LAO PEOPLE'S DEMOCRATIC REPUBLIC

First Decentralized Wastewater Treatment System in Lao PDR

Project Owner(s)	▪ Faculty & Staff of the Faculty of Engineering, National University of Laos in Vientiane Capital
Project Partner(s)	▪ Lao Institute for Renewable Energy (LIRE) ▪ BORDA ▪ Faculty of Engineering (FoE) – NuoL ▪ Finland Futures Research Centre (FFRC) ▪ Finnish Turku School of Economics
Primary Contacts	
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Introduction

Wastewater treatment as part of the sanitation system is an important environmental service that is closely linked to water management. The poor sanitation management in Lao PDR generally contributes to wastewater pollution especially in the urban areas. The major water source for urban supply is surface water since most towns are located along the rivers as groundwater is for the rural population. Now, both the surface and ground water quality are already declining although still within the acceptable limits. Water pollution issues will become increasingly important in the near future.

In an attempt to answer the issue of inadequate water supply, poor sanitation and sewerage and poor hygiene, some non-government organizations in partnership with the National University of Laos in Vientiane Capital established the first decentralized wastewater treatment. This case study describes the first decentralized wastewater treatment established in Lao PDR.

Background

The Lao People's Democratic Republic is a country surrounded by China, Vietnam, Thailand, Cambodia and Myanmar. In 2005, Lao PDR was below average in establishing sanitation access as compared to other Southeast Asian countries. In a study conducted by Multiple Indicator Cluster Survey in 2006 (MICS III), it reflected a 44.8% coverage for those with improved sanitation (or 48% cited by the UNICEF/WHO Joint Monitoring Program) as compared to the 67% average for all the Southeast Asian countries.

In the same study, there are at least fifty-two percent (52%) of the Lao population without access to sanitation. This data equates to over three million Laotians living without improved sanitation - without an easily accessible, private and safe place to urinate and defecate. Furthermore, the growing population of Lao PDR needs to be taken into consideration while looking at the efforts to increase sanitation coverage.

Objectives

DEWATS is an important component of the Community Based Sanitation (CBS) framework whose objective is to improve sanitation conditions in areas with improper sanitation facilities.[1]

The implementation of the first DEWATS was a result of the consultation with the residents, discussions with the lecturers and LIRE to improve the environmental and hygiene conditions around the dormitory buildings.

Beneficiaries

A demonstration DEWATS was completed in 2009 as a community-based sanitation service for the Staff Dormitory Residence in Sokpaluang Campus of the Faculty of Engineering, National University of Laos in Vientiane Capital.

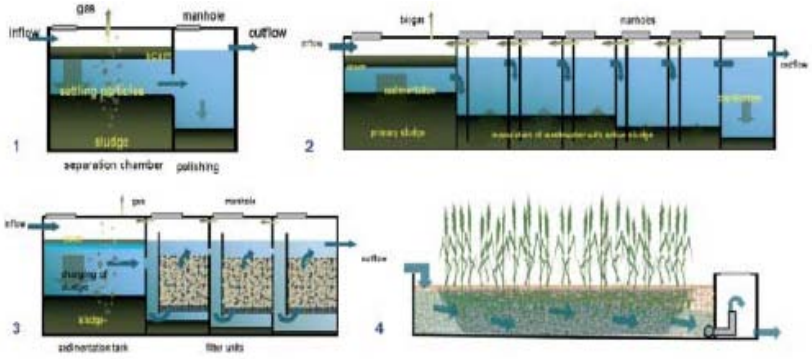
Sanitation Technology / System

Decentralized Wastewater Treatment Systems (DEWATS) is a technical approach rather than merely a technology package. DEWATS applications are based on the principle of low-maintenance since the most important parts of the system work without technical energy inputs and cannot be switched off intentionally.[2]
State-of-the-art technology is being offered in DEWATS applications at affordable prices since all of the construction materials are being sourced out locally.
• DEWATS applications provide treatment for both domestic and industrial sources

[1] Vongsaly, Rietzler, Gaillard. LIRE Annual Review 2009. Vientiane.February 2010. P. 16
[2] Vongsaly, Rietzler, Gaillard. LIRE Annual Review 2009. Vientiane.February 2010. P. 16

- DEWATS applications provide treatment for organic wastewater flows from 1 -1000 m3 per day
- DEWATS applications are reliable, long lasting and tolerant towards inflow fluctuation
- DEWATS applications do not need sophisticated maintenance

The system has the capacity to treat 10m³ of wastewater per day which is sufficient to significantly reduce pollution of water and soil by the wastewater effluent. The existing septic tank was not suitable to the needs of the school due to improper pipeline settings and dimensions. Bad odors often result since rainwater and the septic tank's outlet had joined intersections.[3]



The applications of DEWATS are designed and dimensioned in such a way that treated water meets requirements stipulated in environmental laws and regulations.

