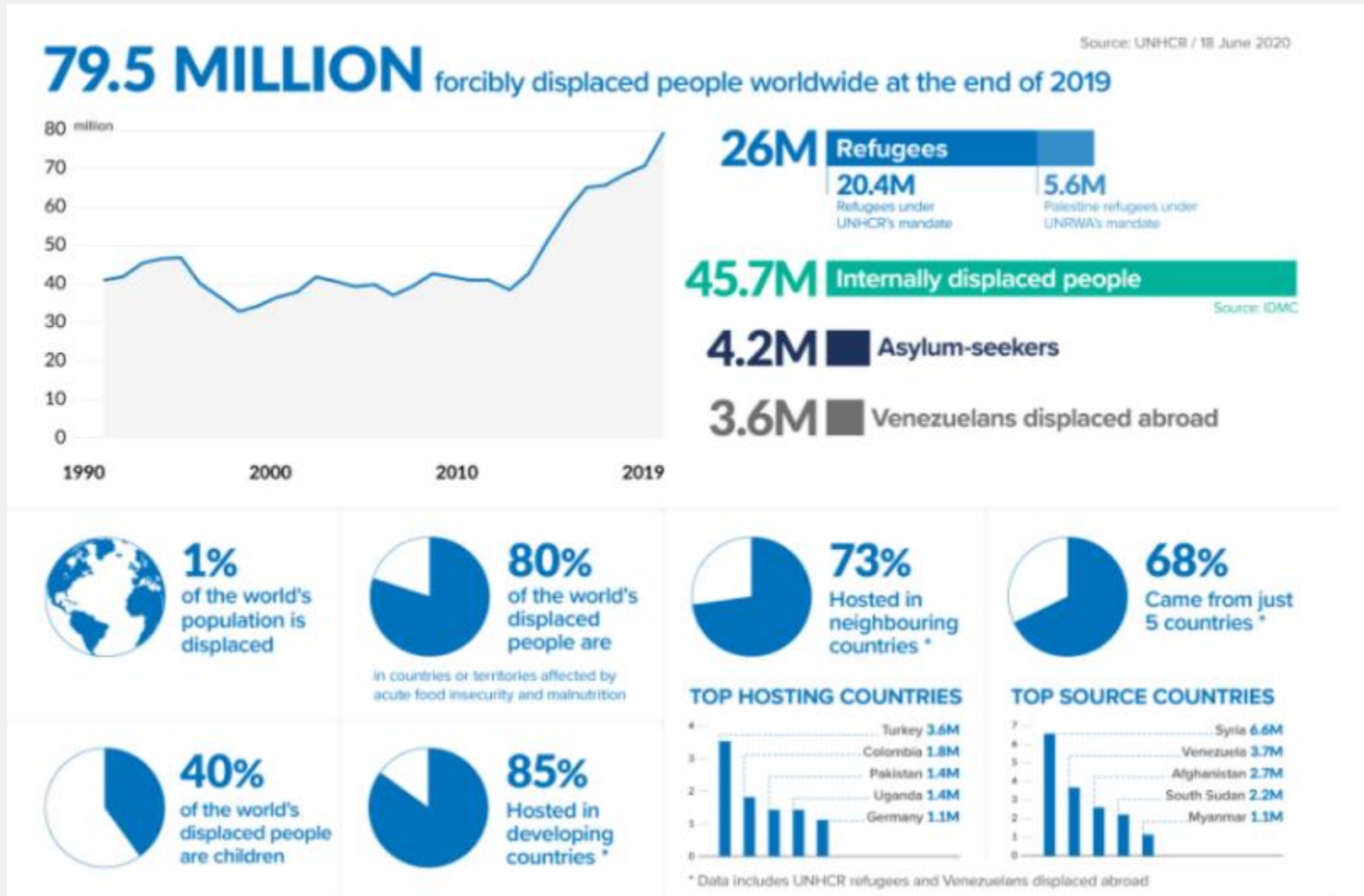


# The development and use of vermifilters in humanitarian settings

Dr Claire Furlong, IHE Delft, Netherlands

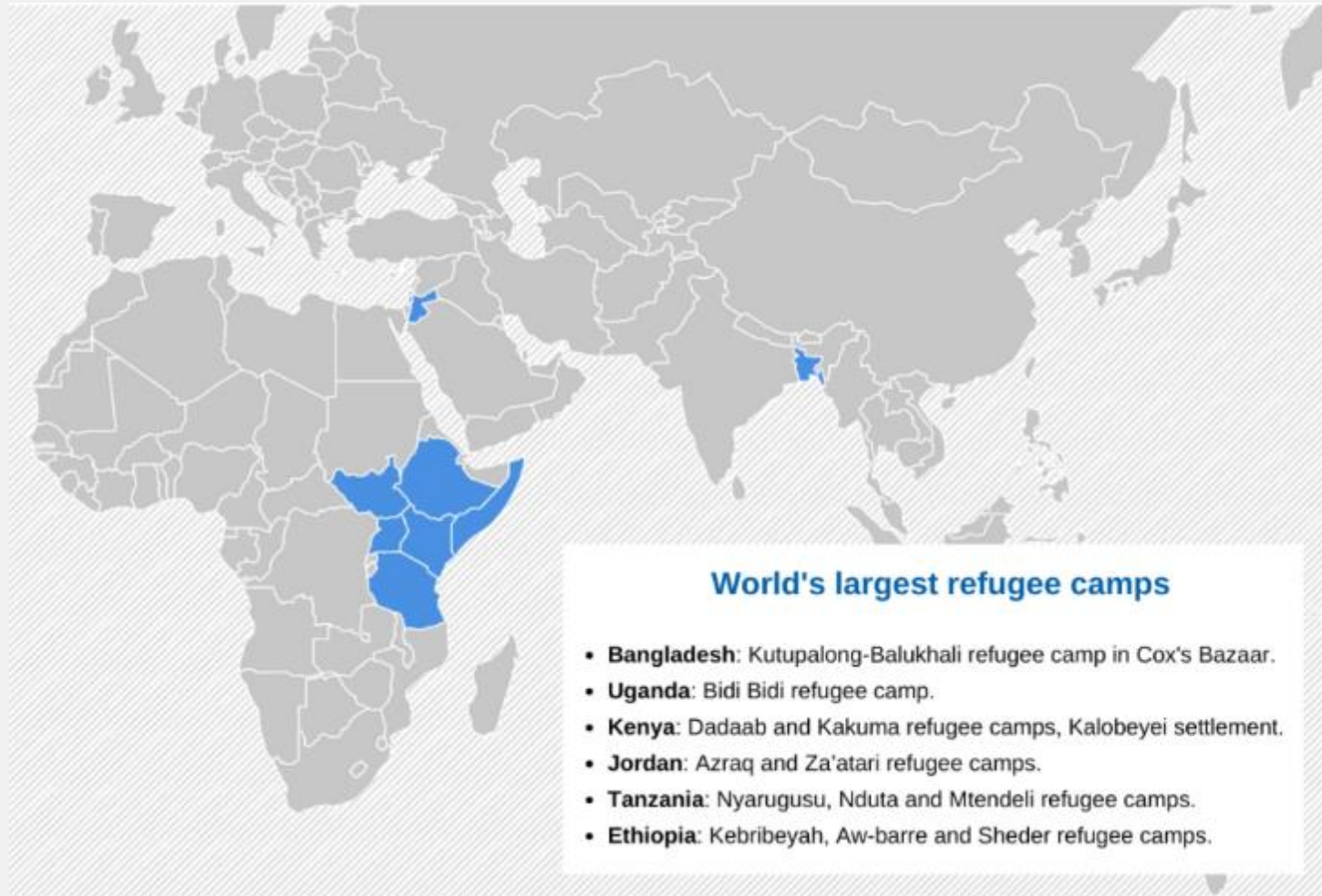


# Why humanitarian contexts...



- UNHCR defines a protracted refugee - 25,000 or more refugees exile for at  $\geq$  5 years
- 15.7 million refugees protracted crisis
- 2.6 million refugees hosted in camps (10%)

# Why camp settings?



- Cox's Bazaar 1 million refugees
- Average camp life is 24 years
- Stat's do not include IDPs camps
- 140,000 stateless Rohingya in Rakhine living in camps or camp-like conditions

