CAMBODIA

Case Study 2: Floating Community Ecological Sanitation Project on the Tonle Sap Lake

Project Owner(s)	▪ Phat Sanday floating communities on the Tonle Sap Lake, Cambodia
Project Partner(s)	▪ Live & Learn Environmental Education Cambodia (L&L) ▪ Engineers Without Borders Australia (EWB) ▪ Ministry of Rural Development (MRD) ▪ Phat Sanday Community ▪ Science and Technology Innovations for the Base of the Pyramid in Southeast Asia (iBoP Asia) ▪ Resource Development Institute Cambodia (RDI) ▪ Royal University Phnom Penh (RUPP) ▪ EEP Mekong
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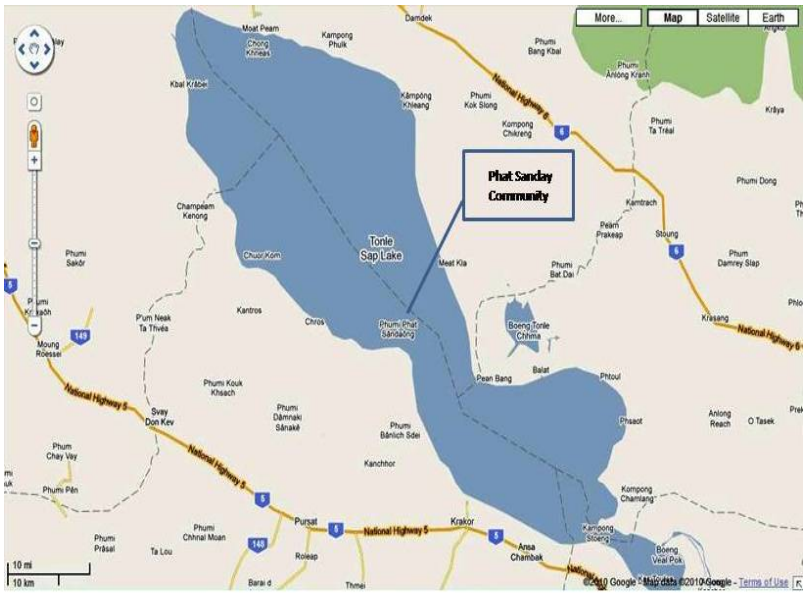
Introduction

Water and sanitation are some of the most pressing issues facing people in rural Cambodia, and they are even more difficult to access for people that live in floating and flood-affected communities on Cambodia's waterways. Human development in the country is still restrained by pollution and poor health, yet there is a lack of appropriate options for addressing these issues and managing sanitation. The end result is that human excreta is disposed in the environment leading to the contamination of waters, soils and dust, thus adding to the burden of diseases. In an attempt to find an innovative solution to the sanitation issues in Cambodia, the Live & Learn Environmental Education Cambodia (L&L) partnered with Engineers without Borders (EWB) to develop technologies suited for the floating communities of the Tonle Sap Lake, Cambodia.



This case study illustrates floating toilets and floating biodigesters developed as affordable sanitation options for the floating communities.

Background

The project is located on the Tonle Sap Lake, Cambodia's largest lake, with an initial focus in Phat Sanday Commune, Kampong Thom Province for trials and demonstrations. For communities on and around the Tonle Sap Lake and other waterways in Cambodia, there are a number of physical limitations due to the challenging environments of floating villages, flood-affected areas, and marginal riverbank areas. There are no currently affordable sanitation options available for these floating and stilted communities, so they are left with no choice but to urinate and defecate directly into the lake contaminating the waters that are the major source of their daily subsistence, including drinking, washing, bathing, and fishing. As a result, the households are exposed to a range of pathogens and residents in the floating communities suffer from diarrhea and other water-borne diseases.

Objectives

In response to this situation, Live & Learn Environmental Education Cambodia and Engineers Without Borders Australia have been in partnership since 2008 to develop affordable, sustainable and appropriate technology for this problem faced by the floating communities on the Tonle Sap. The focus of the project is to develop innovative technologies and practices for the human waste management for the floating communities and then demonstrate these in a method that provides an incentive for the community to take up improved sanitation by generating social, economic and environmental dividends for the floating communities.

