**PHILIPPINES**

**Case Study 1: Ecosan Projects in San Fernando City, Province of La Union**

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| Project Owner(s)<br>Project Partner(s) | ▪ Communities of San Fernando City, Province of La Union<br>▪ Center for Advanced Philippine Studies (CAPS)<br>▪ Solid Waste Management of the Philippines (SWAPP)<br>▪ Foundation for a Sustainable Society, Inc. (FSSI)<br>▪ Institute for the Development of Educational and Ecological Alternatives, Inc. (IDEAS)<br>▪ WASTE<br>▪ City Government of San Fernando |
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## Introduction

This case study is about the first Ecosan pilot projects in the City of San Fernando, Province of La Union, Philippines. These projects were implemented under the Integrated Support for Sustainable Urban Environment (ISSUE) Programme of the WASTE, a Dutch NGO from the Netherlands with the Center for Advanced Philippine Studies (CAPS) as local implementing Partner.

## Background

The City of San Fernando in the Province of La Union is one of the biggest urban centers in Northern Luzon. At the start of the project in 2004, the city had a population of 102, 082 residents (National Statistics Office, May 2000) with an annual average growth of 2.265%. The population rate is expected to increase to 127, 708 by 2010. With the constantly growing population comes different issues and concerns that the city needs to address.

In terms of sanitation, a significant percentage of the city's population has access to water-sealed or flush type toilets. But this is not even enough since there are still those in the coastal and upland barangays who practice open defecation or using unsanitary open pit toilets. Such practice is likely to cause different types of diseases and water pollution directly to those who are unlined or whose pipes are not properly maintained because of the issue of the lack of water source.

**Objectives**

Since sanitation has been pinpointed as one of the major concerns in San Fernando City, the city government took the step of accepting to pilot the Ecosan project in the Philippines. The program objective was to promote and adopt sustainable sanitation as a guiding (and complementary) principle for meeting the sanitation and environmental needs of the core poor in the pilot areas. The pilot project was also to address the sanitation issues of the city such as: the lack of toilets among the poor residents, the scarce water supply and contaminated ground water sources.

**Beneficiaries**

Three low-income, water-scarce communities in San Fernando City, La Union Province in northern Philippines adopted Ecological Sanitation (Ecosan) in 2004 and successfully improved their health and environment conditions with the assistance of the City Government and in partnership with the Center for Advanced Philippine Studies (CAPS. These communities are:

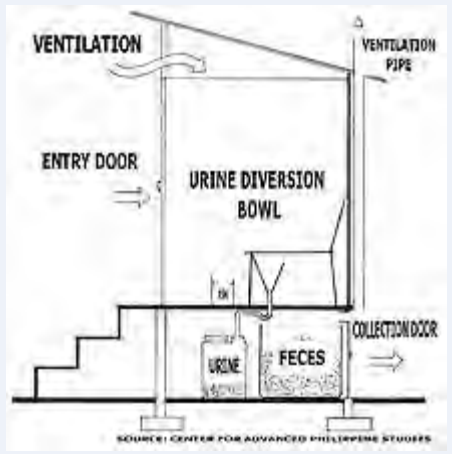
(1) Barangay Nagyubuyuban – an upland farming village with 1,300 people;
(2) Barangay San Agustin – a coastal urban poor village with 1,900 people; and
(3) Fishermen's Village – a resettlement coastal village with 450 people.

These three communities belong to the majority population below poverty line in the City of San Fernando. The poor households do not have toilets so they are left with no choice but to openly defecate. Open defecation has been an accepted practice since time immemorial in the communities of Nagyubuyuban, San Agustin and the coastal community of Ilocanos Norte and Ilocanos Sur where the Fishermen and their families came from before being relocated to the Fishermen's Village. In this kind of situation therefore, it is almost a common illness especially among children in the communities to suffer from diarrhea and soil transmitted helminthes disease (worm infection).

**Sanitation Technology / System**

The birth of the Ecosan in the City of San Fernando was among the many excellent performances of then Mayor Mary Jane C. Ortega in the year 2003. In search for solutions to the city's sanitation problems, then-Mayor Ortega learned about the Ecosan program of the Center for Advanced Philippine Studies (CAPS) which was submitted to the Panibagong Paraan Contest of the World Bank. The program promotes urine-diverting dehydration toilets (UDDT) that use ash to cover and dehydrate the feces. The best part that the City Mayor discovered was that the technology is waterless. So without hesitation, she embraced the project to improve the lives of her constituents.

The system is simple. Urine is separated from feces through the UD bowl, which is built atop a substructure that houses 1 half-drum container lined with plastic bags for the feces and 1 container for the urine. These containers are stored for a period of time to allow pathogen die-off before they are collected and converted into soil conditioner or fertilizer. Retention time (dehydration and pathogen destruction) for fecal material is between 6-12 months while urine can be stored for 30 days before being applied as fertilizer.




The system protects human health, saves water, prevents water pollution, and reuses nutrients in human excreta (closing the loop).

**Key Partners and Stakeholders**

The Center for Advanced Philippine Studies (CAPS) introduced the concept to the city government of San Fernando in February 2004. As the project implementor, CAPS took care of the capacity building work and community relations as well as community organization to enable the communities to deal with the radical changes in social and personal behaviour that will be necessary to adapt to the totally different system of sanitation. By August 2004, the city government, CAPS, together with Solid Waste Management of the Philippines (SWAPP), Foundation for a Sustainable Society, Inc. (FSSI), and the Institute for the Development of Educational and Ecological Alternatives, Inc. (IDEAS) had formed a partnership to mainstream ecological sanitation in the city. Working through its Program on Integrated Support for Sustainable Urban Environment (ISSUE), funded by WASTE, a Dutch NGO, CAPS assisted the City Government from 2004- 2006 to establish Ecosan as a sanitation system appropriate for the three communities. The ISSUE Programme was one of the prime movers in partnering with the local government and the other stakeholders in San Fernando City, La Union to support their work for equitable, affordable, urban environmental service systems with focus on affordable and ecological sanitation in the City.[1]

On the other hand, the LGU under the leadership of its dynamic Mayor invested in the new system and supported the communities as they shifted towards a cleaner, safer and environmentally sound practice of sanitation. The city government budgeted PhP 1 million (US$20,000) for constructing the toilet facilities. Additional funds came from the Dutch government to cover research, capacity development, and public awareness activities.

**Impacts and Challenges**

The advent of the Ecosan in the city brought about radical change in the peoples' lives and perspectives. The communities were pleased and very proud of their new Ecosan toilets. They learned to recognize the value and importance of their waste and appreciated the technology of the application and reuse of urine and feces as fertilizer and soil conditioner in their gardens and farms. With the successful Ecosan project results in the three communities, the city government replicated it in two public elementary schools and, most likely, to other public schools in the future.

[1] Process Documentation of the Ecosan Project in San Fernando City, La Union, Philippines: Lessons Learned and Scaling Up, Cardenas,et.al, April 2007, Page 2.

The Ecosan project even expanded within the City proper and in 2007, 358 units of Ecosan toilets were installed. The city government also constructed dry toilets in 3 elementary schools, in the 20-hectare La Union Botanical Garden and the City of San Fernando Science Centrum and Museum. The project was also replicated in several nursery sites and in a Marine Sanctuary Watch Tower by the San Fernando Bay.

In 2006, sanitation took center stage in San Fernando City's development agenda and updated its Sanitation Code. The city also passed its Sanitation Strategic Plan, which calls for the construction of another 1,000 Ecosan toilets by 2010, among other things.

The City of San Fernando has actually a fund for the EcoSan project operations and allotted PhP300,000 pesos (US$6,000) per year. The City buys 200 sacks per month for an amount of PhP 3,500 (US$70) pesos and the collection of feces costs PhP 800 pesos (US$16) per month (400 pesos per collection inclusive of the salary of personnel and the gas for the truck). To sum it up, around PhP 51,600 pesos (US$1,032) per year is being spent for the collection of feces and the supply of ash. There is also a limitation as to the amount of ash delivered depending on the truck capacity (i.e. the truck cannot take more than 200 sacks in one travel), so the problem on ash supply.[2] When the project started , there was a salt factory in the city and this was the source of ash. Because of air pollution though, the barangay lobbied for its closure and the salt factory transferred to another municipality. The city solved the air pollution problem of the village but the supply of ash became a problem.

The Ecosan project also paved the way of manufacturing local Ecosan toilet design in the Philippines. But the market was not made overnight because commercial toilet bowl manufacturers were not even enthusiastic even if it was stressed that this would be in demand if they kept high standards in their production. It was in 2007 when a ceramics company teamed up with CAPS and accepted the offer to produce Ecosan toilet bowls. They were proven right in accepting the offer and soon many organizations began to discover the technology and started in the advocacy to help the environment through the Ecosan approach.

Success cannot be achieved overnight, though. There are still uncertainties as to this new approach and technology. Equally important is a never-ending thirst for new knowledge as to discovering an appropriate UDDT design for the handicapped that has still to be developed; a sustainable source of ash has to be discovered; and the design of toilet sub-structures in flood-prone areas has to be improved to ensure that the system is not compromised by floods.

The pilot project has shown that Ecosan works, and its champions ensure that gains are spread. The City Government of San Fernando in cooperation with CAPS has shown that investing in a sustainable sanitation system like Ecosan is investing not just in sanitation but in people and in long term development. Three critical factors contributed to the success of the project:

- First, the most critical success factor was the strong local leadership demonstrated by the Local Government Executives imbued with the ability to tap external resources to develop the city and the political will to pioneer a system that was quite unknown.
- Second, a strong factor with the presence of a local NGO that possesses the expertise on Ecosan and the passion to capacitate the locals on how to learn and adapt to the new way of sanitation.

[2] Network Improvement and Ecosan Marketing in San Fernando City, La Union, Pierrick Trioulayre, Page 9.

- Third, the interest and willingness of an international NGO to support and finance the project through its ISSUE Program

## Accounts of the Three Communities with Ecosan

***Barangay Nagyubuyuban***

Brgy. Nagyubuyuban is located in the upland portion of San Fernando City. The system is well integrated in the village and the inhabitants. There are 94 UDDTs installed in the households and 4 in the school. Prior to the project, the people in the barangay used to practice open pit defecation. With the EcoSan Project, majority of the people in the barangay were pleased and proud of the results although there are some who encountered problems of ash supply since the ash from their cooking is inadequate. The people discovered a system of sharing though, and it worked harmoniously with the neighborhood.

Even the schools also encountered problem with the ash supply. One immediate solution they thought of was to ask their pupils to bring ash from their house. The said solution did not succeed since most of the children are not used to defecating in school because they prefer to do it at home. Another issue is that mothers of these pupils did not let their children bring ash to school since the ash is also needed at home and ash supply is also problematic. It was found out in the surveys done afterwards that the production of feces in the schools became lesser because of less number of pupils using the Ecosan toilets (one container per school year). A noted observation is that most of the UDDT owners think that Ecosan management is time consuming.

**Collection, Storage and Reuse**

The collection and storage of feces and urine for Brgy. Nagyubuyuban has not been problematic since space is readily available. Filled up containers or drums are composted in the backyard of the cooperators and were then utilized as fertilizer for the EcoSan demo-farm established in the barangay. However, another constraint in the collection of feces is during the start of the rainy season. In the school, the feces are collected by the teachers and composted in the area of the school. The compost is used to fertilize the garden of the school.

With regards the urine, per household collects urine at a daily basis or three times a week. Full urine containers are emptied at the communal urine tank. The collected urine is being used immediately either by the household or by the community.[3]

Urine is collected in a 1 cubic meter container during the year. The emptying of the container is usually done by the farmers, when they need to fertilized their rice field. The container is near the slope road. When it rains they open the container and the urine is naturally diluted with the rainwater which run on the road and pass by the rice fields.

There is a mutual understanding between inhabitants and the school of the scheduled time to empty the tank and fertilize the fields.[4]

[3] Process Documentation of the Ecosan Project in San Fernando City, La Union, Philippines: Lessons Learned and Scaling Up, Cardenas, et.al, April 2007, Page 17-18.

[4] Network Improvement and Ecosan Marketing in San Fernando City, La Union, Pierrick Trioulayre, Page 6.

***Barangay San Agustin***

Brgy. San Agustin is a coastal barangay in San Fernando City. There were 40 UDDTs placed in the area since the EcoSan project started. But out of 40, there are only 2 UDDTs which are still functioning, 19 where apparently destroyed by typhoons and the rest are unaccounted.[5]

Vegetation enriched by fertilizer from the dry toilets

**Collection, Storage and Reuse**

Physical inspection of the EcoSan facility is undertaken on a monthly basis by the Barangay EcoSan Committee (BEC). This is purposely done to determine who among Ecosan users have containers full of dried feces and need to empty these containers. After inspection, the BEC verbally informs the City Ecosan TWG which Ecosan facility needs emptying. The City Environment and Natural Resources Office (CENRO) is also informed to coordinate on the schedule of collection; request for a dump truck; and coordinate with slaughterhouse personnel to provide an area for secondary treatment schedule of dried feces collection. The BEC also informs cooperators of the staging area or where to bring the containers.

*Ecosan toilet in San Agustin with bonsai plants*

The BEC of the barangay uses the collected urine on the plants around Pennsylvania Avenue located within the barangays and the application is usually done in the evening. Source-separated urine is being collected by the cooperators and used for backyard vegetable gardening or ornamental plant propagation.

***Fisherman's Village***

The City of San Fernando initiated a resettlement program for the people who came from Barangay Ilocanos Norte and Sur and settled in the coastal areas of the city because of the abundance of the coastal resources. The city government took a step to prevent another concern on sanitation and waste management because of the influx of population in the coastal areas. This program of the city government was called Fisherman's Village. The village is situated along the coastal area of Barangay Catbangen about I km away from Poblacion. It is intended for the informal settlers along the Coastal Barangay particularly Barangay Ilocanos Sur (64 families), Olocanos Norte (28 families), Catbangen and Poro (5 families). Total area measures 5,000 sq. meters, composed of 97 units with lot area and floor area measuring to 28 sq. meters and 22 sq. meters respectively. Each of these 97 housing units would be installed with Ecosan toilet facilities. The majority of the UDDT bowls are still being used but some are already idle because of the problems encountered like cockroaches and foul odor. Those with idle UDDTs share with their neighbors with still functioning UDDTs.

[5] Rosa Kuipers's field research report, 2010. Ms. Kuiper is Research Intern of WASTE.

A number of households in the village also have problems on the supply of ash since majority of them use LPG in cooking. Some households opt to buy their own ash, although the ash supply is supposed to be supplied by the City. Ash is a major component to cover and dry the feces to avoid smells and insects and it is the only available and affordable one, although there are other alternatives to it like wood shavings and sawdust from sawmills which are being used for cooking in some households.

**Collection and Reuse**

A plastic bag is placed inside the container under the toilet to store the feces. Then the city collects the plastic bags twice a month. The household have to bring the plastic to the collection truck which stops at every door at a specific day. It is important that every household knows the collection schedule so that their stored feces can be collected, otherwise they can also delegate the work to their neighbors if they are not around.

There is a 20-sqm. area that is designated and reserved for the storage of the feces in the City landfill. All the stored feces in plastic bags are thrown into that wide hole. The City plans to make "Arborloos" to use the composted by-product. However, a problem on the decomposition arises since the stored feces are placed in plastic bags which are non-biodegradable, thus another process of taking out the stored feces from the plastic bags for it to become compost.

On the other hand, all the urine is collected by pipes which are attached to the UDDT. The urine is stored in a special tank buried halfway on the ground and the households have to connect the pipes on their own. Some wash bowl and grey water are also connected to the urine pipes. So the urine is contaminated by pathogens from the wash bowl and diluted in grey water.

Looking at the current collection system that they are using, it is actually impossible to know how to modify the said system. It is suggested that a general control is necessary for all the connection of pipes to avoid contamination of the different stored liquids. Four hundred fifty (450) people use the 87 UDDT bowls within the Village and it produces 8,000 to 10,000 liters of urine per month which is not reused.[6]

**Scaling Up**

The City of San Fernando has served as model and learning example for other municipalities in the Province of La Union. The second phase of the ISSUE Programme (2007-2010) made it possible for CAPS to work with the Provincial Government and reach out to neighboring towns who are also interested in implementing Ecosan projects. During ISSUE2, the Municipalities of Bauang built 85 Ecosan toilets; Santol, 30; Caba, 22; Pagulin, 20 and San Juan, 4.

[6] Network Improvement and Ecosan Marketing in San Fernando City, La Union, Pierrick Trioulayre, Page 8.

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# INTEGRATED WASTE MANAGEMENT SCHEME FOR SMALL AND MEDIUM SCALE SLAUGHTERHOUSES

## Case of the Bureau of Animal Industry Plant in Valenzuela City, Metro Manila

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| Project Owner(s) | ▪ Bureau of Animal Industry, Department of Agriculture |
| Project Partner(s) | ▪ Basic Needs Services (BNS) Philippines<br>▪ German Technical Cooperation<br>▪ Food and Agriculture Organization of the United Nations (FAO) |
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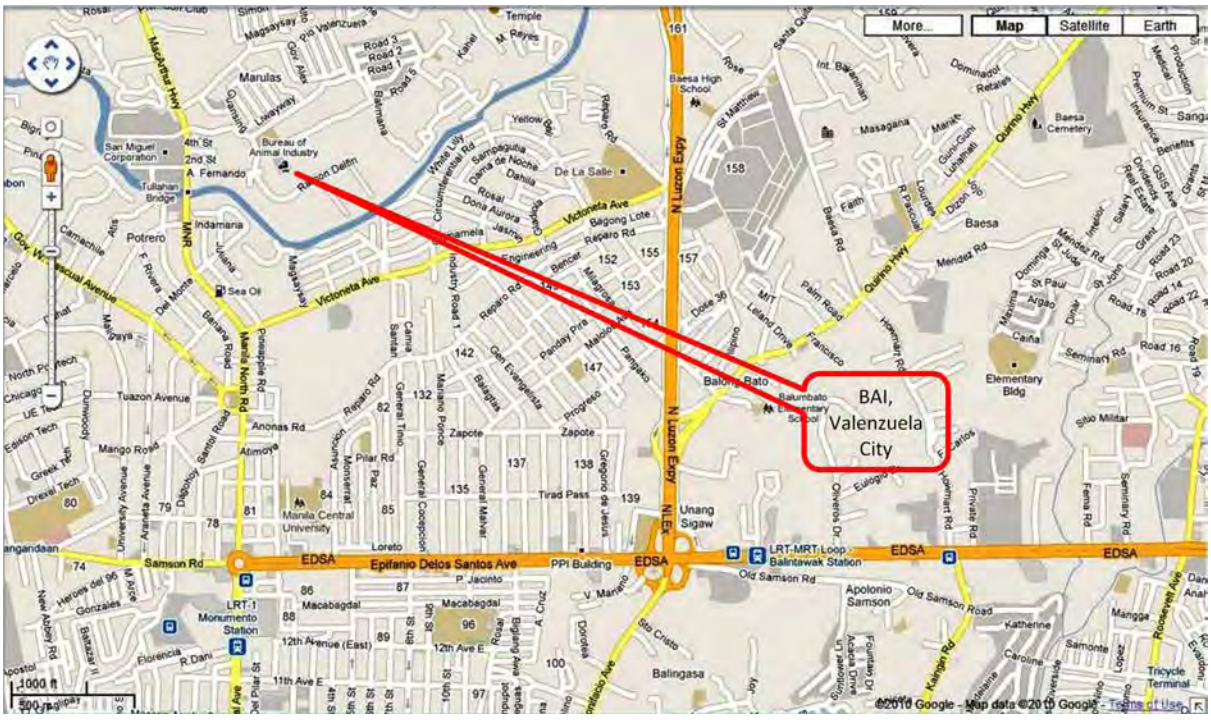
## A. WHAT TRIGGERED THE PROJECT?[1]


The Animal Products Development Center (APDC) of the Bureau of Animal Industry of the Department of Agriculture (DA-BAI) has the mandate to serve the meat sector in the Philippines, through training, development and extension of appropriate technologies, leading to improved methods of handling, processing and utilization of animal products and by-products. APDC also hosted the Asia Pacific Meat Project (APMP). This project was supported by the Common Fund for Commodities (CFC), Food and Agriculture Organization of the United Nations (FAO), Center for International Migration and Development (CIM), German Technical Cooperation (GTZ), and the governments of Bangladesh, Myanmar, Samoa and the Philippines.

Under the APMP, APDC was developed into the Main Center of the Project, and pilot training centers were established in Bangladesh, Myanmar and Samoa. At APDC, slaughter and processing facilities were upgraded to meet international standards on hygiene and workflow and intensive staff training on modern technologies took place. In addition to these improvements in the slaughter and processing areas, the old waste treatment facilities were also

[1] **Pilot Integrated Waste Management Scheme for Small and Medium Scale Slaughterhouses (A Brochure)**; Animal Products Development Center – Bureau of Animal Industry; 2010; page 3.

identified as outdated and dilapidated, as such additional external funds were sourced to start rehabilitation efforts.




A pilot integrated waste management scheme, including waste separation and collection stations, resulting in minimization and transformation of liquid and solid wastes, was developed and introduced with support from the Livestock, Environment and Development Initiative (LEAD) based in the Animal Production and Health Division of FAO. Data collected before and after the intervention indicated that an improved collection of solid wastes results in reduced pollution load for the generated wastewater. In addition, after the introduction of the pilot waste management scheme, effluent characteristics changed, with a significant reduction in total effluent volume by 25% and Biological Oxygen Demand (BOD) load by 35%.

However, to further reduce the BOD load of the remaining wastewater, which goes beyond simply complying with national standards on effluents, the BAI found it necessary to introduce a final treatment system. Cooperation with the Bremen Overseas Research and Development Association (BORDA) with Basic Needs Services Philippines Inc. (BNS) was agreed for the design and implementation of the appropriate waste treatment facility, applying Decentralized Wastewater Treatment Systems (DEWATS) technology.

In line with the Water and Sanitation Program of the GTZ in the Philippines, assistance was provided in the construction of parts of the treatment facility, particularly the biogas digester.

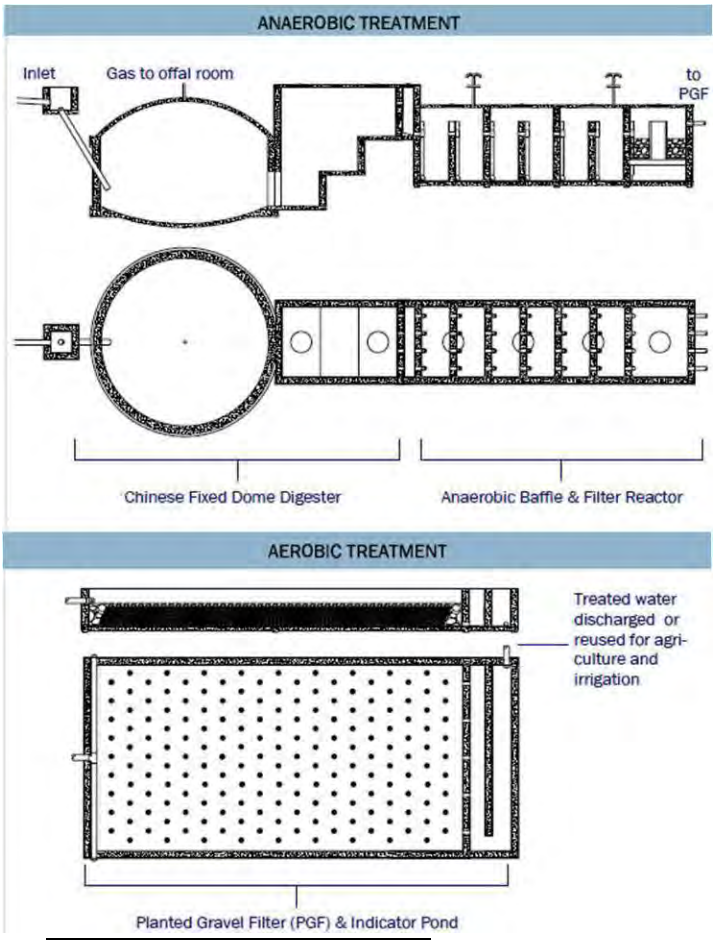
The APDC's waste management approach was to combine its improved solid waste management system with the DEWATS technology brought in by BORDA.

## B. Social and Technical Preparation and Promotion

The slaughterhouse facility located in Valenzuela City, which is managed and operated by the BAI-DA, took part in this Asia Pacific Meat Project of the UN-FAO, as mentioned above. As it did, its operations underwent a thorough assessment in order to identify stages within their operational system where interventions could be introduced, thereby increase their efficacy in complying with concerned health and environmental regulations.

After the conduct of that operational systems review, BORDA came in to design an appropriate treatment facility to process its wastewater, further polishing its water quality more than what is necessitated by regulatory agencies, where the required capitalization would still be considered *affordable*. BNS-BORDA, thus provided BAI a technical data sheet of their designed facility, with a corresponding article of the project posted in BORDA's website.

Operations personnel and management staff were subjected to various training courses on waste minimization techniques that could alleviate the facility's impact on the environment. This included a reorientation of slaughterhouse personnel regarding industry good practices to improve their current methods of stunning, bleeding, flaying and evisceration.[2]




## C. Sanitation Technology/System/Options Observed

Prior to securing BORDA's assistance, the facility instituted its integrated waste management scheme, utilizing waste minimization techniques and recycling before engaging wastewater treatment at the end of the production chain.

Source reduction initiatives included clean up of solid wastes generated within the facility, using simple tools (e.g. shovels, broom, etc.) before introducing water. This way, apart from reducing water consumption, resultant volume of wastewater that requires treatment is lessened as well. Further interventions on waste segregation were also incorporated in their operational procedures. This resulted in a reduction of eventual costs on (i) maintenance, (ii) wastewater treatment, and (iii) disposal.

[2] **Pilot Integrated Waste Management Scheme for Small and Medium Scale Slaughterhouses (A Brochure)**; Animal Products Development Center – Bureau of Animal Industry; 2010; page 6.

Recycling programs were inculcated in their system. It is exhibited through the composting of collected animal manure, rumen contents and condemned materials (i.e. soft animal tissues). These materials are mixed with dried leaves then sun-dried in drying beds at the back of BAI's facility. The resulting compost is then utilized in their respective landscaping and gardening activities. The bile collected from the bladders of cattle or pigs are diluted with water and used as emulsifying agents for grease and fat removal.[3] This corresponds to savings in the purchase of detergent and other cleaning agents employed for grease removal.

The DEWATS modules integrated in the facility designed for BAI include: 1 Biogas Digester (BD), 8-Chamber Anaerobic Baffled Reactor (ABR), 1 Anaerobic Filter (AF), 1 Planted Gravel Filter (PGF) and an Indicator Pond (IP). The entire facility has an area requirement of 108 square meters. This wastewater treatment plant (WWTP) has a treatment capacity of 10 cubic meters per day, enough to cover the wastewater generated from processing 30 hogs 10 cattle per day. Its total anaerobic and aerobic areas are 40 square meters and 68 square meters, respectively.

Average influent water quality for $BOD_5$ is 2,000 mg/L and COD is 3,600 mg/L. With the above specifications of the WWTP, the effluent quality of treated wastewater is expected to meet national discharge standards for Class C waters, with BOD of 50 mg/L and COD of 100 mg/L. Part of the final treated water is discharged to a nearby river and the rest are utilized to water the plants.

## D. SUPPORTIVE ENVIRONMENT

The WWT project amounted to US$ 11,363.63. As mentioned earlier, funding came from FAO-LEAD-AGAL, APMP-BAI, GTZ and BNS-BORDA. BNS-BORDA's technical assistance was secured via a memorandum of agreement with BAI-DA. All construction materials used therein were sourced locally.

The wastewater treatment plant is being operated and maintained by a technical team of BAI, in particular, its Engineering Department, after completing operations and maintenance (OM) training sessions. DEWATS only requires simple OM activities such as (i) regular checking of chambers by opening manholes; (ii) cleaning of gravel bed from rubbish/plastic; and (iii) cleaning of pond in which the frequency will be determined through daily observation. However, desludging in the digester and baffle reactor is designed to be undertaken every 2 years. Sludge thickness should be monitored before desludging.

The WWTP's operational maintenance cost includes the monthly salary of an operator, desludging cost, and other miscellaneous expenses, which may include wastewater sampling, construction repairs and for aesthetic purposes. Details of which are illustrated in the table below. These expenses would be fully shouldered by BAI.

| A Two-Year Estimated Cost for the Operation and Maintenance | | | |
|---|---|---|---|
| **Description** | **Amount (US$)** | **Frequency** | **Total (US$)** |
| Salary of an Operator | 90.90 | 24 Months | 2,181.81 |
| Desludging Cost | 90.90 | 1 in every 2 Years | 90.90 |
| Miscellaneous Expenses | 227.27 | 2 in every 2 Years | 454.54 |
| TOTAL | | | 2,727.27 |

[3] **Pilot Integrated Waste Management Scheme for Small and Medium Scale Slaughterhouses (A Brochure)**; Animal Products Development Center – Bureau of Animal Industry; 2010; page 8.

The DEWATS' performance will be monitored by BNS-BORDA and BAI, specifically by the Engineering Department, during the period of warranty and effluent quality will be analyzed on regular basis. So far, the effluent quality processed by the WWTP has passed Class C standards for the past 3 years (i.e. 2006-09), as illustrated in the table immediately below.[4]

| Parameters | Indicator Pond | Effluent Standards (inland waters Class C) | Methods |
|---|---|---|---|
| Total Suspended Solids, mg/L | 17.00 | 70 | Gravimetric |
| $BOD_5$, mg/L | 22.00 | 50 | 5-day BOD test |
| Settleable solids, mg/L | <0.10 | 0.50 | Imhoff Cone |
| pH | 7.67 @ 28°C | 6.5 – 9.0 | Glass electrode |

By: CJK Air and Water Testing Laboratory; DENR CR No. 052/2009; DoH Accreditation No. 239

This project engagement was pursued owing to BAI's overall goal of serving as a role model for slaughterhouses throughout the country, and promoting the installation of WWTPs for small and medium scale enterprises.

## E. Re-Use Components and Other Features

The wastewater treatment plant employs (i) a biogas digester for anaerobic treatment; then a (ii) constructed wet land to polish the treated wastewater, which is either discharged to the surrounding environment or reused in BAI's vegetable garden within the perimeter. Accordingly, part of the treated wastewater is discharged through a tube that connects the indicator pond and the vegetable garden (plots) that contain radish, eggplant, okra, squash, and other string beans.[5]

The recoverable resource in the digester is methane gas, the byproduct of enteric bacterial activity under anaerobic conditions. The gas is then collected and used by the slaughterhouse to heat its process water, which is used for cleaning of offal and removal of hairs from the feet, face, masks and tails of hogs and cattle. This fuel feedstock is estimated to save BAI at least 2 liquefied petroleum gas (LPG) tanks per month, amounting to US$ 27.27.

[4] **Pilot Integrated Waste Management Scheme for Small and Medium Scale Slaughterhouses (A Brochure)**; Animal Products Development Center – Bureau of Animal Industry; 2010; page 13.
[5] Ibid.; page 13.

## F. ASSESSED AND PERCEIVED IMPACTS

DEWATS is a proven technology that can provide wastewater treatment systems that are relevant, effective and affordable. Thus, the installed WWTP has been able to reduce the odor, organic load and contamination of the treated wastewater before it is discharged to the nearby river. The direct beneficiaries thereto are the residents of Valenzuela City. The indirect beneficiaries, on the other hand, are the aquatic organisms in the nearby river, which is a tributary to Manila Bay.

# INTEGRATED WASTE MANAGEMENT SYSTEM FOR BAYAWAN CITY
## Ecological Sanitation Experiences in Periurban and Rural Communities

| | |
|---|---|
| Project Owner(s) | ▪ Bayawan City |
| Project Partner(s) | ▪ Water and Sanitation Programme, German Technical Cooperation (GTZ)<br>▪ Water and Sanitation Programme, Department of the Interior and Local Government (DILG) |
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## A. WHAT TRIGGERED THE PROJECT? [1]


The concept of *ecological sanitation* was introduced to the Visayas and Mindanao island groups in the country, through the *1st International Symposium on Low-Cost Technology Options for Water Supply and Sanitation* last September 2004 in the province of Bohol. This conference was organized by the Water and Sanitation Programme units of the German Technical Cooperation (GTZ), Water and Sanitation Programme of the World Bank (WB-WSP), and the Department of the Interior and Local Government of the Philippines. Delegates from the City of Bayawan participated in the event. After which, a group of German and Filipino experts visited the LGU for a rapid site assessment, where above mentioned low-cost technology options could be deployed. Consequently, various developmental projects were engaged by the city, with the active support from the GTZ and the DILG.

In addition, the former local chief executive (LCE), Engr. German Seraña participated in a series of workshops and conference on the Water Crisis and how it is affecting the global community. In response thereto, Bayawan City strengthened its resolve to address this *water and sanitation* issue by pursuing the establishment and institutionalization of relevant systems for an integrated approach to waste management.

[1] **Compilation of 31 Case Studies on Sustainable Sanitation Projects**; Sustainable Sanitation Alliance; February 2010; pages 11-2 and 12-2. | http://www.susana.org/images/documents/06-case-studies/book/case_study_book_complete.pdf.

### A.1 PROJECT OBJECTIVE(S)

In consideration of the above, the LGU embarked on 3 initiatives: (i) peri-urban upgrading of a resettlement area co-developed by the City; (ii) rural upgrading pilot project within Villareal, Bayawan; and a (iii) city-wide integrated management system for both its municipal solid wastes and wastewater from household septage.

