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Small-scale wastewater treatment technologies for challenging environments

Floating Houses on the Tonle Sap

Sanitation in a Development Context

- Globally 2.4 billion people lack access to sanitation (UN, 2016)
- To achieve 100% coverage by 2030 requires urgent action.
- New ways of thinking, and innovative solutions needed.

The impact of sanitation

"Before having a toilet, we had to go far from the house – 300 metres into the forest. At night, I had to take a torch and worried about snakes.

In the rainy season we had to go by boat - it was very difficult.

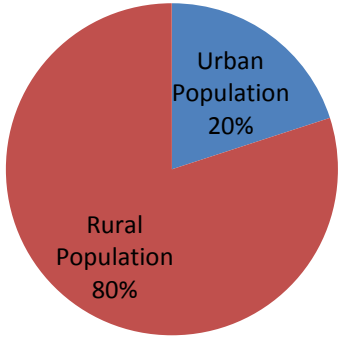
With a toilet, my family members have fewer complaints about diarrhoea. And they have more time to work and earn a living."

- Yeay Voeurt, the beneficiary of a flood recovery project, pictured below with her grandson at their home in Siem Reap province.

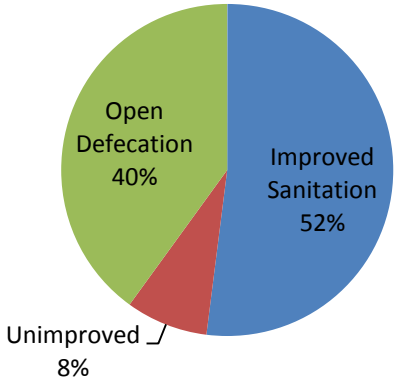
Sanitation in Challenging Environments (SCE)

Cambodia's target is 100% sanitation by 2025 – for success addressing SCE is vital

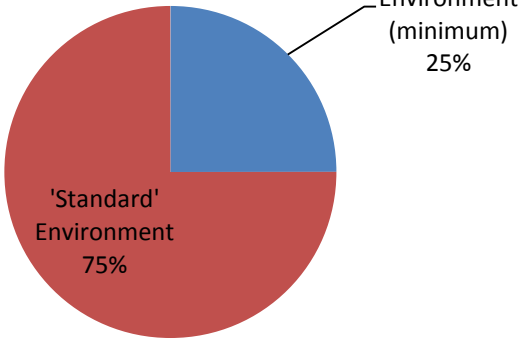
Population Distribution



Sanitation Coverage



Environment Type

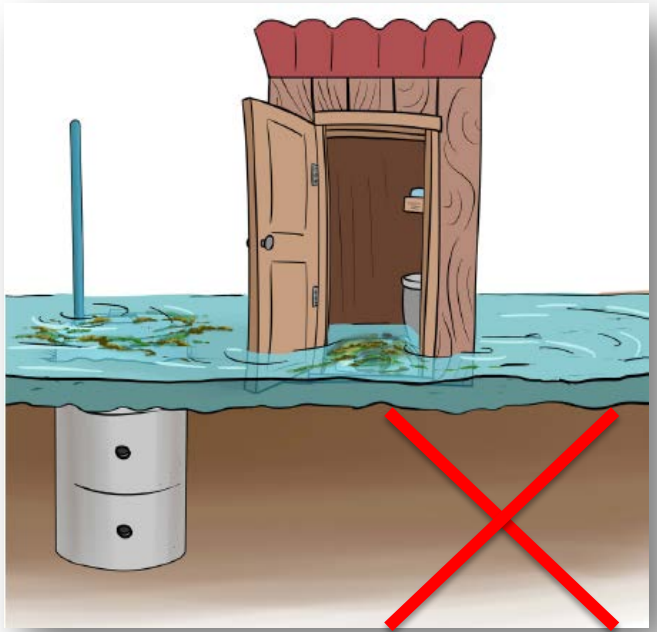


EWB established SCE project in Cambodia in 2014 using a multi-faceted approach:

- Collective Impact
- Technology designs & trials
- Education, research & behaviour change

Challenging Environments

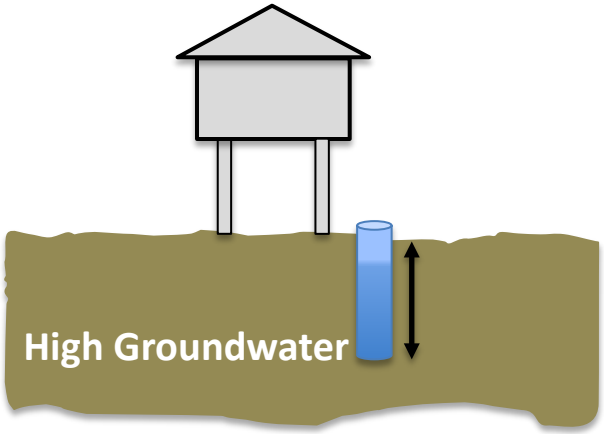
SCE – areas where it is difficult to construct pit latrines or where high risk of contamination to environment exists.