Beneficiaries

The project's initial target is for the surrounding floating communities of Tonle Sap Lake in Cambodia. After assessment and evaluation, the Phat Sunday Commune in the Kampong Thom Province was selected as the first beneficiary of the project. Phat Sanday can be reached by boat from Chhnok Trou and is about 30 minutes across the Tonle Sap. Chnnok Trou is the central port where supplies arrive from and goods are transported to. There are a number of river tributaries of the Tonle Sap, one of them the Stung Sen River where the majority of the villages of the Phat Sunday Commune take haven. The communities are predominantly fishing communities, although during the low water season, the villagers take the opportunity to build their houses and plant crops such as corn.

After demonstrating the technologies, work will focus on scaling up the solutions and implementing them in other communities, as well as disseminating the knowledge to encourage uptake and adaptation by other communities and organizations. The emphasis is on establishing solutions that will be desired by the community and encourage local investment.

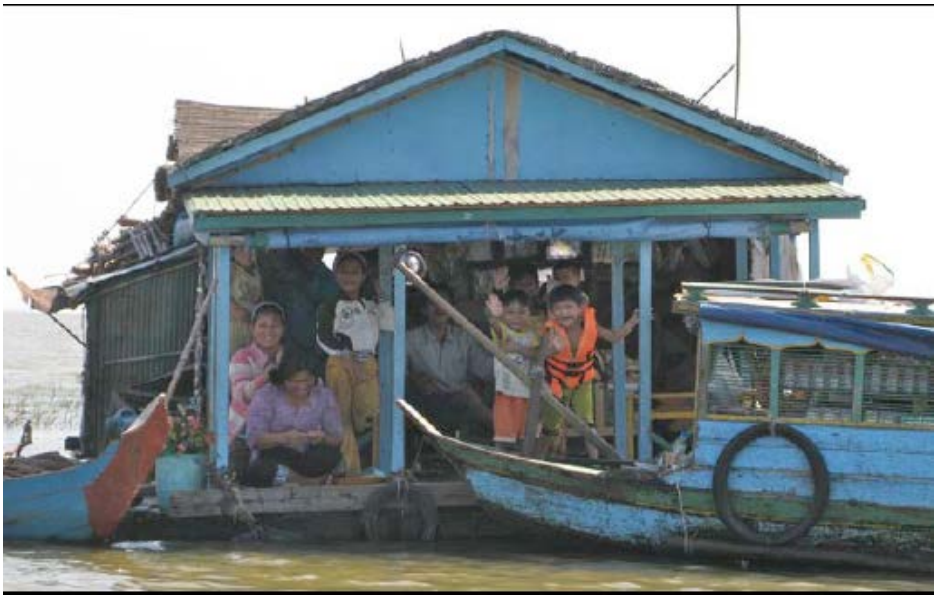


Figure 1: An example of a typical floating house in Phat Sanday (photo courtesy of Michael Brown, et.al)

Sanitation Technology / System

The development of the floating toilet design was initiated by Live & Learn Environmental Education and Engineers without Borders Australia (EWB) in consultation with the community. Participation of the community through field surveys and focus groups was central to the design process. The first design and trial floating toilet was tailored as affordable, low cost technology and would become the basis for a broader and holistic approach to sanitation in floating communities in Cambodia. The EWB team conducted a thorough review of existing sanitation options around the world. Upon thorough review, Urine Diversion Desiccation (UDD) was chosen as the most preferred and appropriate solution for the floating communities. This system separates the waste streams using a dedicated toilet-pan, and stores and treats the waste until it is safe to reuse or dispose. An initial trial was undertaken using this approach.

After the initial trial, a UDD floating toilet was then designed and developed using locally available materials from the community. A manufacturing technique was also developed in collaboration with EWB and RDIC in Cambodia. The uptake of the toilet has been controlled and carefully monitored in order to verify the suitability of the system.

In addition to a UDD toilet, the project is also taking the novel approach of developing floating biodigesters. Biodigesters are well established for land-based communities in Cambodia and numerous other locations, however current designs are unsuitable in these water-constrained communities. A number of modifications are required to adapt biodigestion to the floating communities, but the benefits of methane gas for cooking and light, as well as natural fertilizer, are expected to make sanitation a much more appealing option.

A major goal of the project has been to develop the system on the principals of ecological sanitation, creating a closed nutrient cycle by reusing treated waste for agriculture. As such, there is also investigation into how to apply the resources and ways to increase yield, such as ‘floating land’.

Floating Toilet Design

The pan is a custom-made urine-separating squatting pan fabricated by combining cement with other locally available materials. It was thought to be better to produce this locally rather than importing a latrine pan, to empower the community to improve their own design and open local market opportunities for the locally designed latrines.

