



Fig. 1: Project location

## 1 General data

### Type of project:

Rural upgrading (pilot project)

### Project period:

Start of planning: June 2005

Start of construction: Nov 2005

Start of operation: Jan. 2006

Phase 1 started June 2005 and is still on-going

Phase 2 started in April 2008 and is on-going

### Project scale:

Phase 1: 40 UDD toilets planned in 28 barangays/  
villages (approx. 220 people or 5.5 people per  
toilet)

End of 2008: UDD toilets at 22 households  
(household size: 5-6), 1 rural health centre, 6  
barangay agricultural development centres in  
operation

Phase 2: UDD toilets for schools (planned number not  
yet known);

End of 2008: 8 UDD toilets completed

Project budget (provided by Bayawan City):

Phase 1: € 10,000

Phase 2: € 25,000

### Address of project location:

Private households and public institutions in the rural areas  
(barangays) of Bayawan City

### Planning institution:

City of Bayawan, Philippines

### Executing institution:

Same as planning institution

### Supporting agency:

DILG-GTZ Water & Sanitation Program (technical  
assistance only)

(DILG is Department of the Interior and Local Government,  
Philippines, GTZ is German Development Cooperation)

	biowaste	faeces/manure	urine	greywater	rainwater
collection		Urine-diversion dehydration toilets	Urine-diversion dehydration toilets		
treatment		Dehydration through storage for 12 months	Storage in closed container		
reuse		Soil conditioner in agriculture	Fertilizer in agriculture		

Fig. 2: Applied sanitation components in this project

## 2 Objectives and motivation of the project

The objectives of the pilot project were:

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

Note: The focus of this document is on Phase 1 of the project (Phase 2 is only mentioned for completeness).



Fig. 3 House of a family with a UDD toilet, barangay Villareal, Bayawan City, 2006 (source: DILG-GTZ Program)

## 3 Location and conditions

Bayawan City is located in the south-western area of Negros Island in the Central Visayas region, about 700 km southeast of Manila. It has a population of about 105,000. The city has 7 barangays<sup>1</sup> that are classified as urban and sub-urban areas, and 21 barangays that are classified as rural. 80% of the

<sup>1</sup> Barangay is the smallest administrative division in the Philippines.

population of Bayawan lives in these rural areas which cover 83% of the land area.

The project is located in these rural areas (barangays) of Bayawan City. The people there are engaged in self-employment activities such as farming, fishing or trading activities. In the rural areas the vast majority of the households live of farming, either as tenants of big landowners or on their own small farms. The residents in this region are predominantly Christians.

In the project area only 10% of the population are served with safe drinking water. The majority relies on dug wells and springs. Only 1 % of the rural population has a household water connection (piped water). 63% of the households have a toilet. These are mainly pour-flush toilets with a pit or pit or VIP latrines. However, many of these facilities are in poor condition and are considered unsanitary. A common problem is the lack of water for the pour-flush toilets. In most schools the service level standard of 40 students per toilet is not met. In Bayawan City only 26 % of the students are adequately served with school toilets.

Due to these conditions, water and food borne diseases, i.e. diarrhoeal diseases, are among the leading causes of morbidity. In addition more than 50 % of school children are affected by intestinal worm infections.

#### 4 Project history

The concept of ecological sanitation was introduced to the Visayas and Mindanao regions of the Philippines through the "1st International Symposium on Low Cost Technology Options for Water Supply and Sanitation" in September 2004 in Bohol. This conference was organized by the DILG-GTZ Water & Sanitation Program and the WSP (Water & Sanitation Program) of the World Bank. DILG is the Department of the Interior and Local Government in the Philippines.

The City of Bayawan attended this symposium and a group of German and Philippino experts visited Bayawan City after the conference to conduct an assessment. Two wastewater management and sanitation options were identified: a constructed wetland for domestic wastewater of a peri-urban resettlement area (see separate SuSanA case study description) and a dry sanitation concept for the sparsely populated rural areas (described in this document).