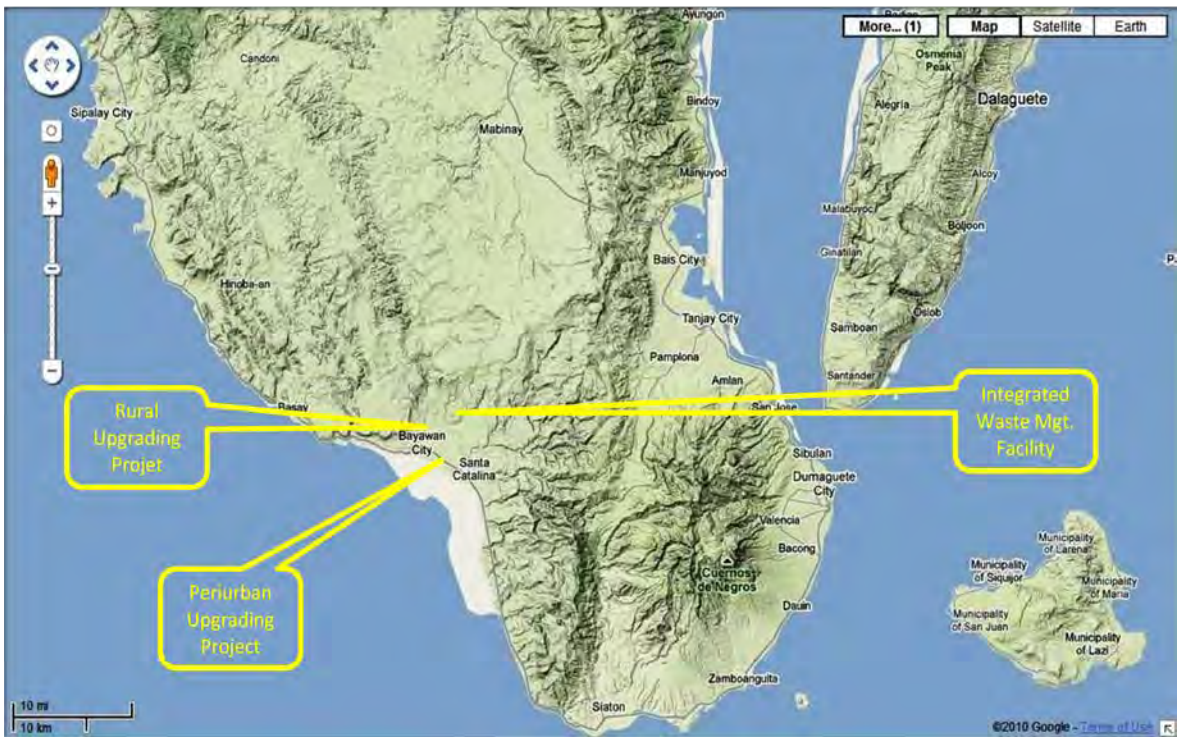
Firstly, the LCE's vision for urban renewal and community upgrading, as well as environmental conservation neatly fitted the concept of ecological sanitation introduced by the German Technical Cooperation (i.e. GTZ), which the LGU adopted. Its objectives in particular were:

- Protect coastal waters from pollution with domestic wastewater;
- Protect the health of the local residents through improved housing with safe sanitation and wastewater treatment facilities; and
- Demonstrate the constructed wetland technology.

Secondly, with the rural upgrading pilot project in Villareal, its objectives in particular were:

- Provide improved sanitation facilities for households and public institutions in the rural areas, in order to improve public health, especially reduce intestinal worm infestation among children; and
- Provide fertilizer for vegetable growers and small-scale farmers.

Lastly, the city-wide integrated management system aims to address the wastewater generated by the rest of the LGU, which is beyond the geographical scope of the other 2 initiatives mentioned above. In addition, the wastewater treatment facility that would be built for the purpose would be integrated with the LGU's municipal solid wastes as well.



### A.2 Profile of the Beneficiaries [2]

Bayawan is considered as a 3rd Class Component City in the 3rd Congressional District of Negros Oriental, Philippines. It is predominantly characterized by a rural setting for only 2.25% of its total land area is considered as urban. The city is basically agricultural and its economy sits on an agricultural platform. Revenues from land farming, livestock production, aqua-culture activities and marine fishing are a major income contribution of the City. In 2000, the assessment of City Agriculture Office (CAO) indicated that agricultural production was valued at PhP 2.3 Billion; 91.4% of which came from crop production, 7.9% from livestock production, and 0.7% from fisheries.

The state of employment in the City is considered very poor, since there are still very limited employment opportunities in the locality. Mostly, the people in the city are engaged in self-employment activities such as farming, fishing, trading or buy & sell activities. Resident professionals in the City are in abundance however they are most often forced to migrate seeking employment opportunities.

In the project area only "10% of the population is served with safe drinking water; only 1% of the rural population is connected to a piped water supply. 63% of the households in the city have toilets, although many of which are in a poor and unsanitary condition. On top of that, only 29% of the student population in Bayawan was served with adequate toilet facilities."[3]

## B. Social and Technical Preparation and Promotion

Right after the introduction of the concept of Ecological Sanitation in CY 2004, a site assessment was conducted by both German and Filipino experts in the field to identify avenues where technical assistance could be provided to Bayawan City. The field assessment (i.e. cited above) led to the identification of 2 wastewater management and sanitation options: (a) constructed wetland for domestic wastewater of a peri-urban settlement area; and (b) a dry sanitation concept for sparsely populated rural areas.

### B.1 Rural Upgrading of Sanitation Facilities[4]

A memorandum of understanding was signed between the DILG-GTZ Water and Sanitation Programme and the City government last June 2005. The covenant covered the planning and implementation of the ecological sanitation pilot project. Consequently, an ecological sanitation (ecosan) Technical Working Group (TWG) was formed, per an Executive Order of then incumbent LCE; comprised of 10 employees from the (a) engineering, (b) environmental, (c) health and (d) agricultural offices of the LGU.

The ecosan TWG was then subjected to a capacity building exercise administered by the DILG-GTZ Water and Sanitation Program. After which, subsequent planning exercises took place, including the piloting of 2 toilet facilities in two different coastal barangays, using: (i) one single vault urine-diverting and dehydration toilet (UDDT), with movable container; and (ii) one double-vault UDDT. Then, with the assistance of the GTZ Program's Community Organizer and

[2] http://www.insidenegros.com/negros-oriental/bayawan-city/ and http://en.wikipedia.org/wiki/Bayawan.
[3] **Compilation of 31 Case Studies on Sustainable Sanitation Projects**; Sustainable Sanitation Alliance; February 2010; page 12-2. | http://www.susana.org/images/documents/06-case-studies/book/case_study_book_complete.pdf.
[4] Ibid.; page 12-2.

Technical Adviser, the TWG developed a work plan, conducted a series of stakeholder workshops, and identified 2 household cooperators.

After a short trial period, Phase I commenced with 40 UDDTs deployed in 28 barangays. The selection of target cooperators were the result of baseline surveys, interviews with selected families, and further consultation with barangay officials. Phase II followed thereafter in April 2008, this time focusing on schools and households that could afford the cost of construction for these UDDTs.

### B.2 Peri-urban Upgrading of Settlement and Wastewater Treatment[5]

An agreement was forged between the LGU and GTZ last April 2005, for the latter's provision of technical assistance in the construction of the constructed wetland treatment facility for the Fishermen's Village. The design of the pertained to facility was developed in partnership with the health, engineering and environment offices of Bayawan City and GTZ. Participation from the relocates was solicited by means of getting their decision and support to have their domestic wastewater treated in a decentralized facility instead of the conventional household septic tanks. Securing the concerned community's support was facilitated via the set up of a village association, which organizes the affairs of the relocation area.

Under the auspices of the GTZ, Oekotec GmbH, through Dr. Joachim Niklas, made 2 site visits last November 2005 and June 2006. Nonetheless, construction of the pertained facility took place between May 2005 and August 2006, under the supervision of the City Engineering Office. The WTP's inauguration was held last September 2006. It has been in operation since then, beyond the lifetime of GTZ's sanitation program in the Philippines. The operation and maintenance of the WTP is now under the jurisdiction of the City Government.

### B.3 LGU-wide Integrated Waste Management Facility

The city-wide waste management system was pursued given the successes of the 2 initiatives illustrated above, as well as the need to address the wastewater treatment needs of the rest of the city's residents, which were not covered in the above cited endeavors. This endeavor was pursued under the auspices of former Mayor Geman Saraña, with the active participation of the (i) Engineering, (ii) Environment and (iii) Health Offices of the City Government.

Similar to the above, a TWG has also been created for the establishment of the pertained facility: from (i) siting, (ii) environmental impact assessment studies, (iii) technical specification and designs, to actual (iv) construction and supervision and (v) eventual operations management and maintenance.

[5] **Compilation of 31 Case Studies on Sustainable Sanitation Projects**; Sustainable Sanitation Alliance; February 2010; page 11-2. | http://www.susana.org/images/documents/06-case-studies/book/case_study_book_complete.pdf.

## C. SANITATION TECHNOLOGY/SYSTEM/OPTIONS OBSERVED

### C.1 RURAL UPGRADING OF SANITATION FACILITIES[6]

The sanitation technologies applied are the (i) single and (ii) double vault UDDTs. Diverted urine is stored in 20-liter plastic containers, while the collected feces is stored in the vaults underneath the toilet superstructure. It is made of concrete hollow blocks with concrete floors and slabs. The single-vault toilets in particular, have mobile collection containers. The toilet rooms are made various materials ranging from bamboo mats, to split bamboo and plywood.

Ash is readily available for use as the absorptive material that would cover the feces, as a majority of rural households makes use of firewood in their cooking activities. Should there be a shortage thereof, the household participants were advised to employ carbonized rice hulls instead.

The design of the double vault UDDT took into consideration a family size of 5-6 members and containment duration of 12 months for the generated feces. The single vault UDDT on the other hand, has a vault dimension of 1 cubic meter for the feces. Its collection containers are either made of plastic or steel drums equipped with bin liners. Both UDDTs employ a 20-liter jerry can for the collection of urine. But despite the projected generation amount of 30 liters per week, less is collected as members of farmer families are out in field, thus urinate in the open and not in their respective toilets at home.

UDDTs are built above ground, with an elevation of approximately 100-125 cm. In addition, the cover panels for the vaults are painted black or made of black metal. The above two factors facilitate high temperature within the vaults, thus, accelerating the drying process for the stored fecal matter. All of the UDDTs built were installed outdoors.

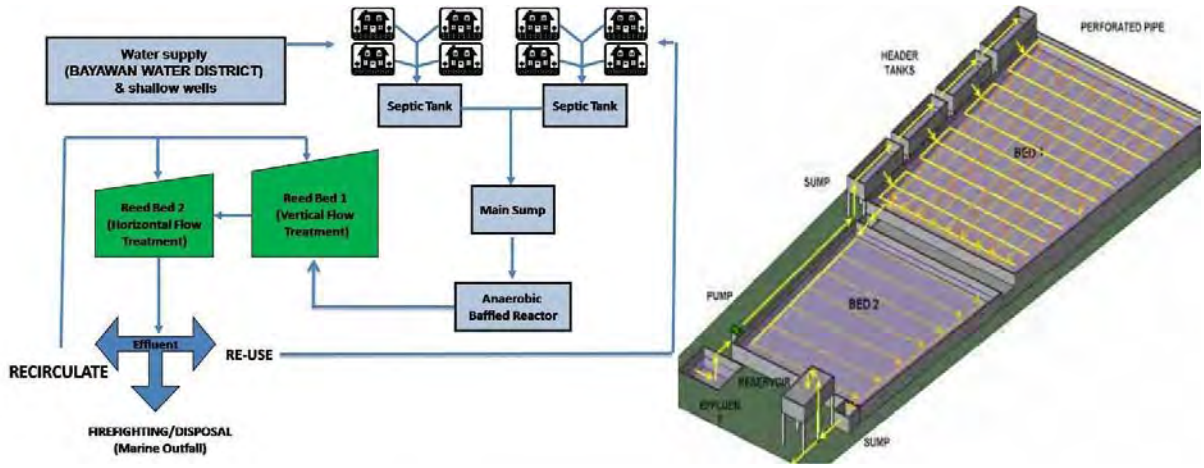
### C.2 PERI-URBAN UPGRADING OF SETTLEMENT AND WASTEWATER TREATMENT

When the city embarked on a construction of a boulevard (i.e. akin to the Baywalk along Roxas Boulevard in Metro Manila) hundreds of households were affected. In response to which, the LGU embarked on a peri-urban socialized housing relocation program, which is now the Gawad Kalinga Village in Villareal, Bayawan City. In the middle of its site development, local officials anticipated the need to address the community's sewage management needs. So it participated in the Water and Sanitation program of the DILG and the GTZ, which identified the utilization of the constructed wetland technology. Accordingly, the then proposed sanitation system was evaluated as the most cost effective and affordable solution for the community and the LGU.

[6] **Compilation of 31 Case Studies on Sustainable Sanitation Projects**; Sustainable Sanitation Alliance; February 2010; pages 12-2 to 12-3. | http://www.susana.org/images/documents/06-case-studies/book/case_study_book_complete.pdf.

These wetlands are closed natural systems that recycle wastewater using biological and chemical means, making use of vegetation that proliferates in wetland ecosystems. Subsurface flow systems incorporated in the facility's design was intended to avoid mosquito breeding as well as contain pathogens that are present in sewer waters.[7]

As illustrated in the schematic diagram below, domestically generated wastewater, coming from both the kitchen as well as household toilets, flow first to communal septic tanks. The overflow from the septic tanks goes to the main sump then flows by gravity to the anaerobic baffled reactor. The partially treated wastewater is consequently pumped to the reed beds. The final effluent is then either re-circulated to the reed beds or reused -- for either the (i) irrigation requirements of the Village's organic farming project or (ii) as standby water for firefighting purposes.




The constructed wetland was "designed for a flow rate of 50 liters per person per day for a total village population of 3,000 people (i.e. 150 cubic meters per day) and a BOD concentration of 300 mg/L. The total surface of the facility is at 2,680 square meters or roughly 0.9 square meter for each resident. The plants used in the planted gravel filter as indigent species of reeds (i.e. *Phragmites karka*)."[8]

Since both the village and the constructed wetland are close to the shore, "groundwater levels rise to ground levels during rainy season. Hence, both cells of the constructed wetland were made of concrete and concrete blocks. Then a drainage system was positioned at the bottom of each cell, which is covered by a separation layer and then a filter layer."[9]

### C.3 LGU-WIDE INTEGRATED WASTE MANAGEMENT FACILITY

The city has also embarked on a treatment facility, which accordingly employs a holistic approach in dealing with both its municipal solid waste as well as wastewater from both (i) community septage and (ii) resultant leachate of the adjacent sanitary landfill. The wastewater

[7] Constructed Wetland for a Peri-Urban Housing Area. **Sustainable Sanitation – Project Data Sheet**; DILG-GTZ Water and Sanitation Program; August 2008; page 1.
[8] **Compilation of 31 Case Studies on Sustainable Sanitation Projects**; Sustainable Sanitation Alliance; February 2010; page 11-3. | http://www.susana.org/images/documents/06-case-studies/book/case_study_book_complete.pdf.
[9] Ibid.; page 11-3.

treatment facility, illustrated in the grouped photo below, to date is treating the collected septage from the LGU's households and commercial establishments. It employs the conventional use of a digester, drying beds and even the reed bed (i.e. the constructed wetland) utilized in the Fishermen's Village in Villareal, Bayawan City.


The sanitary landfill on the other hand, as illustrated below, will be operational within CY 2010. It would take in the locality's municipal solid waste. The leachate that would percolate underneath its network of perforated pipes would drain to the nearby wastewater treatment facility and make use of the same processes as would the treatment of collected septage sludge mentioned above. Thus, this integral approach saved them significant financial resources in building a separate wastewater treatment facility for the leachate.

## D. SUPPORTIVE ENVIRONMENT

### D.1 RURAL UPGRADING OF SANITATION FACILITIES[10]

The City Government allocated approximately US$ 13,400 for Phase I of the project. This fund covered for the financial requirements during the (i) planning process, (ii) social preparation and (iii) construction costs of the sub-structures of the

[10] **Compilation of 31 Case Studies on Sustainable Sanitation Projects**; Sustainable Sanitation Alliance; February 2010; pages 12-5 and 12-6. | http://www.susana.org/images/documents/06-case-studies/book/case_study_book_complete.pdf.

UDDTs. Each UDDT incurred an average cost of US$ 364.48 per unit, making it unaffordable, especially by most low-income households. Its breakdown is as follows:

| Item | Cost in US Dollars | |
|---|---|---|
| | Single Vault | Double Vault |
| Materials (for superstructure) | 80.4 – 113.9 | 80.4 – 113.9 |
| Materials (for substructure) including piping | 160.8 -227.8 | 241.2 -268 |
| UDDT ceramic pedestal | 20.1 | 20.1 |
| Labor *(which could be lower)* | 93.8 – 120.6 | 120.6 |
| **Total** | **381.9 – 455.6** | **462.3 – 522.6** |

For Phase II, the City Government allocated US$ 33,500 for the school toilets.

The cost for operation and maintenance of each toilet facility was conservatively estimated at US$ 6.7 per year, which includes a US$ 1.34 contingency in case the carbonized rice hulls are no distributed for free; time spent for providing ash, carbonized rice hulls and water for hand washing; as well as cleaning the toilet. Maintenance of these facilities is currently being undertaken by the households themselves.

### D.2. Peri-Urban Upgrading of Settlement and Wastewater Treatment

The total project cost for the wastewater treatment plant (WTP) of the Fishermen's Village, which includes consultancy fees, labor and materials amounted to US$ 227,272.72. The estimated operating and maintenance costs of US$ 1,818.18 does not include the electricity costs for the pump as this particular expense item has not yet been accounted for during the preparation of the primary reference material.[11]

Through the project, capacity building activities such as the administration of training courses on the operations and maintenance of the facility was given the staff of the City Engineering Office and members of the village association. However, "water quality monitoring of the WTP's influent and effluent is undertaken by the local water service provider. The parameters analyzed include (a) TDS, (b) $BOD_5$, (c) ammonia, (d) nitrate and (e) phosphate as well as the (f) microbiological parameters for *E. coli*."[12]

### D.3. LGU-Wide Integrated Waste Management Facility

The integrated waste management facility has an estimated cost of US$ 2.5 Million. To date, given developments at the site and the component facilities that have completed construction, the incurred cost is approximated at US$ 681,818 – 909,090. All of the finances utilized for the program have been sourced from the city's internal funds.

[11] Constructed Wetland for a Peri-Urban Housing Area. **Sustainable Sanitation – Project Data Sheet**; DILG-GTZ Water and Sanitation Program; August 2008; page 2.

[12] **Compilation of 31 Case Studies on Sustainable Sanitation Projects**; Sustainable Sanitation Alliance; February 2010; pages 11-3 and 11-4. | http://www.susana.org/images/documents/06-case-studies/book/case_study_book_complete.pdf.

## E. Re-Use Components and Other Features

### E.1 Rural Upgrading of Sanitation Facilities[13]

An information campaign was administered during the project's implementation stages, which included training sessions on the safe use of dried feces and urine. Households adopting the double vault UDDT employ the dried feces, stored for at least 12 months, as soil conditioner for fruit trees, corn and rice. Households using the single-vault UDDT, on the other hand, either dry the collected feces for at least a year or compost it for 6 months with the composting facilities of their respective barangay agricultural development centers.

The collected urine is immediately utilized by the farmer households, with no storage period requirements. The liquid is diluted with 3-5 parts water and applied as fertilizer to rice, selected vegetables and ornamental plants, if needed.

### E.2. Peri-Urban Upgrading of Settlement and Wastewater Treatment[14]

Frequent and exact microbiological analyses of the effluents of the constructed wetlands have been conducted since November 2008. Findings indicate that its fecal coliform and pathogen content is still lower than virtually all the rivers in Negros Oriental. Moreover, the effluent has almost ideal concentrations of nitrate and phosphate and thus be used for the irrigation and fertilization of the village's vegetable and cut flower project. Still, the village farmers were cautioned of the safeguards advised by the World Health Organization on the *Safe Use of Wastewater and Excreta*.

The treated wastewater is pumped from the effluent sump to an elevated tank, which supplies the irrigation system. That water is piped to the garden via a distribution system of standpipes. Thus, as an alternative source of liquid fertilizer, the farmers same money from the purchase of commercially available chemical fertilizers. Moreover, the reuse of treated wastewater helped avoid consuming virgin water, which could have been used for drinking purposed or other means of domestic consumption at home. In addition, the same water has been used by the fire brigade and as a water source for construction purposes.

[13] **Compilation of 31 Case Studies on Sustainable Sanitation Projects**; Sustainable Sanitation Alliance; February 2010; pages 12-4 and 12-5. | http://www.susana.org/images/documents/06-case-studies/book/case_study_book_complete.pdf;.

[14] Ibid.; pages 11-4 and 11-5.

## F. ASSESSED AND PERCEIVED IMPACTS

Hence, the other environmental projects such as the integrated waste management facility and the constructed wetlands all converge as preventive measures in protecting the city's underground water supply. This would ensure good quality water in their aquifer, despite currently utilizing only surface water resources for the city's drinking and domestic water requirements. Particular to the constructed wetland, this endeavor was a pioneering LGU-managed project on the wastewater treatment of 676 households of the residents of the Fisherman's Village. As a result, the community was a recipient of the *Galik Pook* award sometime in CY 2006.

# LOCAL INITIATIVES FOR AFFORDABLE WASTEWATER TREATMENT (LINAW PROJECT)
## Case of Dumaguete City (Public Market and Septage Treatment Plant)

| | |
|---|---|
| Project Owner(s) | ▪ Local Government of Dumaguete City |
| Project Partner(s) | ▪ United States Agency for International Development (USAID)<br>▪ Philippine Sanitation Alliance (PSA)<br>▪ Basic Needs Services (BNS) Philippines |
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| *Partner* | ▪ Lisa Lumbao; 819.0687 (phone); 0917.892.2989 (mobile); llumbao@eco-asia.org.ph (e-mail) |
| *Partner* | ▪ Mary Joy Jochico; 552.9830 (phone); 552.9977 (fax); mjochico@usaid.gov (e-mail) |
| *Partner* | ▪ Engr. Jonas Maronilla; 572-3530 (phone); 913-0806 (fax); Philippines@borda.de (e-mail) |

## A. WHAT TRIGGERED THE PROJECT?

### A.1 PROJECT OBJECTIVE(S)


Public clamor for better sanitation services had been voiced by residents and NGOs active in the area, several years ago. The same concerns have, in one instance or another, been taken up by a member of the City Council, in its deliberation of local issues. It could have been borne out of a discontinued pastime of residents in the locality -- swimming along the coast of Rizal Boulevard. It was also compounded by the fact that locals who undertook their fishing livelihood in the area were also negatively affected.

Prompted by the conditions illustrated above, environmental studies were conducted by Siliman University. Their findings indicated that the coastal waters of Dumaguete showed extremely high *coliform* count, especially along Rizal Boulevard, making the area unfit for water sports or fishing. The observation was aggravated by additional findings that about 10 outfalls discharge untreated wastewaters from residences and the city's business district. Hence, the above findings bore more weight on the fact that some 20,000 poorly designed and maintained septic tanks were perceived as potential sources of contamination to the city's (i) 16 deep well water sources and (ii) 900 shallow well sources, as indiscriminate disposal of septage was observed. Thus, their primary sources of water supply were gravely threatened.

In consideration of all of the above, the LGU took it upon itself to include sanitation as one of its priority areas for development. Hence, it participated in the LINAW Project, which was funded by the United States Agency for International Development (USAID). In this undertaking, city officials and stakeholders developed strategic interventions and solutions to their condition, based on a participatory planning process. Consequently, they worked together in identifying their local priority projects. In particular, the Project extended support by means of:[1]

- Targeted technical assistance, including project design and packaging support;
- Participatory planning workshops;
- Information and resource materials on technology and financing options;
- Public awareness campaigns and media coverage to promote replication; and
- Sharing project results in both local and national forums.


Overall, the facilities developed and planned through the Project included low-cost septage treatment lagoon designed by USAID, and Decentralized Wastewater Treatment Systems (DEWATS), which was developed in partnership with the Bremen Overseas Research and Development Association (BORDA).[2]

## A.2 PROFILE OF THE BENEFICIARIES

Dumaguete City is the capital, sea port and largest city of the province of Negros Oriental. The 2007 census showed a population of 116,392 people. "The City has a land area of 34.26 km², situated on the plains of the southeastern coast of Negros Island near the mouth of the Banica River. As a coastal city, it is bounded on the east by the Mindanao Sea and the Tañon Strait, serving as a natural border to the neighboring provinces of Cebu and Siquijor."[3]

"Its topography is generally flat from 2-6 kilometers from the shoreline. It slopes gently upwards to the adjoining municipality of Valencia. The highest ground elevation is located at the boundary of the municipality of Valencia, about 100 meters above mean sea level. 93% of the lands have slopes of less than 3%, while the remainder has 3% to 5% slope."[4]

[1] http://www.unescap.org/pdd/prs/ProjectActivities/Ongoing/Water/Muntinlupa/LINAW_project_brochure.pdf.
[2] **Local Initiatives for Affordable Wastewater Treatment in the Philippines/LINAW-1 (Final Report)**; PADCO/AECOM; February 2006; page 2. http://pdf.usaid.gov/pdf_docs/PDACI905.pdf.
[3] http://www.dumaguetecity.com/cityprofile.html.
[4] Ibid.

The city's health profile, as indicated in the matrix below, places diarrhea as the 5th leading cause of morbidity amongst its population, with a striking uptrend from CY 2008-09. This observation could possibly be due to the lack of adequate sanitation infrastructure and systems in the locality.

| TEN LEADING CAUSES OF MORBIDITY, DUMAGUETE CITY | | | |
|---|---|---|---|
| Causes | Number of Cases | | |
| | 2007 | 2008 | 2009 |
| Upper respiratory tract infection | 5,628 | 5,116 | 8,002 |
| Bronchitis | 2,270 | 2,273 | 1,300 |
| Pneumonia | 1,696 | 1,115 | 1,165 |
| Wounds (All types) | 1,288 | 350 | 432 |
| Acute gastroenteritis (i.e. diarrhea) | 1,288 | 373 | 1,853 |

Source: City Health Office, Dumaguete City, Negros Oriental

## B. SOCIAL AND TECHNICAL PREPARATION AND PROMOTION

To instill project ownership from all of the stakeholders concerned, participatory planning workshops were staged at the onset of the pertained undertaking. The participants to these public consultation included city LGU officials and staff, barangay officials, students and faculty from the universities and colleges, market vendors, medical practitioners, NGO representatives, members of the City Development Council, and businessmen, among others.

In these consultative meetings, participants helped identify the sources of pollution in the city and suggested possible solutions. They too were oriented of current national and local laws and ordinances on wastewater management. As a form of capacity building to LGU personnel in line with the objective the Project, they underwent various training courses on (i) social marketing as well as (ii) wastewater management. Through it all, the City Government of Dumaguete was in charge.

A technical working group was also established to facilitate the entire planning process cited above. The TWG came to being by virtue of an Executive Order passed by the local chief executive (LCE), involving staffs from the City Planning Office, City Council, City Engineers' Office, City Health Office, representatives from the Provincial Government of Negros Oriental and local NGOs active in the community.

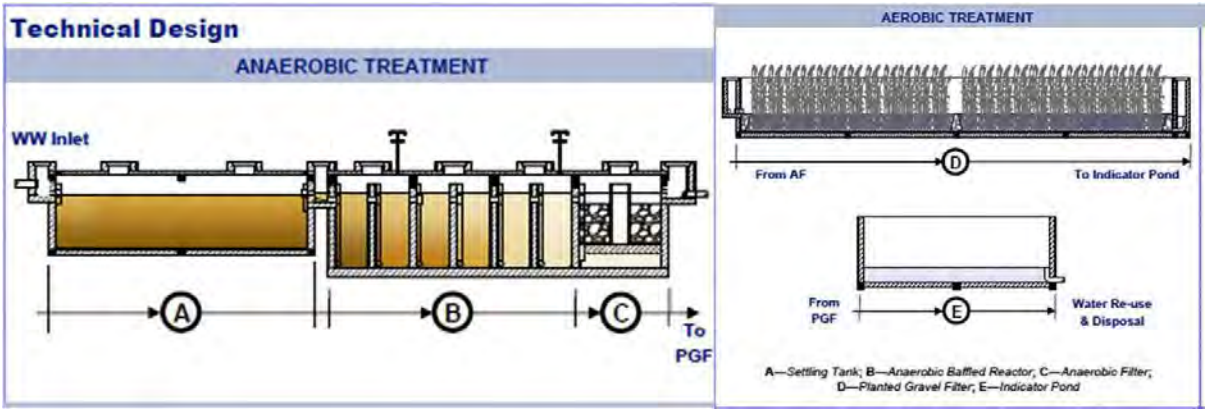
Social marketing was pursed via local radio and television talk shows, print media and grassroots

advocacies. Related information, education and communication (IEC) campaigns, utilized to increase the awareness and solicit further cooperation from the public, were conceptualized during the training programs on promotion (cited above), which are participated by personnel from the LGU, NGO, academe and representatives from the provincial government.

## C. Sanitation Technology/System/Options Observed

### C.1 Public Market WWTP

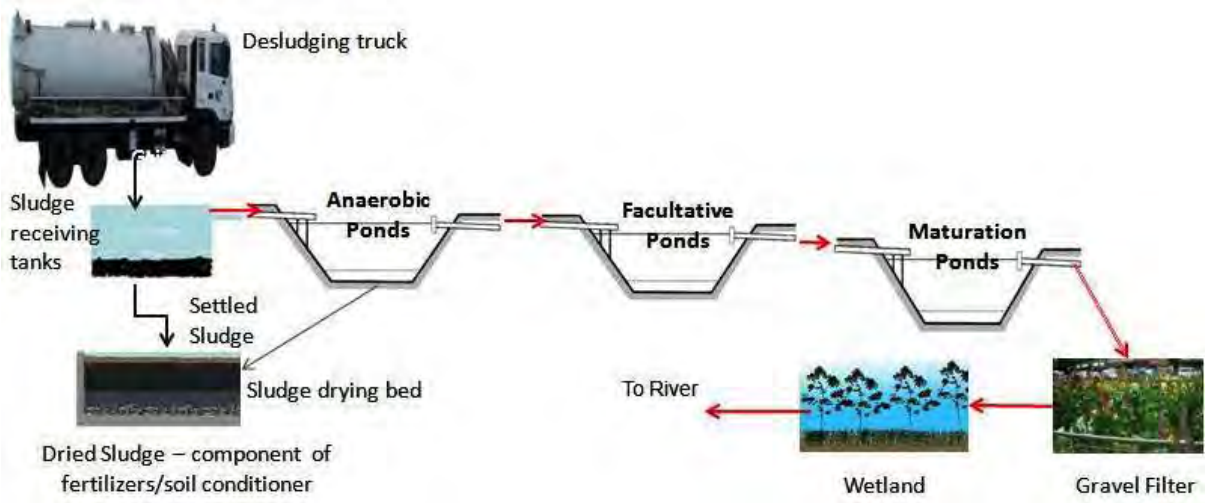
The city's public market made use of the Anaerobic Baffle Reactor System (i.e. illustrated below), a non-mechanized treatment process, which is now widely used in India and Indonesia to treat (i) hospital and (ii) domestic wastewater. This system is composed of a settling tank, an anaerobic baffle reactor, an anaerobic filter and a planted gravel filter. The City's treatment facility can process 80 cubic meters of wastewater per day. The plant has a total area of 600 square meters. Total Construction cost of the plant is US$ 79,545.45. The treatment plant receives public market wastewater whose BOD ranges from 400 mg/l to 800 mg/l. Effluent BOD ranges from 10 mg/l to 50 mg/l. Construction of the treatment plant was supervised by the City Planning and Development Office (CPDO).




### C.2 Septage Treatment Plant

Dumaguete's septage treatment plant (STP) was designed to process all of the LGU's septage generated from both households and business establishments. Its operational system is illustrated in the schematic below. The facility has a total area of 2.0 hectares and currently employs 6 desludging trucks. As with the public market wastewater treatment plant, all construction materials needed for building the facility were sourced locally.

In anticipation of the operating and maintenance costs that would be incurred by the facility, the City Government and the Dumaguete City Water District signed a Memorandum of Agreement (MoA) defining each party's role in the joint ownership and operation of the facility. The agreement included provisions on the sharing of capital and operation costs, mechanisms by which to collect service fees, and sharing of any revenues. The partnership is the first of its kind in the country, where the LGU and the local water district actively collaborate in implementing the city's septage management system, wherein the water district is responsible for collecting septage and transport the same to the treatment facility, collects the septage fees; and the city government is responsible for operating and managing the septage treatment plant.




## D. SUPPORTIVE ENVIRONMENT

### D.1 PUBLIC MARKET WASTEWATER TREATMENT PLANT

The City Planning and Development Office (CPDO) was the lead agency in the planning, construction and operation phases of the STP. Funding requirements for the establishment of the facility was completely sourced from the city's local development fund. It secured technical assistance from Basic Needs Services (BNS) Philippines, BORDA's representative to the country, for the design of the treatment facility itself.

Quarterly monitoring of the treatment plant's influent and effluent are conducted for BOD, TSS and nitrates. Sampling activities are conducted by the City Environment and Natural Resources Office (CENRO). Laboratory analyses are undertaken at the Chemistry Department, Silliman University. To date, the facility incurs a monthly operating cost of US$ 79.54, which is supported by the toilet user fees collected at the public market. Having this cost recovery mechanism in place helps defray the O&M cost of operating the treatment plant.

### D.2 SEPTAGE MANAGEMENT SYSTEM

Ensuring sustainability of operations meant that a cost recovery mechanism has to be in place. This consideration was included in the MoA forged

between the city government and the local water district. That MoA has authorized the latter to collect an additional fee of US$ 0.045 per cubic meter of water consumed. The septage fee is reflected in all of the monthly billing statements issued to consumers within the water concessionaire's jurisdiction. Funds generated from this fee would ensure that households and business establishments would be serviced every 3-5 years, by the fleet of vacuum trucks, and have their respective septage treated in the STP.

The monitoring system for the treatment efficiency of the STP has just been initiated by the city government. Parameters being monitored include (a) characteristics of raw septage; (b) BOD; (c) total suspended solids; (d) nitrates; and (e) microbial removal of the anaerobic, facultative and maturation ponds, including the constructed wetland. The results of these regular monitoring activities would be evaluated in compliance with DENR effluent standards on (i) land disposal of effluents and (ii) industry performance standards for stabilization ponds. The final effluent is not directly discharged to any receiving body but rather made to leach in an area that is at least 100 meters away from the nearest river.

## E. Re-Use Components and Other Features

On one hand, the treated wastewater coming from the public market is reused for landscaping purposes -- watering the plants at Quezon Park. The park is located in between the public market and the city hall; bounded by Perdices, Colon, Sta. Catalina and Bishop Epifanio Suburban Streets; with the Dumaguete City Central Elementary School, Colegio de Santa Catalina de Alejandria, Holy Child Hospital and the Plaza Maria Luisa Suites Inn at its periphery.

On the other hand, settled sludge from the septage receiving tanks and anaerobic ponds are extracted and left to dry at the sludge drying beds. The *sludge cake*, generated from the drying beds are then distributed for free to farmers within the host barangays, who then in turn make use of the material as a component to organic fertilizers or as soil conditioners. The treated wastewater from the STP is still being contemplated for reuse as irrigation in nearby farm lands.

## F. Assessed and Perceived Impacts

The 2 facilities cited in this case study would stand to benefit not only the residents of the Dumaguete City, but the environment as a whole.