The pan is needed to separate liquids from feces in order to enable desiccation as the most efficient method for the destruction of pathogens. The community members are currently using water for hand washing and anal cleansing after defecation, so there is an additional requirement for the disposal of wash water.

The pan has 3 holes; one hole is used to divert urine away from the feces hole, a straight hole for feces, and a large pan area and hole for wash-water. The pan is preferably lightweight, and can also be carefully designed making it a strong structure, scratch resistant, lightly colored and shiny. The current available local pan production is limited to the use of cement. The dimension of the pan is 50cm x 70cm.

For a small-scale trial, the material cost for the pan, frame and buckets was US $35, with a labor cost of US$5 per latrine. Upon completion of the prototype floating latrine, the project team undertook an initial trial of 14 prototypes in the target pilot community. The community was given initial information and given proper demonstration lessons on the use of the floating latrines and the importance of total sanitation. The team conducted their IEC campaigns mostly in the primary and secondary schools in Phat Sanday.

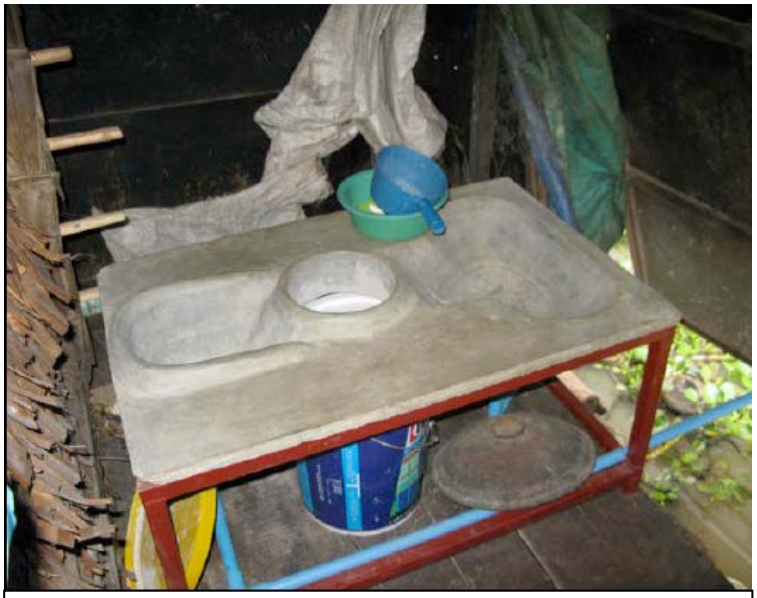


Figure 2: A prototype of a floating toilet (photo courtesy of Michael Brown, et.al)

Constraints around the space, weight and process requirements drove the need for reduced weight and volume systems, and a reduced time for storage. The method in the floating toilet design is to

separate the faeces from the urine and the wash water. A desiccation process is used in treatment of the faeces using the application of additional wood ash to speed up the drying of faeces and to increase the pH for pathogen destruction. This type of treatment is used in land-based settings and the required minimum time for treatment to kill the faecal pathogens is 6 months.

The project has put a strong emphasis on developing solutions that are affordable, culturally appropriate, and sustainable, which has encouraged the use of local materials and skills. Considering the ease of handling and waste management requirements, the chosen core component of the floating toilet design are 20L buckets that are readily available at low cost. The bucket is situated below the pan, which rests on a simple low frame.

The requirements for this type of treatment are the following:

- 20L bucket for storage of waste (diameter 0.32m, height 0.35m)
- 2 or 3 hole pan for diversion of urine and wash water
- Disposal and/or collection method for urine and wash water
- Storage method for faecal waste for sufficient period of time under desiccating and alkaline conditions
- An appropriate additive to assist the desiccation process (ash).
- An effective means to incorporate the design into existing houses and structures

Super Structure

A superstructure is needed to provide privacy and safety for users and necessary to allow storage of faeces above the water line. This structure will also support the pan and to keep the user safe, providing sufficient room for the pan, anal washing, wash water storage, ash storage and menstrual hygiene management.

The preferred approach is to use and adapt (if needed) existing super structure where it exists. Where no super structure exists, incorporate one onto the corner of the floating home/building, utilizing existing walls.

Minimum dimensions are:

- Floor area - 1m x 1m allowing room for a 3-hole squat pan, and storage of ash and solid waste.
- Roof height needs to allow easy access to step in for all users, approximately, 1.8-2.0m.

