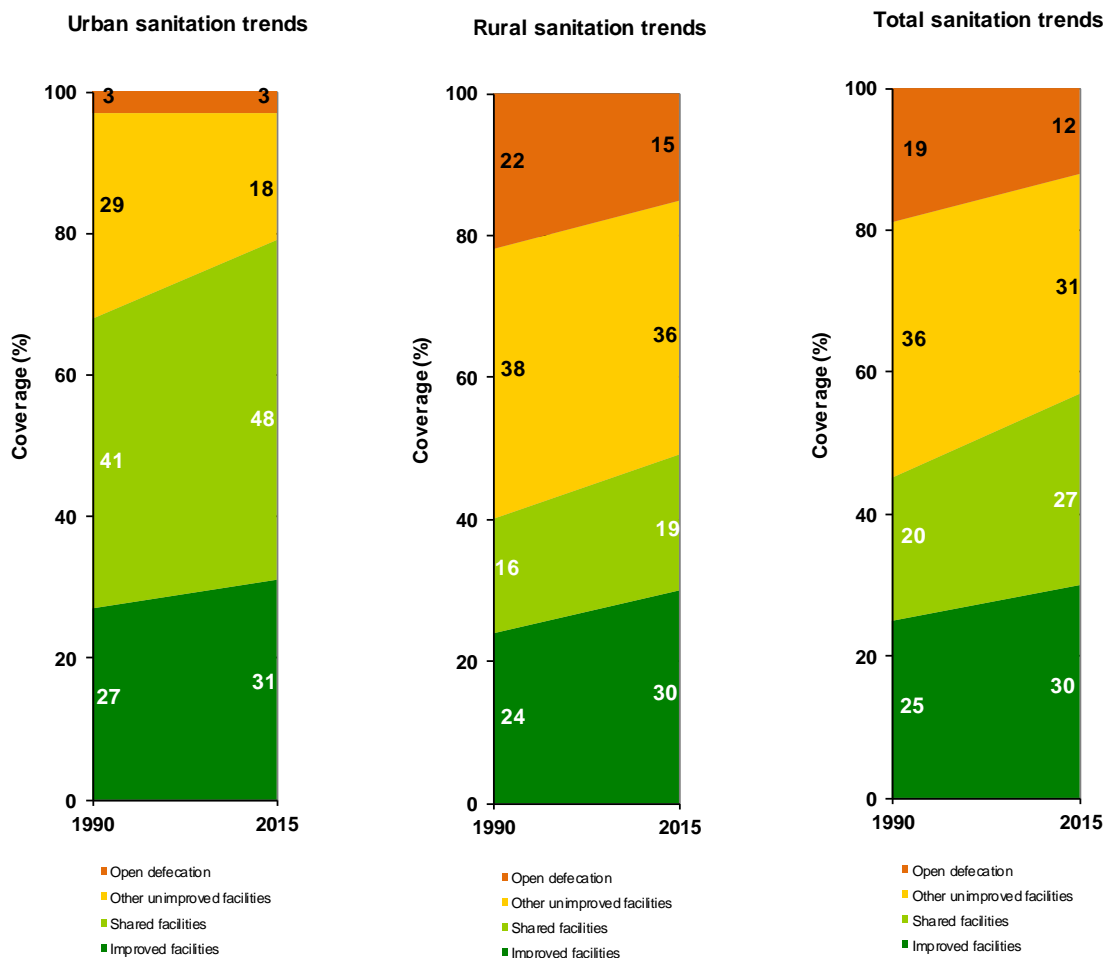


Figure 2-2 Access to Improved Sanitation Facility in Kenya

(Source: UNICEF and WHO, Progress on Drinking Water and Sanitation 2015 Update)

2.2 Market Opportunity

There is high demand of improved and safe sanitation facility, and ecological toilets like waterless GTS. It is critical for the project to identify potential market for GTS, which would be conscious of environmental impacts, can bear the cost for human waste collection system, and has purchasing power on a certain scale. In the planning phase, the potential target was the middle income who can afford an individual house in non-urban areas around Nairobi where sewerage infrastructure is not well-developed. Most of them use water flush toilets made in China or India which cost 2,500Ksh those toilets consume 10 liters of water per one flushing. The market research revealed that they demand water flush toilets because they can access to water easily in their residential areas, and the housing developers also prefer the water flush toilets as part of modern housing facility rather than pit latrines. Therefore, the market opportunity is considered as low.