Conventional pit latrines pose high risk of fecal contamination of groundwater & surface water. Globally 1.77 billion people use pit latrines.

Sanitation in Challenging Environments (SCE)

Three main Challenging Environments in Cambodia (and across SE Asia):



There are also many others including drought prone, riverine & mountainous.

Sanitation in Challenging Environments (SCE)

Wide range of barriers to overcome:

- Cost
- Expectations
- Migration
- Maintenance
- Social, Cultural & Political

Discussing how a bio-digester toilet system works with a local household & mason

Handy-Pod

By Wetlands Work!

Designed for floating and severely flood affected communities

Multiple rounds of prototyping & testing.

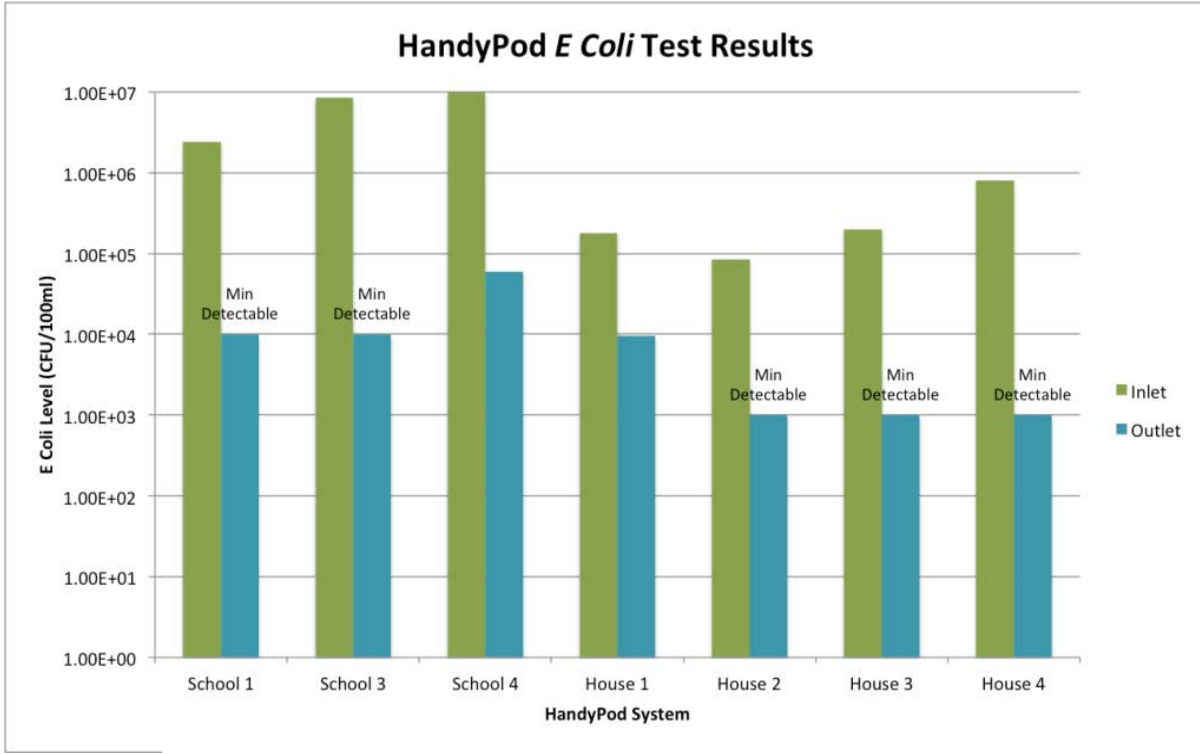
Built from locally available materials.

Larger HandyPod system, complete with final-stage hyacinth pond, at a floating school

Household sized HandyPod systems on seasonally floating household adapted for dry and wet season