Wash water

A ready source of water that includes a 1L ladle (this is commonly found in the market) is necessary for pouring of water to be used for anal washing. A bucket of water outside the cubicle with a rope can be readily filled over from near the house by an adult. This is needed to provide accessible water for all, especially for the children.

Ash/paper delivery

Requirements:

Wood-ash is needed for desiccation in order to increase the pH of the stored feces to speed up the dying process. A bucket is used as a container for the ash with a plastic cup/ladle (about the size of a cup), for use within the cubicle and within reach when standing over the pan.

Faeces Management

The faeces storage bucket fits directly below the pan. The storage should be placed above the water to keep it safe even during storms. The storage should also be able to be sealed for a minimum of 6 months. This faeces storage must be kept away from water to maximize the effectiveness of the treatment. A paint bucket with lid usually 20L is needed. This bucket is also available in the market. Under floor storage can also be considered if the original place for storage is not enough.

Urine Management

The urine is collected from the pan via a small pipe or hose and diverted to a storage container or directly to the water. The pathogen risk from urine is considered to be low and thus disposal to the lake is a safe option, however reuse as fertilizer may be preferable. The container for the urine should be sealable and of a sufficient size so that it can be easily transported and maintained.

Option 1:

The urine is being transported from the pan hole to the storage container using a flexible hose. The average urine storage needed is about 1.2L per person per day with this type of collection. The urine can be stored in 2 alternating plastic cans (20-30L) and should be changed every 5 days or so. The collected stored urine is now ready for reuse. There should be no washing of urine because the water in urine can add to the smell and the risk of bacterial contamination before applying it to plants. An elastic material (such as condom) or other similar material is used by the communities to create a self-sealing pipe in order to prevent the release of urine odors especially in times when no liquid is passing through it.

Option 2:

The urine is directly disposed into the lake via flexible hose. Washing of the urine pan hole is also permitted, being careful not to pour water to the pan hole for feces.

Wash Water Management

This is for the traditional self hand washing after defecation. Wash water only contains low quantities of pathogens, so it can be disposed of into the lake directly. The needed materials can be flexible hose, or jointed pipes, for the wash water to flow directly into lake.

Menstrual Hygiene Management

One fundamental aspect of sanitation for women ages 10 to 50 is the menstrual hygiene management. According to EWB, the results of their surveys and workshops tell them that women in the floating villages almost universally use disposable paper/plastic napkins for menstrual hygiene management. The napkins are either kept in a bag with solid waste and disposed of into the lake later or thrown directly into the lake. The women in the communities really need access to a private

disposal option for sanitary napkins. In demonstrating the floating toilet, menstrual hygiene management has been integrated into the management and education around using the system, and biodegradable materials can be disposed of with the faeces and ash, or a bucket or container can be placed within the cubicle.

Children, Elderly and Disability Considerations

The use of the squat pans can be really difficult for the children, the elderly and those with physical disabilities such as leg amputees. While the current floating toilet design is only raised a small amount, this can still be difficult for less-mobile users, so adapted designs are intended to address this. The use of a seat is being considered and could be made customized by the local manufacturer especially for the families with elderly or disabled family members. An additional consideration is the use of a strong galvanized pipe or a properly constructed wooden handrail to be added on either side of the latrine pan to allow users to lower themselves and raise themselves more easily.

Floating Biodigester

Biodigestion technology is successfully used in many circumstances to treat human waste effectively and rapidly, while at the same time producing methane gas and fertilizer. Standard approaches are not suitable for floating communities with little or no access to permanent land, typically small, weak, and mobile structures, and with small quantities of organic waste. So, floating biodigesters are being developed by EWB and Live & Learn, for trials and demonstration within these floating communities. Both continuous and batch biodigesters are under consideration, as well as systems of varying sizes, to assess which options may be most suitable to the community.

Preliminary designs have been developed, and construction, operation, and maintenance aspects are also under investigation. After development, refinement, and assessment of designs, in collaboration with the Phat Sanday community, the preferred options will be prototyped and tested. Operational aspects are likely to be particularly important, potentially requiring skills and training, as well as correct management of feed inputs to ensure successful biodigestion. The strong relationship with the community will be helpful in developing this solution into one that can bring multiple benefits to communities in challenging environments.

