



Project 3:

# Design of Vermicompost unit for Housing Society

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Guide  
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# Garbage??



Fig. no.1

“Waste” UN definition. –  
“Materials that are not prime products(i.e. product produce for market) for which generator has no further use for his own purpose of production transformation or consumption and which he discards, or intend or is required to discard.”

“(http://unstats.un.org/unsd/environment/envpdf/UNSD\_UNEP\_ECA%20Workshop/Session%2008-3%20Waste%20Statistics%20%28UNSD%29.pdf)”



**\$205.4 billion/year**

World Solid  
waste  
management





**\$375.5  
billion/year  
by 2025**

Ref.

[http://www.wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2012/07/25/000333037\\_20120725004131/Rendered/PDF/681350WP0REVIS0at0a0\\_Waste20120Final.pdf](http://www.wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2012/07/25/000333037_20120725004131/Rendered/PDF/681350WP0REVIS0at0a0_Waste20120Final.pdf)


Fig. [http://articles.economictimes.indiatimes.com/2012-08-27/news/33425186\\_1\\_credit-card-icici-bank-s-platinum-electricity-bill](http://articles.economictimes.indiatimes.com/2012-08-27/news/33425186_1_credit-card-icici-bank-s-platinum-electricity-bill)

# Garbage??



**CONSUMERS IN RICH COUNTRIES WASTE ALMOST AS MUCH FOOD (222 MILLION TONNES) AS THE ENTIRE FOOD PRODUCTION OF SUB-SAHARAN AFRICA (230 MILLION TONNES)**



[www.unep.org/wed](http://www.unep.org/wed)



This poster features a red background. At the top left is the UNEP logo. At the top right is the 'THINK-EAT-SAVE' logo with the text 'WORLD ENVIRONMENT DAY 5 JUNE'. The main text is in white and pink, stating that consumers in rich countries waste almost as much food as the entire food production of sub-Saharan Africa. Below the text is the website 'www.unep.org/wed'. At the bottom is a photograph of a silver trash can with a yellow sticker that says 'REDUCE YOUR FOOTPRINT'.




# Garbage??



AGRICULTURE INCLUDING UNEATEN **FOOD** CONTRIBUTES MORE THAN 30% OF TOTAL GREENHOUSE GAS EMISSIONS

[www.unep.org/wed](http://www.unep.org/wed)



REDUCE YOUR FOOTPRINT

This poster features a dark green background. At the top left is the UNEP logo, and at the top right is the 'THINK-EAT-SAVE' logo for World Environment Day on June 5th. The central text highlights that agriculture, including uneaten food, is responsible for more than 30% of total greenhouse gas emissions. At the bottom, a white bowl filled with various vegetables like bell peppers, tomatoes, and carrots is shown with a knife resting on top. A banner across the bowl reads 'REDUCE YOUR FOOTPRINT'.

# India

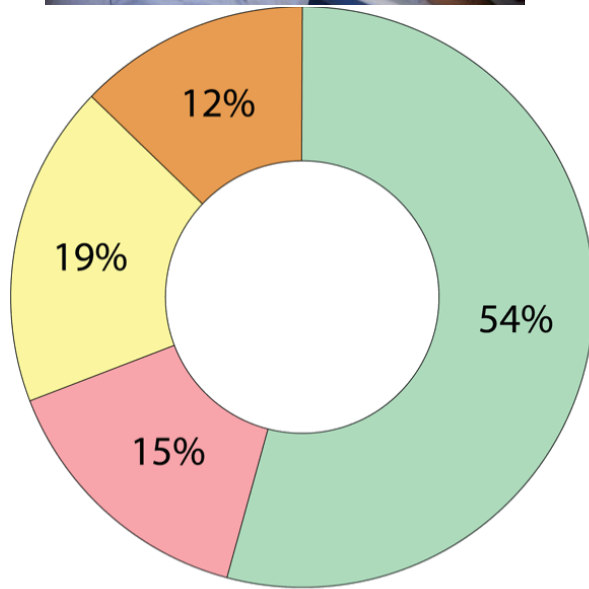
**55 million ton MSW  
(Municipal Solid Waste in 2009-2010)**



# Mumbai



Rishi Aggarwal



■ Wet organic matter   ■ Dry organic matter  
■ Recyclable material   ■ Inert material

- **13 million** population
- **7025 ton/day** = 5000 Bio degradable and recyclable waste + 2025 ton construction debris
- Annual budget for solid waste management of MCGM is Rs.1000 cr
- **30-40%** of budget spend only on Transportation of garbage to the **Landfills**

# Types of waste

## Dry waste -

paper plastic,  
wood,  
cloths,  
glass,  
metals,  
ceramics,  
Garden waste,  
Construction  
debris

## Wet waste -

Food waste,  
Kitchen waste,  
Bio waste

## Bio medical waste

-

Hospital waste,  
Medicines waste,  
Chemicals

## Radioactive waste-

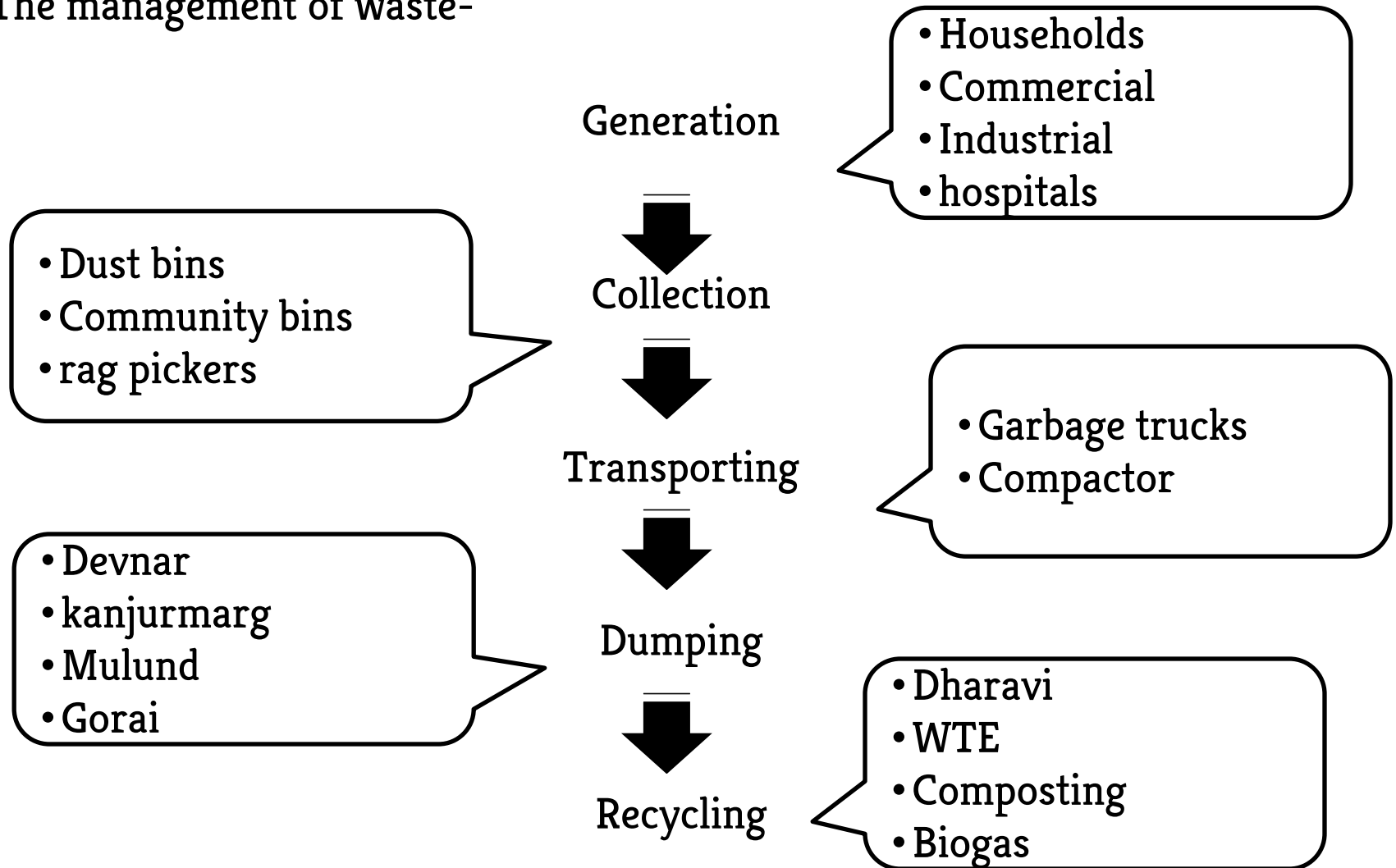
Nuclear waste





# Dealing with waste

The management of waste-



# Collection of waste

- 1,00,000 rag pickers in city
- 5800 community bin across the Mumbai
- MSW rule 2000



Fig.1



Fig.2



Fig.3

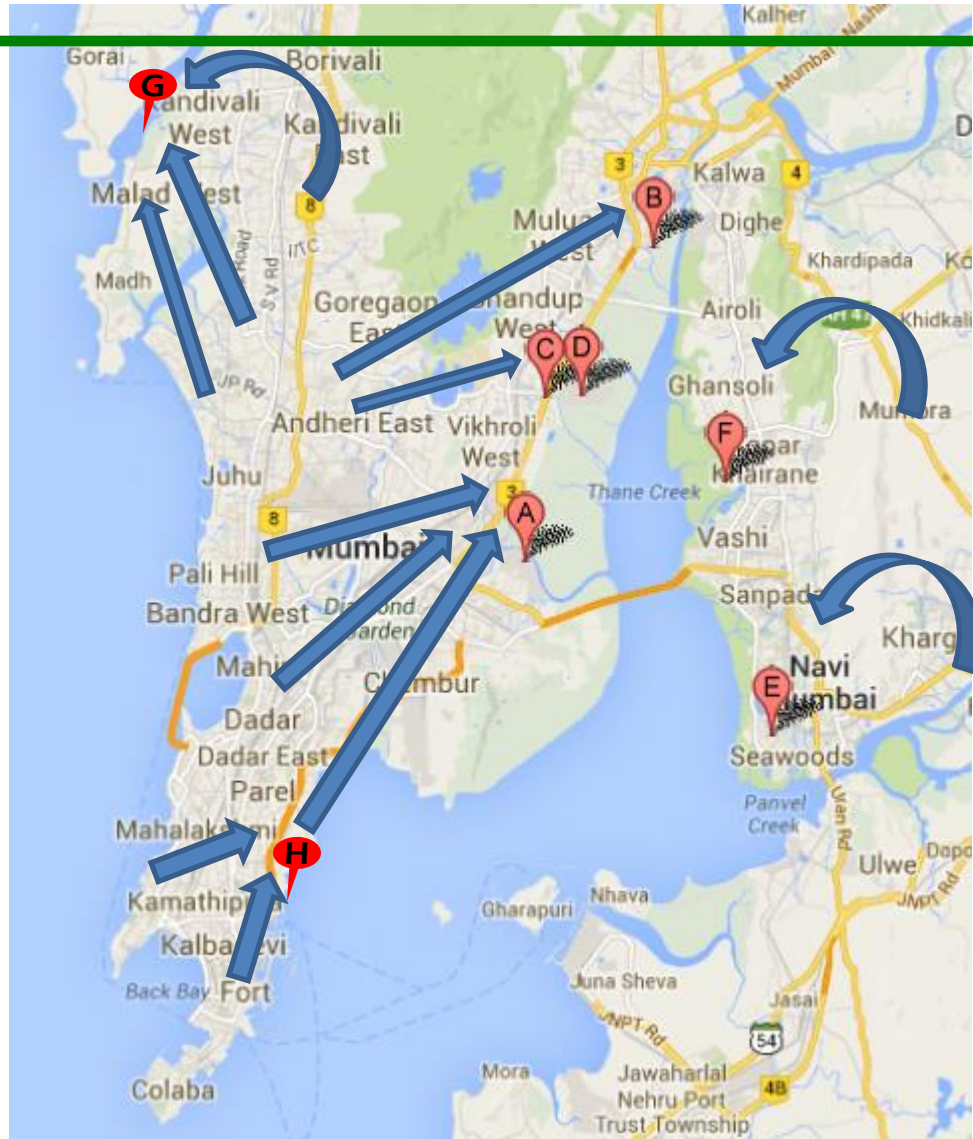
Fig.2 <http://mumbai.metblogs.com/2007/07/01/make-money-from-garbage/>

fig.3 <http://www.stuartfreedman.com/blog/2012/07/the-future-of-the-rag-pickers/>

# Transportation of waste

- A**- Devnar
- B**- Mulund
- C**- kanjurmarg
- G**- Gorai
- H**- Mahalakshmi

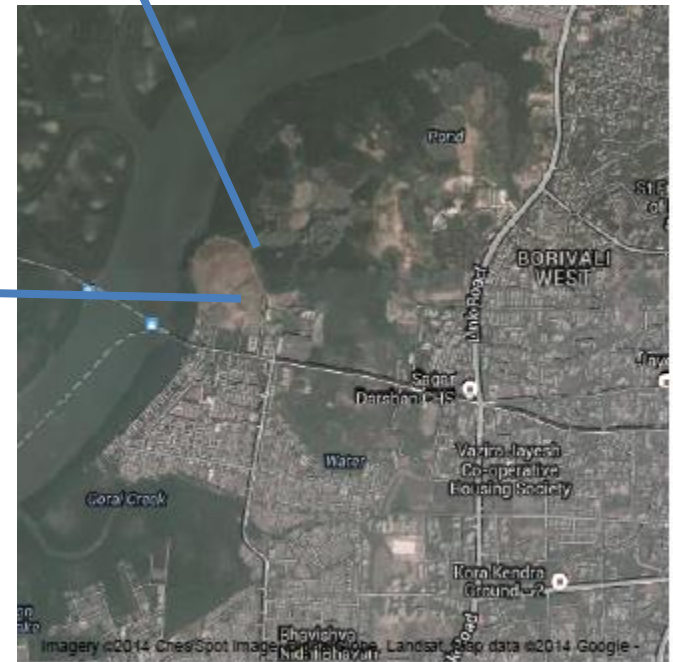
- 800 vehicles running
- 15-20 lakhs /day for just moving the waste.



