

‘Design a Vermicompost Unit For Housing Society’

Submitted in partial fulfillment of
the Requirements of the Degree of
Masters of Design

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INDUSTRIAL DESIGN CENTER
INDIAN INSTITUTE OF TECHNOLOGY BOMBAY
2014



Project 3 :
**Design a
Vermicompost unit
for Housing Society**

By,
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PD 126130003
2012-2014

Guide
Prof. R. Sandesh

Approval

Industrial design Project 3

'Design a Vermicompost Unit For Housing Society'

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M.Des. Industrial design 2012-14

Is approved as a partial fulfilment of requirement of post graduate degree in Industrial Design



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16/06/2014

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Declaration

I declare that this written submission represents my idea in my own words and where other ideas or words have been included. I have adequately selected and referred the original source. I also declare that I have adhered to all principles of academic honesty and integrity and have not misinterpreted or fabricated or falsified any idea / data/ facts/ sources in my submission. I understand that any violation of above will be cause for disciplinary action by the institute and can also evoke penal action from the sources which have just not properly sighted or from whom proper permission has not been taken when needed.


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Acknowledgment

I would like to sincerely thank my guide *Prof. R Sandesh*, for his support and guidance throughout the project

I would also like to thank

Prof. B. K. Chakravarthy,

Prof. V. P. Bapat,

Prof. Purba Joshi,

Prof. Sadhu,

Prof. Hazra,

Prof. Kums and

Prof. G.G.Ray,

For comments and suggestions they gave me during the presentations.

I am grateful to all my batch mates for all the brain storming sessions and discussions and also the workshop in charges for their help.

I would like to sincerely thank *Mr. Prakash Dandekar* for his valuable insights about vermicomposting.

I would also like to thank

Mr. Rishi Agarwal, the Observer, Mumbai

Mr. Satish Athale, from 'Hariyali 'Group, Mulund for his guidance

Mr. Mudhe, Assistant Engineer, SWM, C Ward Mumbai,

Mr. Kadam, Head Clark, SWM, C Ward, Mumbai and

Mr. Bhat, Assistant Engineer, SWM, T ward, Mulund

for their valuable time and guidance.

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Abstract

The global view of waste management is disturbing. As the world's population has increased and become more urban and affluent, the production of waste has heightened by alarming rates - which in turn is a major cause of concern since it is an evidence of overuse of natural resources. Discarded materials, the byproduct of excessive consumption, are being produced faster than other environmental pollutants or harmful gases. Today, solid-waste management is one of the highest expenses to municipal financial plan.

Waste problem is more grave in emerging cities rather than in rural areas. Unless we tackle this serious issue adeptly, the planet will have to bear the brunt of increasing waste burden. The tonnes of rubbish clearly reflect that the present disposal and processing capacity is probably not sufficient to deal with the rising growth of waste. Ironically, all these facts essentially point to one concern and it is perhaps of a greater consequence than anything else -the Basic Human Attitude.

The seeds of this potential

problem were sown quite early by our outlook towards waste and our ignorance in handling it. The importance of segregation of waste into wet and dry units is till now quite unknown to our society. That waste can be a source of value if handled efficiently is still unbeknownst to us.

The aim of this project is therefore to motivate and educate the society to look at waste in a different perspective-in turn making each one of us responsible to understand - that recycling waste can be rewarding in terms of the output and give a sense of satisfaction in improving the health of our planet.

This is achieved by looking at waste as a resource to obtain soil/compost of the finest fertilizing quality-by recycling the wet waste after segregation at a house-hold level through vermicomposting. The idea is to have a unit with the necessary components installed within the premises of a housing society to create a byproduct (vermicompost) for the residents which may eventually be marketable.

1. Introduction

94% of total solid waste collected by municipal is directly dumped on landfills. Only 5% get transformed into Compost.

India is one of the largest nations in the world, with a population of 1.21 billion, accounting for nearly 18% of world's human population; however it does not have sufficient resources or adequate systems in order to handle its solid wastes. Management of Solid waste is one critical area where India has an enormous gap to fill. Proper municipal solid waste (MSW) disposal systems to address the burgeoning amounts of wastes are lacking. The current SWM services are ineffective, incur weighty expenditure and are a potential threat to the public health and environmental quality.[1] Out of the total municipal waste collected, on an average 94% is dumped on land and 5% is composted.[2]

In a city like Mumbai, the Municipal Corporation of Greater Mumbai (MCGM) is officially accountable for the management of waste in the city. The prevalent method has been of assemblage and discarding of garbage from communities in dumping grounds/landfills.

