

River Improvement Project in Cebu City

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1. Introduction

Since the 1997 fiscal year, Kitakyushu City, which is one of the Kitakyushu Initiative Network Cities, has been collaborating with Cebu City, (the Philippines), which is also a Network City, and supporting the voluntary initiatives of local stakeholders with the objective of environment improvement in the region's main catchment areas. Through this process, a diverse set of stakeholders from Cebu City joined to form the Metro Cebu Environmental Initiatives Council (MCEIC) in 2002, which has achieved outcomes that are a model for international cooperation such as the commencement of more voluntary environmental protection programs.

In particular, as part of the Guadalupe River Environmental Restoration Program, a simplified domestic wastewater treatment facility has been approved and budgeted as an initiative of Cebu City, and is currently under construction. Further, this project is one of the pilot projects of the Kitakyushu Initiative for a Clean Environment (below referred to as the Kitakyushu Initiative), supervised by the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) and receives the financial support of UNESCAP.

For the purpose of solving the grave problem of water resource pollution in developing countries, this report compiles the features and know-how involved in the successful introduction of a simplified domestic wastewater treatment facility in Cebu City, and addresses the feasibility of technology transfer.

2. International Environmental Cooperation in Cebu City

There has been an exchange between Kitakyushu and Cebu City since before international environmental cooperation commenced with the establishment in 1997 of the Asia Environmental Cooperation City Network, established by Kitakyushu City encompassing 6 cities in 4 South-East Asian countries including Cebu city. Between then and today, March 2006, a range of environmental cooperation projects have been carried out.

Making use of the experience and technology gained from Kitakyushu City's victory over pollution in 1997, Kitakyushu City carried out an environmental study for the introduction of low-pollution production technologies (below referred to as cleaner production technologies) in the Metro Cebu Area, which has faced environmental pollution problem accompanied with rapid urbanization and population growth. In addition to this, a broad variety of stakeholders from government, local residents, NGOs, and corporations, have carried out various environmental cooperation activities including deployment of technical specialists and involvement of local residents in river clean-ups.

The Institute of Global Environment and Society (IGES) recently supported and participated in the planning of seminars and deployment of technical specialists in order to contribute to the Environmental Restoration projects of Cebu City.

As a reference we collated an outline of the international environmental cooperation in

Cebu City between 1997 and 2006.

Year	All	JICA-Related	JBIC-Related	Environment Ministry-Related	KITA independent operations, etc	CLAIR exchange personnel
1997	Council of Asian Cities for Environmental Cooperation Network of Asian Cities for Environmental Cooperation (7 cities in 5 countries)					
1998, 99					Cebu, Bangkok, Semarang Three City Project (KITA, Nippon Foundation) Expansion of resident exchanges	
2000	Conference for Environment Ministers held by United Nations Economic and Social Commission for Asia and the Pacific (UNSCAP)	JICA Regional-focused researcher (one person)	Conducted study on introduction of CP (in alliance with the Japan Bank for International Cooperation (JBIC))		JICA conducted an environmental research course specifically designed for the Philippines (KITA)	
2001	Regional Action Program: Kitakyushu Initiative for a Clean Environment Designated as a pilot project for the 4 th ESCAP* Conference of Environment Ministers (2000)	JICA deployment of specialists (CP introduction, Environmental Analysis Cities contracted out to KITA) JICA took in 2 regional-focused researchers	(Deployment of 2 CP specialists to the private sector (JBIC, city corporation OB, etc contracted out to KITA)		Mingling of residents of Kitakyushu City and Cebu City in the Butuanon River Clean-Up (Aeon Environment Foundation, KITA) Guidance in waste administration (deployment of employees of environmental agencies)	CLAIR Researcher intake (employee of the Philippine Ministry of Environment and Natural Resources) (Establishment of the Metro Cebu Region Environmental Restoration Project)
Year	All	JICA-Related	JBIC-Related	Environment Ministry-Related	KITA Independent Project, etc	CLAIR exchange personnel
2002		JICA deployment of 3 specialists (Waste management, Environmental assessment,	Workshop held on Environmental Management of Rivers (JBIC)	Cebu City Waste Seminar held by Environment Ministry model project About 80	KITA Global Environment Fund Metro Cebu Atmospheric Environment Monitoring	CLAIR Researcher intake (employee of the Philippine Ministry of

		CP introduction, contracted out by city to KITA)	Metro Cebu Environmental Initiatives Council (MCEIC) established. About 80 residents in the Metro Cebu Region participated over two days. Run jointly by KITA with Ube City, Minamata City, and Kitakyushu City) (Deployment of 2 CP specialists to the private sector (JBIC, city corporation OB, etc, city contracted out to KITA)	residents in the Metro Cebu Region participated over two days. Run jointly by KITA with Ube City, Minamata City, and Kitakyushu City) (Creation of a video on general waste)	Study, PCAPI, etc. Guidance in waste administration (deployment of employees of environmental agencies)	Environment and Natural Resources)
2003	<u>Domestic Wastewater Treatment Primary Study</u> (IGES + Environment Preservation Association, September.) <u>Guadalupe River Improvement Project</u> proposed by MCEIC: preliminary study on the establishment and management of domestic wastewater treatment facilities Inspection of potential sites. <u>Secondary Domestic Wastewater Treatment Study</u> (IGES + Environment Preservation Association, Feb 2004) Inspection of sites, surveying, verification of construction technology, feasibility of supply of materials, estimating expenses)			Three MCEIC Representatives invited (Environment Ministry model project, October) (Cebu City Councilor Mr. Archibald, Mr. Gardin from CLEAR, Mr. Bongo from PCAPI-7 Participant in World Partnership Conference (KitaKyu) - Ube City and Minamata City Inspection	<u>Delivery of Garbage Collection Trucks</u> (Support for <u>general waste collection system.</u> From <u>Kitakyushu City to Cebu City: 1 truck</u>)	
2004	MCEIC Annual	Cebu City				

	Report 2003 -Support operations for the establishment and management of a domestic wastewater treatment plant (WTP) (in Cebu City)	Guadalupe River Environmental Restoration Project, JICA grassroots technological cooperation project (Local theme) Education on rivers and the environment				
2005	Kitakyushu-Cebu Environmental Projects (simple costs/contracting fees) Domestic wastewater treatment plant – technological support				Aeon Environment Foundation (2204 to 2005) (Reforestation, KITA)	

In this report we raise the example of the River Water Quality Improvement Project in Cebu City as a case study where international environmental cooperation has been successful for both cities concerned, and we provide information that will contribute to the improvement of water quality in other Kitakyushu Initiative Network Cities.

3. Projects Relating to Construction of the Simplified Domestic Wastewater Treatment Plant in Cebu City

This project developed as part of the environmental cooperation between Kitakyushu City and Cebu City, but it began with the introduction to Cebu City of a purification tank developed in Japan by Kitakyushu City as one of the domestic wastewater treatment systems.

The position of the water-purification tank, as well as its structure is determined through multiple onsite investigations by Japanese specialists. Construction is carried out by local operators while receiving guidance from Japanese specialists.

The process of the work flow is described below in chronological order.

3.1 Outline of the Environment of the Metro Cebu Area

The Metro Cebu Area is the second largest metropolitan area in the Philippines after the greater Manila area. The area is centered around Cebu City, which has a population of around 800,000 (land area of 328 km²) and is located in the central eastern part of Cebu Island, which is one of the Visayan islands in the central region of the Philippines. The Metro Cebu Area holds a population of about 1.2 million and is made up of 6 local government areas: the 3 cities of Cebu City, and the neighboring Mandaue City and Lapulapu City; and the 3 towns of Talisay, Consolacion and Cordova. With the recent increase in population and the accumulation of business and industry in the area, environmental problems have manifested including waste management and river pollution.