Partners

In March 2008, LIRE and BORDA signed an agreement to develop programs in the water supply and renewable energy sectors. And in 2009, the two organizations already focusing on promoting the "Wastewater Treatment Systems for Community- Based Sanitation and Small and Medium Enterprises" (DEWATS - CBS&SME).

The project was funded by the Finnish Turku School of Economics through its ICI Project, LIRE and dormitory residents.

A completed DEWATS demonstration was done in cooperation with the Faculty of Engineering (FoE) – NuoL through its ICI Partnership Project with the Finland Futures Research Centre (FFRC).

Inauguration of the first DEWATS at the Staff Dormitory of the Faculty of Engineering, National University of Laos in Vientiane Capital on March 31, 2010 was also done with the participation of various representatives from government departments and offices at provincial and district levels as well as international organizations.

Support

The key to the project implementations depend on the active cooperation of communities, governments, NGOs, and the private sector. Implementation of smart and proven technical options are synthesized with capacity building measures and technical expertise to mainstream CBS as a viable technical option in areas, where neither individual on-site systems nor centralized sewerage systems can fulfill the need of stakeholders for basic sanitation.

CBS projects are based on a holistic and demand responsive approach. Instead of simply providing sanitation "hardware", CBS-projects aim to improve hygiene behaviour and sanitation infrastructure

[3] Id, p. 17

in a more integrated and sustainable manner. CBS projects generally focus on poor and densely populated areas and closely reflect preferences of the target communities.[4]

Impacts and Challenges

The report released in May 2009 on Economic Impacts of Sanitation in Lao PDR by WSP revealed:

- Lack of regulation and environmental laws
- Poor sanitation, including hygiene, causes at least three million disease episodes and 6 thousand premature deaths annually (1 death per 1000 inhabitants of 6.2 million total populations)
- About 82% of schools does not have sanitation facilities
- About 40% of the population does not have sustainable access to improved water source (47% in rural areas)
- About 52% of the national population does not have access to 'basic' sanitation (62% in rural areas)

There seems to be a strong partnership between the LIRE DEWATS team and actors in the Water, Sanitation and Hygiene (WASH) sector, including a Joint Cooperation with JICA (Japan International Cooperation Agency), which will facilitate the first implementations of SBS and CBS in Laos. LIRE is also looking at a potential partnerships with the Vientiane Urban Development Administration Agency (VUDAA) and the Department of Public Works and Transport (DPWT) of Vientiane Capital while continuously pursuing opportunities for DEWATS in Small and Medium Enterprises (SME) in the Lao PDR.

Several surveys and studies also showed that there is a high demand for proper wastewater treatment system in the Lao PDR. It is strongly believed therefore, that DEWATS as an effective, efficient, affordable and proven wastewater treatment solution can respond to this demand.

[4] Vongsaly, Rietzler, Gaillard. LIRE Annual Review 2009. Vientiane.February 2010. P. 16

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Laos
Decentralized Wastewater Treatment Systems for a College, Village, and Primary School
BORDA-LIRE DEWATS Projects in Laos

Project Owner(s)	▪ 1) Residents of Units 11, 12, & 13 of Thongkankham Village ▪ 2) Users of the Khoualuang Primary School and Temple ▪ 3) Students of the Agriculture and Forestry College of Luang Prabang
Project Partner(s)	▪ 1) **Funding Agency**: Japan International Cooperation Agency (JICA); **Executing Agency**: Bremen Overseas Research and Development Agency – Lao Institute for Renewable Energy (BORDA-LIRE); **Cooperating Agency**: Public Works and Transportation Institute (PTI) ▪ 2) **Funding Agency**: JICA; **Executing Agency**: BORDA-LIRE; **Cooperating Agency**: Khoualuang Village Office ▪ 3) **Funding Agency**: Helvetas; **Executing Agency**: BORDA-LIRE; **Cooperating Agency**: Agriculture and Forestry College
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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.

The Lao People's Democratic Republic is a country surrounded by China, Vietnam, Thailand, Cambodia and Myanmar. In 2005, Lao PDR was below average in establishing sanitation access as compared to other Southeast Asian countries. In a study conducted by a Multiple Indicator Cluster Survey in 2006 (MICS III), it reflected a 44.8% coverage for those with improved sanitation (or 48% cited by the UNICEF/WHO Joint Monitoring Program) as compared to the 67% average for all the Southeast Asian countries. In the same study, there are at least fifty-two percent (52%) of the Lao population without access to sanitation. This data equates to over three million Laotians living without improved sanitation - without an easily accessible, private and safe place to urinate and defecate. Furthermore, the growing population of Lao PDR needs to be taken into consideration while looking at the efforts to increase sanitation coverage.

With this in mind, BORDA recently established itself in the country, partnering with the Lao Institute for Renewable Energy (LIRE). After completing its first pilot DEWATS, the Agency has successfully completed three more, using the same modular technology for each.

The first area chosen for DEWATS was Units 11, 12, and 13 of Thongkankham Village in Vientiane. In this village, 19% of the households did not have private toilet facilities, and those that did had poor septic tanks that were bottomless and rarely emptied. As well, all other household wastewater was simply discharged to the surrounding ground, as the area lacked a proper canal system, which resulted in foul smells and flood risks during rainy season. Overall, the site had a high risk of groundwater pollution because of these issues.