From an economic standpoint, a portion of the septage user fees would help put up communal sanitation facilities for indigent households that have no sanitation infrastructure (i.e. toilets). Furthermore, the host barangay, where the city-wide Septage Management System facility is located, would retain a portion of the collected user fees, making available another fund source that could be tapped for that town's developmental initiatives.

The wetlands in the septage treatment plant provide an environment for flora and fauna to breed and flourish.

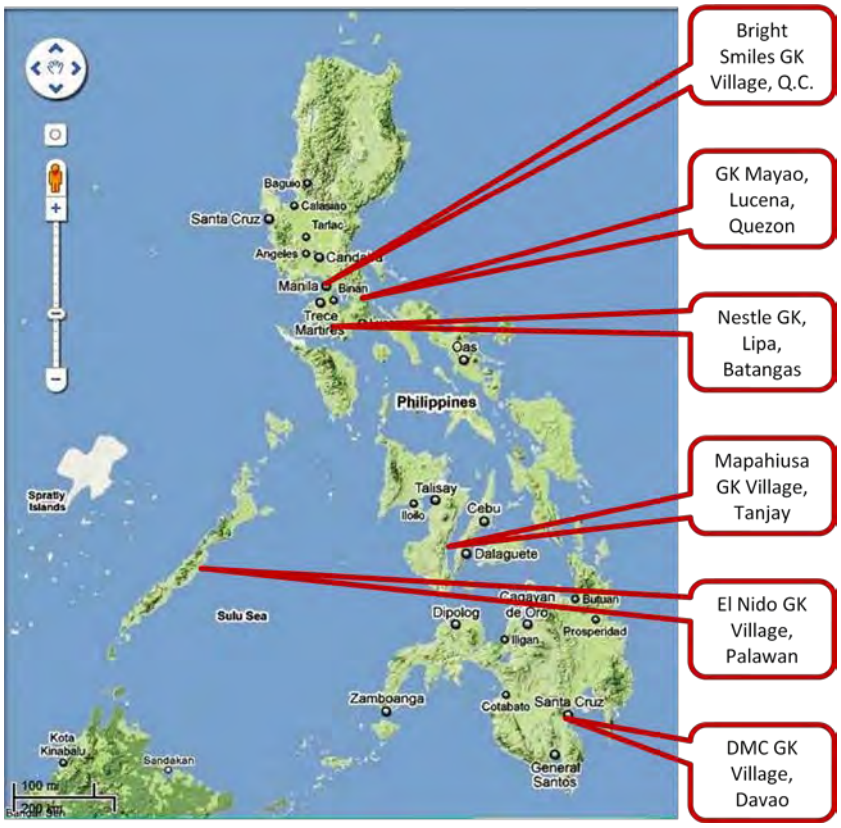
For both undertakings, the leadership and sustained commitment of then City Mayor Agustin R. Perdices was considered crucial to the success of these sanitation projects that the LGU has pursued. The CPDO's oversight and project facilitation was also of big help in these endeavors. Per the LGU's appreciation of these sanitation-related undertakings, the solutions and systems that it has subscribed to were relevant given their local conditions; and certainly affordable given their economic capacity.

Therefore, these projects have become an inspiration to other local government units that have appreciated the value of taking good care of the environment and mulling over pursuing similar undertakings.

# BUILDING COMMUNITIES... EMPOWERING COMMUNITIES
## Case of Gawad Kalinga Villages

| | |
|---|---|
| Project Owner(s) | ▪ Communities in Partner Local Government Units |
| Project Partner(s) | ▪ Gawad Kalinga<br>▪ LGUs of Quezon City; Lucena, Quezon; Lipa, Batangas; Tanjay, Negros Oriental; Davao City, Davao del Sur; and El Nido, Palawan<br>▪ Individual *pro bono* consultants |
| Primary Contacts<br>*Partner* | ▪ Mr. Jerick T. Limoanco; 718.1738 (office); 0917.790.7204 (mobile); jerick.limoanco@gmail.com (e-mail) |

## A. WHAT TRIGGERED THE PROJECT?




Gawad Kalinga is a non government organization that helps build communities. By building each village, the target beneficiaries are provided a sense of security by having a decent home and tenure for their lands. Each community should have access to education, health care, livelihood and other ancillary facilities. The villages that it has helped establish are mostly located in the provinces -- with a good mix of community settings ranging from urban slums to resettlement areas for disaster victims. Other sites especially in the National Capital Region are simply subjected to *re-blocking* in an attempt to make available necessary basic infrastructures needed for a community to progress (i.e. water supply and sanitation facilities); increase resiliency; as well as promote multi-faceted development. GK's thrusts are deeply rooted on empowering the beneficiaries, enabling them to break away from the vicious cycle of poverty, through caring (i.e. *kalinga*) and *bayanihan*.

The sanitation systems that were installed in the various GK villages that were established in the country were not taken in isolation, but rather part and parcel of the master plan for the village.

Hence, putting up anaerobic baffled reactors (ABRs) in lieu of septic tanks was borne out of the policy directive issued by the Management Committee of Gawad Kalinga, which only took effect at the latter part of CY 2009. Such was in full consideration of the recommendations furnished to them by the organization's Environmental Unit -- learning from their lessons while previously building septic tanks during GK's initial 2-3 years of operation. Only in instances that funds were available, due to certain corporate or institutional donations (i.e. including local government support), would the installed sanitation infrastructure consider upgrades like having a biogas reactor or a constructed wetland, to further improve the water quality of the effluents that leave their communal sewage treatment plant (STP).

The rationale in GK's health and sanitation initiatives for their villages is not confined to the access of properly functioning sanitation systems alone, but also to improve the community's health as well as avoid aggravating their indigent water ecosystems, through its respective effluents. Evidently, the treatment efficacy of the ABR is better compared to the performance of septic tanks. This is however tempered by the cost implications of the sanitation technology being subscribed to. Thus, constructing a communal ABR for at least 30 families was found to be more cost effective vis-à-vis putting up a septic tank for each house, for the same 30 families. Nonetheless, in cases where villages are made up of less than 30 households, an exception to the policy would come into play. Constructing septic tanks for each family is permitted, provided that each unit has a sealed bottom to prevent seepage and contamination of (possible) groundwater and surface water resources.

## B. Social and Technical Preparation and Promotion

Prior to erecting the village's sanitation sub-system, as part of the overall village development plan, a project management team is first established. Said team is in charge of the technical specifications of the infrastructure, overall supervision of the activity and sourcing of needed construction supplies. The villagers on the other hand offer their labor services as equity to the entire undertaking.

The project management teams deployed onsite are subjected to varying IEC campaigns, especially as a means of boosting their technical proficiency and understanding of the (sanitation) solution being subscribed. One of such means is through the conduct of Green Kalinga forums that is employed to orient provincial personnel on the various innovations that are available to them, which however is not limited to sanitation concerns only. Technical workshops are also held to orient concerned deployment teams that are on the ground, including one-on-one sessions with the local technical team (if needed). These are supplemented by the dissemination of brochures and manuals on the subject, as well as site tours for better appreciation of the concept.

## C. SANITATION TECHNOLOGY/SYSTEM/OPTIONS OBSERVED

The current standard communal facility is the ABR. "It has an approximate area requirement of 9.5 – 10 square meters and designed for a capacity of 12.5 cubic meters of wastewater per day. Each facility could accommodate the wastewater produced by 30 households. The average household size is 5.5 members, each generating 75 liters of wastewater per day. Its design presumes that the influent to the ABR has an organic load of 300 mg/liter BOD. Therefore, the final effluent could go to a coco peat or a horizontal gravel filter."[1]

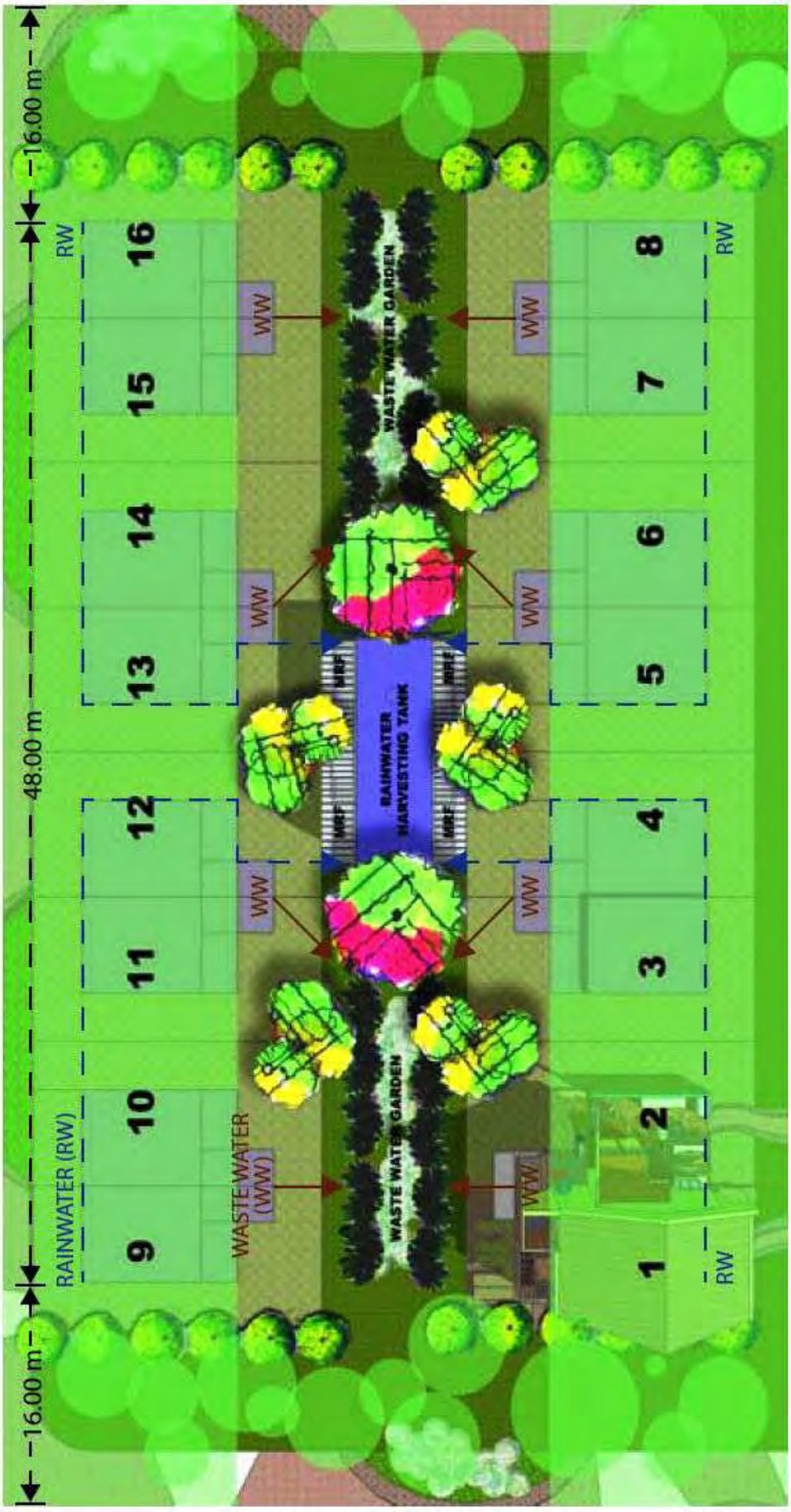
Accordingly, the technology is already adequate in ensuring that the effluents thereof would pass DENR standards for liquid discharges that go directly to rivers, lakes and similar water bodies. A spillover effect of such systems is that other residents, located at the periphery of the village, would be assured of good quality water in their indigent water ecosystems, as the GK Village's effluents would not be contributing additional organic (pollution) load into these rivers and lakes.

Moreover, the location of the facility abides by their guiding principle in planning and designing a community, which they call *Green Architecture*.[2] This principle dictates how to craft the site development master plan of a proposed GK community, ensuring that the village's design optimizes the use of the natural environment, thus creating a healthy and well-built community. The figure below illustrates a sample 16-unit cluster plan for sustainable cluster development.

The provision of upgrades in their sanitation system would only be warranted if (i) additional funds are immediately made available for the purpose; and (ii) the village's master plan would include certain livelihoods that would require for the facility's outputs as inputs for the community's economic undertakings. An example of which is recycling treated sewage water from a constructed reed bed, either for landscaping purposes or backyard vegetable gardens. Another is the installation of a biogas digester, if and only if agricultural livestock would be raised/cultivated within the community or its periphery, which has a high organic load (e.g. animal and human manure, kitchen scraps, garden weed, etc).[3]

Land area would not be a critical impediment for the village, as both infrastructures could be built below ground. However, only in cases when a constructed wet land is to be built, would a significant land area be a pressing concern. The facility would have a total area of 120 square meters, with a suggested aspect ratio of 12m x 10m; a maximum depth of 1 meter; a bed slope of 1%; and a bed structure that is reinforced and lined with high density polyethylene (HDPE). The facility would also have an energy cost of US$ 0.318 per day.[4]

[1] **Green Kalinga Manual**; December 2009; pages 49-50.
[2] Ibid; page 25.
[3] Ibid.; page 52.
[4] Ibid; pages 51-52.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## D. SUPPORTIVE ENVIRONMENT

Having the ABR as the GK Villages' standard system for sanitation was brought about by the GK Board's resolution. There were no cost implications to this policy as original costs and corresponding funds, supposedly allotted for building septic tanks for individual households are diverted for the construction of the ABR. This is also due to the fact that there were no observed price differentiations in the construction of either system. Again, should there be additional finances at the disposal of the Project Manager; it can be utilized for building either a biogas digester or a constructed wetland.

Institutional support, especially from the LGU's concerned, is expressed in the form of granting a parcel of public alienable and disposal (A&L) lands to be used for erecting the village; shouldering the provision of access roads to the site; facilitating the processing of needed local permits; among others.

A monitoring mechanism that would ensure smooth operations and efficacy in treating wastewater is still wanting, as requisite funds and technical capability to undertake environmental monitoring are quite lacking.

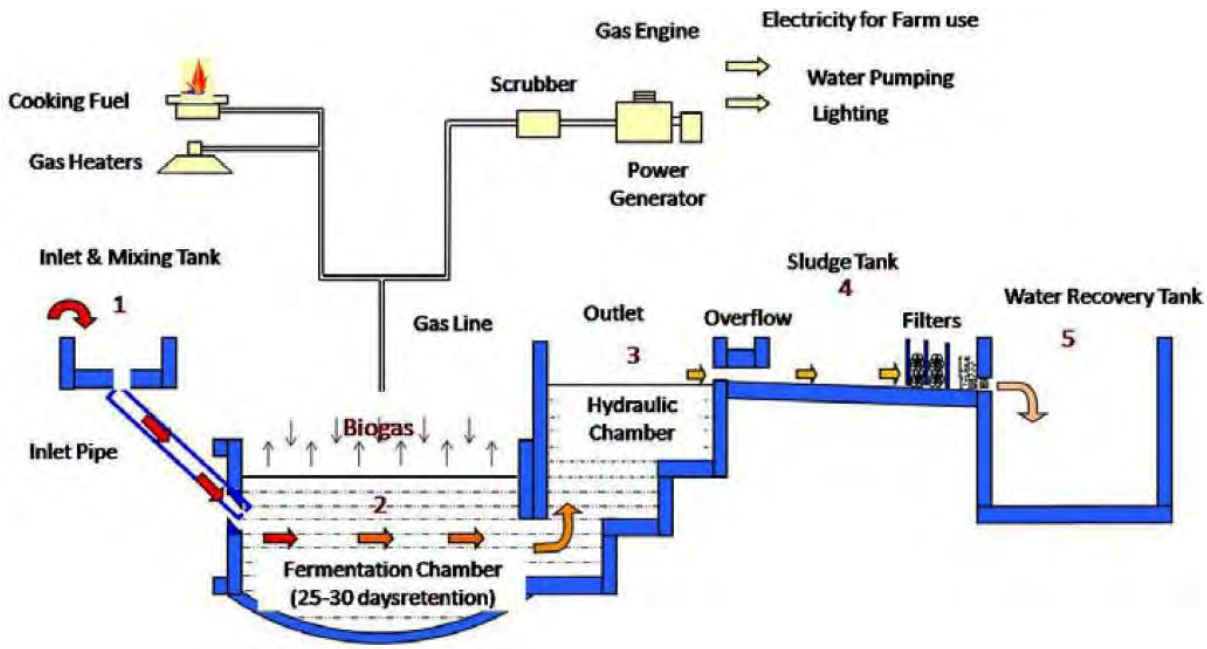
GK has identified a few partners for various alternative sanitation solutions that are available for subsequent villages that would be put up. In case of the technical specifications for the design of an ABR, a USAID consultant has volunteered his expertise on the design and other technical aspects in erecting and operating said system. In terms of constructing biogas digesters, GK taps on the expertise of a local NGO, Sustainable Use of Renewable Energy (SURE), for corresponding technical and design details. Lastly, in putting up constructed wetlands (i.e. the reed beds), it taps on the professional expertise of a colleague and friend who is affiliated with the World Bank and very much involved in this technology.

Subscription to the sanitation technologies enumerated above is guided by GK's overall vision and mission of the program -- saving the poor to save the environment and vice-versa. By allowing access to better and affordable sanitation systems, the poor are empowered to be active stakeholders in preserving the environment, with solutions that are inexpensive and uncomplicated.

## E. RE-USE COMPONENTS AND OTHER FEATURES

Nutrient re-use is only practiced within GK communities in the National Capital Region (NCR). Herein, coordination is undertaken with the water utility companies (i.e. Manila Water Company Inc. and Maynilad Water Services Inc.). The slurry contained in the villages' anaerobic baffled reactors are siphoned off, transported to the concessionaire's sewage treatment facility, and eventually processed as soil conditioners or organic fertilizers.

Per the organization's accepted design specifications: (i) methane gas is recovered from biogas digesters (i.e. illustrated in the figure immediately below), which is tapped as an alternative fuel to commercially available liquefied petroleum gas (LPG); and (ii) the final effluent of reed beds are to be utilized either as fire water (i.e. water that is pumped in fire hydrants) or agricultural water, used to water the vegetable gardens of the villagers. A specific example for the latter mode of reuse is exemplified by the GK Village in Bayawan City, Negros Oriental, as the establishment thereof was spearheaded by the LGU. Given the former mode of reuse, such a unit was installed in the Mapahiusa GK Village, which is located in Tanjay City, Negros Oriental.




Overall, GK does not have enough resources to individually manage the *reuse aspect* for each village's sanitation system.

## F. Assessed and Perceived Impacts

Evidently, the choice of an ABR as its preferred sanitation solution hinges on the economic consideration of building one vis-à-vis a typical septic tank or other available water-based options. Nonetheless, the adopted technologies were deemed relevant given the experience of prior project undertakings, especially in terms of (i) viability given the financial capability of the target beneficiaries; (ii) social acceptance; and (iii) minimal maintenance required; and (iv) environmental soundness of the basic concept of these technologies.

Per GK's experience, the factors for successful implementation would include: (a) availability of technical knowledge on the selected sanitation solution; (b) stakeholder consultation; (c) participative planning; and (d) project monitoring, particularly during the construction phase. Implementation of these sanitation initiatives would be done better and more sustainable if provinces provide the same services as those provide by the concessionaires in Metro Manila. Otherwise, the pertained ABRs would easily get filled up over time. Should the concerned GK villages take it upon themselves to do sludge extraction for their respective facilities, the activity would be a financial burden to the community, which would make the entire initiative unsustainable.

To date, no problems have been experienced in any facility after its construction. However, validating the impact and quality of the villages' final effluent to receiving water bodies is very much wanting. Inasmuch as the GK's Environmental Unit would recommend this protocol, the present level of resources could not warrant such an activity. Hence, management has not included this type of monitoring mechanism in its list of priorities.

KOICA 한국국제협력단
KOREA INTERNATIONAL COOPERATION AGENCY

UNEP

Center for Advanced Philippine Studies

# PRESERVING THE WATER QUALITY OF ILOILO CITY
## DEWATS of the Public Abattoir and Iloilo Mission Hospital

| | |
|---|---|
| Project Owner(s) | ▪ City Government of Iloilo<br>▪ Iloilo River Development Council<br>▪ Iloilo Mission Hospital |
| Project Partner(s) | ▪ United States Agency for International Development<br>▪ Basic Needs Services Philippines Inc. |
| Primary Contacts | |
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| *Owner* | ▪ Engr. Noel Hechanova; 0906.484.4779 (mobile); noel_hechanova@yahoo.com (e-mail) |
| *Owner* | ▪ Engr. James Siosan; 033.320.0315 to 19 (phone); 033.320.0321 (fax); 0918.261.3983 (mobile) |
| *Partner* | ▪ Mary Joy Jochico; 552.9830 (phone); 552.9977 (fax); mjochico@usaid.gov (e-mail) |
| *Partner* | ▪ Engr. Jonas Maronilla; 572-3530 (phone); 913-0806 (fax); Philippines@borda.de (e-mail) |

## A. WHAT TRIGGERED THE PROJECT?

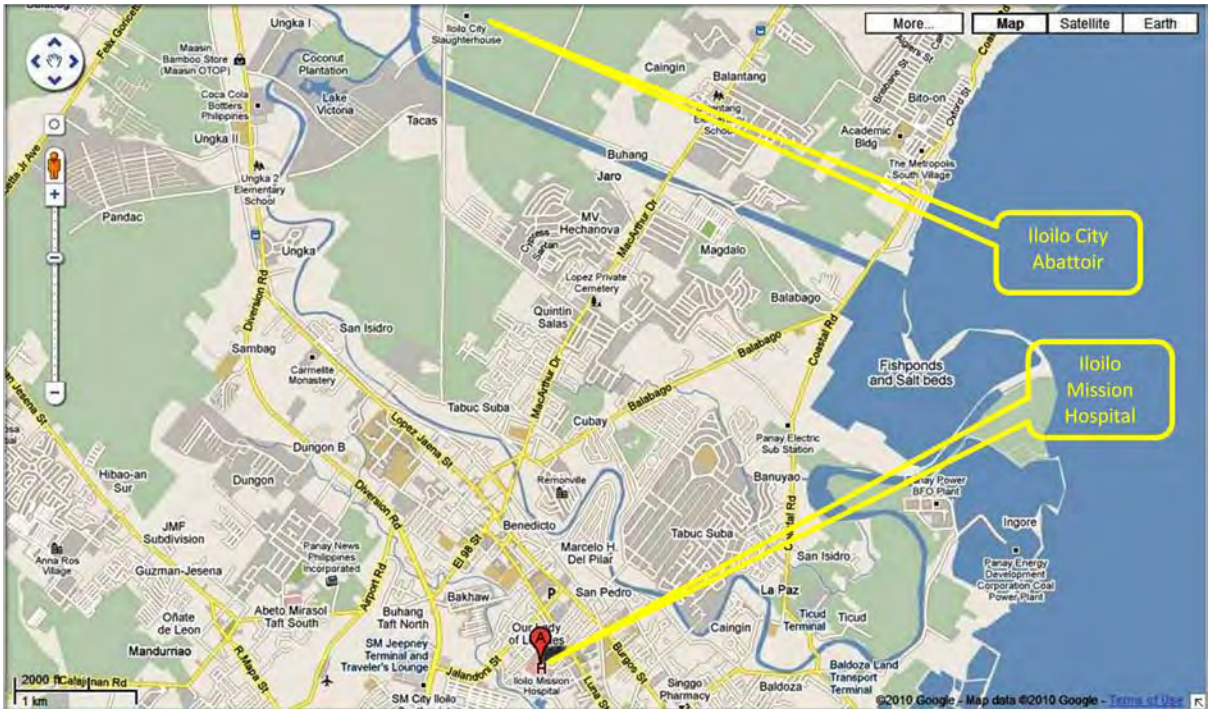

Iloilo River is actually an estuarine that is 15 kilometers long. It derives fresh water from the rivers and creeks that are connected to it and saline water from the sea that feeds it. Iloilo River maintains a high level of productive biological activities. It serves as nursery for many important fish species such as bangus and tilapia; and the rise and fall of the tide makes it possible for nutrients (such as planktons and detritus) to circulate in and out of the estuary. Iloilo River is home to 22 of the country's 35 mangrove species and the rare emerald shrimp species, *metapenaues insolitus*. To some residents of the city who are dependent on fishing, it is a source of sustenance and livelihood. Its estuarine characteristic is an ideal source of brackish water for fishpond cultivation.

Majority of the current changes occurring in the Iloilo River ecosystem originate from human activities. Out of the total 180 barangays in Iloilo City, thirty-five (35) are found along Iloilo River. Land use along Iloilo River is a combination of residential, commercial, institutional, open space, fishpond, transport facility and mangrove areas. Port facilities, storage facilities, commercial buildings, offices in combination with residential structures surround Station 1 (Quirino Bridge- Parola). Hotels, schools, hospitals, offices in combination with residential units

surround Station 2 (IBRD Bridge-Quirino Bridge). Stations 3 (Carpenters Bridge –IBRD Bridge) and 4 (Carpenter's – Upper portion of Iloilo River) are predominantly utilized for fishery activities, fishpond cultivation and salt beds with some residential use.

Over the next few decades the major challenge would be to control the untreated sewage that Iloilo River receives from 121 of the 180 barangays (i.e. villages) of Iloilo City and from 51 other barangays outside the city. There is no sewerage system in the city and majority of the residence rely on on-site treatment through septic tanks that are mostly ill constructed and poorly maintained. The high cost of investment and high operating cost required of conventional sewerage system has been the major setback for controlling untreated sewage.

A two year study conducted by the University of the Philippines in the Visayas (UPV) showed that Iloilo River has been experiencing low dissolved oxygen, which then validates the perception of the river system's ecologic degradation.




## A.1 PROJECT OBJECTIVE(S)

In consideration of the above, the LGU took it upon itself to include sanitation as one of its priority areas for development. Hence, it participated in the LINAW Project, which was funded by the United States Agency for International Development (USAID), in cooperation with the League of Cities of the Philippines (LCP). In this undertaking, city officials and stakeholders developed strategic interventions and solutions to their condition, based on a participatory planning process. Consequently, they work together in identifying their local priority projects. In particular, the Project extended support by means of:[1]

- Targeted technical assistance, including project design and packaging support;
- Participatory planning workshops;
- Information and resource materials on technology and financing options;

[1] http://www.unescap.org/pdd/prs/ProjectActivities/Ongoing/Water/Muntinlupa/LINAW_project_brochure.pdf.

- Public awareness campaigns and media coverage to promote replication; and
- Sharing project results in both local and national forums.

LCP extended assistance through making information materials on sanitation and wastewater treatment technologies available to its member cities via workshops, training sessions, its web portal and the LCP Environment Unit.[2] Overall, the facilities developed and planned through the Project included low-cost onsite treatment systems for public markets and slaughterhouses, offsite septage treatment lagoons, and community-based Decentralized Wastewater Treatment Systems (DEWATS), which were developed in partnership with the Bremen Overseas Research and Development Association (BORDA).[3]

### A.2 Profile of the Beneficiaries [4]

Per the 2007 census, its population stands at 418,710. The figure excludes transients who only work in the province and are bona fide residents of other cities.

The city draws on the region's extensive range of raw materials and its large consumer market. Purchasing power is generally high given the favorable income distribution in Iloilo. It is even dubbed as the financial center in terms of dynamic banking conditions, next to the country's financial capital city of Makati.

There are 8,407 business establishments as of December 2003 in Iloilo City, of which 1,182 are new. A total capital investment for new business establishments is US$ 8,306,955. However, both new and renewed capital investments for the year 2003 amounted to US$ 295.9 Million.

Average Annual Family Income (at current prices) is US$ 6,445.54, or a percentage increase of 32.3 from 1994 to 1997, while Average Annual Family Expenditures is US$ 5,156.52, or a 25.6% increase (2000 FIES). Average per Capita Income is US$ 1,478.09 and Average Per Capita Expenditures is US$ 1,171.75 (FIES 2000).


## B. Social and Technical Preparation and Promotion

The LINAW Program was launched last June 2005 with the Iloilo River as the venue. The highlight of the program launching was a fluvial parade, which was timed during the celebration of the Iloilo River Week. After which, the city undertook related projects and programs that aim to avert water pollution in the Iloilo River through the following methods:

- Awareness campaigns;
- Piloting and modeling;
- Replicating;
- A *River Watch* program;
- Regular clean up.

[2] Ibid.
[3] **Local Initiatives for Affordable Wastewater Treatment in the Philippines/LINAW-1 (Final Report)**; PADCO/AECOM; February 2006; page 2. http://pdf.usaid.gov/pdf_docs/PDACI905.pdf.
[4] http://iloilocity.gov.ph/iloiloct2010/socioeco.php and http://iloilocity.gov.ph/iloiloct2010/economy.php.

Public awareness programs were engaged to establish the connection between haphazard septic tank practices, water pollution and water borne diseases in the public's consciousness. Related initiatives aim to prepare the city's constituency for the eventual implementation of the city's septage management program and the proposed city ordinance requiring households to clean their septic tanks regularly. Academic institutions have been tapped to help out in the LGU's initiative -- the likes of the John B. Lacson Foundation, St. Therese College, Central Philippine University and the University of the Philippines.

A new campaign strategy called *social marketing* is being employed to enhance the abovementioned awareness campaigns. The tasks included therein include persuasion, information, education and triggering actions. The communication materials developed at the initial stage of the program were products of stakeholders' participation during various planning exercises. Communication materials utilized for the purpose consists of radio plugs, tri-media interviews, forums, workshops, exhibits, billboards and posters. Dialogues with the youth sector were actively engaged by the LGU as well.

The construction of a pilot low-cost treatment facility for Iloilo's abattoir was undertaken in collaboration with the Department of Agriculture. This demonstration project helped showcase that the establishment of this wastewater treatment plant (i) is not only feasible; (ii) it could be tailor fitted to match the needs of the client; and that (iii) active stakeholder participation during the planning stage gave a significant leverage to the success of the plant's construction.

Consequently, the Iloilo Mission Hospital and the Iloilo Doctors Hospital established their respective Decentralized Wastewater Treatment Systems (DEWATS). The actual adaptation of the decentralized model by the two (2) hospitals created a demand for technical expertise on low cost treatment, since the model hospitals were also able to demonstrate that low investment and low maintenance treatment is possible. To date, hospitals, malls, schools and hotels who are either applying for building permits or seeking compliance are preparing to pursue their own low cost treatment facilities through the assistance of technical experts who have been identified by the LINAW program.

Relative to the need for the strict implementation of the City's Anti-littering Ordinance along Iloilo River, the Mayor through an Executive Order deputized volunteers from the Philippine Coast Guard Auxiliary (PCGA), the Philippine Navy Naval Reserve Unit (PNNRU) and Bantay Bayan to apprehend then issue Citation Tickets to violators of Ordinance 2004-149. Such was their *River Watch* program.

Lastly, a cleanup drive in Iloilo River is maintained regularly by the City ENRO in collaboration with the PNNRU. The involvement of many schools and university in the city, as well as the private sector, in

the cleaning of the pertained river has prompted the City ENRO to prepare guidelines for volunteers.

## C. SANITATION TECHNOLOGY/SYSTEM/OPTIONS OBSERVED

The DEWATS technology was the solution of choice for the LGU as this is the flagship solution being offered by BORDA. Hence the WTPs for the (i) city slaughterhouse and the (ii) Iloilo Mission Hospital (IMH) made use of the same design schematics for their respective facilities. Superficially speaking, the former differs with the inclusion of a bio-digester as it intends to recover methane gas generated therein. On the other hand, the latter institution (i.e. the hospital) made no such mention of a reuse requirement for their treated wastewater.

### C.1 WTP FOR THE CITY ABATTOIR


The facility in Plaza Libertad has the capacity to treat 75 cubic meters of wastewater daily. This wastewater comes from the holding pen, bleeding area, hide removal, evisceration, offal cleaning, and scalding and hair removal areas of the slaughterhouse. The WTP sits on a 402 square meters of land area.

The DEWATS modules utilized herein include: 2 Biogas Digester (B.D), 8 chamber anaerobic baffled reactor (ABR) and 1 chamber anaerobic filter (AF) divided into 2 modules, 1 planted gravel filter (PGF). A treatment system with 2 modules was designed for operation and maintenance purposes and a common indicator pond (IP) was constructed for both modules.

The influent's water quality for $BOD_5$ is 2,000 mg/L; COD is 4,000 mg/L. The expected effluent quality is ≤50 mg/L.

### C.2 WTP FOR THE ILOILO MISSION HOSPITAL


The facility in Mission Road, Jaro has the capacity to treat 291 cubic meters of wastewater discharged daily. The hospital's wastewater sources generally include: sinks, floor drains, showers, toilets, dish and laundry washing machines, and tubs. The WTP sits on 1,086 square meters of land area.

Each DEWATS module employed in this facility include: 8 chamber anaerobic baffled reactor (ABR), 1 chamber anaerobic

filter (AF). A treatment system with 3 modules was designed for operation and maintenance purposes and a common planted gravel filter was constructed for all the modules.

The raw wastewater's $BOD_5$ is 250 mg/L and expected effluent quality is ≤50 mg/L.

## D. Supportive Environment

On one hand, he project cost for the slaughterhouse WTP is US$ 79,545.45. Funding was sourced purely from the LGU's coffers through the resolutions passed by the City Development Council. On the other hand, the establishment of the hospital's treatment plant was worth US$ 147,727.27, internally sourced from the institution's funding. Both infrastructures were engaged in relation to the LGU's overall water quality management efforts in preserving the Iloilo River.

Construction for the abattoir WTP was done with the active participation of the City Engineering Office. Operational monitoring is undertaken on a daily basis as its operator is part of the City Environment and Natural Resources Office (CENRO), especially when irregularities take place. Bearing in mind that wastewater from the slaughterhouse was discharged to the improvised pond that directly connects with the nearby rice fields, thus, wastewater should be treated first before it discharges there. Consequently, scheduled water quality monitoring activities are undertaken, particularly for Biological Oxygen Demand ($BOD_5$) and Total Suspended Solids (TSS).

The establishment of the hospital's WTP was pursued with the active involvement of its Engineering Department. Taking into account that the Construction, Supervision and Monitoring Contract forged between BNS-Philippines and IMH includes a 1-year warranty, BNS-Philippines conducts wastewater sampling. As such, the treatment plant's water quality for both influent and effluent are being monitored quarterly, particularly for $BOD_5$ and TSS.

The WTP's operational maintenance cost, for either the abattoir or the hospital, includes the monthly salary of an operator, de-sludging cost, and other miscellaneous expenses, which may include wastewater sampling, construction repairs and for aesthetic purposes. Details of which are illustrated in the table below. These expenses would be fully shouldered by the owners of the pertained to facilities.

