WAI FORWARD

WINNOVATORS 2023

Sanitation and Hygiene Challenge

Submitted by the Wai Forward Team at WaterCare

Report Agenda

01 Background

02 Wash Strategy & Objectives Manufahi

03: Education & Segregation

04: Incineration & Sterilisation

05: Metal Recycle & Reuse

06 Glass Recycle & Reuse

07: Transportation

08: Project Implementation

09: Metal Recycle & Reuse

Background

Timor Leste Population: 1.2mil
Manufahi population: 57k (Census 2015 – projection for 2019)
Medical facilities in Manufahi: 27 (No hospitals)
Medical Waste produced in Manufahi: roughly 1140kg/day

Timor-Leste faces significant challenges in effective segregation and management of medical waste. The country's healthcare infrastructure remains limited, particularly in rural and remote regions. Consequently, many healthcare facilities lack the necessary waste management systems and resources, leading to inadequate handling and disposal of medical waste. To tackle this challenge, we've developed a scalable solution tailored to Manufahi, with the potential for wider implementation throughout Timor Leste upon successful outcomes in Manufahi.

Current projects & opportunities

- **PacWasteplus:** Healthcare Waste project
- **Asian Development Bank:** Solid Waste Management in the Pacific
- **United Nations Development Programme:** Strengthening the Resilience of Small Scale Rural Infrastructure and Local Government Systems to Climatic Variability and Risks (SSRI)

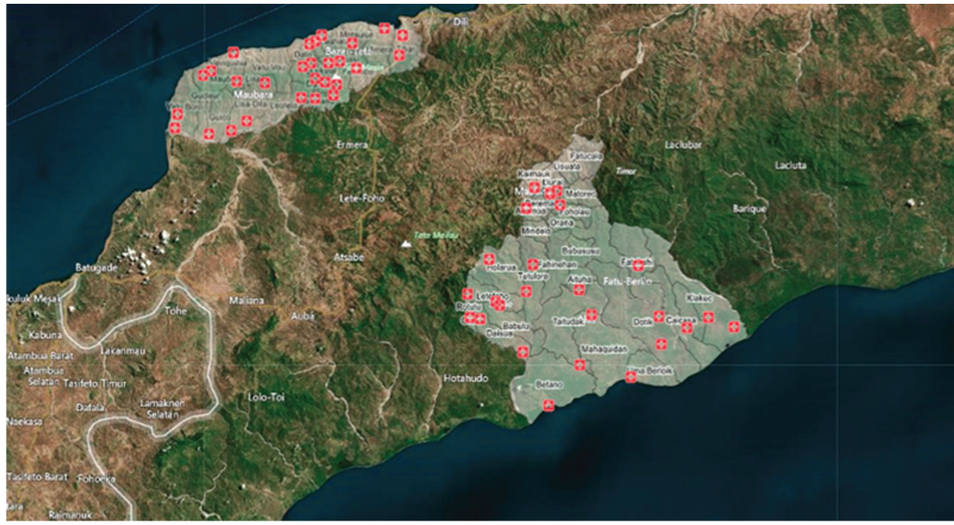


Figure 1. Map of study sites and location of facilities that were assessed.

WASH Strategy & Objectives Manufahi

Allocate Funding towards WaSH in Manufahi

Our solution aims to be **sustainable and cost effective** through our utilization of local materials and resources.

It will incorporate **collaboration with local government, international organizations and partners** to access technical expertise and financial support.

Educate and Segregate

We strive to integrate Timor Leste's culture and values into our **community-led** educational program.

Our approach involves crafting thorough but easy to follow regulations and guidelines for medical waste management and offering training and **capacity-building initiatives for healthcare staff** and waste handlers. This ensures meticulous and long-term waste segregation, handling, & disposal practices.

Incinerate and Sterilize

We combine innovative engineering with locally available materials to create user-friendly incinerators that are simple to construct, upkeep, and operate, while also emitting minimal toxins into the environment.

Employing **year-round incinerator** servicing experts generates additional employment prospects.

Recycle and Reduce

Our emphasis is on **sustainability, resilience, and local employment**.

