Adoption of decentralised waste management systems in Zanzibar

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EXISTING WASTE MANAGEMENT PRACTICES IN ZANZIBAR

Zanzibar municipality is divided into three urban areas- Zanzibar Municipal Council (ZMC), Municipality A and Municipality B. In total there are 40,000 to 50,000 households and the total population of the urban municipality is 2, 23,000. Of the total 230 tonnes of waste that is generated in Zanzibar every day, 120 tonnes is collected. The collection efficiency is 86% in the Stone Town area, however, it is less than 40 percent in other areas. The municipality takes care of solid waste management in four operational areas namely- Stone Town, West, North and South town.

There is door-to-door collection in Stone Town, wherein every morning waste collectors collect waste from households in pushcarts that can go inside the narrow alleys. The waste is then taken to a primary collection point (5 in number), and from there the trucks take waste to the dumpsite, situated 20 km away from the city in Kibele, having an area of 47ha. There is no processing of waste and no sanitary landfill in Zanzibar.

DECENTRALISED WASTE MANAGEMENT APPROACHES FOR ZANZIBAR

Since, the composition of waste in Zanzibar is mainly organic i.e. 86 per cent, whereas the remaining 14 percent majorly comprises of dry recyclable waste such as plastic, metals, textile, cardboard, glass and sanitary waste, adopting decentralised waste management would be a suitable approach.

Decentralised waste management systems help reduce the quantity of waste generated at source by involving communities in segregation at source. The segregated wet waste is then processed by adopting practices such as composting (home composting, bin composting, box composting, vermi-composting). The dry recyclable waste is sent for recycling. Such systems help municipalities save costs of collection, transportation and disposal of waste. The objective of adopting such an approach is to reduce the dependence of land for dumping of garbage and push for Zanzibar becoming a zero landfill island.

PROPOSED PILOT PROJECT FOR DECENTRALISED WASTE MANAGEMENT FOR 100 HOUSEHOLDS (HHs)

1. Brief description of the process

CSE plans to work with Zanzibar Environmental Management Authority (ZEMA), Department of Environment (DoE) and one of the urban municipalities on setting up a decentralised pilot for 100 households in peri-urban, rural areas of Zanzibar, ideally located near one of the major tourism spots of the island. The main objective of the model is to achieve 100 percent source segregation, where wet waste can be composted at source and dry waste is channelized to recyclers.

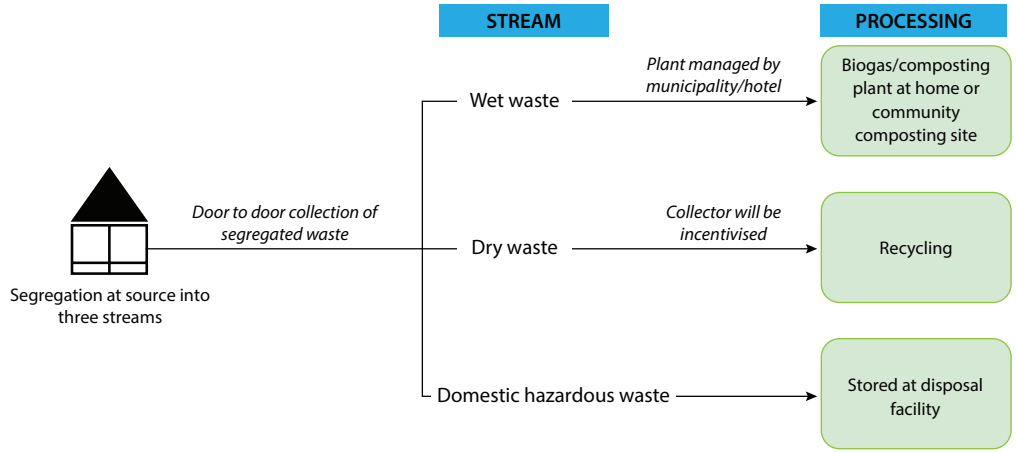
Under decentralised waste management pilot project, following processes will be developed:

- 100 households (HHs) in the rural area to be taken up for the pilot project.
- The HHs will have to compulsorily segregate waste into wet, dry and domestic hazardous waste. The municipality or tourism sector (such as hotels) shall be responsible for provision of one bin and two bags to these HHs (bin for wet waste, one bag for dry recyclable waste and one for domestic hazardous waste).
- The municipality will be responsible for door to door collection of solid waste from the households. In addition, they will need to provide infrastructure such as vehicles (1

tipper), push-carts (2), equipments etc. for collection and transportation of segregated waste.