The second area chosen for DEWATS was the Khoualuang Primary School and temple complex in Vientiane. In this area, an overly shallow and perpetually clogged canal system was causing continuous flooding during rainy season and causing foul odors. As well, the existing school sanitation facilities were in very poor condition, with dirty, old and unsafe toilets. The health and groundwater risks to the schoolchildren and surrounding residents were therefore high.

The third area chosen for DEWATS was the Agriculture and Forestry College (AFC) of Luang Prabang. At this school, all wastewater from the dormitories was being discharged directly to a nearby stream leading to the Mekong River, and with a planned upgrading of the dormitories, the circumstances were ideal for installing a DEWATS system to cease this source of pollution to the stream.

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 1000m^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 the first project in Thongkankham Village, the purpose was to improve the sanitation situation of a portion of the Village by installing a DEWATS for 22 households and one noodle-making shop in the Village, as well as by renovating the toilet facilities of 9 of these households. This had the objectives of reducing groundwater pollution from the poor existing septic tanks (by piping their effluent to the new DEWATS) and reducing the foul odors and flood risks caused by the poor existing drainage and wastewater handling, thus promoting better health and dignity for the local villagers.

For the second project in Khoualuang Primary School, the purpose was to improve the sanitation situation by installing a DEWATS for 14 toilets from the school and 3 toilets from the nearby temple, as well as by renovating the toilet facilities of the school and improving its storm water drainage canals. This had the objectives of reducing groundwater pollution from the existing toilet discharges and reducing the foul odors and flood risks caused by the poor existing drainage and wastewater handling, thus promoting better health and dignity for the school children and monks.

For the third project at the AFC, the purpose was to improve the sanitation situation by installing a DEWATS for 16 toilets from the 2 dormitories, 2 toilets from the canteen, and 1 toilet from the guardhouse. This had the objective of reducing pollution in the nearby stream by eliminating the raw wastewater discharge that had been previously occurring, thus promoting better health for the downstream residents who rely on the water for their daily use.

Partners and Funding Distribution

For the first project in Thongkankham Village, the funding agency was the Japan International Cooperation Agency (JICA), with BORDA-LIRE being the executing agency and the local Public Works and Transportation Institute offering support during the process. The total project cost was $33,154USD.

For the second project in Khoualuang Primary School, the funding agency was again JICA, with BORDA-LIRE being the executing agency and the local Khoualuang Village Office offering support during the process. The total project cost was $36,168USD.

For the third project at the AFC, the funding agency this time was Helvetas, with BORDA-LIRE being the executing agency and the Agriculture and Forestry College offering support during the process. The total project cost was $25,000USD.

Project Activities

The first project in Thongkankham Village began in June, 2009, with construction beginning on 1 September, 2010. The project activities included: consultation with villagers and development of a community action plan for DEWATS, conducting health and hygiene education programs and health impact assessments in the community, construction of the DEWATS, connecting the toilets/showers/kitchens of 22 households and 1 noodle-making shop to the DEWATS via the existing septic tanks, renovating the toilets of 9 households, and training the community on operation and maintenance.

The second project in Khoualuang Primary School ran from October, 2009, until 22 December, 2010, with construction beginning on 31 September 2010. The project activities included: consultation with teachers and monks and development of a school action plan for DEWATS, conducting health and hygiene education programs and health impact assessments for the school, construction of the DEWATS, connecting the 14 school toilets and 3 temple toilets to the DEWATS, renovating the school toilets, improving the drainage piping for storm water in the area, and training the community on operation and maintenance.

The third project at the AFC ran from October, 2010, until April, 2011, with construction beginning on 17 December 2010. The project activities included: consultation with the staff, conducting health and hygiene education programs and health impact assessments for the school, construction of the DEWATS, connecting the 16 toilets from the dormitories, 2 toilets from the canteen, and 1 toilet from the guardhouse to the DEWATS, and training the staff on operation and maintenance.

Sanitation Technology / System

The basic technologies of the DEWATS used in all three of these projects are basically identical, with differences only in treatment capacity. This module of DEWATS used by BORDA-LIRE consists of the following sections, in order of wastewater flow: control boxes, grease trap, primary settling unit, anaerobic baffled reactor, anaerobic filter, and discharge pipe. Control boxes are valves placed at each connection from a toilet / septic tank to the main drainage line. 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.

The primary settling unit then serves as a wastewater retention point and an area for control of influent fluctuations (an equalization tank), which allows 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 two-chambered in all three projects.

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 – the Khoualuang and Thongkankham ABRs both have 6 chambers, while the AFC's has only 4 chambers.

The anaerobic filter (AF) follows the ABR and consists of a dual-chambered tank with a submerged layer of material like crushed gravel or specially formed plastic (BORDA-LIRE uses crushed mountain rock). 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. After the AF, effluent is usually considered clean enough for safe river discharge, or can be held in a separate tank for reuse in watering plants or flushing toilets.