# Dumping of waste

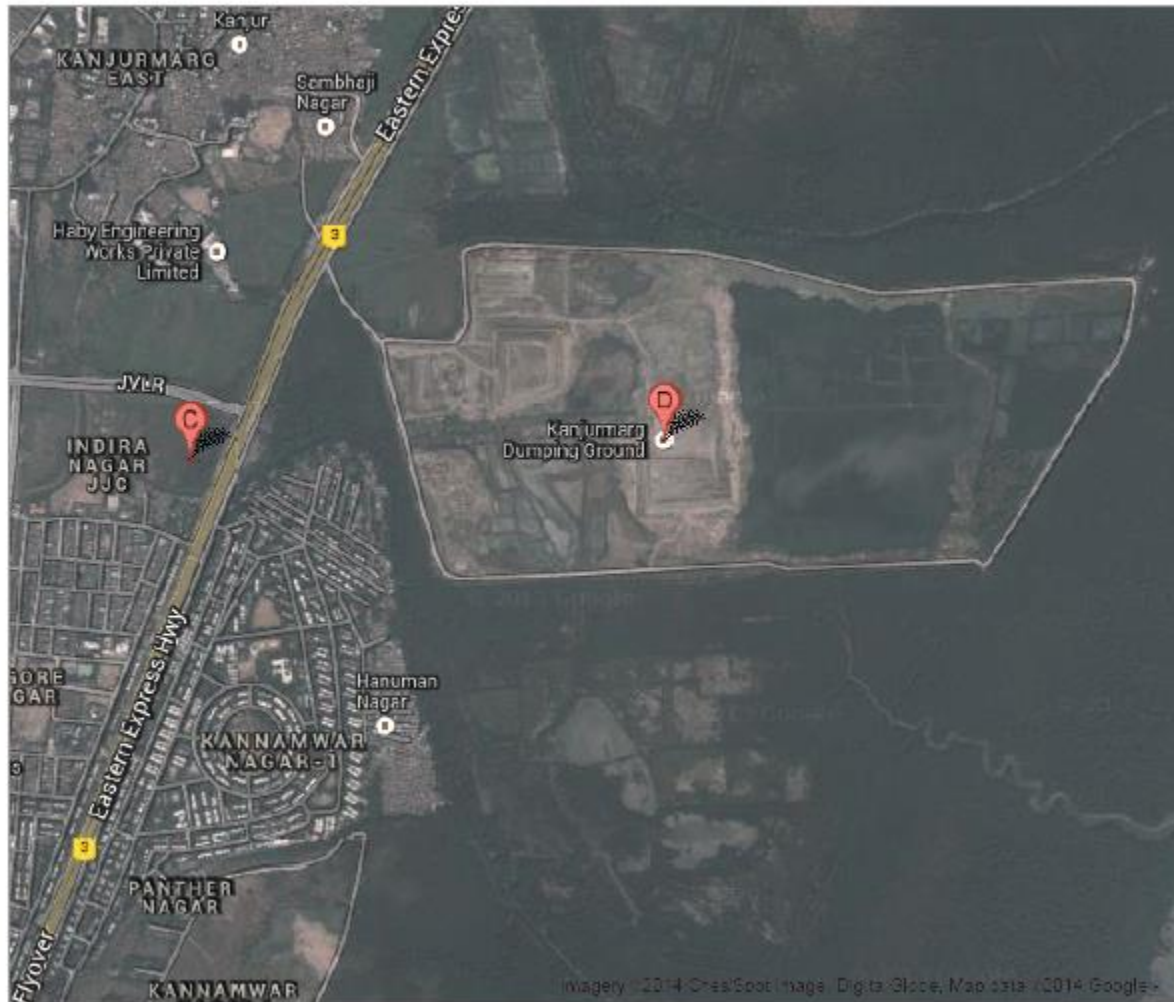


Gorai





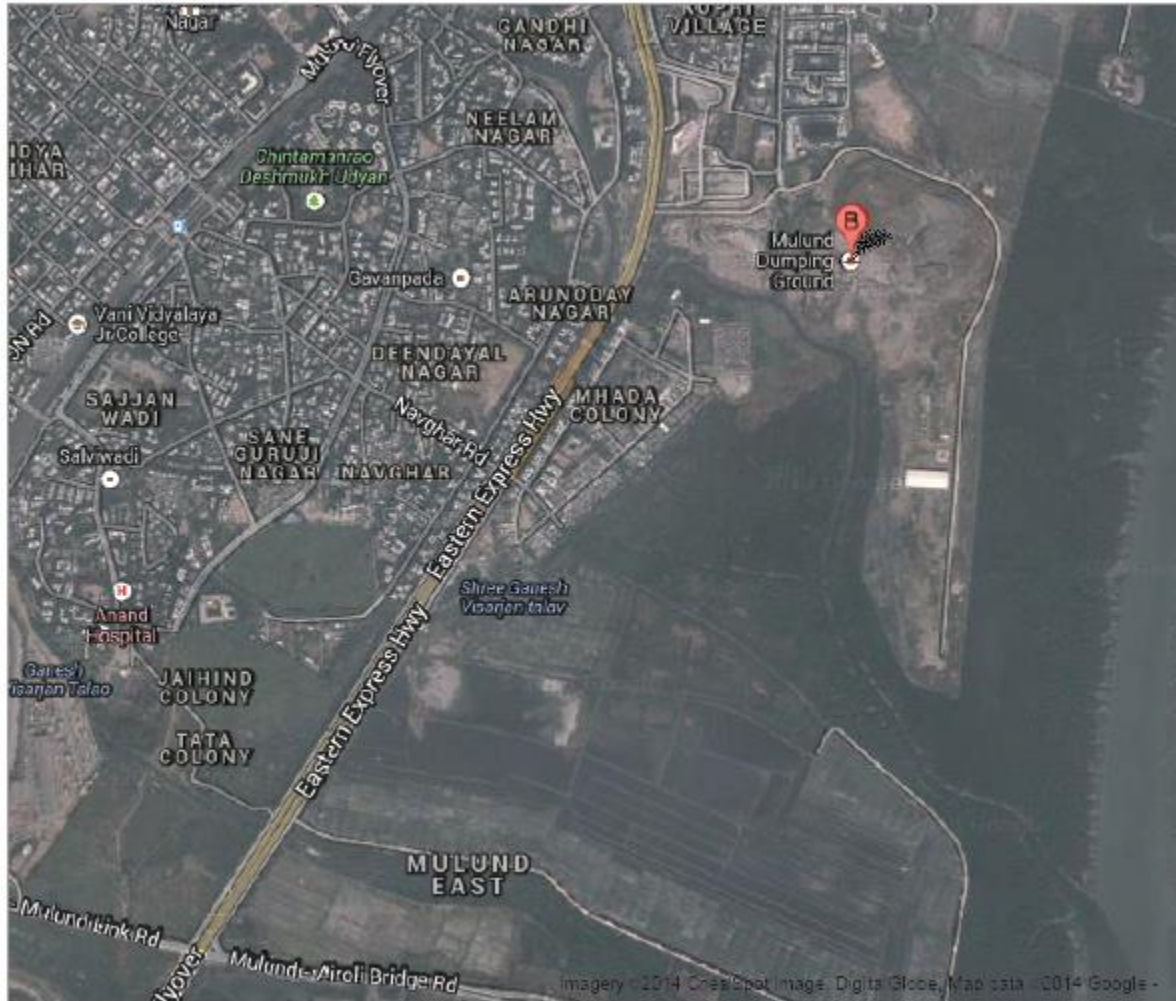
# Dumping of waste



Kanjurmarg



# Dumping of waste



## Mulund

- 95% of waste transport to this dumping grounds
- Leachate
- create Methane gas
- Nashik 3 MW power plant

# Wet waste - dealing at source level

- **WHY it is Important?**- Problems for segregation, Landfill, Leached, Methane
- **RESPONSIBILITY** of waste
- **MOTIVATION**
- **VALUE ADDITION** to the waste



# Wet Waste composting

- Aerobic
- Anaerobic



1. Khamba



2. Composter



3. at IITB

- Microbes
- Decomposing in controlled environment
- Mix of brown and kitchen waste

1. <http://www.dailydump.org/products>

2. <http://lifehacker.com/5931882/build-a-tumbling-composter>



# Wet Waste composting

## Aerobic Vermicomposting

- Red wigglers (*Eisenia fetida*)
- Black gold
- 45 days
- Best natural fertilizer



1. MCGM nursery, Mulund



2. C.D. Deshmukh Garden, Mulund



# Wet Waste composting

## Anaerobic BIOGAS

- In the absents of oxygen
- Methane gas
- Manure



1. TISS, Devnar



2. IITB Staff Canteen



3. IITB up comings



# Why Vermicomposting ?

Vermicomposting ! it's a  
"Culture"

- Faster process than aerobic composting and Biogas
- Easy for setup
- Best fertilizer
- Good business model



# Issues need to address in vermicompost

- Maintaining Temperature
- Worms Handling
- Compost Harvesting
- Tools
- Process Defining





# Vermicomposting Workshop

By Prakash Dandekar, Mahim, Mumbai-



shredder demo



beautiful terrace garden



Home made digester



Discussion on waste management



home grown Tomatoes



Flowering plants

# Vermicomposting Workshop

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## Inferences from the visit -

- Types of worms we can use are “Eisenia fetida” and “Eudrilus Eugenie”
- 25 families need around 25 cubic feet of volume of worm bin
- Worm wash and worms can be produce as byproducts
- ‘Bio culture Powder’ is used as an accelerator
- Harvesting is a difficult and messy process
- Coconut coir and sugarcane bagasse can be used as a worm bed
- Plastic containers are not suitable for worm bin in Indian climate
- Only uncooked food can be processed
- Dry leaves layers can be used to prevent the entrance of flies and insects

# Vermicomposting Workshop

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## **Inferences from the visit -**

- Stirring is important once in a 2 days
- Water need to sprinkle according to dryness
- More the air circulation, less the odor Problem
- Recommend steel wire mesh containers
- Vermicompost is the best for Terrace garden because it has very less weight than soil
- Can be used for any kind of plants
- Fruits like lemon, Pineapple are harmful if mix in large quantity
- Keep it in shades
- Over watering may create slippery in worms



# Data Collection & field Study Analysis-

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- separate the wet waste and dry waste at source level data shows 40 to 50 % is the wet waste, which can be used for biogas, aerobic composting.
- Vermicompost is quicker than other processes like bio gas, aerobic composting etc.
- Requires no electricity, take less space than any other processes.
- This product will teach children's that waste is a resourceful. Not a junk that we have to keep throwing.
- Compact, no energy required, minimum running expenses, quick results, easy to maintain, and basically live, we can actually see the worms doing their work.

# Design Brief

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**“Design a Vermicompost unit”** for housing societies which enables to

1. Convert their kitchen and garden waste into compost.
2. Production of a Vermicompost, worms, worm tea as a commercial product.
3. Which encourage and motivate the citizens / children's to segregate the waste at source level and change their view about waste not as garbage but as a Resource.

## **Specification-**

1. Capacity of process 20-25 homes
2. Foot print 4 ft. X 5ft. Approx.
3. Produce 75 kg of vermicompost /month approx.

# Scope and limitation

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## Scope of a Product-

1. Compost only kitchen waste (uncooked food and garden waste)
2. Enable to harvest vermicompost and worm tea.
3. Educate people about vermicompost.
4. The waste collection method.
5. maintenance and service.

