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)"

Ref. fig no. 1 , on 10/02/14 at 11.22 pm http://commons.wikimedia.org/wiki/File:Mountain_of_garbage_in_Bantar_Gebang_with_some_excavator.jpg

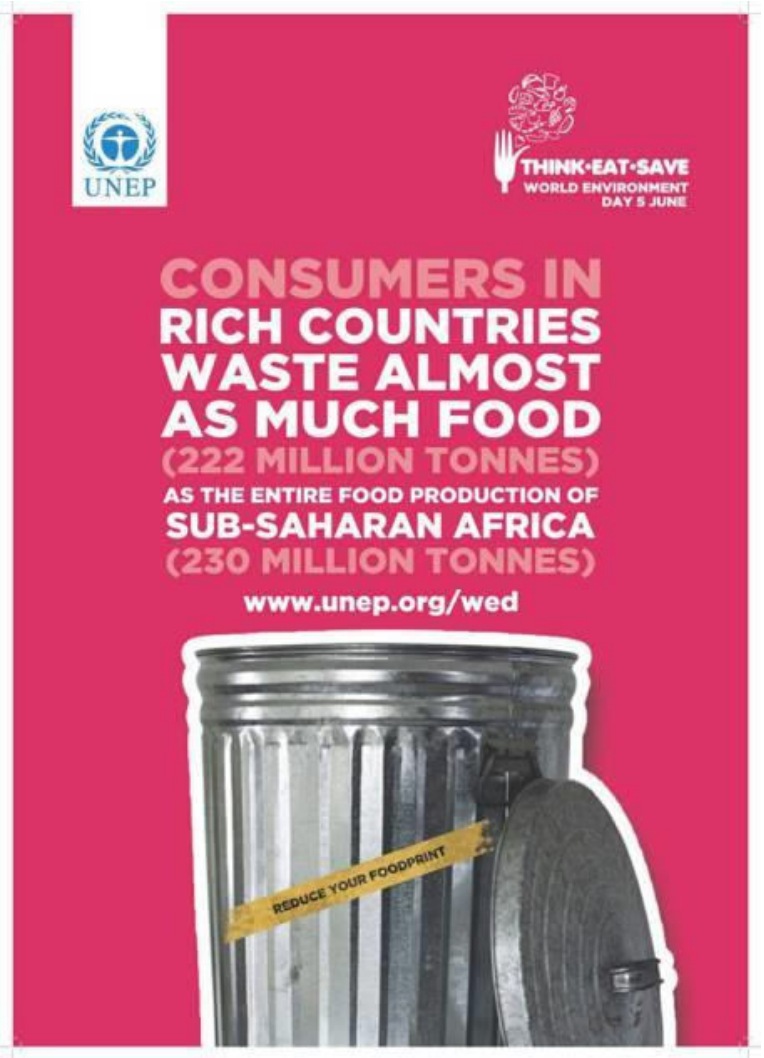
$205.4 billion/year

World Solid waste management

$375.5 billion/year by 2025

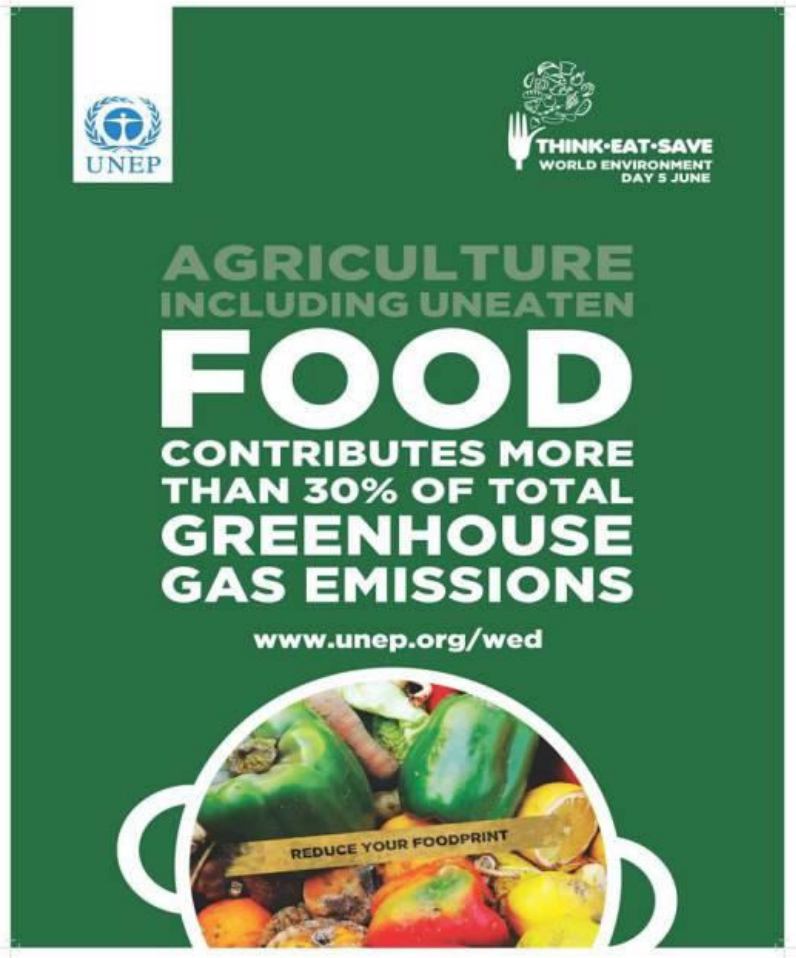
Ref.
http://wwwwds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2012/07/25/000333037_20120725004131/Rendered/PDF/681350WP0REVIS0at0a0Waste20120Final.pdf
Fig. http://articles.economictimes.indiatimes.com/2012-08-27/news/33425186_1_credit-card-icici-bank-s-platinum-electricity-bill

Garbage??



Ref. fig. http://www.unep.org/wed/quickfacts/

Garbage??



Ref. fig. http://www.unep.org/wed/quickfacts/

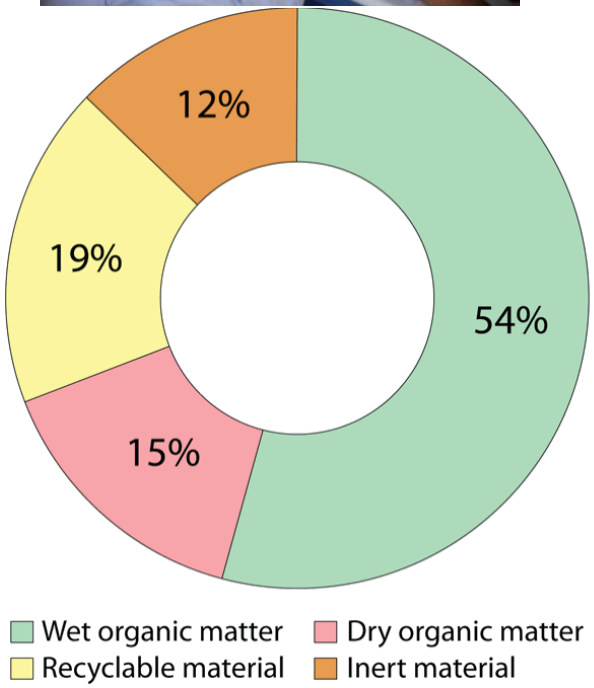
India

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

http://www.livemint.com/Politics/XsXf3cmvKjaoHPnlo31Y0H/South-Asia-to-become-fastest-waste-producer-by-2025.html

Mumbai

Rishi Aggarwal



- 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

Fig.no. http://www.waste-management-world.com/articles/print/volume-11/issue-5/features/the-potential-for-waste-to-energy-in-india.html

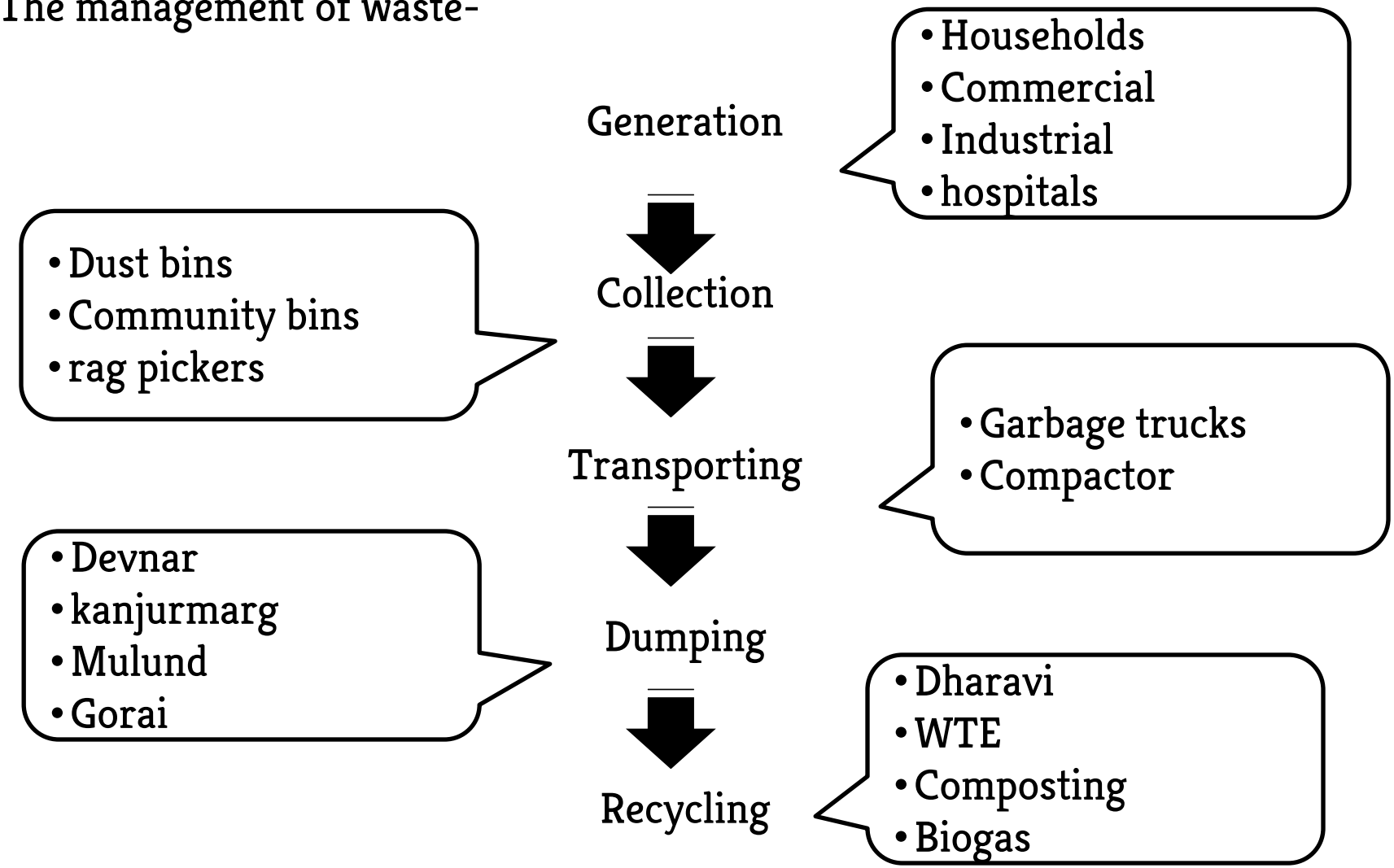
Types of waste

Dry waste –	Wet waste –	Bio medical waste –	Radioactive waste–
paper plastic, wood, cloths, glass, metals, ceramics, Garden waste, Construction debris	Food waste, Kitchen waste, Bio waste	Hospital waste, Medicines waste, Chemicals	Nuclear waste

Ref. fig http://atyourservice.seattle.gov/2010/01/05/resolve-to-compost-food-waste-you%E2%80%99ll-save/

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

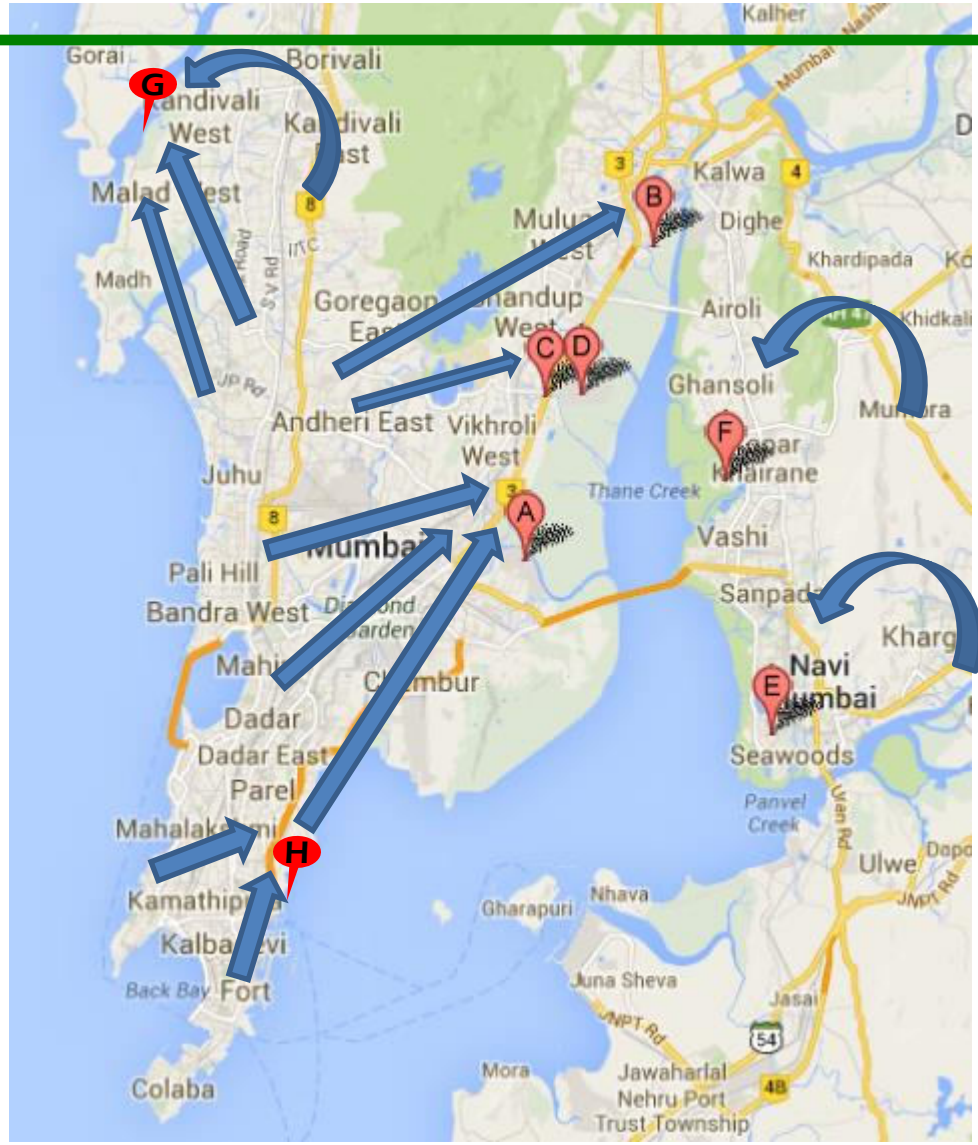
Fig.3

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

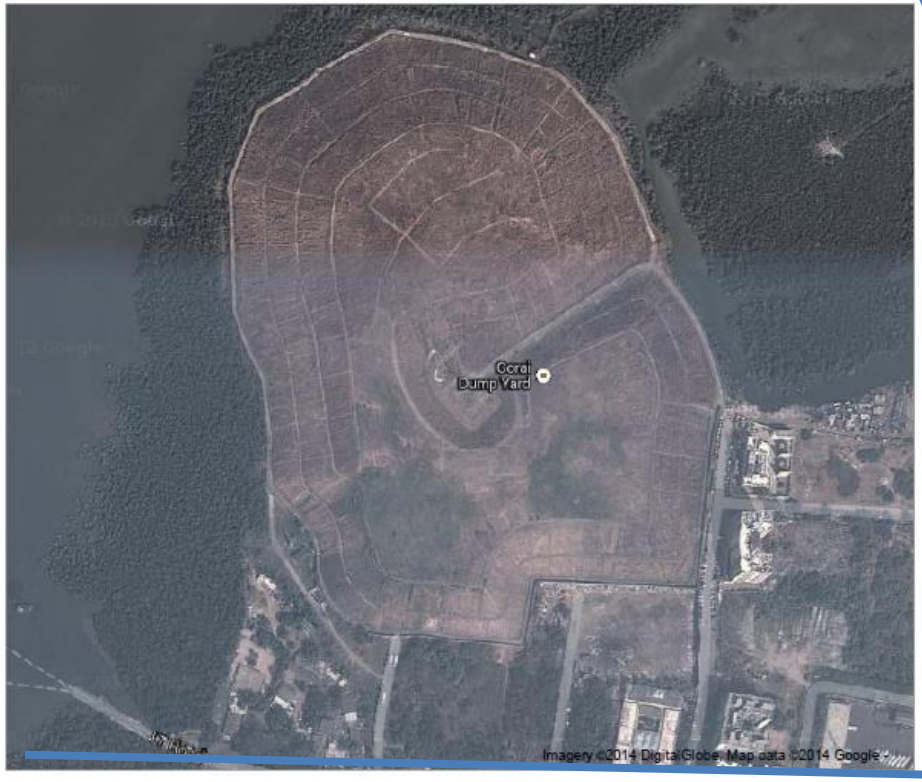
A- Devnar
B- Mulund
C- kanjurmarg
G- Gorai
H- Mahalakshmi