By recycling glass into road materials and repurposing metal sharps for a circular local blacksmithing business, we create a dual-purpose approach: repurposing waste to create valuable resources and creating opportunities for income generation.

Education And Segregation

Our solution starts with an educational program for healthcare staff, teaching them the significance of correct waste segregation and how to operate our integrated waste management system.

To kickstart the educational program, an expert will conduct training for all local Healthcare Facility Representatives (HCF Reps), who will subsequently cascade the knowledge to their respective staff members through 'Train the Trainer' programmes. Enabling local healthcare leaders from Manufahi, to facilitate the on-site training increases responsiveness and receptiveness from HCF staff. This community-based approach is culturally appropriate, inclusive, minimises costs while ensuring better engagement due to ownership and familiarity.
There will be a training program run at each of the 27 HCF's in Manufahi (1).

We seek to tackle Manufahi's medical waste segregation challenge at its source. Each health post will have three well-labeled bins: **general waste, medical waste (including glass), and steel tin container for metal sharps**. The bins will be sized according to needs but should accommodate up to 1 week. The bins should be emptied weekly to minimise odour and spread of diseases.
With just three bins on-site, the segregation process becomes straightforward and seamlessly integrates into daily routines.

- Subject to availability, General Waste can and should be disposed of in municipal landfill. Alternatively, General Waste can be combined with Medical Waste and Glass to be incinerated, leaving ash and glass pieces behind.
- Metal sharps waste will be disposed in locked stainless steel containers designed to safely store sharp metal objects, preventing punctures and access. These containers also facilitate a complete melting and recycling process, as explained in a later section of our solution.

(1) Assessing water, sanitation and hygiene in health care facilities in Liquica and Manufahi 2020-2021, Wateraid, 2021

Inscineration and Sterilization

IMPLEMENTATION

6 incinerators will be installed in Manufahi, each with the capacity to process 50kg of waste per hour. The materials to build the incinerator will be locally sourced, with each incinerator costing roughly 1000USD to build (2) .

We will strategically position 6 incinerators in Manufahi: 2 in the North and Northwest, where healthcare facilities are concentrated, and 4 evenly distributed elsewhere.

For year-round effective incinerator operation, a couple of locally based technicians will be trained to operate and maintain the incinerators. They will be paid and stationed in Manufahi. These technicians will conduct regular inspections and address any incinerator-related issues promptly.

DESIGN & OPERATION

The incinerators are powered by wood burner. Each incinerator includes a metal mesh grate . All waste in the form of ash passes through the grate, whilst glass which is sterilized in the incinerator is left on the grate for efficient recycling. The remaining ash can be buried onsite.
To mitigate air pollution during incineration in Timor Leste, our incinerator design, inspired by the SECMOL team in India, employs a high-temperature combustion process with turbulence and rapid cooling (3). Operating at temperatures exceeding 800 degrees Celsius breaks down toxic gases into harmless compounds during a minimum 2 second incineration period.
Oxygen is then introduced to ensure complete oxidation, requiring temperatures to exceed 1000 degrees Celsius. A vortex in the secondary air mixing process enhances complete oxidation.

BENEFITS

- Can be built in rural contexts
- Produces fewer air pollutants than existing incineration methods
- Creates business opportunity for locals
- Can be sustained over time

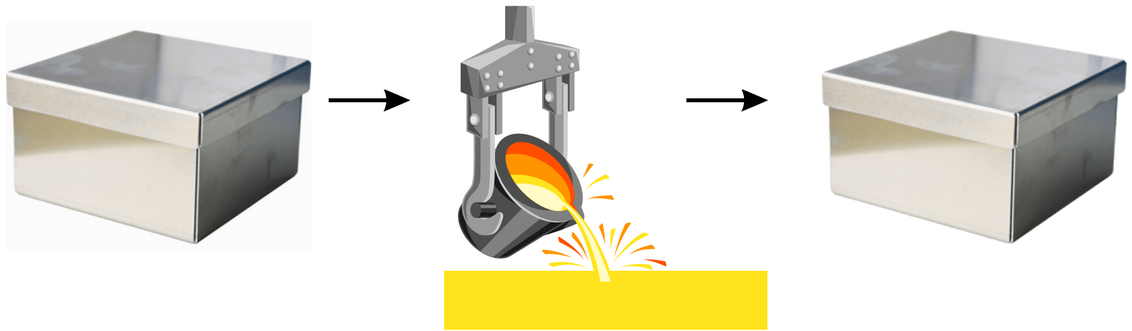
(2) Professor D.J. Picken. De Montfort Medical Waste Incinerator, https://www.engineeringforchange.org/solutions/product/de-montfort-medical-waste-incinerator/
(3) Rohit Ranjan (2018) , Low – Cost, High – Temperature Waste –Disposal Incinerator: A Prototype in SECMOL, https://www.linkedin.com/pulse/low-cost-high-temperature-waste-disposal-incinerator-prototype-rohit/