Partners

The project is an alliance of the different project partners, the Phat Sanday Community, Live & Learn Environmental Education (L&L), Engineers Without Borders Australia (EWB), Ministry of Rural Development (MRD), Science and Technology Innovations for the Base of the Pyramid in Southeast Asia (IBoP Asia), Resource Development Institute Cambodia (RDI), Energy and Environment Partnership Program (EEP-Mekong) and Royal University Phnom Penh (RUPP).

Engineers Without Borders Australia (EWB) is a non-profit group with operations within Australia and abroad that aims to improve the quality of life of disadvantaged communities through education and the implementation of sustainable engineering projects. EWB Australia was established in 2003 by a group of engineers from Melbourne who were inspired to take action on the developmental front through engineering. The group now has 20 active chapters around Australia. The role of EWB

Australia in the project is more on the technical and design support. The Country Manager for the project was also provided by the project team.

Live & Learn Environmental Education Cambodia (L&L) is a non-profit, non-government organization which promotes greater understanding and action toward human and environmental sustainability through education and dialogue building. L&L provided the Coordinator for the project and handles relationship building and community engagement.

Ministry of Rural Development (MRD) on the other hand has a mandate from the Royal Government of Cambodia for the improvement of the living standards of the people and the alleviation of poverty. The agency played an important role because it opened the access of the project team to the WATSAN forum and draw linkages to other organizations that are working in Cambodia. The MRD also provides grant to projects for the alleviation of poverty in the region.

Phat Sanday Community's role is for the engagement and support of the people in the community and the willingness of the people to participate in the project. Through the participation of people in the community, the project is able to input some local designs and materials to fit into the community's needs.

Science and Technology Innovations for the Base of the Pyramid in Southeast Asia (IBoP Asia) was a previous project grantee. Energy and Environment Partnership Program (EEP-Mekong) are currently supporting the demonstration of appropriate energy for floating communities, including developing floating biodigesters.

Resource Development International Cambodia (RDI) is involved in the prototyping and design development. It offered its expertise in working with the Cambodian environment and the use of its laboratory for testing.

Royal University Phnom Penh (RUPP) also offered its venue for laboratory testing. The organization is also involved in relationship building and capacity development.

Impacts and Challenges

The partnership between Live & Learn and Engineers Without Borders Australia with the support of the MRD was able to exhibit great impact and success especially in the trial of the trial of the floating toilets in Phat Sanday community in Cambodia. The partnership has successfully demonstrated the potential of the floating toilet in challenging environments.

The scale up method to enhance sanitation in the floating and flood affected communities will build upon the Sanitation Marketing methods currently undertaken in Cambodia to suit the circumstance of the flooding and flood affected communities. Live & Learn also has experience planning and executing Sanitation Marketing campaigns in Vietnam and Indonesia, which we will be able to draw upon.

The scale up recommendations will be developed in consultation with communities to ensure a truly sustainable uptake process. The project will also address waste life cycle and reuse, hand washing, menstrual hygiene management to ensure a holistic approach is undertaken to maximize the value

of the sanitation solution and to reinforce messages of protecting water quality for the protection of the environment and human health.

The projects future plan will focus on building the supply and demand of floating latrines. The work in progress now is small scale and focused on the prototyping of the designs to ensure a reliable system is developed. With the collaboration of CLTS and Sanitation Marketing, there is a high chance of creating a demand for latrines in the floating communities. If there will be a demand for latrines, then the supply should also be taken into consideration. Working with local suppliers the project aims to improve the quality and the affordability of the system and support the development of local supply chains.

Live and Learn projects to develop a business model using techniques such Community Led Total Sanitation (CLTS) and Sanitation Marketing in order to build supply and demand for floating toilets for floating communities in Cambodia and beyond.

The challenge of this project is to improve the design to make it an attractive option to improve the health and sanitation of communities on Tonle Sap Lake, and other similar communities around the world.

References:

Brown, Michael, *et al*. (2010). *Sanitation in Floating Communities in Cambodia.* Ministry of Rural Development. Cambodia.

Economic Impacts of Sanitation in Cambodia: A five-country study conducted in Cambodia, Indonesia, Lao PDR, the Philippines and Vietnam under the Economics of Sanitation Initiative (ESI), Research Report. (2008).

"Tonle Sap Floating Toilet Project". (2010). *Water Engineering Australia Magazine*.

Van Maanen, Peter. *Soap Stories and Toilet Tales: 10 Case Studies.* USA:UNICEF.

www.ewb.org.au

http://en.wikipedia.org/wiki/Engineers_Without_Borders_%28Australia%29

http://www.livelearn.org/

http://www.mrd.gov.kh