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

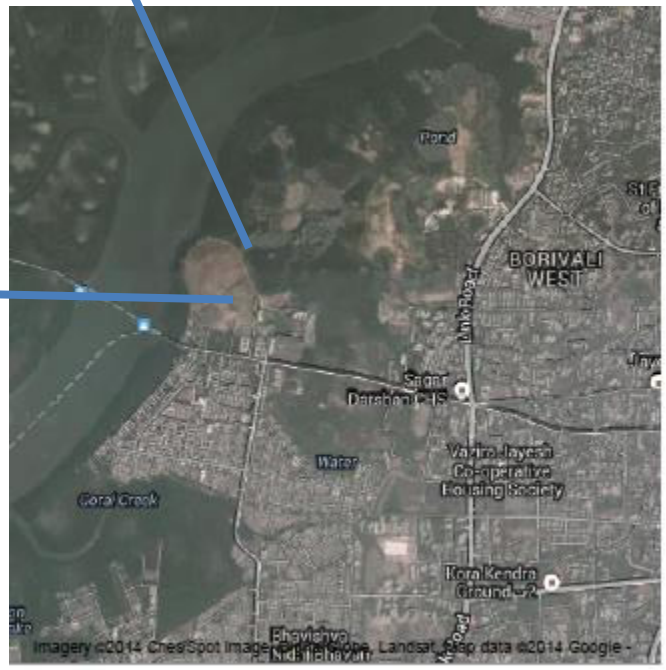


https://maps.google.co.in/maps?hl=en&tab=wl

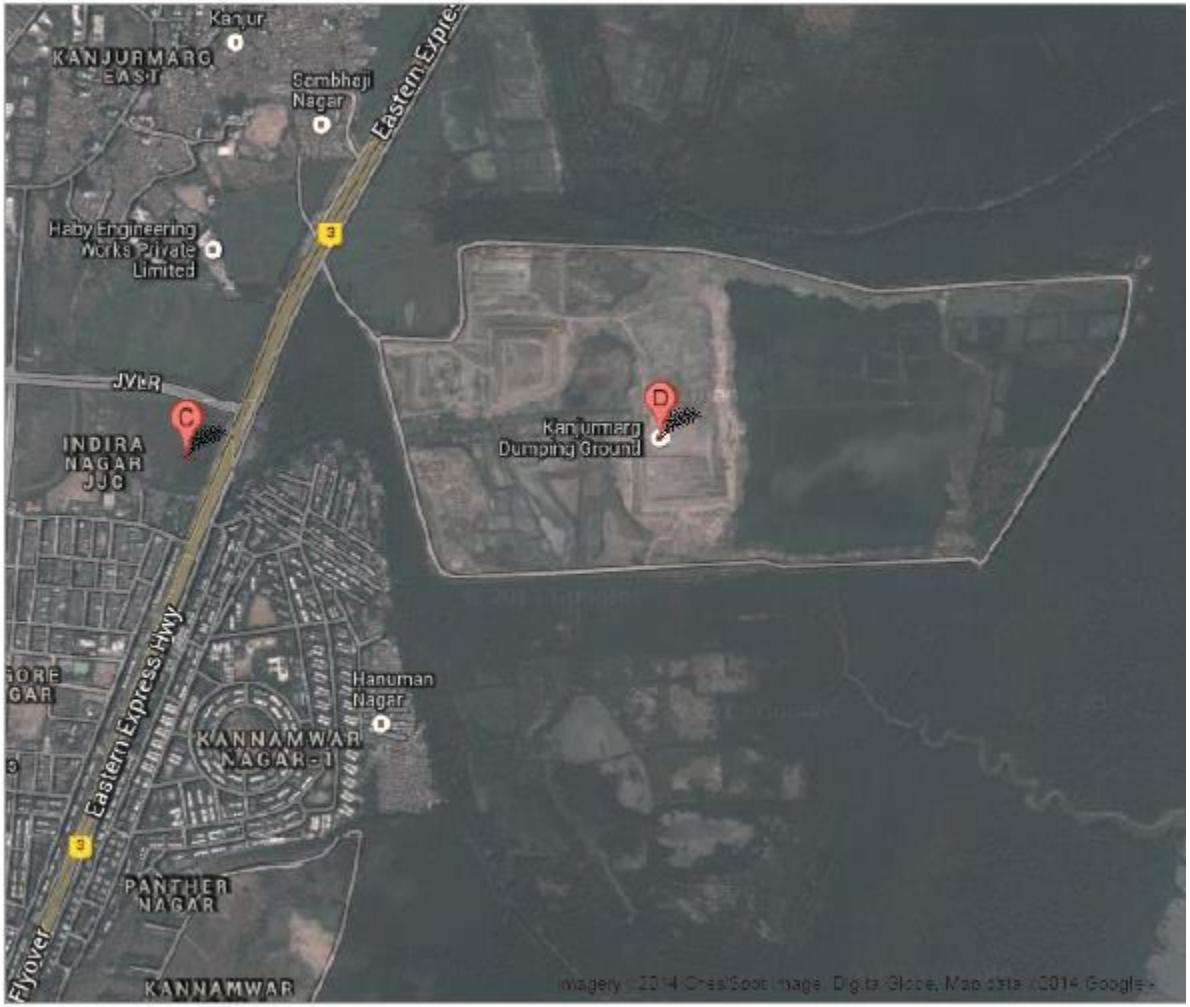
Dumping of waste



Gorai



Dumping of waste



Kanjurmarg

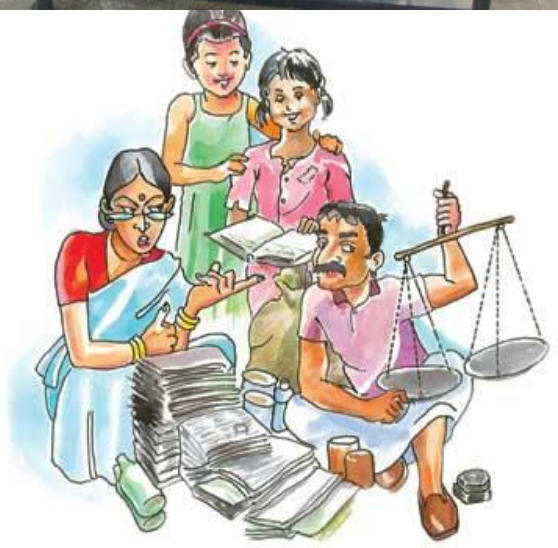
Dumping of waste

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
- **RESPOSIBILITY** of waste
- **MOTIVATION**
- **VALUE ADDITION** to the waste



http://www.teacherplus.org/2007/december-2007/the-raddi-wallah

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

1. http://streemuktisanghatana.org/programs/parisar-vikas/

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 Prakkash Dandekar, Mahim, Mumbai-

shredder demo

beautiful terrace garden

Home made digester

Discussion on waste management

home grown Tomatoes

Flowering plants

Vermicomposting Workshop

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

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-

- 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

"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

Scope of a Product-

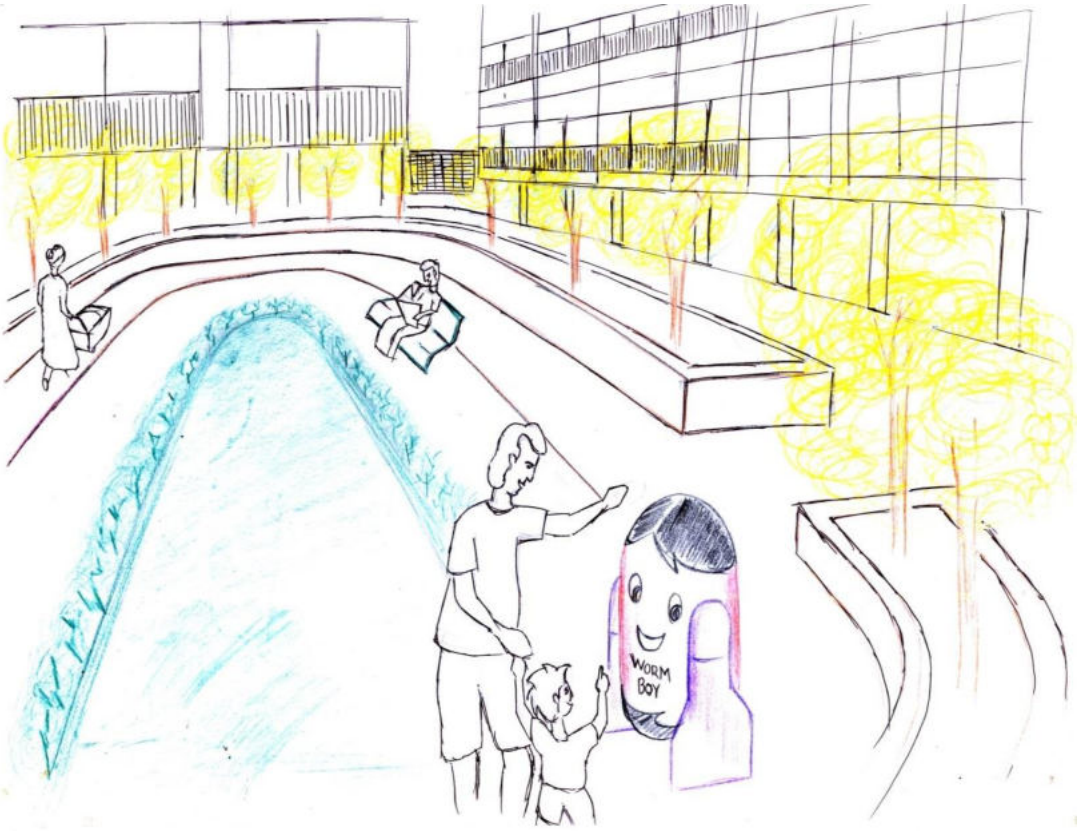
1. Compost only kitchen waste (uncooked food and garden waste)
2. Enable to harvest vermicompost and worm tea.
3. Educate people about vermicompost.
4. The waste collection method.
5. maintenance and service.