- Under the pilot, 5 volunteers shall be hired and trained for propagation work. The volunteers shall play an important role in spreading awareness and will sensitise HHs about segregation at source.
- Also, 2 waste collectors (deputed by the municipality) shall be responsible for collection of segregated waste. The wet waste shall be collected every day, while the dry and domestic hazardous waste shall be collected once every week.
- **Incentivise waste collector:** The collector shall be incentivised for collection of segregated waste and will be liable to sell the segregated dry waste to the nearest franchise or dealer (collector of recyclable goods/recycling station).

Figure 1: Proposed model for waste management in 100 households in Zanzibar



Source: Prepared by CSE, 2017

2. Proposed model for the decentralised composting plant for 100 households

The segregated wet waste can be composted by aerobic composting. On an average, around 70-90 kilograms of wet waste shall be generated from 100 households per day (taking 1kg/hh/day, 86 percent as wet waste). The composting unit will be set up in an area designated by the local authority having a capacity of 50 kg/unit. Three such units shall be required for composting wet waste.

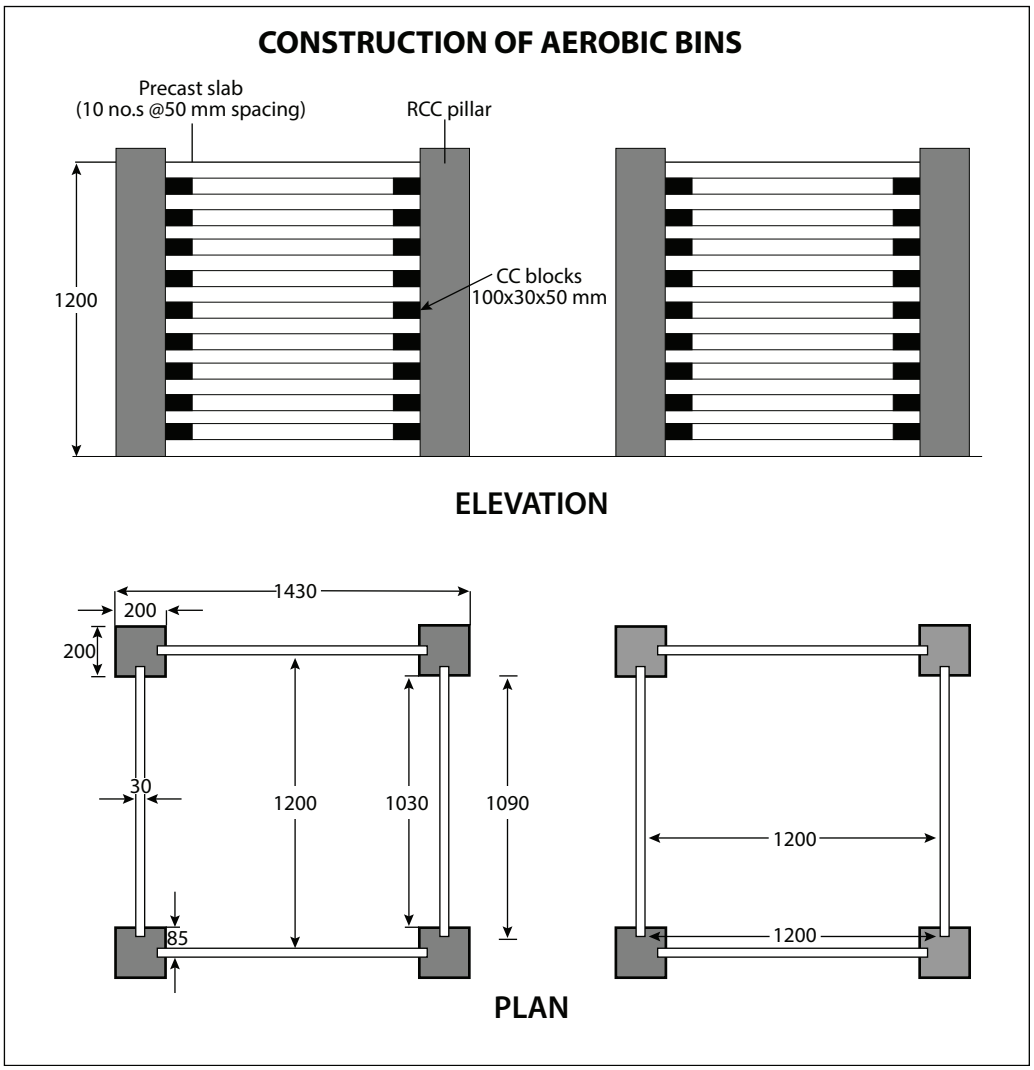
The plant can be either managed by the local authority or by the hotel industry or can be run on a public private partnership (PPP) mode.