The typical life of a dumping ground is 30 years.

Organic waste, old batteries, polystyrene (Thermocol), polythene bags, debris are dumped in huge quantities and since it takes a long time to decompose, when dumped, such waste occupies and fills the low-lying areas the most.[3] Here also the segregation of waste is not taken into consideration hence when the waste is dumped, it does not decompose very quickly and make way for the other kinds of waste. The nature of waste being dumped and the time it takes to decompose, pose a serious threat to the environment as well as human health.

It was noted that these challenges are often symptoms of a number of underlying and inter-related root causes that need to be addressed first. Many of these underlying Causes require close cooperation especially from people who seek to clear their households of the accumulated

waste and are not concerned about the criticality of segregation of their waste into wet and dry units. There has to be a mutual understanding between the waste generator and collector so that the right method of collection and Discarding of waste can take place which eventually leads to better waste management.

Thus to achieve the goal of this project which is to motivate and educate the society and make them aware about the rewards of recycling the waste properly, the following process was followed...

Design Process

During the project, user-centered design process was followed to understand the problems of the user, user needs, tasks and their environment before coming up with the final concepts and solution.

The steps involved in the process are mentioned below.

Data collection

For in depth understanding of the waste management in Mumbai, a visit to MCGM (Municipal Corporation of Greater Mumbai) was made to discuss the handling issues with the officials. The entire process of collection to dumping was observed at the Mulund Dumping Yard and documented.

Waste handling by vermicomposting method was also observed at an NGO and discussions

with the expert in this field were recorded for reference since this method is the best amongst all the other methods for wet-biodegradable waste. After observation and discussion with the officials, waste collectors, waste pick-up transport unit managers, key insights were obtained and listed.

Project Brief/Ideations

A design brief was defined as guidelines for the project. From the data collected, possible solutions were ideated and discussed with the vermicompost experts. The ideations were then clustered according to feedback received.

Final concept and output

The final concept was selected based on the highest conformance to the design brief and feasibility. The details, form and aesthetics of the final concept is yet to be included into this report.

The final output of the project would be a model/prototype to show how the product would be used in the actual environment.

2. Garbage...A world Issues



Fig.1 Mulund dumping ground

*“By 2025 world will generate 2.2 billion tonnes of waste per year.
... World Bank Report”*

What is garbage? A waste which is rejected or a human attitude of negligence toward nature resources!

As human race achieving new heights of prosperity and progress we are misusing all the natural recourse that mother Earth has given us. As you can see all around the world we are creating these mountains of garbage. Where it came from?, are we responsible for this? The garbage issue is getting bigger and bigger day by day.

Definition of “Waste” is stated by United Nations, - “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.” [4]

People are losing sense of responsibility of waste, for them it is the use less thing of which municipal corporation will take care of. But ultimately it

damaging the future of the coming generation.

According to World Bank report [5] by the end of 2025 the world cities will cross the mark of 2.2 billion tonnes of generation of waste per year, which is currently on the 1.3 billion tonnes.

3. World Scenario...

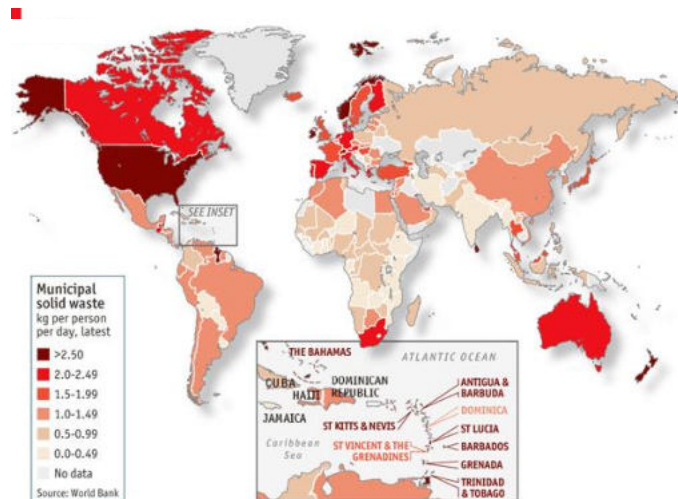


Fig.2 world waste generation map per person per day

Fig.2,
Ref.
<http://www.economist.com/blogs/graphicdetail/2012/06/daily-chart-3>

Today world is spending \$205.4 billion annually on solid waste management in the cities. Which will be \$375.5 billion/year by 2025[5].