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



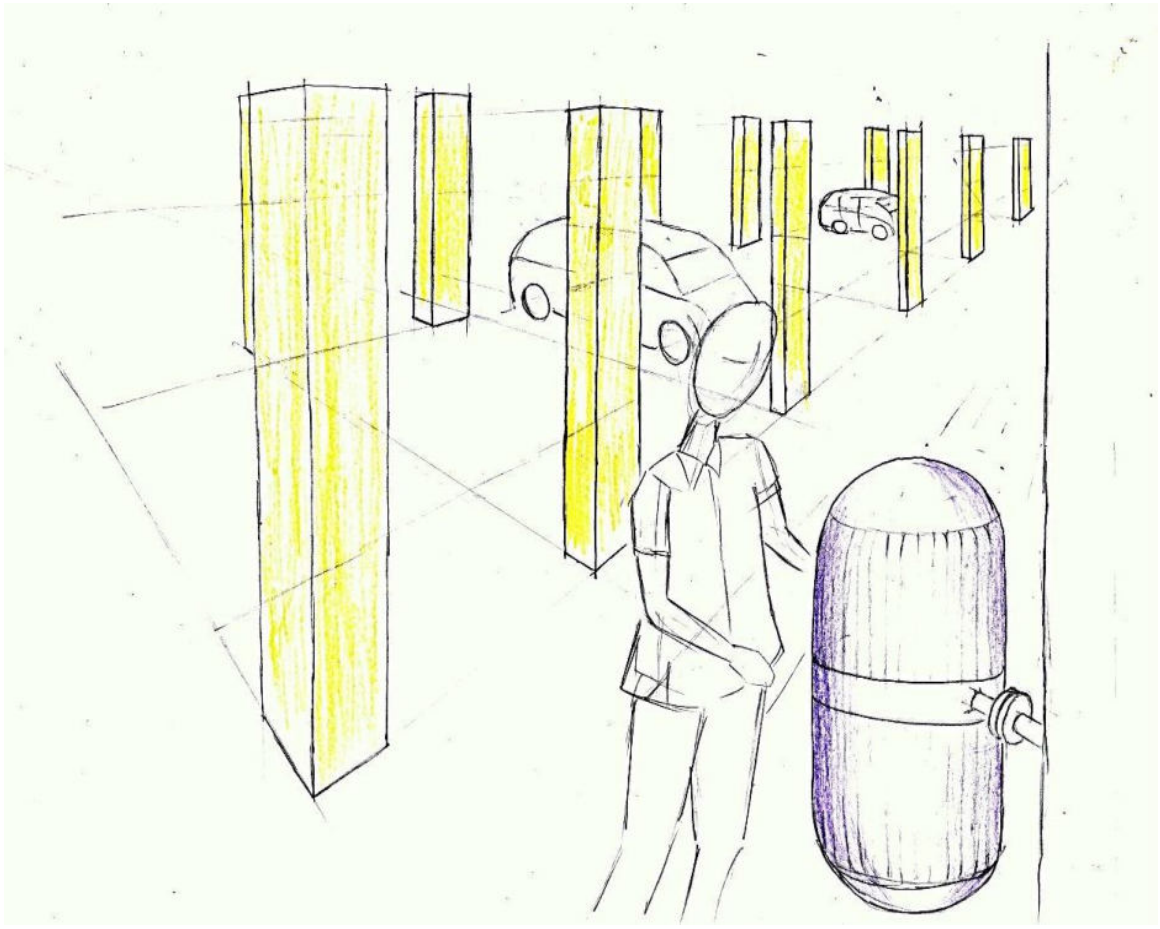
Advantages-

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

Disadvantages-

- Exposed to out side weather

Scenario 2- Into the Parking lot



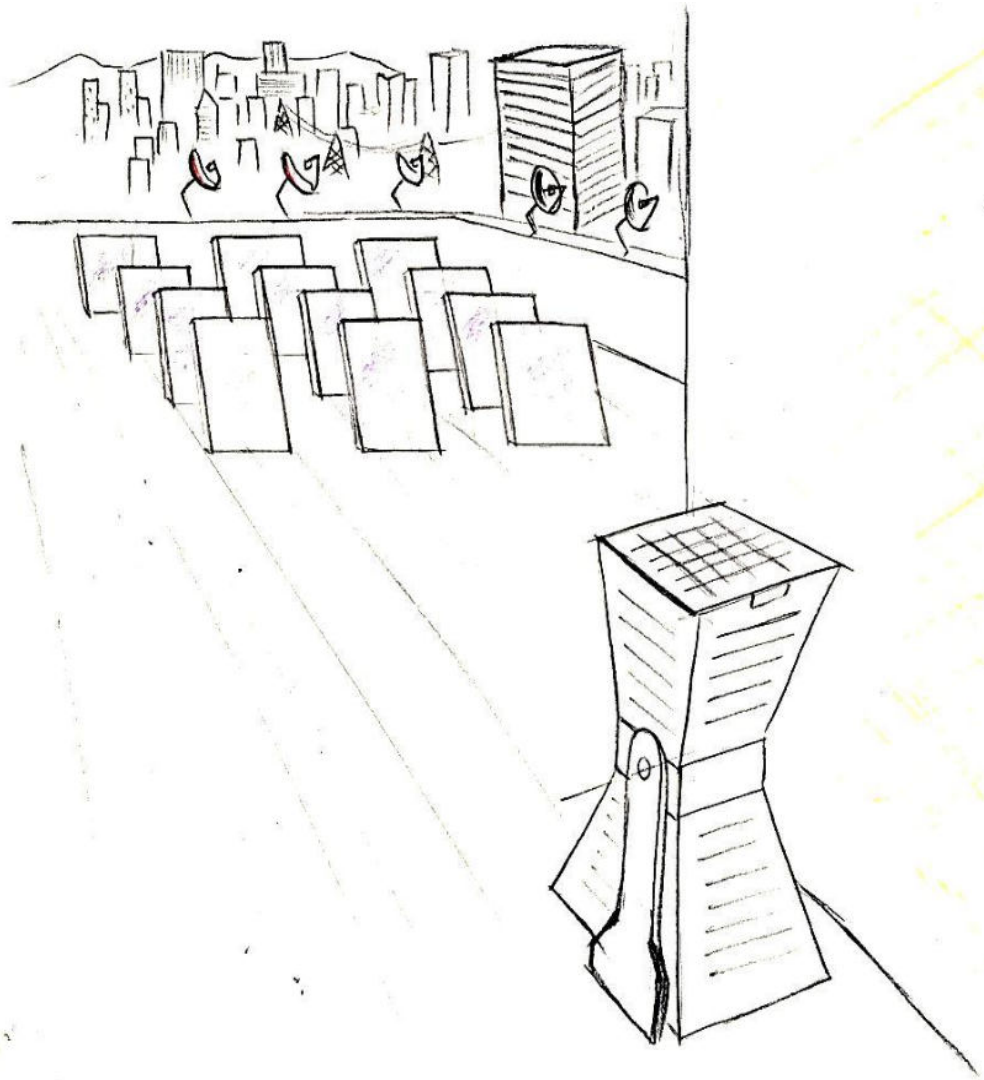
Advantages-

- Space saving design
- Into the shed always

Disadvantages-

- Non educative
- Non informative

Scenario 3 - Terrace



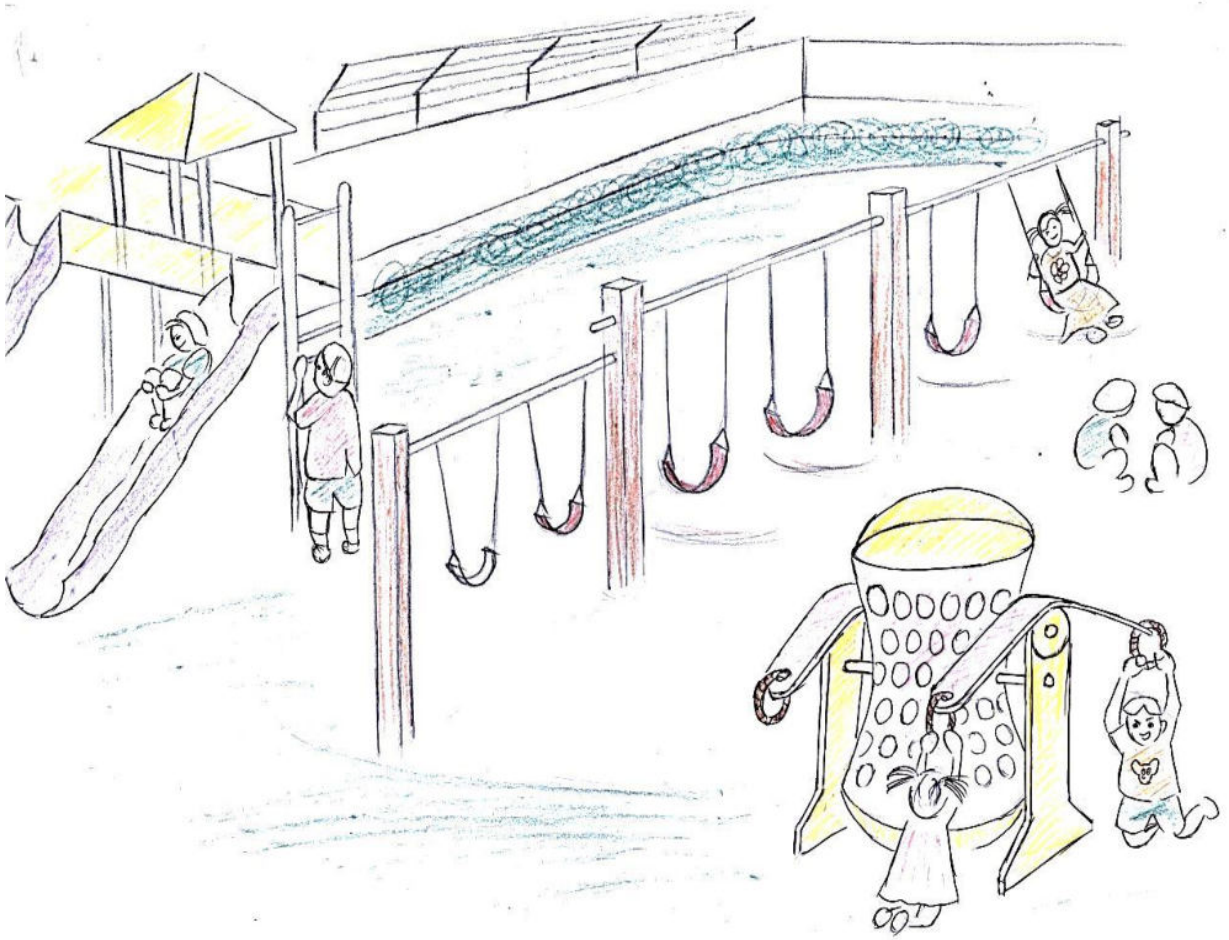
Advantages-

- 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



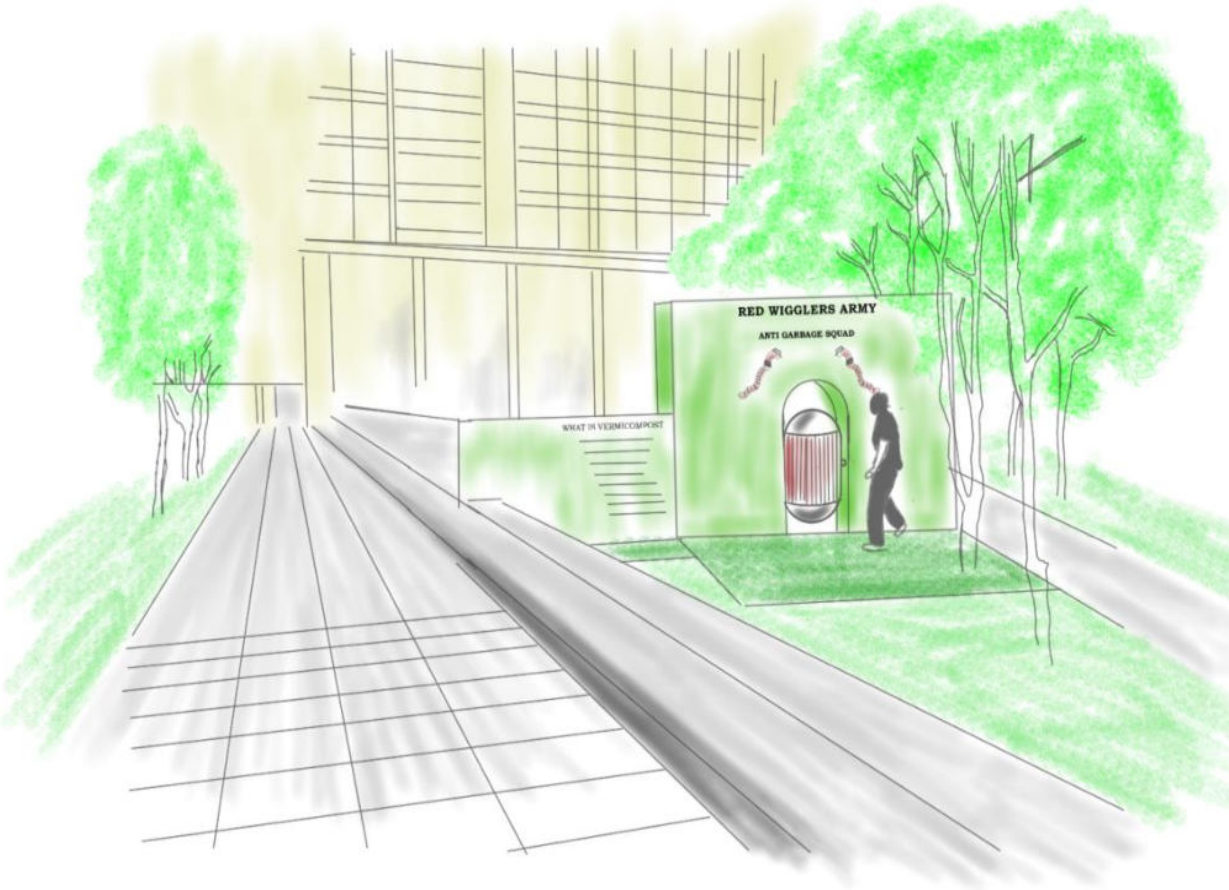
Advantages-

- 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



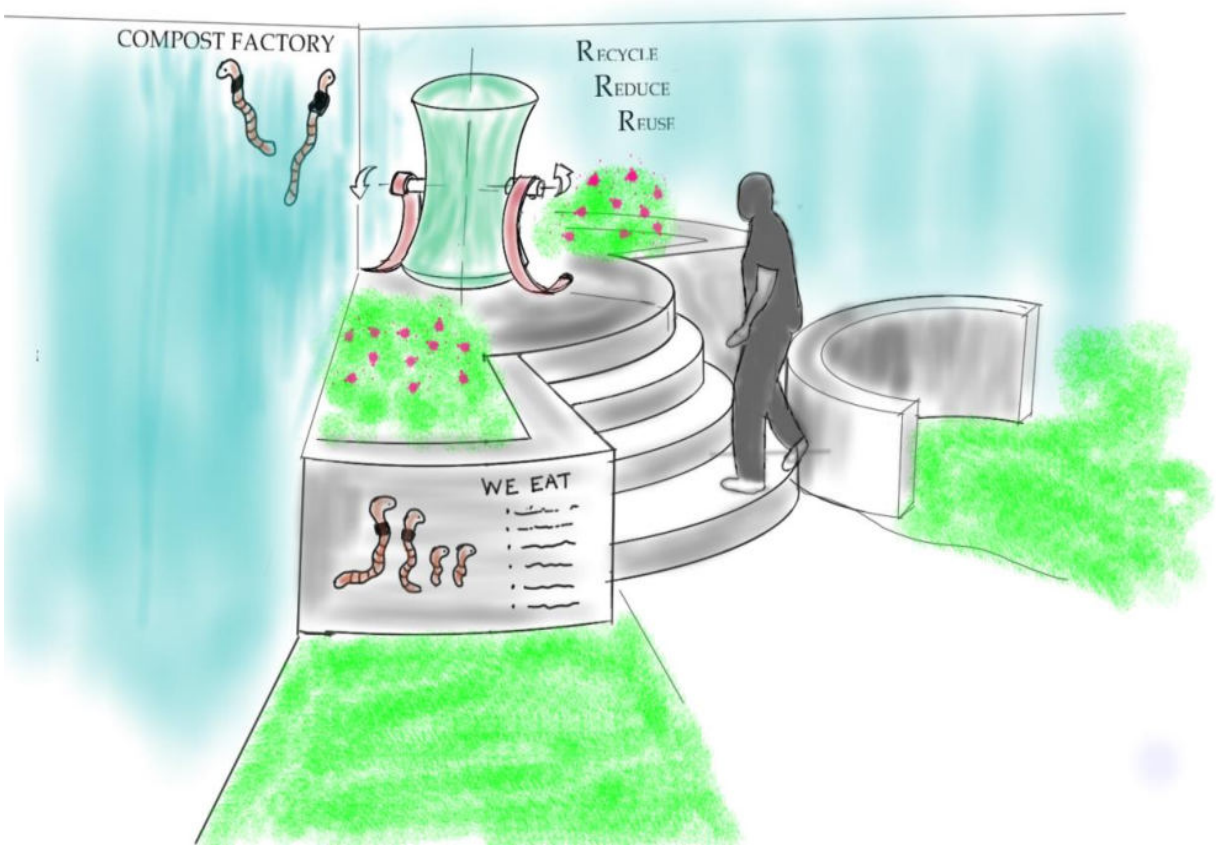
Advantages

- Centre of attraction
- Informative

Disadvantages

- Infrastructure needed
- Exposed to outside weather

Scenario 6 – At corner of the compound walls



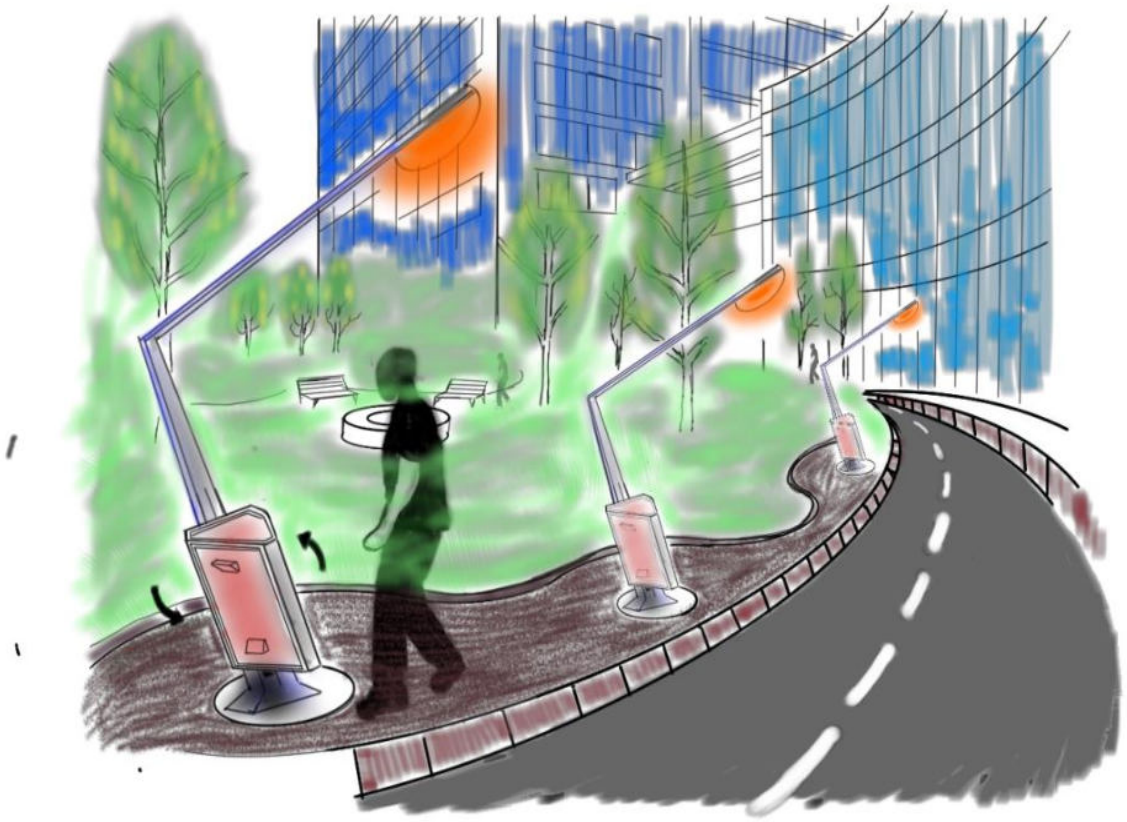
Advantages-