Conducting further market research, the project identified the potential targets which are houses and tenement owners currently using pit latrines in limited water access areas, and the environmentally

conscious plantations and their staff housing. There are some tenement owners who pay for 50,000~80,000 KSh for pit reconstruction every two years. Some of them often bear the cost of human waste collection. Installation of GTS can reduce these cost. The research also found out that plantation companies spend a large expense to comply with environmental and labor regulations for export to Europe. GTS could help them provide ecological, low-cost, safe and comfortable sanitation systems for their employees, and improve their workplace environment.

Chapter 3 Project Progress and Outcomes

3.1 1st fieldwork (5th April to 11th May 2014)

(1) Preparation for a monitoring test

The project team selected a project site for a monitoring test in Katani, one of the suburb areas of Nairobi. The site is a low cost housing development site, managed by AMT, a local NPO, that agreed to install GTS. 12 GTS toilets were produced with local materials and imported parts, and installed to the project site as requested by monitors who will use the toilets.

(2) Collaboration with local government and institutions

To develop a framework and standard for GTS, LIXIL presented the business and product overview to introduce GTS to Nairobi City County and secure its cooperation for the project. The County suggested that the project involve NEMA and KEBS.

(3) Preparation for an exposure visit to Japan

The plan of the exposure visit to Japan has been discussed with Nairobi City County. As the project was carried out, it was agreed that all necessary training on GTS can be conducted in the project sites in Kenya and the visit to Japan is not implemented in the project.

(4) Market Research

With the support of Grohe AG under the LIXIL group who started operation in Kenya, LIXIL conducted interviews with 6 developers and distributors through its network. It was found that the end users and developers are not so interested in water saving toilets as expected, because they can access to water with fair price near Nairobi.

3.2 2nd Fieldwork (4th September to 21st December, 2014)

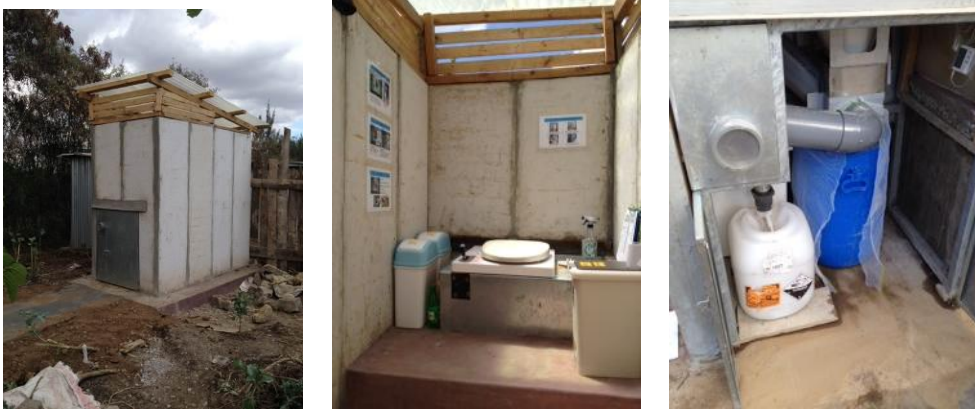
(1) Kick-off of the 1st monitoring test

The project found out that the site identified in Katani during the 1st fieldwork faced a delay of electrical work. It had no clear idea on when users can move into the site and start using the GTS toilets. Therefore, it was agreed that the project site needed to be moved and LIXIL will consider further coloration with AMT.

As an alternative site, teachers' dormitory in Saidia Furaha operated by Japanese representative in Kitengera near Nairobi was selected. One GTS toilet has been installed for 6 users. LIXIL held the workshop on project overview, how to use and manage the toilet (including human resource waste collection and composting process) for the users. Although some users showed hesitation against composting from human waste, it was agreed that the monitoring test would be implemented for one year from October, 2014. In addition, agricultural test for GTS fertilizer was going to be conducted in the support of experienced local consultants in order to prepare for NEMA and Kenya Plant health inspectorate

Service (KEPHIS) standards. To meet KEBS standards, the MOU on joint research with JKUAT has been signed on June, 2014.