In June 2005, Bayawan City and the DILG-GTZ Water & Sanitation Program signed a Memorandum of Agreement for the planning and implementation of the ecological sanitation pilot project. An ecosan technical working group (ecosan TWG) was set up by Executive Order of the City Mayor. The ecosan TWG is a multi sectoral group chaired by the City Health Officer and composed of 10 employees from the engineering, environmental, health and agricultural offices of Bayawan City.

In September 2005, members of the ecosan TWG attended the "First ecosan Training for Rural Areas in the Philippines", organized by the DILG-GTZ Water & Sanitation Program. After the training, the ecosan TWG began with the planning process. The project started with two pilot toilet facilities,

namely one single-vault UDDT<sup>2</sup> with movable container and one double-vault UDDT in two different coastal barangays.

Assisted by the Community Organizer and the Technical Adviser of the GTZ Program, the TWG developed a work plan, conducted a series of stakeholder workshops and identified the two target households. Construction started in November 2005 and the facilities were turned over to the users in January and February 2006.

After a short trial period, the actual Phase 1 of the project began. It was decided to set up 1 to 2 pilot facilities in each of the **28 barangays** of Bayawan City, resulting in a total of **40 UDD toilets**. The target households and public institutions were selected through baseline surveys, interviews with selected families and in consultation with the barangay officials.

In April 2008, the City of Bayawan has started a second phase with a budget of € 25,000. Based on the experience from the previous phase, the second phase focuses mainly on schools and on selected households that can afford to cover the cost for construction material.

The implementation of Phase 1 and Phase 2 is in progress and by the end of 2008, 37 facilities had been completed: 22 in private households, 1 unit in a barangay health centre, 6 units in barangay agricultural development centres (BADC) and 8 units in 4 schools.

The DILG-GTZ Water and Sanitation Program and the GTZ-Philippines did not directly contribute cash to this project, but provided the two ceramic urine-diversion pedestals for the first two toilets and in-kind support such as posters about "Do's and Don'ts". Technical support comprised of several trainings and stakeholder workshops, joint monitoring and general support via staff time.

#### 5 Technologies applied

The ecosan technical working group of Bayawan City decided to use UDDTs because of their comparably easy maintenance and the quick benefit that is generated through the direct use of urine as a fertilizer. Furthermore a dry system is preferred because the majority of households has no piped water supply but has to get water from communal wells or standpipes.

Sanitation technologies applied are single- and double-vault urine diversion dehydration toilets (UDDT) which have a ceramic urine diversion toilet pedestal (see Fig. 4). The urine is drained through a plastic pipe and stored in 20-liter plastic containers. Most toilets have a separate waterless urinal for men made of old 4-liter plastic bottles.

The collection vault for the faeces is made of concrete hollow blocks with concrete floors and slabs. The single-vault toilets have mobile collection containers. The toilet rooms (super-structure) are made of different materials, ranging from bamboo mats to split bamboo and ply wood.

<sup>2</sup> UDDT = urine-diversion dehydration toilet (some people call this also "ecosan toilet").



**Fig. 4** Ceramic urine-diversion toilet pedestal, inside of the toilet house shown in next figure (source: DILG-GTZ Program; see also supplier's website: [www.ecosan.ph](http://www.ecosan.ph))



**Fig. 5** Single vault UDDT, barangay Villareal, Bayawan City, 2006 (source: DILG-GTZ Program)

The vast majority of rural households uses firewood for cooking, which means they have ash available. After defecation the faeces are covered with the ash to enhance the drying process and for optical reasons. In cases where no ash or not sufficient ash is available, carbonized rice hull<sup>3</sup> is used.

About 90 % of the users practice dry cleaning with toilet paper, old paper or other material. For those users which practise anal cleansing with water, all toilets have an anal cleansing area next to the toilet pedestal.

The anal cleansing water is drained into a plant box filled with gravel and soil, which is made of concrete and is attached to the collection vault. The plant box functions as a planted soil filter. Since there are no household water connections, the water used for anal washing is provided in a plastic container.