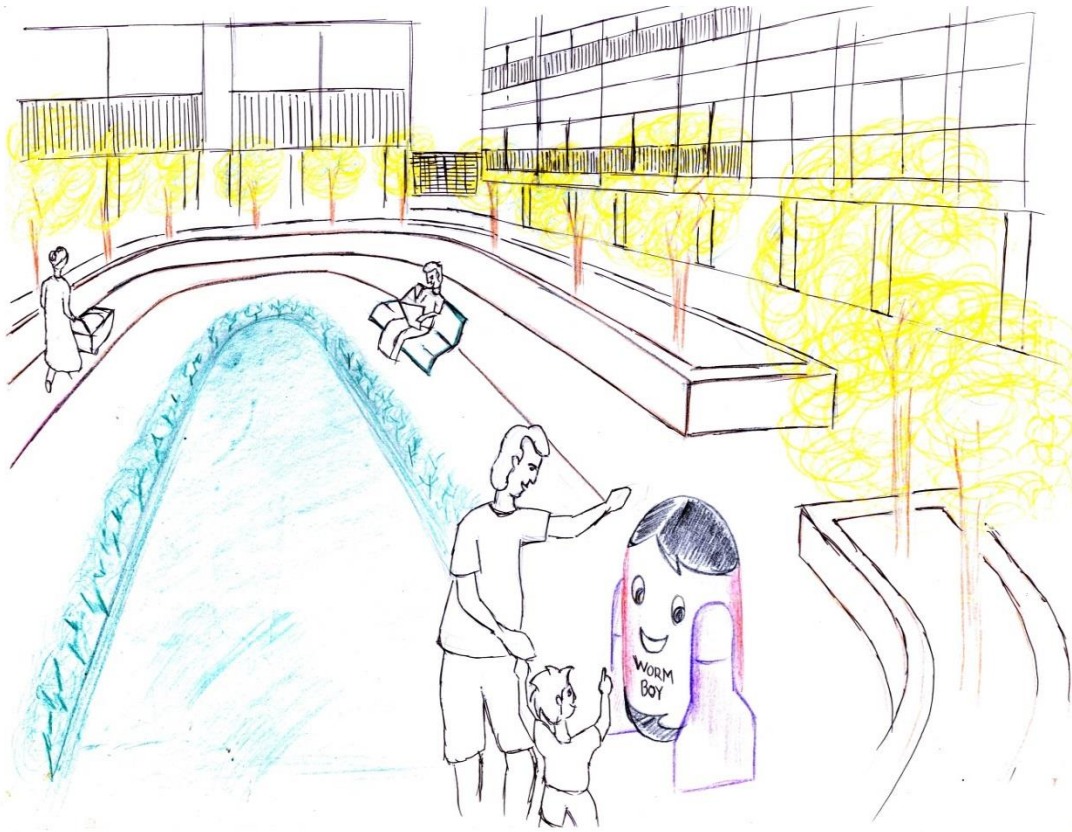
## Limitations-

1. Require one person for maintenance and day to day care.
2. Cooked food can not be use in this vermicomposting.



# Design Directions

# Scenario 1- Into the housing societies garden



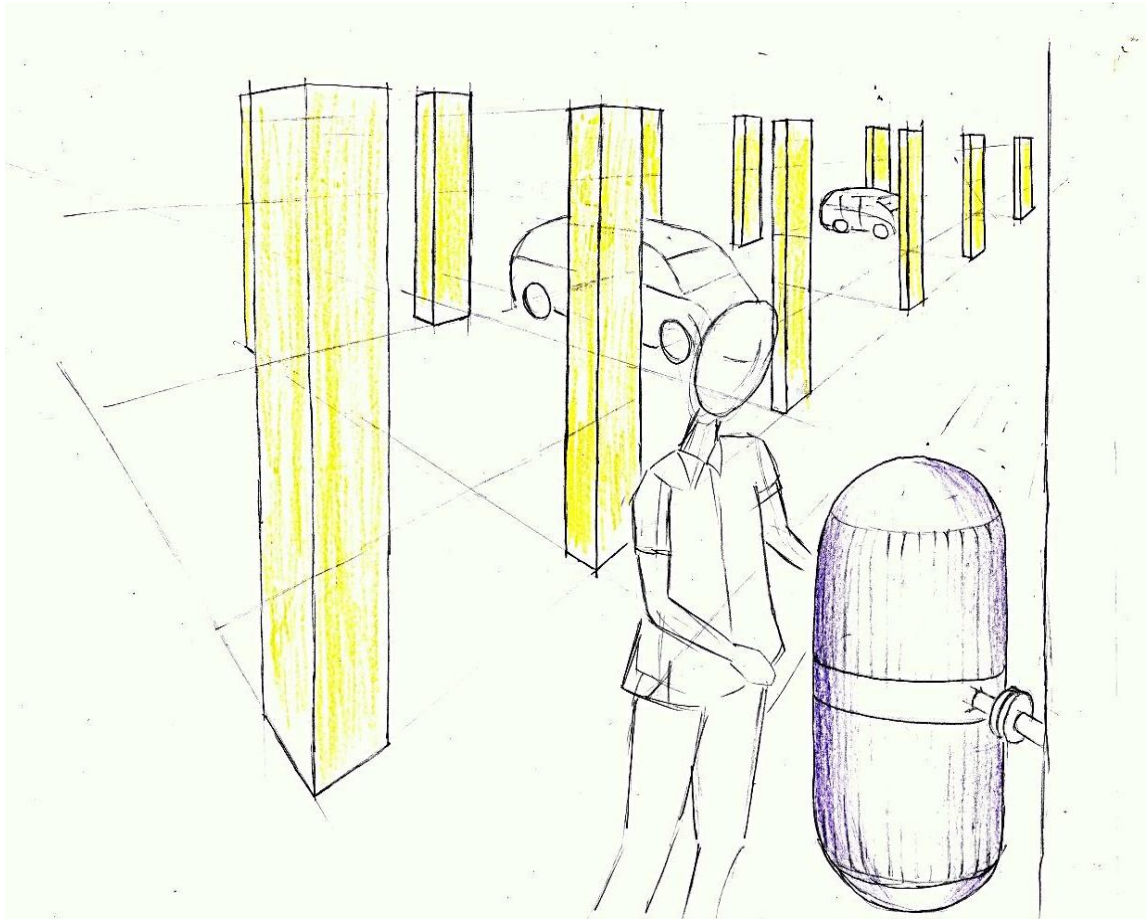
## Advantages-

- Displayable / informative
- Educative/knowledgeable
- Encouraging visitors and children's.

## Disadvantages-

- Exposed to outside weather

## Scenario 2- Into the Parking lot



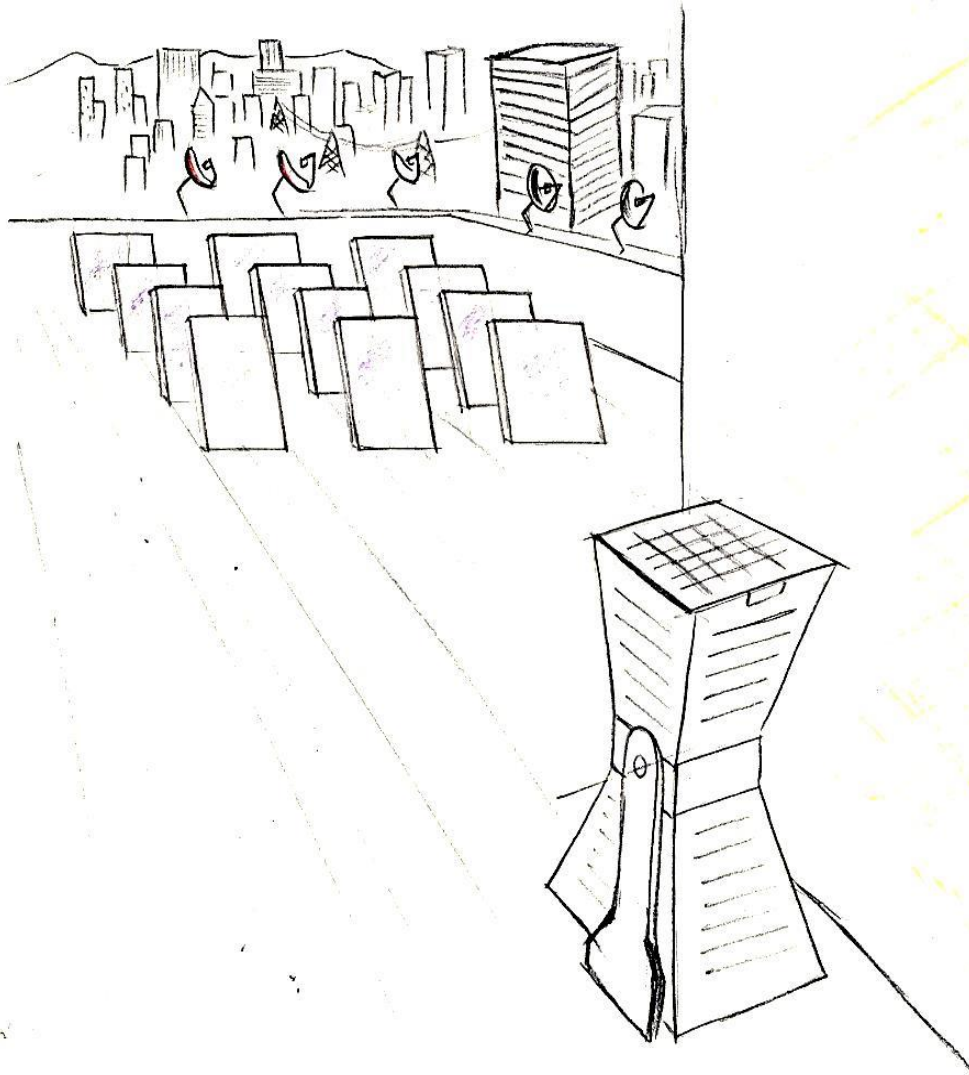
### Advantages-

- Space saving design
- Into the shed always

### Disadvantages-

- Non educative
- Non informative

## Scenario 3 - Terrace



### Advantages-

- Space saving
- Away from the dogs cows and rats.

### Disadvantages-

- Non informative
- Invisible to society
- Exposed to sun..



# Scenario 4 - In to the Play ground



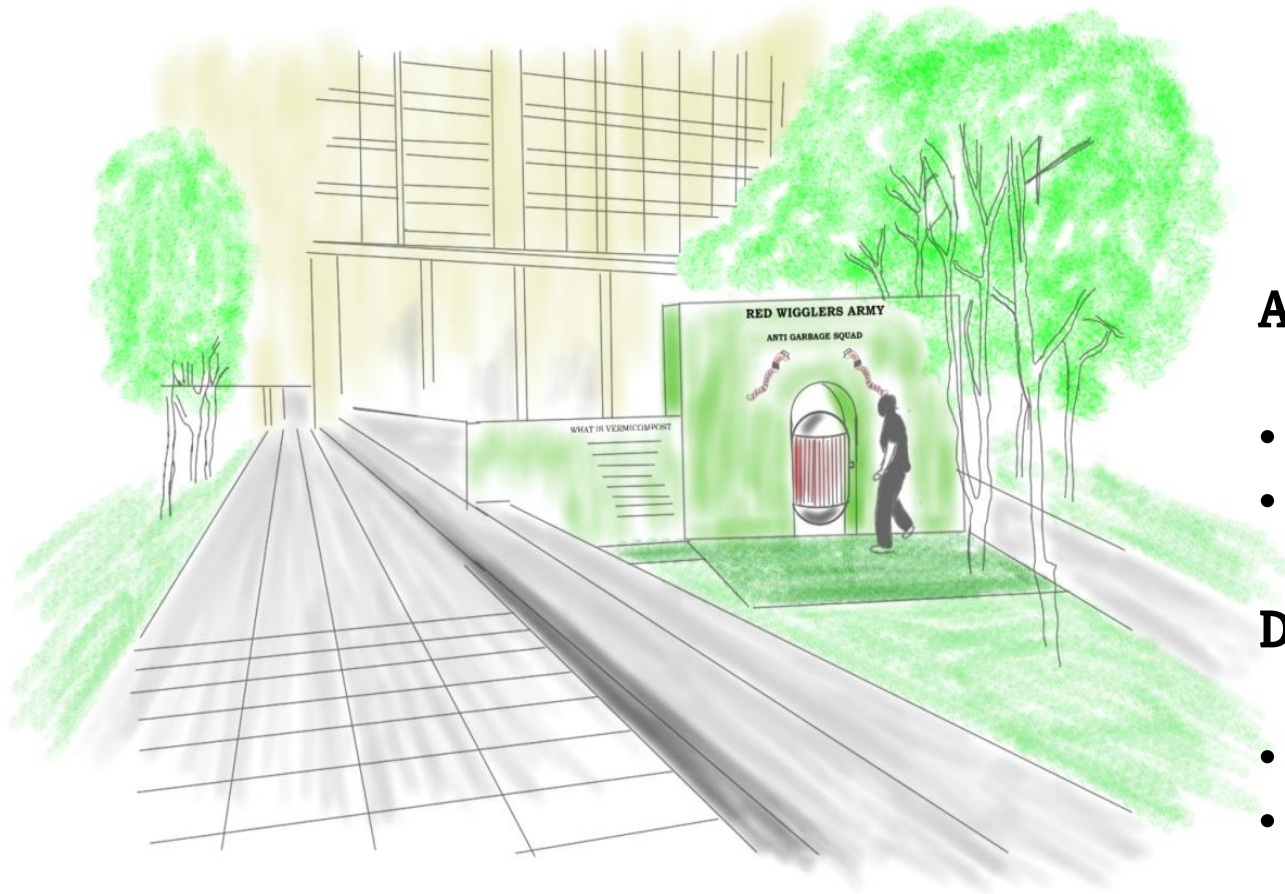
## Advantages-

- Space saving
- Part of a playful installation
- Children can be learn while playing

## Disadvantages-

- Expose to sun
- Too close to children's, hygiene issue
- Easily get damaged by children's

# Scenario 5 - Wall of Information



## Advantages

- Centre of attraction
- Informative

## Disadvantages

- Infrastructure needed
- Exposed to outside weather

# Scenario 6 - At corner of the compound walls



## Advantages-

- Using a wasted corner
- Corner became an information center

## Disadvantages-

- Exposed to sun



# Scenario 7- Vermicompost polls



## Advantages-

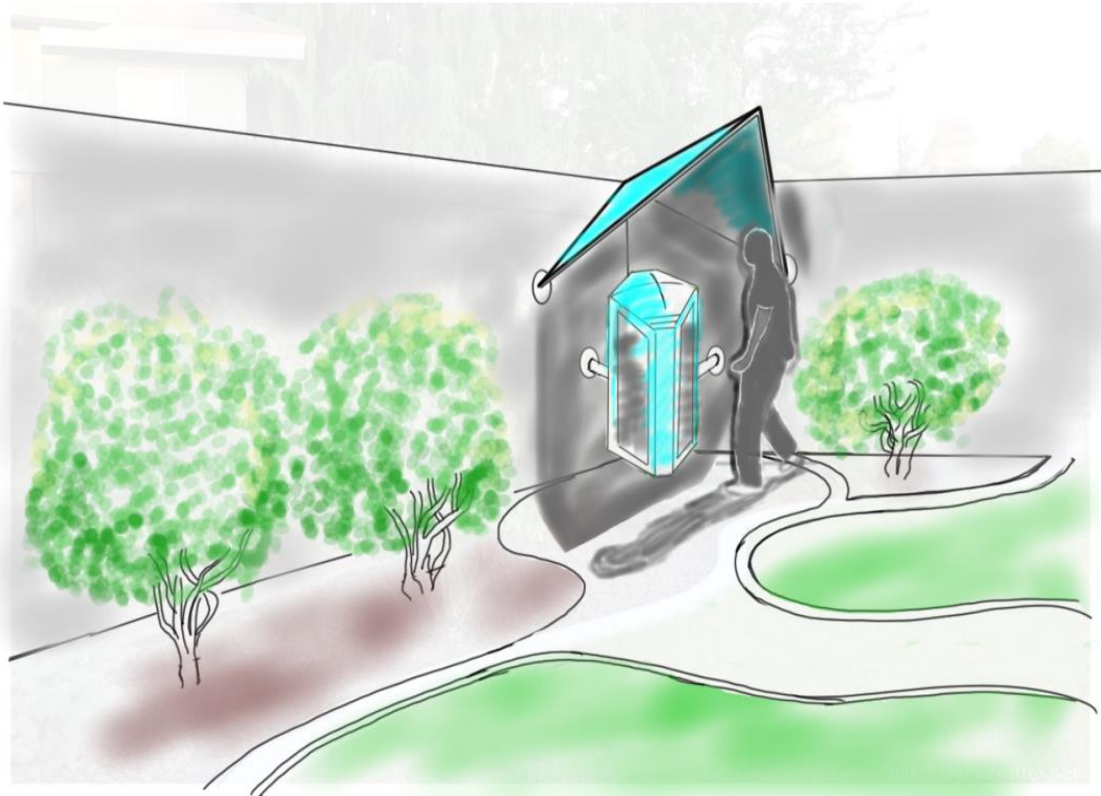
- Spaces saving
- Manageable, because decentralize

## Disadvantages-

- Small worm bin could be misinterpreted as a dustbin.



## Scenario 8 – Wall mounted



### Advantages-

- Wall mounted at the corner
- Space saving
- Walls can be use for displaying the information related worms and worm bin.
- Sheds

### Disadvantages-

- Only from front can be access.