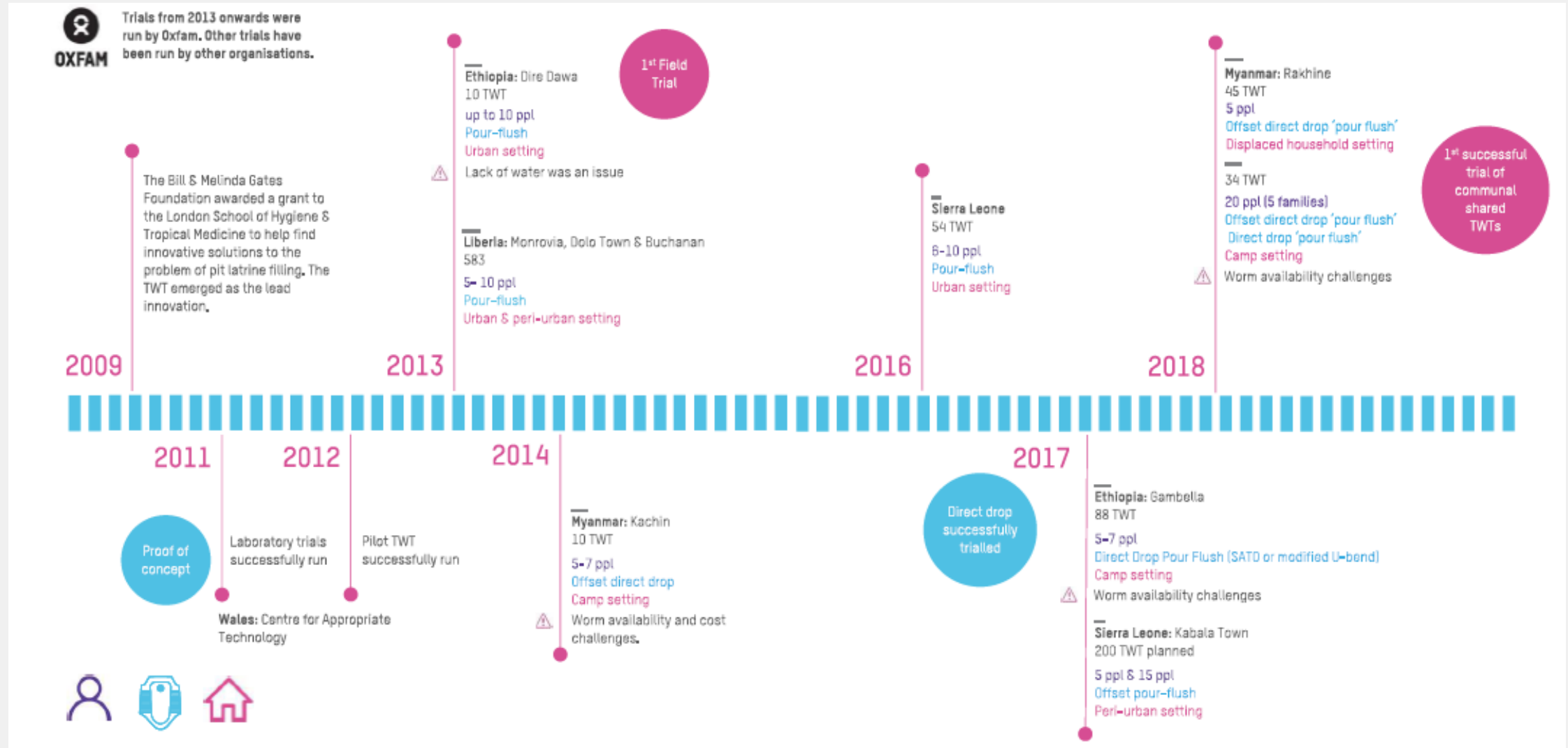


## Why peri-urban?



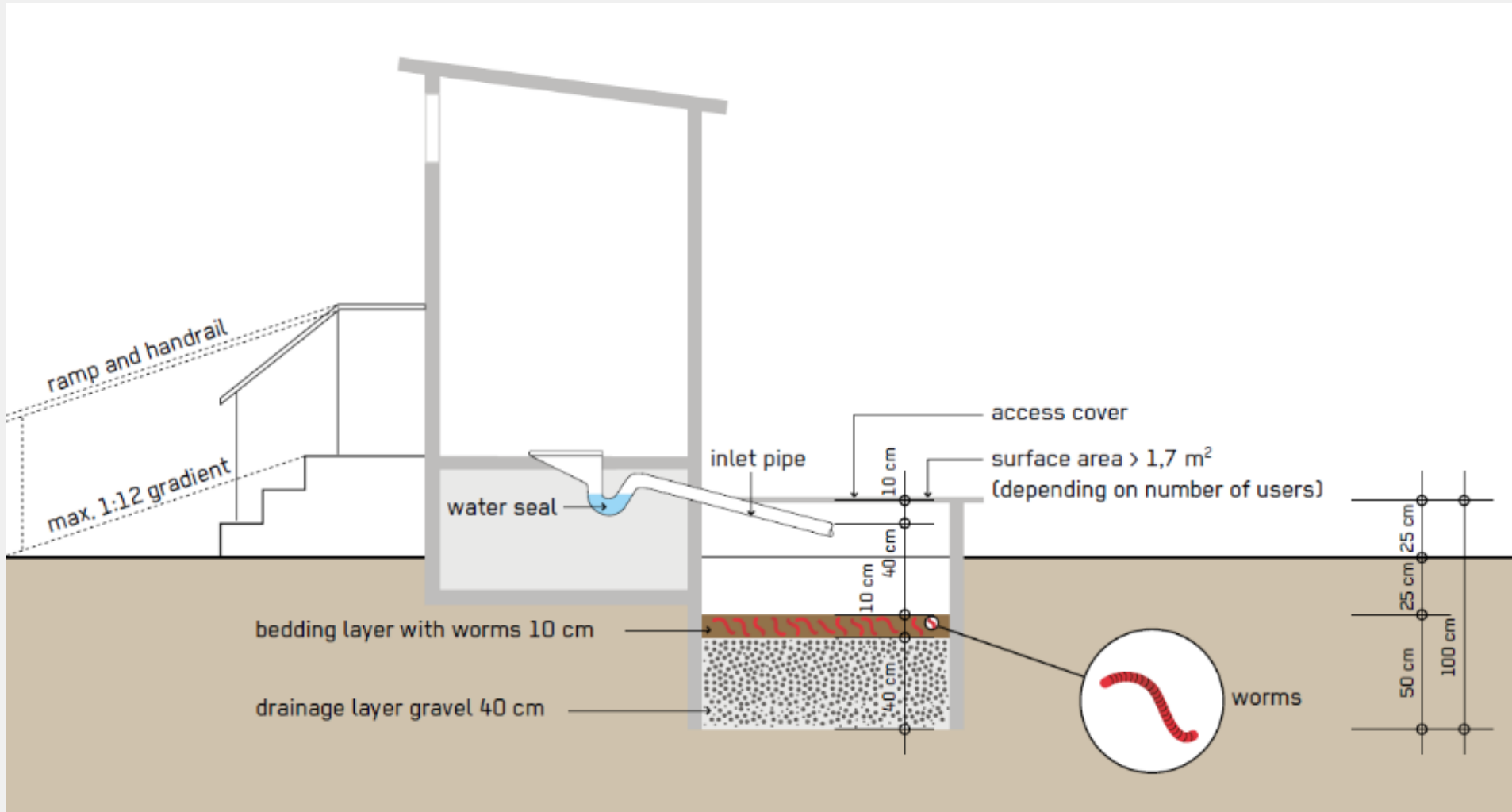
- A majority of refugees and IDPs live in urban areas
- Often in peri-urban areas
- No or low quality san
- Initial service provider external agencies e.g. INGOS
- More sustainable options