Photos: GTS toilets installed in Saidia Furaha (from left, outside, inside and bottom of the toilet)



(2) Market Research

The project team conducted interviews on water and sanitation situation in Banana Hill on the outskirts of Nairobi. Although the area has water and sewerage infrastructure along the main road, the supply lines have not yet extend to all houses in the areas due to financial limitation. Most of them saves raining water in tanks and buy water from private company if needed. Pit latrines with a 20 meter pit are common in the areas. The users have not yet emptied the pit for 20 years, and used volume reduction chemicals twice a year.

Photos: Market Research in Banana Hill



(3) Revision of the business system based on the results of the 1st monitoring test

Due to the unexpected delay of the project site construction, JICA and LIXIL have agreed to extend the project period for one and half years by March, 2016.

LIXIL has also modified the business model and project activities as the results of the fieldworks. First, the target has been shifted from the middle income who owns their own houses, to those who use pit latrines in

high densely populated areas with limited access to water. LIXIL plans to take responsibility of toilet production, collection, composting process, selling fertilizer to farmers, and will transfer the technology of whole system management to local institutions.

3.3 3rd Fieldwork (4th January to 21st February, 2015)

(1) Examination of the new business model

The agricultural test was started in Saidia Furaha with the local consultant who prepared and managed the site. GTS fertilizer has been analyzed and compared with chemical fertilizer and cow manure fertilizer. Since the joint research with JKUAT for KEBS standard was delayed due to discussion on cost-sharing policy, it was decided that the agricultural test also included the analysis aiming at KEBS certification.

(2) Workshop for the monitors of the 1st monitoring test

The workshop on the monitoring test has been conducted to listen to the monitor's voices. It was confirmed that there was no problem on flies and odors as well as composting process so far. But some raised the following concerns, i.e. the operating handle separating urine and feces is too complicated, temperature inside of the toilet is too hot, dust comes inside of the toilets due to the large door for air ventilation. Those points were taken for further modification.

(3) Environmental assessment for standard certification

In Kenya, a NEMA certificate is required to manage waste. Thus, the project started environmental assessment with a private organization accredited by NEMA. The project has decided to complete the assessment by the end of April, 2016.

(4) Market Research

The project team visited new residential areas, Longai and Utawala, 30 km away from Nairobi and conducted market research for waterless toilets. The research showed that it costs 20,000 ~30,000 KSh to construct a pit and 2,000/KSh per month for maintenance and the areas can be potential market for GTS.

Additionally, the project team conducted interviews on organic agriculture market with JICA's SHEP (Smallholder Horticulture Empowerment and Promotion Unit Project), KIOF, Kenya Organic Agriculture Network (KOAN), organic agriculture markets, and farmers. Since KIOF showed strong interest on GTS, the project decided to explore possibilities for joint research.

Photos: Market Research (visiting a farm)



3.4 4th Fieldwork (2nd April to 22nd May, 2015)

(1) Standardization and localization for the Kenyan market

GTS compost produced in the 1st monitoring site in Saidia Furaha has been analyzed by the local research institute. It was confirmed that there is no problem on its safety and component. The sensory assessment on vegetables grown with GTS fertilizer was also implemented by people living around the project site. The monitors preferred the ones with GTS fertilizer, as it looked greener than others.

Photos: Results of the Agricultural Test in Saidia Furaha



(2) Joint monitoring test contract on Improvement of Compost Process with KIOF

LIXIL signed on the contract agreement of the joint monitoring test on human waste compost starting in April, 2015 for one year, with KIOF which has know-how on cow manure composting process. The toilets to be installed were the upgraded ‘screw conveyor’ models based on the monitoring test in Saidia Furaha.

Photos: Installed GTS Toilets

(From left, inside and outside of the toilet and the composting facility)



(3) Market Research

LIXIL commissioned the market research on toilets to one of the local research agencies in order to set a target price of GTS toilets. The research was implemented from 23rd to 30th April, 2015 and interviewed with 420 households in the rock base area where it is expensive to construct and manage pit latrines. The research showed that half of the interviewees use water flush toilets and the other half use non-water flush toilets. It costs 20,000~40,000 KSh/household to construct a non-water flush toilet and it does not cost so much for maintenance. The households with no underground seepage pays 10,000 KSh annually on average for collecting human waste.