- Using a wasted corner
- Corner became a information center

Disadvantages-

- Exposed to sun

Scenario 7- Vermicompost polls



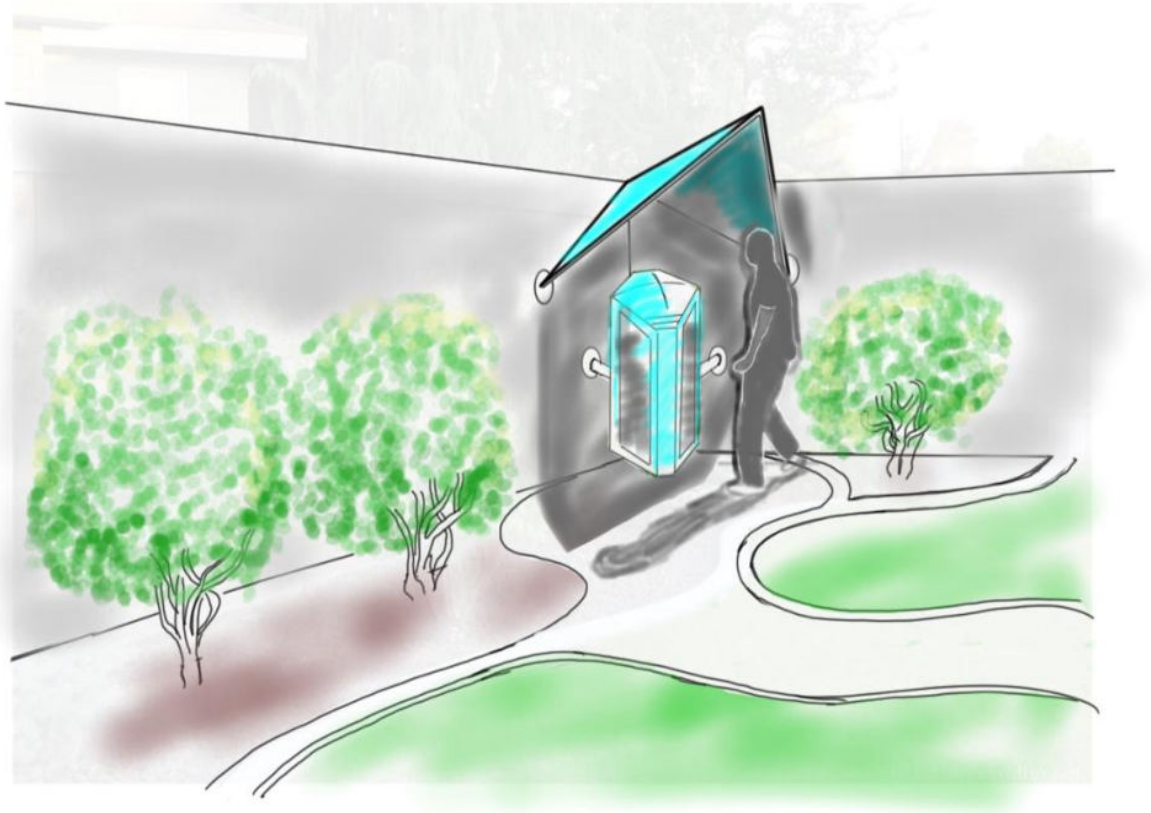
Advantages-

- 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

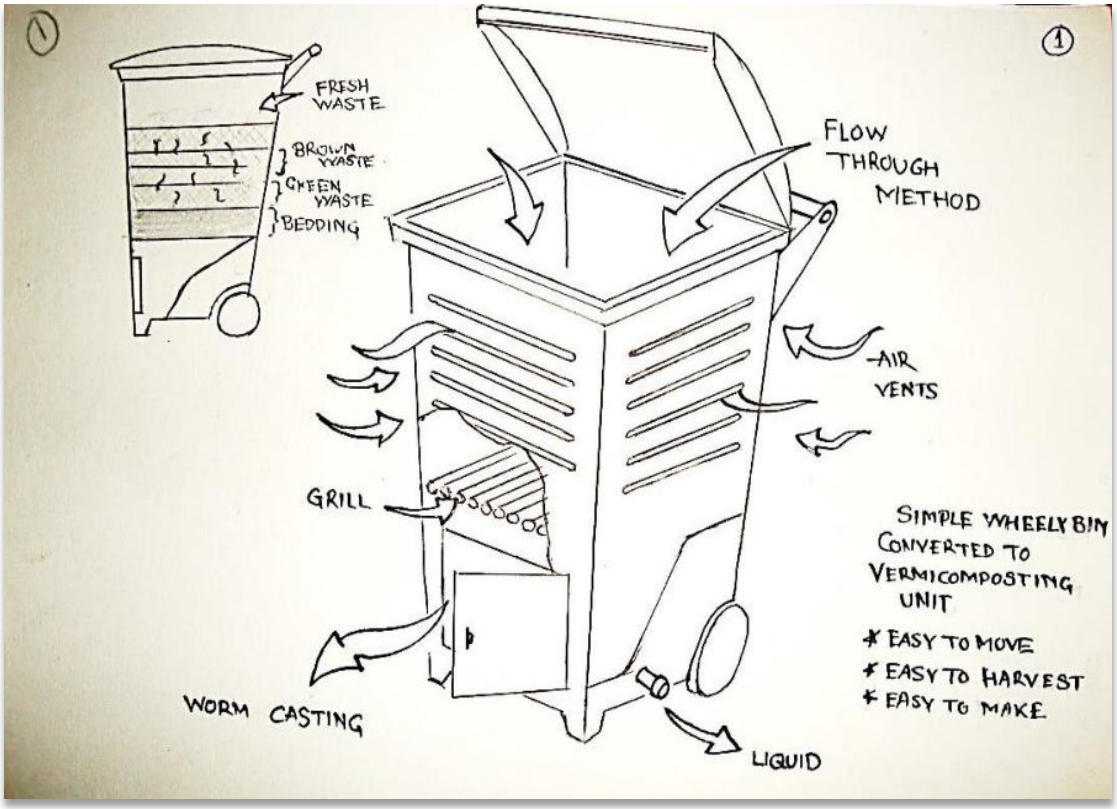
- Centre of attraction
- Informative

Disadvantages

- Infrastructure needed
- Exposed to outside weather

Ideations

1 - Wheelie bin concept



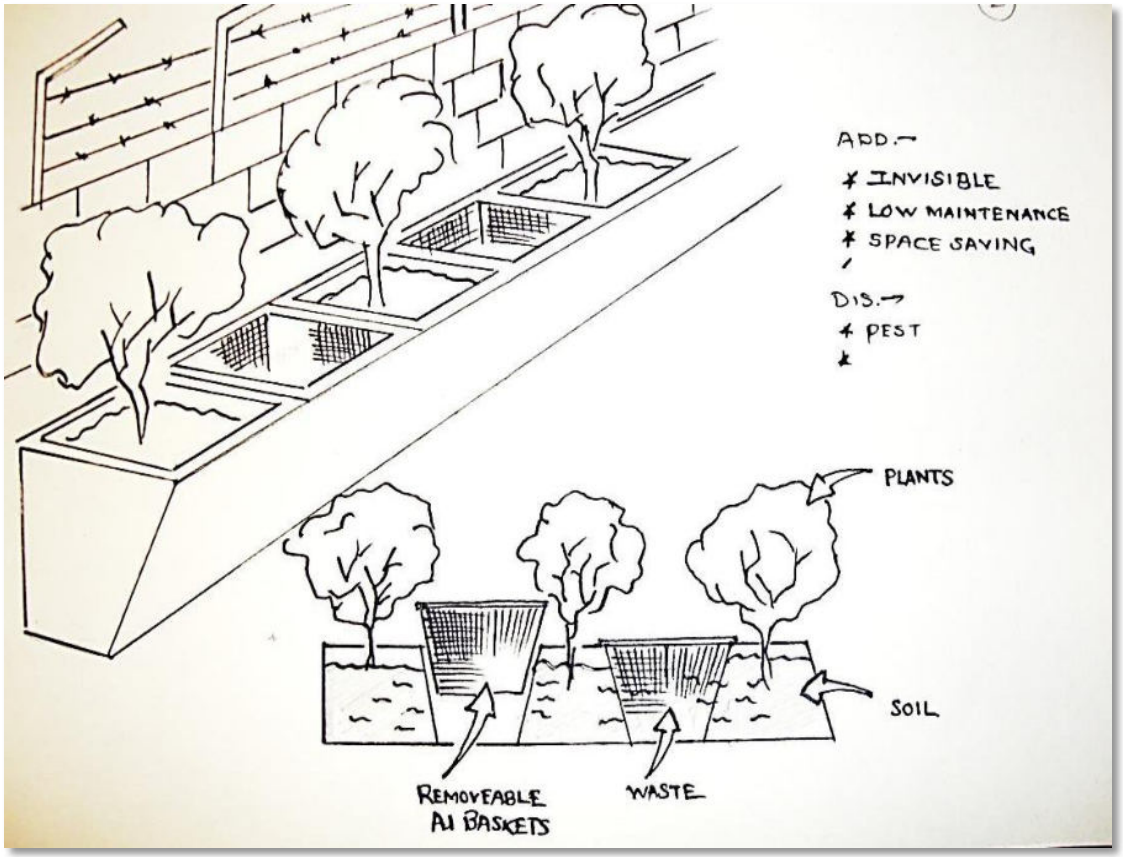
Advantages-

- 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-



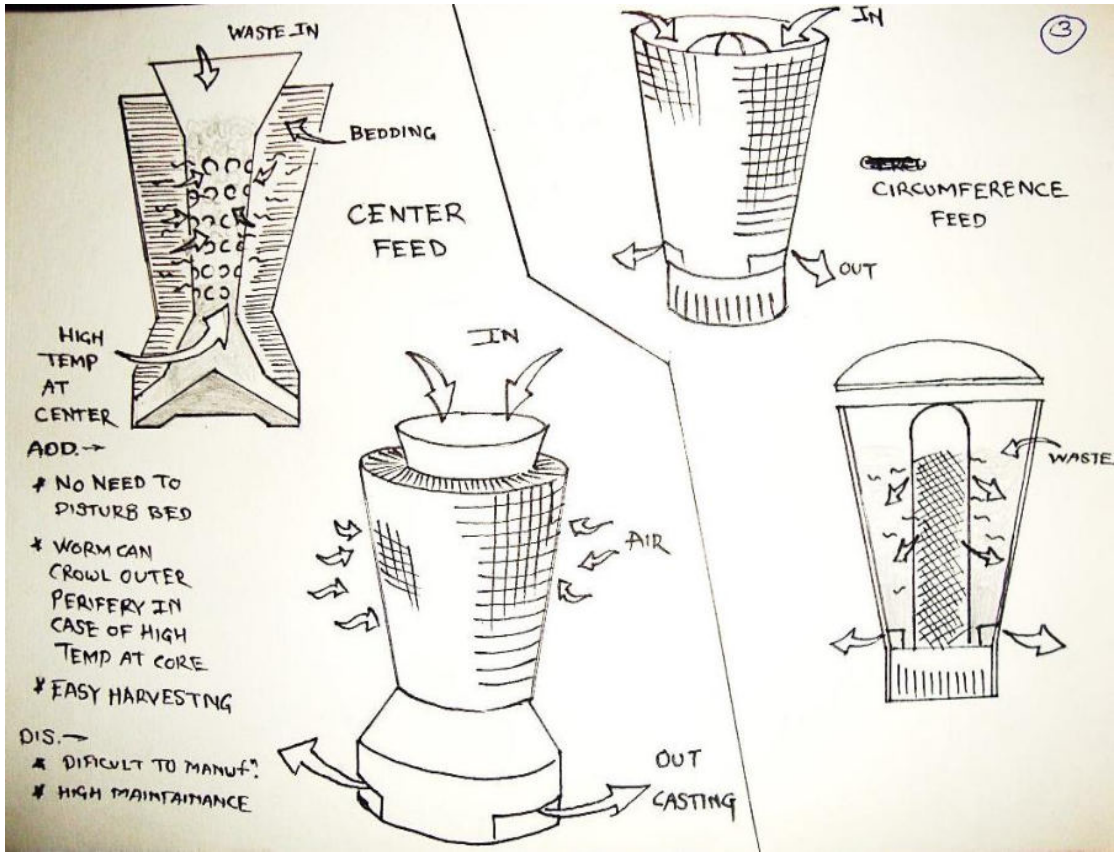
Advantages-

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

Disadvantages-

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

3 - Central feed



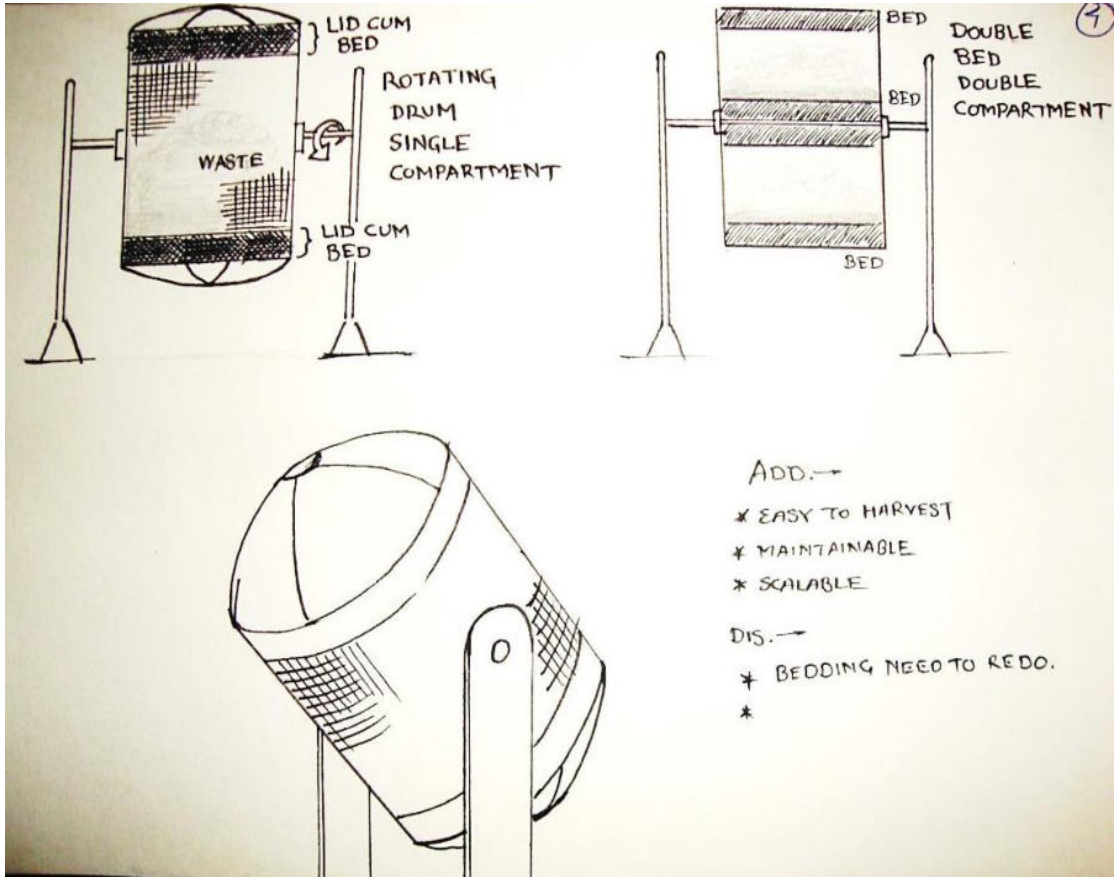
Advantages-

- No need to Disturb worm Bed
- Faster composting Process

Disadvantages-

- Working Principle need to be Verified