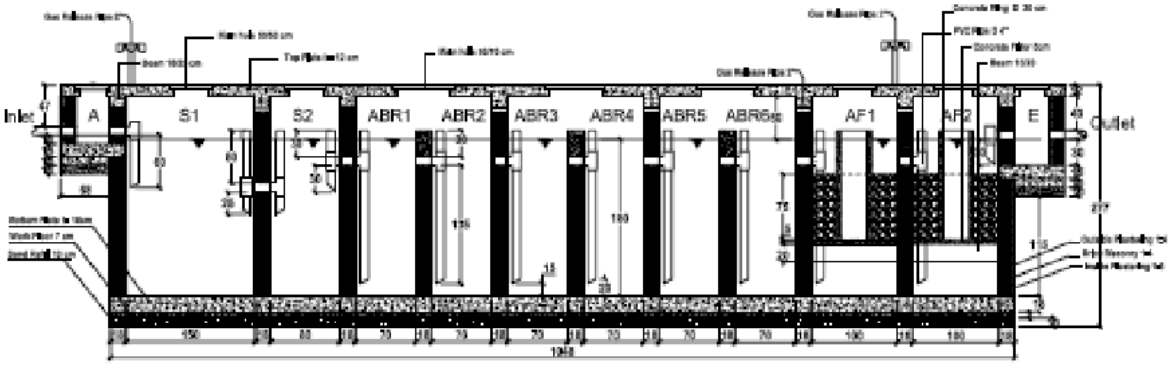

Figure 1. A cross section of the Khoualuang project's DEWATS, showing the 2 chambered primary settling tank, the 6 chambered ABR, and the 2 chambered AF, as well as influent and effluent piping (Not shown: control boxes and grease trap, which are further up the influent piping)

As mentioned previously, the main difference between the three projects was in the size of this DEWATS module installed. For the Thongkankham Village project, the system is able to treat 11.2m^3/day of wastewater. For the Khoualuang Primary School and Temple project, the system is able to treat 7m^3/day of wastewater. For the AFC project, the system is able to 15m^3/day of wastewater.

Number, Type, and Location of Beneficiaries

For the first project in Thongkankham Village, the DEWATS was connected to 22 households and 1 noodle-making shop, with approximately 146 total users. As well, 9 of the households also received toilet renovations, which make them the most direct beneficiaries of the project. The improvements made in wastewater management, however, extend beyond the 146 users, and other residents in the Village area will also benefit from the reduction in groundwater pollution, foul odor, and poor drainage.

For the second project in Khoualuang Primary School and Temple, there are approximately 116 students and monks who are now covered by the DEWATS. As well, since the project included renovation of the school toilets, the students will now be able to enjoy this additional benefit. The residents of the surrounding area will also benefit from the reduction of foul odor, groundwater pollution, and flooding from these nearby sanitation improvements.

For the third project in the AFC, there are approximately 128 students who will be living in the upgraded dormitories, while the canteen, which also had its toilets connected, serves approximately 80 people daily. The most direct beneficiaries of a less polluted stream, though, will be the residents living along it on its lower banks, who draw water from it for their daily use.

Impacts and Challenges

All three projects are now underway and being operated and maintained successfully by the community members of each project site. For each project, the funding grant was used to cover construction costs, community engagement costs, and initial water quality testing costs. In all three projects, a single operator was appointed from the community who is responsible for general operations and maintenance of the DEWATS. In all three projects, an O&M fee was therefore formulated with the community in order to cover the O&M costs, an allowance for the operator, and the costs of desludging the system every 2 to 3 years. In the Khoualuang and AFC projects, this fee is paid by the school itself (~50,000LAK per month for Khoualuang, no data yet available for the recently begun AFC), while in the Thongkankham project, the villager beneficiaries of the project agreed to a 5,000LAK per month fee to cover the estimated 70,000LAK per month O&M costs.

The water quality testing carried out upon the completion of each project indicates the efficient nature of the DEWATS design. The three projects, Thongkankham, Khoualuang, and AFC, had influent BOD and COD values (in milligrams per liter) of 970/540, 970/540, and 880/490, respectively, which do not comply with any national discharging regulations. However, the resulting effluent BOD and COD (in mg/L) after treatment at these three projects was 28/80, 23/65, and 36/91, which comfortably complies with the respective national standards of 200/400, 40/130, and 60/350, respectively, for these different types of projects. These values should continue given proper O&M and indicate that these projects were successful in their objective of treating the wastewater from these communities to reduce groundwater pollution, foul odors, and health risks.