**A Two-Year Estimated Cost for the Operation and Maintenance**

| Description | Amount (US$) | Frequency | Total (US$) |
|---|---|---|---|
| Salary of an Operator | 90.90 | 24 Months | 2,181.81 |
| Desludging Cost | 90.90 | 1 in every 2 Years | 90.90 |
| Miscellaneous Expenses | 227.27 | 2 in every 2 Years | 454.54 |
| TOTAL | | | 2,727.27 |

## E. Re-Use Components and Other Features

The major characteristics of wastewater discharged from slaughterhouses have high organic strength, sufficient organic biological nutrients, adequate alkalinity, relatively high temperature and free of toxic materials, which are well suited to anaerobic treatment. Resource recovery by capturing methane ($CH_4$) is utilized. Release of methane to the atmosphere is not an acceptable practice since it

has a high heat trapping capacity and is a major component of green house gas. The treatment can be designed to fit existing condition and meet the requested discharge standard. Thus, the recovered methane is utilized for heating water that is being used for the slaughterhouse's activities. Consequently, monthly savings are incurred from the avoided cost of heating fuel that was consumed prior to this intervention.

## F. Assessed and Perceived Impacts

Both facilities were able to reduce the odor, organic load and contamination of the generated wastewater before it discharges to the nearby river. Most especially for the management of the IMH, the erected facility significantly enabled it to respond to its organizational value system, where one of which is environmental preservation.

The assistance offered by the LINAW Project, especially during the social preparation and (technology) promotion stages have helped boost acceptance and adaptation of relevant and available low-cost technologies in addressing their local environmental concern on preserving the Iloilo River. The *participatory approach* employed by the LGU, in soliciting the cooperation of the hospitals within its jurisdiction has created a synergy, with the replication of the low-cost model now expanding to other groups of stakeholders -- hotels, markets and restaurants. In addition, joint water quality testing has helped establish a clear understanding of the stakeholders' (i) contribution to the pollution problem as well as (ii) how it could help in solving the same.

# LAGUNA DE BAY INSTITUTIONAL STRENGTHENING AND COMMUNITY PARTICIPATION PROJECT
## DEWATS of the Slaughterhouses of Sta. Cruz and Nagcarlan, Laguna

| | |
|---|---|
| Project Owner(s) | ▪ Municipal Government of Sta. Cruz, Laguna<br>▪ Municipal Government of Nagcarlan, Laguna |
| Project Partner(s) | ▪ World Bank (WB)<br>▪ Laguna Lake Development Authority (LLDA)<br>▪ Basic Needs Services (BNS) Philippines |
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## A. WHAT TRIGGERED THE PROJECT?

### A.1 PROJECT OBJECTIVE(S)[1]


In December of 2003 a US $ 5 Million grant was provided by the Royal Government of the Netherlands through the International Bank for Reconstruction and Development (IBRD) for the Philippine government, as it embarked on the Laguna de Bay Institutional Strengthening and Community Participation (LISCOP) Project, which was overseen by the Department of Environment and Natural Resources (DENR), in particular, its attached agency, the Laguna Lake Development Authority (LLDA).

The Project's aim was to assist the LLDA, local government units and other stakeholders within the Laguna de Bay watershed to improve its overall environmental quality through: (i) behavioral changes and activities undertaken by watershed users; and (ii) improved planning, regulatory instruments and incentives, and participation in environmental management.

[1] **LISCOP Project description**. http://siteresources.worldbank.org/INTPHILIPPINES/Resources/LISCOP.pdf.

The project has two components: (a) co-managed micro-watershed environmental interventions and (b) strengthening institutions and instruments. The former component would support demand-driven sub-projects that were designed to improve the environmental quality of the watershed, based on the results of a participatory micro-watershed-based planning and identification process. These identified sub-projects would form part of the integrated program of 66 LGUs surrounding the lake. It is expected that around 25-35 sub-projects with an average size of US$100,000-200,000 will be implemented. The sub-project has four categories: (a) waste management and sanitation; (b) natural resources management; (c) soil erosion and localized flood prevention; and (d) eco-tourism.

## A.2 PROFILE OF THE BENEFICIARIES

- **Municipality of Sta. Cruz**[2]

Santa Cruz is a 1st class urban municipality in the province of Laguna as well as the provincial capital town. According to the latest census, it has a population of 101,914 people in 19,627 households and with a growth rate of 1.37%). Projected population for 2009 is 104,615.

Santa Cruz is situated on the banks of the Santa Cruz River, which course its way along the eastern part of the famous Laguna de Bay. The town is bounded by the Bay on the north, by Lumban and Pagsanjan towns in the east, Pagsanjan and Magdalena towns in the south, and Pila and Liliw towns in the west. It is approximately 87 kilometers from Manila via Calamba and 105 kilometers via Pililla, in the province of Rizal. It is accessible by land from the nearby 28 municipalities and by water through Laguna de Bay from Manila and some towns in the province of Rizal.


The municipality functions as the service center for transportation, commerce, health, education, and other social services for the predominantly rural northeastern municipalities of

[2] http://en.wikipedia.org/wiki/Santa_Cruz,_Laguna.

the province. Boosting the economy of the municipality are the incipient and fast growing agribusiness industries such as livestock raising, horticulture and aquaculture. The town is composed of twenty-six (26) urban barangays. All barangays are being classified as urban.

The center of business activities is in the poblacion, specifically at Barangay V where the four (4) buildings of the public market is situated. Development in this vicinity has been a quasi-residential commercial type as manifested by the proliferation of structures, which are used both for business and residential purposes by the proprietors/owners. There is also concentration of business establishments at the section of the national highway/expressway especially Barangay Gatid where the Sunstar Mall is located (and the abandoned PNR Railway).

- **Municipality of Nagcarlan**[3]

Nagcarlan is a 5th class municipality in the province of Laguna, Philippines. It is 21 kilometers northeast of San Pablo City, or 99 kilometers south of Manila, Philippines. The municipality has a total population of 43,416 and a total land area of 11,489.4 hectares which consists of 3 urban barangays and 49 rural barangays. Total agricultural area is 10,015 hectares or 87.17% of the total land area. Basic crops are coconut, rice, lanzones, coffee, bananas, root crops and vegetables.

## B. Social and Technical Preparation and Promotion

Through the LISCOP project, the LLDA has issued a directive that all major contributors of pollution surrounding the Laguna de Bay should treat their wastewater before it discharges to its river tributaries. As such, concerned staff from the LGUs has been subject to various training programs on (i) wastewater management and (ii) project promotion, among others. In the course thereof, an information, education and communications (IEC) campaign was conceptualized with the participation of representatives from the municipal government, NGOs, and the academe. This included the wide dissemination of printed project materials to the general public. Particular to the municipalities of Sta. Cruz and Nagcarlan, project implementation was under the overall coordination and supervision of their respective (a) Municipal Planning and Development Office as well as the (b) Engineering Department.

Basic Needs Services Philippines, Inc. (BNS-Phils.) in partnership with Bremen Overseas Research and Development Association (BORDA) provided the detailed engineering design (DED) and rendered the *construction supervision* and *monitoring* during project implementation. The actual construction of the DEWATS facility was awarded to I.M. Bongar & Co., Inc., funded by a grant from the World Bank.

## C. Sanitation Technology/System/Options Observed

- **Municipality of Sta. Cruz**

The wastewater treatment plant (WTP) has the capacity to treat 30 cubic meters of wastewater discharged daily. The facility sits on 185 square meters of land area. Each DEWATS module has: 1 Settling tank (ST), 8 chamber anaerobic baffled reactor (ABR), 1 chamber anaerobic filter (AF),

[3] http://en.wikipedia.org/wiki/Nagcarlan,_Laguna and http://nagcarlanlaguna.info/.

and 1 planted gravel filter (PGF). A treatment system with 2 modules was designed for operation and maintenance purposes and a common indicator pond (IP) was constructed for both modules.

Average $BOD_5$ of the influent is 600 mg/L and expected effluent quality is ≤30 mg/L.

- **Municipality of Nagcarlan**

The DEWATS modules for Nagcarlan's slaughterhouse includes: 1 Biogas Digester (BD), 8 Chamber Anaerobic Baffled Reactor (ABR), 1 Anaerobic Filter (AF), 1 Planted Gravel Filter (PGF) and an Indicator Pond (IP). This WWTP has a treatment capacity of 25 cubic meters per day and sits on 186 square meters of land area. Vacuum tankers are employed for desludging the sedimentation tanks of the DEWATS BD and ABR. It treats only the wastewater generated by the pertained municipal abattoir.

The $BOD_5$ quality of the influent is 1,270 mg/L and the expected effluent quality is ≤50 mg/L.

## D. SUPPORTIVE ENVIRONMENT

On one hand, the project cost was US$ 40,909.09, partially sourced from the internal funds of Sta. Cruz, Laguna, with the support of the LISCOP Project of LLDA and a loan from the Royal Government of the Netherlands, which was coursed as a grant from the World Bank. All construction materials used for the project were acquired locally. The appropriation of counterpart LGU funds came to pass through corresponding Municipal Council resolutions. The (i) Municipal Planning and Development Office and (ii) Engineering Department were Sta. Cruz' lead units in the overall coordination and implementation of the WWTP project.

On the other hand, the project cost for the WWTP of the Municipality of Nagcarlan amounted to US$ 38,636.36. Fund augmentation from the LISCOP Project of the LLDA and the World Bank were also secured.

The WWTP's operational maintenance cost includes the monthly salary of an operator, desludging cost, and other miscellaneous expenses, which may include wastewater sampling, construction repairs and for aesthetic purposes. Details of which are illustrated in the table below. These expenses would be fully shouldered by the Municipalities of Sta. Cruz and Nagcarlan.

| A Two-Year Estimated Cost for the Operation and Maintenance | | | |
|---|---|---|---|
| **Description** | **Amount (US$)** | **Frequency** | **Total (US$)** |
| Salary of an Operator | 90.90 | 24 Months | 2,181.81 |
| Desludging Cost | 90.90 | 1 in every 2 Years | 90.90 |
| Miscellaneous Expenses | 227.27 | 2 in every 2 Years | 454.54 |
| TOTAL | | | 2,727.27 |

The DEWATS facility's performance will be monitored by BNS-BORDA during the one year warranty period (i.e. at least once a month or as needed) and effluent quality will be analyzed on a regular basis by DENR-accredited laboratories. As per agreement, monitoring of Biological Oxygen Demand (BOD) and Total Suspended Solids (TSS) must be put into consideration as parameters or performance indicators in assessing project progress.

Aside from BNS-BORDA's role of providing the (a) technical specifications for the construction of the WWTP; (b) assistance in the conduct of water quality monitoring tests, which concluded last June 2010; it also assists in (c) monitoring the operation and maintenance of the DEWATS facility. If and when irregularities were identified during monitoring exercises (d) it submits corresponding proposals and recommendations to both the LGU and the LLDA.

## E. Re-Use Components and Other Features

The recoverable resource in the digester is the methane gas, the byproduct of enteric bacterial activity under anaerobic conditions. As of the moment, the slaughterhouse personnel make use of the produced gas for cooking their food for the whole day. The butchers also use the gas for heating water for their coffee during the operation. Roughly, the slaughterhouse personnel and butchers save at least two tanks of liquefied petroleum gas (LPG) per month, amounting to US$ 27.27.

## F. Assessed and Perceived Impacts

The organizational arrangements engaged by the stakeholders were sufficient to implement the project. At the latter part of the construction though, a conflict situation arose between the contractor and the LGU to the point where the LGU took over and finished the construction by administration.

After a six-month wastewater sampling exercise, the result of the water quality analyses yielded the following values: $BOD_5$ at ≤ 50 mg/L and TSS at ≤ 70 mg/L, which is an indicator that the sanitation technologies are relevant, sufficient, and effective.

The discipline of the butchers and slaughterhouse personnel were a crucial factor for the effective operation of the DEWATS facility. They complied with a standing operational protocol to avoid the entry of too much detergent and bleach in order to maximize the production of methane gas.

With the above improvements, the environmental quality of the river tributary to the Laguna de Bay was ensured, not only for the residents of the municipalities of Sta. Cruz and Nagcarlan, but also the endemic organisms that thrive in its ecosystem.

# CLOSING THE LOOP BETWEEN SANITATION AND FOOD SECURITY
## Ecological Sanitation Case of the Municipalities of Initao, Libertad and Manticao, Misamis Oriental

| | |
|---|---|
| Project Owner(s) | ▪ WAND Foundation, Inc. |
| Project Partner(s) | ▪ iBop Asia<br>▪ Xavier University (XU) – Ateneo de Cagayan<br>▪ Center for Advanced Philippine Studies (CAPS) |
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## A. WHAT TRIGGERED THE PROJECT?

### A.1 PROJECT OBJECTIVE(S)


The intervention entitled *Closing the Loop Between Sanitation and Food Security*, aimed at a group of contiguous barangays, within the Municipalities of Initao, Libertad and Manticao, Misamis Oriental, were all under the auspices of the WAND Foundation, which is headed by Dr. Elmer Sayre. Hence, this initiative was spearheaded by him, urged by the Foundation's advocacy and societal concern for the communities that have very poor sanitation conditions, but are unable if not incapacitated to uplift their own socio-economic conditions. The initiative's primary funding agency is iBoP Asia (i.e. Science and Technology Innovations for the Base of the Pyramid in South East Asia) -- a collaborative undertaking of the Ateneo School of Government and Canada's International Development Research Center (IDRC).

The Water, Agroforestry, Nutrition and Development (WAND) Foundation is an active local NGO in the Province of Misamis Oriental. One of its long time partners is the German NGO named *German Doctors for Developing Countries*. The initiatives supported by the German Doctors include agro-forestry, ecosan and sustainable small farm development.

The undertaking is primarily an action-research endeavor that intends to seek for solutions to the (i) health and sanitation; as well as (ii) food security issues of the target beneficiaries. These two developmental concerns were intertwined, considering that the Foundation's advocacy on

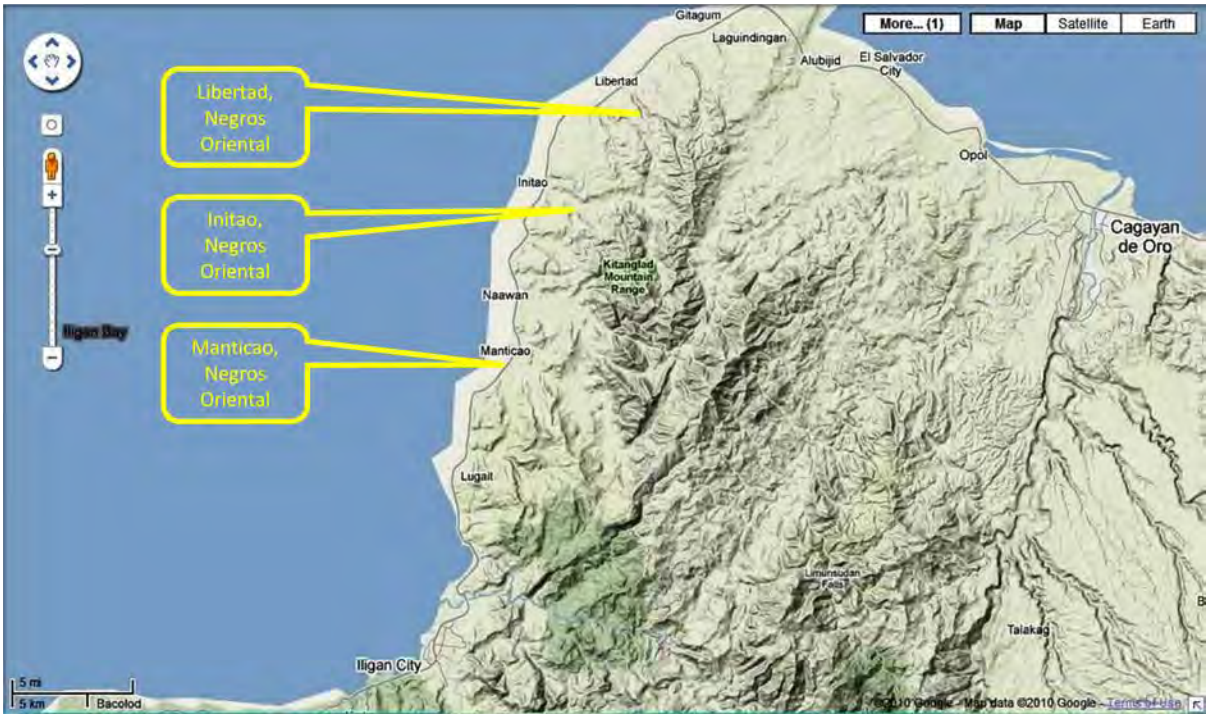
the philosophy of *Ecological Sanitation* posits the principle of excrement containment that minimizes if not eliminates corresponding health and environmental impacts of poor sanitation, while allowing for nutrient recovery and hygienic reuse for agricultural activities, predominantly engaged by the rural populace. The lynch pin to this effort is the *popularization of the use* of urine diversion and dehydrating toilets (UDDTs).

In particular, the objectives of the research are:

- To explore the localization and popularization of ecological sanitation solutions, through the development of more affordable yet effective UDDT designs;
- To pre-fabricate UDDTs that can address emergency situations, with ease of transport and installation as primary considerations;
- To develop a mechanism of providing the needed implements to building a UDDT, which is sustainable to both the supplier and the recipient;
- To package a knowledge product, containing available affordable technologies as well as IEC methods and materials, which could be easily accessed by local government units (LGUs), international NGOs, and other stakeholders; and
- To conduct a preliminary study on crop productivity, using both components of human excreta (i.e. urine and feces), to selected crops.

## A.2 PROFILE OF THE BENEFICIARIES

The municipalities of Initao, Libertad and Manticao are located approximately 40 kilometers west of Cagayan de Oro City -- the provincial capital. In these municipalities, "the average household size is 5 family members, and 95% of which are farmers. These small-scale farmers have an average agricultural estate of 1.5 hectares per family. The locality's main staple crop is corn, among other produce like tobacco, banana and vegetables."[1]




[1] **Compilation of 31 Case Studies on Sustainable Sanitation Projects**. Sustainable Sanitation Alliance; February 2010; page 14-2.

In general, "the communities therein have poor sanitation conditions and lack proper toilet facilities. Hence, many of the residents (30%) defecate in the open. As a result, there is a high prevalence of parasites, worms and transmission of sanitation-related communicable diseases, like soil transmitted helminthes (STH)."[2]

Beneficiary communities in Barangays (i) Oguis in Initao and (ii) Tuod in Manticao are located in the upper slopes of the two municipalities. Their primary problem is the lack of an adequate water supply, hence, pour flush toilets are highly irrelevant and relatively costly considering that we are dealing with highly marginalized communities. In the coastal areas, there are poor families who are unable to build their own toilets and thus defecate along the shore. Some of their houses are also built very close to each other and the conventional toilet design is not applicable.

## B. Social and Technical Preparation and Promotion

The project's soft launch started with an orientation of the project staff, which made use of UDDTs in a community setup, but not necessarily communal in use. This visit was in collaboration with the Environment and Natural Resources Office (ENRO) of the city government of San Fernando.

Then the same delegation mentioned above made a visit to the EcoSan project implementation areas of the Xavier University within Cagayan de Oro City. It was undertaken in close coordination with the university's Sustainable Sanitation Center.

Various insights were gained from those site visits, especially from the vantage points of (a) materials and design; (b) social acceptability; (c) facility maintenance and use; (d) adequacy of municipal sanitation systems; and (e) ease of installation for different environmental conditions. As such, the requisite technical preparation was facilitated in collaboration with the CAPS and XU.

On the other hand, social preparation was done by continuing the IEC campaigns in sanitation and hygiene conducted by WAND in the communities that have already adopted the use of UDDTs vis-à-vis the (new) communities that are within the geographical scope of this action-oriented research study. An example is the constant dialogue with the village leader of Snowland, Libertad, Mr. Ruel.[3] Herein, after introducing an alternative toilet structure to the said village leader, a group of approximately 26 barrio folks were toured in the nearby Municipality of Initao, to see the UDDTs that are being used by that community. After which,

[2] **Compilation of 31 Case Studies on Sustainable Sanitation Projects**. Sustainable Sanitation Alliance; February 2010; page 14-2.

[3] Sayre, Elmer. **WAND Foundation Successfully Implemented Coastal EcoSan Toilets in Libertad, Initao Municipalities, Misamis Oriental**; DED Philippines' Water and Solid Waste Newsletter No. 20; 20 September 2010; page 8.

the group was led to the Foundation's production site in Barrio Gimlayan as well as the adjacent vermi-composting facility. A demonstration was given on how human manure generated in the UDDTs is processed in the composting facility, and how it is being used in fertilizing various crops within the area. As the delegation was convinced on what they saw, they adopted the concept and installed UDDTs in their respective family abodes.

Participating families who have implemented the practice of ecological sanitation in their respective communities then became members of the EcoSan Club (Philippines). It is a fairly new association registered with the Securities and Exchange Commission (SEC), whose activities revolve on the promotion of ecological sanitation at the grassroots level. These families serve to strengthen the drive of getting more communities to adopt their practices on sanitation, especially with the various study tour guests that frequent their place, validating and documenting the communities' collective experience and successes on the initiative.

## C. SANITATION TECHNOLOGY/SYSTEM/OPTIONS OBSERVED

Bearing in mind that the communities being targeted are poor, the Foundation is constantly looking for means to bring down the costs of having a toilet facility installed for each family. Thus, the conventional double-vault UDDT was redesigned into a (i) single vault system and (ii) hanging toilet. The redesigned systems also took into consideration the use of more locally available materials, in order to bring down costs and stimulate the local economy. As such, the toilet bowls are made of cement instead of ceramics (i.e. as illustrated by the photo above). Current total installation cost of this type of toilet is approximately PhP 1,500$^{.00}$. The materials utilized for the new design include bamboo, wood poles, coconut fronds, coconut lumber and recycled plastics and drums. These units

were then field-tested in Barrio Oguis in Initao and Barrio Tuod in Manticao.

For beneficiaries in coastal communities, the UDDTs took into account that family houses are spaced very close to one another, and with little or no space for conventional toilets. As such, the design has to be adapted to their environmental conditions. In response to that challenge, the coastal UDDT is the *hanging type* toilet. Roofing materials are made of woven coconut palm fronds; the walls are either bamboo or heavy-duty sacks; and the flooring is constructed out of bamboo, reinforced with coconut lumber. The total installation cost of each facility ranges from US$ 11.36 – 27.27. The coastal UDDT is illustrated in the photo above -- views from the outside and inside of the house.

The above designed facilities were field tested in Initao Poblacion. All in all, a total of 95 redesigned UDDTs comprising of: (i) 65 arborloo, (ii) 21 single-vault and (iii) 4 hanging toilets, were established with the iBoP beneficiaries.

## D. SUPPORTIVE ENVIRONMENT

After the initial pilot, the Foundation designed a micro-financing scheme to sustain the efforts as well as to discourage dole-outs. Thus, given the significantly reduced cost of having a toilet facility, the funds required for construction are given to interested families on a loan basis, through micro financing and integrated into the larger micro-financing activity that the Foundation engages. From the lender's end, funds disbursed to the first borrower are assured of return, making it available to subsequent families who would opt to avail of the same assistance. From the borrower's side, engaging in this (financing) arrangement exhibits the family's commitment to fully utilize the (toilet) facility. Hence, there would be this implicit assurance from them that the UDDT would not end up poorly maintained, misused or eventually abandoned as with the case of most dole-out projects.

In terms of popularizing the concept of ecological sanitation, WAND hosted study tours from various organizations that plan to implement the same initiative in their areas. One of such is hosting a 20-person delegation from the provincial government of La Union and some delegates from Metro Manila. Although the province of La Union pioneered the promotion of the use of UDDTs through pilot initiatives, they were amazed at the rapid localization of the pertained facility and practice in the assisted communities in Misamis Oriental.

In relation to the above, the implementation of the *hanging UDDT* is a first in the country. As such, it is frequently visited by foreign tourists and even locals, who are interested to see how the entire system works. The attention that it has stirred was taken notice by the German Technical Cooperation (GTZ). Consequently, the GTZ allocated additional funds for the implementation of 100 more units, covering the coastal areas within the municipalities of Libertad and Initao, Misamis

Oriental. The German Embassy also provided funding assistance to scale up project efforts in the Municipality of Manticao as well as corresponding interventions in Dipolog City.

In the pursuit of developing knowledge products that would aid WAND in its advocacy, it came up with the field guide entitled *With Our Own Hands: Experiences in Promoting Ecological Sanitation and Food Security in Mindanao*. The publication features the various UDDT designs that the Foundation was able to develop and localize, along with other initiatives (e.g. rainwater harvesting, etc.) that complement or align with ecological sanitation principles. A similar publication is also about to be printed out, which is a joint undertaking between XU and CAPS.

## E. Re-Use Components and Other Features

In support of the reuse of recovered nutrients in both components of human excreta that are stored in the containment chambers of UDDTs, WAND Foundation offers three primary support services: (i) a regular collection service for both urine and manure; (ii) a secondary treatment facility for feces; and (iii) a 6-hectare demonstration farm in Libertad.

First, the collection service especially for human manure, is provided free of charge and as a way of ensuring that the collected material would not pile-up within the premises of the assisted communities. This provides the volume that would be processed by its vermi-composting facility. While urine is collected by individual households in 20-liter jerry cans, and utilized in their respective backyard gardens, excesses thereof are collected by WAND an utilized in its demonstration farm. To complement the initiative, the Foundation also distributes vegetable seed packets for the gardens of these families.

Second, a vermi-composting facility was established within its demonstration farm, to provide secondary treatment for the collected human manure. Acknowledging the research findings of Xavier University's College of Medicine, illustrating the persistent infective capability of *ascaris lumbricoides*, this treatment facility offers to eliminate the health hazard of the pathogen. Accordingly, the pathogen could survive the aerobic conditions of the vaults where these are contained, even for durations ranging from 6-8 months. Thus, with the introduction of vermi-worms, the digested human manure is transformed to vermi-casts. These byproducts are then made usable, either as organic fertilizer or soil conditioner. With the recent visit of 2 notable experts in *Terra Preta* technology (i.e. Drs. Otterpohl and Ricken), it is hoped that the processed human manure and urine could be further developed into higher grade fertilizers. Accordingly, the technology would make use of several strains of effective microorganisms. Xavier University would be engaging a corresponding field study in order to identify endemic microorganisms, thus do away with importing the microorganism strains used by the above mentioned German experts.

Lastly, the demonstration farm serves to exhibit the use of processed human excreta in fertilizing coconuts, bananas and other fruit trees therein. In doing so, the assisted communities would have the needed empirical evidence of the agricultural value of processed excreta, more importantly, the

role being played by their respective toilet facilities in recycling the nutrients that are found in human wastes. Thus, the economic value of this type of wastes would be extended and diverted from its conventional means of disposal, which generally pollutes the environment.

## F. Assessed and Perceived Impacts

The adaptation as well as innovation of UDDT designs suitable to the overall conditions of the beneficiaries was a critical factor in securing *buy in*, especially from marginalized families in both upland and coastal communities in selected municipalities in the province of Misamis Oriental.

Therefore, the project was regarded as successful, as the stakeholders were in one accord in terms of (i) addressing the need for affordable and effective sanitation and hygiene solution in the locality; (ii) maximizing usage of available resources; (iii) and immediately integrating the by-products of ecosan technology to their respective livelihoods (i.e. agriculture).

The establishment of the EcoSan Club came as a supplementary factor in (i) promoting the concept of ecological sanitation to interested stakeholders and (ii) assisting the Foundation in monitoring and assessing project implementation.

# COMPLIANCE TO ENVIRONMENTAL STANDARDS TO ABATE FURTHER VIOLATION
## DEWATS of Selected Slaughterhouses and Public Markets; and a University

| | |
|---|---|
| Project Owner(s) | ▪ Ateneo de Manila University (AdMU)<br>▪ Provincial Government of Bohol<br>▪ Provincial Government of Negros Oriental<br>▪ Municipal Government of Sorsogon City, Sorsogon<br>▪ V.R. Abattoir<br>▪ Provincial Government of Negros Oriental |
| Project Partner(s) | ▪ Basic Needs Philippines, Inc. (BNS-BORDA)<br>▪ Water and Sanitation Programme, German Technical Cooperation (GTZ)<br>▪ Water and Sanitation Programme, Department of the Interior and Local Government (DILG)<br>▪ Laguna Lake Development Authority |
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| *Owner* | ▪ Engr. Rosalinda B. Yu; 038.411.4820 (phone); 038.411.3030 (fax); 0926.255.8611 (mobile) |
| *Owner* | ▪ Harry R. Calumpang; 035.404.1136 (phone/fax); 0905.853.8560 (mobile); mpdc_manjuyod@yahoo.com (e-mail) |
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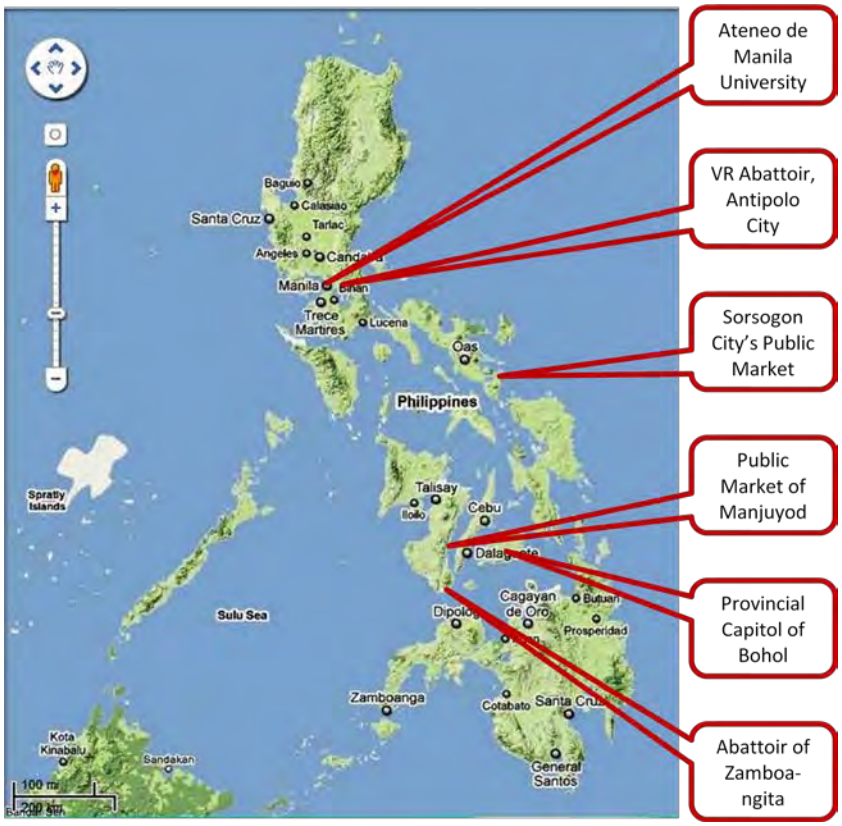
## A. WHAT TRIGGERED THE PROJECT?

In this aggregate case study is the implementation of 6 project initiatives that made use of the Decentralized Wastewater Treatment System that is being promoted by the Basic Needs Philippines, Inc. (BNS). Most owners of the wastewater treatment plant (WWTP) facilities decided to engage in putting such infrastructure to improve its performance, insofar as its compliance to existing environmental rules and regulations pertaining to effluent discharges that are generated by each project proponent.

Most of the cases below involve discharges of either a public market facility or a slaughterhouse. These wastewaters if left untreated would cause significant nutrient imbalance in the receiving bodies of water, where such effluents are discharged. In addition thereto, the dissolved oxygen




within the receiving bodies would be severely depleted, robbing endemic species in these ecosystems of needed oxygen to sustain life. Ripple effects may be felt if the rivers and creeks that receive these discharges lead to a bigger body of water that is either (i) the source of livelihood of indigents or (ii) serves as the source of water utilized for drinking and other domestic usage.

Consequent to the project proponents' heightened awareness of the roles that they play in holistically preserving and improving their respective environments, they have engaged in the establishment of solutions, one of which is putting up WWTP infrastructures that aim to reduce, if not eliminate the pollution load that ends up in their respective rivers, lakes and seas.

## B. Social and Technical Preparation and Promotion

### B.1 Ateneo de Manila University

The University's management was of the desire to concretely comply with environmental regulations on the effluents generated from their domestic consumption of water, such as those coming from their toilet facilities within the campus. Thus, it decided to engage in this DEWATS project, with the aim to treat wastewater generated by 7 of its buildings, which is just Phase I of the institution's Wastewater Management Program, before discharging these into the nearby creek.

In consideration of the above, the University entered into an agreement with BNS Philippines for the design and construction of the wastewater treatment plant. The Physical Plants Department of AdMU is in charge for the implementation of the project.

Information campaigns were administered through the print and media department of the University. Accordingly, the university's print and media department played a significant role in the institution's engagement of environment related projects.

### B.2 Provincial Capital of Bohol

The DILG-GTZ Water and Sanitation Program and the Bohol Integrated Water Resources Team (BIWRMT) introduced the DEWATS approach to the Provincial General Services Office (PGSO) of

Bohol. Together with representatives from the media, business sector, Sangguniang Panlalawigan, NGOs and representatives of community groups, a rapid environmental assessment was made. This was in reaction to the public's negative sentiment and impression where the capitol's wastewater flows directly to the storm drain along CPA Avenue.

As such then Governor Erico B. Aumentado issued Executive Order No. 15 Series of 2007. The directive states the province's thrust of *strengthening its initiatives to prevent water pollution by enforcing the installation of waste water treatment facilities for hotels, resorts and restaurants and such other industries, which require usage of water volume in commercial quantities, urging the use of recycled water and for other purposes*.

The provincial government took charge of providing a solution that would help them comply with the provisions of the Clean Water Act (i.e. Republic Act 9275) -- establishing a wastewater treatment plant for the blackwater and graywater generated by the provincial capitol building and stalls surrounding the perimeter. BNS Philippines was thus invited to provide the detailed engineering design for that facility. Public support was solicited through information dissemination campaigns coursed through radio and print media.

### B.3 Public Market of Manjuyod, Negros Oriental

Government agencies and the community were involved in assessing the environmental situation of the locality. In particular the black water generated by the pertained establishment was observed to contribute to the degradation of the water bodies present within the municipality. In the course thereof, the LGU embarked on the establishment of a treatment plant for the wastewater generated from its public market. The municipal government was in charge of the overall management of this project.

A task force was created to oversee the planning and construction of the WWTP. Information dissemination was only undertaken during assemblies mobilized by the municipality.

### B.4 Public Market of Sorsogon City, Sorsogon

A participatory rapid assessment of the environment was conducted by representatives of the (a) City Planning and Developing Office, (b) City Government of Sorsogon, (c) BNS-BORDA, (d) other NGOs, (e) academe, (f) public market personnel, and (g) community representatives of the city. The City Government of Sorsogon is primarily in charge of this undertaking -- establishment of a treatment facility for the effluent generated by the city's public market.