Fig.2 clearly shows the difference between developed and developing nations in garbage generation per person per day. It is "out of sight, out of mind" situation for the world. The way world dealing with garbage is creating a more harmful problem than the garbage itself. Everywhere in the world we can see the un-proper practice to deal with garbage. There is no fix norms and standard to control the issue of waste.

The most common way to deal with the garbage in all around in the world is to dump it on the open spaces called 'landfills'. These landfills basically allow waste to decompose naturally. It is very slow and time consuming process but the

rate at which we are generating the waste is far more than the time required to decompose any thing. As a result landfills are getting over filled and are left with no space to dump except over the half decomposed waste. This creates anaerobic (without oxygen) decomposition. Resulting generation of greenhouse gasses e.g. Methane cause global warming.

Some quick facts for clear picture of world garbage problem are given below [6]

- 200 million people can be fed with the amount of food wasted in Europe
- Consumers in rich countries waste almost as much food (222 million tonnes) as the entire food production of sub-Saharan Africa.(230 million tonnes)
- **Agricultural including uneaten food contributes more than 30% of total greenhouse gas emission.**

4.India

“*55 Million tonnes MSW ,
India generating annually*
....Ministry of New and Renewable Energy
(MNRE)”

India is a rapidly growing nation. Our GDP reached 8 %, but we are also becoming the biggest waste generator in the world. In a developing country like India where rapid industrialization and urbanization is taking place, waste management is becoming very essential.

The new middle class group has become economically strong to consume all kinds of goods and consumable products that they were used to dreaming of.

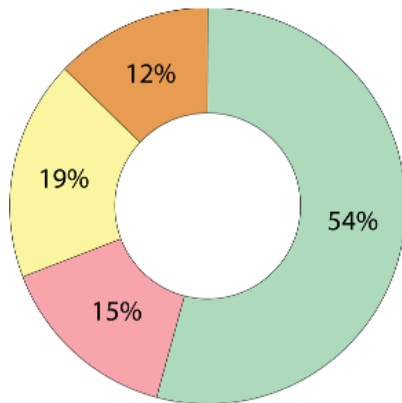
Ever since the Indian market has open up for international trade at the beginning of this century, the no of jobs and prosperity index gone up.

“55 million tonnes MSW (municipal solid waste)” yes this is what the 2009-10 report of Ministry of New and Renewable Energy (MNRE)[7] is says.

And it is increasing at the rate of 1-1.33% annually.

According to the Central Public Health and Environmental Engineering Organization (CPHEEO, the Ministry of Urban Development, Government of India), an average Indian person generate 0.5 kg of garbage per day, it is how ever very less compared to American who generates 2 kg of garbage per day. But if you think of Indian population which is 4 times the American population; we could actually creating 27 million tonnes more garbage than US.

5. Mumbai



Wet organic matter Dry organic matter
Recyclable material Inert material

Fig.3 Mumbai waste types

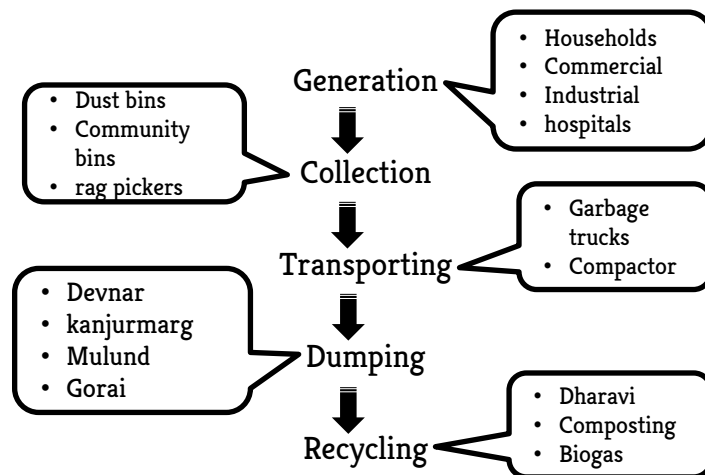
Fig.,3 Ref. [7]

Mumbai is the economic capital of India. Approximately 13 million is the population of Mumbai and this huge population generate 7025 tonnes/day waste which is divided in to 5025 tonnes of bio degradable and recyclable waste, 2000 tonnes of debris waste. The data collected in 2008 shows that it escalated to 9000 tonnes/ day the main reason is increasing population. [8].

