Adoption of decentralised waste management systems in Swaziland

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EXISTING WASTE MANAGEMENT PRACTICES IN SWAZILAND

The last waste inventory was done in Swaziland in 1997, the generation was close to 86,000 tonnes/year. At present, there is no estimation of how much waste is generated in the country. But it is clear that it is increasing. As per available estimates, per capita waste generation is 0.2 kg/day in Swaziland. The waste composition majorly comprises of 50-55 per cent organic and remaining 45-50 percent comprises of recyclable waste (such as paper, plastic, metal, glass) and inerts. The town councils and town boards (referred as municipality in this document) are responsible for management of waste in urban areas that focuses entirely on collection (efficiency is over 65%) and disposal.

For disposal, there are 3 landfill sites owned by municipality in the towns of Mbabane, Matsapha and Piggs Peak. There is also one industry owned landfill in the country. However, these are not engineered landfill sites. The country also has a huge issue of informal settlements in peri-urban areas where there is no system of waste management.

DECENTRALISED WASTE MANAGEMENT APPROACHES FOR SWAZILAND

Adoption of decentralised approaches for waste management in Swaziland is the need of the hour in order to reduce the quantity of waste generated. 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 and vermi-composting). The dry recyclable waste is sent for recycyling. 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 making Swaziland a zero landfill country, that is in coherence with the country's goal to become developed by 2022.

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

1. Brief description of the process

CSE plans to work with Swaziland Environment Authority (SEA) and one of the urban town councils or town boards on setting up a decentralised pilot for 100 households (HHs) in urban or peri-urban areas of Swaziland. 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 HHs in urban or peri-urban 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 shall be responsible for provision of one bin and two bags to these households ((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

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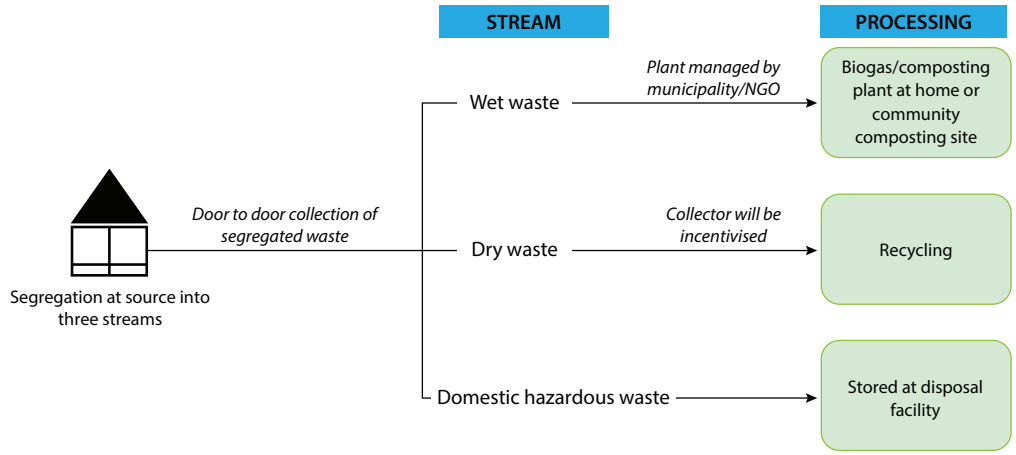
volunteers shall play an important role in spreading awareness and will sensitise HHs about segregation at source.

- 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 incentivized for collection of segregated waste and will be liable to sell the segregated dry waste to the nearest dry waste collection centre (DWCC).
- **Setting up of DWCC:** A DWCC could be set up where recyclable material is further sorted into different categories that can be further sent to recyclers. The centre could be owned by the municipality and the informal sector, who have the knowhow to sort dry recyclable waste, can run such centres.
- **Encourage recycling and upcycling centres:** The SEA and municipality should encourage recycling and upcycling centres in Swaziland to boost parallel economies thriving on waste.

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



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 50-55 kilograms of wet waste shall be generated from 100 households per day (taking 1kg/hh/day, 55 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.