Photos

Figure 2. Construction and community engagement at the Thongkankham Village project

Figure 3. Construction and renovated toilets at the Khoualuang Primary School project

Figure 4. Construction and completed works at the AFC project

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Laos
Decentralized Wastewater Treatment System & Desludging Service for Hin Heup Town
A GRET MIREP Pilot Project in Laos

Project Owner(s)	▪ District Authorities of Hin Heup & the Local Private Water Supply and Wastewater Operator
Project Partner(s)	▪ **Funding Agencies**: GRET (via grants from SEDIF, French Ministry of Foreign Affairs, AFD, and to a lesser extent the Municipality of Paris & UN-Habitat) ▪ **Executing Agencies**: GRET & Dept. of Housing and Urban Planning (DHUP) of the Ministry of Public Works and Transport (MPWT) ▪ **Cooperating Agency**: Water Supply Regulatory Office (WASRO), Vientiane Province
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Introduction and Background

The French NGO GRET, established in 1976, has a mission of fair international development, through designing and implementing field projects, providing expertise, conducting research, and running information and exchange networks for development issues, and currently works in 27 countries. As part of this mission, GRET professionals have taken on various water and sanitation projects in developing countries, including, since 2004, the Lao PDR.

The Lao People's Democratic Republic is a country surrounded by China, Vietnam, Thailand, Cambodia and Myanmar. In 2005, Lao PDR was below average in establishing sanitation access as compared to other Southeast Asian countries. In a study conducted by a Multiple Indicator Cluster Survey in 2006 (MICS III), it reflected a 44.8% coverage for those with improved sanitation (or 48%

cited by the UNICEF/WHO Joint Monitoring Program) as compared to the 67% average for all the Southeast Asian countries. In the same study, there are at least fifty-two percent (52%) of the Lao population without access to sanitation. This data equates to over three million Laotians living without improved sanitation - without an easily accessible, private and safe place to urinate and defecate. Furthermore, the growing population of Lao PDR needs to be taken into consideration while looking at the efforts to increase sanitation coverage.

Since 2004 until 2011, GRET has been undertaking a programme in Lao known as MIREP ("Mini Reseaux d'Eau Potable", i.e. "Small Scale Water Supply Networks"), which aims to improve access to safe water supply and sanitation in small towns through public-private partnerships and appropriate financing/technologies. One project of this programme aims to undertake a pilot of decentralized wastewater treatment system, using a small-scale sewer system and a non-mechanized wastewater treatment system, some technologies which are almost nonexistent in Laos.

The town chosen for this project was Hin Heup, a district capital with moderate economic profile located only two hours from the capital of Vientiane. With favorable topography for a gravity sewer system and with villagers willing to pay for simple sanitation services, the town was ideal for GRET's purposes. While 99% of the town's households already used pour-flush latrines, simple soak pits, rather than sealed septic tanks, were the norm, and only 24% of these households had desludged their pits when full (the rest simply built a new pit or had yet to fill their pit). As well, only 10% of households had any form of grey water collection. Overall then, the town had a relatively high risk of pollution of the groundwater and of the nearby touristic Nam Lik River, which threatened the environment and the sources of drinking water for the town's population.

Project Purpose and Objectives

For this project, the specific purpose was to improve the sanitation situation of Hin Heup town and provide a model pilot project for other Lao towns to learn from. This was done by installing a simplified sewer system, leading to a small-scale wastewater treatment plant (WTP), for 60 households of the town, while 300 more households began to receive local desludging service. The septage generated from this desludging service, as well as the sludge from the WTP, would be treated in new sludge drying beds. This had a two-fold objective: 1) to reduce pollution of water bodies from the poor existing soak pits and direct discharge of grey water into open canals; and 2) to provide cheaper and 'greener' desludging service, since existing desludging trucks usually empty the fresh fecal sludge in rivers or rice fields as soon as they leave the city. The overall objective was to promote better health and environmental protection for the town.

Partners and Funding Distribution

For this project, the funding agency was GRET, with funds for the overall MIREP programme supplied by grants from the French organizations SEDIF, the French Ministry of Foreign Affairs, AFD, and to a lesser extent the Municipality of Paris and UN-Habitat. As well, the local water supply operator, selected by public authorities to be operator of the waste water management service, provided some minor additional funding toward the project (a vehicle). GRET was the primary executing agency, together with the MIREP programme owner, the Department of Housing and Urban Planning (DHUP) of the Ministry of Public Works and Transport (MPWT). The WASRO (Water Supply Regulatory Office, of the MPWT) and the Provincial administration office and its relevant departments also supplied cooperative assistance and project approvals. The total project cost was approximately $61,000USD, with GRET supplying about $54,000 of that, the water operator supplying $5,000, and the remaining $2,000 coming from user connection fees placed on the residents.

Project Activities

The MIREP programme of GRET began in 2004 and will run until 2011, with this pilot project being one of its last activities. Under development for the last 2.5 years (as of April 2011), the project activities included: initial research investigations and surveys to establish the project idea and location, consultation and validation of the project with decision makers at local, provincial and central levels, capacity building with these decision makers, planning the project layout, user fees, and construction, signing a 10 year management contract between district authorities and the local water supply operator, constructing the WTP and sewer mains (completed in April 2011), connecting users (due to be done from May 2011) and starting the desludging service.