Cebu City is separated from Lapulapu City only by the Mactan Channel, and on Mactan Island there is an international airport and international resorts. Roads, electricity and water supply facilities are in place, but the wastewater treatment measures are behind the times. In the industrial parks, hotels, and airports, however, there are aeration ponds, and wastewater treatment facilities that utilize natural vegetation, and activated sludge methods. Sewage is treated in septic tanks, but much of this is discharged directly into the waterways. There are also many residences without toilets, and Guadalupe River, which flows through Cebu City, is seriously polluted by sewage and illegal dumping of garbage, with an average BOD of 66mg/L (A Cebu City study done in 2000).

The climate of the Cebu Region is dominated by a wet season and dry season, and in the wet season pollutants including garbage are all washed away by the rain so there is little sign of water pollution. In the dry season, however, there is no rain, so the rivers overflow with decomposed sewage, and the stench is terrible.

(photograph) Garbage dumped in the river	(photograph) The river has become a waste dump
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(photograph) Residences built along the river	(photograph) Clothes are washed with the river water
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3.2 Guadalupe River Environmental Improvement Project

(1) Guadalupe River Environmental Restoration Project

In February 2003, Cebu City held a Seminar Workshop on Environmental Management with the cooperation of Japanese Kitakyushu Initiative Network Cities including Kitakyushu City and Ube City, and as part of this the multi-stakeholders of the Metro Cebu Area gathered together to discuss approaches to environmental restoration, and this resulted in an action plan being proposed for environmental restoration of Cebu Area's waterways. It was also decided in this seminar that a committee (Metro Cebu Environmental Initiatives Council (MCEIC)) made up of these stakeholders would be set up to implement the action plan.

Following this, MCEIC designated Guadalupe River, which flows through Cebu City, as the model river for implementing the action plan, and held a hearing for residents in the catchment area to determine an action plan for environmental restoration of this river. Once the approval of the residents was received the plan was submitted to Cebu City. On receiving the proposal, Cebu City designed an environmental restoration project composed of 3 pillars: environmental education, solid waste management, and environmental restoration of waterways; and in addition to this they proposed a master plan to ESCAP as a pilot project of the Kitakyushu Initiative.

As part of this it was specified that a plan should be drawn up under the Guadalupe River Environmental Restoration Project to restore the water quality by establishing a model domestic wastewater treatment plant in a place where there is severe water pollution from

incoming domestic wastewater in the model river.

(2) Allocation of roles and costs for this project

Cebu City decided in FY2006 to carry out the construction of the simplified domestic wastewater treatment plant and allocated a budget of 5 million pesos for its construction.

The following points regarding allocation of roles and costs among stakeholders are noteworthy. In brief, 1) local operators were chosen to curb costs. 2) Cooperation of residents living in barangays (community associations, local government units) was requested in order to cut human resources costs. 3) The project was implemented based on the cooperation received from the unified body of industry, scholarship, government, and residents (Metro Cebu Environmental Initiatives Council – MCEIC), and 4) the structure of the wastewater treatment plant is relatively simple. 5) The treatment method does not utilize electricity. 6) Another important point is that the maintenance and management of the system is easy. IGES and Kitakyushu City deployed specialists to determine the location of the plant, its design and construction, and maintenance and management, and monitored the progress of the project throughout the process. In addition to this the project received \$5,000 in capital support from UNESCAP as external funds due to the fact that the project was recognized as a pilot project for the Kitakyushu Initiative.

3.3 Preliminary Study for Construction of the Simplified Domestic Wastewater Treatment Plant

(1) Wastewater treatment method

The status quo in sewage treatment is treatment methods that use microorganisms (such as anaerobic and aerobic treatment). Microorganisms can be used in the trickling filter method (microbes are adsorbed to the filter media) and the activated sludge method (microbes suspended in liquid), and in both cases conditions in a biological reactor such as a trickling filter or aeration tank are adjusted to maximize the degradative activity of the microorganisms so that organic material can be decomposed within a set time frame. In operations using the activated sludge method one has to be careful when using electricity continuously and managing activated sludge, and it is used in large-scale treatment plants such as public sewage systems, as well as company wastewater treatment. However, when the activated sludge method is used in medium-scale wastewater treatment plants (residential), problems arise such as who will be responsible for the supply of electricity and the management of sludge.

Therefore, considering the budget and the experience of Cebu City in sewage treatment, a simplified wastewater treatment plant was proposed with low-cost, easily-maintained and managed water purification tanks and the trickling filter method in mind.

In other words, this plant is an improved version of a technology developed in Japan 30 years ago that combines anaerobic tank treatment and sprinkle-style aerobic treatment where parasites and pathogenic bacteria are destroyed by anaerobic treatment and some BOD is removed, and then in the subsequent aerobic treatment more BOD is removed. The

main body of the treatment plant is large, but a natural drainage method is employed using an incline to reduce energy consumption, and because maintenance is simple compared to the activated sludge method, it is thought to be a technology well suited to developing nations. In addition, because the local climate facilitates year-round maintenance of a wastewater temperature that is ideal for multiplication of bacteria, excellent conditions for both anaerobic and aerobic treatment can be maintained throughout the year, making the trickling filter method highly suitable.

There are two main ways to discharge the treated water from the treatment plant: 1) Natural discharge making use of the shape of the land, or 2) when the plant is located on flat land and natural drainage cannot be utilized, the treated water must be discharged somehow. Method 1 applies for plants located on sloping ground or at the edge of a cliff, and because the treated water is discharged naturally there is no need for electricity for pumping so it is an energy conserving structure. Method 2 applies to plants on flat ground and requires a pump to draw up the treated water. Pumps require power, but the position of the water treatment plant is a crucial decision determining the method by which treated water is discharged. In Japan treated water is discharged with a normal wastewater pump, but there are also methods that utilize wind power and solar power. Also, in developing countries there may also be methods (technologies such as water turbines and irrigation) where the treated water is drawn up with independent technologies.

(2) Preliminary Study

IGES and Kitakyushu City began the preliminary study on construction of the simplified domestic wastewater treatment plant in Cebu City in September 2003. The first study addressed the model plant location previously chosen by Cebu City and determined a location where the plant could be built. After concluding a study based on local conditions, the basic design for the model plant was finalized.

The first report addressed the following issues.

A Collection of local information

Planned location of the plant, lay of the land, amount (number of houses, *etc.*) of domestic wastewater to be treated at the plant, presence of human sewage (amount generated), local wastewater treatment technologies (cost of equipment), *etc.*

B Local study and public hearing

C Basic design of model plant, estimated construction costs and costs of maintenance and management

(photograph) The signboard standing on proposed site	(photograph) Proposed area for construction of the treatment plant
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(photograph) Cooperation with residents of the area	(photograph) Cooperation with Cebu City stakeholders
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proposed for construction	and business people
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(photograph) Cooperation with Cebu City stakeholders and business people	(photograph) Cooperation with Cebu City stakeholders and business people
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The second local study was done in February 2004.

The following factors were addressed leading up to the construction of the wastewater treatment plant.

A Confirming the land for the proposed construction has been secured

Did simple surveying, *etc.*, to verify whether construction using the size of the basic design was actually possible at the proposed site considering local conditions. Made necessary adjustments to the size, according to site conditions, leading up to design of the real plant. Surveying determined that construction would be carried out in a location where treated water could be discharged naturally, so the final structure was an energy-conserving one.