SPECIFICATIONS OF THE COMPOSTING PLANT

A. Model 1 – Aerobic Composting Bin

The proposed composting plant will have 3 pits made of precast ferro-cement slabs, which could be assembled, dismantled and fixed. The dimension of the pit is 4 x 4 x 4 ft size. Four corner pillars will have to be set up and precast slab @50 mm spacing needs to be placed. The blocks should be of size 100× 30× 50 mm. The best part about the bin is that it is movable. Based on the average humidity, wind speed and ambient temperature, the bin will work well in Zanzibar. Refer to Figure 2 for the schematic diagram of the proposed model.

Figure 2: Schematic diagram of the proposed aerobic composting bins



(Not to scale, for understanding only)
Note: All dimension in mm.

Treatment process

The model is designed in such a way that air enters into the tank through the gaps on the sides. It should be kept under a roof to avoid rainwater falling into the tank. About 1-2 tonnes of waste can be processed into compost in 90 days in this tank. A layer of fresh cow dung is put at the bottom of the tank to generate microbes for composting. Above this, a 6-inch layer of dry leaves or dry grass or small pieces of paper is placed. Over this, layers of bio-waste and cow dung are placed. Instead of cow dung, an *inoculum* or *bio-culture*[1] can also be used; dry leaves and dry grass absorb water oozing from garbage. The temperature inside the tank goes up to 75°C. This prevents mosquitoes and flies and other small creatures from entering. The construction cost of each tank is around 20,000 INR. Please refer to the economics of the model for construction of the bin below.

1. Inoculum or Bio culture is a mixture of microorganism culture that accelerate the aerobic composting process.

Figure 3: Photograph of the aerobic composting bin model

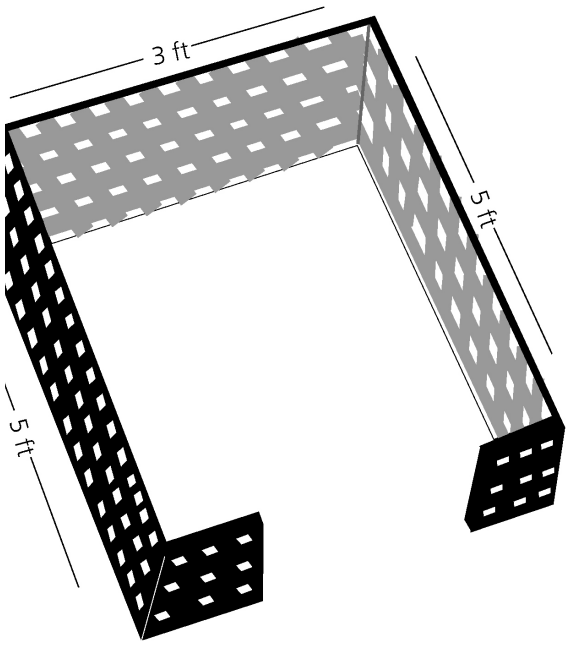
Figure 4: View of ferro-cement corner pillars and side bars dismantled