Sanitation Technology / System

GRET based their WTP system on Brasilian and Pakistani experiences in simplified sewers (documented by Dr. Duncan Mara) as well as on a simplified version of the BORDA DEWATS model. For the 60 household recipients of the simplified sewer system, the system consisted of the following sections, in order of wastewater flow: greywater & blackwater collection pipes, collection box, sewer (with manholes), primary settling unit, anaerobic baffled reactor, and discharge pipe. As well, sludge drying beds were constructed to treat the septage collected from the 300 households that would receive desludging services, as well for the sludge collected in the WTP itself.

The household collection piping consists of simple PVC pipe that is connected to the main greywater producing areas of the households and the toilets (thus bypassing the soak pits and ceasing their pollution inputs to the surrounding groundwater). These pipes merge at the collection box that is installed for each household before the pipe proceeds to the main sewer line, which then flows to the WTP. This sewer works by gravity, without pumps, meaning that all piping has to flow downhill to the WTP.

Once at the WTP, the primary settling unit allows large sludge, debris, and other floatable/visible wastes to settle or be screened out and also allows to distribute evenly the flows of wastewater to proceed to the subsequent chambers (through an opening throughout the tank's width). This unit is single chambered here.

The anaerobic baffled reactor (ABR) is then the main treatment area of the WTP. 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/volume, and funds – this unit uses 5 chambers, after which the liquid effluent is discharged to a nearby natural wetland, where additional natural treatment of organics can occur.

In a separate area of the site, two sludge drying beds, each 16m^2 in area, serve to dry – and therefore partially treat and reduce in volume – the sludge that will be regularly removed from the ABR, as well as all of the septage collected from the desludging operations by the local water supply operator. These beds are lined at their base with successive layers of large-grained sand, small gravel, coarse gravel, and then the natural soil base, with drainage pipes running through the coarse gravel layer. This will help act as a natural filter for all liquid from the sludge that drains down through the beds. Once dried, the sludge will be suitable to be used as a soil fertilizer. The drying time is estimated to be six months and the 2 beds allow one to be filled while the other is at rest for drying.

The WTP itself was designed to handle up to 30m^3/day of wastewater flow, which is the flow estimated in 15 years from the current 60 households and 4 small businesses (taking into account 2% population growth, a unit water consumption assumed at 100 liter per capita per day in 2015, and other technical factors).

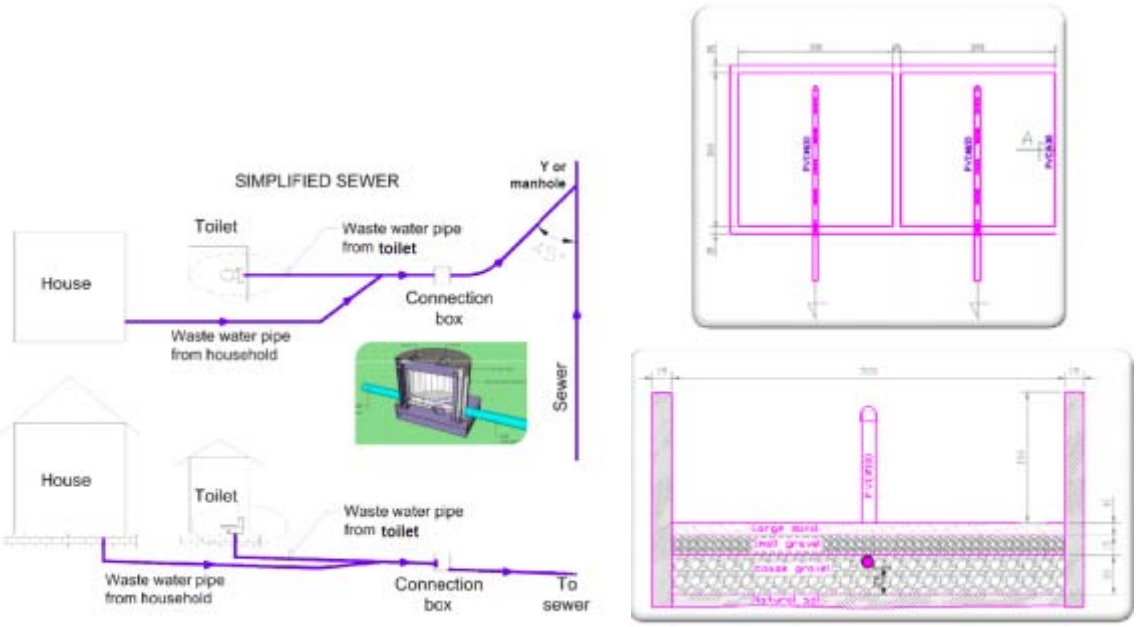

Figure 1. A schematic of the Hin Heup simplified sewer piping and an overhead view and cross-section of the sludge drying beds.