As a means for capacity building for LGU staff involved in the project, training courses on (i) promotion and (ii) wastewater management were administered. The IEC campaign employed for the purpose was conceptualized during the above mentioned training program, with the participation of delegates from the LGU, NGO, and university. These IEC campaign initiatives were conducted through radio and print media.

### B.5 V.R. Abattoir of Antipolo City

A rapid environmental assessment was conducted by the management of VR Abattoir, representatives of communities surrounding it, NGO, barangay officials and the Laguna Lake

Development Authority. VR Abattoir's management quickly appreciated the impact of the effluent generated by the operations of its plant that it decided to pursue a solution on its own, without any financial commitments asked of the LGU and other stakeholders in the locality. Through the referral made by the LLDA, BNS-BORDA was invited to provide a concept presentation of its DEWATS technology. After this, BNS-BORDA was commissioned to prepare the design specifications of the proposed WWTP and was also in charge of project management of the pertained facility.

Soon as the designs were completed, training courses were administered by BNS-BORDA for management and operational personnel of the slaughterhouse on the principles of DEWATS as well as the proper operation and maintenance of the facility.

In addition to the above, IEC materials were developed by BORDA. These materials were later distributed during an information drive administered to residences surrounding the abattoir.

### B.6 Abattoir of Zamboangita, Negros Oriental

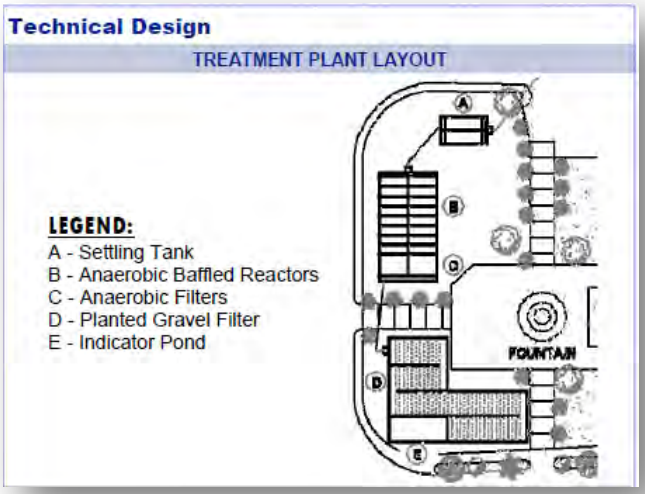
Government agencies, NGOs, the local community, private sector representatives, religious community and other interested groups were consulted prior to engaging the establishment of the wastewater treatment plant (WWTP) of the Municipality of Zamboangita, Negros Oriental. This project was formalized through the passage of a Sangguniang Bayan resolution. Corresponding information, education and communication (IEC) campaign tactics were conceptualized during committee meetings.

## C. Sanitation Technology/System/Options Observed

### C.1 Ateneo de Manila University

ADMU's WWTP sits on 496 square meters of land area and is designed to accommodate a maximum capacity of 110 cubic meters per day. It serves as the secondary treatment facility of effluents emanating from the septic tanks of the 7 buildings in the campus that are included for Phase I. The implemented DEWATS facility contain the following modules: 1 Settling Tank (ST), 8 Chamber Anaerobic Baffle Reactor (ABR), 1 Anaerobic Filter, 1 Planted Gravel Filter and Aerobic Pond/ Lagoon. Vacuum tankers would be used for desludging sedimentation tanks of the WWTP's ST and ABR.

### C.2 Provincial Capital of Bohol




The Decentralized Wastewater Treatment System (DEWATS) sits on 287 square meters of land area; has a treatment capacity of 40 cubic meters per day. The wastewater being treated by the plant are those coming from the toilets and domestic activities of the provincial capital and stall surrounding the building, as illustrated by the adjacent photo.

The DEWATS modules applied for the Bohol Capitol Compound includes: 1 Settling Tank (ST), 8 Chamber Anaerobic Baffled Reactor (ABR), 1 Chamber Anaerobic Filter (AF), 1 Planted Gravel Filter (PGF) and an Indicator Pond (IP). Vacuum tankers are being employed for desludging sedimentation tanks of the DEWATS ABR. It only operates for 6 hours every day.

The average water quality for its influent is 270 mg/L for $BOD_5$ and 540 mg/L for COD. The expected water quality for it s effluent is <50 mg/L for $BOD_5$ and <100 mg/L for COD.

### C.3 Public Market of Manjuyod, Negros Oriental

The Decentralized Wastewater Treatment System (DEWATS) has a treatment capacity of 40 cubic meters of wastewater discharged daily, generated from the toilets of the public market complex. The plant sits on 252 square meters of land area. The modules in the plant include: 1 Settling Tank (ST), 8 Chamber Anaerobic Baffled Reactor (ABR), 1 Anaerobic Filter (AF), 1 Planted Gravel Filter (PGF) and Indicator Pond (IP). Vacuum tankers are being used for desludging sedimentation tanks of the DEWATS ABR.

The average water quality of the influent, particularly for the $BOD_5$ parameter, is 600mg/L and expected effluent quality is ≤30mg/L.

### C.4 Public Market of Sorsogon City, Sorsogon

The Decentralized Wastewater Treatment System (DEWATS) for the public market sits on a 530 square meter land area. The modules for the facility include: a Settling Tank (ST), Anaerobic Baffled Reactor (ABR), Anaerobic Filter (AF), Planted Gravel Filter (PGF) and Indicator Pond (IP). Vacuum tankers are employed for desludging the sedimentation tanks of the DEWATS ABR. The wastewater being treated only comes from the operations of the public market.

### C.5 V.R. Abattoir of Antipolo City

The DEWATS modules designed for V.R. Abattoir include: 1 Biogas Digester (BD), 8 Chamber Anaerobic Baffled Reactor (ABR), 1 Anaerobic Filter (AF), 2 Planted Gravel Filter (PGF) and an Indicator Pond (IP). Vacuum tankers are employed for desludging sedimentation tanks of the DEWATS BD, ABR and AF. The WWTP sits on a 350 square meter land area and is for the exclusive use of the company.

### C.6 Abattoir of Zamboangita, Negros Oriental

The constructed DEWATS facility has the following modules: 1 Biogas Digester (BD), 8 Chamber Anaerobic Baffle Reactor (ABR), 1 Anaerobic Filter (AF), 1 Planted Gravel Filter (PGF) and an Indicator Pond (IP). Vacuum tankers are employed for desludging sedimentation tanks of the DEWATS BD, ABR and IP. This WWTP only processes the wastewaters exclusively generated by the slaughterhouse of Zamboangita.

## D. Supportive Environment

For all 6 WWTP projects concerned, its operational maintenance cost includes the monthly salary of an operator, desludging cost, and other miscellaneous expenses, which may include wastewater sampling, construction repairs and aesthetic improvements. Details of which are illustrated in the table below. These expenses would be fully shouldered by the project proponents (i.e. the local government units, the University and private slaughterhouse owner/operator). Further details for each project engagement are elaborated below.

| A Two-Year Estimated Cost for the Operation and Maintenance | | | |
|---|---|---|---|
| **Description** | **Amount (US$)** | **Frequency** | **Total (US$)** |
| Salary of an Operator | 90.90 | 24 Months | 2,181.81 |
| Desludging Cost | 90.90 | 1 in every 2 Years | 90.90 |
| Miscellaneous Expenses | 227.27 | 2 in every 2 Years | 454.54 |
| TOTAL | | | 2,727.27 |

### D.1 Ateneo de Manila University

The total project cost of the AdMU's DEWATS facility is US$ 136,136.36. Project funding is generated internally, without seeking external (funding) assistance. All construction materials being utilized for the project are sourced locally.

Since the operations and maintenance (O&M) cost of the DEWATS facility is low, part of this cost will be covered by a part-time facilitator. Desludging activities would take place only every 2-3 years. No running expenses for electricity would be needed.

### D.2 Provincial Capital of Bohol

The Sangguniang Panlalawigan has authorized the Governor to enter into an agreement for the construction of a WWTP, with BNS-BORDA providing its technical expertise in the design and construction of the facility. The facility was established with a cost of US$ 61,363.63, per the approved allocation of funds for the purpose that was passed by corresponding Provincial Council resolutions. Its funding was primarily sourced from the province's coffers. Construction materials utilized in the engagement were all sourced locally.

The treatment plant's influent and effluent are regularly monitored for $BOD_5$ by the provincial Environment and Natural Resources Office (PENRO). Analysis is done at the Siliman University or other DENR-accredited laboratories.

### D.3 Public Market of Manjuyod, Negros Oriental

Putting up the treatment plant required US$ 38,636.36. Funding for this capital outlay was generated from the internal resources of the LGU, which was augmented by funds from the coffers of the Provincial Government of Negros Oriental.

Water quality monitoring, as a measure of evaluating the efficacy of the treatment plant, is undertaken by the Municipal Environment and Natural Resources Office (MENRO). The primary parameters being monitored are (i) $BOD_5$ and (ii) TSS.

### D.4 Public Market of Sorsogon City, Sorsogon

The City Development Council passed resolutions appropriating funds for the construction of the public market's wastewater treatment plant, in the amount of US$ 131,818.18. Financial resources utilized for the project were only sourced from its city development fund. Moreover, all construction materials utilized for the project were sourced locally.

The LGU units actively involved in the pertained undertaking are the (i) City Planning and Development Office, during the planning phase; and (ii) Engineering Department during construction and operation phases.

The treatment plant's influent and effluent are regularly monitored quarterly by the City Environment and Natural Resources Office (CENRO) after the 1-year warranty period of BNS-BORDA has lapsed.

### D.5 V.R. Abattoir of Antipolo City

V.R. Abattoir's owner independently financed the establishment of its WWTP, which costs US$ 54,545.45. BNS Philippines was the contract holder for the facility's construction supervision

and monitoring. That same agreement included a provision that BNS Philippines would undertake regular wastewater sampling and site visits, within its 1 year warranty. Water quality monitoring would include the parameters on Biological Oxygen Demand (BOD) and Total Suspended Solids (TSS), as performance indicators in assessing project progress.

BNS-BORDA monitors the project's progress at least once a month or as needed. Should there be observed irregularities in the treatment system, these are reported directly to the owners of VR Abattoir.

### D.6 Abattoir of Zamboangita, Negros Oriental

The facility's construction is currently ongoing. Its overall project cost is estimated at US$ 113,636.36, whose funds originate from both local and national sources. The pursuit thereof was facilitated by the passage of local council resolutions as well as the adaptation of national laws on the environment.

The facility is not yet operational. However, project construction is being monitored on a monthly basis.

## E. Re-Use Components and Other Features

The inclusion of the *re-use* feature for the treated effluents various among the 6 project initiatives discussed in this paper. Further details are illustrated below.

### E.1 Ateneo de Manila University

Treated wastewater will be pumped-out to water the football field and other plants inside the campus.

### E.2 Provincial Capital of Bohol

Treated wastewater is discharged directly to the drainage system.

### E.3 Public Market of Manjuyod, Negros Oriental

Reuse of the treated wastewater is still being evaluated by the LGU.

### E.4 Public Market of Sorsogon City, Sorsogon

Treated wastewater will be used for gardening and watering of the plants near the public market.

### E.5 V.R. Abattoir of Antipolo City

V.R. Abattoir's Decentralized Wastewater Treatment Facility (DEWATS) has the provision for methane gas utilization produced from the constructed Biogas Digester. As of the moment, the slaughterhouse personnel and two households used the produced gas for cooking their food for the entire day. The butchers also use the gas for heating water for their coffee during working hours. Roughly, the (i) slaughter personnel, (ii) identified households and (iii) butchers saved at least two tanks of LPG per month, amounting to US$ 27.27.

### E.6 Abattoir of Zamboangita, Negros Oriental

Provided that the slaughterhouse's WWTP has a bio-digester, the recovered methane gas might be used for heating the process water of the slaughterhouse. The remaining effluent that goes out of the indicator pond is being intended to water the foliage within the perimeter of the abattoir and other landscaping purposes.

## F. Assessed and Perceived Impacts

For the 4 WWTP facilities that are already fully operational, the project proponents have realized improvements in the water quality of their respective effluent discharges. At the very least, they have more than complied with the water quality characteristic of Class C waters, per the Clean Water Act. Thus, the communities being served by the pertained DEWATS facilities were provided with a means to reduce the pollution load that eventually ends up in their river systems and other water bodies.

On one hand, the environmental conditions of these affected ecosystems are preserved. On the other hand, these same water bodies that serve as sources of water for human consumption are ensured of an improved quality.

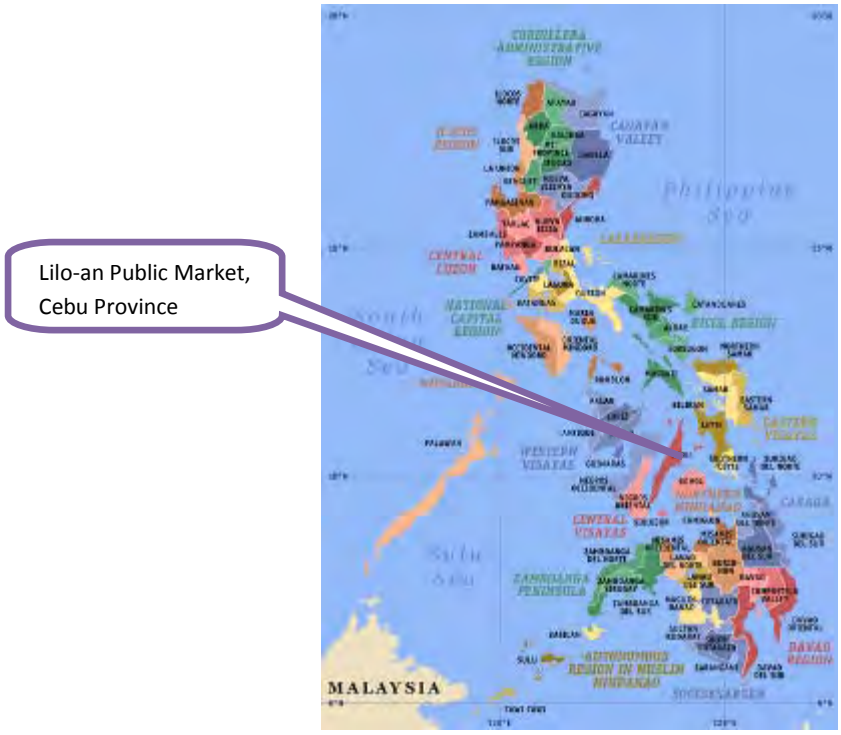
As for the 2 WWTP facilities that are currently under construction (i.e. the DEWATS in Ateneo de Manila University and the slaughterhouse of Zamboangita, Negros Oriental), the project proponents are eager to experience the same improved water conditions given the successes of those 4 projects that have been operational for at least 1 year.

**Philippines**
**Decentralized Wastewater Treatment Facility for the Lilo-an Public Market:**
**A Pilot and Demonstration Activity of the Asian Development Bank**

| | |
|---|---|
| Project Owner(s) | ▪ Lilo-an Community Multi-Purpose Market Vendors Cooperative |
| Project Partner(s) | ▪ **Funding Agency:** Asian Development Bank<br>▪ **Implementing Agency:** Municipality of Lilo-an<br>▪ **Cooperating Agencies:** Environmental Management Bureau of the Department of Environment and Natural Resources, JV Baring Consultants & Allied Services (Contractor) |
| Primary Contacts | ▪ Shigehiko Muramoto, smuramoto@adb.org, |

## Introduction and Background

The municipality of Lilo-an is located in the province of Cebu, Philippines, a short distance away from Cebu City. A once popular tourist attraction for visitors from both Cebu City and abroad due to its beaches and proximity to the City, the area was host to thriving tourist infrastructure services, such as restaurants, beach vendors, and souvenir shops. However, in the years preceding 2004, the beach area was becoming increasingly polluted, with high fecal coliform counts being registered in the coastal waters. This resulted in a sharp drop in tourist activity, which prompted the Lilo-an Municipality and its partners to begin to address the issue by first targeting the major source of water pollution along the beach area: the Lilo-an public market and surrounding residential areas.



**Project Purpose and Objectives**

In order to address the pollution from the public market and residential areas, the wastewater that was being discharged to the ocean would require proper treatment. At the time before the start of the project, all of the market wastewater and blackwater was being processed only by an old and inadequate septic tank, while the wastewater from a nearby residential area was simply draining to a roadside canal which drained directly to the ocean. It was estimated that this volume amounted to the need for a $60m^3$ per day treatment capacity. While a new wastewater treatment plant was therefore needed, the Municipality could not afford a centralized system for its entire area, so the Municipality and its partners decided that a small scale decentralized wastewater treatment facility (WTF) targeting these two main emitters would be the most suitable for the circumstances. The Asian Development Bank (ADB) agreed to fund this project under its "Pilot and Demonstration Activity" small-scale funding program due both to the need of Lilo-an as well as the passage at that time of the 2004 Philippine Clean Water Act, which made an ADB-funded wastewater treatment project a timely demonstration activity.

The objectives of the project were therefore: 1) To construct a decentralized WTF at the Lilo-an public market area, designed to treat the $60m^3$ per day of wastewater outfall; 2) To install new public toilets in the market itself, to promote better hygiene and sanitary practices among the users and vendors; 3) To ensure the sustainable operation and maintenance of the facility by promoting the market vendors to organize a managing cooperative group that would collect fees from market vendors for O&M expenses and perform the necessary O&M duties with these fees; 4) To attempt to demonstrate full project cost recovery in 10 years by the cooperative through the collected fees; and 5) With the completion of this project, to achieve clean coastal water again for the beaches of Lilo-an, which should lead to a renewed tourist industry.

**Partners and Funding Distribution**

The project partners, in descending order of organization size and prominence, were the ADB, the Environmental Management Bureau of the Department of Environment and Natural Resources (EMB-DENR), the Municipality of Lilo-an, the contracting group JV Baring Consultants & Allied Services, and the Lilo-an Market Vendor's Association. ADB served as the funding agency while the Municipality of Lilo-an was the implementing agency. Serving as a liaison between the two agencies was the EMB-DENR (specifically, a "project champion" EMB consultant from Region 7), as the cooperating agency. After a formal bidding process, the JV Baring Consultants and Allied Services was chosen as the contractor, due to their organization being locally-based and their bid being the most feasible given the space constraints posed by the proximity of the market to the ocean.

The ADB supplied the grant funding for this project, which amounted to $50,000 USD. The grant was allocated as follows: $46,964 for construction and labor costs for the WTF; $2,500 for social preparation activities related to the organization of Lilo-an market vendors into a managing cooperative group; and $536 to the Region 7 EMB-DENR Office for laboratory analysis fees.

**Project Activities**

The project ran from March, 2004, until March, 2006, and was accomplished in 4 phases. While originally only scheduled to run from July, 2004, until June, 2005, a variety of delays prevented full completion of the objectives until March, 2006. The 4 phases of the project were:

1) Mar. 04 – Sept. 04. Project Pre-Phase: Introduction of project idea to ADB and LGU, and elaborating and approval of project proposal.

2) Oct. 04 – May 05. Preparation Phase of Project Implementation: Setting up of project structure and project committees, and performing necessary legal compliances (public contractor bidding, attaining a DENR Environmental Clearance Certificate).
3) Jun. 05 – Nov. 05. Ground Development Phase: Construction of WTF and conducting social preparation activities for the managing market cooperative.
4) Dec. 05 – Apr. 06. Running-in Phase of WTF and Project End: Adjusting and optimizing the WTF operations, monitoring its performance (via the university thesis of a local student), and undertaking final social preparatory activities (regarding O&M, IEC, and turn-over of the facilities).

**Sanitation Technology / System**

Because the Lilo-an Market was close to the ocean, lacked nearby open land, had limited budget for electrical expenses, and needed to treat 60m$^3$ of wastewater per day, the contractor, JV Baring, proposed the Rotating Biological Contactor (RBC) as the primary treatment technology to be employed. The RBC is a type of aerobic wastewater treatment that uses far less energy than other aerobic technologies like activated sludge or trickling filter systems. This is due to the fact that no vertical wastewater conveyance is required (as is needed for trickling filter systems), nor is there a need for any sort of high pressure air injection system (as is needed for activated sludge systems). Instead, an RBC consists simply of an array of plastic discs (which were 2.4m in diameter for this project) that are slowly rotated horizontally inside a tank containing horizontally-flowing wastewater. The discs are positioned so that their upper halves lie above the wastewater while their lower halves lie submerged. The system is aerobic since the tanks are open to ambient air and the rotating discs, with time spent both in the air and in the water, provide a suitable environment for aerobic bacterial growth, in the form of biofilms. These biofilms will then biologically degrade the organic compounds within the wastewater.

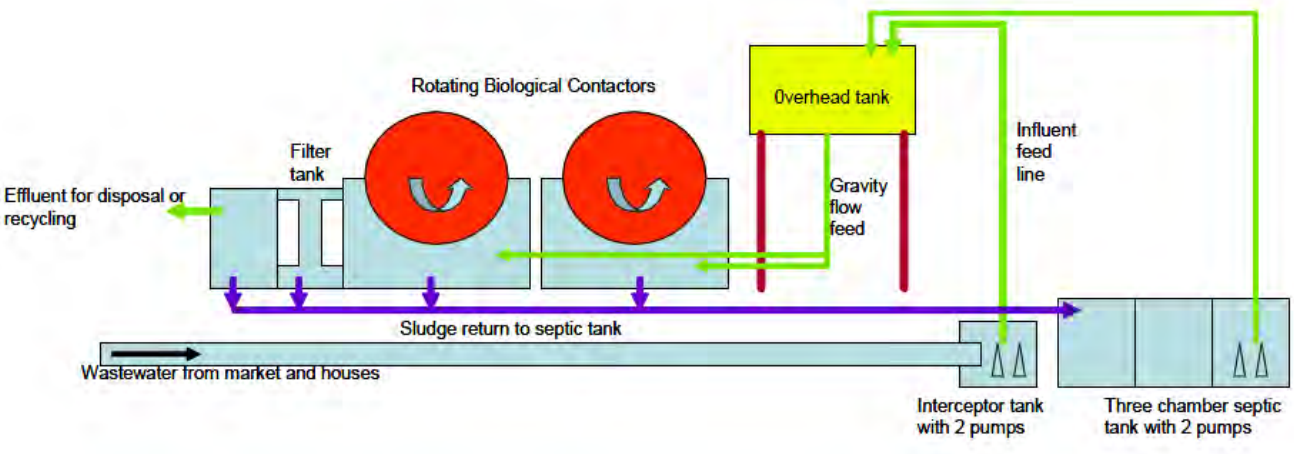



**Figure 1:** Flow chart of the RBC system installed at the Lilo-an Public Market

Figure 1 shows the flow chart of the RBC installed for this project. As visible, the system consists first of an interceptor tank that receives all of the wastewater from the market and nearby homes, which includes a coarse screen before the tank itself to remove large debris that could clog the pumps. From the interceptor tank, two alternating pumps then raise the wastewater to an overhead holding tank (the water level of which controls the pump activity), which was installed to then allow the wastewater to flow gravimetrically through the RBC tanks. As visible in the chart, this wastewater is able to flow to either RBC tank independently, to allow for the tanks to be run either in series (one

after another, for more effective treatment) or in parallel (any individual unit of wastewater is only ever treated in one of the tanks without transfer to the other, for faster treatment in higher-than-60$m^3$/day flow circumstances). The RBCs rotate fully about once per minute (with rotation powered by a small 1hp motor), with average retention time of the wastewater in the tank being about 10 hours. After the RBC tanks, the water passes through a filter tank consisting of cloth filters, to remove any unsettled sludge from the RBCs, and then flows to a final holding tank, whereupon it can be discharged or collected for reuse purposes (such as toilet flushing or gardening). In all the chambers following the overhead tank, there are pipes at the bottom to allow the flushing of accumulated sludge to the first chamber of the original 3 chamber septic tank of the market. This septic tank was modified so that the former effluent pipe of the third chamber was connected back to the overhead tank, via another set of pumps, thus "closing the loop" on the sludge management. Sludge maintenance therefore only requires an occasional desludging of the septic tank, with appropriate septage treatment to follow.

This system has few maintenance requirements compared to other aerobic systems, which is appropriate for the low-budget nature of this project. Regular maintenance activities would consist of: daily cleaning of inlet canals and screens from large debris, bi-weekly cleaning of the RBC disks from excess biofilm and subsequent flushing of accumulated sludge to the septic tank, and weekly cleaning of cloth filters and inspection/lubrication of motor and pumps. The septic tank would likely require desludging on an annual or two-year basis.

**Number, Type, and Location of Beneficiaries**

It is difficult to quantify the number of beneficiaries of this project. There were various different groups of people either directly or indirectly involved with this project, including the market vendors, the citizens of the nearby residential area whose wastewater was draining to the new WTF, all of Lilo-an's citizens as part of the Municipality itself, and the rather ambiguous "tourist/visitor" group. While the market vendors group could be argued to have initially suffered from this project, due to the new requirement that they pay a daily fee (of 5 Pesos) (which may also be applied to the nearby residential citizens if the cooperative group can achieve it), they also benefit in health and comfort from the new public toilet facilities that were installed and will benefit financially when tourists return and begin to spend money in the town and market again. Likewise, the citizens of the Municipality as a whole will benefit from these increased tourist dollars and also benefit from the cleaner coastal waters in terms of public health and recreation value. Tourists and visitors will of course also benefit from the revitalized waters for their recreational activities.

**Impacts and Challenges**

This project, accomplished with a grant of $50,000 USD, was done both to clean up the coastal waters of Lilo-an as well as create a model demonstration site that could showcase the economic feasibility of such a project to other Municipalities through its cost recovery efforts.

In terms of cleaning up the coastal waters, a quantitative assessment of the influent and effluent water quality was performed in cooperation with a local undergraduate student, who elected to carry out the water quality testing as part of her undergraduate thesis (and which also reduced the potential cost of this aspect of the project). However, the study was undertaken during a time when the WTF was not operating normally. This was due to a power dispute with the electric utility, which will be discussed below, that forced the WTF to only operate during the day time, which greatly lowered the treatment efficiency of the system, as it should normally operate 24/7. Once the dispute was resolved, the system was again able to operate 24/7, but at this point the study had already concluded and there was no more budget for any further water quality monitoring.

Nevertheless, the data that was collected showed a good removal of BOD and COD, minor removal of phosphate and ammonia, and no removal of nitrate or nitrite. This data would be expected to improve significantly had there been budget for further monitoring once the system was operating normally. Regardless, later sampling of the coastal waters by EMB-DENR found a 99.8% and 97.8% improvement for total coliform and fecal coliform levels, respectively, which means the WTF is having a positive effect.

In terms of the community engagement and creation of a managing cooperative aspects of the project, these were implemented in cooperation with the Lilo-an Municipality and its Market Vendors Association. The Association was enthusiastic from the start regarding forming a separate cooperative group to manage the WTF. Through IEC sessions, a daily fee per market vendor of 5 Pesos was decided and implemented, to be collected by the cooperative. The cooperative members were also trained in the proper O&M procedures for the WTF, so that costly maintenance calls to the contractor could be avoided.

In terms of cost recovery demonstration for future projects, with approximately 120 vendors using the market, a 5 Peso per day fee (P600 total), minus estimated yearly maintenance costs (spare parts, electricity, and labor), results in a 26 year full cost recovery time. This is not a particularly enticing figure for other Municipalities considering a similar project, though this is not the only source of revenue. In addition, the contractor undertook a renovation of the public toilet facilities, and the cooperative will manage its cleanliness and collect additional revenue from its use (1 Peso for use of urinal, 2 Pesos for use of flush toilet). This is, at last measure, generating an additional P360 per day average, which lowers cost recovery to around 11 years. If the cooperative then pursues additional fees for nearby residents or tricycle/jeepney drivers that use the market, the cost recovery could be brought below 10 years, which is a more enticing figure for Municipalities interested in a similar, self-funded project.

The main challenges of the project were the multiple delays caused by various bureaucratic and technical issues. These included a delay caused by the unforeseen need for a DENR Environmental Clearance Certificate (requiring a lengthy report), which was required for all WTFs treating more than $30m^3$ per day. It also included various issues with the status of the funds. ADB made the deposits into a local bank account of the Municipality, which prompted the Municipality to insist it be treated as local money and be subject to national laws regarding taxes and the requirement to have a formal bidding process for the contractor (who had, at that point, already been informally chosen), even though ADB funds should technically be exempt from these matters. Thus, a formal bidding process had to take place that also caused delays. A dispute with the electrical company over a proposed new transformer for the project, as well as the presence of only single phase electricity, also caused delays while the design (originally proposed for triple phase electricity) was reworked and the transformer issue was settled. Unfortunately, single phase electricity decreases the effectiveness of the system's pumps, meaning that a proposed primary settling tank had to be scrapped, meaning the overall system is less effective at treating the wastewater than originally designed and also that sludge accumulates more quickly in the RBC tanks.

**Photos**


**Figure 2:** Photos of Lilo-an Market and shoreline prior to project, and of the WTF construction

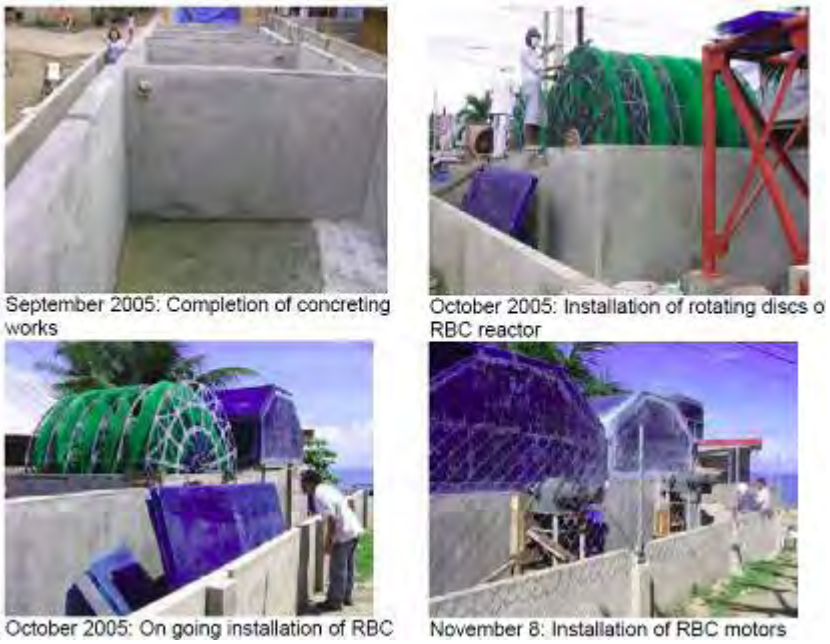



**Figure 3:** Photos of the WTF under construction, showing the RBCs


**Figure 4:** The completed WTF and images of the influent and effluent quality

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**Philippines**
**Decentralized Wastewater Treatment "Eco Tanks" for the Riverside Communities of Barangays Catbangen & Poro, & the Seaside Community of Barangay San Francisco**
**A CITYNET-funded Pilot and Demonstration Activity in the City of San Fernando, La Union, Philippines**

| | |
|---|---|
| Project Owner(s) | ▪ Barangays Poro, Catbangen, and San Francisco of the City of San Fernando, La Union (SFLU) |
| Project Partner(s) | ▪ **Funding Agencies**: CITYNET, through funding from UNITAR, through funding from the Prince Albert II of Monaco Foundation (FPA2); USAID-Rotary San Fernando City Sewerage and Septage Management Project (implemented by the USAID Philippine Sanitation Alliance and Rotary Club of San Fernando, LU); and the City Government of SFLU<br>▪ **Executing Agency**: City Government of SFLU<br>▪ **Cooperating Agencies**: Barangay Councils and staff of San Francisco, Catbangen, & Poro; Premier Products Inc. |
| Primary Contacts | ▪ Ms. Rizalyn Medrano, City Environment and Natural Resources Office (CENRO) of SFLU, rizalyn_medrano@yahoo.com |

## Introduction and Background

In many dense, low income areas of Southeast Asia and elsewhere, effective sanitation solutions are difficult to come by. These areas are often largely unserviced by sewerage systems and the residents may not have had the income available during their home's construction to install a proper septic tank. Even if they did, unless a subsidized tank desludging program exists in the area, it is likely that the septic tanks in these areas have rarely, if ever, been desludged. Their correspondingly dangerous effluent therefore pollutes the groundwater or discharges into a nearby drainage canal. Other, even poorer, residents often rely on unsanitary methods instead, such as defecation into a nearby waterway, either directly or via the 'flying saucer' technique of defecating into a plastic bag that is then thrown into the waterway.

Effective, low-cost, solutions to manage a problem like this are therefore needed, primarily via the use of decentralized wastewater treatment systems. However, even in the realm of decentralized wastewater treatment systems, there remain few solutions that are applicable to dense urban areas, such as slums, due to the relatively large land footprint often required by such systems (for example, a system using a planted gravel filter). As well, their cost can still be prohibitive for a low income community without outside subsidies. For example, the popular and effective decentralized wastewater treatment projects of BORDA (Bremen Overseas Research and Development Agency) still often run upwards of $30-50,000 USD.

One new solution to this problem is the Eco Tank, a lightweight, low cost, non-mechanized, easy-to-install, small land footprint, fiberglass tank that essentially serves as a large, slightly enhanced, septic tank. This tank is a concept created by Premier Products Inc. in Bangkok, Thailand, in cooperation with CITYNET, an IGO of Asian partner cities working together on environmental / infrastructure / disaster issues. CITYNET provided the idea for this technology as a simplified version of the more complex "jokaso" decentralized wastewater treatment system that is used in Japan.

With the product now developed, CITYNET received funding from the Prince Albert II of Monaco Foundation, via UNITAR, to develop the Eco Tank project by piloting these tanks in three of the CITYNET member cities. The City of San Fernando, La Union, Philippines (SFLU) was one of these chosen beneficiaries, due to the City's prior record of environmental achievements and its work on improving sanitation for its residents. The other two cities selected were Palembang, Indonesia, and Negombo, Sri Lanka. CITYNET provided funding for the purchase of 2 of these Eco Tanks for the City and, when word of the project reached the staff at the USAID-funded Philippine Sanitation Alliance (PSA) – who was working already in SFLU on a septage project with Rotary International – they decided to provide funds for the purchase of an additional, third, tank for the City.