4 - Rotating drum



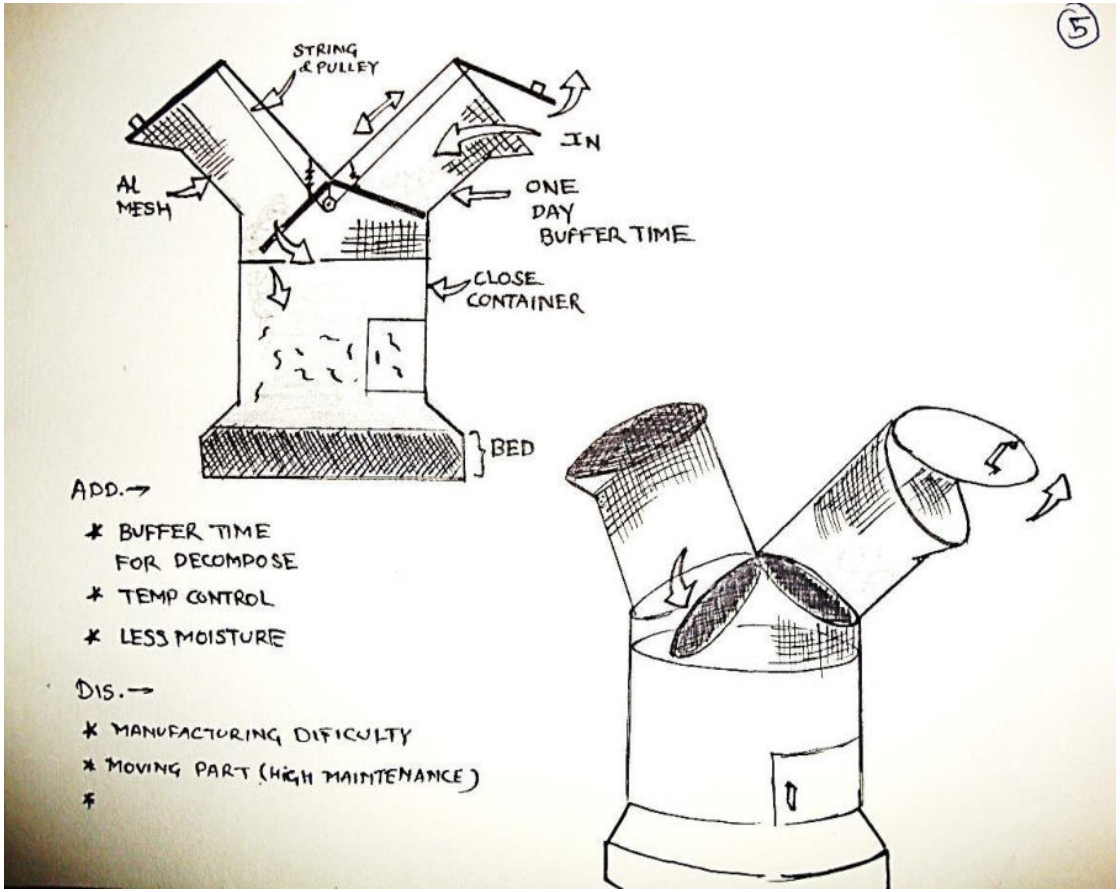
Advantages

- Stirring is Possible
- Buffer time for aerobic decomposition

Disadvantages

- Bed need to prepaid at the time of harvesting

5 - Two side feed



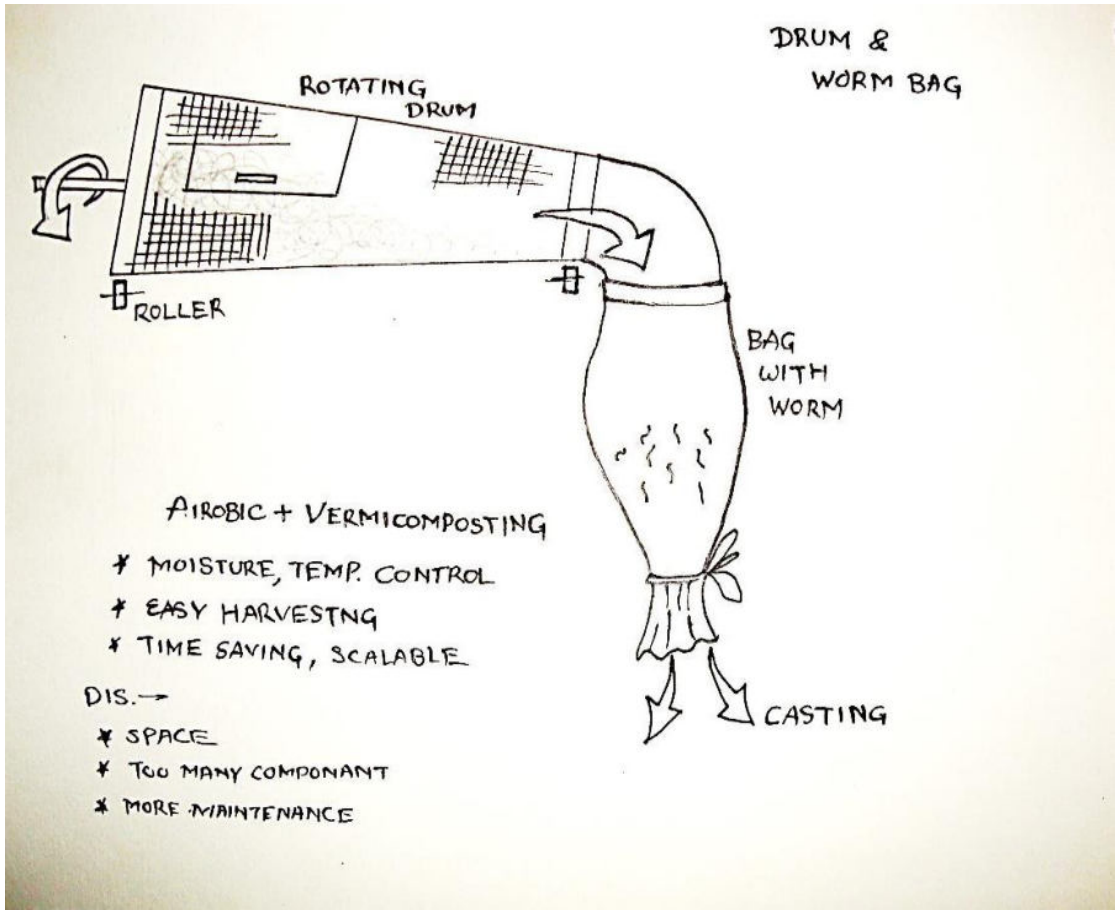
Advantages-

- Buffer time for aerobic decomposition
- Temp can be control

Disadvantages

- Too many moving parts

6 - Worm bag



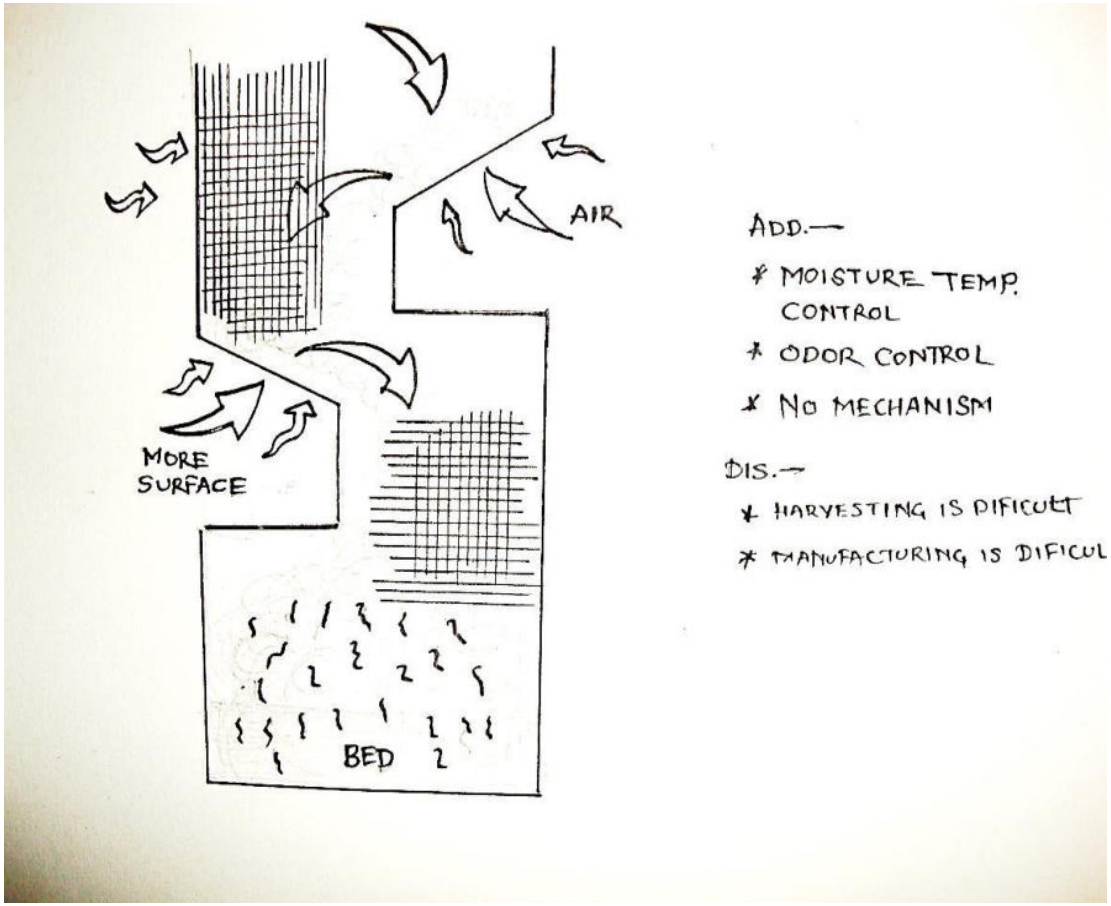
Advantages-

- Buffer time for aerobic decomposition
- Stirring is Possible

Disadvantages-

- Too many moving parts

7 - Steps bin



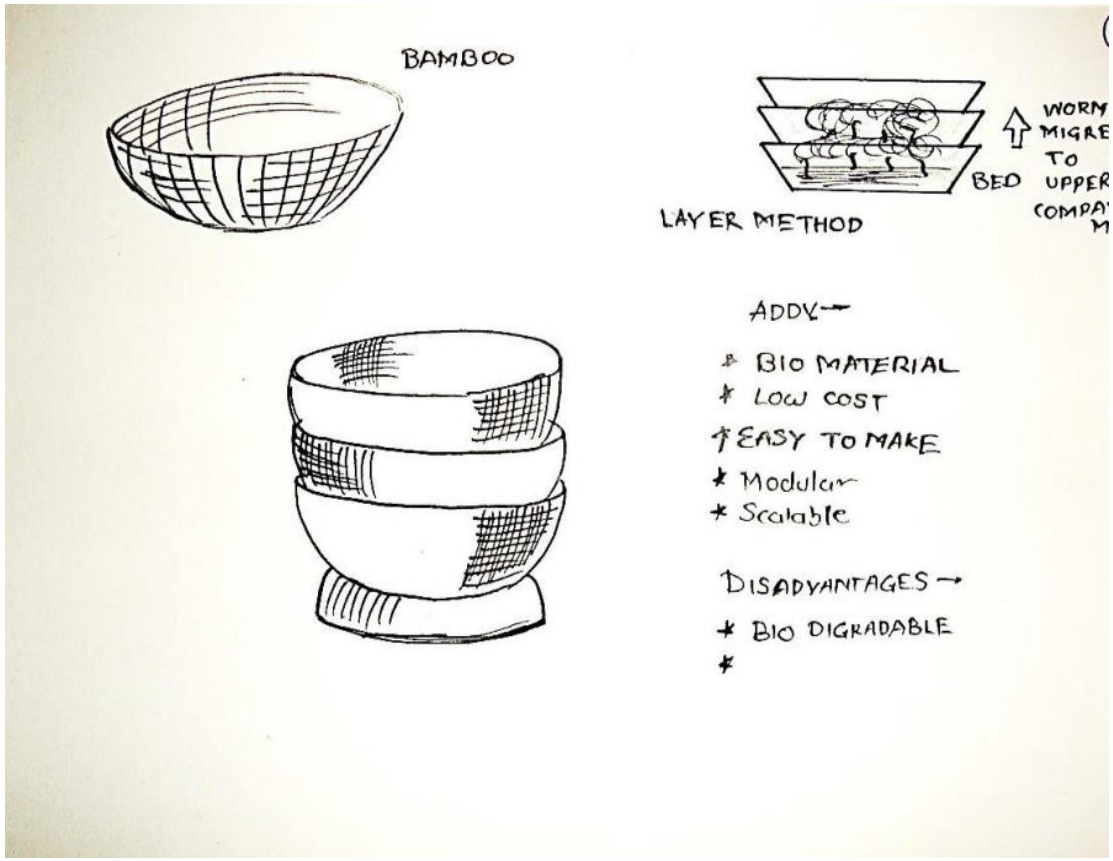
Advantages-

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

Disadvantages-

- Harvesting is Difficult

8 - Bamboo baskets



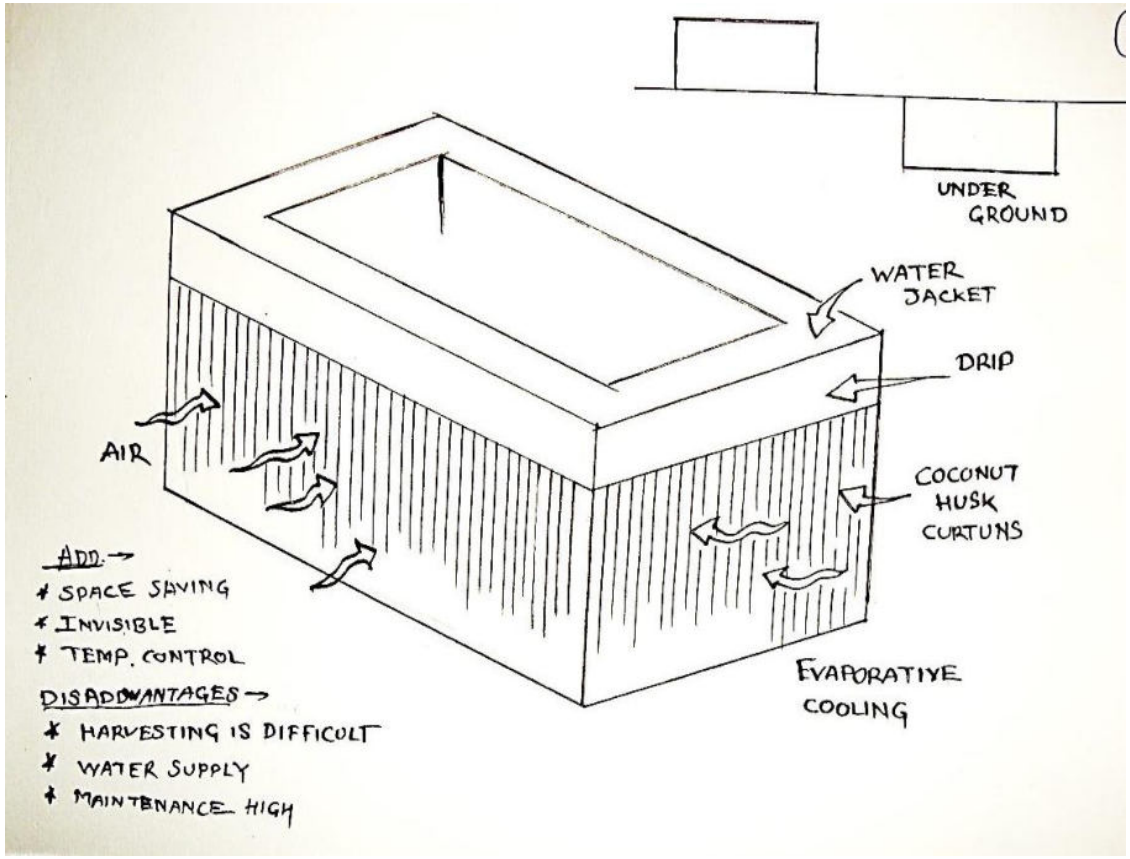
Advantages-

- Low Cost, bamboo availability
- Easily available

Disadvantages-

- Bio Degradable
- Pests will dig into it.