All toilets have a handwashing basin either inside or outside the building. The used water is drained into the plant box as well.

## 6 Design information

The double-vault UDDTs were designed for households with 5 to 6 members and a 12-month storage time for the faeces. The required faeces storage vault volume per person was estimated at 110 liters. Based on these design parameters, each faeces collection vault has a storage capacity of 0.7 m<sup>3</sup>.

The single-vault toilets with mobile collection containers have a faeces vault volume of about 1 m<sup>3</sup>. The collection containers consist of used plastic or steel drums equipped with bin liners. When the bags are full they are stored in the vault next to the container or in another safe place if the vault is full.

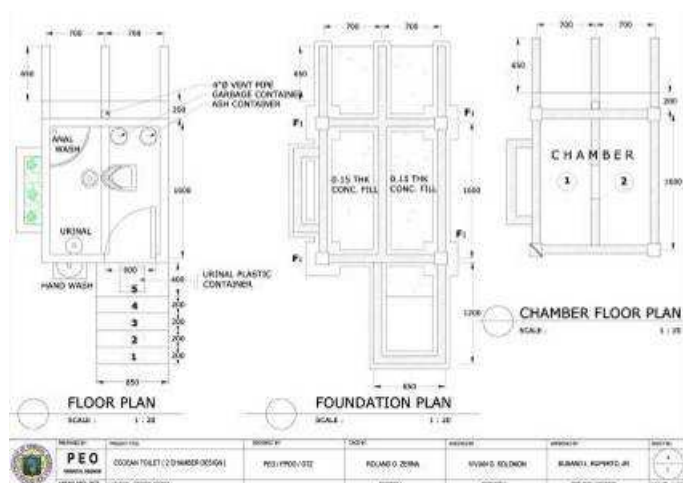
The size of the urine container is limited by the space that is available below the toilet stairs (see Fig. 9). The urine containers vary in size: Most UDDTs have a 20-liter container which was shown to last a family of 5 for about one week. If the urine of 2 adults and 3 children was collected for one week at 1.25 L per adult per day, and half the amount for a child, this would result in 30 L of urine per week. But in farmer families people are often out in the fields, and urinate in the open and hence, less urine is collected. Moving the 20-L container is not too difficult, especially not for people who are used to physical work such as farmers.

The UDDTs are all built entirely above ground to facilitate high temperatures in the vaults and thus accelerating the drying process. Therefore the buildings have a small staircase. The number of steps varies, depending on the individual design. The standard design has 4-5 steps of 20 and 25 cm width and height, respectively.



**Fig. 6** Single-vault UDDT, technical drawings (source: Provincial Engineering Office, Negros Oriental, 2007)

<sup>3</sup> Carbonized rice hull is made by partly burning rice hulls so that the hulls keep their texture and do not turn into ash.



**Fig. 7** Floor plan double-vault UDDT (source: Provincial Engineering Office, Negros Oriental, 2007)

Both UDDT types have access hatches for the faeces vaults which are at an angle and made of black metal to attract heat. The big doors make it easy to spread the faeces and empty the collection vaults. Ventilation is provided through ventilation pipes at the back of the building. The pipe is usually made of PE and 20 cm in diameter. It starts in the vault and reaches up to 0.3 m above the roof. The openings are covered with fly screens to prevent insect infestation.

The faeces collection vaults of both toilet types are made of concrete hollow blocks with concrete floors and slabs. The storage space for the urine storage containers is under the stairs and easily accessible through a separate door.

The toilet pedestals are made of sanitary ceramic which is easier to maintain than concrete pedestals. The pedestals were purchased through a manufacturer in Luzon (Centre for Advanced Philippine Studies, CAPS – [www.ecosan.ph](http://www.ecosan.ph)), who is the only producer of ceramic UDDT pedestals in the Philippines so far.

The toilets are also equipped with waterless urinals for the men because they prefer the urinals instead of the UDDT pedestal for urinating. The urinals are made of old plastic bottles. The drainage pipes for the urine have a sufficient slope to drain completely. Thus urine odour can be kept at a minimum.