B Study of market prices for a detailed investigation into construction costs

In order to do a detailed study of the construction costs for the model plant, local market prices were investigated for labor, concrete and other building materials, construction equipment, *etc.*

C Verification of the technological capacity of local contractors for construction works

Verified the technological capability of local contractors in relation to all aspects of the model plant construction. Specifically, for wet concrete contractors, this included mold making, reinforcing, plastering, *etc.*

D Coordination with related institutions

We will deploy stakeholders (employees, residents) of Kitakyushu City to Cebu as specialists for the construction and prudent management of the model plant, so we approached the local NEDA-7 (National Economic & Development Authority-7: The 7th regional office of the Philippines' national aid administration institution), and made several requests including that procedures be initiated to request JICA specialists to be deployed.

Regarding support for the construction costs of the treatment plant, the plant had to await to be approved as a pilot project for the Kitakyushu Initiative program, administered by UNESCAP.

(photograph) A meeting with stakeholders at the construction site.	(photograph) A presentation on the treatment plant
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(photograph) Wastewater from laundry, <i>etc.</i> , being	(photograph) Toilets in barangay residences
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discharged to a nearby river via a drain	
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(3) Technological guidance relating to construction of the simplified wastewater treatment plant

Cebu City is taking the lead in large-scale development facilities with the wastewater treatment plant, but there is no public sewage system for treating general residential wastewater. Because of this, all domestic wastewater flows into the rivers, which are experiencing worsening water quality. The local Cebu City authorities do not plan to build a public sewerage system due to various circumstances including lack of funds, but they plan to improve water quality in rivers by building a small-scale wastewater treatment plant (with a treatment capacity of about 100 people) as a model and substitute for a public sewage system, and to subsequently build more in several locations. This treatment plant is designed to treat domestic wastewater (especially BOD), but the wastewater from households in Cebu City is characterized by a lot of laundry wastewater (making their living doing laundry as a business), and little bath water and kitchen wastewater. In the slum regions there are few baths and toilets and it is true to say human waste is discharged untreated.

The wishes of the Cebu authorities

- For the residential small-scale wastewater treatment plant, to adopt systems that don't use electricity, such as ventilators and wastewater pumps, because the power situation is bad.
- To employ local residents in the construction.
- To adopt a system that treats all domestic wastewater.
- To obtain assistance from Japan in the construction.

After the two local studies by specialists on September 2003 and February 2004 were completed, construction began on the treatment plant. The Cebu City office, which is responsible for the construction works, divided the construction project into Stage 1, Stage 2, and Stage 3, and began construction.

IGES and Kitakyushu City again deployed specialists in August and November 2005 to check on the progress of the construction works, and to give guidance and advice on Stage 2 of the project.

3.4 Construction of the Simplified Domestic Wastewater Treatment Plant

The status of progress of design, specifications, and construction of the simplified domestic wastewater treatment plant are as follows.

(1) Design and specifications of the simplified domestic wastewater treatment plant

The features of the design and specifications of the treatment plant (model plant) are as follows.

1) Building with special materials (e. g., plastics) is difficult because replacing components locally would be difficult, so the plant will be built with reinforced concrete, which can be easily procured locally.

2) Treatment capacity: 64-person tank, 12m³ of wastewater per day (rough estimate, to be precise: 53-person tank, 10.6 m³ wastewater per day)
(Japanese standard).

3) The treatment method to be adopted is the anaerobic trickling filter method (Watanabe Method), which is an improvement on the trickling filter method used in Japan since long ago. All materials will be procured from within Cebu City. Depending on the location of the plant, purification using this method is possible without using electricity. The structure is simple and maintenance and management is straightforward.

4) The treatment plant will be built by the Guadalupe River. The plant is located at a point 5m above the level of the river, so pumping power (electricity) is not required for discharge. The wastewater is gravity-fed through the purification process so purification is possible without the use of electricity in pumps, *etc.* In addition, a public toilet and public laundry facility will be built side by side on the upper level of the plant for the sake of the residences that have no toilet.

(Note: The next construction site will require use of a wastewater pump).

The head drop from the incoming pipe to the treatment plant and the outlet for treated water is 4m or less (corresponding to the depth of the treatment facilities).

5) L 8m x W 2 m x D 4 m (external dimensions).

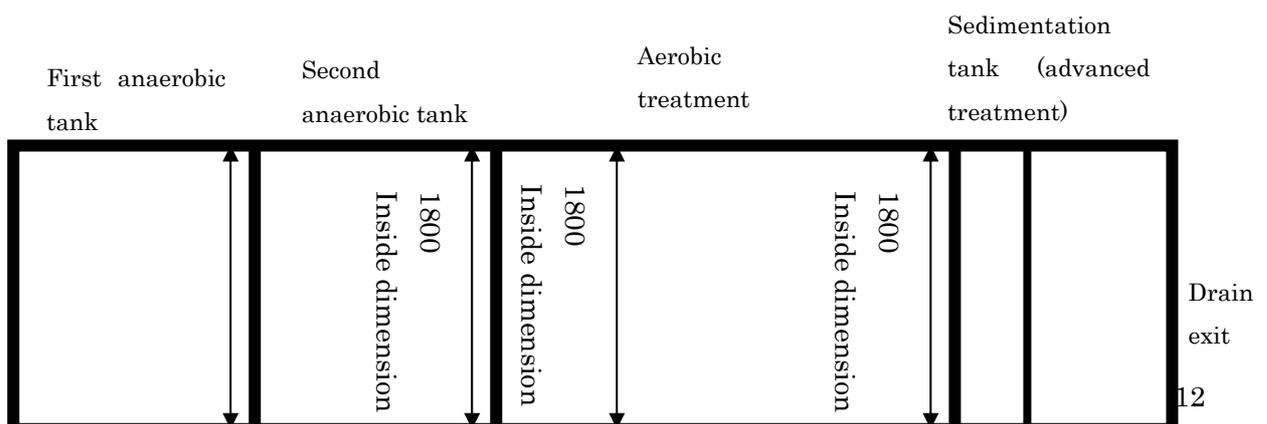
6) BOD concentration of the treated water = 30 mg/l (estimate)

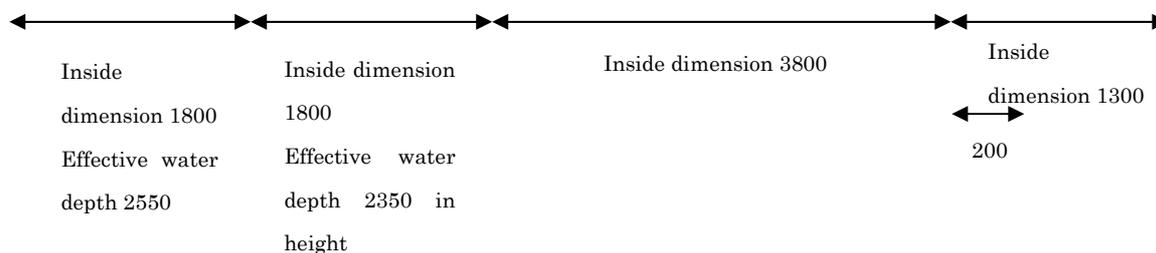
7) The construction of the most important sections (set up and adjustment of the sprinkling weirs) will be overseen by specialists from Japan. It is planned for them to also provide guidance in the future for water quality monitoring, clean-up and inspections.

(Note: The policy of our specialists is to build the public toilet and public laundry facility on the upper level of the treatment plant without laying sewerage pipes, but the policy of the Cebu City authorities is to lay sewerage pipes. The building of public toilets and public laundry facility in Cebu City is still unclear at this time.)

(2) The process of water purification in this treatment plant

The floor plan of the treatment plant is as shown below (units are in mm).





The wastewater that comes into the treatment plant is discharged after purification at the same rate (when there is no inflow there is no outflow). The treatment plant is made up of anaerobic tanks (1 and 2), aerobic treatment tank and sedimentation tank, and deodorization, and the wastewater flows through them in this order: first anaerobic tank, second anaerobic tank, aerobic treatment tank, sedimentation tank.