Brgys. San Francisco, Poro, & Catbangen, San Fernando City, La Union Province


The project sites selected were the riverside slum communities in Barangays Catbangen and Poro, as well as the oceanfront beach shed area of Barangay San Francisco. The former two sites lie near the ocean on either side of the Catbangen Creek. These sites consist of informal settlers / squatters who are living densely in small homes that lack any regulatory oversight on private land owned by the national Philippine National Railway Company (there was, many years ago, a rail line passing through SFLU). The homes there mainly have some form of septic tank – likely of bottomless construction – though most have not been desludged, with effluent pipes emptying into the main drainage canals that run into the river. A few of the residents still engage in the 'flying saucer' practice, however. From the main drainage canal on either side of the river flowed all of the wastewater generated in these households, along with lots of solid waste, due to the open nature of the canals along much of their length. The creek, in part due to these discharges (but also due to similar discharges along its length), was correspondingly filthy. Some open space was present at the riverside areas where these two canals discharged, so it was proposed that, instead of attempting to improve the households' septic tanks or install sewer lines to each, these two canals could simply be re-routed into the two Eco Tanks that could be placed in the open areas.

The latter site, at Barangay San Francisco, was an ocean-front, white-sand beach area popular with locals and tourists. Along this stretch of beach lay approximately 30 beach sheds: wooden, open-air structures built to accommodate picnicking families who pay to rent them. Most of these sheds also

have a concrete toilet and water well area behind them. These toilets were simply draining to dug pits or improper septic tanks, which was threatening the seawater quality of the beachfront area, due to the toilets being less than 20m away from the high tide line. As basically the only popular swimming beach in SFLU, and with a City-planned redevelopment of the sheds to increase their aesthetic appeal and their number to more than 50, this area was also seen as an ideal location for an Eco Tank that could process the wastewater from these otherwise risky toilets.

**Project Purpose and Objectives**

This project had 4 main components: 1) assess the wastewater flow rate and characteristics of the users at each site via a rapid technical assessment, 2) install the necessary supporting infrastructure for each Eco Tank (diversion piping & solid waste screens from each drainage canal, initial holding tanks and electric pumps to raise the wastewater to the Eco Tank inlet, etc.), 3) receive the Eco Tanks from Bangkok and install them, and 4) liaise with, and perform IEC (information, education, communication) activities in each project community, in order to negotiate O&M responsibilities, reduce solid waste in the canals, and promote better management of wastewater among the residents. The CITYNET project, as a whole, had the objectives to: 1) reduce water pollution from domestic sources in the selected cities, 2) raise public awareness on sanitation issues and about the advantages of Eco Tanks, and to train people on the proper usage of Eco Tanks, and 3) increase community participation in solving environmental problems.

**Partners and Funding Distribution**

For this project, the main funding agency was SFLU, with CITYNET and USAID and Rotary also providing funding and technical assistance. USAID-Rotary will provide $15,000USD to be used generally for all three Eco Tank projects. For the Catbangen/Poro projects specifically, the City is providing a sum of 884,760 Pesos (~$20,600USD), while CITYNET is providing 1,004,410 Pesos (~$23,500USD). The City's funds paid for the rapid technical assessment, the two Eco Tanks ("EC-75" model) and pumps needed, shipping costs for the tanks from Manila to SFLU, and installation of the tanks and all associated infrastructure. CITYNET's funds paid for the shipping of the tanks from Bangkok to Manila and all IEC activity costs.

For the San Francisco project, the City is providing a sum of 1,230,000 Pesos (~$28,600USD), which will pay for the installation of the tanks and all associated infrastructure. About $6000USD of the USAID-Rotary funds paid for the Eco Tank ("EC-15" model) and pumps needed, and shipping from Bangkok to SFLU.

The total project cost for all parties was therefore approximately $87,000USD. Much of this is due to the need for international shipping of these large tanks, as well as the installation costs for diverting the drainage canals and, in the case of San Francisco, creating a new drainage system to the Eco Tank. The Eco Tanks themselves, as sold by Premier Products, only cost as much as $5000 USD for the largest model.

**Project Activities**

This project began in earnest for SFLU in approximately April, 2010, and is still ongoing. The first activity was to select the pilot sites from a number of candidate areas of the City. A technical consultant from Premier Products Inc. then visited the City to assess the specifications of each site and recommend an appropriately-sized Eco Tank and supporting infrastructure. A visit from CITYNET representatives and numerous visits from a PSA technical consultant also occurred during these early months, for further technical planning. In February 2010, the City Mayor, City Environment and

Natural Resources Officer and PSA staff member went to Bangkok to visit Premier Products and learn more about the Eco Tanks and discuss the details of ordering and shipping them to the Philippines.

The rapid technical assessment for Barangays Catbangen and Poro was then carried out. This involved staff from the City Environment and Natural Resources Office of SFLU (CENRO) contracting local sanitary engineers and barangay health workers of the two barangays to do area and drainage mapping, house-to-house wastewater practices surveying, and flow rate tests of the main drainage canal on each side of the river over a period of 2 days (including a weekday and weekend). The survey and mapping activities were designed to estimate which days would produce the highest volume of wastewater, whether residents were receptive to the project, what kind of sanitary risks these residents were facing (by, for example, mapping the proximity of their water wells to their septic tank), and how many houses were draining greywater / blackwater / septic tank effluent to the canals. The flow rate tests were performed by creating temporary dams at the outlet of each drainage canal, then performing a bucket test (measuring the time taken for a bucket of known volume to fill up when placed under the spout of the dam overflow area) several times a day for 2 days.

With this data and the other technical analysis that had taken place, a detailed engineering proposal for the entire site was created by the City Engineer and final decisions were made on the specific size of the Eco Tank model, and electric pumps, to order. Pumps were needed due to the higher elevation of the open areas and the Eco Tank inlet pipes than the re-routed drainage canals. Once the tanks and accessories arrived by boat from Bangkok, the City Engineer's Office has begun installing them. The Eco Tank and all associated infrastructure are now complete and underway for the Barangay Poro site (construction completed in December, 2010), but preliminary construction work is only now, as of May 2011, beginning for the Barangay Catbangen site. No progress at all has been made yet on the San Francisco site, as CENRO is awaiting the formal beach shed redevelopment proposal to be created by other City departments and the local beach shed association. The Eco Tanks for both Catbangen and San Francisco have already arrived and are waiting in storage for eventual installation.

**Sanitation Technology / System**

As mentioned previously, Eco Tank technology consists of a simple fiberglass tank or pair of tanks, for the models designed for larger flow volumes. The tank(s) consists of just two chambers: an anaerobic settling area / holding tank, and a chamber filled with small, porous, plastic balls that will harbor anaerobic bacteria and act as an anaerobic filter. In addition, all three sites include inlet piping and outlet piping to discharge to the creek. The inlet piping for Catbangen & Poro includes a solid waste screen that will be regularly cleaned and an exterior holding tank for settling of large debris and to allow for a relatively constant flow into the tank, avoiding fluctuations. Prior to this holding tank, an overflow pipe was also installed, so that, if high flows cause the holding tank to fill up, any excess flow diverts directly to the river. The Poro site is currently functioning without pumps, as the tank was installed low enough to allow flow by gravity. The Catbangen and San Francisco sites, however, will likely require a pair of alternating pumps to pump the wastewater from the drainage canal up to the open land nearby. These simple pumps operate automatically based on floats; when the holding tank they are placed in fills up, the float rises with the water level and eventually triggers the pump to operate. Its descent as the water level falls similarly triggers its ceasing of operation.

The settling area of the Eco Tank serves mainly for holding of wastewater prior to the anaerobic filter, but also allows for the settling of sludge and other debris. The anaerobic filter (AF) then follows and consists of a tank with a submerged layer of porous plastic balls. On to this media grows

a thick layer of anaerobic bacterial biofilm, which the upflowing influent wastewater then passes through. These biofilms help remove some of the dissolved solids and organic materials in the wastewater, as well as some of the pathogens and chemicals. For the larger EC-75 models ordered for Catbangen and Poro, the settling chamber is one cylindrical tank, while the AF is another, separate tank. For the smaller EC-15 model ordered for San Francisco, both chambers are combined in one spherical tank.

The EC-75 model being used for Poro and Catbangen is able to treat up to 15$m^3$/day of wastewater, while the EC-15 model being used for San Francisco is able to treat up to 3$m^3$/day.

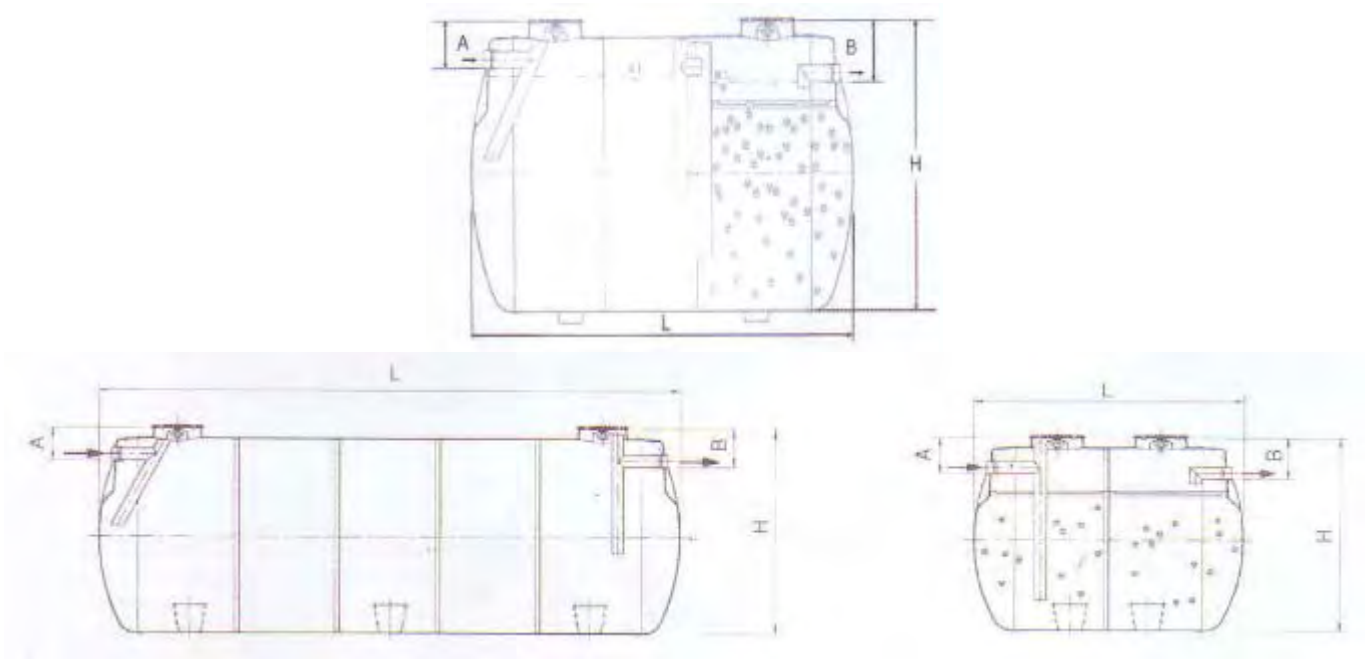


**Figure 1.** Schematics of the smaller EC-15 (top) and paired tanks of the larger EC-75 (bottom). The AF area in both is indicated by the small balls drawn, while the settling area is the remaining white space. Contrary to the indication given by the settling tank of the EC-75, it does not consist of baffles inside of it – the four vertical lines drawn are simply raised ribs along the inside of the tank.

**Number, Type, and Location of Beneficiaries**

After the mapping performed for the rapid technical assessment, the Poro site was assessed to have the wastewater from 280 people in 56 homes draining to the main drainage canal. The Catbangen site was similarly assessed to have the wastewater from 190 people in 38 homes draining to its main drainage canal. Interestingly though, the flow rate of the Catbangen canal was much higher than Poro's, averaging 17.6$m^3$/day compared to 10.6$m^3$/day. These residents will all benefit from the IEC activities to be undertaken on better wastewater management, which will reduce groundwater pollution and pollution in the creek. This should therefore improve their health, as both children and adults use the creek for swimming and fishing, while most of the residents rely on well water drawn from wells that are located far too close to improper septic tanks. The City's parallel program on septic tank desludging will also contribute to this.

**Impacts and Challenges**

This project is the first of the three city projects sponsored by CITYNET to have gotten underway, and many valuable lessons have already been learned. As mentioned previously, the main selling

points of these Eco Tanks are their small land footprint, non-mechanized nature, and low cost. However, from looking at the overall project budget of $87,000USD, one is right to question the "low cost" nature of this project. Because this was a pilot project, the tanks required shipping from Bangkok, Thailand, which drove the project price up excessively. The remaining majority of the costs came from the infrastructure installation work required by the City Engineer's Office. Both of these costs can be avoided in future projects. In fact, the idea of these Eco Tanks is that, since they are simple in design and made of fiberglass, local manufacturers can purchase the tank molds from Premier Products and then manufacture many more tanks at a far lower cost than what it took to ship them from Thailand. While some infrastructure installation costs will be required for any Eco Tank project, some of it can be avoided by, for future projects, selecting areas that do not require significant canal diversions or mechanized pumps. For example, it may be cheaper for the City to simply relocate one of the families living beside the canal and install the Eco Tank there in their place, rather than strive to only install them in existing open areas. With local manufacturing and smart site decisions, costs can be lowered substantially compared to this project and the Eco Tanks can become much more prolific, having one on every drainage canal, for example.

As to the water quality of the Eco Tank effluent, the installed tank in Poro is already discharging effluent, but its quality is still very poor. This is likely due to the fact that the main treatment device of the Eco Tank is an anaerobic filter, which takes time for anaerobic bacteria colonies to establish on its plastic media. Until the colonies are abundant in growth, essentially no treatment is being provided to the wastewater, so its effluent quality will be correspondingly poor.

Once the bacteria has established, the resulting effluent water quality should be better than that of the influent, but may still not meet national standards. Given that the tank consists only of a settling area and an AF, there is not a great deal of treatment taking place, compared to, for example, a BORDA DEWATS, which will often consist of a settling area, anaerobic baffled reactor, anaerobic filter, and planted gravel filter. But then, the strength of wastewater from a drainage canal is much weaker than that of the pure blackwater often treated by BORDA DEWATS systems. Nevertheless, the project team will install some form of secondary treatment to follow the outlet of the remaining two tanks that will be installed in Catbangen and San Francisco, in order to improve water quality, such as a simple gravel filter.

Assuming an efficient management system is in place, supported by local manufacturing, there is still a place for these Eco Tanks in the realm of decentralized sanitation. Future projects should have much lower costs, which make them a good option for interested low income communities who may not have any international donor support. While not performing as well as other treatment systems in terms of reducing harmful compounds in wastewater influent, Eco Tanks nonetheless offer a low-cost, small area solution for dense slums and other low income areas that, if placed in numerous locations around the community, could, on the whole, create a much less polluted society for these communities.

**Photos**

**Figure 2.** The San Francisco beach shed area, for project development

**Figure 3.** The settling tank portion of the EC-75 model being unloaded (left) and the EC-15 model at the storage site (right)

**Figure 4.** The inside of the settling tank portion (left) and AF portion (right) of the EC-75, with plastic media visible underneath the mesh used to contain them

**Figure 5.** The completed Poro site (left) and a view inside the influent holding tank (right)

**Figure 6.** A view of the Poro site and Catbangen Creek from the bridge over the creek (left) and a view up the creek (right). From the point of view of the left photograph, the Poro drainage canal is located to the left of the house in the image, running up and away from the creek. Diversion piping was laid from the canal through an alleyway located behind the house in the image.

**Figure 7.** The present state of the Catbangen drainage canal, near its outlet (left) and the proposed site for the Catbangen Eco Tank (right). From the point of view of the right photograph, the drainage canal is located about 5 meters behind the photographer, at a ~90 degree angle to the line of sight

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**Philippines**
**Decentralized Wastewater Treatment Systems for the San Fernando City Slaughterhouse**
**A BORDA DEWATS Project in the Philippines**

| | |
|---|---|
| Project Owner(s) | ▪ 1) City of San Fernando, La Union |
| Project Partner(s) | ▪ **Funding Agency**: Congressional Development Fund of Congressman Victor F. Ortega<br>▪ **Executing Agency**: Bremen Overseas Research and Development Agency – Philippines (BORDA-Philippines)<br>▪ **Cooperating Agency**: City Government of San Fernando, La Union |
| Primary Contacts | ▪ Valmar Valdez, City Environment and Natural Resources Officer, valmar_valdez@yahoo.com |

## Introduction and Background

The Bremen Overseas Research and Development Agency (BORDA) has a mission to improve the living conditions of disadvantaged communities and to preserve the environment through decentralized sanitation projects. As part of this mission, the Agency has developed modular, decentralized, and cost-effective wastewater treatment service packages that they have termed 'DEWATS' – decentralized wastewater treatment systems, which, with the help of funding agencies, are being installed throughout Asia and Africa.


One area in need of this DEWATS was the San Fernando Slaughterhouse, in the City of San Fernando, La Union (SFLU), Philippines. As the city's primary slaughterhouse, its existing wastewater treatment

system prior to the project was largely ineffective and was polluting the surrounding groundwater and nearby creek, and was affecting residents with its foul odors. It consisted simply of a septic tank, a grease trap, and an open lagoon that allowed for some settling, evaporation, and aeration to take place. This was not enough to treat the high strength and mixed composition wastewater generated by a slaughterhouse though, and this potent effluent was both being allowed to percolate into the groundwater and discharge to the nearby creek. The lagoon area had a foul smell, many flies, and was unsightly. The health and environmental risks of this status quo were therefore high, as slaughterhouse wastewater is more potent that domestic wastewater, and a more effective treatment system was therefore needed to prevent further environmental pollution and its resulting threats to public health.

SFLU, as an environmentally active city committed to improving its sanitation situation, therefore decided to tackle this problem by contracting BORDA to create one of its DEWATS systems for the slaughterhouse, after City officials visited other BORDA-Philippines projects in mid-2007 on a study tour. This will help ensure SFLU continues to be a leading city in the Philippines for environmental projects.

**Project Purpose and Objectives**

BORDA's general purpose for the DEWATS projects is to further their goal of "Improved Sanitation for All". Their systems help to fulfill this purpose, which can provide wastewater treatment for domestic or industrial sources and for flows as high as 1000$m^3$ per day, and are tolerant to flow fluctuations, require low maintenance, and are durable. In addition to this general purpose, each project undertaken by BORDA has its own purpose and objectives, based on the problems being experienced by the project site.

For this project, the purpose was to prevent continued pollution of the local environment by slaughterhouse wastewater by installing a DEWATS capable of treating up to 20$m^3$/day of wastewater from the approximately 80 pigs, 6 cattle, 2 water buffalo, and 10 goats per day that are being slaughtered there. This had the objective of ensuring that the area around the slaughterhouse would stop being polluted, with subsequent reduction in the health, odor, and environmental issues that were occurring.

**Partners and Funding Distribution**

For this project, the funding authority was Congressman Victor F. Ortega, through his Congressional Development Fund. As husband of former Mayor Mary Jane C. Ortega, who, during her 9 year term, spearheaded most of SFLU's environmental projects, Congressman Ortega is also motivated to advance his district on environmental projects, and was happy to provide funding. This sum has so far amounted to approximately 2 million Pesos (~$46,500USD), though more may be dispensed, as work on the project's biogas reactor is not yet complete. BORDA Philippines was primary executing agency for the project, while the City Government of SFLU, primarily through the City Environment and Natural Resources Office and the City Engineer's Office, provided logistical and administrative support.

**Project Activities**

This project is still ongoing, though nearly complete. It began in April 2007 with the visit of City officials to other BORDA project sites and a visit by BORDA staff to the SFLU slaughterhouse for technical consultations. After this point, the project was delayed until 2010 due to previously planned improvements on the other parts of the slaughterhouse, as well as due to the challenge of

locating project funding. Construction of the DEWATS took place from October to December, 2010, with operations beginning in January 2011. However, the biogas reactor component of the DEWATS is not yet complete, with a temporary biogas reactor – not connected to the rest of the DEWATS – handling some of the sludge. Work is due to begin on the construction of the proper biogas reactor in the coming months. The project activities included: consultation with the staff of the slaughterhouse, construction of the DEWATS, connecting the drainage pipes of the corrals, slaughtering, and butchering areas to the DEWATS, and training the staff on operation and maintenance.

**Sanitation Technology / System**

This module of DEWATS used by BORDA Philippines consists of the following sections, in order of wastewater flow: septic tank / biogas reactor, settling unit, anaerobic baffled reactor, anaerobic filter, horizontal gravel filter, indicator pond, and discharge pipe.

As the biogas reactor is not yet built, the septic tank that was part of the original treatment system is still in use as the initial receiving unit for the wastewater. This will likely be disconnected when the biogas reactor is built.

The biogas reactor is an anaerobic, sealed chamber that serves as a primary settling tank, with relatively fast passage of the liquid effluent through the chamber and digestion of much of the settled sludge by anaerobic bacteria. In this way it is much like a septic tank, except that its sealed nature allows all of the 'biogas' – a mixture of methane and carbon dioxide that is released from anaerobic digestion – to be captured and used. Depending on the size of the biogas reactor, this generated gas can be used either for small scale applications like operating a gas stove or larger scale applications like powering the scalding vats of the slaughterhouse. Since most of the organic matter is converted to biogas, sludge production is relatively low. The settled sludge usually remains in the unit for several years and, when removed, is relatively pathogen-free, requiring only some post-composting to ensure sterility. As well, biogas units are climate-friendly, since the generated biogas is offsetting the need for additional gas at the project site. The biogas reactor is not yet built for this DEWATS, though a small, temporary version, not connected to the DEWATS, is receiving some of the wastewater, but its gas is not yet being used for anything.

The primary settling unit serves as a wastewater retention point and an area for control of influent fluctuations (an equalization tank), which allows any remaining large sludge, debris, and other floatable/visible wastes to settle or be screened out and also allows a relatively constant flow of wastewater to proceed to the subsequent chambers (rather than having high flows during peak hours and no flow during nighttime). This unit is single-chambered for this project.

The anaerobic baffled reactor (ABR) is then the main treatment area of the DEWATS. As the name implies, this multi-chambered tank is closed from the air and anaerobic. Wastewater flows slowly up (and back down through pipes) through its several identical chambers, each time entering the chamber at its bottom, where it passes through the accumulated sludge. This allows solids to settle out into the sludge and anaerobic bacteria living in the sludge to degrade much of the harmful organic and chemical components of the wastewater. The number of chambers can vary depending on available land area, wastewater strength, and funds, though is usually 4 – 6.

The anaerobic filter (AF) follows the ABR and consists of a tank with a submerged layer of material like crushed gravel or specially formed plastic. On to this media grows a thick layer of anaerobic bacterial biofilm, which the upflowing influent wastewater then passes through. These biofilms help

remove more of the dissolved solids in the wastewater, as well as other pathogens and chemicals still remaining in the wastewater.

The horizontal gravel filter (HGF) (synonyms include: planted gravel filter & horizontal constructed wetland) follows the AF and consists of a shallow concrete basin filled with fine gravel, with influent and effluent pipes on opposite ends of the basin. Hardy reed plants, such as Canna, are planted in high density in this gravel layer before the DEWATS becomes operational and are allowed to grow in clean water that is initially flowed through the basin. Once the plants are established, the DEWATS can become operational and introduce the wastewater from the AF into the basin. The plant roots within the gravel help to oxygenate the wastewater, which has been anaerobic to this point and still usually has a noticeable odor, as well as remaining organic compounds. This oxygenation helps to degrade these remaining organic pollutants, which also reduces the odor.

After the HGF, the effluent proceeds to an indicator pond. This pond allows the effluent further aeration and settling time, and can also serve as an indicator for the effluent's quality. That is, if surrounding plants or small animals that were living around the pond suddenly die, this indicates a problem in the treatment process. After this pond, the effluent is usually then considered clean enough for safe river discharge.

For this project, this DEWATS was designed to treat 20$m^3$/day of wastewater.

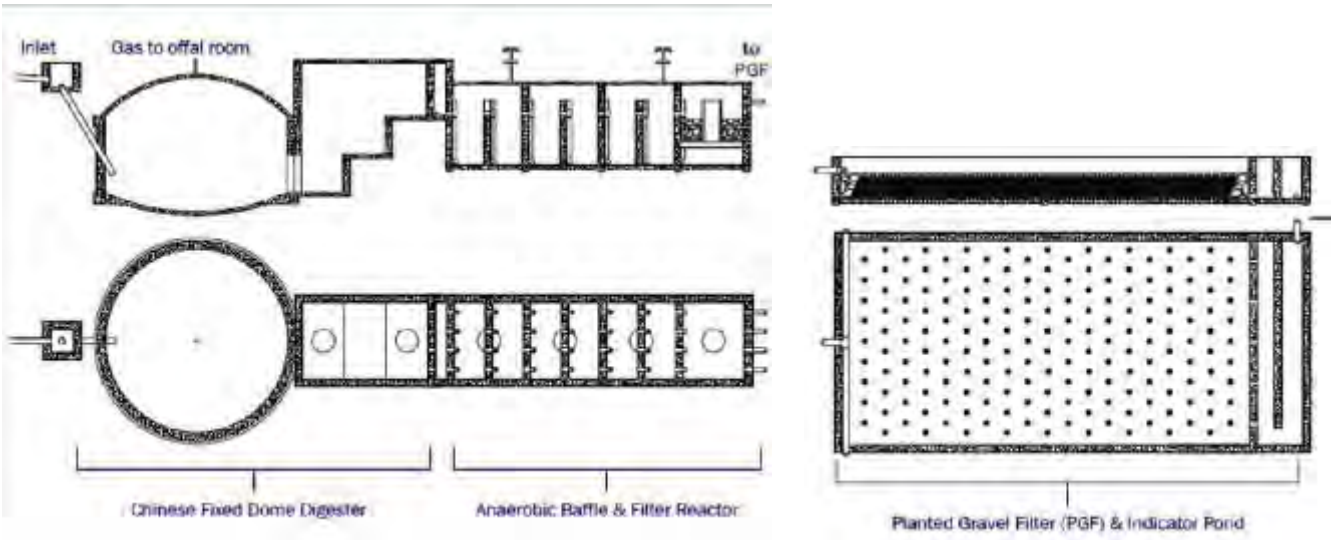


**Figure 1.** A cross-section and overhead view of a typical BORDA slaughterhouse project DEWATS, showing the biogas reactor, the settling tank, the ABR, the AF, the HGF, and the indicator pond, as well as influent and effluent piping.

**Number, Type, and Location of Beneficiaries**

For this project, the wastewater generated from the excrement, blood, trimmings, hair, and other results of the animals that are slaughtered at this plant are now covered by the DEWATS. The improvements made in wastewater management, however, extend beyond this slaughterhouse, as a strong source of water/groundwater pollution to the surrounding area has been eliminated, thus reducing the potential health and environmental risks to nearby citizens and natural life.

**Impacts and Challenges**

This project is now partially underway and is being operated and maintained successfully by the staff members of the slaughterhouse. The funding grant was used to cover construction costs and community engagement costs. The staff of the slaughterhouse were trained in appropriate O&M and will take this responsibility, though O&M duties are minimal, and amount mainly to checking inside the ABR once a week for clogs and removing accumulated debris. The costs of this O&M and the costs of desludging the system every 2 to 3 years will be covered in the budget of the City Government, which already manages the slaughterhouse.

While mainly successful, this project has not been without some issues. The biggest unresolved issue to date concerns the HGF, in which the plants are not growing well or are dying altogether. This seriously reduces the treatment efficiency of the DEWATS, since, without an established plant root network to aerate the wastewater and break down its remaining organic compounds, the wastewater is essentially just flowing through a bed of gravel, with very little further treatment taking place. This has been reflected in the initial set of water quality data gathered since the construction, which indicate that the BOD and COD values of the effluent are not yet in compliance with the national standards of 120 and 200mg/L (respectively) for slaughterhouse wastewater. It is also clear from looking at the indicator pond, which is already filled with green algae and still retains some odor. Plants in an HGF can be sensitive to wastewater conditions, especially if not given enough time to establish in clean water before being subjected to the wastewater. Hopefully this problem will be resolved in the coming months. Nevertheless, the effluent from the slaughterhouse is now far cleaner than it ever was with the previous treatment system, and so the project can be deemed a success for reducing the environmental pollution and health risks in the area.

**Photos**

**Figure 2.** Photo of the ABR/AF, HGF, and indicator pond (under the green mesh) units of the DEWATS

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**Philippines**
**Biogas for the Cagayan de Oro City Jail**
**An ICRC-Funded Environmental and Livelihood Project in the Philippines**

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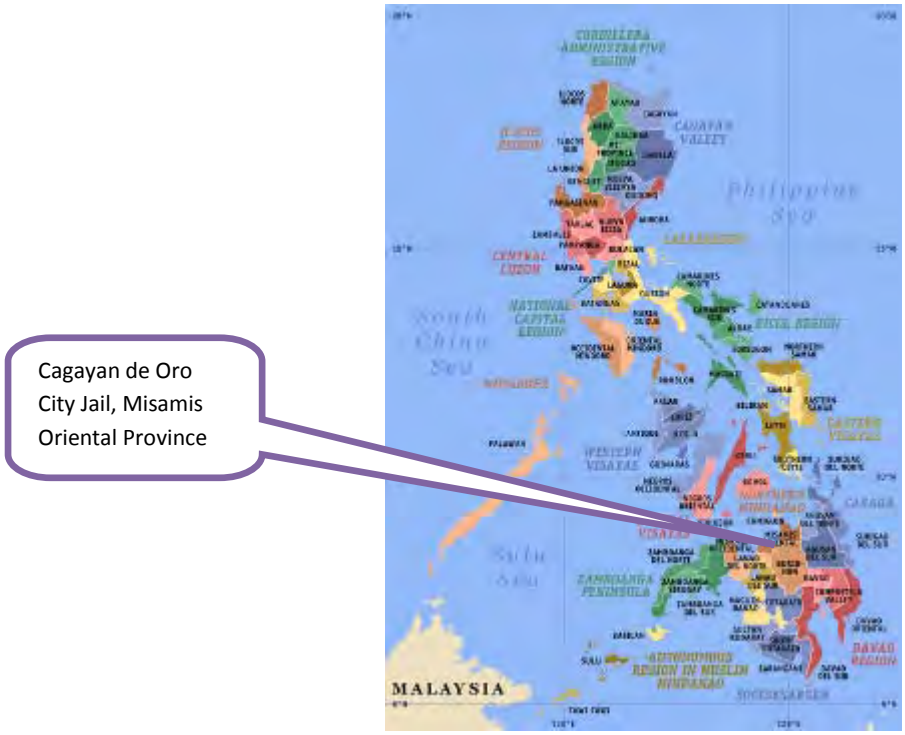
|---|---|
| Project Owner(s) | ▪ Staff of the Cagayan de Oro City Jail |
| Project Partner(s) | ▪ **Funding Agency**: International Committee of the Red Cross (ICRC)- Philippines<br>▪ **Executing Agencies**: ICRC and Staff of the Cagayan de Oro City Jail<br>▪ **Cooperating Agency**: Bureau of Jail Management and Penology (BJMP) and Cagayan de Oro City Government |
| Primary Contacts | ▪ Jeza Mae Sarah C. Sanchez, Community Relations Service Office – BJMP, jmscsanchez@yahoo.com |

## Introduction and Background

Jails may not be the first places that come to mind when thinking about environmental projects, but the International Committee of the Red Cross (ICRC) Philippines nevertheless recognized great potential for such a project in the jails of the Philippines. Philippine jails, which are managed by the Bureau of Jail Management and Penology (BJMP), are, like many jails in developing countries, overcrowded and underfinanced, often due to a legal system unable to keep up with the influx of new suspects. While this obviously makes the lives of inmates uncomfortable, it can also pose an environmental and fiscal problem, since the high prison populations literally consume away much of the BJMP's budget in their need for food and correspondingly produce large volumes of wastewater. If this wastewater is simply discharged or inadequately treated in an outdated septic tank, as is often the case, then the local environment can become degraded through surface and groundwater pollution, which can then result in health problems for nearby residents relying on that water.

Thus, the ICRC decided to pilot a program aimed at reducing prison costs, reducing wastewater pollution, and improving prisoner's lives through the installation of biogas reactors in several pilot jails. BJMP's jail in the City of Cagayan de Oro (CDO), Misamis Oriental, Philippines, was one of these recipients. Prior to the project, the 1000+ inmates of the jail had their meals cooked using firewood, which created an unpleasantly hot and smoke-filled environment for the chefs and also necessitated costly trips outside of the jail to collect firewood. However, this was no longer an option after 2009, when the BJMP banned the use of firewood in its prisons, due to the deforestation issues it was creating. With LPG (liquefied petroleum gas, the main medium used for lighting stoves) being even more expensive, and whose combustion contributes to climate change, the biogas project offered a welcome alternative. As well, prior to the project, the wastewater generated from these same 1000+ inmates was draining simply to an old septic tank, which likely was improperly constructed and rarely, if ever, desludged. Installing a biogas reactor in its place could therefore also mitigate the environmental issues and resulting health risks being generated by this poor treatment system.




**Project Purpose and Objectives**

This project's main component was the installation of a biogas facility for the CDO City Jail. The purpose of this task was to provide an alternative wastewater treatment system for the jail while simultaneously providing a source of free cooking fuel from the methane biogas generated in the reactor. This had the objectives of: 1) reducing local deforestation by eliminating the need for firewood, 2) reducing the emission of greenhouse gases by using the carbon-neutral biogas, 3) reducing the surface and groundwater pollution – and their related health risks – caused by the input of essentially untreated wastewater into the local environment, 4) reducing costs to the prison by reducing the need for the purchase of cooking fuel, and 5) empowering the lives of the prisoners by engaging them in a new inmate-run bakery that is fuelled in part by the biogas.

**Partners and Funding Distribution**

For this project, the funding and main executing agency was the ICRC, who provided a sum of 1.2 million Pesos (~$27,700USD) for all aspects of the project, including labor, materials, and IEC (information, education, communication) training. Staff of the CDO City Jail, BJMP Regional Staff, and the CDO City Government also gave their support to the project.

**Project Activities**

This project ran for approximately one year, from 2009 to 2010. The project began following the BJMP Order banning the use of firewood in its prisons, and construction and implementation of the biogas reactor took about 1 year. The activities included consultation with CDO Jail and BJMP staff by ICRC, construction of the biogas reactor and connection of all drainage and toilet piping to the unit, connection of the gas vent to the kitchen, and helping to initiate the prisoner-led bakery project.

**Sanitation Technology / System**

The biogas reactor is an anaerobic, sealed chamber that serves as a primary settling tank, with relatively fast passage of the liquid effluent through the chamber and digestion of much of the settled sludge by anaerobic bacteria. In this way it is much like a septic tank, except that its sealed nature allows all of the 'biogas' – a mixture of methane and carbon dioxide that is released from anaerobic digestion – to be captured and used. Depending on the size of the biogas reactor, this generated gas can be used either for small scale applications like operating a gas stove or larger scale applications like powering the scalding vats of a slaughterhouse. With 1000+ inmates contributing wastewater to this unit, enough biogas can be generated for a majority of the kitchen's cooking needs.