Metal Recycle & Reuse

Full metal container to be picked up and sent to blacksmith

Blacksmith to melt entire container and form into another recycled container

Drop off recycled containers to HCF , pick up after a week once full



Our innovative solution revolves around the efficient melting and sterilization of metal sharps (4) . To establish a secure protocol for handling metal syringes among healthcare professionals, we propose implementing specialized metal receptacles designed to accumulate metal waste. These receptacles can then be subjected to a controlled melting process, incorporating both the waste pieces and the containers themselves.

Each healthcare facility will be equipped with an ample supply of these designated metal containers, intended to cover their needs for a week. At the end of this period, the filled containers will be collected and promptly replaced with fresh containers for the subsequent week. This seamless rotation ensures an uninterrupted flow of safe metal disposal.

The metal waste, enclosed within the containers, will be transported to a local blacksmith, if available. Alternatively, one will be established to carry out this function. The facility will be strategically situated at the central hub of Manufahi in Aituha. In this facility, the collected metal will undergo a meticulous repurposing procedure, ultimately contributing to the fabrication of additional recycled metal containers. These newly created containers will subsequently be distributed to healthcare facilities, forming a continuous and sustainable cycle.
The main component of a purposed built facility is the forge. A coal forge is estimated at $300. The blacksmith will be trained and paid for their services. They will also be empowered to seek opportunities to secure and expand their business.

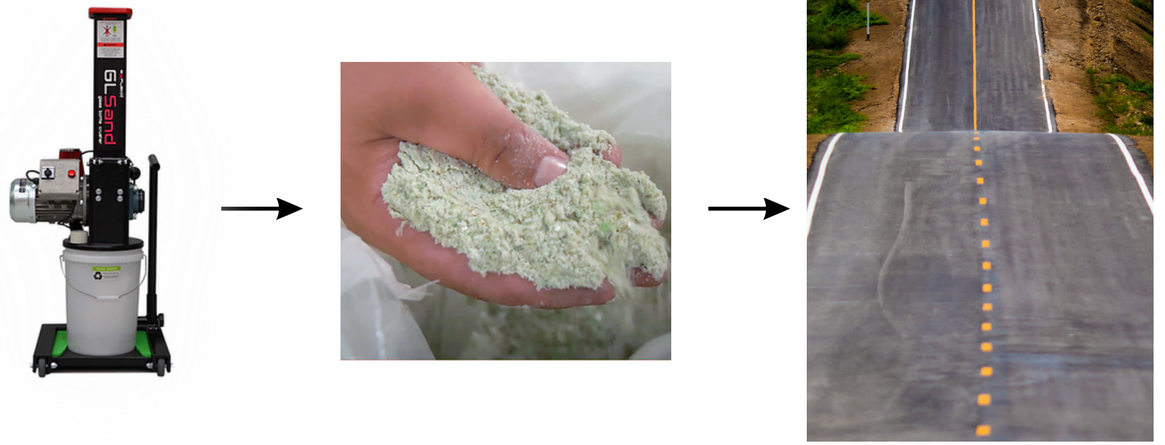
To ensure the success of this process, it is crucial that the application of heat during the melting procedure reaches and maintains a temperature exceeding 165 degrees Celsius, guaranteeing thorough sterilization and reformation.
For the seamless integration and successful adoption of this innovation, a strategic investment is essential in acquiring detachable metal equipment that can be easily separated from its plastic or glass components. This strategy guarantees that the designated containers are exclusively utilized for the containment of metal materials.