The expenditure Municipal Corporation of Greater Mumbai (MCGM) is spending on garbage management is around whopping Rs.1000Cr./year. about 30 to 40% of this budget dedicated to only transporting the garbage to the landfills (Rishi Agrawal, The Observer, NGO from Mumbai)

“Mumbai creates 9000 tonnes of waste per day.”

6. Waste Management



1) <http://www.recyclingsupply.com/biog/?tag=waste-warrior>
 2) <http://www.jpmscaro.com/recycle.php>
 3) <http://www.guamsolidwasteauthority.com/gswa-residential-recycling-faq.shtml>
 4) <http://www2.le.ac.uk/offices/estates/environment/wasteandrecycling/what/a-z>
 5) <http://www.dreamstime.com/stock-photography-food-waste-image14654962>

6.1 Types of waste-

Waste is the mixture of all organic and non-organic materials. The general categorization of the waste is as follows.

Dry waste-

paper
Plastic
Wood
Cloth
Glass
metals, ceramics
Garden waste
Construction debris

Wet waste-

Food waste
Kitchen waste
Bio waste

Bio Medical waste-

Hospital waste,
Medicines waste,
Chemicals

E-waste-

Waste of Electronic products

Radioactive waste-

Nuclear waste



“

*In Mumbai average person
create 1 kg of solid waste
per day.*

”

6.2 Generation of waste-

An average person in Mumbai generate 1 kg of waste per day, it again depends on his socio-economic status. For example middle class family will generate between one to two kg of mixed waste per day, and a family living in the slums create a waste around 500 gm. The source of waste is generally as follows.

1) House hold-

It contains kitchen waste, cloths, food packaging, electronic waste, wood, old toys, plastics, glass, etc. 60% of the household waste is the wet waste which is bio degradable.

2) Industrial-

It is the waste created by manufacturing and food processing industries around the city. It includes raw material like metals, machine waste, oils, and chemicals.

3) Commercial -

Waste created at public places, like malls, beaches, bus stops, railway stations, markets, food stalls etc. Mostly it contains PET bottles, food packaging, half eaten foods, Styrofoam plates, paper plates, tea cups etc.

4) Bio-medical-

It is the waste which generated at hospitals, medicals, blood banks, bio labs etc.

5) Debris -

It include the waste which is generated at construction sites like concrete, stones, sand, metal rods, bricks, glass, aluminum frames, wood etc.



Fig 4.Street garbage collection



Fig 5.Dust bin



Fig 6.Rag pickers



Fig 7 BMC compactors

6.3 Collection of waste-

There are 5800 community bin across the Mumbai installed at colony level where household waste dumped by resident of respective colonies/housing societies.

There are lots of issues about collection of garbage.

Most of the people don't know that according to MSW rule 2000, wet waste and dry waste must be separated at source level. It is mandatory for every citizen. But people are not following it. Then it became very difficult to segregate.

There are 3,00,000 rag pickers (Fig.6)in city who are doing this job of segregation[12]

This man-force is completely un-organised and they are actually helping city and environment by segregating the recyclable waste from mixed waste.

6.4 Transportation of waste-

All garbage collected from these community bins transport to "Mahalakshmi" at a place called transfer station. Following it is distributed among three landfill which is Devnar, Kanjur and Gorai.

There are nearly 800 vehicles running all around the Mumbai for transporting the garbage[10].(Fig.7) Mumbai municipality is spending a spending huge part of its budget only to transport this waste.

“
*There are 3 lakh Rag
pickers in Mumbai city of
which 1,20,000 are kids*
Parasher bharuah”

Film. director .."waste"



Fig. 8 Mulund dumping ground



Fig. 9 Plastic Recycling plant at Dharavi

6.5 Dumping of waste-

There are three main dumping grounds in city; Devnar, Kanjur and Gorai

95% of the waste transport to this dumping grounds. The concept of dumping at ground is to allow waste to decompose by creating layers of it, and as days passes the lower layer get decompose and landfilling can be ready to continue for dumping. But there are lots of problems about dumping grounds. as waste start decomposing it creates Fluid called "leachate" which penetrate to ground water and pollute it. Leachate makes land barren forever.

The other effect of landfilling is that, it creates Methane gas which is biggest contributor in global warming than CO₂. There are some power plants runs on this landfill gas. In Nashik 3 MW power plant is coming which is running only on methane gas created by landfill.

6.6 Recycling of waste -

There is a definite need of recycling of the waste. We can recycle almost everything from food waste to electronic or e- waste.