LIXIL explored possibilities to use GTS compost for non-food product in order to avoid consumer’s hesitation. As one of the potential target, the project visited Twiga Roses, a rose plantation company. It was found that plantation companies have the concerns on environment impact in the surrounding areas and pay for the countermeasures to mitigate environmental damages in order to meet the criteria of export certificate to Europe. The company showed their interest in using GTS compost and toilets as long as the safety and effectiveness are proved.

Furthermore, the market research on human waste compost was conducted with the local research company. Although the current market demand is still limited, there is a new move in the market. For instance, a major fertilizer company has just penetrated into organic fertilizer market. It shows that there is a possibility that the market for organic fertilizer will grow in the near future.

(4) Joint research with JKUAT

JKUAT has agreed with the detailed plan on the 6-month joint research on GTS compost. LIXIL and JKUAT agreed to share the cost, which is estimated 240,000Ksh in total, and the output from the research

with LIXIL.

3.5 5th Fieldwork (2nd June to 23rd July, 2015)

(1) Standardization and localization for the Kenyan market: Improving GTS toilets and composting.

The upgraded screw conveyor model that supposed to be installed in KIOF was modified further in order to improve waste transportation. The screws for the upgrade model are not produced in Kenya, which is one of the challenges for GTS commercialization in the future. KIOF and the project have agreed to analyze component and cost for composting produced in accordance with KIOF's guideline.

A compost comparative test for agricultural products started in order to see differences among four plots (only water, KIOF liquid fertilizer, urine fertilizer, and urine fertilizer with additives). The project selected the common products in Kenya, which are cabbages and maize, for the comparative study. The workshop was scheduled to be held for the neighboring farms after 3 months in order to show the progress of the test.

LIXIL has completed the monitoring test in Saidia Furaha. The lessons learned from the test have been incorporated to the 2nd monitoring test in KIOF.

(2) Preparation for a large-scale demonstration for commercialization

Based on the two monitoring tests to develop the entire GTS mechanism, the project has decided to implement a large-scale demonstration in plantation companies to see a feasibility of scale-up. The main objective of the large scale demonstration is to collect data on scale-up collection system from the certain number of toilets, the composting process from large amount of waste, the initial and operation costs for commercialization and the market price for toilets and fertilizer. LIXIL has started working to obtain necessary permits and certificates with the support from one of the local environment consultants in order to conduct the demonstration. Naivasha, 2-hour driving from Nairobi, was selected as a demonstration site. In Naivasha, there are many flower plantations which are interested in environment and labor environment improvement in order to meet the standard for export to Europe. Compared with Nairobi, Naivasha has more farms which can be potential users of GTS fertilizer. Furthermore, sewerage system has been under developed and 85% of the population use pit ratlines, according to KNBS Census 2009.

Florensis, who is a partner for the demonstration, is a flower nursery firm exporting to Europe. It employs more than 600 staffs and 300 staff houses with schools for its staff family. Florensis expects that GTS can improve the staff sanitation environment and to reduce environmental impacts and its cost of toilet's maintenance. For the GTS fertilizer monitoring, KALRO (Kenya Agriculture and Livestock Research Organization) and Department of Agriculture in Naivasha were identified as monitoring partners. KALRO suggested that Tuberose be a sample product to apply GTS fertilizer, because it needs a lot of fertilizer and it can be a one of the high value added potential plants. Department of Agriculture in Naivasha introduced the Pyrethrum association as a potential partner. Although Kenyan Pyrethrum had 70% of the world market share in 1990s, currently it is only 2% of the market due to the decrease of the number of the farms as well as corruption in the association. The government is now promoting Pyrethrum in order to recover the

market share. Since both plants are not for food, and requires no standard of human waste fertilizer, the project decided to test both for the GTS fertilizer.

(3) Safety Evaluation on GTS compost

With the support of KIOF, the component assessment has been analyzed. It showed that GTS fertilizer produced in KIOF is as good as other kinds of fertilizer. The local agricultural consultants also analyzed the balance of the three major nutrients (N, P, and K) and concluded that GTS fertilizer is suitable to be used in the early stage of agriculture.