# Scenario 9 - Central installation at the park



## Advantages

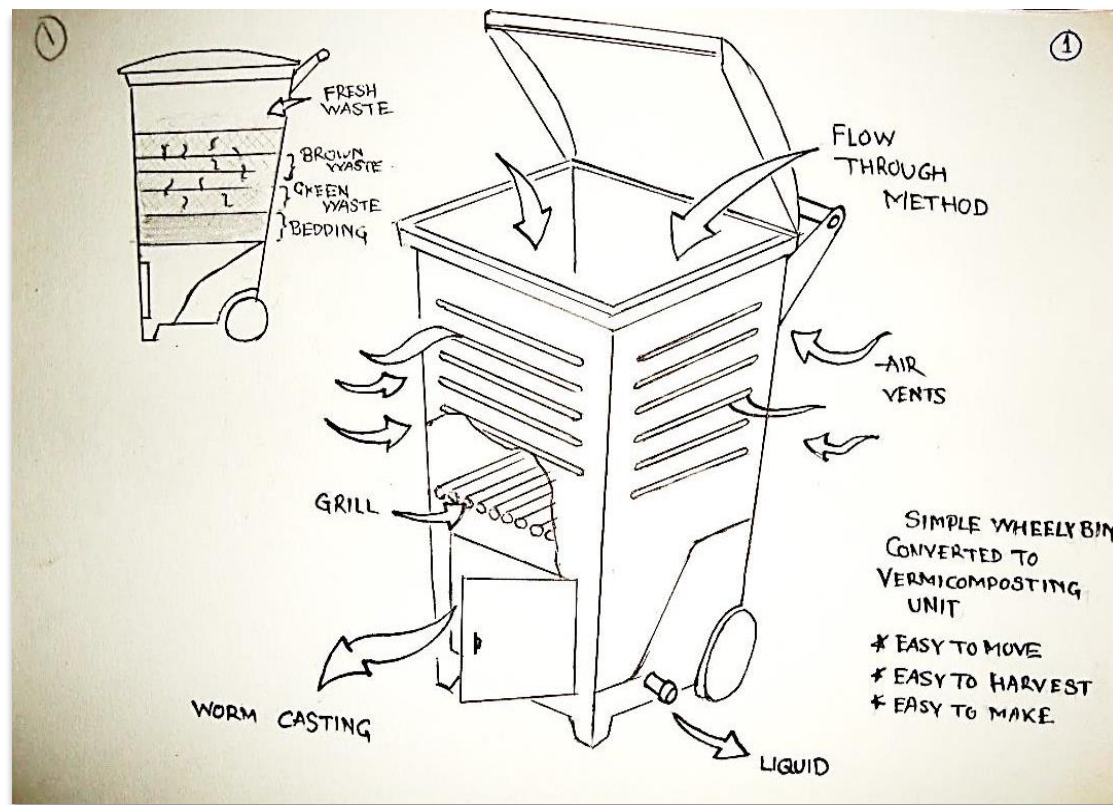
- Centre of attraction
- Informative

## Disadvantages

- Infrastructure needed
- Exposed to outside weather

**Ideations**

# 1 - Wheelie bin concept



## Advantages-

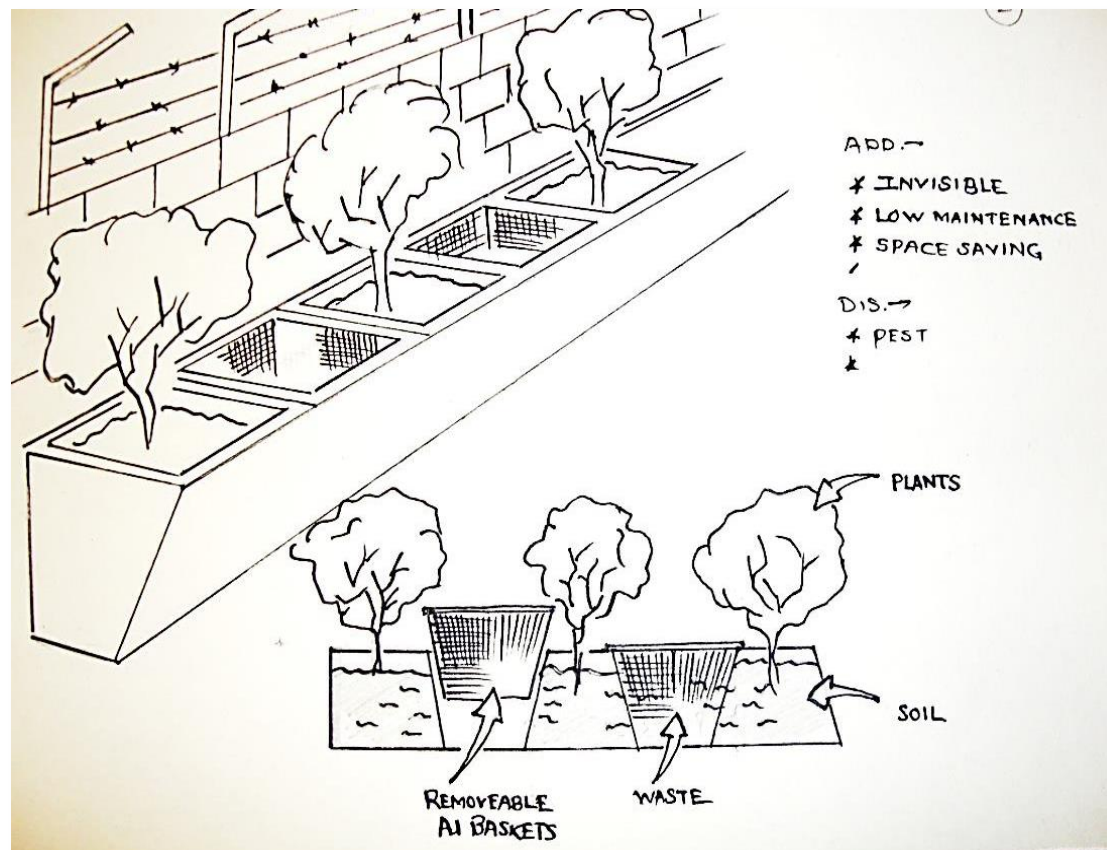
- Wheels add Portability
- Easy Harvesting from bottom door

## Disadvantages-

- High manufacturing cost
- Some loss of worms possible during harvesting, while scraping a worm casting at the bottom worms can get kill.



## 2 - Vermicompost Garden-



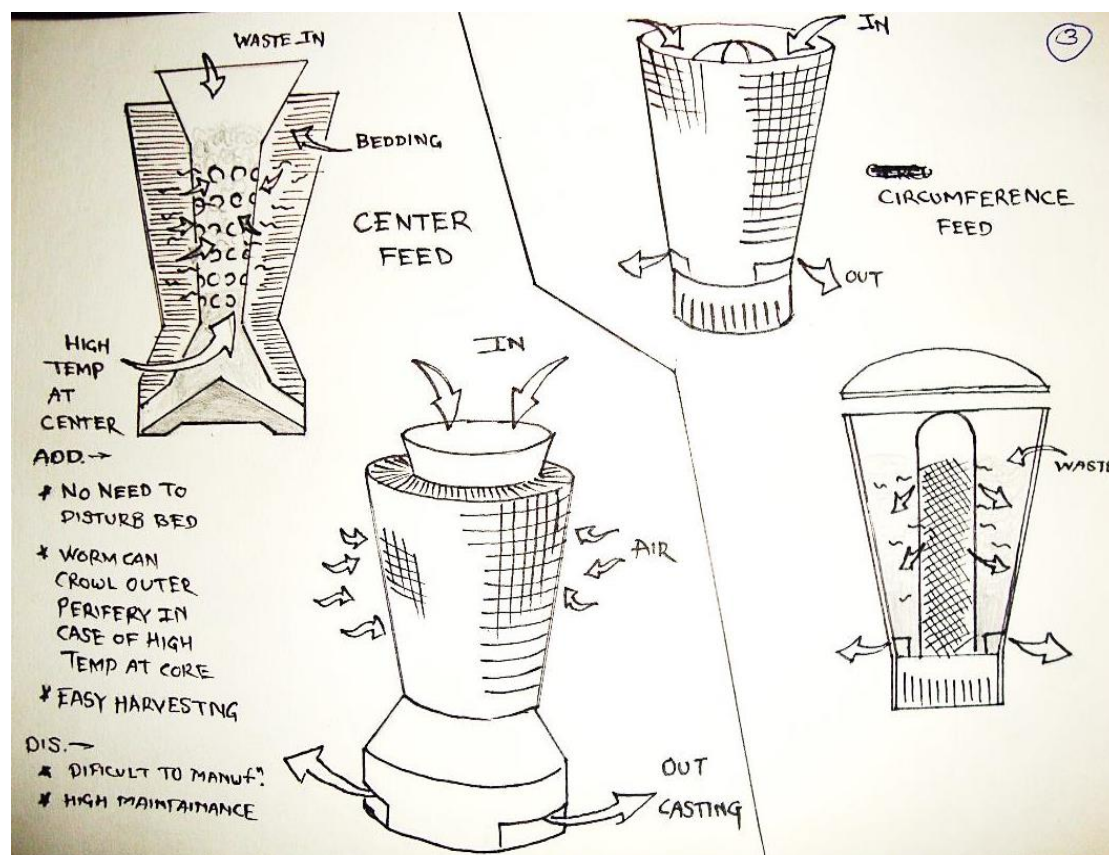
### Advantages-

- Hidden; under ground
- Direct application of Compost, no harvesting

### Disadvantages-

- High Installation cost. extra infrastructure
- No harvesting of Vermicasting.