Look at the following facts about recycling...

If we recycled a **1 tonne paper-**

We can save almost 17 trees which might take 15-20 years to grow up, and 60,000 gallons of water [11].

If we recycled a **plastic bottles**

Plastic takes hundreds of years to decompose. around 250000 plastic bottles are dump every hour in the world. They are the biggest contributor in the garbage.[11]

If we Recycled **Glass**

Glass can be recycled as many times as we can. But because of mixing with all other waste it reaches to a dumping ground and stay there forever because it never decompose.[11]

“ 250,000 plastic are dump every hour in the world. ”

7. Data collection and Field studies



Fig 10 Mr. Rishi Agarwal

*“MCGM spend
Rs.1000Cr. Annually on
waste management...
...Rishi Agarwal*”

Fig.10 Ref.
<https://twitter.com/rishi75>

7.1 Rishi Agarwal, the Observer NGO, Mumbai-

Rishi Agarwal is the activist, since fifteen years fighting for issues related to waste management in Mumbai.

I had a privilege to have a Conversation with him on waste management in Mumbai. He is with NGO called The Observer, which fighting against the miss management of waste handling in Mumbai. He is more concern about environmental issues.

We discussed about existing waste management system of MCGM, the basic civic sense is not observed by the people. Throwing garbage on the street is very common. BMC is almost spending Rs.1000 Cr. annually on waste management. In the name of Waste management MCGM only focusing on transporting the waste to landfills such as Gorai, Kanjurmarg . Soon there will be no place to dump this increased garbage. At present they invaded the mangroves area which is very crucial element of ocean eco system.

by just filling the land with garbage is creating entirely new substantial problems to surroundings and people who are living around. This landfill became source of generation of methane gas which is one of the biggest cause of global warming .

Inferences from the visit -

- 40% of the MCGMs budget of the waste management is spend on only transporting the garbage.
- Wet waste and dry waste has to be separate at source level.
- Mixing of wet waste and dry waste reduces the recycling value of dry waste, and create a problem in landfills such as creating “Leached and methane gas”.
- Rag pikers are very essential player of entire waste cycle. they are actually helping to reduce and recycle that garbage.
- Peoples attitude has to change about garbage. They have to understand that garbage is the resource not waste.



Fig .11 Dust bin at Juhu beach



Fig 12 Beach Garbage collector



Fig.13 "Pollbin"

7.2 Juhu Beach-

To understand the people's behavior at open spaces I visited to Juhu beach. It is the biggest and crowded place in Mumbai. People came here for picnic with family. Their favorite task at beach is eating at beach side food stalls. There are so many mobile venders which has this portable stand, over which they make and trade the food like 'Bell' and Tea/coffee, 'is not the issue because they serve it in paper plate but Tea cup is the problem because those are plastic cups. Which you can see spreads over entire beach by the evening. The dump styrene food plates are serious problem, this plates and cups get mixed with sand and then it's difficult to pick them.

MCGM implemented a Beach cleaning vehicles for sand cleaning. I saw the dustbins are placed at very far from the beach and it's completely empty, because nobody walks to dustbin. People saw garbage at sea sour and they simply dump garbage over the garbage.

Very interesting observation was a pole mounted beside those food stalls. Initially I couldn't figure it out what it is for? But we saw the garbage is mounting up at the bottom of this pole. Then we realize that people are walking by and they are passing by this pole, the idea is people are not looking at bottom but they can see the poll so they walk by side so that garbage can't be scattered. And then one of the workers from food stall picked it up.

Instead of this poll if they install the garbage bin it would have kicked off by people.

Inferences from the visit -

- People see garbage they start trashing more garbage at same place.
- Ignorance of the people towards surrounding environment.



Fig.14 Waste plastic collected from all over India



Fig.15 Workers at Dharavi



Fig.16 Plastic Segregation Room

7.3 Dharavi Recycling plant-

World knows Dharavi as a biggest slum in Asia but once you enter in to Dharavi it will change your perspective about slum completely. When I visited the Dharavi I observed completely self-sustain Micro Industries over there and it absolutely functional.

Leather, Pottery, cloths dyeing, etc. are some of the famous industries in Dharavi. But Recycling also a big industry here . From all over India they bought waste Plastic here for recycling. Every day one recycle plant recycled 1 tonnes of waste plastic.