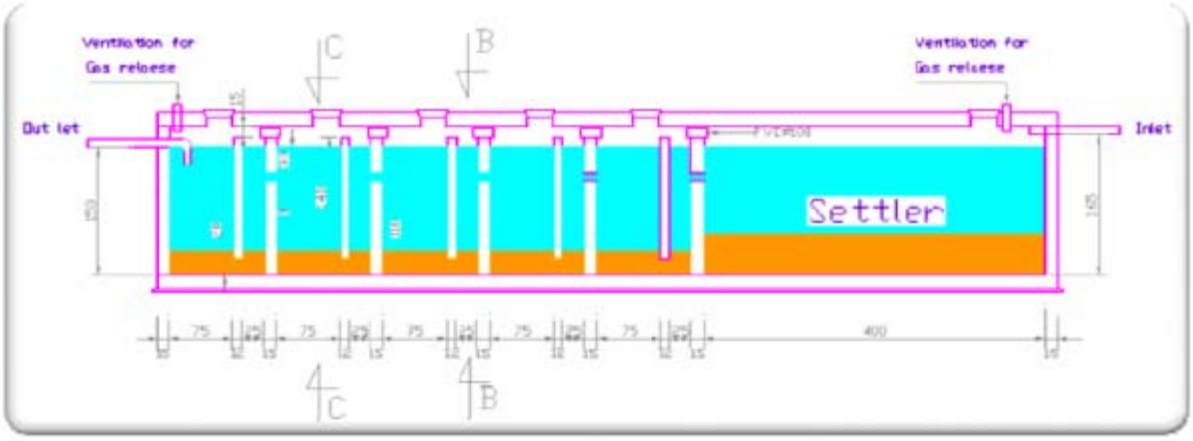

Figure 2. A cross-section of the primary settling unit and 5 chambered ABR of the WTP

Number, Type, and Location of Beneficiaries

For this project, the simplified sewer system is being connected to 60 households (approx. 300 people), while desludging service is being offered to a further 300 (approx. 1,500 people). This translates into approximately 1,800 residents whose wastewater will be better-managed as a result of this project. The improvements made in wastewater management, however, will extend beyond these users, and other residents in the town area will also benefit from the reduction in pollution of ground and surface water bodies.

Impacts and Challenges

This project is still in construction stages (main works to be finished in May 2011 and first connections expected in June 2011), so its quantitative impacts and O&M success cannot yet be judged. Once complete, the local wastewater operator will operate and maintain the facility and perform desludging services for at least the 10 year duration of the initial management contract. It is estimated that O&M will cost around $40/month for labor and $40/month for maintenance. The WTP itself will be very low maintenance, essentially requiring only the desludging of the ABR every 2-3 years.

For this project, the funding grant was used to cover design and monitoring costs, the WTP construction, equipment for the desludging service (the private operator shall bring in its own vehicle/small truck or local tractor), and other consultation and engagement costs. To ensure project sustainability, a connection fee and a user fee were formulated in consultation with the locals to cover the O&M costs as well as part of the project cost. Each household being connected to the sewer system is being charged a connection fee of ~$30USD, followed by a fixed monthly user fee of ~$1.30USD. For those households receiving desludging services, they will be charged a fee of ~$20USD for each desludging, which is lower than it previously was before this project began (at least ~$50USD for desludging trucks coming from Vientiane). It remains to be seen whether the residents will all be willing to use this desludging service or will prefer alternative options such as digging another pit or paying the modern but expensive vacuum truck services coming from other cities. As well, institutional incentives or laws in place shall play an important role.

It should be noted as well, that, in terms of water quality of the WTP, the effluent will still not be particularly clean upon discharge. This is because the system is more simple than any comparable BORDA model, which follows the ABR with other treatment units. It will nevertheless still make the wastewater cleaner than it was as influent, and its subsequent discharge to a nearby natural wetland (natural ditch leading to a small pond before going to the Nam Lik river) should serve as effective additional treatment. It remains to be seen whether the effluent quality will meet national discharge standards.

Overall, the 60 households on the sewer will have much better-managed wastewater, as their greywater and blackwater will all be treated, while the 300 households with desludging service will have better-managed wastewater. While their greywater will still not be treated and they are still relying on soak pits for their latrines, these soak pits will at least be desludged regularly, which means that the septage will not soak too thoroughly into the soil before it is removed. Improvements are expected as regards quality and sustainability of the sanitation value chain, with local services financially accessible: households connected to sewer won't have to desludge their pits anymore and all other households will access a cheaper and 'greener' local desludging service Thus, assuming construction and implementation finish as planned, it can be said that this project will serve as useful pilot project for the area, reducing pollution of water bodies and the associated health and environmental issues that go with it. It will also be a useful first reference for the country in terms of simplified sewer and local desludging service. The lessons learned from the project will hopefully allow other interested NGOs and Lao public authorities to implement further decentralized wastewater treatment projects and local desludging services in the future.