1) Anaerobic tank

The anaerobic tank is composed of two tanks, which are always kept full.

- First anaerobic tank

The first anaerobic tank is a simple water tank, and wastewater first comes into this tank. The solids in the wastewater (called sludge) accumulate at the bottom. The organic matter in these solids is decomposed (consumed), releasing gas. The gas attaches to the organic matter and floats to the surface where it accumulates as scum. The scum and sludge accumulate as the plant operates so regular clean-up is required. After passing through between the tanks the wastewater enters the second anaerobic tank.

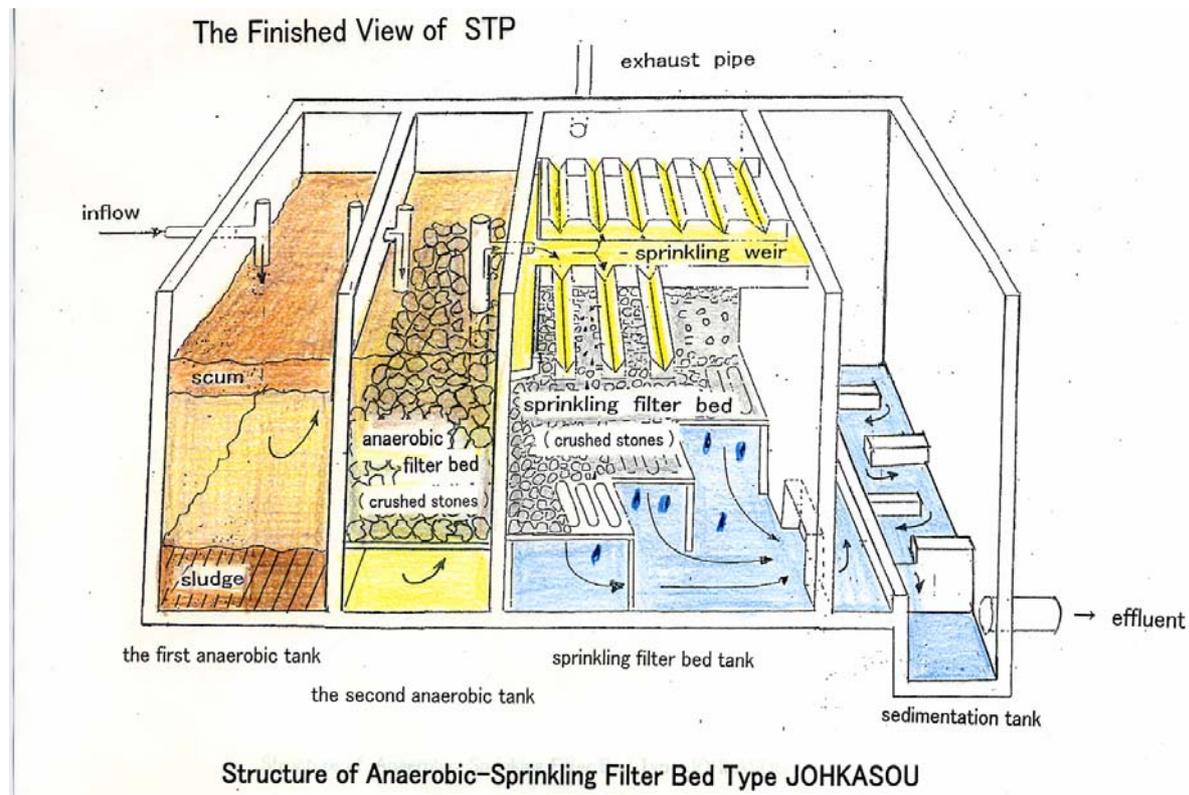
An anaerobic filter bed was not included in this project because the condition of the incoming wastewater is unknown and people tend to throw plastic bags into it, but depending on the situation after construction is completed, the door is left open to make the improvement of establishing an anaerobic filter bed.

- Second anaerobic tank

The middle portion of this tank is packed with filter media (stones). The BOD material in the wastewater is decomposed by the anaerobic microorganisms attached to the surface of the filter media. It is important to always maintain an anaerobic condition in the anaerobic filter bed. The multiplying anaerobic microorganisms peel off from the filter media and fall down to accumulate at the bottom (sludge). Some is encased in the methane gas generated and floats to the top as scum. From this tank the wastewater enters the next aerobic treatment tank. The anaerobic treatment releases a bad smell, but this is naturally released from the odor exhaust pipe.

Once the scum and sludge accumulates to a certain degree the unit needs cleaning (usually once a year). For anaerobic filter beds, because each tank is packed with filter media, to remove the sludge at the bottom a hose is inserted into the tank's exit pipe and the sludge is

extracted.



- Aerobic treatment tank

The aerobic treatment tank is made up of the sprinkling weirs, odor exhaust pipe, and filter media, and is structured so that air is continually flowing through it, and to avoid submersion of the filter media the tank must never be full.

Wastewater from the second anaerobic tank drips down from notches in the sprinkling weir to the filter media surface in the lower section. It is crucial that the wastewater is dispersed evenly from all the notches in the sprinkling weirs, and this is called uniform sprinkling. It is an important factor in inspections. The falling wastewater droplets are aerobically purified as they fall by the aerobic microorganisms on the surface of the filter media. The newly created aerobic microorganisms peel off and fall down. As these microbial membranes accumulate at the bottom more suspended solids appear in the treated water, so regular cleaning is required.

Air (oxygen) is required for the multiplication (respiration) of the aerobic microorganisms. This air enters from the air inlet in the upper part of the sedimentation tank, and passes through the filter media from the bottom of the aerobic tank, then flows naturally to the exhaust pipe. The opening at the end of the exhaust pipe is built higher than neighboring roofs, and by drawing out air from the aerobic treatment tank under the influence of the outside breeze (natural ventilation), it supplies air to the aerobic microorganisms. For this reason the air intake must be covered.

The aerobic filter bed is usually cleaned once a year, and the filter bed is washed with tap water (pressurized water), removing the surplus microorganisms. If they do not come off, several sprinkling weirs are removed and the filter bed section removed before washing.

- Sedimentation tank

The sedimentation tank is a simple tank with channels built into it. In the upper portion there is an air intake. Usually in Japan disinfectant tubes are installed in these channels, but in Cebu it is difficult to source disinfectant, so the treated water is not disinfected. The treated water is mostly extracted with a pump, but natural drainage is used when the plant is located on sloping ground so a pump is not needed.

The plant's structure provides the option to apply advanced treatment to the treated water by placing bags packed with activated carbon (powder) in the sedimentation tank. A more advanced treatment than just passing treated water through the tank is placing coconut shell activated carbon (powder or granular), made by baking coconut shells, which are abundantly available in the area, in coarse-mesh bags and hanging them from the upper section. Used activated carbon is regularly replaced.

(3) Status of Stage 1 Construction

Cebu City decided to construct a model domestic wastewater treatment plant in the Sambag 1 barangay, and have assigned this project a budget of 1.54 million pesos (Approximately 3 million yen, including \$5,000 (about 550,000 yen) from ESCAP) as a project for FY2005.

Stage 1 Construction (excavation and construction of the external framework) was completed 3 weeks ago, and the contractors for Stage 2 (interior and upper construction) have now finally been chosen. Stage 3 of the construction (laying the drainpipes) is planned for after the plant has been built.