(4) S. Batterman (2004), Findings on an Assessment of Small-scale Incinerators for Health-care Waste., Water, Sanitation and Health Protection of the Human Environment World Health Organization Geneva

Glass Recycle & Reuse

Sterilizing hospital glass waste before utilizing a crusher to transform it into reusable sand particles presents a sustainable solution. Through proper sterilization, any potential contaminants are eliminated, ensuring safety for the waste handlers. The subsequent crushing process reduces glass waste into sand-like particles that can be repurposed for road construction, minimising the demand for natural resources. This innovative approach combines sterilization, waste reduction, and resource conservation, exemplifying responsible waste management with positive environmental impacts.

Timor-Leste has an extensive road network of about 6,000 kilometers (km), half of which are undeveloped rural tracks. The core network comprises 1,400 km of national roads connecting the capital, Dili, and 13 districts, and 900 km of district roads linking major population centers to the national roads. About 80% (1,800 km) of core roads are (or used to be) paved. A road survey conducted in 2008 found that only 8% of core roads were in fair condition, with the remaining in poor (22%) or very poor condition (70%). The current state of roading infrastructure, presents the need for roading to be improved. Through creating roading aggregates our innovation can help service this need.



The GLS-sand glass crusher functions by loading glass bottles into a hopper, which are then crushed by internal rotating blades or hammers. Following the crushing process, the glass fragments are sorted by size using screens, resulting in sand-like particles. This byproduct, known as GLS-sand, offers a sustainable substitute for natural sand in road construction. The uniform particle size and abrasive texture of GLS-sand make it suitable for mixing with asphalt or concrete, enhancing road surface durability. Additionally, its use reduces the need for traditional sand extraction, promoting environmental conservation in road infrastructure projects. With an effective cost of $5k USD a couple of these machines can be installed at Manufahi.
It is proposed to work with the Ministry of Public Works and partners such as Asian Development Bank, to fund and operate this facility, and to integrate the end product in their strategic plan to build and rehabilitate the roads nationally.

https://www.expleco.com/
https://www.ilo.org/dyn/asist/docs/F-906908386/RuralRoadMasterplanTimorLeste.pdf

Transportation

Transportation serves as a critical link tying together the various aspects of our innovation. It encompasses two key domains:

- **Moving Metal Sharps Containers:** These containers journey from blacksmiths to 27 healthcare facilities and back.
- **Transporting Glass:** This involves transferring glass from healthcare facilities to the glass collection point.

To meet our transportation needs effectively, our solution leverages the existing waste collection services contracted by the DDA (Dili District Administration) for private contracts (5). There is currently a big fleet of 30 private contractor vehicles for waste collection and transportation. The transportation service will be operational six days a week in Manufahi, with a daily visit to each locality housing an incinerator.

This dedicated service will not only collect glass scraps from the incinerator pick-up locations but will also retrieve metal tins from each healthcare facility individually. As part of this process, the transportation service will replenish each facility with an adequate supply of metal tins, ensuring they have sufficient quantities until the next scheduled pick-up, which occurs once a week.

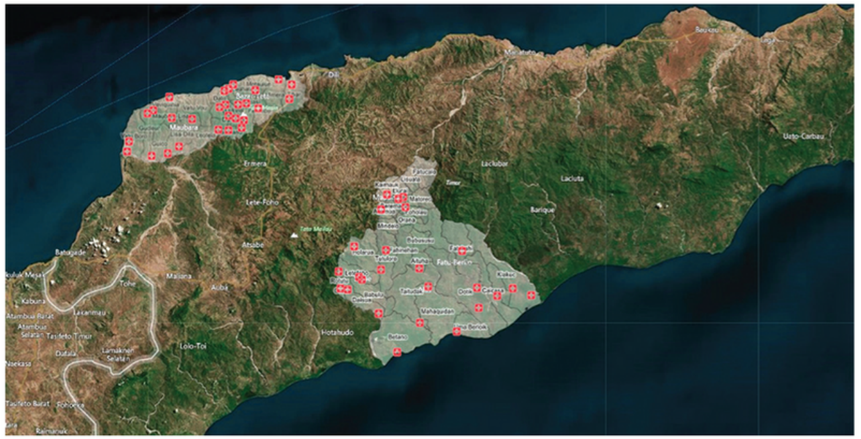


Figure 1. Map of study sites and location of facilities that were assessed.