Photos

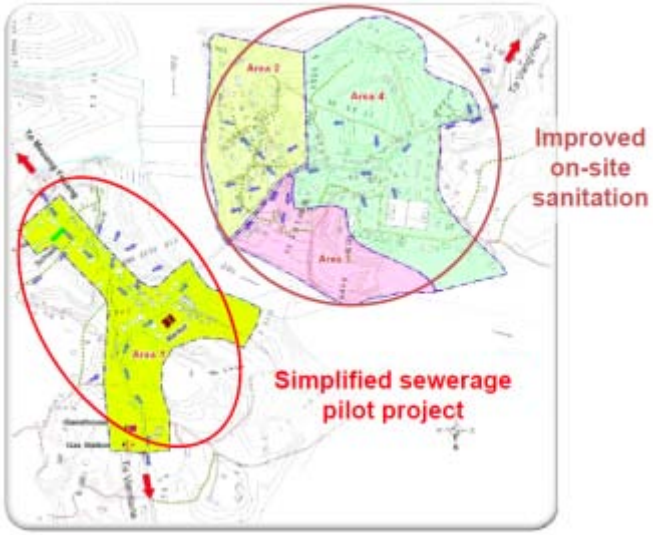

Figure 3. Basic sanitation mapping of Hin Heup town, though any household can benefit from the desludging service

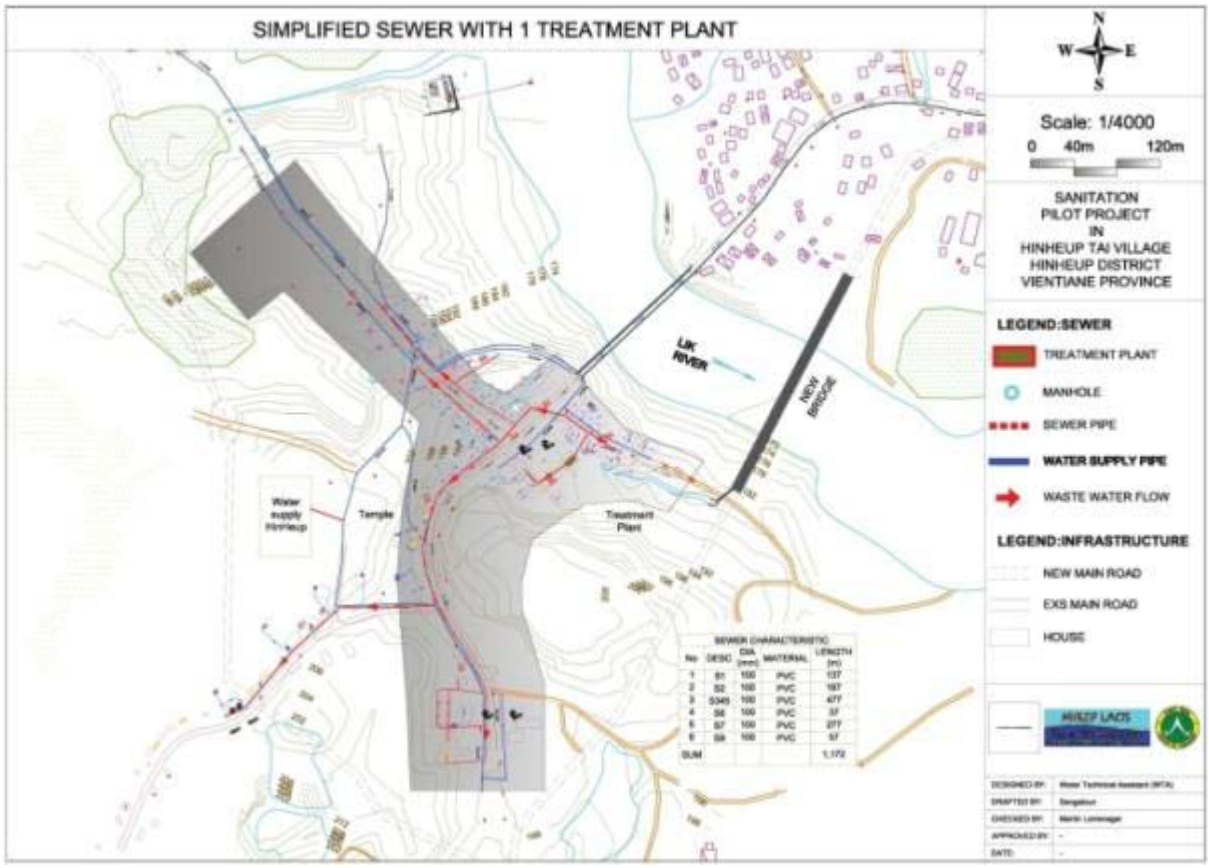

Figure 4. A detailed map of the simplified sewer and WTP in Hin Heup town

Figure 5. Photo of the construction of the simplified sewer (left) and a manhole along its path (right)

Figure 6. Photo of the completed WTP (left) and the sludge drying beds under construction (right)

References

GRET. (2011). "Hin Heup Waste Water Project: Project Overview". PowerPoint presentation given at the *Phnom Penh Sanitation Workshop, 16 Feb. 2011.*

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