Because little flush water is used, making drains easy to block and their management difficult, and construction of the drainpipes will take significant time and money, the specialists have proposed that the upper part of the plant and the public toilets and laundry should be built first without laying the drainpipes. However, Cebu City decided to lay drainpipes for most of the residences (about 70 dwellings) in the barangay, so to maintain the height difference with the drainage the treatment plant was being built 1.4m below ground level. We explained to them that while this releases the treated water to the river, the downside is that in the rainy season when the river level rises it will flow back into the plant, and if the aerobic tank is submerged for over 3 days, the microbial membranes will be destroyed and the ability of the system to treat water may be lost.

Due to the fact that laying of the drainpipes in Stage 3 is the last planned construction, and that the barangay residents are voicing their desire for a public toilet to be built, Cebu City are considering building a temporary public toilet and laundry in the upper level of the treatment plant.

Also, seeing as it is dangerously built 1.4m below ground surface, Cebu City plan to build a fence, but as is this could result in the distortion and collapse of residences on either side.

(photograph) Checking the status of construction	(photograph) The river into which water is discharged, the water-pipes from toilets can be seen.
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(photograph) Stage 1 construction (excavation and construction of the external framework) is complete but it has been left for 3 weeks	(photograph) The plant itself was built 1.4m below ground level, which is not what the specialists proposed
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(4) The plan, technical guidance and advice for Stage 2 of the construction

A purification tank specialist was deployed to Cebu City in August 2005 and gave the following advice and guidance regarding Stage 2 of the construction of the interior and upper section of the treatment plant.

- 1) Build the floor with a 1:400 incline to ensure good drainage from the aerobic tank
- 2) To strengthen the slits that support the contact medium (stones) of the second anaerobic tank, and the sprinkling weirs and aerobic filter media (stones), they must be dried for at least 4 weeks, so they should be prepared at the start of the construction works
- 3) The thickness of the sludge outlet pipe in the second anaerobic tank must be large enough so that a vacuum pipe can be inserted.
- 4) The aerobic tank's air extraction pipe should have a diameter over 30cm to account for air circulation, and should be installed in the diagonally opposite corner to the drain exit, and because the smell is strong its height should be above the roofs of residences.
- 5) A manhole of at least 60cm should be built into the upper layer (ceiling) so that a person can enter for maintenance work. The toilet and laundry should be built so as not to cover the manhole.
- 6) The channels in the initial sedimentation tank should be built so that water flows through them smoothly.
- 7) Construction of the sprinkle weirs requires delicate work to ensure water is sprinkled uniformly, so we explained that if possible a specialist should come to directly supervise, and requested that they inform us of the status of work.

The following guidance and advice was given regarding the laying of drainpipes in Stage 3 of the construction.

- 1) Invert levels should definitely be installed at pipe connections and turns.

(photograph) Searching upstream in the river for rocks to be used as filter media	(photograph) The size of rocks used for contact medium and filter media
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(photograph) An explanation on the structure and way of preparing invert levels	(photograph) An explanation on the structure and way of preparing invert levels
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(5) Onsite technical guidance for Stage 2 of the construction

In November 2005 we deployed 2 specialists to Cebu City, and they consulted with local stakeholders regarding construction of the interior and upper section of the treatment plant in Stage 2 of the construction. They gave the following guidance and advice at the construction site.

1) Confirmed issues to date and their solutions

The initial plan proposed by the specialists was to build a common toilet and place to do laundry in the upper section of the construction. However, in an August 2005 study, the structure of the wastewater treatment plant planned by Cebu City was quite different to Kitakyushu City's proposal. Specifically, in Kitakyushu City's proposal the upper section of the wastewater treatment plant was to be positioned at the same height as ground level, but in Cebu City's design, it was dug below ground level 1.1 to 1.4m. This was done to collect wastewater from a broad area through drainpipes. Also, while Kitakyushu City proposed building a public toilet and laundry facility in the upper section, Cebu City's plan included only a public toilet.

From the recent fact-finding inquiry, we learned that the plan is to build 2 toilets in the upper section. The specialists proposed the building of a laundry facility because there will be insufficient incoming water with only a toilet. With regard to this they plan to verify the needs of the local residents before going ahead. Also, they were initially planning to lay drainpipes but due to budget-related issues, they decided to build them gradually in the future rather than now in one go.

The barangay captain and the head of the Sambag 1 ward, who are also carrying out other construction projects, pointed out that the fact that the upper structure of the wastewater treatment plant is constructed 1.1 to 1.4m below ground level is quite dangerous. Notices requesting something to be done about this were submitted to Cebu City and to the mayor of Cebu City in late November 2005, resulting in a decision to consult with residents in future before making decisions. Cebu City indicated they would investigate the possibility of somehow raising the upper section to ground level. The budget was insufficient so construction would be postponed until January 2006.

(photograph) Packing the aerobic tank with filter media (large stones)	(photograph) After packing the anaerobic tank with filter media
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2) Guidance in construction of the sprinkling weir

The technology of joined purification tanks in this wastewater treatment plant has been amended to suit circumstances of a South-East Asian developing nation, and this facility has never been built in the Philippines before. For this reason Mr Otsuka, a construction specialist, and Mr. Watanabe, the inventor of this wastewater treatment method, offered technological guidance and advice.

Specifically, they focused on the core components of the wastewater treatment plant that are difficult to build such as the mounting for the filter media, the sprinkling weir mount, and the leveling of each component. The details of the advice provided are as described later in the Service Record. Technological support was completed as initially planned without any major problems.

(photograph) Mounting the sprinkling weir	(photograph) Completion of mounting of the sprinkling weir
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Despite being the first time this kind of plant has been built in the Philippines, construction progressed extremely smoothly, excluding a few minor local faults. Cebu City indicated unofficially that because Sercher Development Corp., which managed the project this time round, has a relatively high technical ability and has accumulated know-how from this project, there is a high chance they will be chosen again for construction of wastewater treatment plants in future.

(photograph) Adjusting the sprinkling weir	(photograph) Checking the sprinkling is uniform
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We also tied up with local NGO PCAPI-7 to carry out a fact-finding inquiry in the barangay where we are treating wastewater, to find out how much domestic wastewater is released from each family, and what the needs of residents are regarding domestic wastewater treatment plants.

(6) The plan moving forward

Cebu City has secured 5 million pesos (approximately 10 million yen) for the budget for the Guadalupe River environmental restoration project in FY2006. The budget for the wastewater treatment plant project is planned to be 120,000 pesos for water quality monitoring, 1 million pesos (500,000 pesos x 2) for the construction of two small parks, and about 3.8 million pesos for laying drainpipes. They want to build a new one around the middle of FY2006. However, the details are still not finalized and remain malleable. The water quality monitoring data post-construction will be received from Cebu City. This needs to be checked in future while maintaining close communication with Cebu City Office.

The following projects are required as follow-ups to this project.

- A method of regular maintenance and management (cleaning and inspection) after commissioning of the wastewater treatment plant
- Correct use of the wastewater treatment plant

We summarized the method of maintaining and managing the plant, but we have doubts as to the degree of understanding that resulted, because we did so before completion, and the audience was made up of administrative people. In future we should focus on the people who actually do maintenance and management, while taking into account waste-related laws, regulations, and advice in the Philippines. For the explanation of proper use of wastewater treatment plants we will focus on the barangay residents. Because this is a method for laying drainpipes, the objective will be to eliminate problems like blockages of drainpipes caused by dumping of solid waste. This is due to the fact that we felt residents didn't realize the value of the plant.