9 - Underground



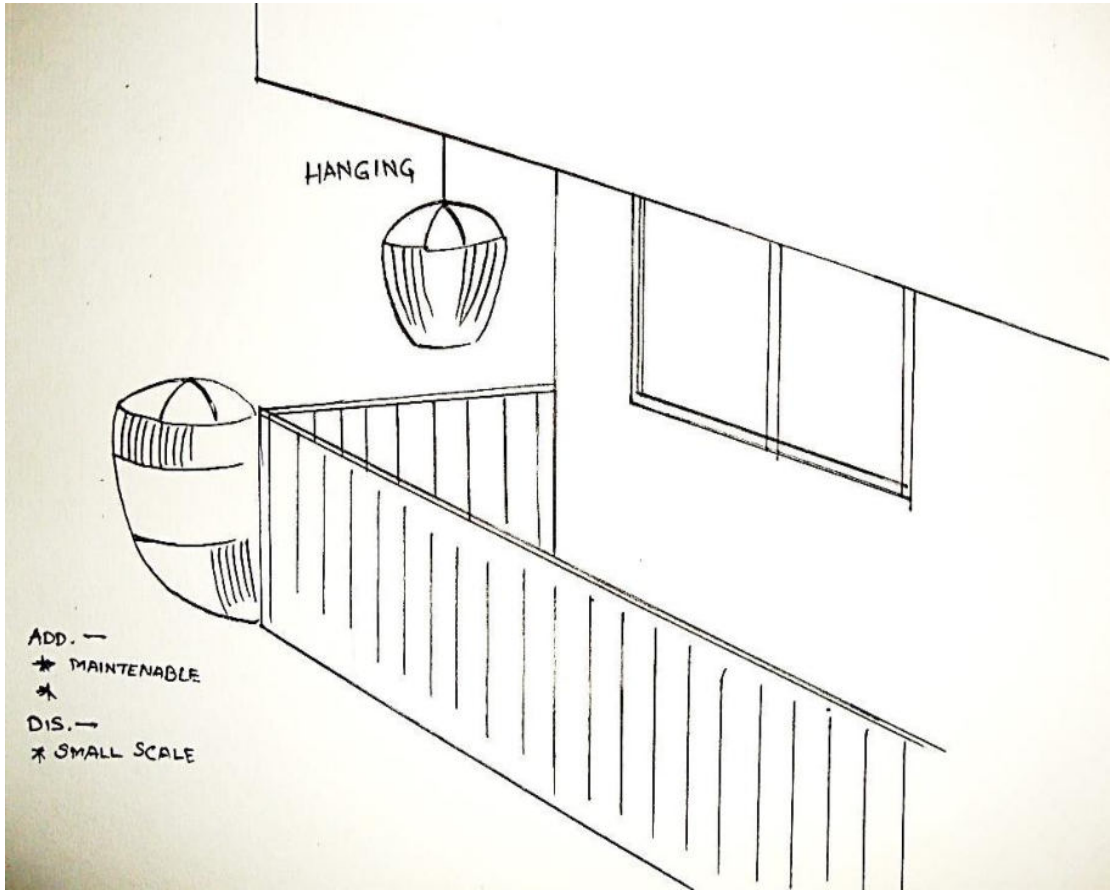
Advantages-

- Hidden
- Temperature and Moisture control

Disadvantages-

- Harvesting is difficult

10 - Personal modules-



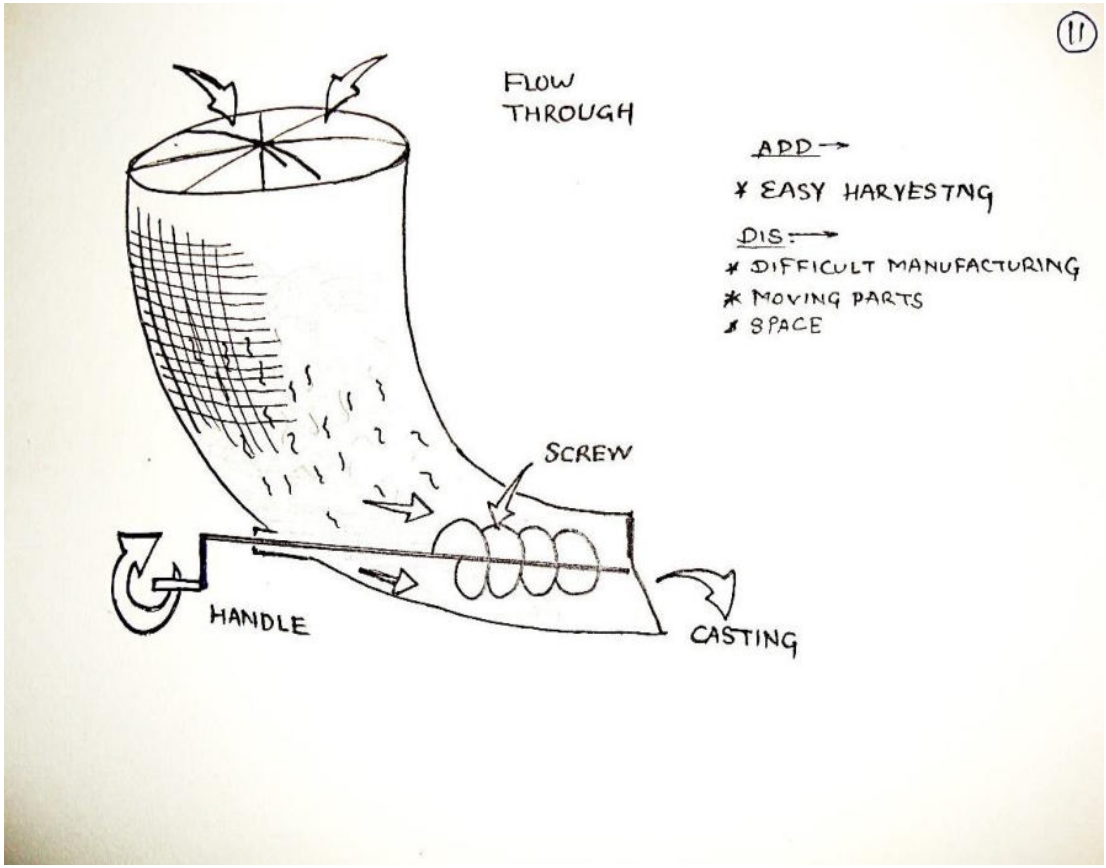
Advantages-

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

Disadvantages-

- Only for Personal use

11 - Screw Bin



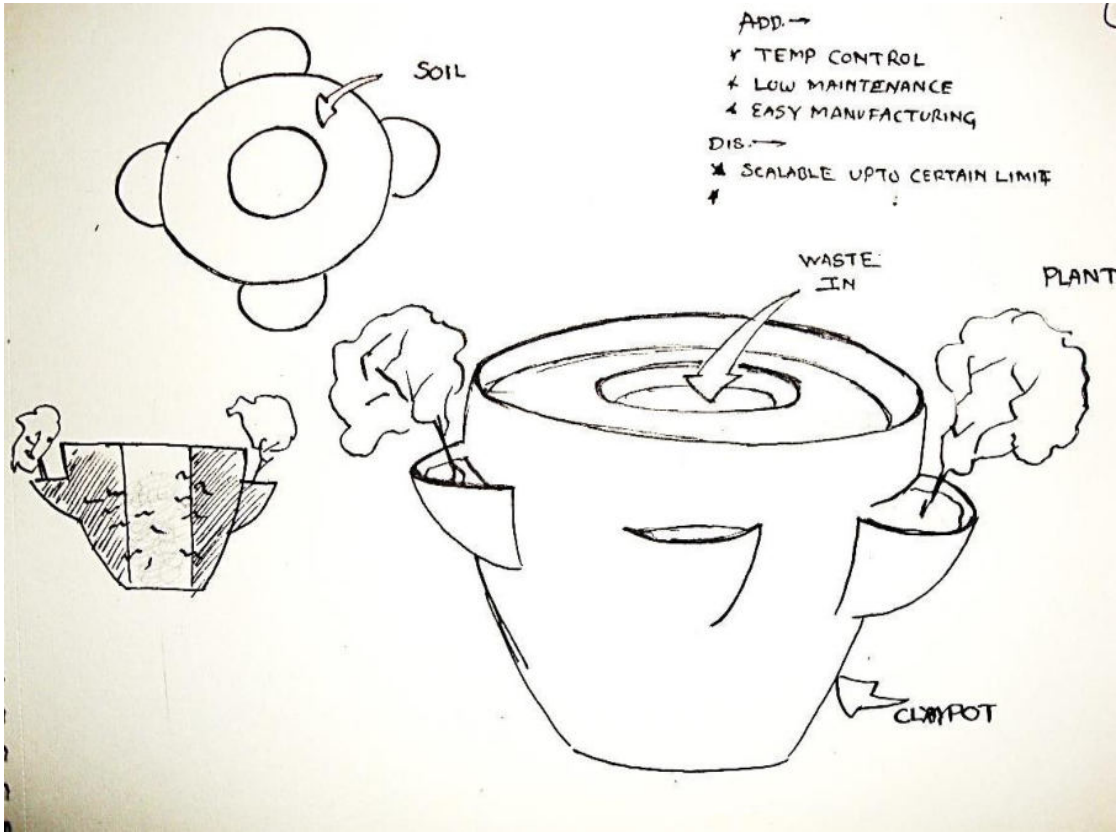
Advantages-

- Easy Harvesting
- Continues flow system

Disadvantages-

- Moving Parts/mechanism

12 - Clay pot



Advantages-

- Direct application of Casting
- Naturally control Temperature

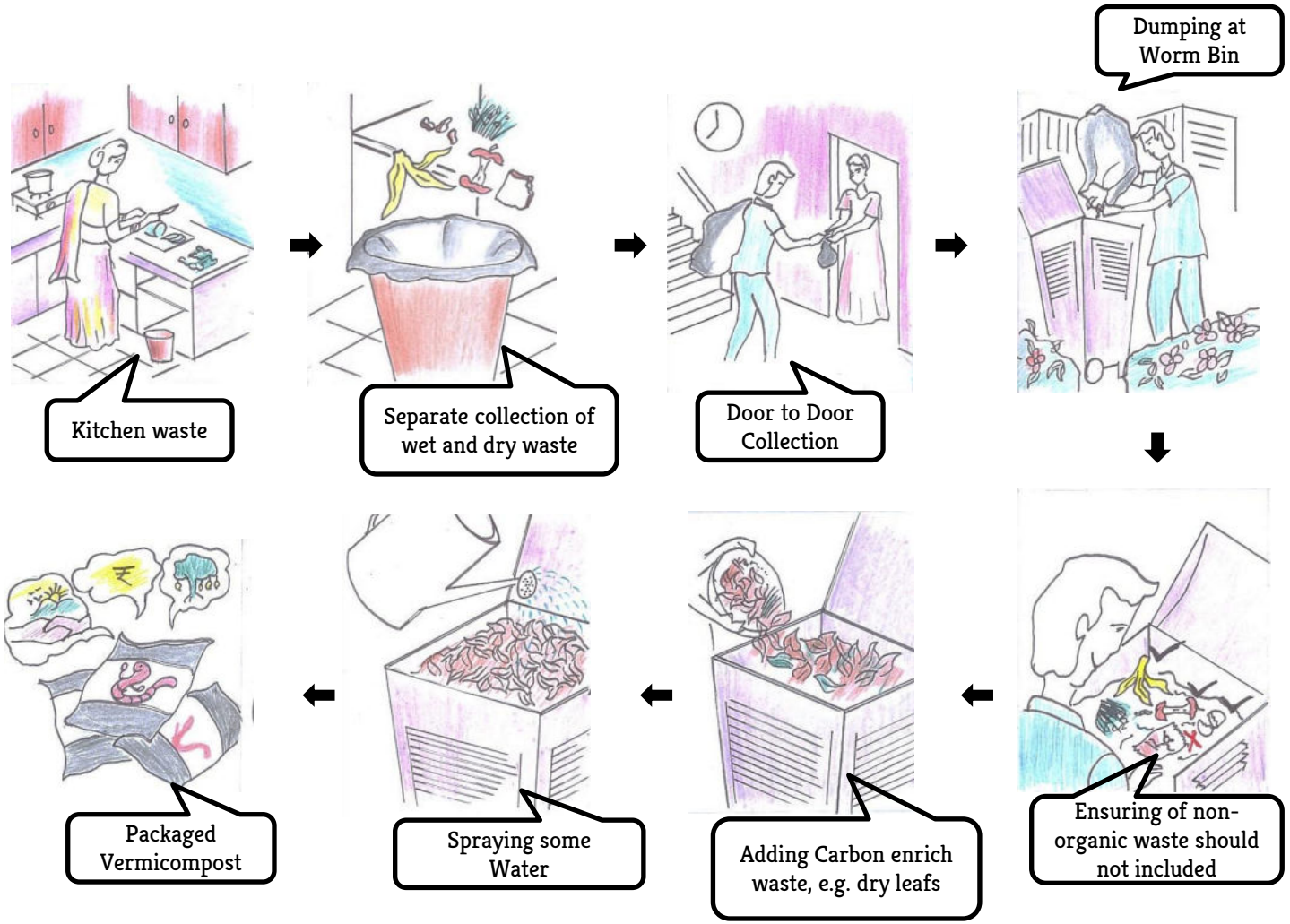
Disadvantages-

- Low Cost
- Delicate

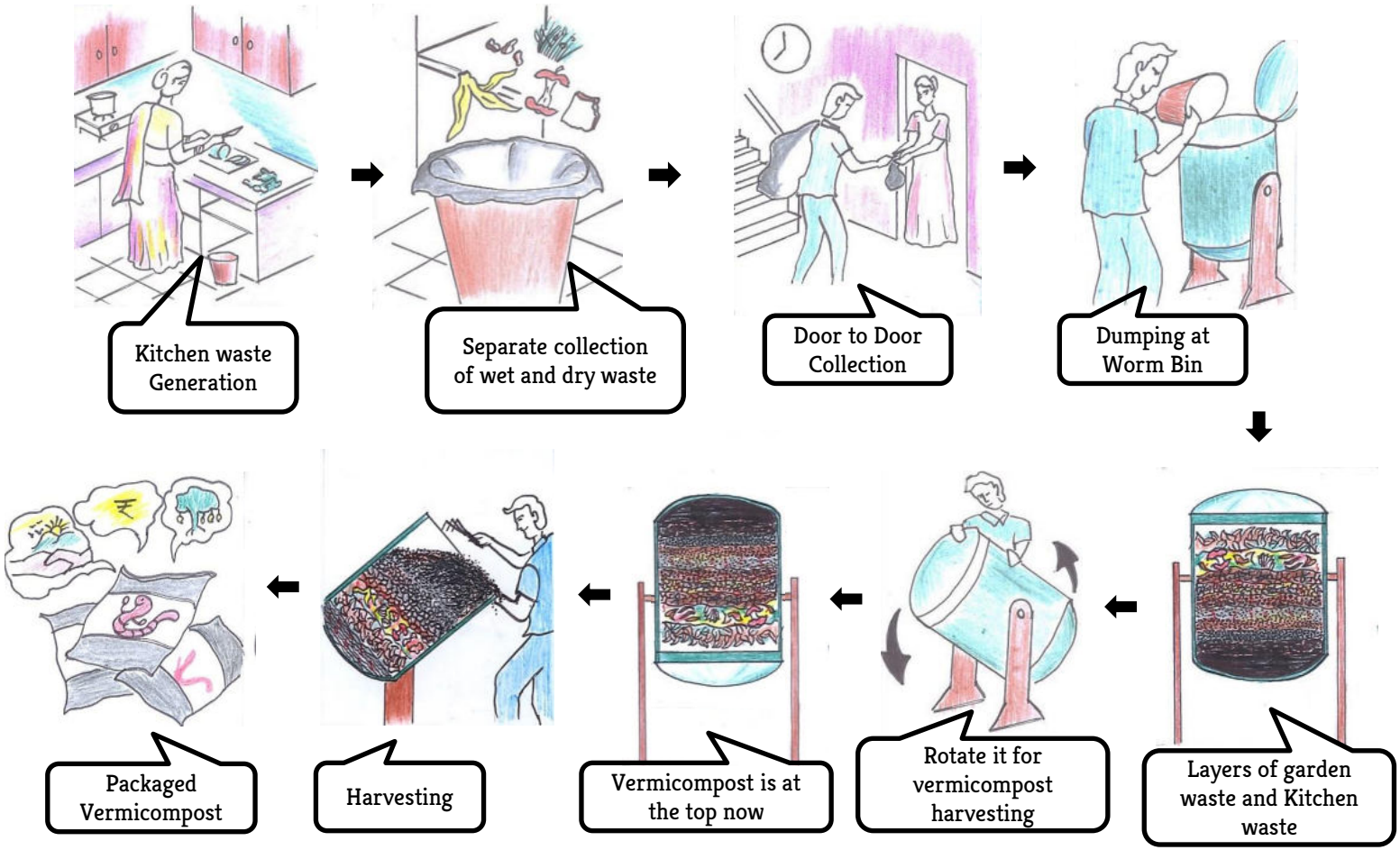
Concepts

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

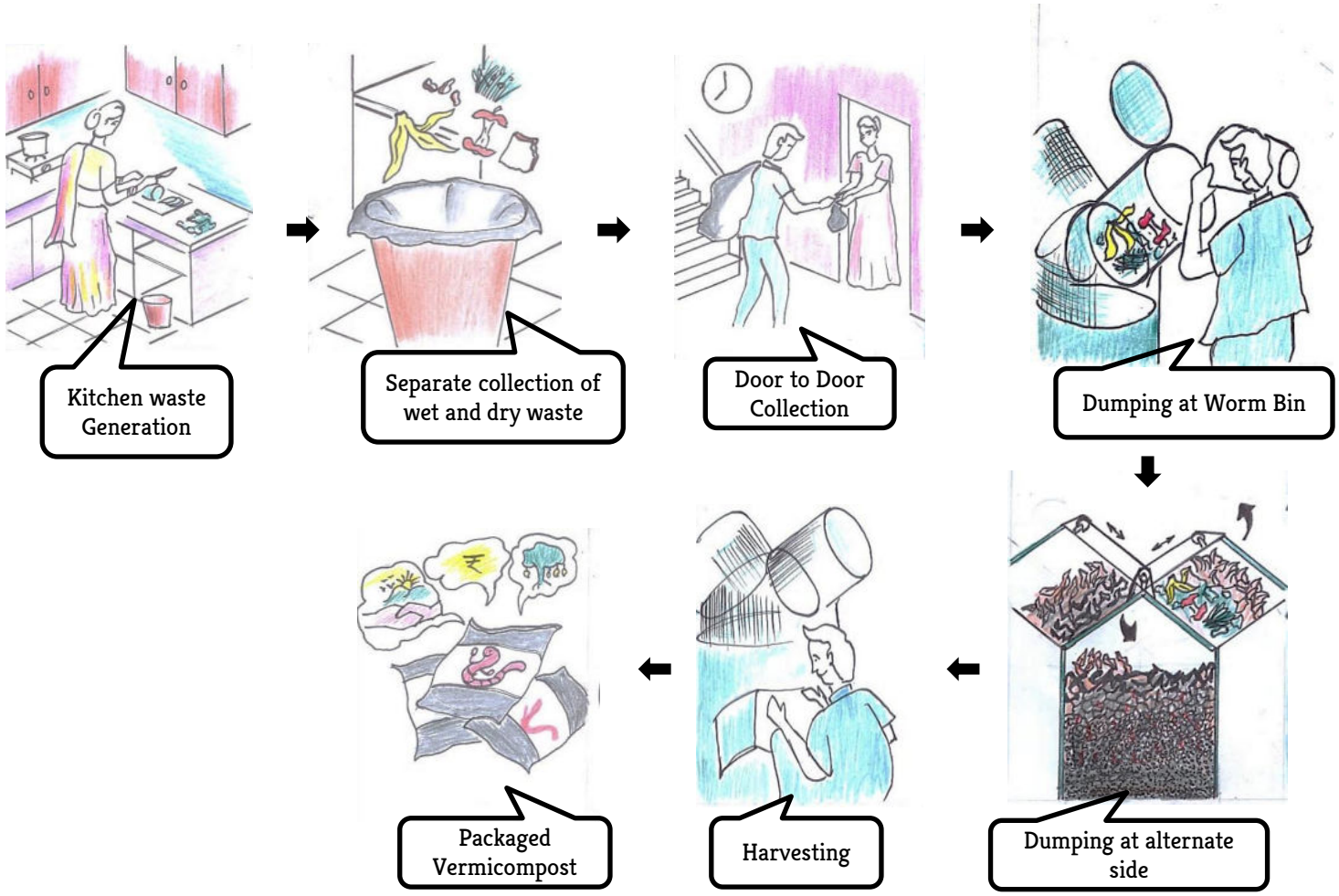
1. Story board for wheelie bin concept



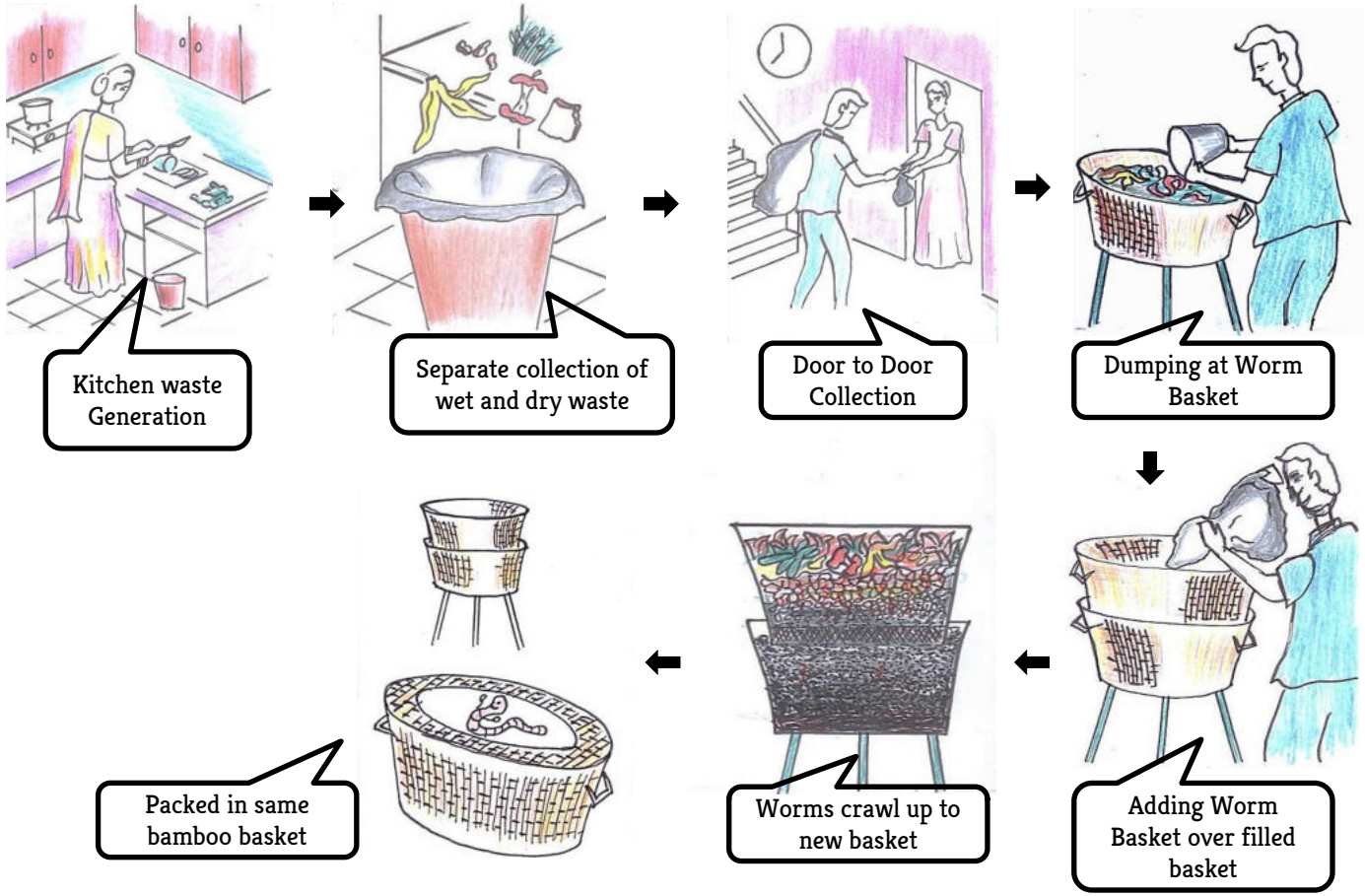
2. Story board for Drum concept



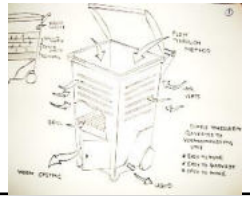
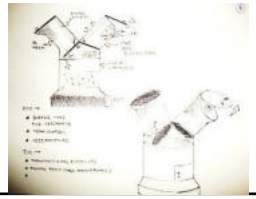