# 3 - Central feed



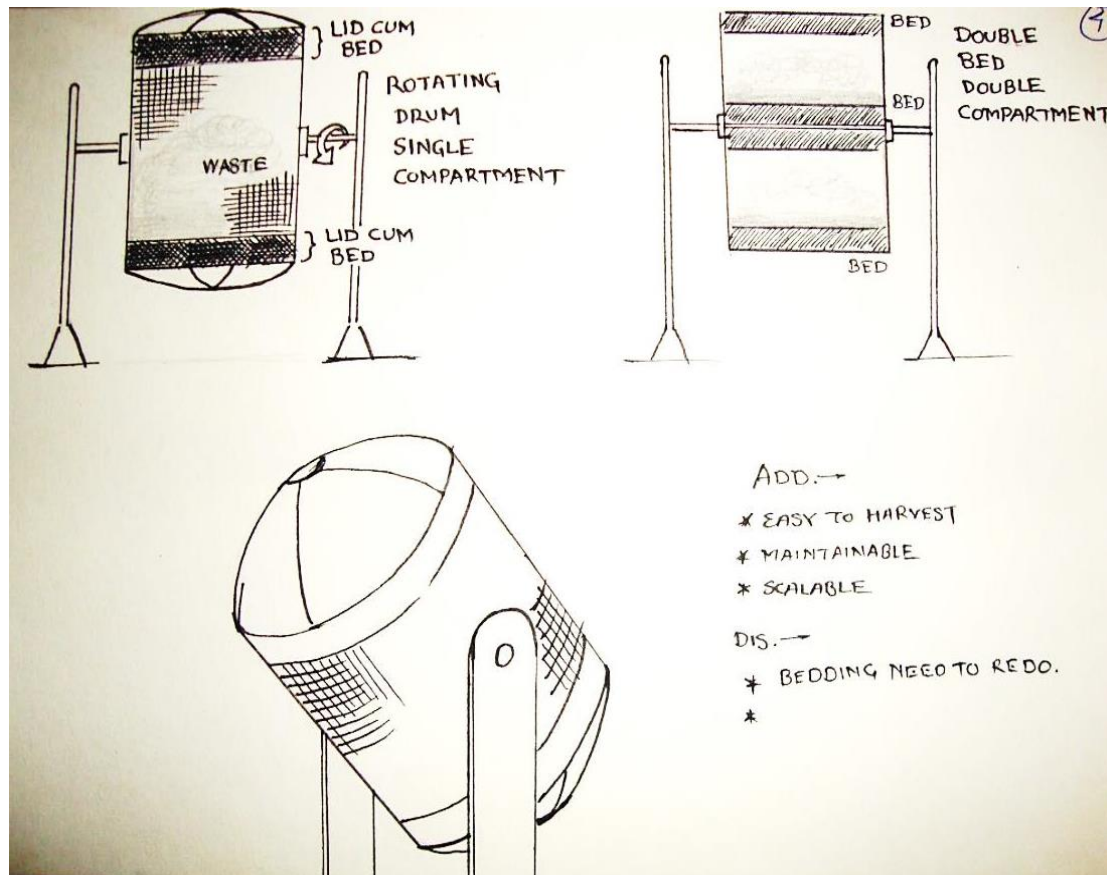
## Advantages-

- No need to Disturb worm Bed
- Faster composting Process

## Disadvantages-

- Working Principle need to be Verified

# 4 - Rotating drum



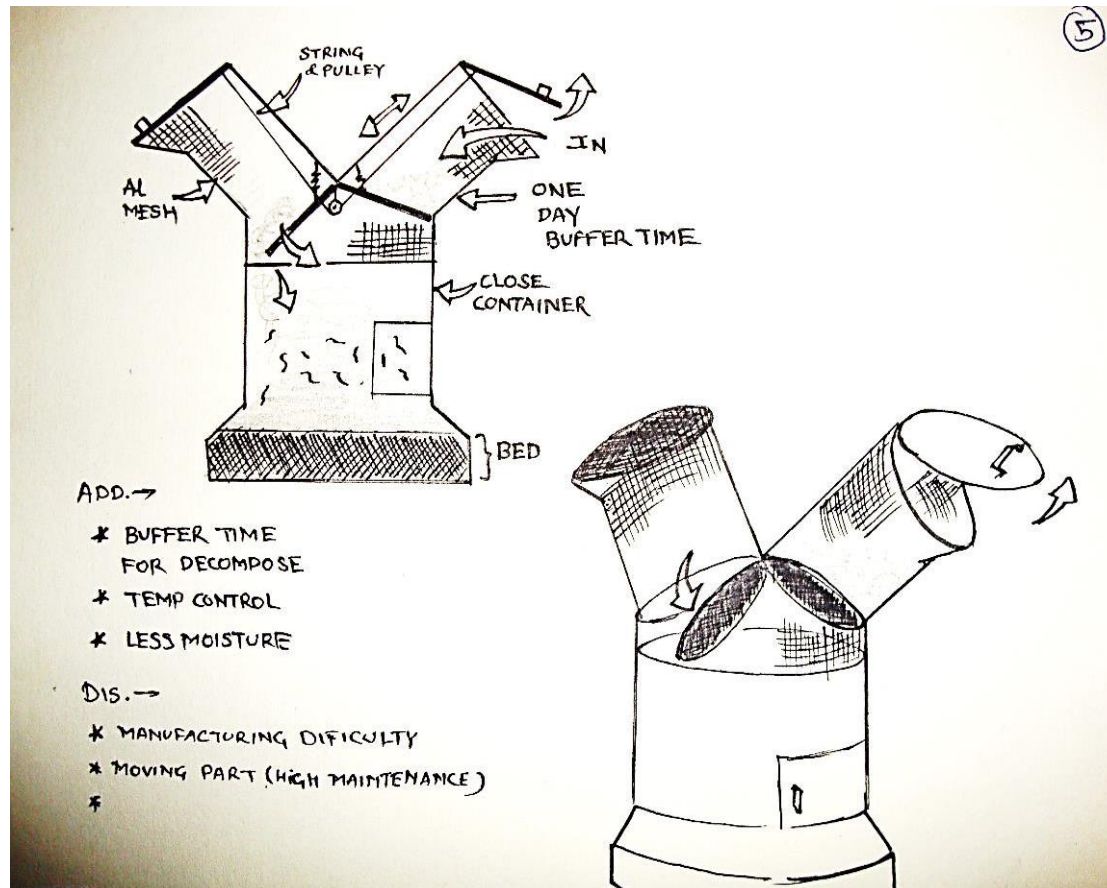
## Advantages

- Stirring is Possible
- Buffer time for aerobic decomposition

## Disadvantages

- Bed need to prepaid at the time of harvesting

# 5 - Two side feed



## Advantages-

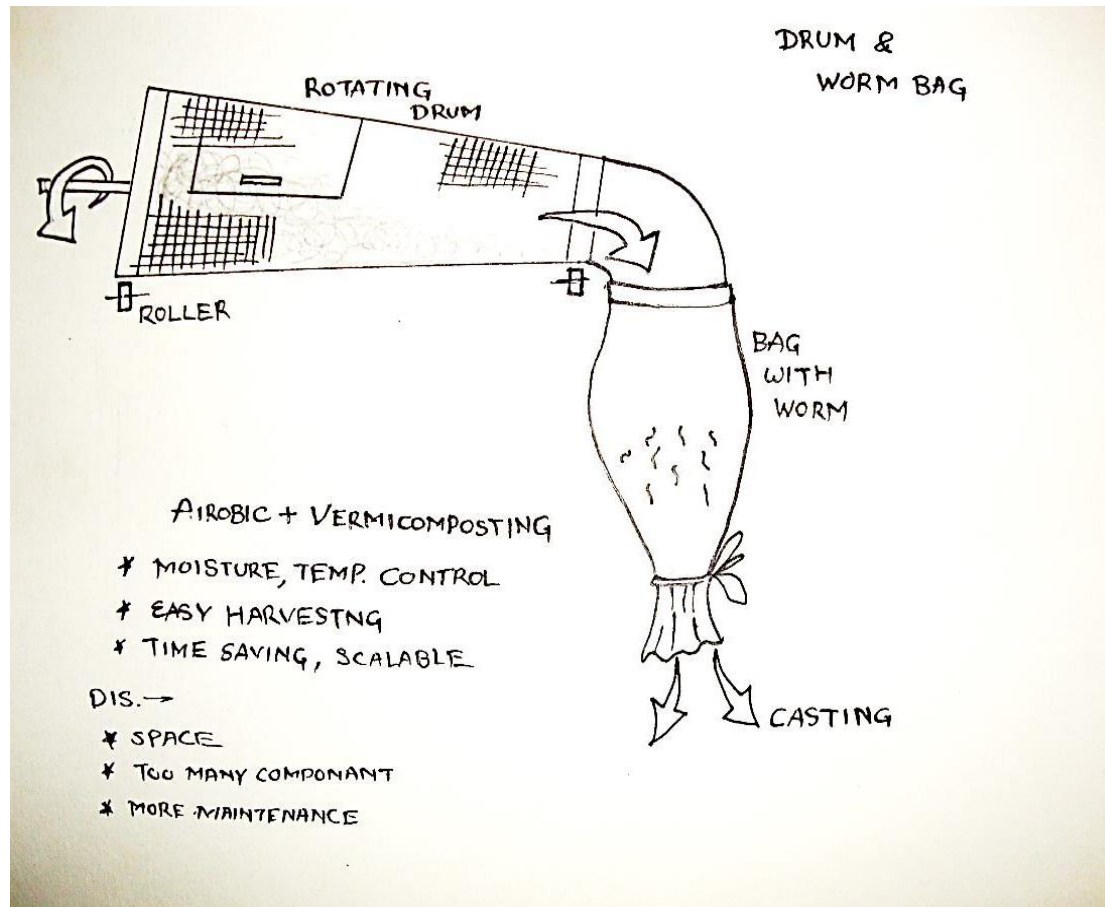
- Buffer time for aerobic decomposition
- Temp can be control

## Disadvantages

- Too many moving parts



# 6 - Worm bag



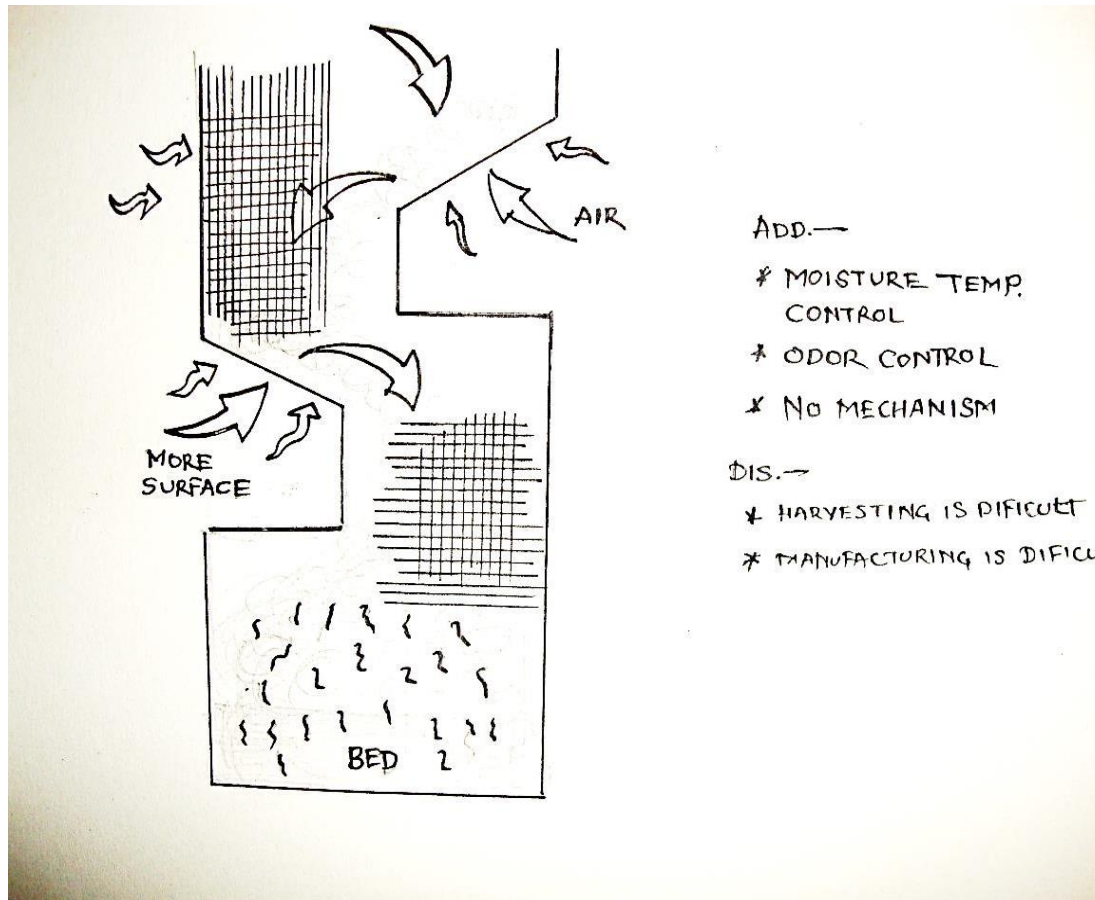
## Advantages-

- Buffer time for aerobic decomposition
- Stirring is Possible

## Disadvantages-

- Too many moving parts

# 7 - Steps bin



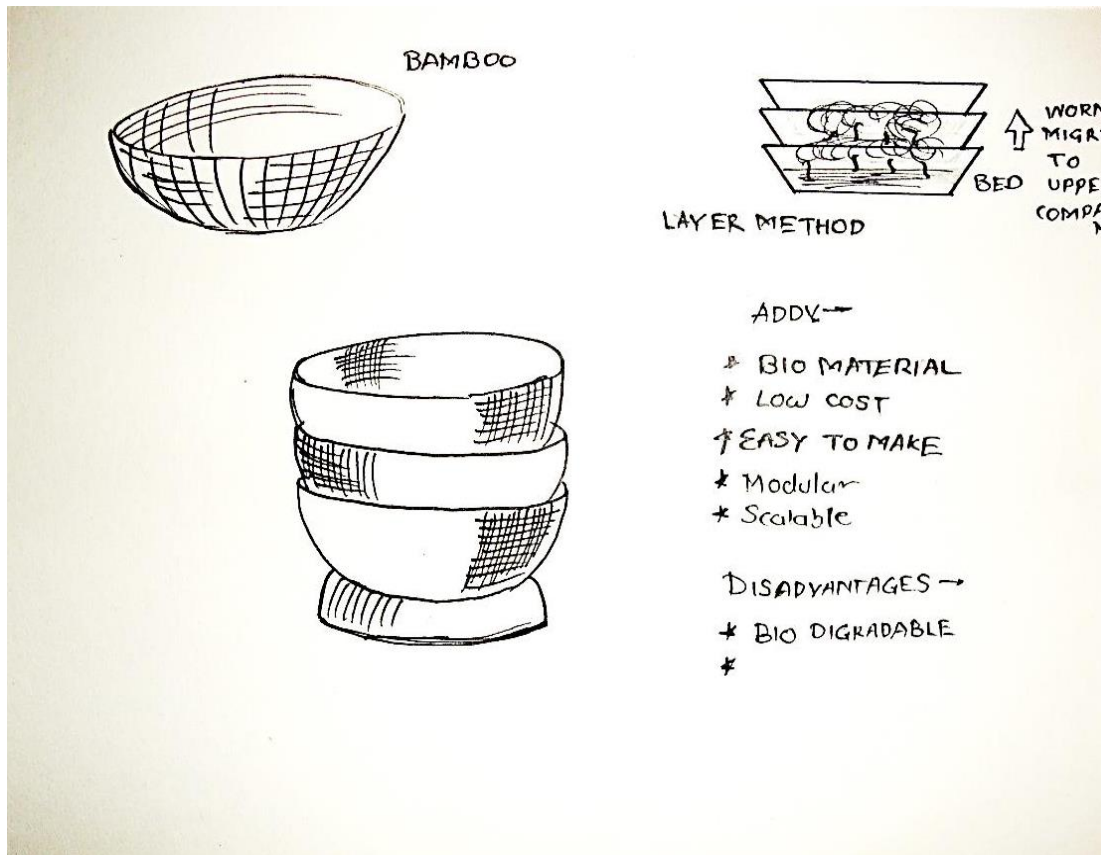
## Advantages-

- Simplicity (No Mechanism)
- Buffer time for aerobic decomposition

## Disadvantages-

- Harvesting is Difficult

# 8 - Bamboo baskets



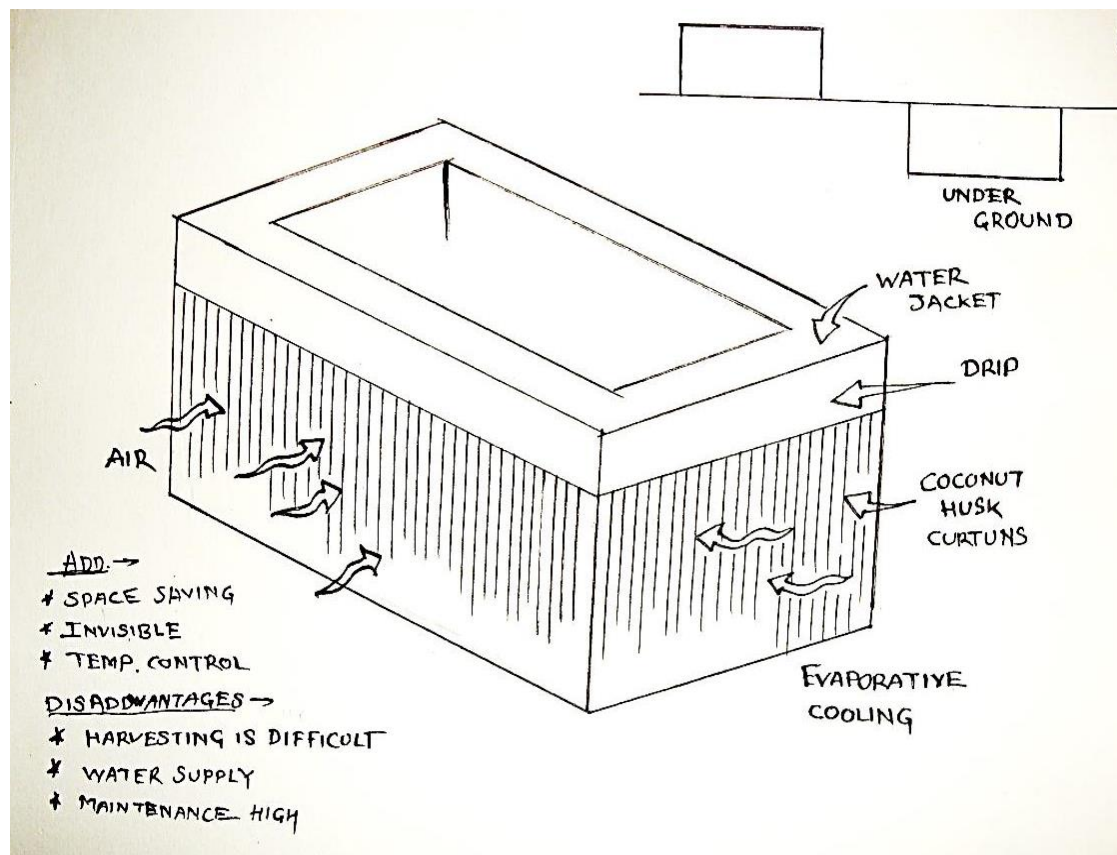
## Advantages-

- Low Cost, bamboo availability
- Easily available

## Disadvantages-

- Bio Degradable
- Pests will dig into it.