3.5 Assessment of the Construction of the Simplified Domestic Wastewater Treatment Plant

(1) An outline of the treatment plant

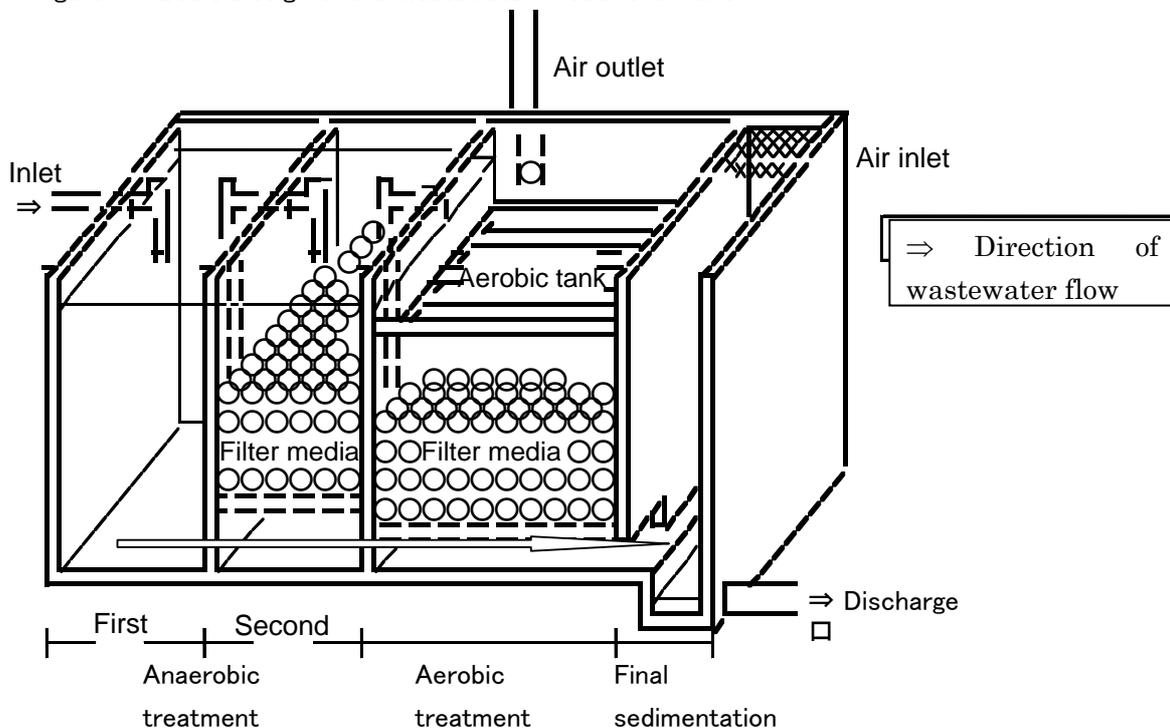
Cebu City constructed a simplified domestic wastewater treatment plant (model plant) in the Sambag 1 barangay. An outline of this plant is shown below.

Treatment Plant

- Location of construction: The Sambag 1 Barangay in the Metro Cebu Area (by the Guadalupe River)
- Specifications: Made of reinforced-concrete: 2m in width, 9.8m in length, 4.1m in height (external dimensions)
- Construction method: Underground installation
- Cost of construction: Approximately 3 million yen
- Specifications: Anaerobic filter - trickling filter type
- Treatment capacity: 10.6m³/day (equivalent to 50 to 100 people, assuming 100 to 200 L discharged per person per day)
- Quality of treated water: 30mg/L BOD; removal rate: 85% (assuming incoming BOD is 200mg/L)

A schematic diagram is shown below.

Figure 1 – Basic Design of the Wastewater Treatment Plant



(2) Assessment of the construction of the plant

In the construction of this treatment plant there were two or three rifts (misunderstandings) between what we were planning on our side and what actually developed. During discussions with stakeholders in November 2005, we asked the opinion of the Cebu City local authorities regarding the 3 points outlined below.

- 1) The plan for the drainpipe construction project
- 2) The problem of collapsing ground in neighboring dwellings due to the constructed treatment plant being set lower in the ground than planned
- 3) The problems with the construction of the public toilet and shared laundry facility

above the treatment plant

The responses to these issues from the Cebu City local authorities were as follows.

1) The city authorities planned to build the drainpipes once the treatment plant was built, but they were of the opinion that the drainpipes should be built gradually rather than in one go, due to financial difficulties.

If the drainpipes are not built as a single project, we believe there is little value in using the treatment facilities.

2) The problem of collapsing ground in neighboring dwellings

The construction has continued for several months and the current situation has become quite dangerous (children play nearby and it is dangerous).

Initially the city authorities explained that it was not dug in very deep.

In reality there is an extremely large height difference, and there is a risk that buildings may collapse.

There was indeed a point where these changes were suspected to be a result of instructions on the Japanese side. These problems were attributed to the Cebu City local authorities, and at the time the Cebu City local authorities were absent, and our side only ever provided technical guidance, and we responded that we were never in a position to determine the policies of the Cebu City local authorities. We also responded that we had submitted our proposed measures to the Cebu City local authorities regarding the upper section of the treatment plant.

We have presented the proposed measures to the Cebu authorities and they have informed us that they plan to carry out Proposed Measure 1 (construction of a retaining wall).

3) The Cebu City local authorities planned to only build the public toilet next to the treatment plant itself.

The objective of this project from the beginning was to improve the water quality of Guadalupe River. A major pollution source for the river at present is laundry wastewater, and we emphasized that if this is not treated also, there is no point in building the treatment plant, and future improvements in water quality cannot be expected.

As a result, the Cebu City authorities agreed to build a public laundry facility.

We also explained that it is possible to build the public toilet in the upper section of the treatment plant, and if this is done the ideal location would be on top of the anaerobic tank, which would require changing the initially planned location of the manhole.

Further, some problems were noticed on site so we pointed them out to the construction contractors.

The work for the sprinkling weir mount was planned for between 24 and 26 November 2005, but the sprinkling weir and the weir mount prepared on-site were coated with

waterproof coating. This will cause the wet concrete to fail to adhere when mounting the sprinkling weir, so we needed to remove the coating from the contacting surfaces. This work was not planned and we decided to take it as far as mounting the sprinkling weir.

Also, the end of the pipe between the anaerobic tank and the aerobic treatment tank was inside the parent weir, and due to the fact that this will obstruct the final finish (wet concrete coating), we recommended cutting it 10cm from the end of the pipe.

The outlet of the aerobic treatment tank is almost submerged, so we recommended removing the opening and increasing its height. (to intake air well)

(2) The capacity of the treatment plant to purify wastewater

Considering the treatment capacity when applying the wastewater treatment plant to Sambag 1 area (50 dwellings).

The treatment capacity of the wastewater treatment plant is as follows.

Specifications	Anaerobic filter bed - trickling filter style
Treatment capacity	10.6 m ³ /day (53-person tank, computation in Japan)
Incoming BOD	200mg/L (Estimate, by Japanese design policy)
Incoming BOD load	2.1kgBOD/day
BOD of treated water	30 to 40 mg/L (estimate) (70 to 80 mg/L in the Phillipines, ? un-confirmed)

1) Basic data

The current state of the Sambag 1 Area (as found in survey by PCAPI-7) is as follows.

- Trial calculation of the daily wastewater discharge per person (answer was used in basic calculations)

	Number of homes	Total number of residents	Water usage (L/month)	Wastewater per person per day (L/day. person)	Calculation in Japan (L/day. person)
Phase 1	8	60	129,522.40	71.9	200
Phase 2	9	65	77,427.80	39.7	
Phase 3	19	103	155,039.0	50.2	
				Average: 54	

Note: Phase 1 (fully-equipped water service), Phase 2 (water service not running), Phase 3 (water service not running), the wastewater treatment plant between Phases 2 and 3 is under construction.

The wastewater generated daily per person is 54 (L), which is about a quarter of the equivalent Japanese figure of 200 (L), and most of it consists of wastewater from laundry.