Since most of the organic matter is converted to biogas, sludge production is relatively low. The settled sludge usually remains in the unit for several years and, when removed, is relatively pathogen-free, requiring only some post-composting to ensure sterility. As well, biogas units are climate-friendly, since the generated biogas is offsetting the need for additional gas at the project site.

The biogas reactor built for CDO City Jail is of the 'fixed dome' type, with an inlet area where the wastewater enters the reactor, the main chamber where the anaerobic fermentation and biogas production takes place, and the raised outlet area, where the liquid effluent and sludge is gradually discharged. This outlet is often connected to further treatment processes, such as an anaerobic baffled reactor/anaerobic filter unit, though for this project, effluent sludge is simply being collected and disposed of or used as fertilizer in the prison garden. The reactor also includes a pipe into its main chamber that allows for desludging of the oldest, least pathogenic sludge at the bottom of the chamber without disturbing the fresh and less treated sludge on top.

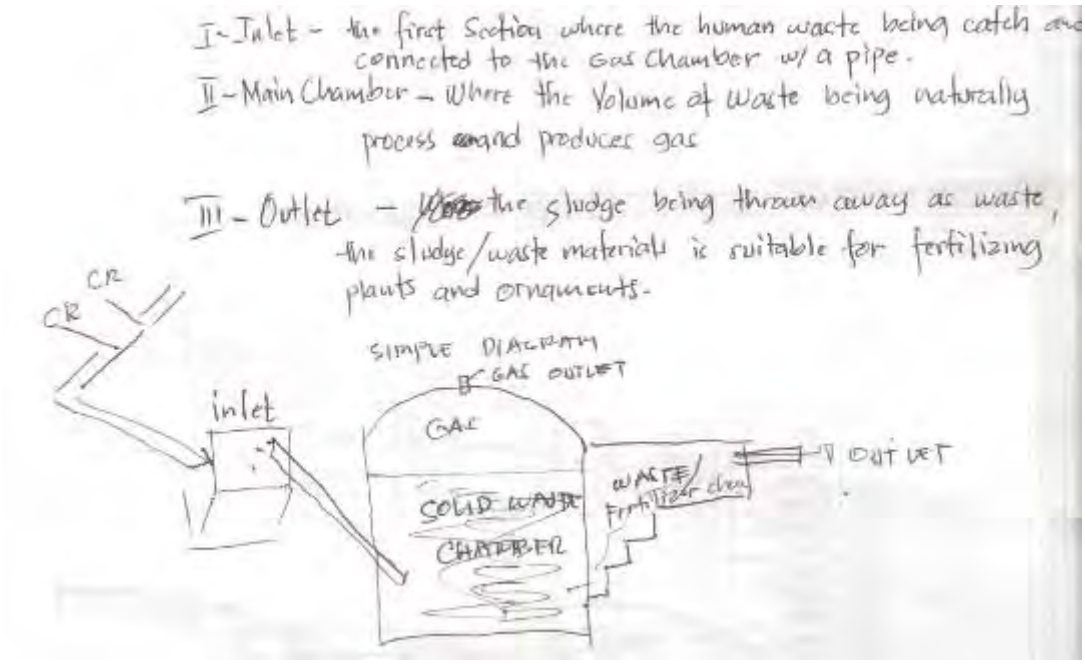



**Figure 1.** Sketch of the CDO City Jail biogas reactor provided by the BJMP

Figure 2 below shows an schematic representation of a typical fixed dome biogas reactor like the one installed at CDO City Jail, including an inlet pipe, main chamber, biogas collection pipe, raised outlet, and desludging pipe

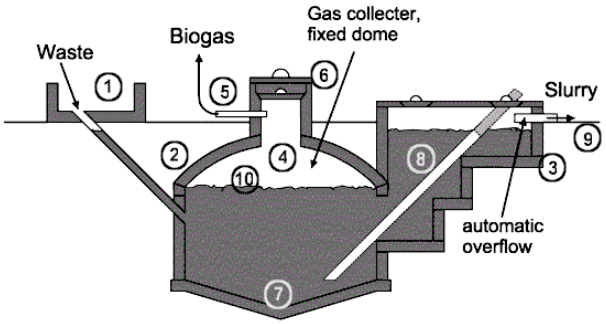



**Figure 2.** Schematic of aTtypical Fixed Dome Biogas Reactor

**Number, Type, and Location of Beneficiaries**

The wastewater generated from the 1000+ inmates and the prison staff at the CDO City Jail is now being treated more effectively by this biogas reactor, thus also reducing the potential health and environmental risks of this formerly poorly treated wastewater to nearby citizens and natural life. The generation of biogas for use by kitchen staff has also improved their workplace, eliminating the hot and smoky environment created by the use of firewood. As well, the prisoners who were engaged in using this new biogas for starting a bakery now have livelihoods to keep them busy and are learning useful skills that they can apply when released.

**Impacts and Challenges**

This project has now been underway for over one year and is being operated and maintained successfully by the CDO City Jail staff and inmates. The bakery of the inmates – powered in part by biogas and in part by LPG – bakes various kinds of bread daily for visitors to purchase and often sells out. The biogas is also used for cooking the viands for the 1000+ inmates, though LPG is still required for boiling the huge pots of rice that are needed. The outlet sludge of the reactor is being used in the prison's vegetable garden, which further reduces costs by eliminating the need for fertilizer purchases and also promotes sustainability by using the waste for local food production. Burning carbon-neutral biogas also helps mitigate climate change by reducing the need for regular LPG, whose burning would add greenhouse gases to the air, or for firewood, whose harvesting causes deforestation and whose burning created a smoky and unhealthy environment for the kitchen staff.

In short, this project – one of the first of its kind in the Philippines – was successful and appears capable of long-term sustainability in its O&M. With even the national newspaper reporting on it, it is hoped that more NGOs and government agencies will see the value in small-scale projects like this that not only address sanitation, but also financial, social, and other environmental issues too.

**Photos**


**Figure 3.** Photos of the biogas-fuelled bakery and kitchen area of the jail

**Figure 4.** Photos of the biogas reactor, inlet canals of wastewater, and the outlet biogas pipe

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**Philippines**
**Decentralized Wastewater Treatment System for LORMA Medical Center – San Fernando City**
**A LORMA-funded Project to Better Manage its Wastewater**

| | |
|---|---|
| Project Owner(s) | ▪ LORMA Medical Center |
| Project Partner(s) | ▪ **Funding Agency**: LORMA Medical Center<br>▪ **Executing Agency**: Biosafe Inc. (Contractor)<br>▪ **Cooperating Agencies**: City Government of San Fernando, La Union; Department of Environment and Natural Resources Regional Office, USAID Philippine Sanitation Alliance |
| Primary Contacts | ▪ Valmar Valdez, City Environment and Natural Resources Officer, valmar_valdez@yahoo.com |

## Introduction and Background

In cities lacking a centralized sewerage system, hospitals can pose a significant sanitation threat. Their often high population of patients and staff creates a large wastewater problem that could easily overwhelm a normal septic tank. Worse yet, the wastewater generated is often much higher in pathogen levels, due to the waste outputs of infected patients. Thus, hospitals need to take a lead role in ensuring this wastewater is treated properly to avoid environmental and health risks to the neighboring community.

LORMA Hospital, San Fernando City, La Union Province

Following a meeting with the USAID Philippine Sanitation Alliance, the LORMA Medical Center of the City of San Fernando, La Union (SFLU) decided to be proactive and fund the installation of a new wastewater treatment plant (WWTP) for its wastewater. As the only ISO-certified medical center north of the Philippine capital city of Manila, LORMA has had a desire for excellence ever since it began operation in 1934. The current facility consists of 136 beds and around 450 employees, and is therefore producing a large volume of wastewater daily. Prior to the project, the hospital's wastewater was simply being treated in septic tanks before discharge to the adjacent Carlatan Creek, which was not providing sufficient treatment and was causing unnecessary pollution to the creek. With the passage of the Philippine Clean Water Act of 2004, the LORMA staff soon realized the benefits of more effective wastewater treatment and began work on their new WWTP in 2008, with the help of contractor BioSafe Inc. and technical assistance from the USAID Philippine Sanitation Alliance.

**Project Purpose and Objectives**

This project had two main components: 1) select an appropriate treatment technology for the WWTP, and 2) install the WWTP and connect the hospital effluent to it. The purpose of these tasks was to implement for the hospital a larger and more effective WWTP than simply septic tanks. This had the objective of reducing pollution by the hospital into the Carlatan Creek and subsequently reducing the environmental and health risks being created for downstream users.

**Partners and Funding Distribution**

This project demonstrates that outside agencies like foreign NGOs are not always required for funding a project, as the main funding agency for this system was LORMA Medical Center itself, providing approximately 2 million Pesos to fund the construction of the WWTP (~$46,000USD). The executing agency was Biosafe Inc., a Philippine wastewater company contracted to build the WWTP, while USAID-PSA provided technical assistance and the idea for the project. The City Government of San Fernando, La Union (SFLU) and the Regional Office of the Department of Environment and Natural Resources provided further input to, and continue to monitor, the project.

**Project Activities**

This project was completed relatively quickly, with construction beginning in September 2008 and finishing in December, 2008. The project activities included: selecting the contractor, selecting the appropriate treatment technology based on calculated flow volumes of the hospital's wastewater and available budget, selecting the site for the WWTP, constructing the WWTP, connecting the existing septic tanks of the hospital to the WWTP, and training an operator on O&M.

**Sanitation Technology / System**

Due to limited land area at the LORMA Medical Center site, the planners opted for a more mechanized, small area system that would have higher O&M costs, rather than a larger area, non-mechanized, and low O&M cost system. After preliminary treatment and settling in the hospital's existing septic tanks, which are regularly desludged for efficiency, the wastewater then proceeds to an aerobic activated sludge tank, followed by an aerobic clarifier tank, followed by discharge to the creek. Considering the WWTP is able to process up to 80$m^3$/day of wastewater from the hospital, its land footprint is quite small, at only 8m x 5m aboveground, which indicates the efficiency of the activated sludge treatment process.

The activated sludge tank consists of an open-air tank that is vigorously aerated from air injection pipes located at the tank's bottom. When aeration like this is controlled at a certain rate, the environment created is very favourable for the growth of aerobic bacteria. These bacteria clump together in groups known as 'flocs' – staying suspended in the tank due to the aeration – and consume the organic compounds and nutrients (such as ammonia) present in the wastewater. These organic compounds are primarily responsible for the magnitude of the wastewater's BOD and COD (biological oxygen demand and chemical oxygen demand) values. These are two of the main values measured when treating wastewater, since, if untreated, these organic compounds degrade in the water body they are disposed into and can reduce or eliminate oxygen in the water and cause the death of much of the marine or river life that was present. After several hours of retention and treatment time, the wastewater passes to the clarifier tank.

The clarifier tank consists of an open-air tank that is filled with baffles, which encourage the settling of the flocs and any remaining sludge. This tank is important since the activated sludge tank is always being throughly mixed such that very little sludge can settle out into it. Once settled (total retention time in both tanks averages about 9 hours), the effluent passes out of the top of the tank and is discharged into the river, as it is now clear and much cleaner. Importantly for the process, though, is that some of the settled sludge and flocs in the clarifier need to be recycled back into the activated sludge tank in order to preserve and continue the same microbial environment. As it is often a challenge to get the right kinds of aerobic bacteria established and growing in the activated sludge tank, once that has been achieved, the recycling of the same bacteria back into it again and again allows the environment to remain relatively static. The excess sludge can be disposed or composted for use as soil additive.


**Figure 1.** Schematics of a generalized activated sludge tank and clarifier (left), the WWTP flow process (middle), and a more detailed schematic of a typical clarifier, with baffles visible (right)

**Number, Type, and Location of Beneficiaries**

The wastewater generated from the patients of the 136 medical center and their 300+ staff and visitors are now being covered by the WWTP, thus reducing the potential health and environmental risks of this wastewater to the river life and downstream residents, and setting a positive example for other hospitals to follow.

**Impacts and Challenges**

This project is now underway and is being operated and maintained successfully by the LORMA Medical Center. An operator was trained in appropriate O&M and is taking this responsibility. O&M generally averages about 30 minutes per day for cleaning of clarifier, recycling of sludge, and other work. The costs of this O&M amount mainly to the operator's salary of about $6USD per day. In addition, the electric costs for the aeration of the system average about 7000 Pesos per month

(~$160USD). These funds are paid for by LORMA exclusively, with no additional fees passed on to patients.

One issue of the project was that the WWTP was originally designed with an additional chlorination tank that followed the clarifier; however, the tank was not able to provide enough retention time to dissipate the chlorine after application. This meant that the chlorinated water being discharged posed a danger to river life – since chlorine is poisonous – and had to be ceased.

While this means that effluent quality is lower than it could be, water quality testing undertaken by the Regional Office of the Department of Environment and Natural Resources indicates that the BOD and COD of the effluent are nevertheless below national standards, with BOD less than 50mg/L, and the water appears clear and clean on observation.

In short, the LORMA Medical Center has set a positive and proactive example with this project, by funding it entirely on their own. While the electricity costs for the unit are higher than O&M on non-mechanized systems, the system can operate on a very small land area and produce consistently clean effluent that meets national standards and requires minimal day-to-day labor. The Carlatan Creek is now cleaner thanks to this project, which hopefully will be mimicked by more hospitals in other parts of the Philippines and abroad.

**Photos**

**Figure 2.** Photos of the LORMA WWTP showing: the side of the facility and the effluent discharge pipe to the river (top), the activated sludge pond (middle), and the clarifier (bottom)

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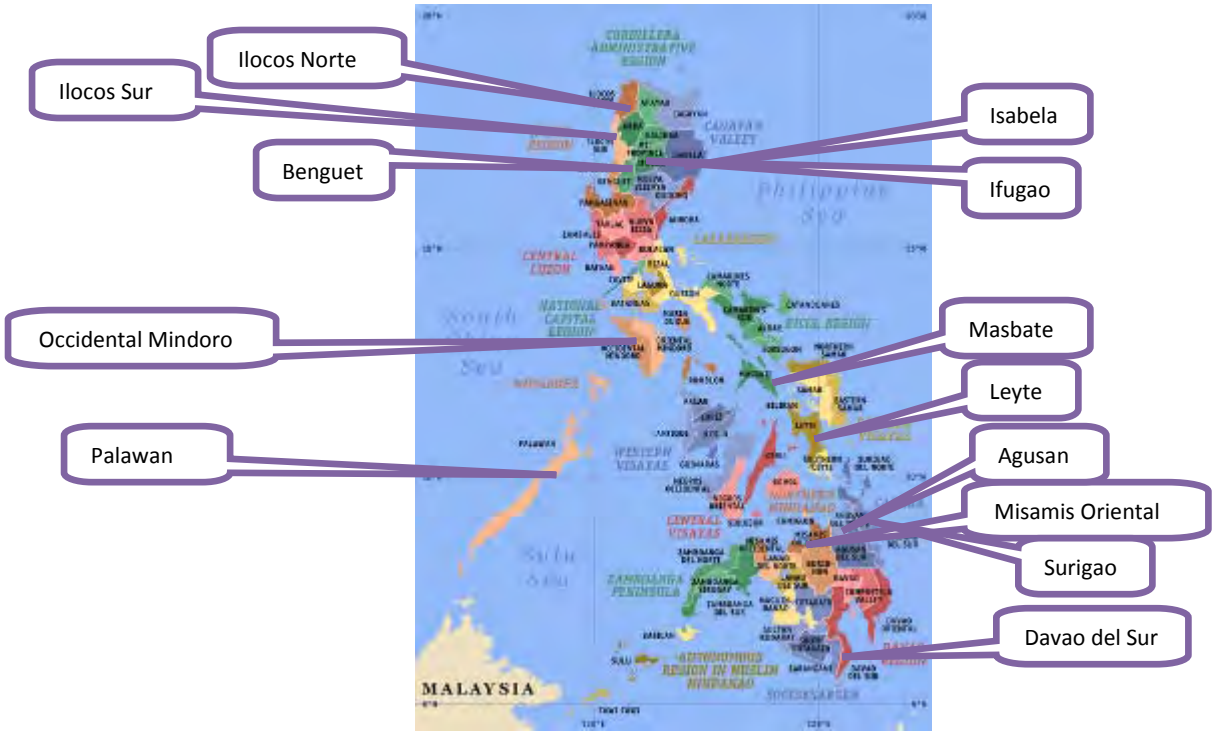
**Philippines**
**Biogas Wastewater Treatment Systems by the Philippine Center for Water and Sanitation**
**A Community-Managed Potable Water Supply, Sanitation, & Hygiene (CPWASH) Project**

| | |
|---|---|
| Project Owner(s) | ▪ Residents of 13 targeted Agrarian Reform Communities (ARCs) |
| Project Partner(s) | ▪ **Funding Agencies**: Department of Agrarian Reform (DAR), through its Bureau of Agrarian Reform Beneficiary Development (BARBD) Central and Regional Offices, and Recipient Barangays / Community-Based Organizations (CBOs)<br>▪ **Executing Agency**: Philippine Center for Water and Sanitation (PCWS)<br>▪ **Cooperating Agencies**: CBOs, DAR-BARBD Regional Offices |
| Primary Contacts | ▪ Engr. Jose Carmelo Gendrano, PCWS, bojig@yahoo.com |

## Introduction and Background

The Philippines, like many developing countries, has serious sanitation issues for both their urban and rural citizens. Specifically for rural citizens, data from 2008 estimated that 17% of this population still had no access to improved sanitation, with 14% estimated to be practicing open defecation. With much of the Philippine countryside devoted to agriculture, this is a serious concern, as pollution generated from poor sanitation can adversely affect the health of agrarian practitioners and pollute their fields. However, since many of these farmers and their communities have very little cash at hand, any proposed sanitation solutions must be low-cost, low maintenance, and provide some quantitative benefits for their users in order for them to be accepted.



Recognizing this issue, the Philippine Center for Water and Sanitation (PCWS) decided to implement a sanitation project aimed at rural Philippine farming communities. Under the Government's Comprehensive Agrarian Reform Program, which is managed by the Department of Agrarian Reform (DAR), various farming communities (located in a barangay or cluster of barangays) who consist of a majority of organized and active farmers are known as agrarian reform communities (ARCs), and are subject to investment from the program. The PCWS thus targeted some of these ARCs for a community-managed potable water supply, sanitation, and hygiene (CPWASH) project that would bring clean water, improved sanitation through the installation of biogas reactors, and better hygiene to these communities, with the assistance of the DAR's Bureau of Agrarian Reform Beneficiary Development (BARBD) and the local ARCs themselves.

**Project Purpose and Objectives**

This project had two main components: 1) install low-cost water supply and sanitation technologies in 10 ARCs and demonstrate their ability to enhance local livelihoods, and 2) encourage the support of the LGUs and Community-Based Organizations (CBOs) within the ARCs through IEC (information, education, and communication) and capacity building activities for the sustainable O&M of the installed technologies and for future, community-led replications of these technologies for additional households. The purpose of these tasks was to bring about low-cost, culturally acceptable, and appropriate water supply and sanitation technologies in each targeted ARC that can be managed and sustained as rural enterprise by the community. This had the objective of reducing health issues in the communities from poor wastewater management that was resulting in polluted groundwater by both reducing the groundwater pollution via improved sanitation and by treating the groundwater prior to consumption via water filters.

**Partners and Funding Distribution**

For this project, the main funding agency was the DAR-BARBD, who supplied a grant of 1,500,400 Pesos (~$34,500USD) for the various project activities and administrative costs for PCWS. As well, the project partners and recipients, including the Regional Offices of the DAR, the recipient LGUs/Barangays, and the recipient ARCs / CBOs would cooperatively counterpart approximately 754,200 Pesos (~$17,380USD) to the project's transportation expenses, labor, and materials. The main executing agency to use these funds was the PCWS, who supplied the technical designs, project management, and community IEC activities. The total project cost for all parties was therefore 2,254,600 Pesos (~$51,900USD).

**Project Activities**

This project ran from November, 2009, until October, 2010. The project activities included: 1) selection and enrollment of willing ARCs / LGUs for the project, 2) surveying the community's water and sanitation resources, 3) planning for the engineering and construction portion of the project, 4) constructing the demonstration water supply and sanitation facilities, which also served as hands-on training for the community members for future constructions, and 5) performing IEC and capacity-building in the recipient communities regarding O&M of the systems and future expansion potential.

**Sanitation Technology / System**

The sanitation technology installed by PCWS was the ferrocement biogas septic tank, installed for individual households or small clusters of households.

Ferrocement is a concrete construction technology favoring the use of closely-spaced mortar and small diameter reinforcements (like wire/mesh instead of conventional rebar). This method allows greater crack resistance and thinner concrete sections, meaning that costs compared to conventional concrete construction methods are often reduced by 65-85%. These thinner concrete sections also allow the use of curved, reuseable molds, which further save costs and allow for the construction of systems like the biogas reactor.

The biogas reactor is an anaerobic, sealed chamber that serves as a primary settling tank, with relatively fast passage of the liquid effluent through the chamber and digestion of much of the settled sludge by anaerobic bacteria. In this way it is much like a septic tank (and can act as one), except that its sealed nature allows all of the 'biogas' – a mixture of methane and carbon dioxide that is released from anaerobic digestion – to be captured and used. Depending on the size of the biogas reactor, this generated gas can be used either for small scale applications like operating a gas stove or larger scale applications like powering the scalding vats of a slaughterhouse. On an individual household level, the biogas generated may be enough to power a small stove for a few minutes per day; enough time, for example, to cook viands for each meal.

Since most of the organic matter is converted to biogas, sludge production is relatively low. The settled sludge usually remains in the unit for several years and, when removed, is relatively pathogen-free, requiring only some post-composting to ensure sterility. As well, biogas units are climate-friendly, since the generated biogas is offsetting the need for additional gas at the project sites (if put to use). PCWS has built biogas reactors of both the 'fixed dome' (dome made of concrete) and 'floating dome' (dome made of PVC tarp, to save on construction and O&M costs) types. Both have an inlet area where the wastewater enters the reactor, the main chamber where the anaerobic fermentation and biogas production takes place, and an outlet area, where the liquid effluent and sludge is gradually discharged. This outlet, in larger projects, can be connected to further treatment processes, such as an anaerobic baffled reactor/anaerobic filter unit, though for this project, effluent sludge can simply be collected and disposed of or used as fertilizer in the ARC fields. The reactor also includes a pipe into its main chamber that allows for desludging of the oldest, least pathogenic sludge at the bottom of the chamber without disturbing the fresh and less treated sludge on top. Reactors built by PCWS can have a capacity of 2 – 4$m^3$ per day and can cost between 5000 to 8000 Pesos (~$115 - $184 USD) for materials and labor.

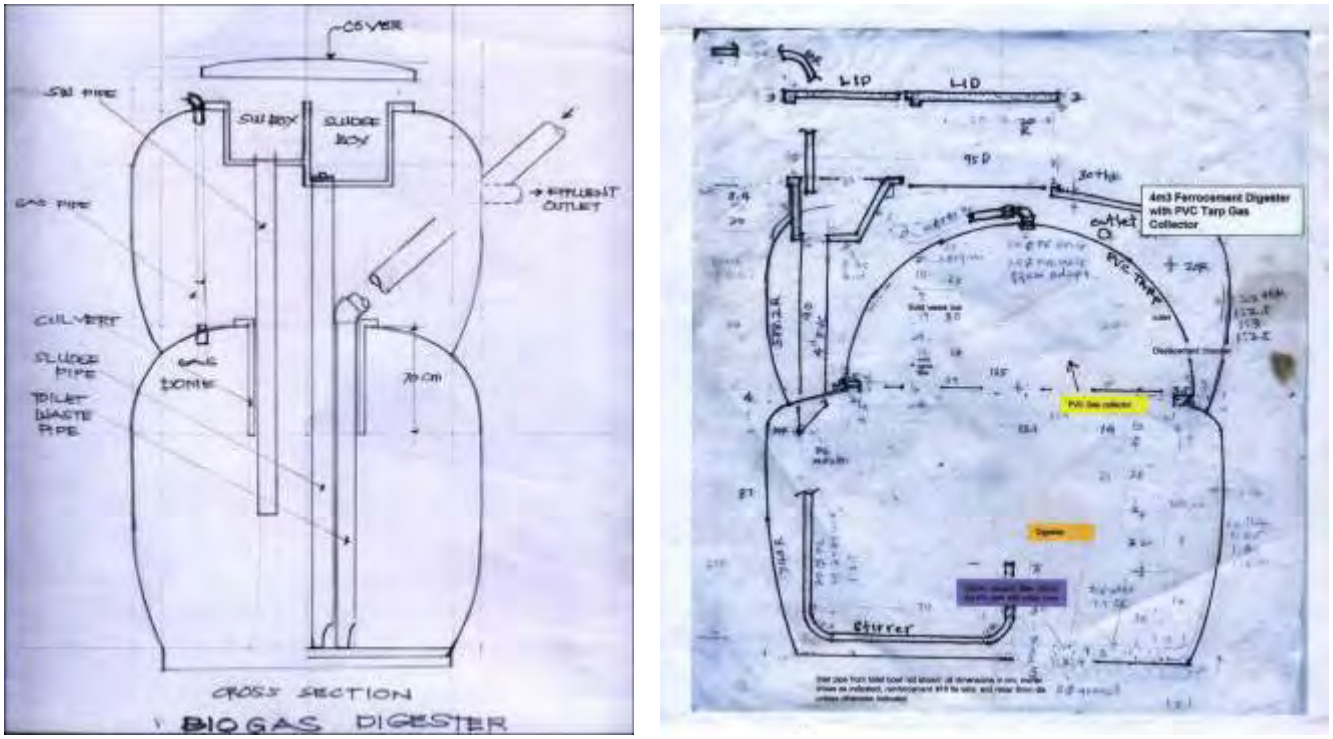



**Figure 1.** Schematics of the PCWS 'fixed dome' (left) and 'floating dome' (right) models of biogas reactor, showing the wastewater influent and desludging pipes, the gas vent, and the effluent pipe.

**Number, Type, and Location of Beneficiaries**

This project was targeted for recipients in 10 of the country's ARCs, though resulting activities actually took place in 13 ARCs, one per province. The following provinces were included: Misamis Oriental, Isabela, Ifugao, Benguet, Ilocos Norte, Ilocos Sur, Palawan, Occidental Mindoro, Davao del Sur, Masbate, Leyte, Surigao, and Agusan. Across the 13 ARCs in these 13 diverse provinces, PCWS constructed 70 water supply and sanitation facilities, 18 of which were biogas septic tanks for between 1 to 4 households each. In addition, CBO members in Ilocos Norte, Masbate, Surigao, and Agusan are already using their training to begin replications of the biogas system themselves, with 4 more units being added thus far. Of the 18 constructed by PCWS, 6 are so far having their biogas generated (for use as cooking fuel), while the others are simply using the tank like a septic tank for the time being. Thus, 22 households – or clusters of up to 4 households – are now having their wastes treated by the biogas reactors.

**Impacts and Challenges**

This project is now complete and the biogas reactors and water filters are being operated and maintained successfully by the members of the ARC CBOs, with any necessary O&M costs being shouldered by these CBOs.

In addition to the biogas reactors now treating the beneficiaries' wastes – thus reducing pollution to the groundwater and subsequent health and environmental risks – the recipients are also benefitting from the low-cost water filters installed and the IEC performed on proper hygiene. These combined activities should serve to help clean the environment of the ACR communities, lower the frequency of contracted water-borne diseases, and allow the recipients to be more productive in their livelihoods. The hands-on training provided will hopefully also allow the recipients to construct more of these systems, especially since many of the recipient ACRs had, at the end of the project,

left-over budget that had been allotted from their respective NGOs. Most were planning on using these funds for continuing the programs in their communities. Optimistically, a follow-up performed 6 months after the project's end showed all of the installed water supply and sanitation facilities still in use and operational with the exception of one biogas reactor (due to odor issues that needed remedying) and two of the water filters (due to cracks in the concrete).

While no water quality testing was performed on the biogas reactor outputs, nor is it known whether there will be user motivation for the desludging of the reactor that is required every few years, it is clear that, at least at the start, the recipients were motivated and gave their financial and physical assistance to help the project succeed. With more projects like this, it would not take long before the rural sanitation statistics of the Philippines begin to see noticeable improvements.

**Photos**


**Figure 2.** A photo of one of the biogas reactors under construction (left), and the simple gas burner used for its biogas (right) – made out of a pop can and some low cost plastic piping and valves


**Figure 3.** A photo of a nearly complete biogas reactor (left) and of one of the IEC sessions (right)

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**Philippines**
**Ecological Sanitation for the Municipality of Bauang, La Union**
**An ISSUE2-Funded Program with CAPS in the Philippines**

| | |
|---|---|
| Project Owner(s) | ▪ Residents of Barangay Parian Oeste, Bauang, La Union |
| Project Partner(s) | ▪ **Funding Agencies**: Provincial Government of La Union, Municipality of Bauang, La Union, and the Recipients<br>▪ **Executing Agency**: CAPS<br>▪ **Cooperating Agencies**: Barangay Council of Parian Oeste, Foundation for a Sustainable Society Inc., and Solid Waste Management Association of the Philippines (SWAPP) |
| Primary Contacts | ▪ Leo de Castro, Program Officer, CAPS, leopdecastro@gmail.com |

## Introduction and Background

The Philippines, like many developing countries, has serious sanitation issues for both their urban and rural citizens. Specifically for rural citizens, data from 2008 estimated that 17% of this population still had no access to improved sanitation, with 14% estimated to be practicing open defecation. With much of the Philippine countryside devoted to agriculture, this is a serious concern, as pollution generated from poor sanitation can adversely affect the health of agrarian practitioners and pollute their fields. However, since many of these rural villagers have very little cash at hand, any proposed sanitation solutions must be low-cost, low maintenance, and provide some quantitative benefits for their users in order for them to be accepted.

The ecological sanitation concept using urine diverting dehydrating toilets (UDDTs) is one such solution for rural areas. This concept links human waste to food security, recognizing the value of treated human waste for fertilizer. The UDDT, in short, is an efficient way to harness these 'resources' by preventing the mixing of urine and feces and by providing an area for these separate waste products to be treated. Just as it is easier to recycle a tin can instead of a multi-metallic CD, it is easier to recycle separated urine, feces, and anal wash water (if present) than it is to recycle them when all mixed together. When separate, urine simply needs about a month of storage before application to consumable crops, anal wash water can be applied directly to non-consumable crops, and feces needs about one year of composting before it can be used as a soil additive. With nothing more than this specialized toilet facility then, poor rural villagers can improve their health, reduce pollution to their groundwater from improperly managed wastewater, and reduce their dependence on costly manufactured fertilizer products. The waterless nature of the facility is also beneficial for those areas where water is difficult to obtain.

Recognizing this, the Center for Advanced Philippine Studies (CAPS), undertook UDDT installation in a poor rural area of the Municipality of Bauang, La Union. Barangay Parian Oeste, an area of marginalized fisher and farmerfolk that was suffering from poor sanitation availability, was selected by CAPS for UDDTs as part of its larger ISSUE2 Program (Integrated Support for Sustainable Urban Environment) that was being undertaken by it and partner NGOs in the Province of La Union. Prior to the project, many of the poor villagers in this barangay were engaging in the "flying saucer" practice of defecating into a plastic bag and throwing it into the nearby creek. The creek, as a result, was polluted, and much of the area had a foul odor, with correspondingly high risks to the safety of the groundwater being used by the residents and a negative impact on the surrounding environment. CAPS aimed to install UDDT facilities with the help of the Municipality of Bauang and the residents themselves, as well as provide extensive IEC (information, education, communication) training on the use of these facilities and on proper hygiene in general.

**Project Purpose and Objectives**

This project in Bauang had three main components: 1) perform initial seminars and surveys of the Municipality to locate and engage the neediest community for UDDTs, 2) provide the UDDT materials and carry out their construction for 35 households, and 3) engage the recipients in further IEC activities on proper O&M of the facilities and on proper hygiene. The purpose of these tasks was to bring about an effective ecological sanitation program for this poor rural community. This had the objectives of demonstrating the effectiveness of the ecological sanitation concept with UDDTs, reducing the groundwater pollution and corresponding health risks resulting from poor existing sanitation, and helping the villagers 'close the loop' between their wastes and food by giving them a way to reduce their dependence on costly fertilizers by treating and reusing their waste.

**Partners and Funding Distribution**

For this project, the main funding agency was the Provincial Government of La Union, with support from the Municipality of Bauang and the recipients themselves. The Province purchased the 35 UDDT ceramic bowls, at 1200 Pesos (~$28USD) each, while the Municipality funded the concrete sub-structures for each facility, at 4000 Pesos (~$93USD) each. The recipients then provided the materials and labor for the superstructures of each facility, with some Municipal/Provincial funds supporting the very poor households in this component. Each superstructure cost an estimated 1000 to 3000 Pesos ($23 - $69USD). The Province, overall, set aside 200,000 Pesos (~$4,600USD) to support the project, including administrative/logistical work. The executing agency for the project was CAPS, while the Barangay Council of Parian Oeste, and the other NGO partners of the ISSUE2

Program (Foundation for a Sustainable Society Inc. and Solid Waste Management Association of the Philippines) provided support.

**Project Activities**

This project ran from approximately January, 2009, until December, 2010. The project activities included: 1) formalization of the project (Jan 09), 2) survey on the sanitation practices in Bauang and study tour of relevant project staff to a UDDT project in neighboring San Fernando City (Mar 09), 3) selection of Barangay Parian Oeste as the recipient community (Mar 09), 4) procurement and provision of materials by CAPS to the LGU and Parian Oeste Barangay Council (Jun 09), 5) groundbreaking ceremony (24 Jun 09), 6) construction of the superstructures for the toilets (until Dec 09, and 7) ongoing IEC on proper O&M and hygiene and follow-up monitoring by CAPS/LGU staff.

**Sanitation Technology / System**

The UDDT is a simple, but powerful, sanitation technology for the rural setting. Its basic principle is to use a specially designed toilet bowl – along with properly trained users – to separate urine, feces, and, if present, anal wash water. The way it does this can vary for 'sit-type' or 'squat-type' bowls and can also be adapted for various challenging circumstances, such as for 'floating homes' situated on or over lakes/rivers.