Space is the biggest enemy of Dharavi industries but the utilization of space is very smart . Every day they segregate this plastic by manual checking, every worker check each piece of plastic and segregate it according to deferent types of plastics. Just by tapping it or by burning test they get to know that which plastic it is. Then this segregated plastic transform in to small granules by melting process.

This is very labors work but this kind of industry they manage to run is enormous. It means we have industries which act like a engine for Recycling the waste. but we need to channelize it properly. They got this waste plastic from rag pickers. Which are not a part of any organization . It is very mind boggling that they are processing 1 tonnes of garbage every day. The demand and supply is there. Why don't we connect this all dot

And it could became a self-propelled system which helpful for all stake holders in this Cycle, the person who throw the garbage at street, the rag pickers who collect this sprayed garbage and segregate it from all Other garbage, and at the end this industries which bring back this resource full material in to the system again.

Inferences from the visit -

They recovered 90% off the material from waste Connecting the organization lead us to a complete self-sustain system which will automatically help to solve the bigger problems.

“One Recycling plant at Dharavi Recycled 1 tonnes of waste plastic per day.”



Fig.17 rag pickers at Horniman Garden CST,Mumbai



Fig.18 Waste Transporter at CST, Mumbai

7.4 A Day with Rag pickers-

The person you can see in Fig. 17 is the Rag picker at CST, Mumbai. He used to seat outside of Horniman Garden at CST. He actually living on that foot path with his wife and 13 year old son, I saw him doing segregation of waste at footpath which he got from bank and offices nearby. He told me that the all building s near to that garden is his "Territory". There are actually 1 lakh rag pickers in Mumbai city alone, doing their job quietly. Every day he goes to these offices nearby and buys all garbage from the house keeping staff from the buildings. He buys it for Rs. 500 and sale it to the waste collector trucks which connect this rag pickers to the recycler plants. They collect papers, aluminum cans, pet bottles, card board sheet, and plastic bags. He manages to earn Rs. 300 every day.

He told that initially they used to get all this garbage at free of cost but now days they have to pay for it. His wife and son help him to segregate the garbage. They don't have any safety gears.

The biggest problem he faces is the food waste and other recyclable waste get mixed and then it became time consuming process to segregate them. Some time he found curry over the paper or bottles with liquids. He has to do all this dirty job to get Rs.300 a day, he is doing this since 15 years and he will keep doing it.

The collection trucks collect and measure all the waste from him and pay accordingly.

Inferences from the visit -

Wet waste reduces the value of recyclable waste .When food waste get mixed with other stuff it become very unhygienic to separate them,. Because food waste started decomposing.

The industries are there to recycle the waste .instead of Dumping at land fill it can directly go to recycling. This is the benefits of segregation at source level.

There are one lakh people in this business to save tremendous amount of resource full garbage from dumping at the landfills.



Fig 19. Vermicompost unit at MCGM nursery, Mulund



Fig 20. Vermicompost unit inside view

7.5 Visit to Mulund BMC, Vermicomposting unit-

During the visit to the Mulund BMC office "T" section of Mumbai. We met solid waste management department's assistant engineer "Mr. Bhat sir". They are very helpful and supported me doing project on waste management. They show me very interesting thing that is "Vermicomposting unit". These vermicomposting units are very cheap and easy to install in to BMC Gardens. This vermicomposting unit used to compost the garden waste and within 40 days they give us the natural fertilizer that is called Vermicompost.

This is very innovative steps taken by BMC. By the reference of 'Mr. Bhat sir' we get the permission to attain the inauguration of one of the Vermicompost unit at C.D.Deshmukh Garden at Mulund on 21st Feb at 9.00 am.

Inferences from the visit -

- Vermicompost is one of the best methods to process wet waste at housing society level.



Fig 21. A Little gap between buildings called "Gully"



Fig 22. "Gully"

7.6 Visit to Zaveri market-

I got a chance to go with BMC officers on Round at Zaveri market in town. Zaveri market known for jewelry industry, It's very old establishment and all buildings over there are having a 2 or 3 feet distance in between those gap called "Gully", the people from both side of the building are used to throw their garbage in this 'gully' and BMC people are having a difficulty to clean those gully. Because it's very dark and narrow, only one man can go inside at a time so the cleaning has to do manually no machine can go inside. People are worn by BMC officials so many times but they continue throwing the garbage in to the gullies. The interesting story we came to know about Gullies is, this gullies are surrounded by gold jewelry shops and all drainage and waste water pipes goes through this gullies, people scavenges the gold dust into that gullies for entire days in that sewage water .we shock to see person who is trying to hunt for the gold dust in such unhygienic conditions shown in Fig 23. People used to found gold dust.