2) Treatment at the wastewater treatment plant

- Calculation of the total amount of wastewater in the case where all homes have sewage pipes in place

We assume the average amount of wastewater per home in the survey is the average for the whole region.

	Number of homes answering	Total wastewater volume (L/month)	Wastewater per home per day (L/day. residence)	Total number of homes	Wastewater per day (L/day)	
Phase 1	8	129,522.40	540	15	8,100	
Phase 2	9	77,427.80	287	16	4,592	
Phase 3	19	155,039.0	272	19	5,168	
				Total	17,860	17.9 m ³ /day

If drainpipes were laid for all homes (50 dwellings) in Sambag 1 Area and all wastewater brought into the treatment plant, there would be 17.9 m³/day of wastewater, which would exceed the designed capacity (10.6m³/day). However, the estimated amount of wastewater is the amount of water supply used, and not all of this will be discharged. In the Philippines the amount of wastewater is usually estimated to be about 80% of the water supplied, so considering this, it becomes 14.3 m³/day. On considering the following points it is likely the treatment plant will be able to sufficiently cover wastewater treatment for the Sambag 1 Area: A) the design capacity was calculated using Japanese standards, B) it is predicted that the ability of anaerobic-aerobic to remove BOD is higher than in Japan (because the temperature of the wastewater is higher throughout the year), and C) not all of the 50 homes will be able to be connected to the wastewater treatment plant (due to height differences).

Further, it became apparent that people use too much detergent in their laundry. Detergent is sold in disposable packaging and the packaging cannot be recovered. This is thought to be caused by the fact that whitening is apparently popular for laundry in the area, and the tap water is hard water so it does not tend to foam up unless a lot is used. Recommending use of liquid detergents with defined usage amounts may be one method.

4. Technology Transfer Feasibility Analysis Relating to the Simplified Domestic Wastewater Treatment Plant

4.1 Water Quality Problems and Wastewater Treatment Measures in Developing Countries

(1) Water-Related Environmental Problems in Developing Countries

In developing nations, populations increase and when excessive numbers of people flock to

the cities, fundamental infrastructure such as roads, electricity and water become insufficient. They also struggle to find effective environmental policies relating to the problems of environmental preservation such as wastewater treatment and waste management. In this context, severe water problems exist in developing nations, and there are many people who do not have access to safe, clean water, and it is not an exaggeration to say that there are almost no wastewater treatment policies in place that are sufficient.

In developing nations, pollution from domestic wastewater makes up a large proportion of the total load, and these are discharged without treatment into rivers and waterways, leading to severe water pollution and spreading of infectious diseases. This requires urgent action.

(2) Wastewater treatment measures in developing nations

Developing nations like the Philippines have no basic wastewater treatment plan and are struggling with how to solve the problems of sewage and wastewater treatment. There are several reasons for this, including: 1) There are more immediate needs associated with construction of roads and water systems, and the incentive to invest is minimal; 2) there is insufficient knowledge on public hygiene; and in particular 3) the largest restriction is public finance and the power situation. In Japan the generally observed sewerage systems involve enormous construction costs, using large amounts of power to increase efficiency, and while large-scale sewerage systems may be suitable for places like Manila with high population densities, they are not suitable everywhere.

At present in cities like Cebu City a simple treatment system exists called a septic tank (releasing normal sewage into the ground) that decomposes and breaks down sewage under anaerobic conditions, but laundry water and domestic wastewater from the kitchen, *etc.*, is discharged into the rivers and ocean without treatment, leading to water pollution and affecting not only people's health, but leading to increasingly serious eutrophication.

Suggested reasons for why these problems are not easily resolved include: 1) lack of sufficient governmental organizations and legal systems to solve the problems; 2) insufficient environmental technologies; 3) lack of funds to invest in policies and environmental infrastructure; and 4) an undeveloped environmental awareness among the city's residents.

4.2 Feasibility of Technology Transfer Relating to the Simplified Domestic Wastewater Treatment Plant

(1) A wastewater treatment system suitable for a developing nation

In developing nations, a large-scale concentrated facility like a sewage system is required to treat domestic wastewater, including sewage, where the population is concentrated, but in the outlying regions and new residential regions small-scale, dispersed, simple domestic wastewater treatment plants such as purification tanks can be considered. At present small-scale treatment plants (oxidation ditches) that use aeration ponds (lagoon) and activated sludge are common, and in large cities like Manila construction of large-scale public sewage systems could be kept in mind for the future, but in other areas, from the perspective

of finance and technologies for maintenance and management, it is more suitable to proceed with establishment of small-scale, simple treatment systems.

The simplified domestic wastewater treatment plant: 1) has lower construction costs; and 2) can be maintained and managed in an energy-efficient manner; and 3) is a low-maintenance technology so it is a system that is suitable to developing nations.

(2) Simplified domestic wastewater treatment plants

The conditions (necessary technological level), and the needs and penetration of technology in developing nations appropriate for simplified domestic wastewater treatment systems, as well as the outcomes to be expected from them are as follows.

1) Technological compatibility

As described above, this technology is quite compatible for developing nations and could even be said to be the appropriate technology. This method uses materials that can be sourced locally (concrete, *etc.*), and is a construction method that can easily be mastered by local technicians. Maintenance and management is also easy, so it could even be said that the facility is able to be relocated.

2) The needs of a developing nation

Japan International Cooperation Agency (JICA) accepts researchers from developing countries into Japan and conducts technological research in environmental fields. In one such international group study, the domestic wastewater course, many researchers have raised in the themes of their action plans the need for construction of purification tanks as a domestic wastewater treatment measure in developing countries

3) Spread of the technology

Due to the fact that this technology is low-cost, easy to maintain and manage, and quite suitable to the natural (climate, landscape, *etc.*) and sociological (culture, customs, *etc.*) conditions of developing countries, we can expect it to spread into other regions. It can be built on relatively small lots of land, time and money required for construction is small, maintenance and management is simple, and the capacity can be changed simply by altering the scale of the treatment facilities. It is also a system that can be easily taken on board by local communities.

The treatment plant has the following specific characteristics. 1) It has a flexible treatment capacity, from a population of 5 to 5,000 (Japan). 2) If built with joined purification tanks it can treat domestic wastewater as well as sewage. Also, the quality of treated water is the same as in large-scale treatment plants. 3) It is much cheaper than other wastewater treatment plants and can be built with as little as 500,000 pesos. 4) Maintenance and management are simple. Regular washing of the filter media is all that is needed. It would not be an overstatement to say that it is maintenance-free. 5) It can be built in a short time frame. Large-scale sewage operations take 2 to 3 years while this plant takes 2 to 3 months to complete. 6) Depending on the location chosen for

construction it can be built so that it doesn't use electricity and thus conserves energy. It is a typical example of a technology that is suitable for relocation to developing countries.

However, the major issue presiding over all others is finance, and the current design handles 100 people at a cost of 1.54 million pesos. For 100,000 people 1.54 billion pesos would be needed. To receive support from the Philippine government and Japanese ODA, the performance and economic efficiency of the model plant needs to be thoroughly inspected.

As the model plant, the treatment performance of this treatment plant needs to be monitored over a fixed period of time. Once this is done the design should be amended in consideration of the difference in air temperature and way of use with Japan, construction costs, maintenance methods, *etc.* It is important that after a comprehensive evaluation of the regional compatibility in technological, economic, and social terms, the spread of technology into other regions is promoted.

The most effective way to promote penetration is to consider obligating the construction in laws or regulations. For example, it would be effective to build the plant preferentially in public facilities including new residential developments, city offices, schools, and hospitals.

It is important to combine this with educational activities for the local residents and cultivation of technical personnel for construction and maintenance.