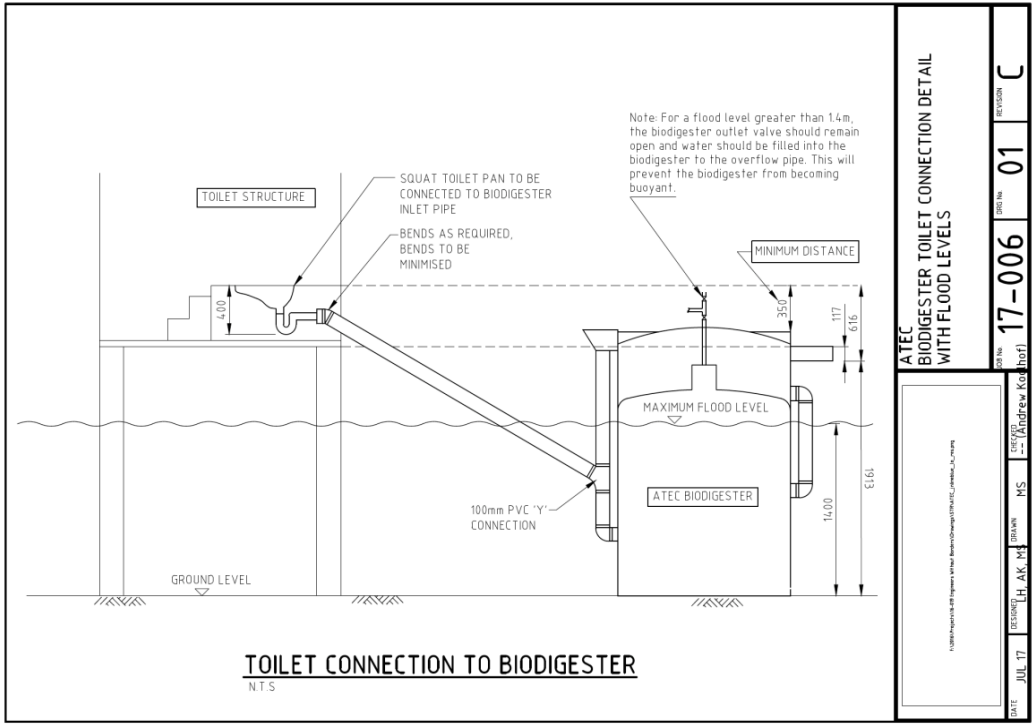
Handy-Pod

- Latest model iteration in use for 8 - 12 months
- Minimum 2-log order reduction in *E Coli* across systems
- System ready for scale-up



Results from HandyPod Testing show E Coli reduction

ATEC* Biodigester

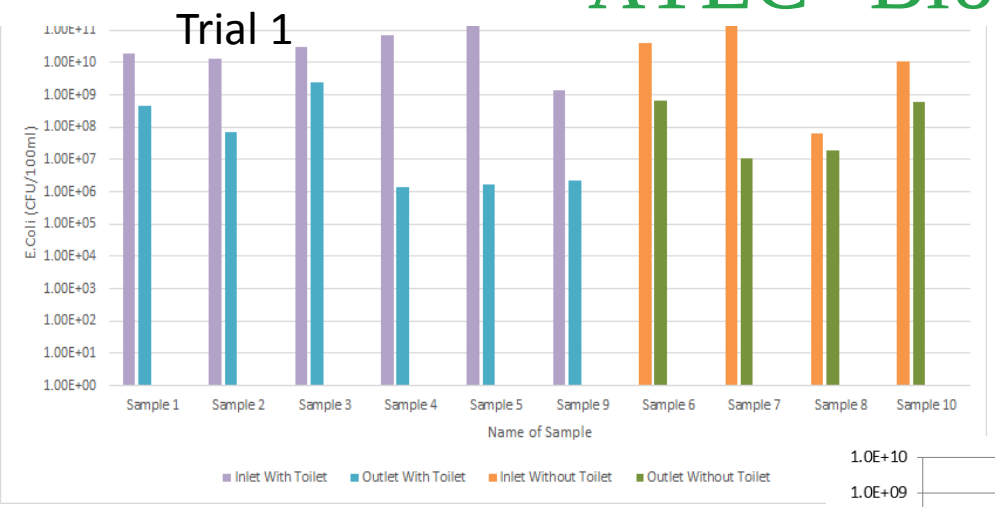


Details of the ATEC Biodigester with toilet connection

Model of the ATEC Bio-digester*

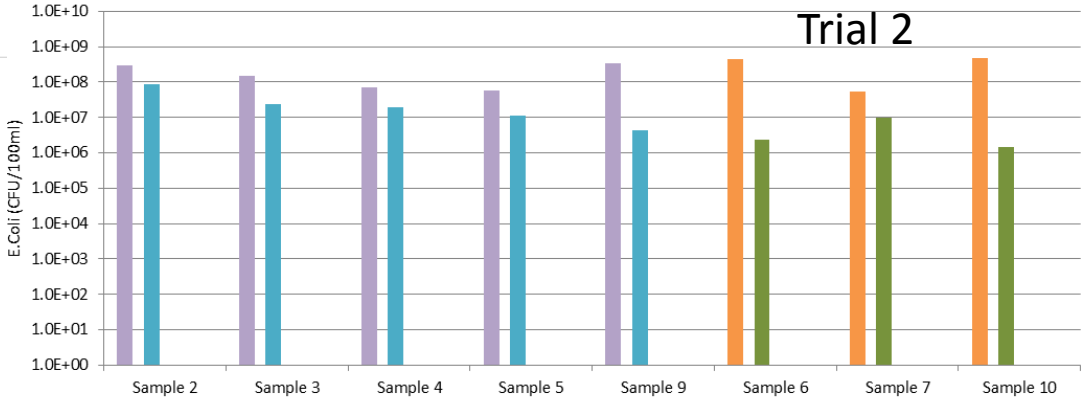
Bio-Digester installed as part of the toilet trial

