

DOCUMENT

# *A Sustainable Toilet Solution to Fight the Global Sanitation Crisis*

## *(Sanitation System Overview)*



**Australian Centre for Education & Training**

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## **A SUSTAINABLE TOILET SOLUTION TO FIGHT THE GLOBAL SANITATION CRISIS**

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### **INTRODUCTION**

Globally, limited access to adequate sanitation and clean water remains a formidable threat to humans. Thousands of people, particularly women and children, die every year due to lack of basic water, sanitation and hygiene (WASH) services. Insufficient WASH lead to a huge economic loss annually - approximately 1.5% of the global gross domestic product (GDP).

Since 1990, significant progress has been made to improve the world's access to clean, safe water sources and adequate sanitation facilities. Yet 663 million people still lack access to safe water, and 2.4 billion continue to suffer from a lack of access to basic sanitation facilities. ACET-Global's environmentally-friendly, financially viable sanitation system aims to address this world sanitation crisis. To achieve this, we are harnessing the combined power of innovative technologies and social enterprise models to empower local communities.

Our primary goal was to develop a safe, effective, simple sanitation solution, useful in every situation. For maximum impact, it needed to offer local economic benefits and overcome the limitations of existing systems. The conventional faecal sludge management systems common in developed countries feature flush toilets, extensive infrastructure to support sewage systems, and centralised sewage treatment plants (Figure 1). These systems are usually water-dependent, costly and unsustainable, rendering them ineffective in solving current sanitation issues, especially in developing regions. In addition, natural disasters and regular events (e.g. earthquakes, floods and monsoons) often destroy or compromise existing WASH infrastructure. This undermines WASH efforts, leaving people even more vulnerable to water-borne and faecal-oral diseases.

Importantly, any WASH solution must also be community-centred and culturally-appropriate, and encourage local people to take ownership of a new, often radically different system. Recognising the opportunity to provide local economic benefits to support our system, we also needed a decentralised method of effectively and safely processing the waste into a product to be sold locally to generate income. This income would be used to fund incentives for toilet end-users, in the form of community support services.

### **HIGHLIGHTS**

- We design a safe, affordable, culturally-appropriate portable dry toilet unit, which forms part of a comprehensive, closed-loop system.
- The system uses sustainable technologies to convert waste into a valuable product.

- Decentralised waste treatment and end-product usage safely benefits the environment.
- The system provides local entrepreneurial opportunities and supports WASH education.
- The resultant community-centred value chain creates local jobs and social benefits.

## PROCESS

We researched existing processes for managing human waste and reviewed literature on current sanitation promotion models, identifying design limitations and barriers to the widespread adoption of sanitation solutions (Table 1). Combining this information with new findings and advancements in waste management technology, we conceived an initial solution to effectively improve sanitation. This solution was further refined by applying engineering design principles, incorporating appropriate, sustainable waste treatment technologies, and developing a system that will be applicable in various settings globally.

## RESULTS

Drawing on the skills of a diverse team of professionals, academics and partnering universities, along with our dedicated staff and volunteers, the design process of developing our affordable, portable toilet prototype has been completed. The proposed sanitation system is sustainable, globally applicable, environmentally-friendly, and community-centred. The system has been designed to take menstrual hygiene into consideration, and can safely and effectively address sanitary items. It minimises water usage, can manage all human, animal and organic waste, and economically benefits local community and enterprises, consequently driving the continuous improvement of local sanitation and hygiene (Figure 2).

We used detailed research to devise a solution appropriate for all communities, considering cultural, traditional, and religious practices (Table 2). The base dry toilet unit comprises a seat, lid and replaceable barrel to contain faecal waste. The simple 'flush and forget' system is technologically-appropriate for end-users. Globally, communities with differing cultures and religions require different systems. In recognition of this, our toilet unit offers both 'Eastern' and 'Western' designs to better cater for different regions' needs.

Once full, the barrel is sealed, collected and transported by local enterprises to a waste treatment mini-plant. The system's design prevents the contamination of water supplies with faecal waste, even in the event of floods or earthquakes. Sustainable technologies, such as solar energy, are used to safely disinfect the waste and convert it to valuable material, whilst ensuring zero waste (Figure 3). These soil additives can be sold to generate income to fund incentive programs for toilet users, or used for revegetation and reforestation locally.

It has been estimated by the World Bank that a global investment as high as US\$114 billion, every year until 2030, is required to finance WASH. Implementation of our proposed system has the potential to significantly decrease the funds required to improve sanitation. After initial establishment, the system becomes financially self-sufficient, repaying its set-up costs and continuing to generate income for the local community. This makes our solution very economically appealing, as it has the potential to substantially reduce both the

establishment and running costs normally associated with WASH improvements and the provision of comprehensive sanitation facilities.

Our proposed sanitation solution emphasises the involvement and empowerment of local communities. Local enterprises can earn revenue by offering sanitation services, significantly lowering the capital and operational costs of the whole system, and encouraging collaboration between governments and the public. With some of the profits, enterprises will be encouraged to invest in the promotion of local WASH education programs, supporting the expansion of their sanitation businesses. Such community WASH programs will inform and support the behavioural changes necessary to move towards widespread system implementation and improved sanitation practices. With this positive cycle, local communities receive economic benefits to drive the continuous improvement of WASH practices and services.