# Development of TWT...



Source: Tiger Worm Toilet Manual: Global Relevant Learnings from Myanmar

# The general concept of the TWT...



Source: Compendium of Sanitation Technologies for Emergencies

# Oxfam's TWT research ...

Project area	Project years	Toilet type	Pan type	User No.	Surface area	Worm species	Bedding material	Worm density kg/m <sup>2</sup>	Main innovation
Dire Dawa	2013-2014	Household with superstructure	Pour-flush	10	1 m <sup>2</sup>	Eisenia fetida	Wood shavings	2	Proof of concept
Monrovia & Sierra Leone Trials	2013-2018	Internal toilet with external tank	Pour-flush pedestal	5 -10	1 m <sup>2</sup>	Eudrilus eugeniae	Coconut or palm husk	2	Worm species Permeable slab Charcoal layer Sealed tank
Kachin	2013-2015	Household with superstructure	Myanmar style	5-7	0.78 m <sup>2</sup>	Eisenia andrei	Woodchip	1.9	Smaller surface area
Gambella	2016-2018	Household with superstructure	Direct drop pour-flush	~5-10	0.70 m <sup>2</sup>	Eisenia fetida	Fine woodchip	0.7	Direct drop
<b>Sittwe STMG</b>	<b>2017-2019</b>	<b>Communal with superstructure</b>	<b>Direct drop pour-flush</b>	<b>~30</b>	<b>6 m<sup>2</sup></b>	<b>Mixed mainly Perionyx excavatus</b>	<b>Coconut fibre</b>	<b>0.66</b>	<b>Communal design</b>
Sitwe MRA	2017-2019	Household with superstructure	Myanmar style	5	0.70 m <sup>2</sup>	Mixed mainly Perionyx excavatus	Coconut fibre	1.4	Addition of the worms after 1 month

Source: Learning from Oxfam's Tiger Worm Toilets projects



## Monrovia, Liberia (2013)





## Kachin, Myanmar (2014)



Photo credit: Claire Furlong

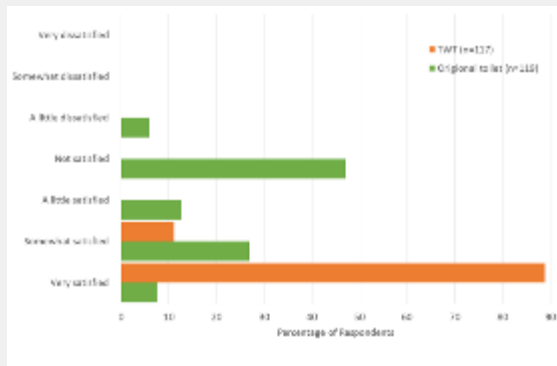
## Gambella, Ethiopia (2017)