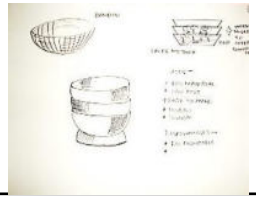
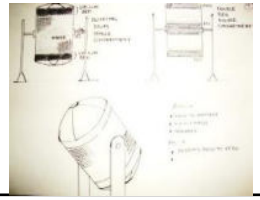
3. Story board for two side feed



4. Story board for bamboo baskets



Concepts evaluation

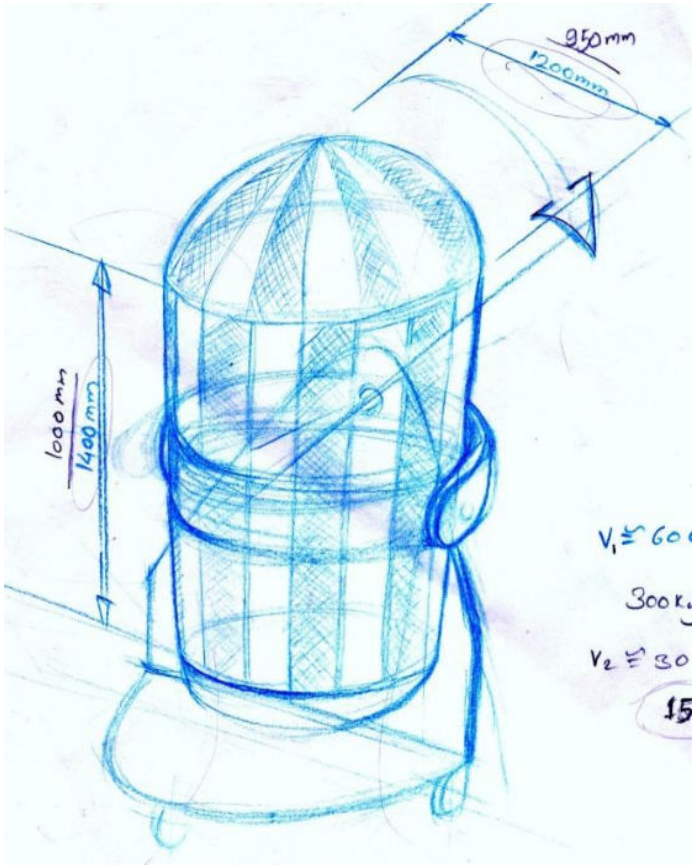
Concepts No.	1.Worm bin	2.Two side feed	3.Bamboo Basket	4.Rotating Drum
				
Implementable	✓	✓	✓	✓
Manufacturing-	` ✗	✓	✓	✓
Capacity	✓	✓	✗	✓
Space Required	✓	✓	✓	✓
Maintenance	✗	✗	✓	✓
Man power-	✓	✗	✓	✓
Scalable	✗	✗	✗	✓
Modularity	✗	✗	✓	✗
Total-	4	4	6	7

Concepts evaluation

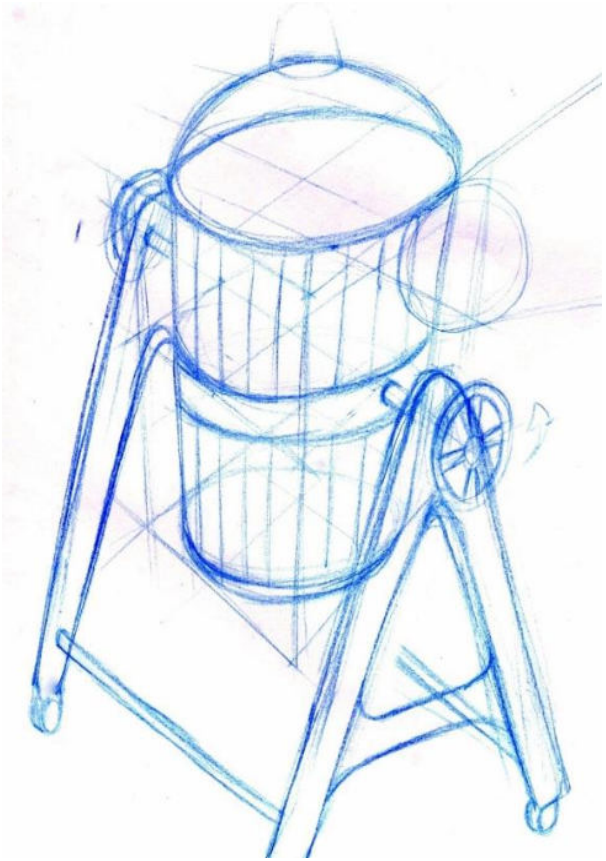
Evaluation criteria from Product brief-

- **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



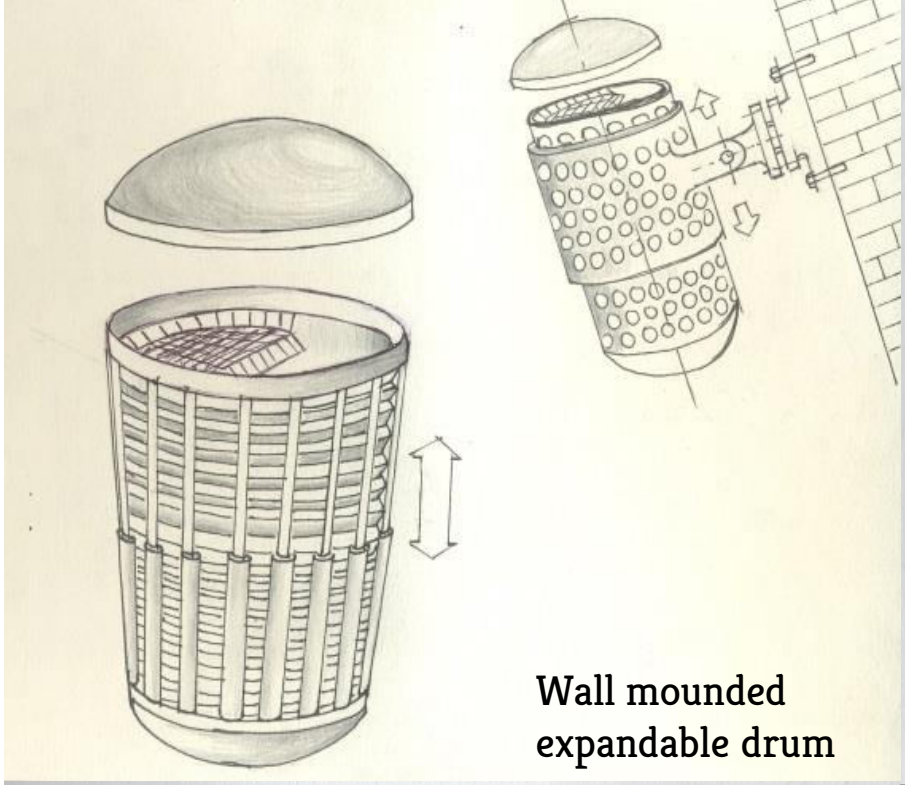
side wise rotating drum, will help to locate it along with the wall



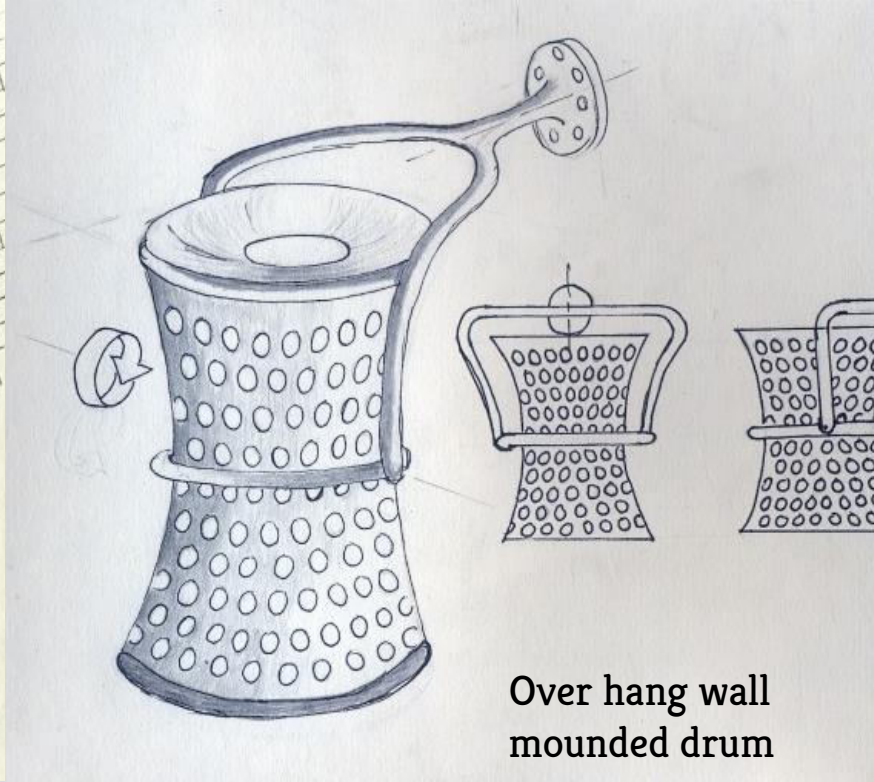
It can't be placed along the wall so it will take some more space.

Advantages:

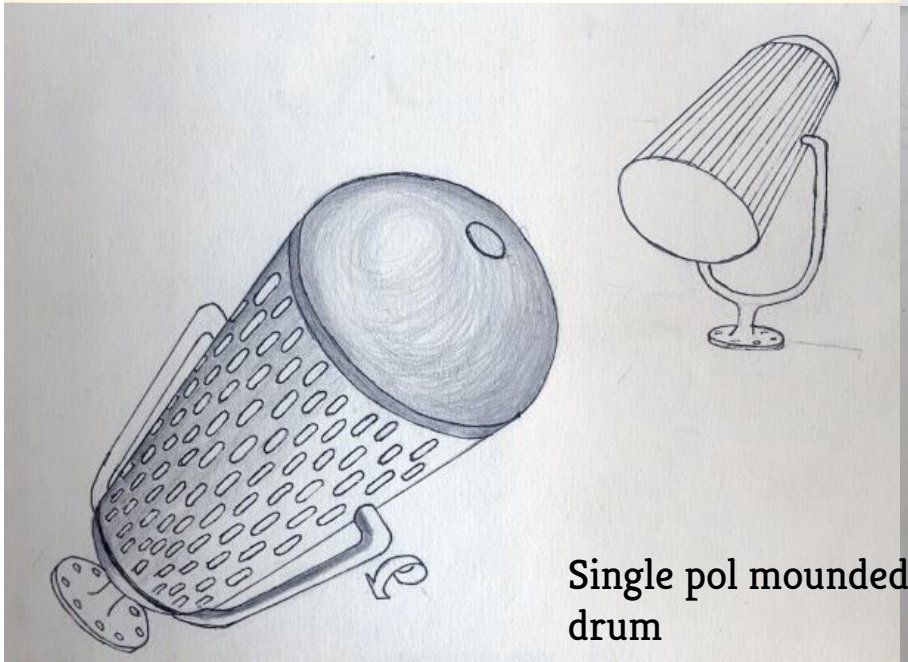
- It has less moving Parts
- High capacity
- Simplified
- Elevated from ground
- Implementable