The toilet super-structure (“house”) is made of different materials. The material is chosen by the household and depends on availability and affordability. Thus the material ranges from split bamboo to plywood for the walls and GI galvanized steel sheets to palm leaves for the roof.

All UDDTs were built as outdoor toilets. The main reason for this was that the users felt at the beginning more comfortable with this conventional setting. Many users were concerned about insects and bad odours as it is known from simple pit latrines. Future UDDTs could also be built indoors.



**Fig. 8** Inside a UDDT, barangay San Miguel, 2008 (source: DILG-GTZ Program). Note waterless urinal on the left. Area for anal washing in the far left corner.



**Fig. 9** Urine container, UDDT in barangay Villareal, 2007 (source: DILG-GTZ Water and Sanitation Program)

## 7 Type of reuse

The use of human faeces as a fertilizer has no tradition in Bayawan. However, many households have practiced the use of urine as a fertilizer for a long time. It is usually collected in vault pots. In the morning the urine is diluted with water and directly applied as fertilizer.

At the beginning of the project the ecosan technical working group informed the households about the benefits of using urine and dried faeces for crop production.

The information campaigns during project implementation included training sessions on the safe use of dried faeces and urine. Households with a double-vault UDDT store the faeces in the vaults for 12 months and use it directly as soil conditioner around fruit trees as well as for corn and rice fields. The faeces of the single-vault UDDTs are either stored

for 12 months as well or are composted after 6 months in the composting facilities of the city (barangay agricultural development centres) before it is used<sup>4</sup>.

The urine from the UDDTs is usually directly used (without any storage period). The farmers dilute one part of urine with 3 to 5 parts of water and use it as fertilizer for rice, certain vegetables and ornamental plants as needed.

The farmers reported that plants grow better than before. Since the majority of farmers have no money to buy commercial fertilizers, the fertiliser from the ecosan UDD toilets is perceived as a big advantage.

The Periurban Vegetable Project of Xavier University in Cagayan de Oro, Mindanao, which is a partner of the DILG-GTZ Program, has carried out various research projects on treatment and reuse of faeces and urine (see <http://puvep.xu.edu.ph/> and also the separate SuSanA case study description).

## 8 Further project components

The project put a strong focus on active household participation during the planning and implementation stages. It started with information campaigns on health, hygiene and sanitation, which included discussions of the existing situation.

The planning phase included baseline surveys of the project area, a series of stakeholder workshops and household interviews to generate interest, confirm the commitment of the selected households and to agree on design parameters.

The households were involved in the construction process by providing building material and assisting the construction workers in the construction of the toilets. Thus local people were trained in UDDT construction.

Training sessions in maintaining the UDDTs and in practices of safe reuse constituted further important aspects of the implementation phase. Once the toilets were completed, the project team conducted household visits to monitor the use of the toilet and the reuse practices.

Monitoring activities throughout the entire project phase are an integral part of the project cycle. They made it possible to improve the design, mitigate construction errors and to ensure that the households maintain their new toilet facilities properly and are encouraged to apply safe reuse practices.

A short monitoring visit to observe of the proper use and operation of UDDTs is usually conducted a couple of weeks after the users begin to use the facility. A more comprehensive monitoring is conducted after several months of operation. This includes technical aspects (maintenance, functionality) as well as the general perception of the users, their satisfaction with the ecosan system and reuse practices.

Until the end of 2008, monitoring was conducted by members of the ecosan technical working group (TWG) with support of

<sup>4</sup> Unfortunately, Bayawan city does not monitor the amount of compost produced from this facility.

GTZ-Philippines personnel. From January 2009 onwards, monitoring of new facilities will be done by the ecosan TWG only.



**Fig. 10** Construction of a double-vault UDDT, barangay Narra, 2007 (source: DILG-GTZ Program)

## 9 Costs and economics

The capital costs for the two types of UDD toilets are shown in Table 1 below. Attempts were made to reduce the costs through a modified design. However, especially for the single-vault UDDT, the cost could only be reduced by about 16% by choosing cheaper materials for the super-structure.