# 9 - Underground



## Advantages-

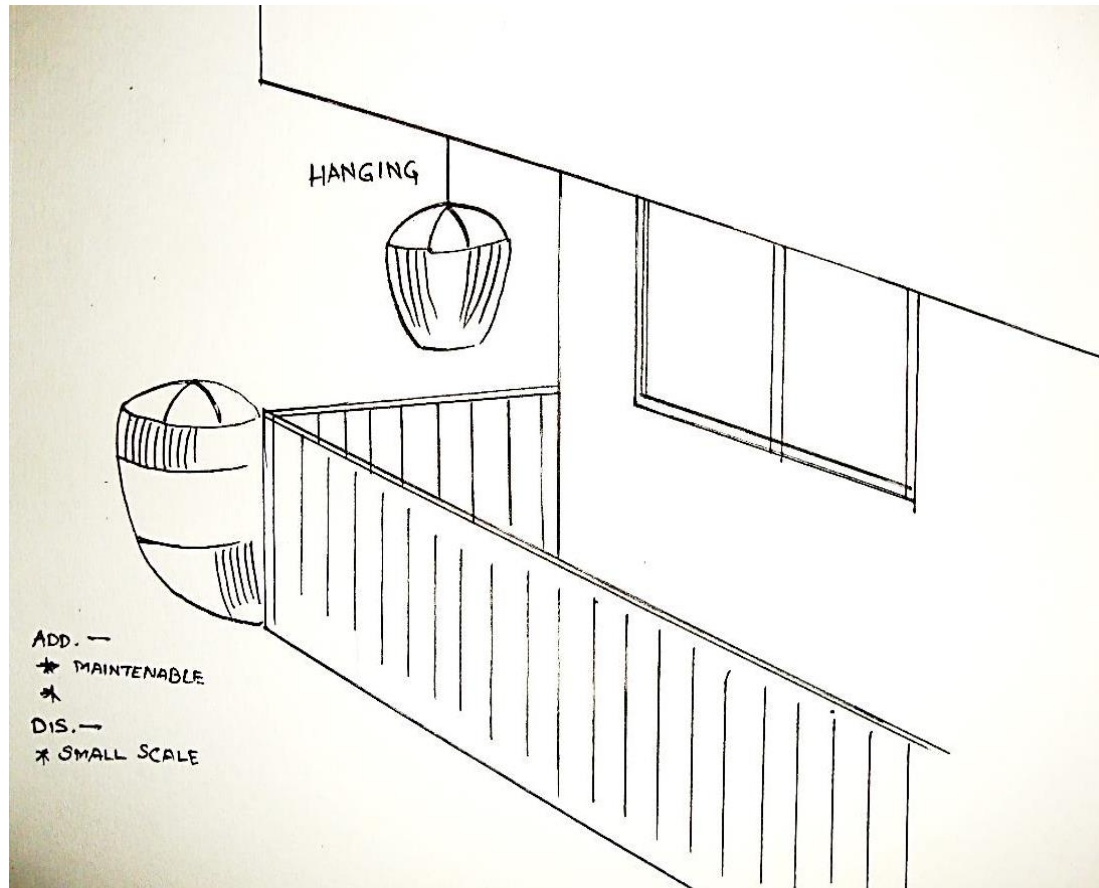
- Hidden
- Temperature and Moisture control

## Disadvantages-

- Harvesting is difficult



# 10 - Personal modules-



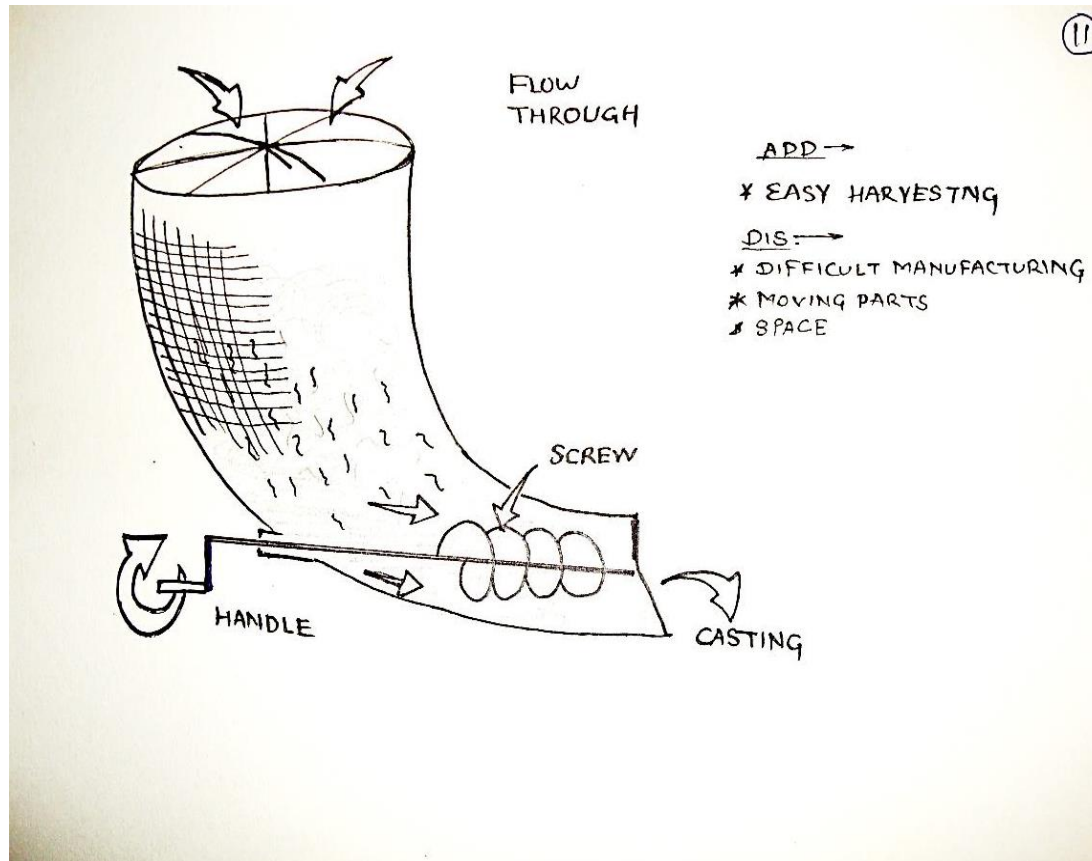
## Advantages-

- Portable - its small and light in weight
- Displayable.

## Disadvantages-

- Only for Personal use

# 11 - Screw Bin



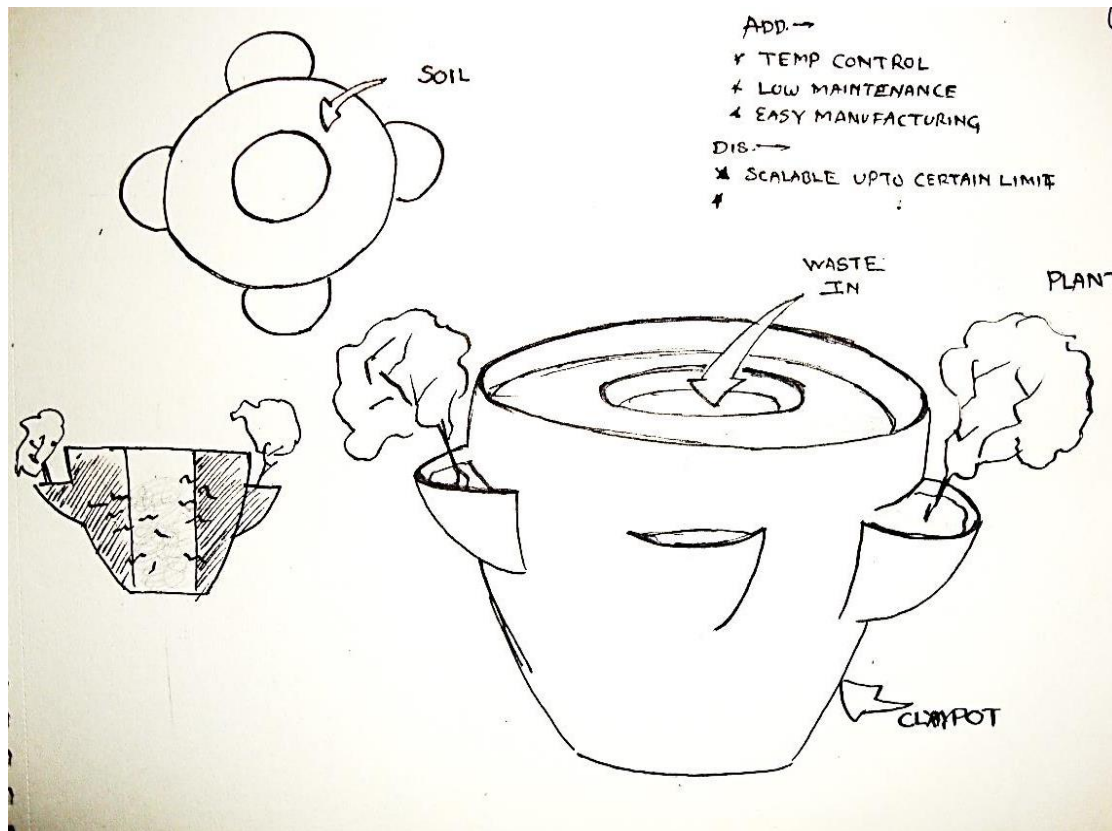
## Advantages-

- Easy Harvesting
- Continuous flow system

## Disadvantages-

- Moving Parts/mechanism

# 12 - Clay pot



## Advantages-

- Direct application of Casting
- Naturally control Temperature

## Disadvantages-

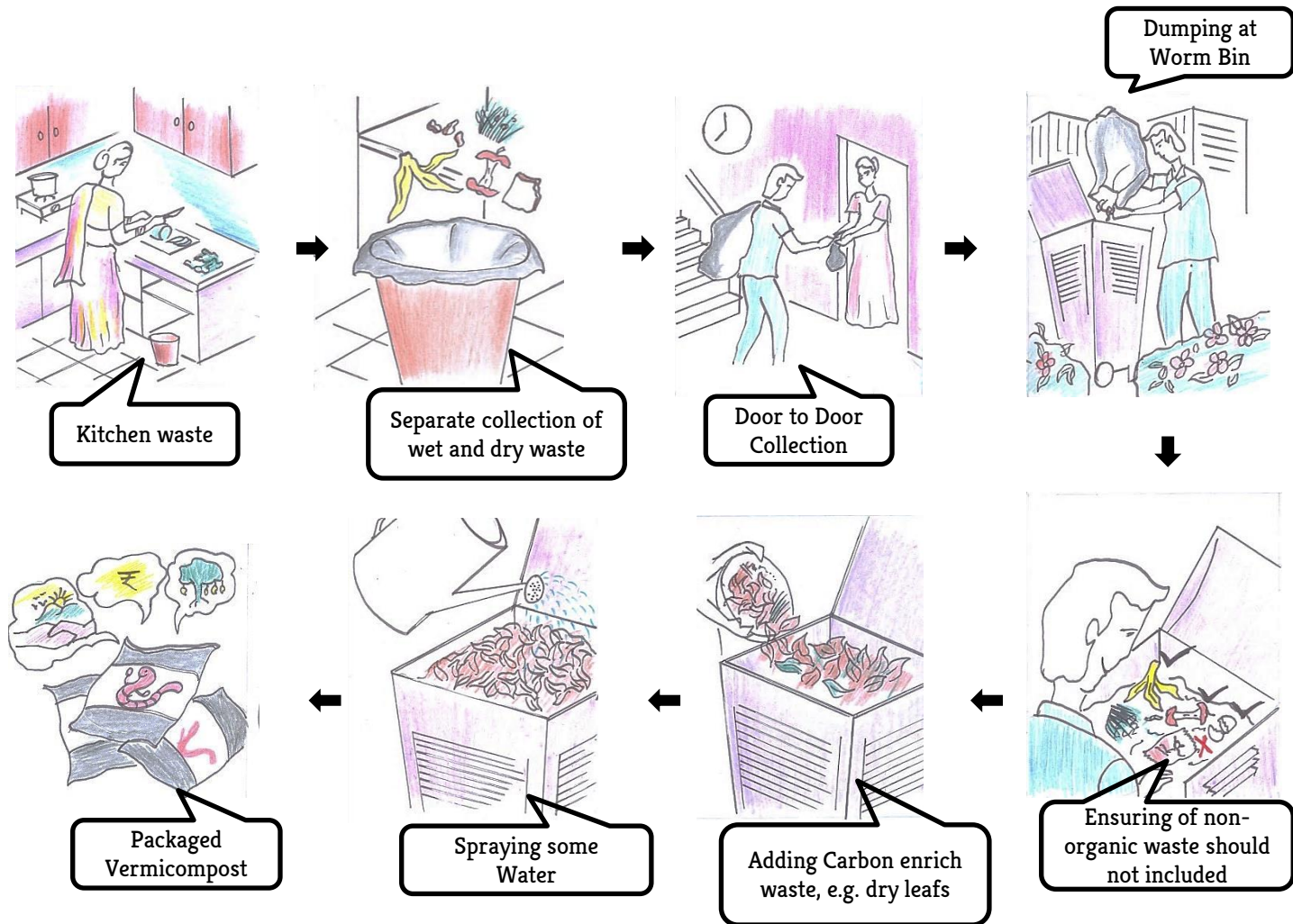
- Low Cost
- Delicate

# Concepts

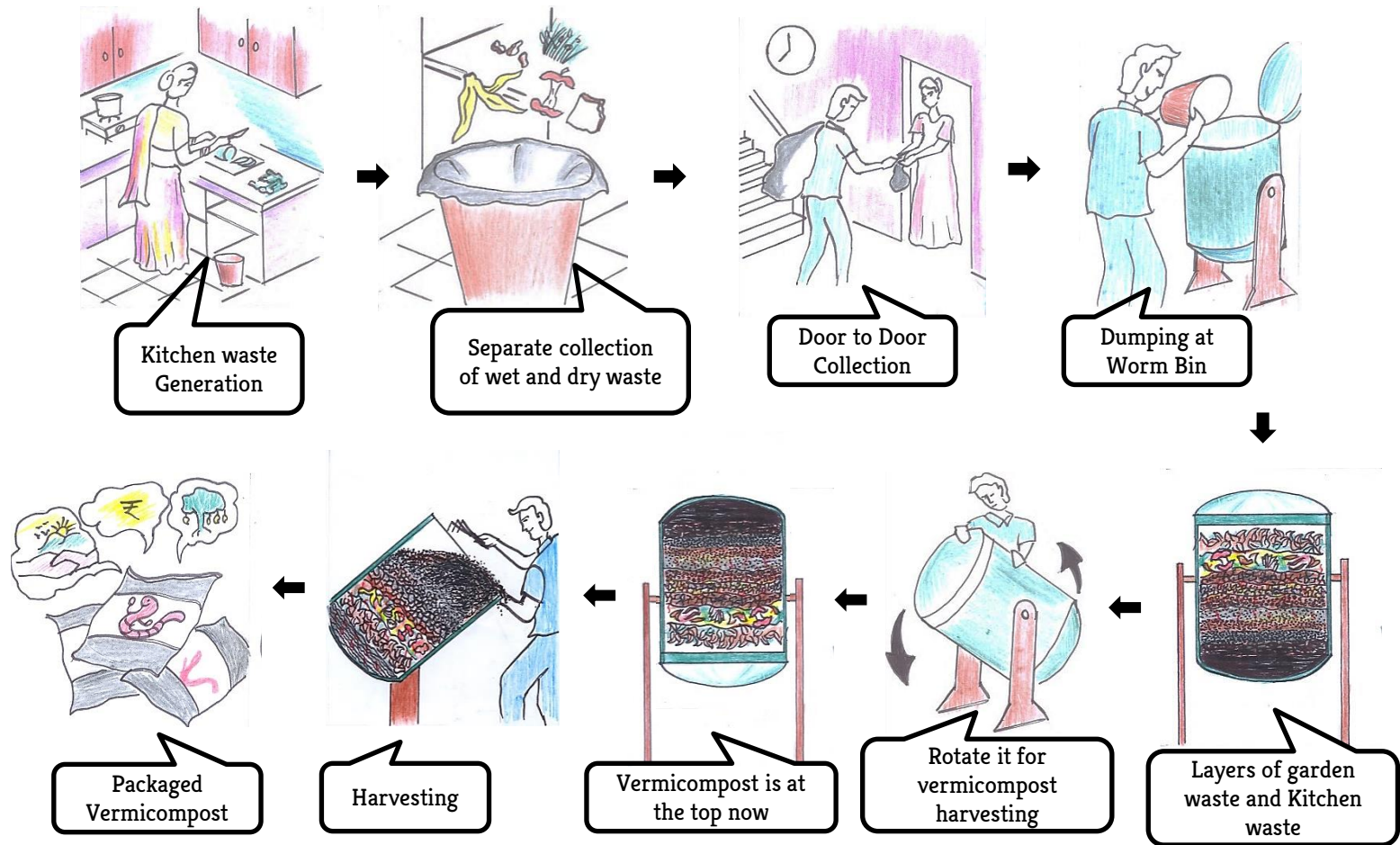
Next step is to create Story board for these ideas and to understand, check the entire flow of process.