Photo credit: Claire Furlong



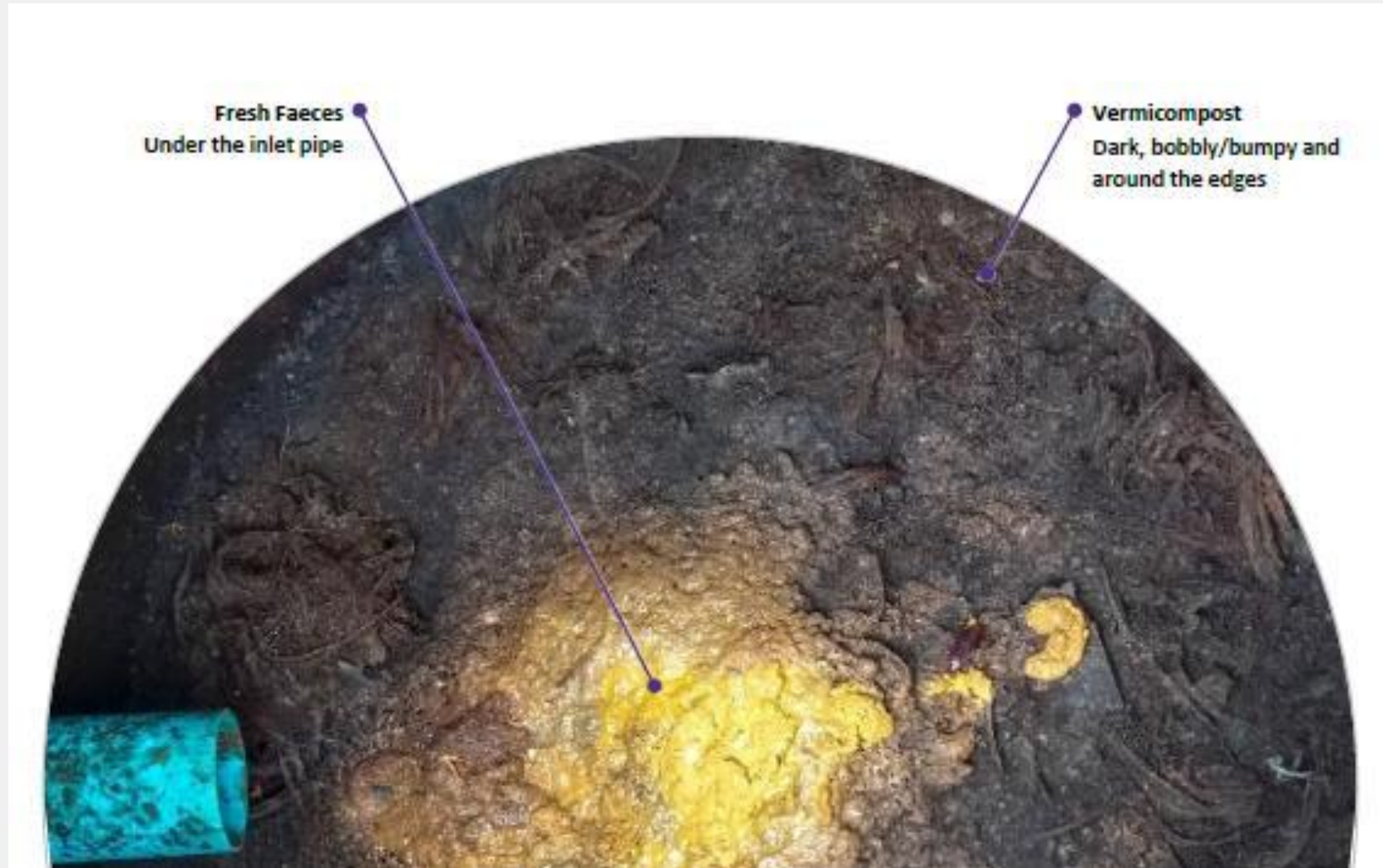
# STMG Sittwe, Myanmar (2018)