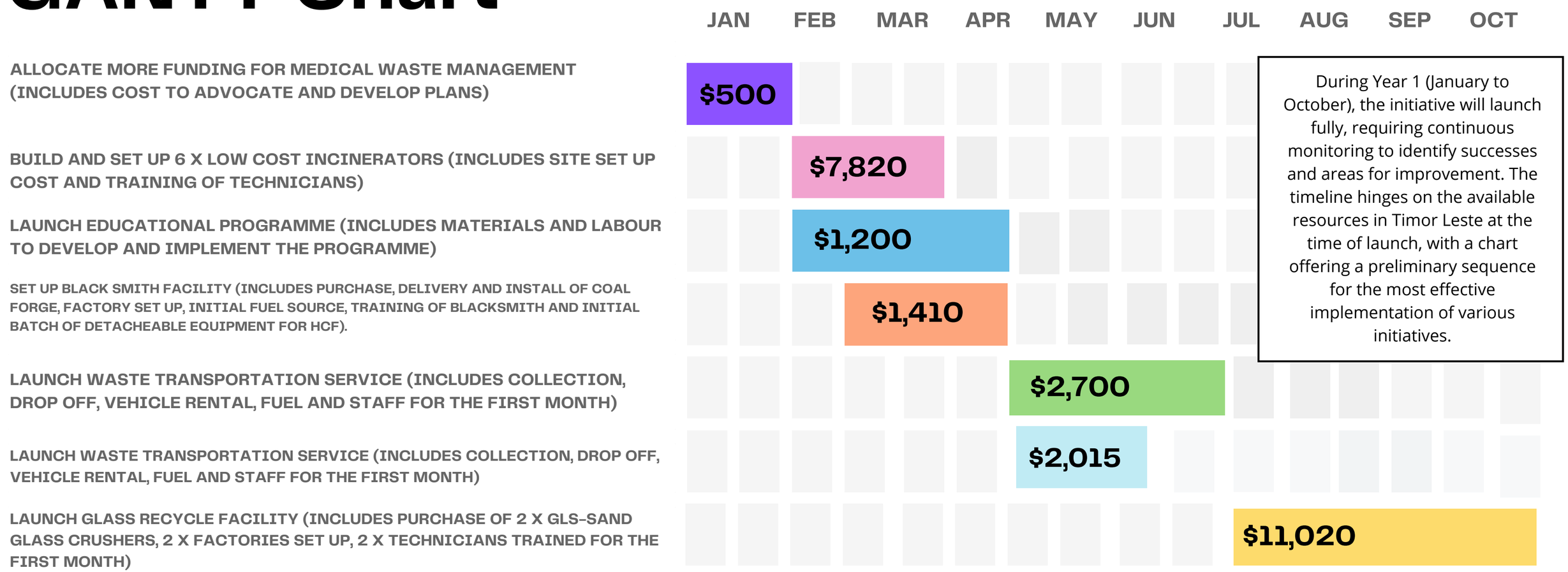
Drop off
Both the blacksmith and glass collection point will be located in close proximity of each other so that the drop off process can be carried out efficiently each day.

Cost
Payment is generally about $60–$65 per truck per day for collection and disposal of waste, including vehicle rental, fuel, and staff

(5) Solid Waste Management in the Pacific Timor-Leste Country Snapshot. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.adb.org/sites/default/files/publication/42661/solid-waste-management-timor-leste.pdf

Timeline and Cost – Implementation GANTT Chart

Estimated Implementation Cost
*Assuming that the Ministry would cover for cost of land/site



During Year 1 (January to October), the initiative will launch fully, requiring continuous monitoring to identify successes and areas for improvement. The timeline hinges on the available resources in Timor Leste at the time of launch, with a chart offering a preliminary sequence for the most effective implementation of various initiatives.

Total Implementation Cost	**$26,665**
Total Implementation Cost Per Site	**$ 988**