In regard to the joint research with JKUAT, it was found that some legal clearance was needed in JKUAT and it may take long time and not be operationalized during the project period. Further follow up and discussion on cancellation of the joint research would be needed.

(4) Visits to government organizations and presentation to donors.

LIXIL, with the officer from JICA Kenya Office, visited Ministry of Water and Ministry of Health in order to collect updated information on the Kenyan government's policy and the necessary license for GTS's commercialization. It was found that Ministry of Water, in charge of sewerage system, has implemented no sanitation improvement activities so far and each county has their own regulation for licensing. Ministry of Health shared the information on other collaboration projects with private companies and on Technical Working Group (TWG) on water and sanitation. LIXIL attended in the following TWG held on 19 June, 2015, and introduced the project and business plan to development partners. LIXIL will continue attending TWG after the project period and exchange information with relevant stakeholders.

Photo: Presentation at the Technical Working Group in Ministry of Health



3.6 6th Fieldwork (8th September to 26th October, 2016)

(1) Standardization and localization for the Kenyan market:

The project confirmed that the monitoring test in KIOF has been implemented smoothly. The monitors felt comfortable to use the updated operational handles. Further modification for the toilets was considered

especially to improve the issues on visibility of human waste. The monitoring test showed that the Kenyan market prefers a squatting model. Therefore, a new squatting model has been developed and installed for monitoring (as shown in the following photo). While the monitors like it, some showed the concern on urine spreading around the toilets. So the project will take a necessary modification based on the voices from those who conduct maintenance of the toilets.

Photo: The Upgraded Squatting GTS Toilets



The monitoring tests also revealed that comfort in the GTS toilets has not been achieved as expected due to the quality of construction. Stone-made toilet buildings need solid foundation which increases construction costs. Thus, the design of light and quality toilets which can be built with wooden materials by local constructors has been developed.

The project team confirmed that the comparative study on agriculture products has been implemented as scheduled. The same study has been launched for GTS fertilizer made from human feces and it showed that the beans growing with the GTS fertilizer have a better appearance. It is considered that the balanced major nutrients in GTS fertilizer made it happen.

(2) Preparation for a large-scale demonstration for commercialization

It was agreed with Florensis that 10 GTS toilets will be installed to their plantation compound for the demonstration. The toilets will be constructed in housing areas but also plantation areas too. The estimated number of the monitors is 100. The project conducted the site visit to KIOF for the monitor representatives and explained the project concept and activity. The monitors showed understanding and their collaboration on the demonstration site. Additionally, the project visited neighboring farmers who can be monitors of the GTS fertilizer to be made in Florensis. They agreed to be a monitor for the demonstration, and the site visit was planned to be conducted during the 7th fieldwork. The demonstration period will be one year. The necessary licenses to conduct the demonstration has been identified and the project has started preparation for applying for the license with one of the local legal firms.

(3) Safety Assessment

KALRO has agreed to implement a joint research on effectiveness and promotion of human waste compost and start a comparative test on Tuberoses in the KALRO's compound. KALRO also agreed to make a monitoring report in the workshop to be held by LIXIL in March 2016.

Unfortunately the joint study with JKUAT has been cancelled due to the long process for approval. However, LIXIL will explore possibilities to continue flexible cooperation with JKUAT by accepting student interns and sponsoring workshops.

(4) Market Research

The market research has identified three target criteria for GTS toilets: 1) bearing the cost for water and sewerage, 2) having a certain purchasing power, and 3) living in high population density areas. Meeting with these criteria, plantations companies and tenement owners as well as individual houses in the suburb were selected and to be studied further in the next fieldwork.

3.7 7th Fieldwork (5th November to 16th December, 2016)

(1) Standardization and localization for the Kenyan market:

The screw conveyor toilets with squatting style has been finalized for the demonstration in Florensis. The users were satisfied with the finalized model because comfort in the toilets (odor and flies) were improved. This model can be installed to switch with the existing pit latrines too.

GTS compost in the 1st batch at KIOF has been completed and analyzed by the private analysis company. It was confirmed that there is no problem in terms of safety and components. Thus, the GTS will apply the KIOF standard guideline for composting.