***99% users wanted to continue to use them after the trial***

Photo credit: Lucy Polson

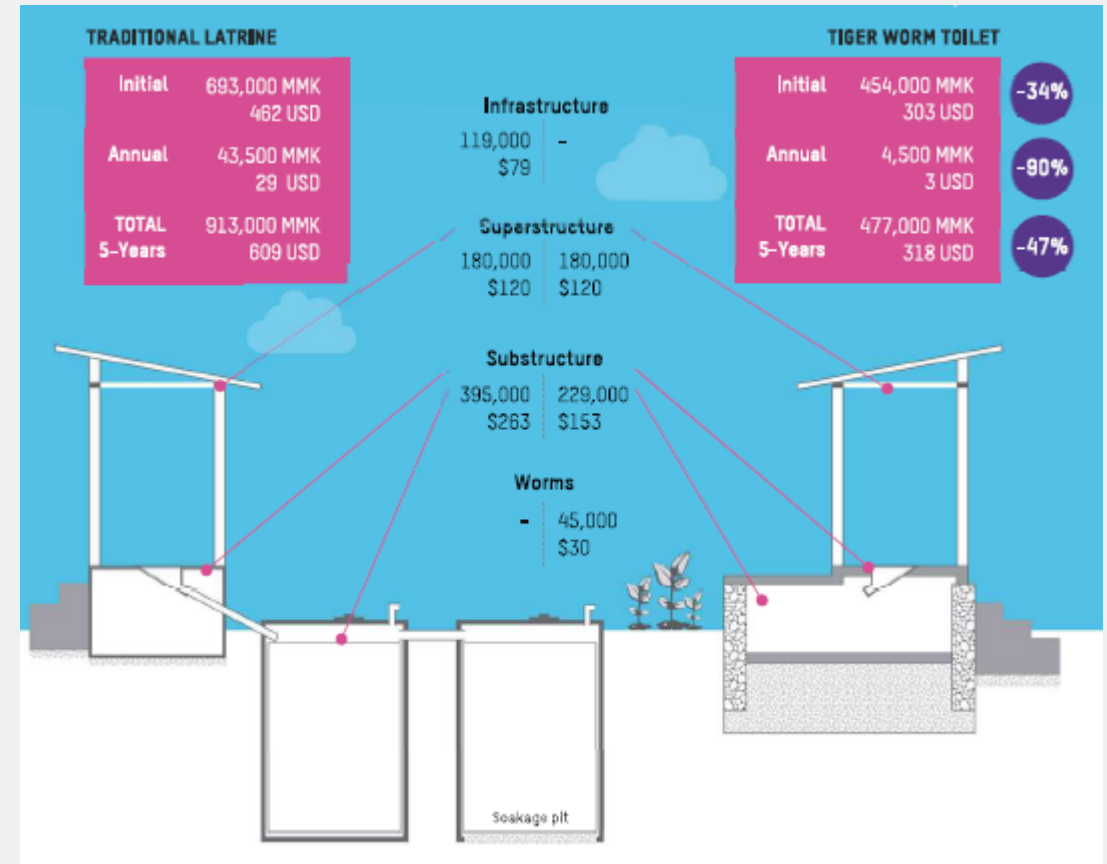
# Inside a Tiger Worm Toilet





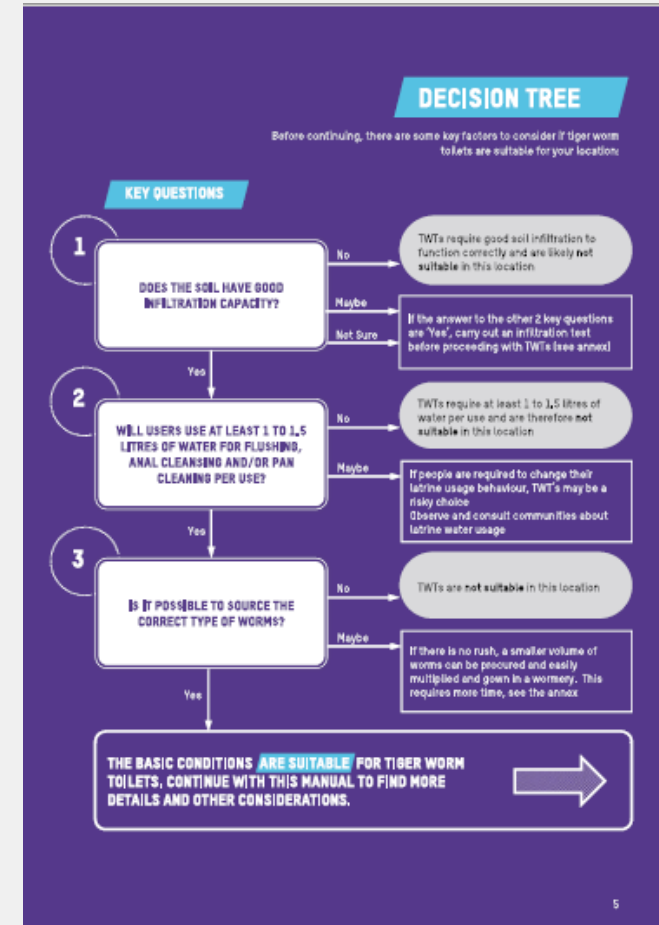
# Costing

- CAPEX
  - Context specific
  - US\$175-400
  - Worms costly (US\$10-210 per kg)
- OPEX
  - Emptying twice a year or every two months
  - Cost emptying US\$400 per year +
  - All trails less emptying