# 1. Story board for wheelie bin concept



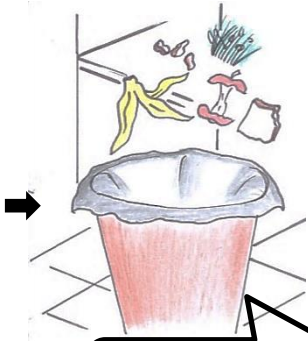
## 2. Story board for Drum concept



# 3. Story board for two side feed



Kitchen waste Generation



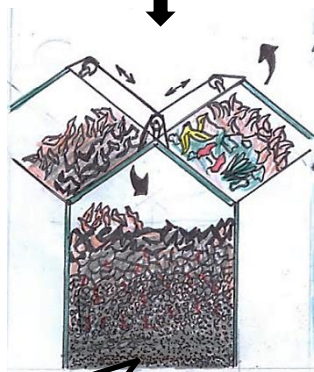
Separate collection of wet and dry waste



Door to Door Collection



Dumping at Worm Bin



Dumping at alternate side



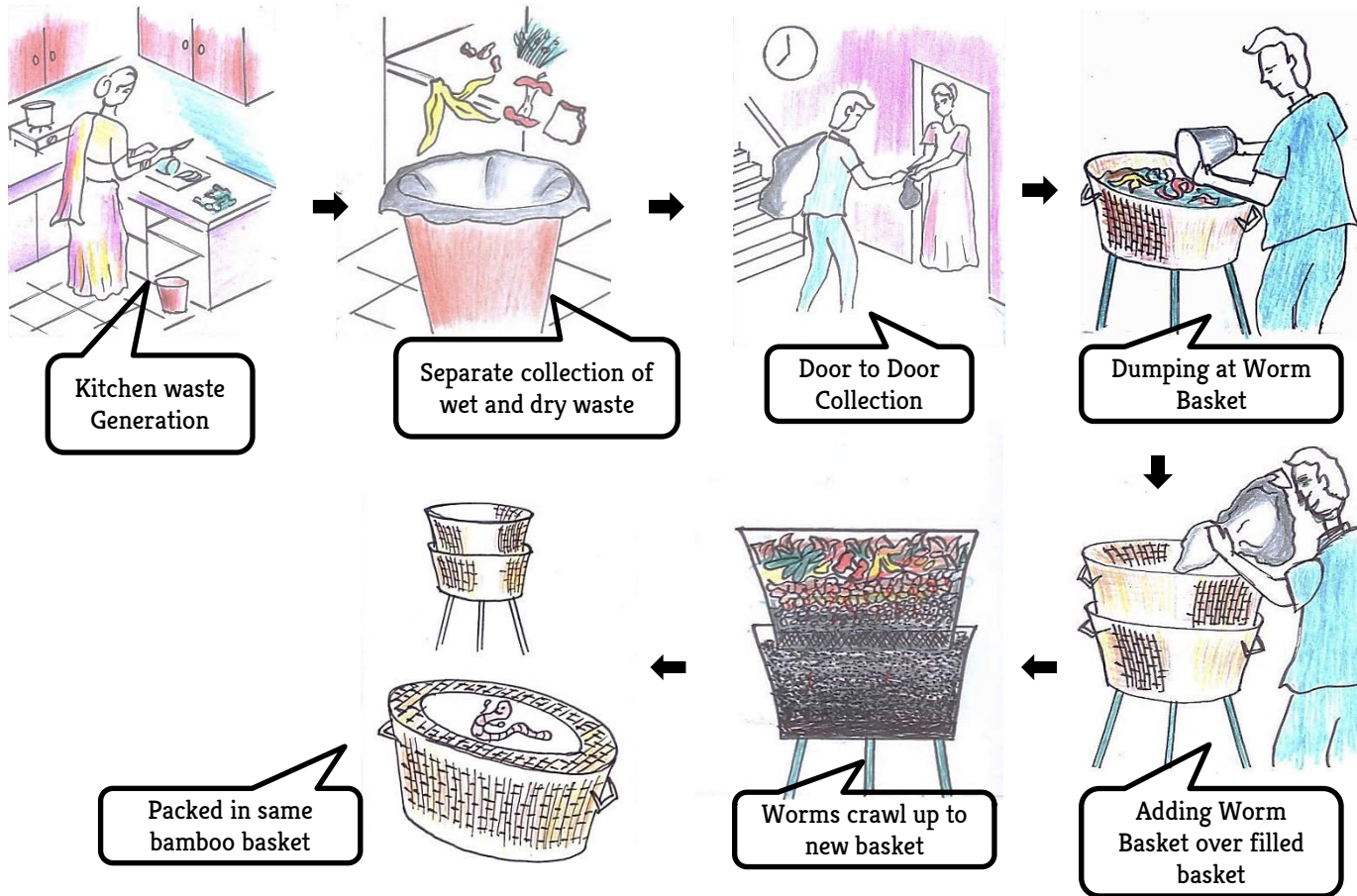
Harvesting



Packaged Vermicompost



# 4. Story board for bamboo baskets





# Concepts evaluation

Concepts No.	1.Worm bin	2.Two side feed	3.Bamboo Basket	4.Rotating Drum
				
Implementable	✓	✓	✓	✓
Manufacturing-	✗	✓	✓	✓
Capacity	✓	✓	✗	✓
Space Required	✓	✓	✓	✓
Maintenance	✗	✗	✓	✓
Man power-	✓	✗	✓	✓
Scalable	✗	✗	✗	✓
Modularity	✗	✗	✓	✗
<b>Total-</b>	<b>4</b>	<b>4</b>	<b>6</b>	<b>7</b>

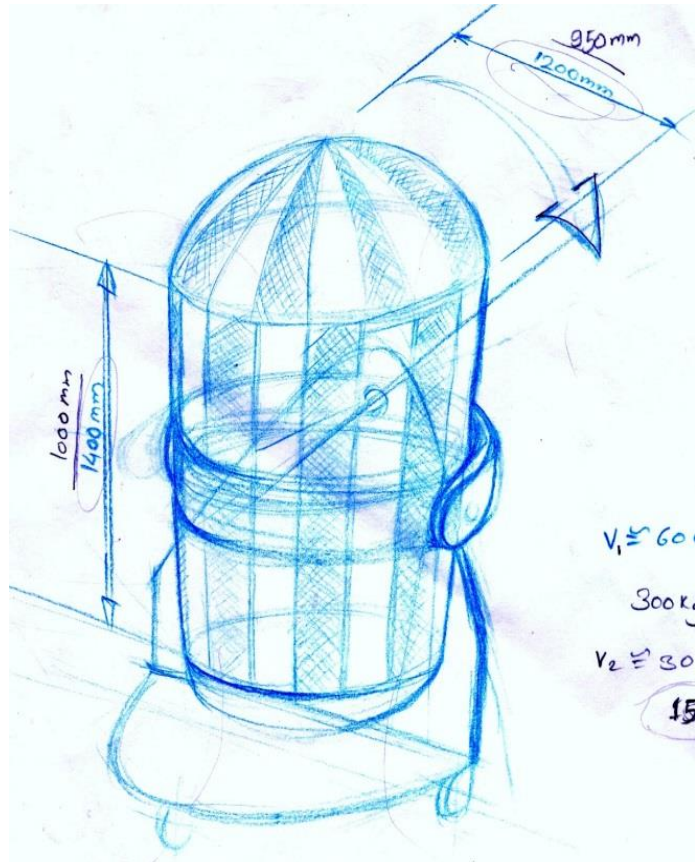
# Concepts evaluation

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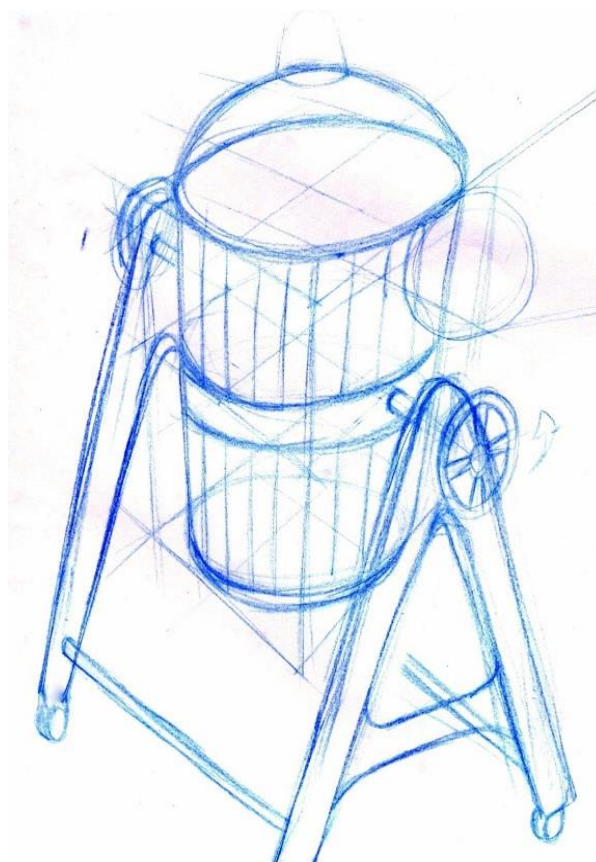
## Evaluation criteria from Product brief-

- **Implementable**- It should be easily implementable in any housing society
- **Manufacturing**-easy to manufacture by conventional manufacturing techniques.
- **Capacity**- it should be able to process 20-25 homes kitchen waste.
- **Space Required** - as minimum as possible.
- **Maintenance**- low
- **Man power**-it should be maintained by single person.
- **Scalable**-it should be scalable as number of houses varies.
- **Modularity**-or it could be modular for varying number of houses.

# Rotating drum Concepts



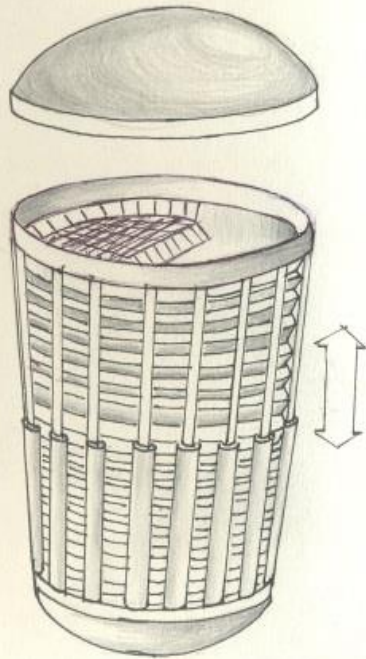
side wise rotating drum, will help to locate it along with the wall



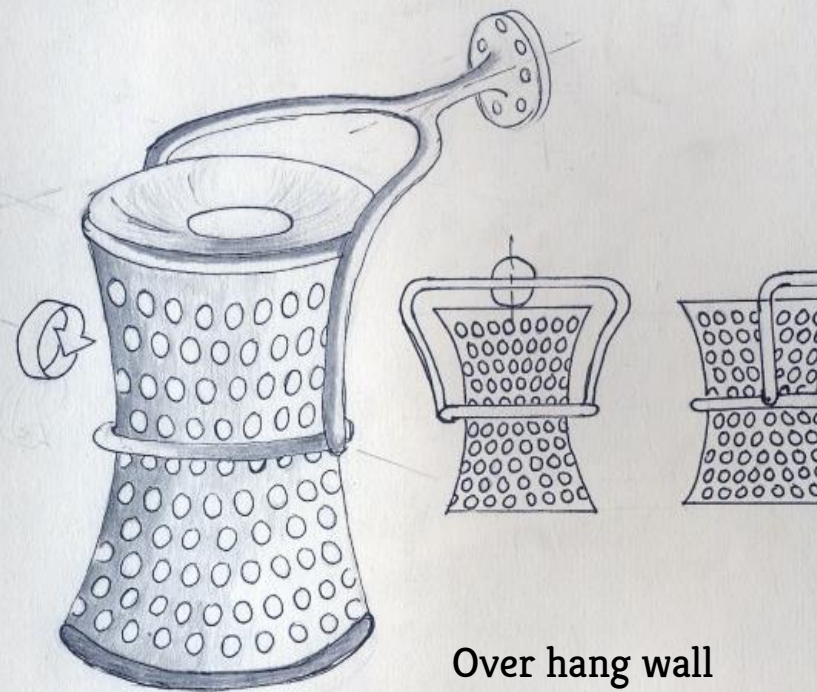
It can't be placed along the wall so it will take some more space.