**Table 1:** Budget with cost breakdown of UDDT units in this project (including material and labour cost)

Item	Cost (€)	
	Single-Vault	Double-Vault
Material super-structure	60 – 85	60 – 85
Material sub-structure (including piping)	120 – 170	180 – 200
UDDT ceramic pedestal	15	15
Labour cost <sup>a</sup>	70 – 90	90
<b>Total</b>	<b>285 – 340</b>	<b>345 - 390</b>

<sup>a</sup> Actual labour cost might have been lower

The costs are so high that most low-income households cannot build UDDTs without external funding. Currently the City of Bayawan funds the substructure (collection vault), the pipes and the toilet pedestal. The households contribute around 30 % of the construction costs through material for the super-structure and unskilled labour.

Bayawan City allocated approximately € 10,000 for the first phase of the ecosan project. The budget included costs for the planning process, i.e. social preparation and construction costs for the substructures. The planning process (social preparation) consumed about 40% of this budget.

This means that the 22 UDD toilets were built with approx. € 6000 equating to approx. € 272 per toilet. Bayawan City used a lot of surplus material from other construction projects for the UDDTs and the real labour costs might have been lower than in the cost calculation shown in Table 1.

For Phase 2 Bayawan City allocated € 25,000 for school toilets. So far 8 units in 2 schools have been completed. The target number of schools and toilets has not yet been published. If the costs per toilet were the same as in Phase 1, and 60% was again used for hardware, then about 55 UDD toilets could be built in Phase 2.

The costs for operation and maintenance have not been monitored. However, the time spent for providing ash, carbonised rice hull and water for handwashing as well as the cleaning of the toilet (emptying the urine container and the faeces vault) was conservatively estimated as € 5 per year. This figure includes € 1 contingency in case people have to pay for the carbonized rice hull. At the moment it is still for free.

## 10 Operation and maintenance

Operation and maintenance include keeping the toilets clean, covering the faeces after defecation with carbonised rice hull or ash, and monitoring the urine and faeces levels in the collection containers and vaults. The faeces are spread in the vault from time to time to enhance the drying process. All these tasks are done by the households themselves. In the barangay agricultural development centres and the health centre the facilities are maintained by the staff.

The results of the comprehensive monitoring showed that the vast majority of users is motivated and able to operate and maintain their UDDTs properly. However, in some cases additional instructions were necessary. This was mainly the case with families who had undergone the training several weeks before the facilities were completed and the first monitoring visit had been delayed.

A number of completed facilities were only monitored for a few months after completion. Some of these UDDTs had not been used at all because the households didn't feel confident to use the new facilities. Refresher trainings resolved the problem and the vast majority of facilities are used and well maintained at the time when this document was last updated.

## 11 Practical experience and lessons learnt

Intensive social preparation through stakeholder workshops and recurring household visits ensured that the future users participated right from the beginning in the planning and implementation processes.

Training sessions on operation and maintenance as well as on safe reuse practices were part of the implementation process and prepared the households for the new concept.

All UDDTs have a poster with Do's and Don'ts in picture format. However, households needed refresher training in operation, maintenance and reuse when the time between training and completion of their facility was too long.

The planning and implementation process took much longer than originally planned because the project area covered all rural barangays of Bayawan City. Each pilot site covered only

one to two families. This made especially the planning process with its numerous social preparation activities very time consuming and expensive for the city administration.

Monitoring visits by the ecosan technical working group (TWG) ensure that the users can discuss issues and ideas with the members of the ecosan TWG. The ecosan TWG uses the information for the ongoing ecosan activities.

The comprehensive monitoring of the GTZ program showed that most users and the city government prefer *single vault* UDDTs with mobile container (rather than double-vault UDDTs). The users state that is more pleasant to use and maintain. For the city government the lower cost are an important advantage. For the schools, the single-vault with mobile container is the better option because the storage volume for faeces is more flexible with this system.