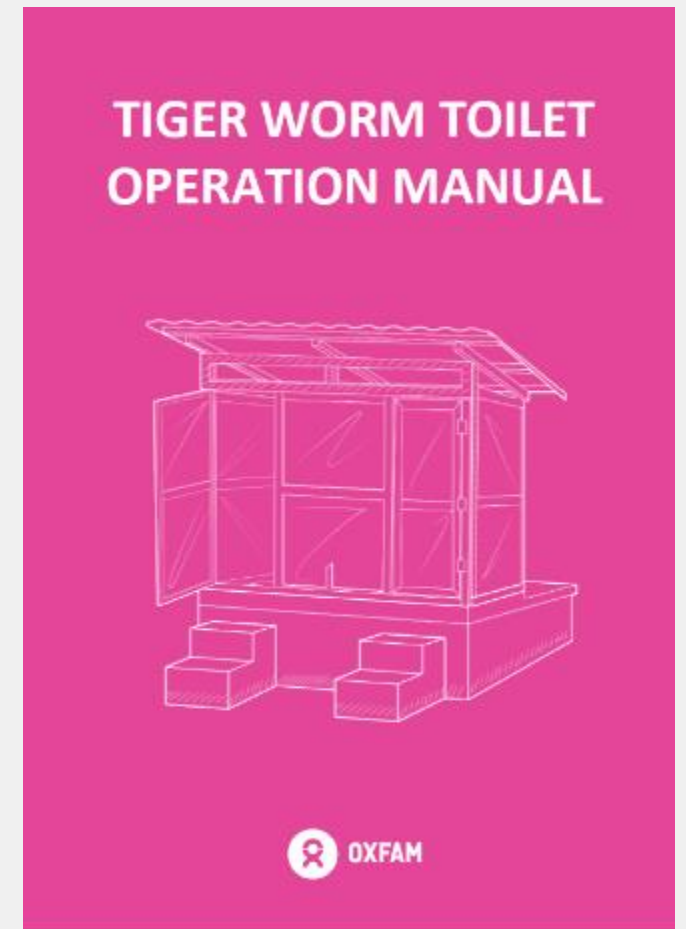
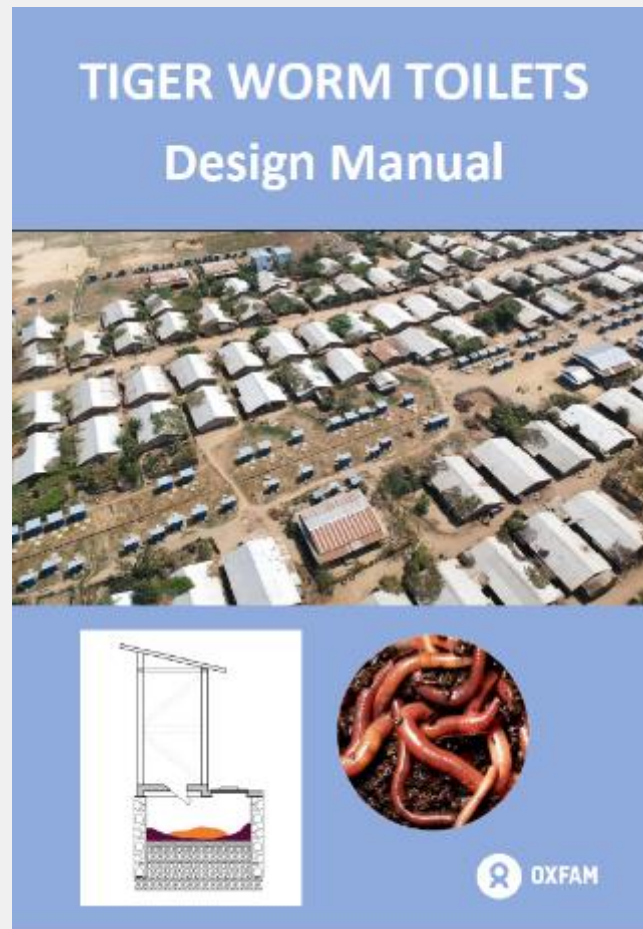
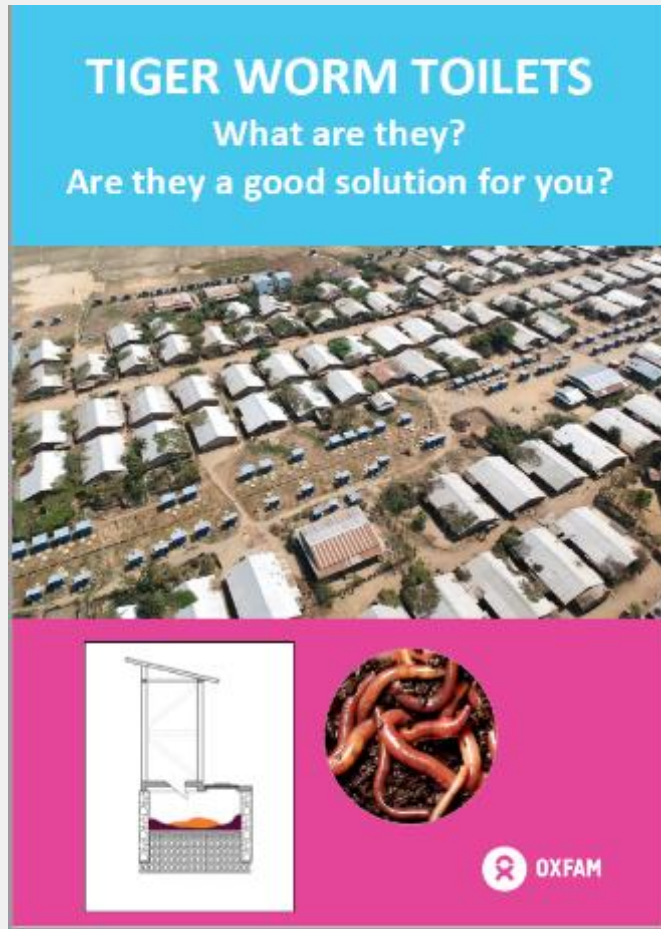


# Oxfam's learning to date...

1. Adaptable design
2. Community engagement is key
3. Quality control issues with builds
4. Different worm species can be used
5. Worm supply
6. Monitoring and documenting trials
7. Knowledge management



# Key resources...





# Technology mainstreaming...

## Compendium of Sanitation Technologies in Emergencies

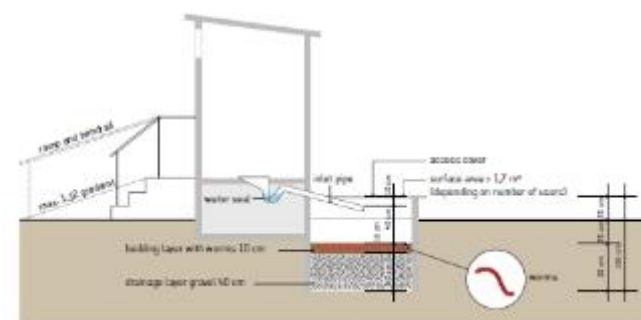
1<sup>st</sup> Edition



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### Worm-Based Toilet (Emerging Technology)

Phase of Emergency	Application Level/Scale	Management Level	Objectives/Key Features
<ul style="list-style-type: none"> <li>Acute Disaster</li> <li>Displacement</li> <li>Recovery</li> </ul>	<ul style="list-style-type: none"> <li>Household</li> <li>Neighbourhood</li> <li>City</li> </ul>	<ul style="list-style-type: none"> <li>Household</li> <li>Neighbourhood</li> <li>Public</li> </ul>	<ul style="list-style-type: none"> <li>Reduce odour, reduce volume</li> <li>Reduce odour, reduce volume</li> </ul>
Space Required	Technical Complexity	Inputs	Outputs
<ul style="list-style-type: none"> <li>Small</li> </ul>	<ul style="list-style-type: none"> <li>Medium</li> </ul>	<ul style="list-style-type: none"> <li>Worms, compost</li> <li>Leaky latrine material</li> <li>Leaky latrine material</li> <li>Leaky latrine material</li> </ul>	<ul style="list-style-type: none"> <li>Worm-based toilet</li> <li>Worm-based toilet</li> </ul>



The Worm-Based Toilet is an emerging technology that has been used successfully in rural, peri-urban and camp settings. It consists of a pour flush pan connected to a vermifilter (filter containing worms). The effluent infiltrates into the soil and the vermicompost (worm waste) is emptied approximately every 5 years.