## Advantages:

- It has less moving Parts
- High capacity
- Simplified
- Elevated from ground
- Implementable



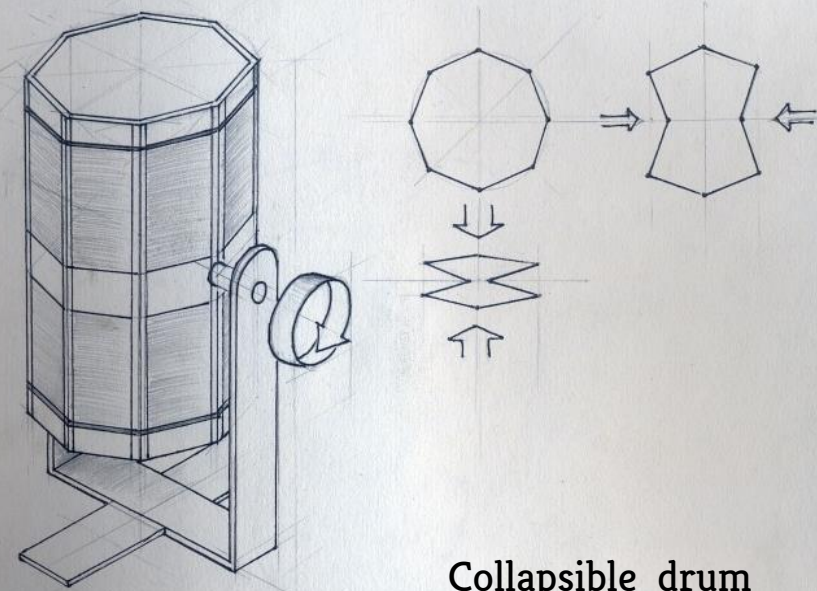
Wall mounted expandable drum



Over hang wall mounted drum



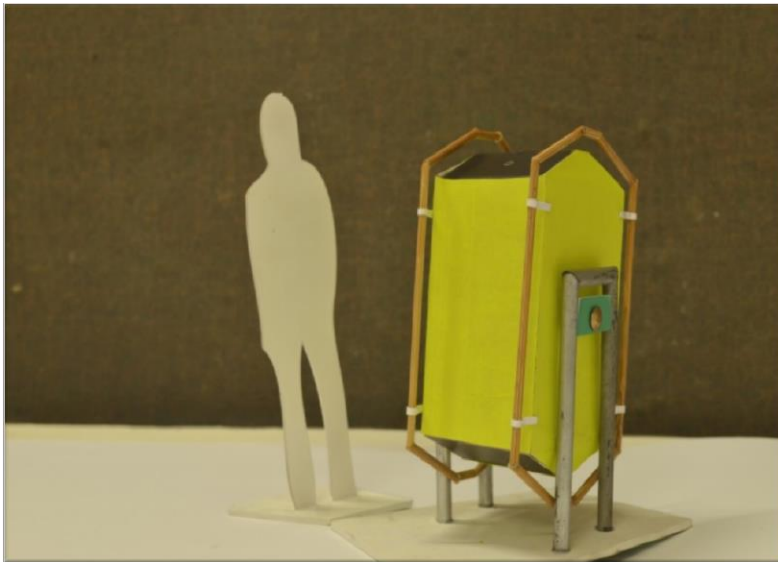
Single pole mounted drum



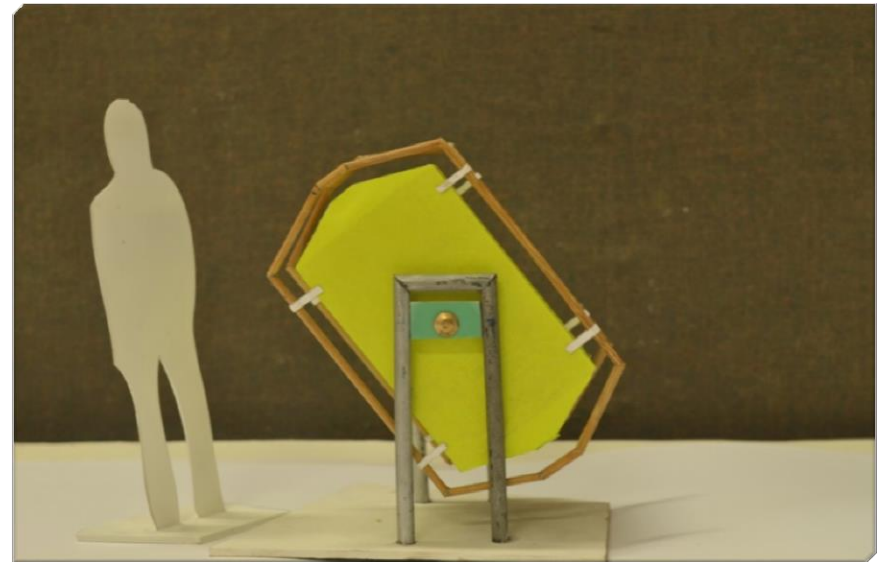
Collapsible drum



# Mockup 1



Rectangular box concept



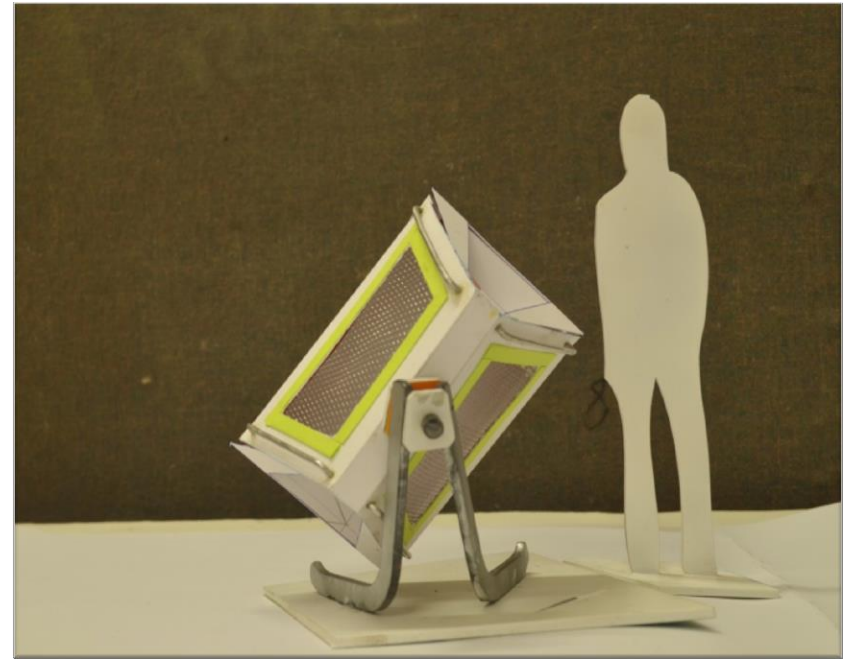
Rotated view

- Better control over rotation
- Large surface area for air ventilation
- Two way access
- Unique form for vermicompost

# Mockup 2



Prism concept



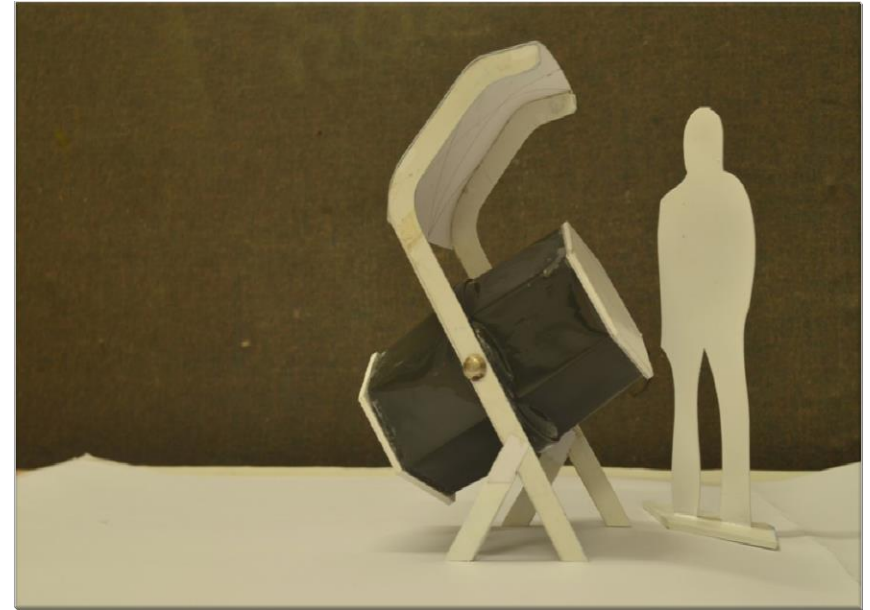
Single bearing mounted

- Completely new form for waste related devices, breaking semantic of a dustbin or any vermicomposting unit
- Side wise rotation.
- Less space
- Single bearing mounting will increase maintenance

# Mockup 3



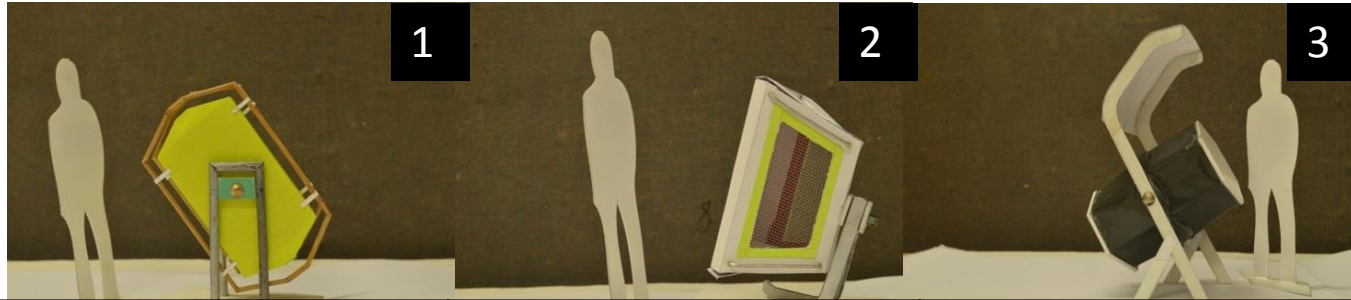
Hexagonal drum



Hexagonal drum during rotation

- Strong ribbing structure
- Sun shed
- Common container form.
- Can be manufactured by FRP process

# Final concept evaluation

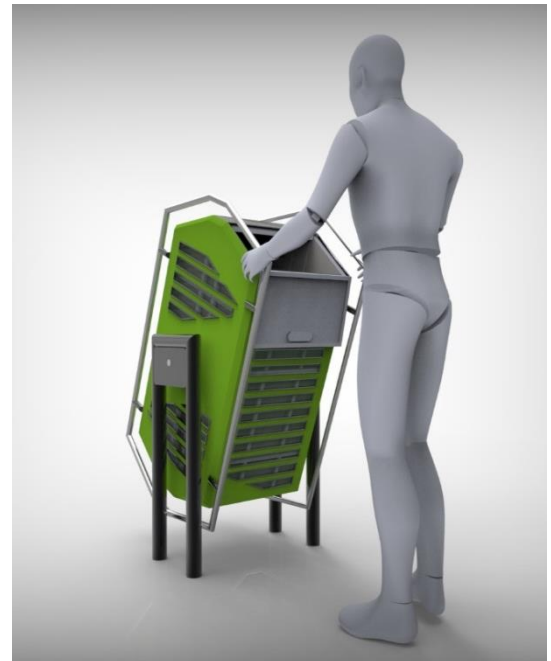


Evaluation criteria from product brief.

This form is very simple and sober and new as well the handle added some play element in it.	This form is very futuristic and dynamic. Its also break the relation with dust bin family.	This is not a new form for drum kind of things, its not a attention catcher as such.	<b>Form-</b>
Sheet metal/FRP/Fabrication	Sheet metal/ fabrication	FRP	<b>Manufacturing</b>
Maximum utilization of volume	Lower than the rest of two	Satisfying the brief.	<b>Capacity</b>
Satisfying the brief.	Satisfying the brief.	Satisfying the brief.	<b>Space Required</b>
Less parts less maintenance.	On higher side	minimum	<b>Maintenance</b>
One	One	One	<b>Man power</b>
Control over Rotation, and two way access.	Front face can be use as display, or as graphic area. Side wise rotation. Platform for segregation of waste.	Sun shade, strong structure body	<b>Added feature</b>
<b>7</b>	<b>5</b>	<b>5</b>	<b>Total</b>



# CAD Model Renderings.



# CAD Model Assembly.



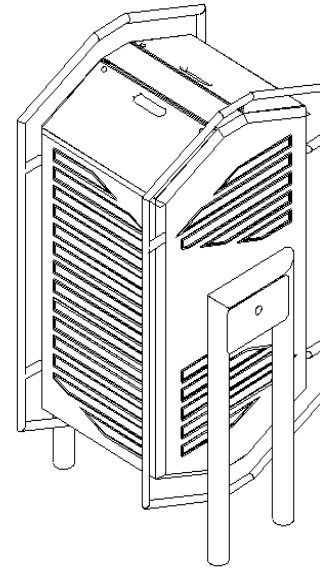
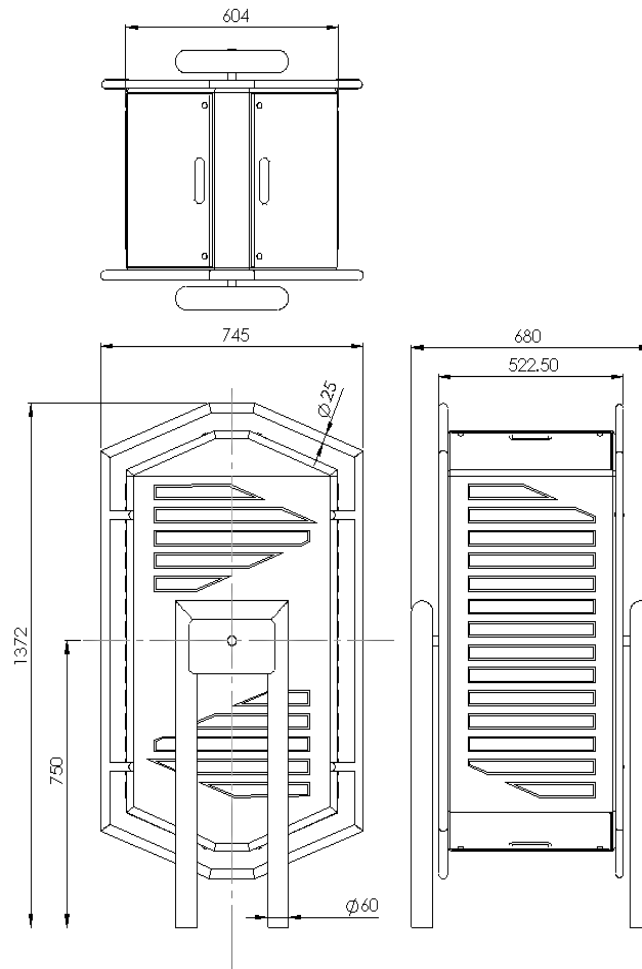
Main Assembly outer skin and handles

Internal SS chassis

SS Pillars

Bearing Assembly

# CAD Model drafting.



All Dimensions are in MM

# Final Model.