The design used by CAPS is one where the UDDT is placed in a superstructure that is raised above the ground, so that collection containers for the urine and feces can be placed underneath the superstructure at ground level. The design includes a plastic hose pipe to channel the urine into a plastic jerrycan or bottle and a wicker or plastic container lined with a large plastic bag to collect the feces which drops into it. For 'washer' communities, such as the Philippines, a floor drain is then placed adjacent to the UDDT bowl, over which anal washing should occur via squatting. The floor drain pipe is then directed to drain out to an adjacent flower-bed or non-consumable plant/tree that is located near the superstructure. The superstructure itself is usually built with a concrete base and stone/brick stairs, with a rising sheet metal / concrete / wicker (most common) superstructure in the shape of a square, and topped with a corrugated galvanized iron sheet for a roof. Most of the toilets have flat galvanized iron sheets for doors that are kept closed when not in use. There is also a similar, smaller door installed on ground level that allows access to the feces and urine containers. There can also be a ventilation pipe extending from this ground-level area up to a level above that of the roof and fitted with a screen at its top. This functions to carry out any odor from the chamber, through the action of the wind passing over the top of the pipe that creates airflow in the chamber, and also minimizes flies in the chamber, as any that enter will attempt to exit toward the light at the end of the vent pipe, only to get stopped by the mesh screen and futilely remain there until their death.

As mentioned, the UDDT requires both the ceramic bowl, as well as properly trained users, in order to function. Some guidelines have to be instructed to any recipient via IEC to ensure proper function. These include, most importantly, the addition of ash or carbonized rice husks to the feces container after every defecation. This addition of dry material helps to dehydrate the feces, subsequently killing its pathogens, preventing odors, and preventing fly or insect problems. Many of the most common issues encountered when using UDDTs are as a result of this step not being followed correctly. In this project, villagers are supplying themselves with carbonized rice husks collectively; the village owns one carbonizer device and its outputs are shared among the UDDT owners, training of which was provided by CAPS and the Office of the Provincial Agriculturist, through their Research and Extension Division.

As well, it is beneficial to cover the bowl with a lid, keep the bowl and inner area of the superstructure clean, and keep the door closed when not in use, to further prevent odors and insects. Of course, it must be emphasized that no urine should enter the feces container and no feces should enter the urine container. Anal wash water must also not enter either of these chambers, which is why it is performed separately over the adjacent drain. Since it contains traces of feces, it would contaminate the urine (which is relatively pathogen free, even upon excretion), and would liquify the feces container, preventing proper dehydration. As for toilet paper, while it can be placed in the feces container, it does not degrade while inside, so it is much better if it placed in an adjacent garbage can for later disposal or burning.

As for the outputs – the urine container and feces container – they have different requirements for treatment once filled. Once filled, a urine container should be tightly sealed (to prevent odor) and allowed to rest for at least one month. The strength of the ammonia in the concentrated urine will kill any pathogens present in this time. The urine can then be diluted with water and applied to plants as fertilizer. For a full feces container, the plastic bag holding the feces should be removed from the container, tied closed, and then given a shallow burial into the earth, where it should remain for at least 1 year. This allows the contents to further compost and degrade, and, when unearthed, a humus-like soil additive product will be ready for mixing into growing soils. The feces can also be emptied from the bag and conventionally composted in a heap, but this is more challenging, so the former method is the one recommended by CAPS for this project.

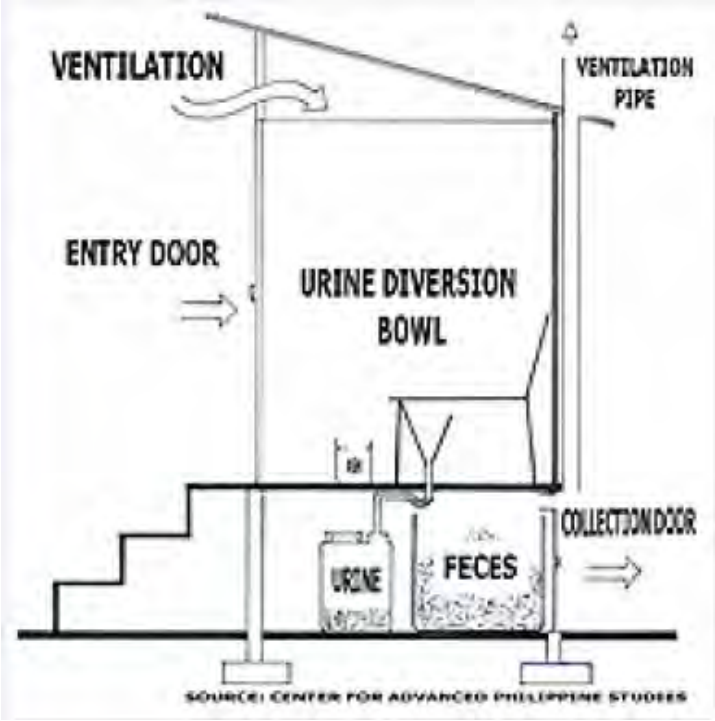


**Figure 1.** A schematic of a UDDT 'ecosan' toilet, showing UDDT bowl, urine and feces containers, and ventilation pipe

**Number, Type, and Location of Beneficiaries**

For this project, 35 recipient households were selected to receive a UDDT facility. These households were selected through the Municipal Health Office and CAPS, with priority given to those households who were at the time still practicing the 'flying saucer' method or who were sharing a toilet with

another household. The wastewater generated from these households is now being properly treated by these UDDT facilities, and is also allowing the households to 'close the loop' between their wastes and food, by using these treated wastes in their food production or flower beds. The IEC performed in the community on hygiene and proper use of the facilities will reach beyond these 35 households though, as these recipients promote the good practices throughout their community.

**Impacts and Challenges**

This project is now complete and is being operated and maintained successfully by the recipient households. A follow-up visit in April 2011 showed all of the facilities still being kept in pristine condition, with many of the households now having incredibly vibrant flower gardens and vegetable beds. None of the toilets examined had any noticeable odor or insect problems. The recipients were grateful to the project for improving their sanitation situation as well as cleaning up their community. The 'flying saucer' method has been all but eliminated in this village and the creek looks cleaner and without any foul odor. The intensive IEC trainings received by the villagers means that they are capable of operating their UDDTs to full efficiency, including their collective efforts to produce carbonized rice husks for use in the toilets. The project is also still providing financial incentives for the low income villagers; the barangay council regularly purchases toilet paper, soap, and the large plastic feces container bags for the recipients as their counterpart to the project. This ensures there are no disincentives to long-term participation by the residents. In fact, the people of the village exhibited strong participation throughout the project, as did the local rural sanitary inspectors and Barangay health workers, who continue to regularly inspect the facilities and hold monthly competitions that award the best maintained toilet. The residents value their toilets because they are able to use it and its products with comfort and ease. The community has also become a destination for numerous study visits, which affirms and reinforces their support for proper care of their facilities.

Overall then, it can be said that this project was a great success, especially when compared with similar UDDT projects that had previously taken place previously in La Union Province, which, due to their more pioneering nature, have seen some of the toilets already fall into disuse. With the collaboration between CAPS and all levels of government in La Union (Provincial, Municipal, and Barangay), the recipients were able to be properly trained and given adequate financial incentives to remain as project participants for the long term. It is no wonder then, that with these existing resources present in the community, CAPS is now undertaking (in 2011) another UDDT project in the Municipality of Bauang.

**Photos**

**Figure 2.** An Ecosan UDDT installed in Barangay Parian Oeste (left) and a view inside the unit (right), showing the UDDT bowl, the anal washing drain, and a water bucket for anal washing. The ash bucket is also present, but out of view of the photo.

**Figure 3.** The floor drain pipe for anal wash water draining to an adjacent tree (left), and the ground level of the urine and feces containers underneath the UDDT superstructure (right)

**Figure 4.** A cleaner creek (left) and a vibrant garden of one of the recipient households (right)

**References**

Municipality of Bauang, La Union. (2011). Personal interview with staff members, 14 Apr. 2011

Barangay Parian Oeste, Bauang. (2011). Personal interview with staff members and recipients, 14 Apr. 2011

**Philippines**
**Small-Scale Wastewater Treatment Systems for 3 Markets**
**USAID Philippine Sanitation Alliance Projects in the Philippines**

| | |
|---|---|
| Project Owner(s) | ▪ 1) Muntinlupa City Government, Metro Manila<br>▪ 2) San Fernando City Government, La Union<br>▪ 3) Manila City Government, Metro Manila |
| Project Partner(s) | 1) **Funding Agency**: Muntinlupa City Government<br>**Executing Agency**: USAID LINAW<br>**Cooperating Agencies**: local barangay council, market vendors association, League of Cities of the Philippines, and the DENR<br>2) **Funding Agency**: City Government of San Fernando, La Union<br>**Executing Agency**: USAID PSA & City Government of San Fernando, LU<br>**Cooperating Agencies**: Department of Environment and Natural Resources (DENR) Region 1, Bongar Co. (contractor), local barangay council, and market vendors association<br>3) **Funding Agencies**: USAID-Philippine Sanitation Alliance (PSA) and Rotary International District 3810<br>**Executing Agencies**: Metro Manila Development Agency (MMDA) and City of Manila<br>**Cooperating Agencies**: Lola Grande Foundation, local barangay council, Solid Waste Management Association of the Philippines (SWAPP) and market vendors association |
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## Introduction and Background

Lack of access to improved sanitation and lack of sanitation treatment infrastructure is a major issue facing the Philippines and other Southeast Asian countries. 2008 data estimated that 24% of the Philippine population still did not have access to personal improved sanitation, 15% of which rely on shared sanitary facilities and 9% of which rely on open defecation or the use of unimproved sanitation. Given the large population of the Philippines, this means that around 10 million Filipinos still defecate in the open on a daily basis, with serious consequences to their local environment and their health, dignity, and human development. In addition, even those people that have access to improved sanitation are very likely using a 'basic' form of improved sanitation – such as a septic tank-connected toilet – since only 4% of the country's residents/businesses are connected to a sewerage system with proper treatment. Since septic tanks, even at their very best, do not in themselves provide adequate wastewater treatment, this means that the Philippines is grappling with a serious problem of groundwater and surface water pollution, with all of the resulting health consequences that this entails. It is estimated that 55 Filipinos die every day as a result of poor sanitation and that it poses economic losses exceeding $1.4 billion yearly.

Recognizing this, the USAID Philippine Sanitation Alliance (PSA) project, implemented by AECOM International Development, was established to facilitate compliance with the 2004 Clean Water Act

of the Philippines. The law calls for all sources of water pollution to be connected to a sewerage system or septage management be employed. The PSA grew from a previous USAID project called LINAW (Local Initiatives for Affordable Wastewater Treatment) and focuses on designing and implementing decentralized sanitation systems and septage management programs at the local level for all types of facilities or cities in the country. Through these programs, the PSA estimates to have already provided 400,000 people with access to improved sanitation facilities.

Three of the PSA's most prominent and recent projects will be outlined here, though the organization has undertaken many more, including large scale decentralized wastewater treatment systems for places like the SM group of malls, small scale systems for selected markets, slaughterhouses, hospitals, resorts, etc. across the country, and a variety of septage management programs. The organization's primary role in all of these projects is as technical consultant and project initiator, with the partner government, water utility or company funding the construction of infrastructure.


The first project is the small-scale wastewater treatment system for the Muntinlupa City Public Market, in Muntinlupa City, Metro Manila. As a major market of 1,445 stalls, it was a foul-smelling place that was discharging all of its sewage, grease, and washings from the meat and fish areas to a septic tank. The partially treated wastewater then flowed into a nearby creek, which flows to Laguna Lake – a vital inland water body and source of drinking water and freshwater fish for much of Manila. To reduce the amount of pollution flowing into the lake, the city government and PSA's precursor, LINAW, undertook to construct a sewage treatment system for all of this market's wastewater that would meet the government's discharge standards.

The second project is the small-scale wastewater treatment system for the San Fernando Public Market, in San Fernando City, La Union. As the main city market with about 700 stalls (up to 900 on the 'market days' of Wednesday/Saturday/Sunday), it was discharging all of its sewage, grease, and washings from the meat and fish areas to a septic tank and then to a drainage canal. This was posing

a significant threat to the City's coastline (the City borders the ocean), as the wastewater was polluting the nearby beaches and threatening the health of nearby citizens. With technical assistance from the USAID-funded Environmental Cooperation-Asia project, the City constructed a sewage treatment system for all of the market's wastewater to clean up the City's coastline.

The third project is the small-scale wastewater treatment system for the Sta. Ana Public Market, in Manila City, Metro Manila. Situated alongside the Pasig River, known infamously as one of the world's most polluted rivers, the bustling market of 220 stalls was discharging all of its wastewater, including sewage, grease, and washings from the meat and fish areas, into an inadequate and rarely desludged septic tank, which then proceeded to discharge this partially treated effluent directly to the river. Inputs like these all along the river, in addition to domestic wastewater, are the reason why the river is considered "biologically dead." Thus, as part of a larger effort to start cleaning up the river, the PSA and Rotary worked with the city government and MMDA to construct a sewage treatment system for all of the market's wastewater, as a model for other markets and facilities along the river's length.

**Project Purpose and Objectives**

These three projects were implemented using the following process: 1) initial consultations and outreach, 2) IEC (information, education, communication) activities on the project and on improving hygiene and sanitation in general, 3) construction of the facilities, and 4) follow-up IEC and training on O&M responsibilities. The purpose of these tasks was to build effective wastewater treatment systems for the markets that would positively impact the sanitation situation of the establishment and its surrounding community. Another objective was for all three markets to meet the national government's effluent discharge standards, which was not possible with septic tanks.

The specific objectives for the Muntinlupa City Market project were to reduce pollution to Laguna Lake, to clean up the market and its surroundings, and to build a model small scale wastewater treatment plant that could be replicated in other markets and establishments throughout the Philippines.

The specific objectives for the San Fernando City Market project were to reduce pollution inputs to the City's coastline and contribute to the City's overall goal of becoming a leader in the Philippines for effective sanitation management (the City has also implemented several other sanitation projects).

The specific objectives for the Sta. Ana Public Market project were to reduce pollution flowing into the Pasig River and to build a model wastewater treatment plant that can be replicated in other establishments along the river.

**Partners and Funding Distribution**

For the Muntinlupa City Market project, the Muntinlupa City Government provided approximately 6.7 million pesos (~130,000 USD) for the construction, which was done by city staff. About P4.5 million was allotted for materials, P890,000 for labor, P220,000 for administration, P270,000 for excavation, and P760,000 for mark-up. USAID LINAW initiated the project by conducting a stakeholder workshop, developing an action plan and organizing a study tour to DEWATS projects in Indonesia. LINAW provided technical advice before, during and after construction and helped the

city conduct an IEC campaign. Other decision-making and cooperative groups included the League of Cities of the Philippines, the DENR, the local barangay council, and the market vendor's association.

For the San Fernando City Market project, the City Government of San Fernando, La Union, provided approximately 5 million pesos (~116,000 USD) for the construction. The USAID ECO-Asia project worked with the city to develop the project, conduct an IEC campaign, and provided technical advice before, during and after construction. Other cooperative groups included the local barangay council, the market vendor's association, Bongar Co. (the construction contractor), and the Regional Office of the Department of Environment and Natural Resources (DENR).

The Sta. Ana Public Market project was initiated by the USAID-Rotary Pasig River Improvement Project, which is one of five projects in the Philippines supported by the USAID-Rotary International H2O Collaboration. A memorandum of agreement was signed among the project partners to provide the following: USAID Philippine Sanitation Alliance provided technical assistance, Rotary International District 3810 purchased most of the construction materials, MMDA supplied in-kind labor and equipment for the construction, and the City of Manila provided in-kind engineering services and are now operating and maintaining the system. The PSA led the preparatory work, designed the facility, and oversaw the construction and support activities. Other cooperative groups included the Solid Waste Management Association of the Philippines (SWAPP) – who was contracted to develop a solid waste and grease management program for the market's barangay – the local barangay council, the market vendor's association, and a community group called the Lola Grande Foundation, which provided day-to-day support, coordination and facilitation services and carried out IEC activities on sanitation and hygiene.

**Project Activities**

The Muntinlupa City Market project ran from 2004 until 2006. Due to the innovative nature of the wastewater treatment system, the planning and design phase took nearly a year and construction lasted from July to December 2005. The project activities included: 1) Stakeholder workshop to develop an action plan for addressing wastewater in the city, 2) Study tour to Indonesia to learn more about DEWATS technology employed by BORDA, 3) Consultation with stakeholders and formation of a technical working group, 4) Design of the facility, 5) Carrying out an IEC campaign involving AV materials, posters, leaflets, comics, and news features on the need for wastewater management and proper sanitation; 6) Construct the facility, and 7) Determination of O&M responsibilities, training and promotional follow-up.

The San Fernando City Market project ran from March 2005 until Dec. 2005. The project activities included: 1) Consult with the City of San Fernando and stakeholders to develop an action plan for addressing water pollution in the city, 2) Design the treatment system for the market and associated infrastructure, 3) Consult with market vendors and other stakeholders to determine how to fund the project (a 10% increase in rent per stall, but not technically a 'users fee'), 4) Renovate the toilet facilities of the market, 5) Undertake IEC in cooperation with the market vendor's association to promote the project and promote overall hygiene improvements among the vendors and local community, 6) Construct the facility, and 7) Determination of O&M responsibilities and training.

USAID-Rotary assistance to the Sta. Ana Public Market began in mid-2009 and the wastewater treatment plant was constructed from March to October 2010. The project activities included: 1) Consult with project stakeholders to obtain funding and in-kind support, namely from the City of Manila, the Metro Manila Development Authority (MMDA), USAID and Rotary (the Foundation and

International District 3810), 2) Hold focus group discussions and workshops for market vendors, local officials, neighboring schools and churches, and other neighboring establishments, to inform and involve them in project activities, 3) Undertake education campaigns, via a local community organization (the Lola Grande Foundation), on improving hygiene and sanitation in the market and surrounding communities, 4) Decide on treatment technology and prepare the design, 5) Undertake the construction, and 6) Follow-up IEC on the project and determine O&M responsibilities. To ensure that garbage and grease would not clog up the treatment plant, the USAID-Rotary project hired the Solid Waste Management Association of the Philippines (SWAPP) to help the vendor's association develop and implement a solid waste management program and a grease management program. The project also repaired the public toilets and sinks in the market, encouraged the local barangay to pass an ordinance requiring soap in all public restrooms and is currently developing a system that will pipe treated water to the restrooms to address water shortages.

**Sanitation Technology / System**

Each of these three projects utilized a similar technology package, with minor differences adapted to each local situation.

The system installed in Muntinlupa City Market consists of the following sections – all located entirely underground (excavated under the parking lot / loading bays due to lack of above-ground space) – in order of wastewater flow: bar screen, lift station, equalization tank, anaerobic baffled reactor (ABR), upflow anaerobic sludge blanket (UASB), sequencing batch reactor, lamella clarifier, cocopeat filter, recycling to toilets for flushing. This system was designed to treat up to 210$m^3$ of wastewater per day.

The system installed in the San Fernando City Market consists of the following sections, in order of wastewater flow: bar screen, lift station, equalization tank, upflow anaerobic sludge blanket (UASB), sequencing batch reactor, clarifier and chlorination tank (combined), and discharge.

The system installed in the Sta. Ana Market consists of the following sections, in order of wastewater flow: grease trap, bar screen, lift station, equalization tank, upflow anaerobic sludge blanket (UASB), sequencing batch reactor, clarifier, chlorine contact chamber, and discharge.

A grease trap is a simple tank, one or two chambers, with influent and effluent pipes positioned fairly deep below the anticipated water level. Since grease (oil) floats on water, influent grease rises to the surface and is trapped there, while the remaining wastewater exits through the sunken effluent pipe.

Bar screens are located at each main inlet area to the equalization tanks, in order to filter out any large floatable debris, such as garbage, meat/fish trimmings, or other solids that could clog the rest of the treatment system. These screens are manually cleaned on a regular basis.

The lift station is a simple chamber containing paired automatic pumps that serve to pump the collecting wastewater to the equalization tank of the system. The pumps switch on as the chamber fills up because of floats that rise with the water level and trigger the pump switch. They likewise switch off as the floats lower with the falling water level.

The equalization tank serves as a wastewater retention point and an area for control of influent fluctuations, and allows a relatively constant flow of wastewater to proceed to the subsequent

chambers (rather than having high flows during peak hours and no flow during nighttime). This unit is single-chambered for these projects.

The anaerobic baffled reactor (ABR) (Muntinlupa project only) is one of the main treatment technologies used in DEWATS. As the name implies, this multi-chambered tank is closed from the air and anaerobic. Wastewater flows slowly up (and back down through pipes) through its several identical chambers, each time entering the chamber at its bottom, where it passes through the accumulated sludge. This allows solids to settle out into the sludge and anaerobic bacteria living in the sludge to degrade much of the harmful organic and chemical components of the wastewater. The number of chambers can vary depending on available land area, wastewater strength, and funds – this project uses a 4 chamber ABR.

The UASB is a single-chambered tank with a baffled configuration near the top of the water level. Anaerobic wastewater is introduced along the bottom of the tank at evenly spaced inlets. It then flows upward through (once established) an layer of anaerobic sludge that has accumulated there, during which time anaerobic bacteria established in the sludge decompose much of the organic and chemical compounds of the wastewater. This degradation generates biogas (mainly composed of methane and carbon dioxide gases), the bubbles of which rise upward in the tank and provide natural mixing to the liquid above the sludge layer. The baffles then direct the gas bubbles toward the top and center of the tank, where there is situated a 'three-phase separator' / 'gas cap'. The biogas mainly enters this cap and can be harnessed for use in lighting or cooking. Meanwhile, the baffled nature of the gas cap prevents much of the remaining solids from continuing on with the liquid effluent to the next tank. The liquid, though, is able to move around the baffles and continue upward to the top of the tank, where it spills over into weirs that carry it to the next tank. This tank can provide 50-70% treatment of the wastewater, especially in terms of BOD, COD, and TSS values.

The sequencing batch reactor (SBR), as the name implies, is a chamber that treats wastewater in batches, not continuously, using an activated sludge process. The activated sludge process consists of an open-air tank that is vigorously aerated from air injection pipes located at the tank's bottom. When aeration like this is controlled at a certain rate, the environment created is very favourable for the growth of aerobic bacteria. These bacteria clump together in groups known as 'flocs' – staying suspended in the tank due to the aeration – and consume the organic compounds and nutrients (such as ammonia) present in the wastewater. These organic compounds are primarily responsible for the magnitude of the wastewater's BOD and COD (biological oxygen demand and chemical oxygen demand) values. These are two of the main values measured when treating wastewater, since, if untreated, these organic compounds degrade in the water body they are disposed into and can reduce or eliminate oxygen in the water and cause the death of much of the marine or river life that was present. For SBRs, the stages of this cycle are: 1) Filling: the SBR is filled with pre-treated wastewater from the UASB, 2) Reaction: the filled tank is aerated vigorously, prompting the growth of flocs; length of time aerated depends on tank volume and desired treatment level, 3) Settling: aeration is then stopped and flocs are allowed to settle for around 1 hour, leaving clear effluent on top of a sludge blanket, 4) Decanting: effluent is pumped out of the tank through a pump that draws out the effluent from the top of the water level in a manner so as to not disturb the sludge blanket at the bottom, 5) Idling: the SBR idles until it is time for the next cycle, and 6) Sludge Wasting: excess sludge is periodically removed from the tank (automatically through the base), which maintains floc growth and effluent quality; the sludge can be recycled back through the system or dried and composted separately. The decanted effluent then passes to the clarifier.

The clarifier tank consists of an open-air tank that can be simply an open tank for gradual settling or can be filled with baffles (a lamella clarifier), which encourage the settling of any remaining flocs and solids.

The chlorination tank or contact chamber (Sta. Ana and San Fernando only) consists simply of a tank and device that applies chlorine to the wastewater at a fixed rate, to kill any remaining pathogens or bacteria in the water. After a resting period for the chlorine to again dissipate, the effluent can then be discharged or recycled for toilet flushing.

In Muntinlupa, a cocopeat filter was built for demonstration purposes and used for about one year. Treated wastewater dripped through a box containing cocopeat, which is the dust left over when coconut husks are processed to remove the coco coir or fibers. It is normally discarded as waste material. This material functions as an efficient filter to polish the wastewater before the effluent is either reused or discharged. The treated wastewater was reused for toilet flushing for about a year, then the flushing system in the restroom broke down (due to undisciplined use) and the market management decided not to repair it. Treated wastewater is currently used for cleaning the streets within the market complex.

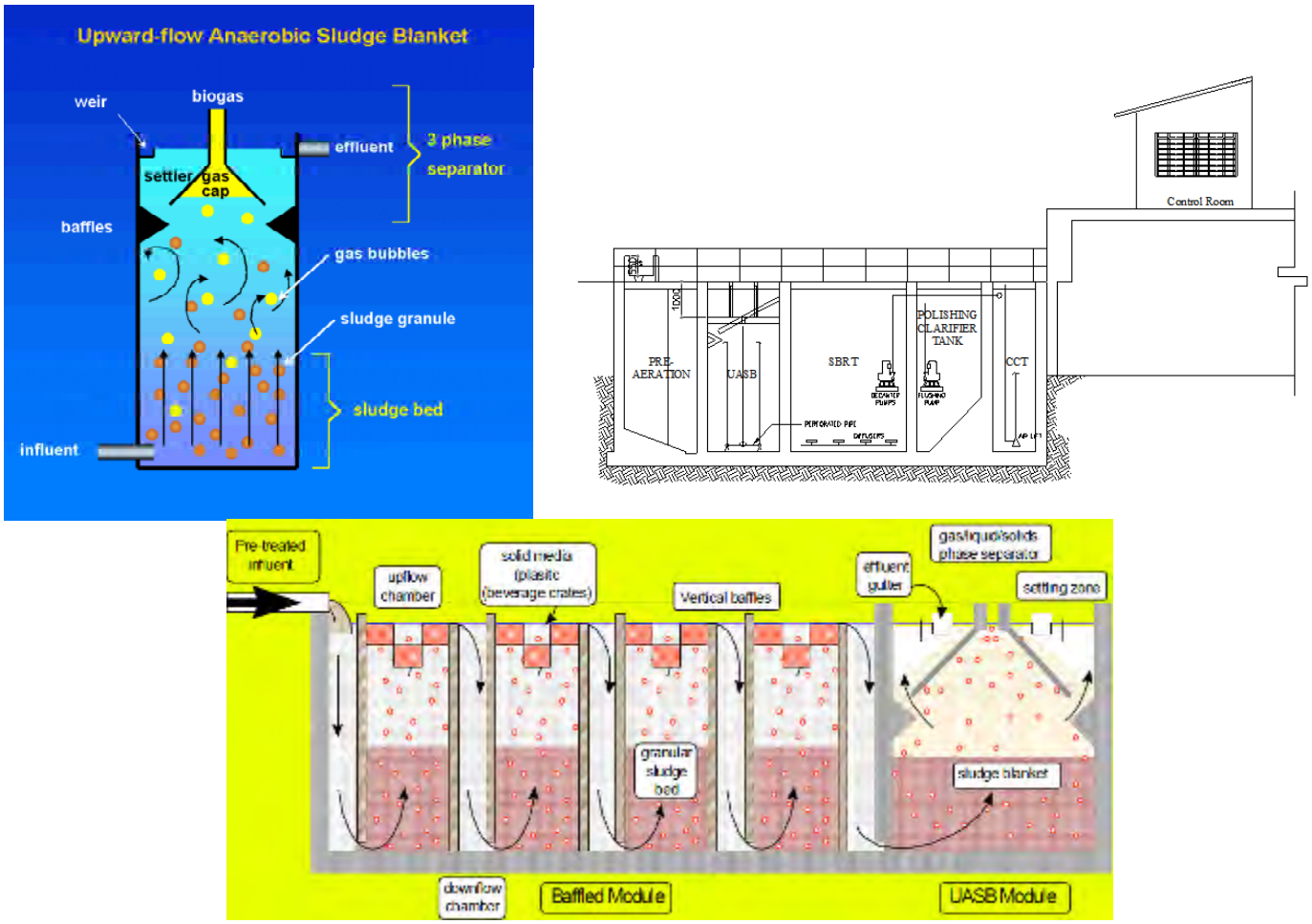



**Figure 1.** A typical UASB system (top left), the schematic of the Sta. Ana Market treatment system, showing the equalization tank, UASB, SBR, clarifier, and chlorine contact chamber (top right), and the ABR and UASB of the Muntinlupa Market treatment system.

**Number, Type, and Location of Beneficiaries**

For the Muntinlupa Market project, the wastewater generated from the 1445 stalls, their vendors, and their customers are now covered by the project. In additional, the IEC activities performed by the project partners educated many people of the market and surrounding community on the benefits of proper hygiene and sanitation.

For the San Fernando Market project, the wastewater generated from the 700-900 stalls, their vendors, and their customers are now covered by the project. In addition, the IEC activities performed by the project partners educated many people of the market and surrounding community on the benefits of proper hygiene and sanitation.

For the Sta. Ana Market project, the wastewater generated from the 220 stalls, their vendors, and their customers are now covered by the project. In addition, the IEC activities performed by the project partners, especially the Lola Grande Foundation, educated many more people of the surrounding community on the benefits of proper hygiene and sanitation.

**Impacts and Challenges**

These projects are now complete and being operated and maintained by market staff. All three are still functioning properly and serving as models for small-scale wastewater treatment in the Philippines. Muntinlupa Market, especially, is serving as a significant model, as it was the first plant of its kind in the Philippines, and also had the innovative feature of being built entirely underground due to space constraints at the project site.

These treatment systems are also low cost for O&M compared to conventional systems, as they utilize mainly non-mechanized processes (other than the pumps and SBRs) that are low maintenance. As an example of the O&M costs, the Muntinlupa Market – the project with the largest wastewater load – incurs approximately 27,000 pesos (~ 620 USD) a month in O&M fees, which includes the salary of its two maintenance personnel. Considering the volume of wastewater treated (210$m^3$ per day), this is a very reasonable sum. As well, the Muntinlupa Market implemented – with the agreement of the market vendors – a users fee of 5 pesos per stall per day, which allowed the City to recover its costs for the project in merely 3 to 4 years. By reusing the effluent for toilet flushing (for one year) and street cleaning, the Muntinlupa Market also saves money on water bills. The San Fernando Market also implemented an indirect cost-recovery measure by increasing rental rates for stalls by 10%, though the additional revenue collected also goes to other market maintenance and initiatives in general. In both cases, the IEC performed by the project teams allowed market vendors to be engaged in the projects and agree to paying these additional fees in exchange for doing their part to clean up their surrounding waterways and meet national government regulations.

All of the projects faced challenges. In Muntinlupa, several pumps broke down and needed to be replaced, which took time. As mentioned earlier, the reuse system for the public toilets broke down and was not repaired. In San Fernando, the system quickly got clogged up with trash and grease due to poor design and construction. This was remedied, and the lesson was incorporated into the design and management of the Sta. Ana system.

As for water quality, these combinations of anaerobic and aerobic treatment processes allow these plants to be very effective at reducing BOD, COD, and TSS values of the wastewater, and the

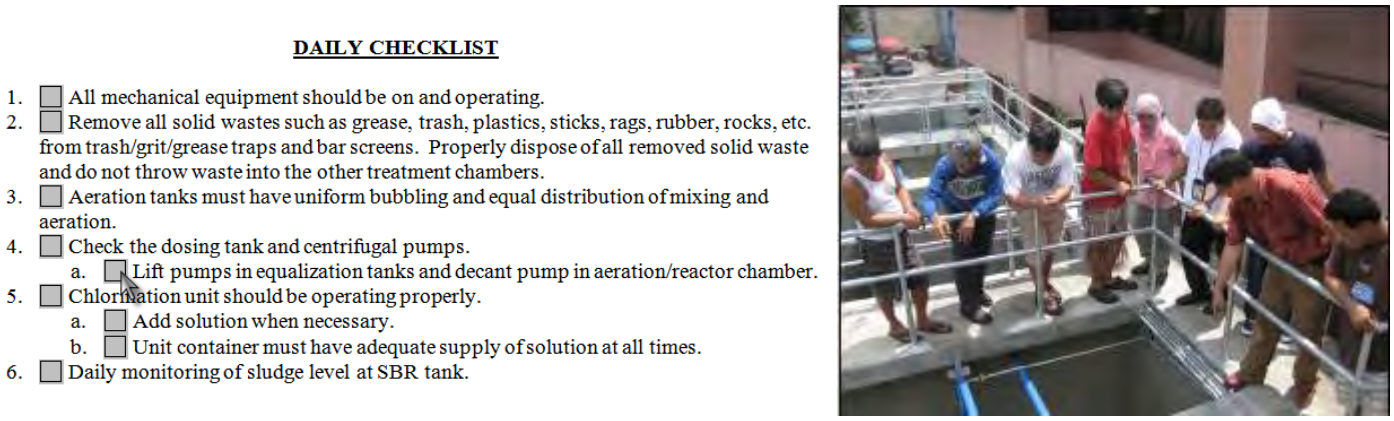
chlorination/filtration steps also help to remove pathogens. For example, at the San Fernando Market project, influent BOD/COD/TSS averages around 153, 439, and 148mg/L, respectively, with DENR national standards of 100/200/150mg/L for markets. After treatment, these values fall drastically to averages of around 11/27/11mg/L, respectively – far below the national requirements. The same applies for Muntinlupa, which reduces its BOD from more than 300mg/L to below 30mg/L (with a DENR standard for discharge to Laguna Lake at 50mg/L). These plants are therefore being very successful in treating the water of these markets.

Overall then, these projects are successfully contributing to the improvement of the sanitation situation in the Philippines, by essentially eliminating some of the largest and highest strength inputs of wastewater into important water bodies like the Pasig River, Laguna Lake, and the country's coastlines. While they have only a small impact in the overall picture (Pasig River is still biologically dead), their positive examples provide the groundwork for many more projects like these in the future.

**Photos**

**Figure 2.** The San Fernando Market wastewater treatment plant (left) and its SBR and UASB (foreground/background, right)


**Figure 3.** The Muntinlupa Market wastewater treatment plant under construction (left) and one of the IEC ads made by the project team as part of social outreach for the project (right)



**DAILY CHECKLIST**

1. ☐ All mechanical equipment should be on and operating.
2. ☐ Remove all solid wastes such as grease, trash, plastics, sticks, rags, rubber, rocks, etc. from trash/grit/grease traps and bar screens. Properly dispose of all removed solid waste and do not throw waste into the other treatment chambers.
3. ☐ Aeration tanks must have uniform bubbling and equal distribution of mixing and aeration.
4. ☐ Check the dosing tank and centrifugal pumps.
   a. ☐ Lift pumps in equalization tanks and decant pump in aeration/reactor chamber.
5. ☐ Chlorination unit should be operating properly.
   a. ☐ Add solution when necessary.
   b. ☐ Unit container must have adequate supply of solution at all times.
6. ☐ Daily monitoring of sludge level at SBR tank.

**Figure 4.** The daily checklist for operators of the Sta. Ana Market wastewater treatment plant, as part of the operations manual provided to them by the project team (left) and visitors touring the Sta. Ana plant (right)

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