Regarding the on-going compost comparative study on agricultural products, cabbages, one of the test vegetables, were harvested and analyzed. There is no clear difference among samples in four plots (only water, KIOF liquid fertilizer, urine fertilizer, and urine fertilizer with additives). The local consultants suggest that further study be conducted in the same site because it was the first trial and the effectiveness of the urine fertilizer was limited to change soil. Microorganism test on cabbage leaves showed that GTS fertilizer reduced *Escherichia coli* and had advantages in microorganism activities and spreading. The samples for the GTS compost made from human feces also will be examined, once the crop can be harvested in January 2016.

Photos: Test Sites (The left used urine fertilizer and the right used feces compost)



(2) Preparation for a large-scale demonstration for commercialization

LIXIL visited the Department of Environment in Nakuru County which is in charge of Naivasha, where the demonstration site is, in order to explain the company profile and project overview. The department has showed strong interests in the demonstration and agreed to facilitate the demonstration.

The workshop and site visit to KIOF has been held for the 3 representative from the Muki Cooperative Society which has 13,000 members. They have seen the toilets, the composting site and the comparative test site and especially showed the expectation on GTS as a fertilizer improving soil condition. They have agreed to join the compost monitoring and try GTS fertilizer to be made from human feces from January 2016.

Photos: The Workshop for the Monitors at KIOF



(3) Market Research

As one of the potential market identified in the last market research, the project conducted the market research on tenement owners. According to Kenya Population and Housing Census, there are 61,200 households, 20 % of the city population, living in tenement housing. If one toilet is shared by 6 households, 10,200 toilets are constructed in tenement housing. It is assumed that annual sales could be 1,052 toilets if GTS can be installed or reformed in 1% of the market every year. The research with 190 tenements houses in 5 different areas in the outskirt of Nairobi revealed that there are not so many houses who rebuild the toilets even though the pit is filled. Most of them uses the toilets with collection system. They pay 7,000~30,000 KSh per year for collection and maintenance. GTS could reduce this cost. Therefore, further study on this market will be continued after the project period.

The market research on fertilizer was implemented to identify potential customers and market size for feces compost, called a soil conditioner. 52 farmers with different size of the famers in various areas were interviewed in addition to several fertilizer sales companies. It was found that soil damage is one of the concerns shared among all interviewed farmers. To improve productivity, crop rotation and cow manure fertilizer were introduced, although only half of the interviewees said they were effective enough. So countermeasures against soil damage are at urgent need but there is no effective product and project to deal with it so far. 9 maize farmers out of 15 interviewees had used soil conditioners and 5 of them used Phymyx fertilizer. Out of 31 famers in total who had used soil conditioners, 22 of them used Phymyx one. They have applied soil conditioners not every year, but once in 2-3 years due to cost saving. The research showed that a certain amount of the conditioner, 200kg per acre can be used for maize famers. Most of them expect that soil conditioners can work immediately and they feel 'no impact' if there is nothing to be improved in one season immediately.

The market for most major product, Phymyx, can be considered as the market demand for soil conditioners. Calculating from the sale of Phymyx fertilizer, the market size for soil conditioners can be 140,000 KSh by 2020. In the case that maize farmers can use them, the market size could be bigger as 500,000~45,000,000 KSh.

The research confirmed that some farmers have bought and used soil conditioners and there is a possibility to penetrate to the soil conditioner market. However, it should be noted that customers expect immediate effects from soil conditioners and it should be considered well in advance on how to penetrate into the market to meet their needs. Further market research will be conducted even after the project ends/

Chapter 4 Future Plan and Possibilities of Collaboration with ODA

4.1 Lesson Learned from the Project

The project contributed to developing and modifying the GTS system to meet needs of the Kenyan market, and creating a foundation to start a business in Kenya, through monitoring tests and market research. According to the implementation policy presented in the inception report, the following outputs have been achieved.

[Policy 1] Customize GTS for African through monitoring tests

LIXIL has conducted two monitoring tests in Sadia Furaha and KIOF. As a result, GTS has been customized to meet the needs of the Kenyan market. Through the joint research with KIOF, standardization for composting procedures has been completed. Whole process of GTS has been upgraded for commercialization. Additionally, the market research on toilets and compost has identified market opportunities, potential targets, and challenges to be considered.

[Policy 2] Develop markets and target customers through demonstration in monitoring sites.