4) Maintaining regulations such as wastewater standards

In the Philippines, the Clean Water Act, equivalent to Japan's Water Pollution Control Law, was recently drawn up with the support of JICA, and this law stipulates that in future new public facilities and residential land must either be connected to a sewer or provided with a wastewater treatment plant. In future we will need to prepare a manual on the construction and maintenance of this treatment plant, and to gather sufficient water quality data to show the efficiency and effectiveness of the plant.

When the effectiveness of this treatment plant (anaerobic wastewater treatment and trickling filter treatment) is recognized by governmental institutions, laws can be established such as setting wastewater standards based on use of this treatment plant, and we feel that by doing this the technology could spread not only throughout Cebu City but the whole of the Philippines.

5) The Outcome that can be expected

Despite having a treatment performance slightly inferior to that of the activated sludge method, this wastewater treatment system can dramatically reduce BOD, and can contribute significantly to environmental improvement of cities, including improving water quality and reducing eutrophication. The predicted treatment capacity of this treatment plant is as follows (re-listing).

- Specifications: made of reinforced concrete, 2m in width, 9.8m in length, 4.1m in height (external dimensions)

- Construction method: Underground and above-ground construction
- Method of discharge of treated water: energy conservation possible depending on the lay of the land
- Construction cost: About 3 million yen
- Treated wastewater: 10.6m³/day (equivalent to about 50 to 100 people, assuming discharge of about 100 to 200 L per person per day)
- Quality of treated water: BOD 30mg/L, Removal rate: 85% (Trial calculation with incoming BOD as 200mg/L)

At present PCAPI-7 is moving to have this wastewater treatment method, the so-called Kitakyushu Method, recognized by the DENR-7 as one of the domestic wastewater treatment methods. If this goes through, it will be publicly recognized in the country as the wastewater treatment method recommended by the Philippine National DENR.

4.3 Social Adaptability of this Wastewater Treatment System

This section discusses the ability of the local community to adapt to this wastewater treatment system and the factors required for it to take root as a local technology.

(1) The adaptability of this wastewater treatment system in the local community

At present septic tanks are used in the communities to treat sewage, *etc.*, and if this wastewater treatment system is to be built, it must make the best use of these previously existing technologies. For example, in homes that have septic tanks, a new pipe could be attached to connect the sewage to the wastewater treatment plant, or in homes with low standards of living and no toilet, a public toilet could be built in the wastewater treatment plant.

One possible cause for failure to transfer technology lies in imposing technologies and systems on communities. In order to successfully transfer technology it is important to be thorough in: 1) carrying out preliminary studies into the social adaptability of the technology or system; 2) maintaining frequent communication with the community; and 3) conducting after-care and follow-up. If even one of these factors is lacking it may affect the success of the technological transfer.

Forcing differences in construction methods can also lead to failure to transfer technology. Construction of the main part of this wastewater treatment plant uses reinforced concrete like in Japan and it is expensive. It is more common in developing nations to build the structure with bricks, which is cheaper method. At the preliminary study stage of the construction there was a desire to build with bricks (with built-in reinforcing), but considering the potential failure of the structure in earthquakes or other natural disasters after construction due to the lack of basic data on the materials (strength of the bricks and cement, *etc.*) and the unknown strength of foundations, the final specification chosen was reinforced concrete as used in Japan. We gained their understanding on the fact that this is only a model plant. In future we will recommend this reinforced concrete method for construction of wastewater treatment plants, but we will not force it. We were also able to make a cheaper

construction method using the technical experience and study garnered through this construction, and creation of an advice system to answer questions.

(photograph) The privately built laundry facility in Sambag 1 Area	(photograph) Discussion with local residents
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The following responses were received from a survey of residents of Sambag 1 Area, where the model plant was built.

1) The survey on this wastewater treatment plant and its results

	Phase 1	Phase 2	Phase 3
If a public toilet is built in the plant	All homes 15	All homes 16	All homes 19
	# homes answered 8	# homes answered 9	# homes answered 19
1) Is there a toilet in your home?	Yes 7	Yes 7	Yes 18
	No 1	No 2	No 1
2) If a public toilet (pay per use) was built in the plant would you use it?	Yes 2	Yes 2	Yes 7
	No 6	No 7	No 11
			Undecided 1
How much would you pay to use the public toilet? (only those who answered yes)	1 peso per use 1	Average 6 pesos	1 peso per use 4
	? 1		0.5 pesos per use 1
			? 1

Note: Phase 1 (fully-equipped with water service), Phase 2 (water service not running), Phase 3 (water service not running), A treatment plant is being built between Phases 2 and 3.

Note: 1 peso is approximately equivalent to 2 yen.

20 to 30% of respondents answered that they would use a pay toilet, and most of these were people with toilets in their homes.

However, if there is no toilet in your home, you would probably use a pay toilet.

	Phase 1	Phase 2	Phase 3
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If a public laundry facility was built in the plant	All homes	15	All homes	16	All homes	19
	# homes answered	8	# homes answered	9	# homes answered	19
1) What water do you use for doing laundry?	Tap water	6	Tap water	8	Tap water	16
	Other	2	Other	1	Other	3
2) Where do you do your laundry?	Toilet	3	Toilet	1	Toilet	11
	Outside	5	Outside	7	Outside	8
	Inside	0	Inside	1	Inside	0
3) If a public laundry facility (pay per use) was built above the plant, would you use it?	Yes	3	Yes	7	Yes	11
	No	5	No	2	No	6
					Probably	2
4) How much would you pay to use the public laundry? (only those who answered yes)	5 pesos per use	1	Average	3.9pesos	10 pesos per use	2
	20 pesos per use	1			25 pesos per use	1
	Don't know	1			Don't know	1
					(only 5 homes answered)	

All except Phase 1 want to build and use the public laundry. It is thought this is because Phase 1 has a running water service. However, the fee would have to be lower than that of the private laundry facility.

2) Issue to consider

The following issues for consideration arose from the results of the survey.

- It seems the residents do not have a good understanding of the objective of the treatment plant, its value, or the benefits to be derived from it. Continued educational activities are required to gain recognition of these things.
- If we do not provide guidance to stop residents throwing garbage in the treatment plant, there may be problems when the drainpipes are constructed in the near future.
- It may also be necessary to conduct educational activities to reduce the amount of detergent used, and recommend use of non-powder, non-solid detergents.

From the above points, it is crucial that education and environmental awareness programs

are provided for the local residents on an ongoing basis into the future, and without these, this treatment system will not succeed.

(2) Factors required for this technology to take root

For this technology to take root, it is necessary for the people who have mastered it to push forward to develop the technology further on their own. It is a necessary condition that, technologically, the economical efficiency and energy conservation of its construction, management and operation are further developed, and socially, the environmental awareness is heightened so that the consensus of the local residents can be gained. Without achieving this it is difficult for a technology such as this to take root, and it depends entirely on the self-help efforts of the developing nation itself.

Also, if this kind of technology takes root in one's own country, as can now be seen in China, the fruits of this can then be exported to other countries.

(3) Increasing environmental awareness of the local community

We are holding environmental learning events in Cebu City with the aim of educating the residents through the Metro Cebu Environmental Discussion Groups. The name of the event is Cebu Enviro-Pop, and is held in the largest local commercial complex with the support of many corporations, the Philippine Ministry of Environment and Natural Resources, and NGOs. A competition is held for the best self-composed song that delivers an environmental message. Mr. Ivy of PCAPI-7 explained that the Philippines are a people who like to sing and dance, and this kind of approach is the most effective. This highlights the interesting differences in national characteristics. In this event the winning song is recorded and sold as a CD.

This kind of event is also one way to gain understanding and cooperation for the wastewater treatment system from a variety of stakeholders.