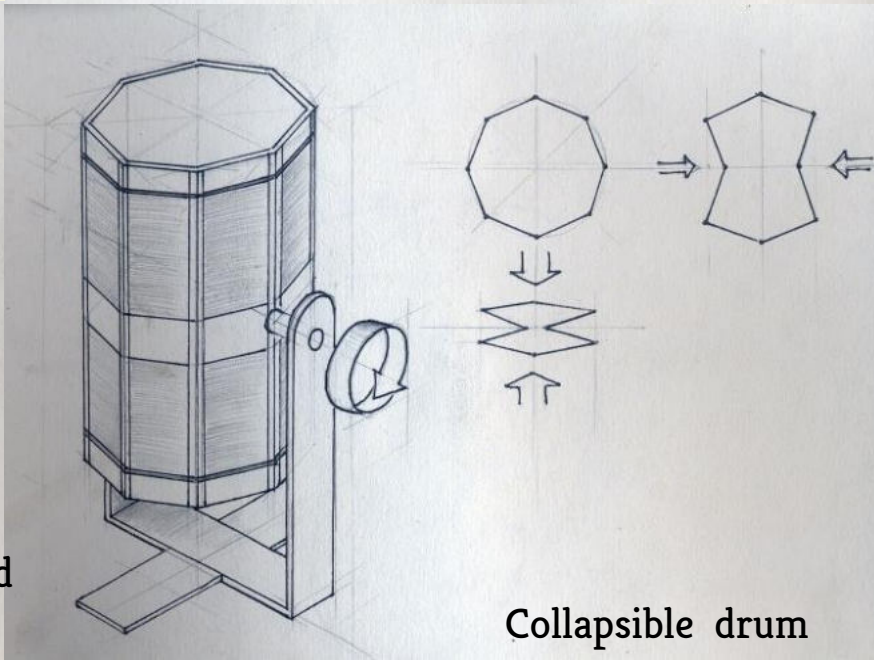
Wall mounded expandable drum



Over hang wall mounded drum

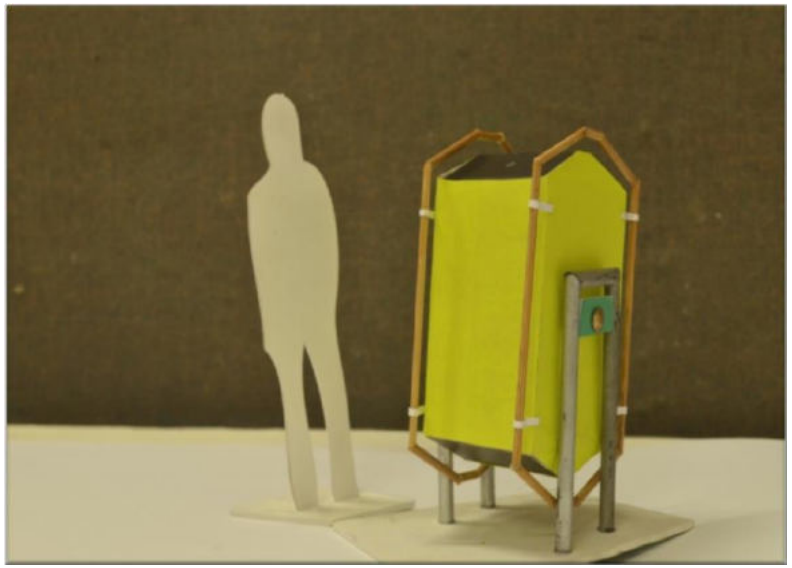


Single pol mounded drum

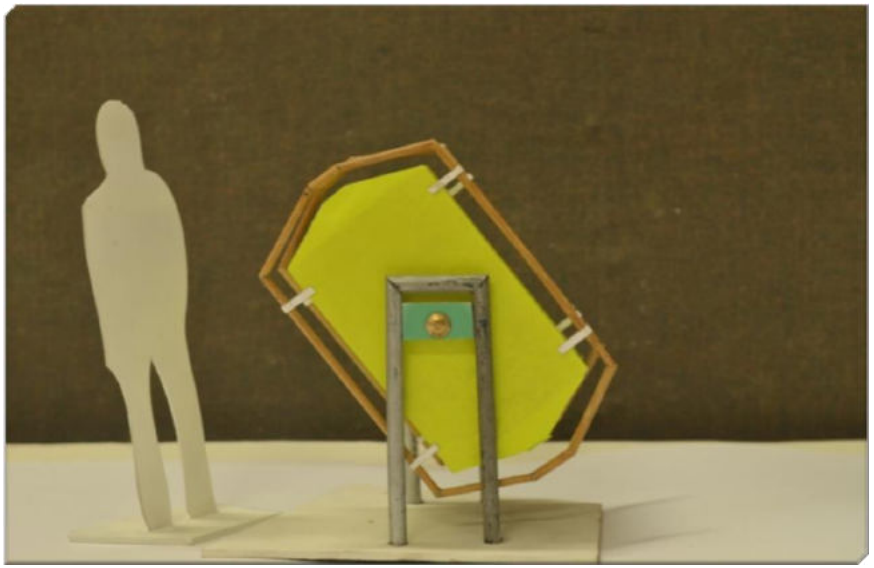


Collapsible drum

Mockup 1



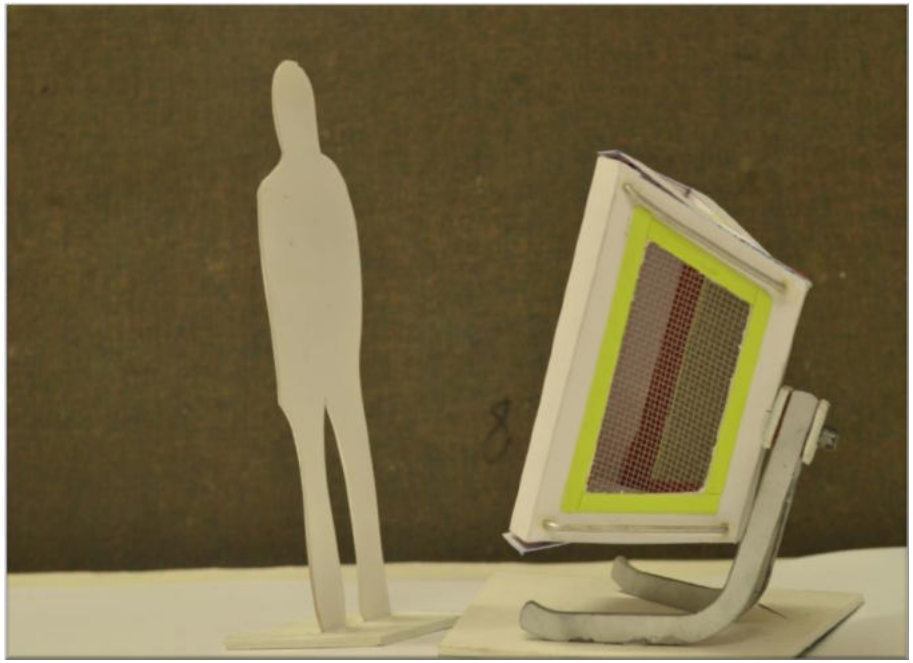
Rectangular box concept



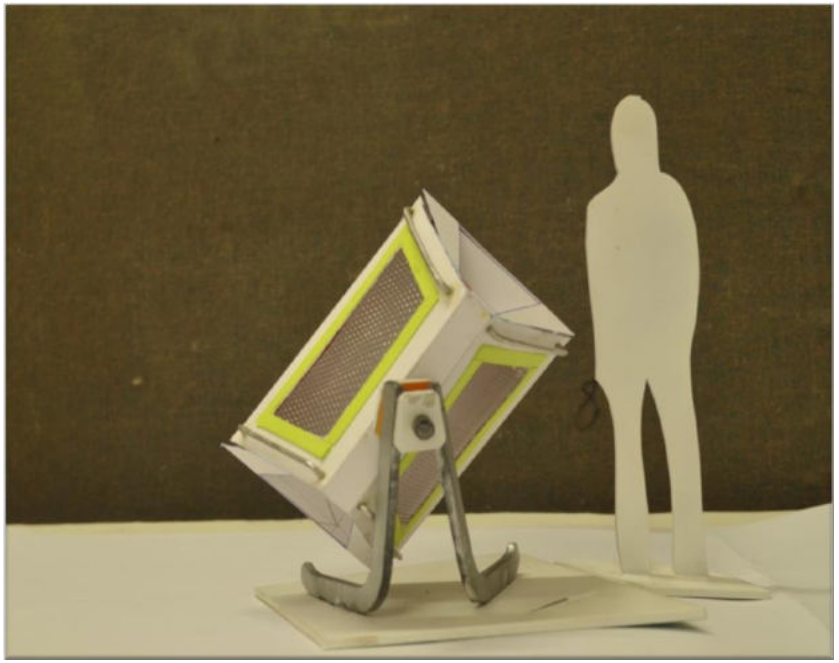
Rotated view

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

Mockup 2



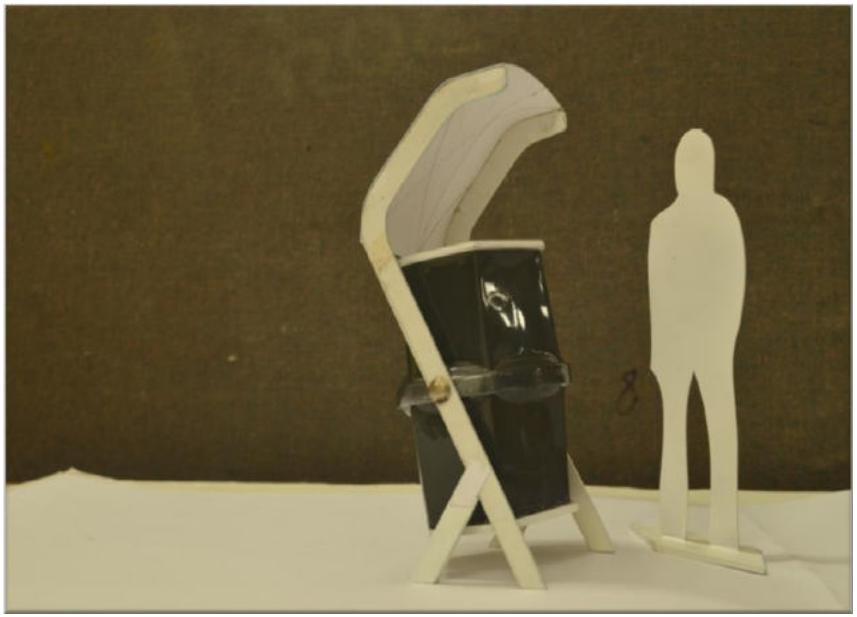
Prism concept



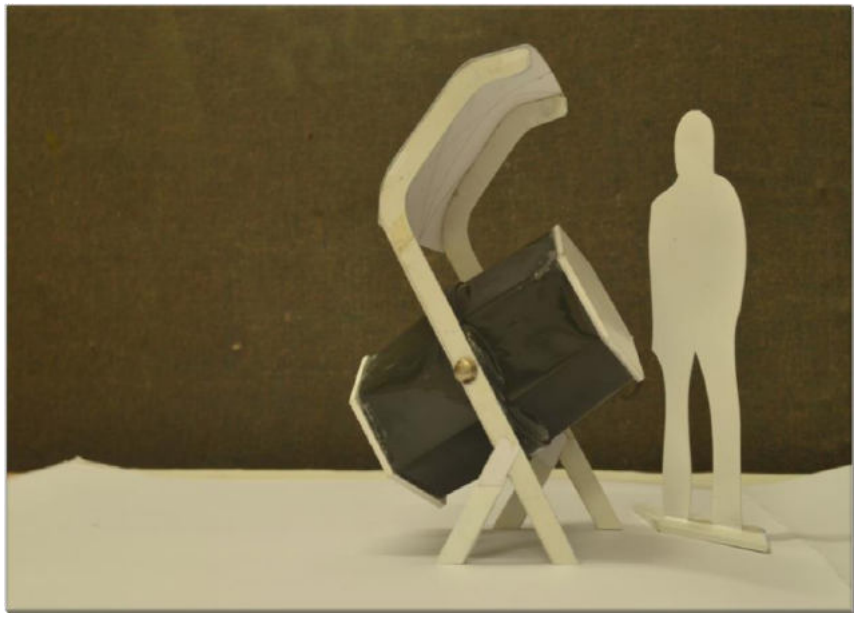
Single bearing mounted

- 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



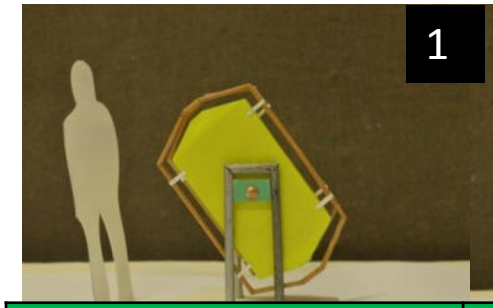
Hexagonal drum



Hexagonal drum during rotation

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

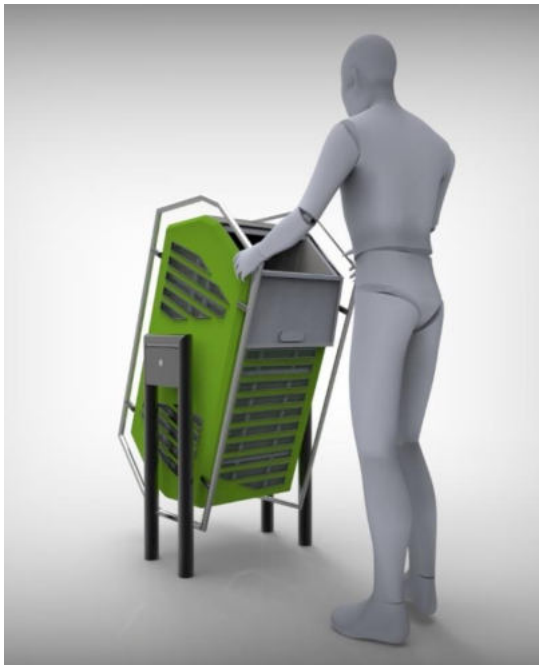
Final concept evaluation



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.	Form-
Sheet metal/FRP/Fabrication	Sheet metal/ fabrication	FRP	Manufacturing
Maximum utilization of volume	Lower than the rest of two	Satisfying the brief.	Capacity
Satisfying the brief.	Satisfying the brief.	Satisfying the brief.	Space Required
Less parts less maintenance.	On higher side	minimum	Maintenance
One	One	One	Man power
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	Added feature
7	5	5	Total

CAD Model Renderings.



CAD Model Assembly.

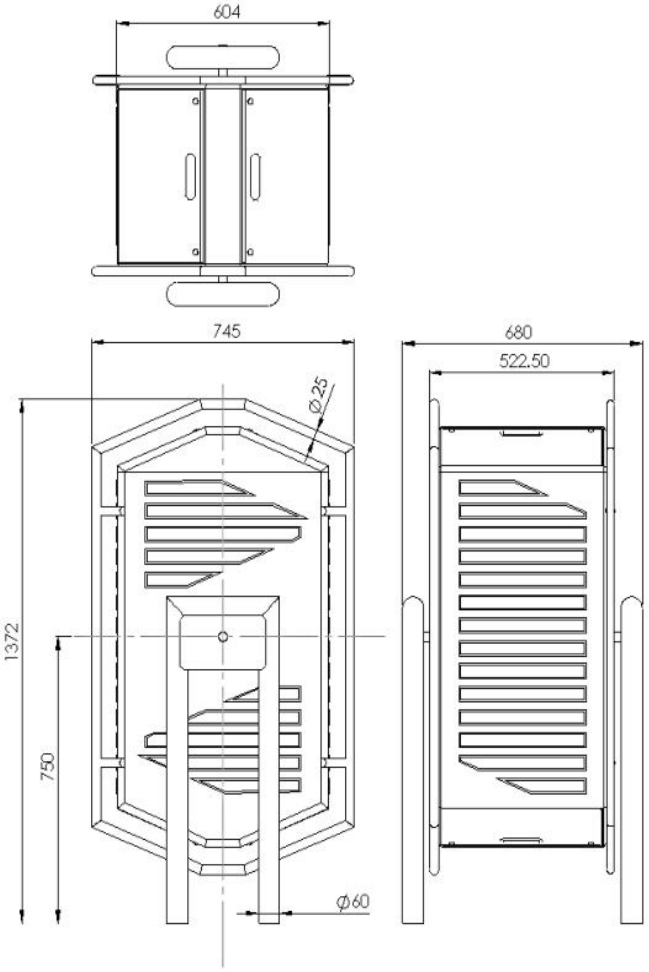
Main Assembly outer skin and handles

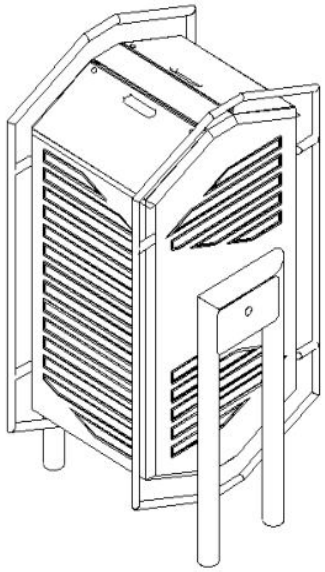
Internal SS chassis

SS Pillars

Bearing Assembly

CAD Model drafting.





All Dimensions are in MM

Final Model.