## CONCLUSION

This document has introduced the sanitation system developed by ACET-Global, summarising its development, and outlining the proposed benefits and application of the resultant solution.

Our proposed sanitation solution is sustainable, globally applicable and financially viable, using a value chain model to drive self-improvement in local communities' WASH practices. It can be used in both remote, rural areas and densely populated urban areas, whether as a permanent solution or a portable solution that assists in mitigating the after-effects of natural disasters (Table 3).

The solution is based upon a culturally-appropriate, dry, portable toilet unit that minimises water usage, with local, decentralised mini-plants to process waste safely and effectively. The system incorporates on-road waste logistics and sustainable, locally-appropriate waste management technologies, enabling safe disposal and beneficial reuse of processed waste. In this way, local communities and enterprises are major players in the sanitation cycle. These groups are economically benefited, through both supporting improved sanitation practices, and utilising the treated waste in local businesses and revegetation efforts.

We aim to complete further research to improve the system's technology-readiness levels, and to fund and implement the solution around the world. Our goal is to share the final, tested system with governments and organisations globally, to improve sanitation facilities for as many people as possible. To enable this, ACET-Global will share the licencing of the entire system as a low-cost, not-for-profit franchise model.

Support of this non-profit initiative is warmly welcomed. We value all contributions from governments, organisations and individuals. We are excited to engage with other organisations on a mutually-beneficial basis, and believe that our comprehensive sanitation system will complement and support new and existing WASH programs to help solve the world's sanitation crisis.

For further information, visit <http://www.acet-global.com/global-sanitation-and-sustainability-project.html> and to discuss collaborations please contact our Managing Director Mr. Syed Shah on [md@acet-global.com](mailto:md@acet-global.com)



Figure 1: Complex, Expensive Construction of Conventional 'Western' Sewage Treatment Plant

Table 1: Limitations Associated with Some Existing Sanitation Options

Type of sanitation system and common applications	Toilet examples	Issues and limitations
<p>On-site:</p> <ul style="list-style-type: none"> <li>- Low income and less developed areas</li> <li>- Areas where water is scarce and/or often collected from a stand-post or well</li> </ul>	<ul style="list-style-type: none"> <li>- Simple pit latrine;</li> <li>- Ventilated Improved Pit (VIP) latrine;</li> <li>- Pour-flush latrine;</li> <li>- Aqua-privy;</li> <li>- Septic tank;</li> <li>- Ecological sanitation (ecosan) latrine</li> </ul>	<ul style="list-style-type: none"> <li>• Possible groundwater contamination and related health risks if pit is not completely lined;</li> <li>• Flies and mosquitoes, leading to increased disease transmission;</li> <li>• Smell/odour nuisance;</li> <li>• Can require considerable ground space (often limited in urban areas);</li> <li>• Difficult to construct in rocky or unstable ground;</li> <li>• Lack of privacy for users;</li> <li>• Need to be rebuilt regularly, or require regular removal and treatment of sludge;</li> <li>• Need to keep inside of latrine dark (VIP latrine);</li> <li>• Need water supply (pour-flush latrine, aqua-privy, septic tank);</li> <li>• Limited cleansing materials can be used (pour-flush latrine, ecosan latrine);</li> <li>• Need training of users (ecosan latrine);</li> <li>• Need permeable land to drain effluent (aqua-privy, septic tank).</li> </ul>
<p>Off-site:</p> <ul style="list-style-type: none"> <li>- Developed countries, affluent areas, cities and high population density areas</li> <li>- Areas with reliable water supply and sewage systems to treat wastewater</li> </ul>	<ul style="list-style-type: none"> <li>- 'Western' water closet;</li> <li>- Squatting pan;</li> <li>- Anglo-Indian toilet;</li> <li>- Smart toilet</li> </ul>	<ul style="list-style-type: none"> <li>• Need reliable water supply;</li> <li>• Need provision of wastewater treatment;</li> <li>• Need extensive permanent infrastructure;</li> <li>• Involve very high capital and operational costs;</li> <li>• Potential for land ownership issues to arise.</li> </ul>