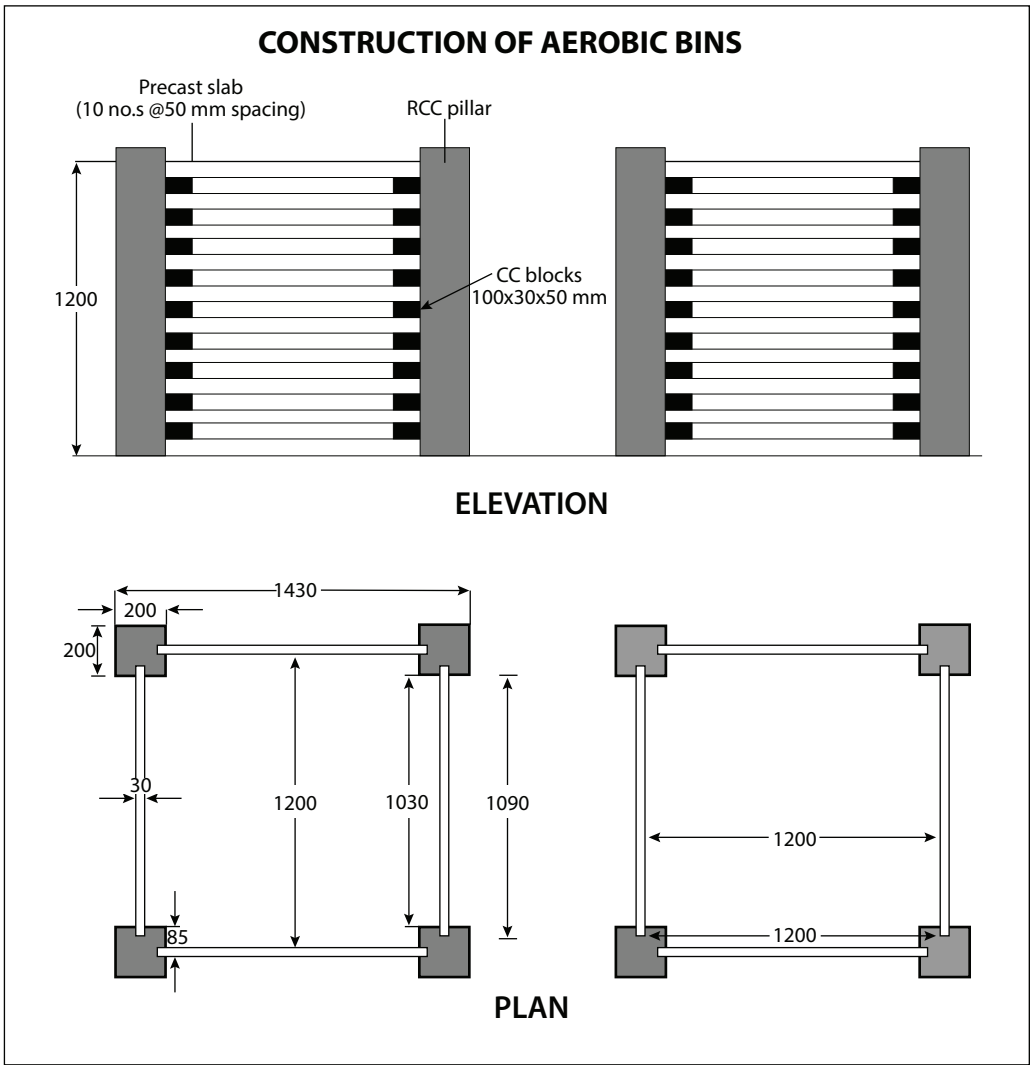
SPECIFICATIONS OF THE COMPOSTING PLANT

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 x 30 x 50 mm. The best part about the bin is that it is movable. The proposed bin will work well in Swaziland. 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

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

economics of the model for construction of the bin below.

Figure 3: Photograph of the aerobic composting bin model

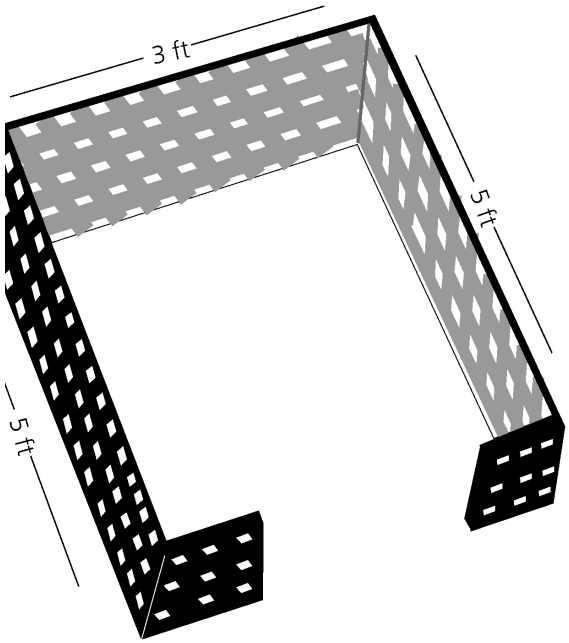
Figure 4: View of ferro-cement corner pillars and side bars dismantled

B. Model 2 - Box composting

The box composting model will have 3 equally sized cubical pits of size 3 x 5 x 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 labourer.

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 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 1088 USD approximately. However, incase box composting is chosen, the total cost would be 435 USD. Also, 5 volunteers shall be required for door to door propagation @50 INR per day (1500 INR per month, approx. 298.71 SZL/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 SZL @ 0.20/ INR
100 Bins (one time investment)	70/bin	7000	1395.32
2 Bag (one time investment)	15/bag	3000	598.00
3 aerobic compost pits (one time investment)	20000/pit	60000	11959.92
Total		70000	13953.24

Table 2: Economics with box composting (Model 2)

Materials required	Estimated cost in INR/Rs	Total estimated cost (in INR/Rs)	Amount in SZL @ 0.20/INR
100 Bins (one time investment)	70/bin	7000	1395.32
2 Bag (one time investment)	15/bag	3000	598.00
3 box compost pits (one time investment)	6000/pit	18000	3587.98
Total		28000	5581.3

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. Ideally, the local authority should be responsible for provision of land, infrastructure and workers for collecting the waste from the households whereas the private sector could invest in the upkeep and maintenance of the decentralised model. Also, NGOs and community based initiatives can take up this model and replicate it in different areas of Swaziland.

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