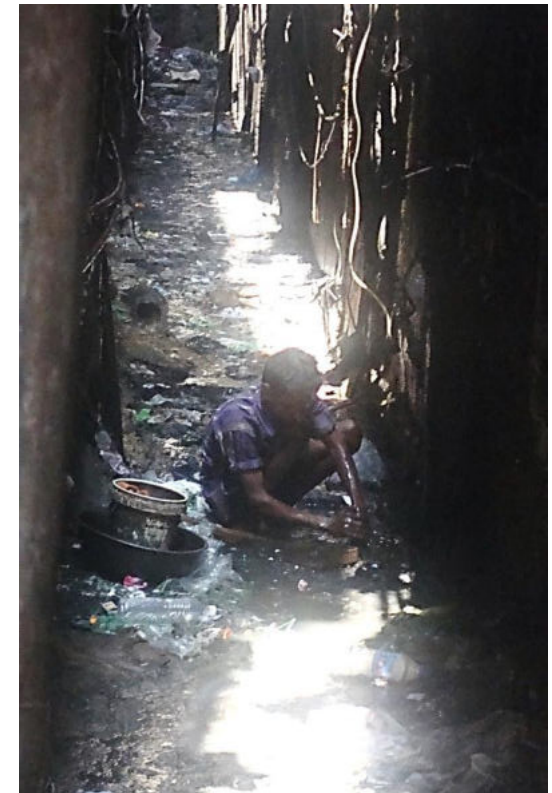


Fig 23. Gold hunt into "Gully"



Fig 24. Dust bin "Inauguration"

and the other side we witnessed one special event, the Inauguration of dust bin for jewelry shops. its very irony that we are surrounded by tremendous garbage and one politician come for the inaugurating this small dust bins ensuring that all dirt will vanish with just installing of this two dustbins. We can see in Fig.24 the way they decorated the bins with flowers. We wait half an hour then this politician came and inaugurated this Dust bins and appeal to shop owners to use those dustbins. But nobody asking the question about garbage we surrounded there it was very funny.



Fig 26. Shops are all over surrounded with debris and other waste.



Fig 25. They hang bags for garbage collection



Fig 27. "Photo Session"



Fig no. 28 Residential building inside IITB



Fig no. 29 Trolley parked at out side building compound

7.7 IIT Bombay Waste Management-

To understand waste handling cycle I started studying IITB campus. there are 15 hostels, 584 buildings including academic and staff residential 6000 student are living in to this 550 acres area.

There are following types of waste generate in to IITB campus.

- Household- Buildings, Colonies
- Hostel - Mess
- Canteen- Food packaging
- Garden waste
- Admin. buildings- Papers
- Labs & Workshops

7.7.1 Household garbage-

There are three contractors hired for door to door collection of waste. above image showing how the waste collectors use metal trollies to collect the garbage from building to building. They park their trollies outside the compound of the building then they goes to the top floor and start collecting this polythene bags filled with garbage, inside the IITB it is mandatory to maintain separate bin for wet and dry waste.

but the thing is when they came back to their trolley they dump all bags in to that and it became difficult to recognize them, that which one is what?

Generally they carry too many bags and they are too heavy to handle. These workers are generally ladies; they find difficulties in pulling those trollies.



Fig no. 30 Collection of garbage at Morning



Fig.31 Dogs and Crows attacked this parked trolleys

While parking their trolley at the gate the crows and dogs are scattered all garbage.

All garbage collector staff assembled at some common decided point where one small truck came to pick it up, and dump behind the MSEB building where MCGM compactor came to collect it.

Hostel mess- all 15 hostel has a mess which create lot of wet bio waste which can be used for bio gas plant.

7.7.2 Food waste at hostels-

There are 15 hostels inside the campus and each hostel has their own mess which creates lot of food waste.

The cooked food waste or half eaten food is collected in the blue colored drums. Which is later on collected by pickup trucks specially hired for managing this waste? and the waste generated during coking also collected in the separate bags.



Fig. 32 Hostel garbage collection



Fig. 33 Cooked food waste



Fig. 34 Un Cooked food waste



Fig. 35 loading of waste

DATE	B/E	LUNCH	T/F	DINNER
13/2/14	24KG	116KG	16KG	104KG
14/2/14	21KG	109KG	19KG	119KG
15/2/14	18KG	106KG	24KG	116KG
16/2/14	22KG	112KG	21KG	148KG
17/2/14	28KG	109KG	18KG	128KG
18/2/14	19KG	135KG	26KG	116KG
19/2/14	24KG	109KG	23KG	132KG
20/2/14	26KG	126KG	19KG	106KG

Fig. 37 waste tally board.