## 12 Sustainability assessment and long-term impacts

A basic assessment (Table 1) was carried out to indicate in which of the five sustainability criteria for sanitation (according to the SuSanA Vision Document 1) this project has its strengths and which aspects were not emphasised (weaknesses).

The technology was assessed as easy to use during the monitoring in late 2008 and early 2009, and especially the easy reuse of urine was considered a strong point.

With regards to long-term impacts of the project, the main expected impact of the project is lower disease and parasite infestation (intestinal worms).

Water pollution is not an issue here because of the hydrological conditions in the project area.

At least the 220 people who will have UDD toilets at the end of Phase 1 will be positively affected by the project. But, more importantly, it is the expectation that this concept and technology will be copied by others who see the UDD toilets and understand their benefits. This should particularly occur with the UDD toilets located at the rural health centres and the barangay agricultural development centres.

**Table 2:** Qualitative indication of sustainability of system components. A cross in the respective column shows assessment of the relative sustainability of project. (+ means: strong point of project; o means: average strength for this aspect and – means: no emphasis on this aspect for this project).

Sustainability criteria:	collection and transport			treatment			transport and reuse		
	+	o	-	+	o	-	+	o	-
• health and hygiene	X			X			X		
• environmental and natural resources	X			X			X		
• technology and operation	X			X			X		
• finance and economics		X			X		X		
• sociocultural and institutional	X			X			X		

### 13 Available documents and references

Some of the documents listed below are available on <http://www.watsansolid.org.ph/>. Those which are not on this website can be obtained via the PEN (Philippine Ecosan Network) Yahoo Group. Robert Gensch from CIM at Xavier University has taken over the administration of this group in Feb. 2009 (robert.gensch@web.de).

- DILG-GTZ Water & Sanitation Program (2004) 1st International Symposium on low cost technology options for water supply and sanitation, September 2004
- DILG-GTZ Water & Sanitation Program (2005) Ecosan potential for Bayawan, Anne Kleyboecker, January 2005
- City of Bayawan, Office of the City Mayor (2005) Executive Order No 2005-20, Creating the ecological sanitation technical working group for the implementation of the ecosan project of Bayawan in cooperation with the German Technical Cooperation Agency, June 2005
- DILG-GTZ Water & Sanitation Program (2005) 1st ecosan training for rural areas in the Philippines, September 2005
- Provincial Engineering Office Negros Oriental (2006) Technical Drawings for double and single vault UDDT, February 2006
- Bayawan City (2007) Bayawan City adopts ecosan as a tool for health and environmental management, Mayor Herman P. Sarana, presented at International Conference on Sustainable Sanitation, Dongsheng, China, 28 August 2007, <http://www.ecosanres.org/icss/proceedings-presentations.htm> (under: 28 August 16:00-17:30, Room #2)
- DILG-GTZ Water & Sanitation Program (2008) Project Report on Monitoring of ECOSAN Urine Diversion - Dehydration Toilets (UDDT) in Southern Philippines, Philippines, Imelda Balbuena and Ulrik Lipkow, February 2009<sup>5</sup>

<sup>5</sup> The final report is not yet complete. However, most of the information for this case study is based on data from the last

- DILG-GTZ Water & Sanitation Program (2006 and 2008) Guideline for planning and implementing ecosan projects in rural and peri-urban areas of the Philippines, Bianca Gallinat and Ulrike Lipkow, December 2008

### 14 Institutions, organisations and contact persons

Office of the City Mayor, City Hall  
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Web: [www.watsansolid.com.ph](http://www.watsansolid.com.ph)  
Note: this project will finish in July 2010.

**Supplier of ceramic UD toilet pedestals:**  
Ecosan Philippines  
c/o Centre for Advanced Philippine Studies  
[www.ecosan.ph](http://www.ecosan.ph)

**Case study of SuSanA projects**  
**Urine-diversion dehydration toilets in rural areas, Bayawan City, Philippines**  
**SuSanA 2009**  
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monitoring trips and the draft report. The report will be available in March 2009 either through PEN or the DILG-GTZ program website.