B. Model 2 – Box composting

The box composting model will have 3 equally sized cubical pits of size 3×5×5 feet. The pits are made using basic construction materials such as bricks and cement. They are designed in such a way that the decomposing waste receives sufficient oxygen flow from all the sides.

This is very important in order to speed up the rate of decomposition. Moreover the design is very user friendly as the pits are above the ground, which makes filling, emptying and mixing easier. Also, pits are provided with wide opening in the front which again makes the work convenient for the laborer.

Figure 5: Schematic diagram of the proposed box composting model



(Note to scale, for understanding only)

Figure 6: View of the proposed box composting model

Treatment process

In this particular setup, there is no need for any motorized machines; only manual labour is required to carry out the process. A layer of discarded green coconut shells is arranged upside down at the bottom of the pits so as to let the leachate flow out of the heap efficiently

and to improve the ventilation of the heap. Over this a layer of husk or horticultural waste such as dry leaves, grass etc. is placed and on top of it a layer of cow dung is spread. This is done in order to facilitate the growth of the microorganisms which in turn increases the rate of decomposition of waste. Above this, the wet waste is placed. After putting the segregated wet waste in the cubical pits, it is mixed manually after every 2-5 days using a shovel or a diamond fork.

It takes around 45-60 days for the compost to get ready depending upon the weather. Once ready, the mixture is sieved so as to separate the impurities such as plastics, paper etc. and get homogeneous and fine compost. The decomposition process can be enhanced by utilizing the cow dung and cow urine. Every time the wet waste in the pit is mixed, fresh cow dung is added to the decomposing pile. Cow dung helps to maintain the nitrogen balance of the mixture; similarly dry leaves are mixed so as to maintain the carbon level. Maintaining both carbon and nitrogen level is important for achieving optimum decomposition. To speed up the decomposition process, *bio-culture* can be added to the pile. This product also helps in reducing the odour from the decomposing waste.

3. Economics of the model

The total estimated cost in case the aerobic bin model is adopted would be 1100 USD approximately. However, incase box composting is chosen, the total cost would be 450 USD. Also, 5 volunteers shall be required for door to door propagation @50 INR per day (1500 INR per month, approx. 52000 Ts/month). Refer to table 1 and 2 for detailed economics of the two models.

Table 1: Economics with aerobic bins (Model 1)

Materials required	Estimated cost in INR	Total estimated cost (in INR/Rs)	Amount in Ts @34.79/ INR
100 Bins (one time investment)	70/bin	7000	244230
2 Bag (one time investment)	15/bag	3000	104370
3 aerobic compost pits (one time investment)	20000/pit	60000	2087400
Total		70000	2436000

Table 2: Economics with box composting (Model 2)

Materials required	Estimated cost in INR/Rs	Total estimated cost (in INR/Rs)	Amount in Ts @34.79/ INR
100 Bins (one time investment)	70/bin	7000	244230
2 Bag (one time investment)	15/bag	3000	104370
3 box compost pits (one time investment)	6000/pit	18000	626220
Total		28000	974820

Note: Both the models require a shed, whose cost shall be based on the availability of local material for construction

3. Ownership of the proposed model

The model can either be single handedly looked after by the municipality or it can operate on a PPP mode. The economy of Zanzibar thrives on tourism (upto 80 percent) and hence tourism sector can provide infrastructure and resources for the maintenance of the proposed model. Ideally, the local authority should be responsible for provision of land, infrastructure and workers for collecting the waste from the households whereas the hotel sector could invest in the upkeep and maintenance of the decentralized model. Also, NGOs and community based initiatives can take up this model and replicate it in different areas of Zanzibar.

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