LIXIL has organized several site visits and workshops for monitors and potential customers throughout the project. The participants' feedback showed that GTS toilet users think that GTS has less odors and more comfortable than ordinary pit latrines. At the beginning of the project, there were some concerns on people's perception against the fertilizer which is made from human waste. However, the participants understood the safety of the GTS fertilizer and showed no hesitation on using it, once the results of the safety assessment were presented and they confirmed its safety by seeing and touching them at the sites.

[Policy 3] Build standards and a framework to promote GTS with local government.

Although Nairobi City County expressed its understanding and cooperation to the project, the project site for the first monitoring test was moved to the site located in other County due to unexpected delay of construction. For the upscale demonstration in Naivasha, LIXIL has already opened up cooperation with Nakuru County.

[Policy 4] Conduct the training on GTS maintenance and management in Japan for key stakeholders.

Since the monitoring test sites that demonstrate whole GTS process have been successfully developed at KIOF in early stage of the project, it made possible for LIXIL to hold site visits and trainings that meet the needs of the participants. Therefore, the exposure visit to Japan were not implemented in the framework of the project.

LIXIL put forth the following lessons learned through the project.

- (1) Collaboration with local institutes/organizations

It was found that collaboration with prominent academic research institutes such as JKUAT takes time and certain procedures on legal and cost sharing scheme. LIXIL will explore possibilities to continue flexible cooperation with JKUAT by accepting student interns and sponsoring workshops.

Instead of JKUAT, local organizations such as KIOF and relevant local consultants were identified as potential partners through data and information collection. With the collaboration with them, necessary tests and analysis have been implemented to examine the safety and effectiveness of GTS compost.

(2) Two-stage approach to monitoring tests and change of the target County

Even though the project had to change the project site at the beginning of the project as mentioned before, the 1st monitoring test were conducted with small scale in the early stage. LIXIL has taken the gradual approach to expand the test sites and its scale. Showing the stakeholders how GTS works at the project sites, this approach facilitated gaining cooperation from the potential partners, such as KIOF and Florensis at Naivasha. The small scale project sites also contributed to establishing the cooperative relationship with a new County, Nakuru, where the large-scale demonstration will be implemented.

(3) Speed and timeline as part of ODA program

There were unexpected delays and changes because it took some time to start the project after planning and screening processes. It is not easy to deal with changes of the plan, since this is a project with a certain implementation period. Flexible extension helped the project achieving the goal to customize the GTS for Kenya and to build a foundation for further business.

(4) Modification of Business Model

Flexible modification of the business model were required to meet the needs and the reality in Kenya. Through the project, it was found that the newly developed residential areas for middle income class prefer water flush toilets. The market research identified potential markets in the non-urban and the high population density areas with limited access to water. GTS will target those who use shared toilets in such areas, rather than individual housing in non-urban areas. Shifting the business target, LIXIL has modified its business plan and decided to take a responsibility in not only GTS production and sale, but also human waste collection and composting processes.

4.2 Future Business Plan

The three-year business plan has been developed through the project. Implementing a large-scale monitoring test in Naivasha, business model and plan will be finalized for commercialization. During the TICAD VI to be held in August 2016, LIXIL is considering to hold a site visit and workshop to promote GTS.

4.3 Possibilities of Future Collaboration with Japan's ODA

In order to promote GTS, it is important to build capacity of local government and composting facilities as service providers who can provide human waste collection and composting services in a sustainable manner with fair price. GTS can help local government reducing the cost for sewerage system and generating revenues from human waste collection and fertilizer sales. Therefore, it is suggested that as one of the collaboration with LIXIL, JICA explore a possibility to develop a technical cooperation project on improvement of sewerage system in local government in non-urban areas which will transfer the technology to manage whole process of GTS and run a composting facility. Starting with pilot counties, it will develop a model of GTS composting operation to be rolled out in nationwide.

Additionally, GTS can be introduced to the farmers who are involved in the current JICA projects in order to accelerate their project's activities. It could improve their soil condition and reduce the cost of fertilizers for the project beneficiaries. Since GTS can be installed to the areas with limited access to water, it can be introduced to any public facilities to be constructed by Grant Aid and Grant Assistance for Grassroots Human Security Projects in non-urban areas. Thus, they can have economic and ecological improved sanitation facility.