ATEC* Biodigester



Test Results - Inlet and outlet E.coli concentration of biodigester with and without toilet connection

Trial 1 - average 2-log order reduction in *E Coli* AND no difference between toilet connected & manure only installations

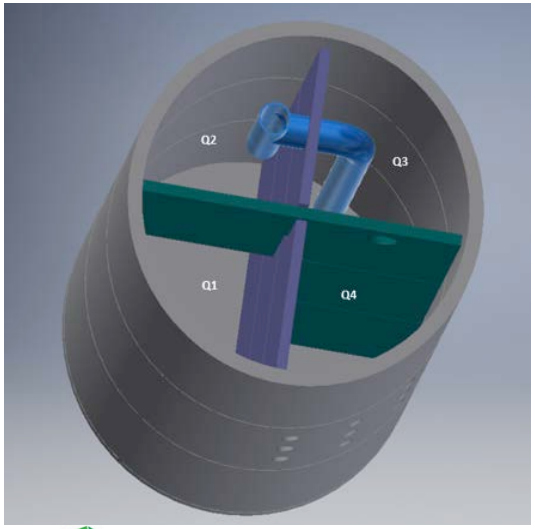


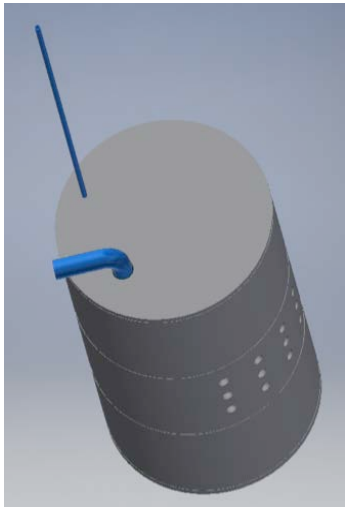
Trial 2 - Smaller reduction in *E Coli* of 1-2 log order – with lower overall levels of E Coli at inlet than first round tests

3C Pit

Adaption to ‘standard’ pit latrine to make it more suitable for high-ground water & flood-prone locations.

Pit divided into multiple chambers to improve retention time





3C Pit

Uses locally available materials & construction techniques

Multiple rounds of construction prototyping

Trial underway with partner iDE – comparative *E Coli* results between standard & 3C pits will be collected

Discussing the new 3C Pit design with an iDE Mason

Technology Comparison

Technology	Product Cost (exclusive of super-structure)	Challenging Environment	Treatment Efficiency (E Coli log-order reduction) - *preliminary*	Comments
Pour Flush Pit Latrine (not SCE appropriate)	US$50	N/A - not appropriate for challenging environments	N/A - effluent can travel directly into soil or ground- or surface waters	Moderate cost, well known, and easily accessible.
3C Pit	US$90	• High groundwater (primary) • Flood-prone (secondary)	2 log reduction (based on similar designs)	Custom concrete moulds for design cost ~$210 per set for mason's yard. Requires additional care and attention in construction.
Handy-Pod	US$150	• Floating • Flood-prone	2 log reduction	Product designed & developed by Wetlands Work! Adapted to amphibious conditions
ATEC* Biodigester	US$680	• Flood-prone • High groundwater	1-2 log reduction	Significant capital outlay offset by removal of cooking fuel costs. Requires two cow.

Conclusions

Pit latrines are not suitable everywhere.

100% sanitation requires scalable, appropriate designs for all situations.

Solutions for challenging environments require significant investment in R&D, supply chains and education programs.

Knowledge sharing and collaboration are vital.

Sector, NGO, Donor and Government engagement (as well as community education & involvement) is critical to solving the challenge of SCE

Call to Action

Pictured: Chom Chin (far left) with his wife (centre right), mother (far right), sister and niece (centre left)

Acknowledgments

EWB would like to acknowledge the contributions of its partner organisations:

- Wetlands Work!
- ATEC* Biodigesters
- Khmer Community Development (KCD)
- International Development Enterprises (iDE)

The work of EWB Australia in Cambodia is made possible through funding provided by the Australian Government Department of Foreign Affairs and Trade.