## Value Chain of the Proposed Sanitation Solution

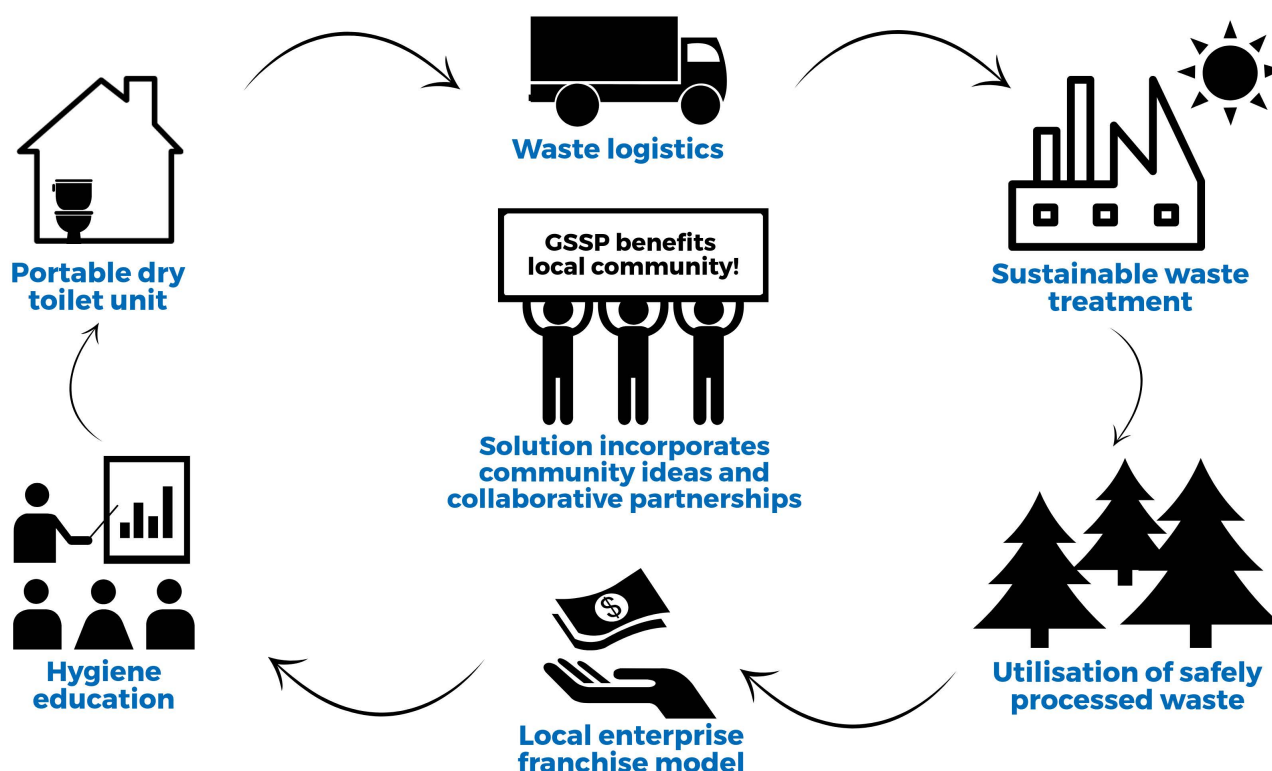


Figure 2: Value Chain of Proposed Sanitation Solution

Table 2: Social Barriers That May Limit Implementation of New Sanitation Systems and WASH Practices

Cultural/Traditional Barriers	Religious Barriers
Belief that it is shameful to be seen walking to a toilet	Belief that using a toilet may leave you vulnerable to evil spirits or demons
Odour emitted from the toilet	Belief that using a toilet may make you lose any magical powers
Belief that only wealthy people own toilets, so they are not affordable/appropriate for the poor	Belief that excrement is impure, and contact with it should be limited
Belief that it is polite to defecate in the field of someone who has given you food	Other Barriers
Belief that using a toilet can shorten life span	Perceived lack of privacy when using a toilet and belief that it is uncomfortable or unnatural
Centuries-long practice of defecating in the open	Inadequate education on the benefits of using toilets
Comfort with toileting in the open, so do not see need to change	Sanitation may not be a habit that is regularly practised
In some cultures, only people of low social status are responsible for removal of excrement (e.g. the 'Untouchables' in India)	Decrease in open defecation may reduce food for pigs





Figure 3: The Proposed Zero-Waste Solution is Applicable in Diverse Contexts, including Floating Villages

Table 3: Global Applicability of ACET-Global's Proposed Sanitation System

Type of variable	Examples of where the proposed sanitation solution may be used
Geographical region	<ul style="list-style-type: none"> <li>• More developed 'Western' areas – e.g. Australia, NZ, Europe, North America;</li> <li>• Less developed areas – e.g. Africa, Asia, Oceania, Central America, South America</li> </ul>
Context	<ul style="list-style-type: none"> <li>• Remote and/or inaccessible areas where traditional sanitation infrastructure is not possible, due to logistics or short-term nature of settlement (e.g. Antarctic and Arctic regions; scientific fieldwork and expeditions, mining settlements);</li> <li>• Water-based communities, such as Thailand's floating communities;</li> <li>• Urban areas with high population densities, such as slums and favelas;</li> <li>• Rural/remote areas with low population densities, such as national parks, wilderness areas, and camping areas that lack infrastructure;</li> <li>• After natural disasters – floods, earthquakes, tsunamis, cyclones, typhoons, etc. - especially when existing sanitation infrastructure has been damaged;</li> <li>• Crisis areas, such as refugee camps and temporary settlements</li> </ul>
Climate	<ul style="list-style-type: none"> <li>• Hot, cold, temperate, dry, and wet climates</li> </ul>
Environment	<ul style="list-style-type: none"> <li>• Flood-prone, drought-affected, and earthquake-prone environments</li> </ul>