By using composting worms the solids are considerably reduced. 1 kg of human faeces is converted into approximately 100-200 g of vermicompost. The system thus needs emptying less frequently than traditional pit systems. The vermicompost is generated at the top of the system and is a dry humus-like material, which, compared with untreated excreta, is relatively easy and safe to empty.

**Design Considerations:** The surface area of the household tank for the vermifilter varies from 0.7 m² to 1 m² depending on the number of users. The depth of the tank is approximately 1 m. The bottom of the tank is exposed to the soil. The tank contains 40 cm of drainage material (gravel or stones), 10 cm of organic bedding material (woodchips, coconut husks or compost) and the worms. The lid to the tank needs to fit extremely well, but should not be sealed. This is then connected to the pour flush system.

**Materials:** Worm-Based Toilets can be constructed from locally available materials. The superstructure should contain a roof and a door for privacy. A pour flush pan is also required. The effluent tank can be made from various materials including concrete rings, masonry and brickwork. The most important material is the worms (100 g per person). The type of worms required are composting worms. Four species of worms have been successfully used to date, namely *Eisenia fetida*, *Eisenia hugoborni*, *Eisenia andrei*, and *Eisenia tetraea*.

*Eisenia andrei* and *Eisenia tetraea*. They can be found locally, bought from vermicomposting or vermiculture businesses, or imported.

**Applicability:** Worm-Based Toilets are a viable solution if long-term household sanitation is required and emptying is an issue. They are particularly appropriate in contexts where water is available and used for flushing, and in camp communities that have a strategy of implementing household systems. As the toilets can be built half above and half below the ground they can be used in areas with relatively high water tables (approx. 1 m). As the effluent enters the soil, a certain infiltration capacity is required. Securing a worm supply can be an issue.

**Operation and Maintenance:** General operation and maintenance (O&M) measures include regular cleaning of toilets, advice on proper use, minor repairs, regular checking of the well-being of the worms and the monitoring of the filling of the tank. These toilets require emptying approximately every 5 years. Ideally, the toilets are emptied by the household after they have been on-site for one week, allowing the fresh faeces to be converted into vermicompost. The vermicompost should be removed from the edges of the tank with a small spade, then the vermicompost from the middle should be spread across the surface to create a bedding layer. The harvested vermicompost can be buried on-site. When sanitising the users, it should be highlighted that only water, faeces, urine and possibly toilet paper should go into these toilets. The toilets should only be cleaned with water and a brush, and should be flushed after every use including urination. O&M is still a gray area as the systems which have been built have not been emptied yet. If emptying by the households is not an option (due to acceptability issues or other reasons) other options involving local service providers need to be identified.

**Health and Safety:** If used and managed well, Worm-Based Toilets can be considered a safe excreta containment technology. They need to be equipped with Handwashing Facilities (HWF) and proper handwashing with soap after toilet use needs to be addressed as part of the hygiene

promotion activities (K.12). Recent research studies suggest that the effluent from worm-based systems can be considered safer than the effluent from septic tanks and that the vermicompost generated can be considered safer than faecal sludge. However, more research is required to confirm this.

**Costs:** Worm-Based Toilets can be built using locally available materials. The worms can be costly, but in large-scale projects worm cultivation can be incorporated. The cost is comparable to that of a well-constructed pit latrine. O&M costs should be included over the lifetime of the toilet. Over time this technology becomes increasingly financially viable compared with other pit latrine systems.

**Social Considerations:** The potential handing over to beneficiaries and the roles and responsibilities for O&M need to be agreed upon from the design phase and closely linked to respective hygiene promotion activities (K.12) to ensure appropriate use, operation and maintenance of the facilities. The community needs to be sensitised to the worms and toilets. This can be done by highlighting advantages of the system, i.e. little space required, convenient water-based system, no odour, less emptying, rather than discussing the use of the worms. There has been little adverse reaction to the use of worms.

#### Strengths and Weaknesses:

- ⊕ No odour
- ⊕ Design is adaptable to locally available materials
- ⊕ Low emptying frequency (5 years of use)
- ⊕ Easier and more pleasant to empty
- ⊖ Requires water for flushing (min 200 ml) and composting worms (100 g per person)
- ⊖ Unclear if menstrual hygiene products can be digested by the worms
- ⊖ Bleach or other chemicals cannot be used to clean the toilet
- ⊖ Lack of evidence on O&M

+ References and further reading material for this technology can be found on page 181.

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## Who funded this work...

- Bill and Melinda Gates Foundation
- Oxfam's internal WASH Innovation
- Comic Relief
- EU
- USAID DIV (AID-OAA-F-13-00049)
- UNHCR on 'Waste to Value Sanitation Solutions in Refugee Camps in East and Horn of Africa'
- Elrha's Humanitarian Innovation Fund
- Band Aid Trust



Acknowledge those who  
have worked on and  
managed these different  
trials



**OXFAM**