Fig. 36 collecting waste at mess.



Fig. 38 bio gas plant at IIT Bombay.

This all waste collected by this worker which measure the waste every time they load the trucks. Approximately 2 tonnes of cooked-Uncooked food waste they used to dump every day.

Only this hostel food waste goes to the 'Vihar lake side', here the new Bio-gas plants (Fig. 38) are coming soon.

Rest of all the waste which is solid waste collected by this garbage pickup trucks goes to common dumping point located behind MSEB office Building. From there it gets picked by MCGM Compactor trucks at every morning around 11 am.



Fig. 39 Dumping ground off IITB.



Fig. 40 On the way to Mulund dumping Ground.

7.8 Mulund Dumping ground visit-

This is the common dumping point for IITB waste. From here MCGM take charge. They are generally using this European standard compactor which compresses garbage at the force of 8 tonnes capacity basically to accommodate maximum garbage. From here it goes directly to Mulund dumping yard. We manage to convince this compactor driver to allow us to come along with them till dumping yard.

This people are very hard workers, every compactor truck driver has 3 members of crew who help him to collect the garbage. Here is the same situation I found that they don't wear any protection gear as same as zaveri market workers. I found one worker had wounds on his feet but still he is working in to that garbage with bare foot which is very unhygienic.

As we reached there it's like a "hell" I couldn't believe on my eyes,



Fig. 41 workers without any protection gear has open wounds

I never imagined that we created this much garbage. It's literally mountains of the garbage.

As soon as this compactor trucks dump their garbage rag pickers who used to live there at dumping ground rush to this trucks to collect recyclable. The living condition of these people is certainly not good, but in return the work they are doing is very important..



Fig. 42 Mulund dumping Ground.



Fig.28 Vermicomposting unit at C.D.Deshmukh Garden Stish Athalye at center



Fig.29 Worms

Fig 30 Vermicompost

Ref. Fig 31
<http://www.cityfarmer.info/2012/01/22/composting-at-home-in-india-the-daily-dump/>

7.9 Visit to C.D. Deshmukh Garden-

7.9.1 The Hariyali Group -

It's a Mulund based nature lovers group. They are working since last 10 years in this social service and creating awareness amongst people about nature and its importance. C.D. Deshmukh garden is the oldest garden in the Mulund area. This Vermicompost unit is Sponsored by "HRIYALI GROUP". This group basically known for their tree plantation campaigns in to deserted areas of Maharashtra, specially at historical places like forts etc.

This vermicomposting unit basically processes the garden waste like dry leafs etc. Mr. Sathish Athalye announces that people around the garden can be dump their kitchen waste in to this unit.

7.9.2 Composting-

The Satish Athalye, Hariyali group activist talked about...

Composting is the natural process of decomposing. Any natural material like fruits, vegetables , paper, wood, leafs, cardboard etc. are degradable. All leftover food started decomposing because micro organism started living on it. Micro organisms lives on organic material. There are two types of decomposition happen in organic material one is Aerobic and the other one is Anaerobic.

a) Aerobic decomposition-

Aerobic decomposition take place in the presence of oxygen, the micro organisms which lives on oxygen started eating organic matter and decompose it completely. This bacteria never create a odor while decomposition. If we properly aerate the garbage it will never create a foul smell.

Prof. Sandesh shown me one waste management project which actually works on aerobic decomposition. It is Bangalore based designer "Poonam Bir Kasturi" who change the perspective of people the way they look at garbage. Not as a waste but as a Resource. She came up with an idea of having a personal clay pot at home which allows



Fig 31 Poonam Bir Kasturi with Aerobic composter pot



Fig 32 TISS Biogas plant

Ref. Fig 32
<http://streemuktisanghatana.org/programs/parisar-vikas>

Aerobic decomposition at home and you will be able to convert your daily kitchen waste into resource full Manure. She assured that it didn't smells at all. This product having a huge demand and people started making their own Manure for their gardens.

B) Anaerobic decomposition- Anaerobic process take place in absents of oxygen, the microorganism lives on very little oxygen of decompose material and they exhale Methane gas. This Methane is the reason we experience smell while organic matter discomposes. If we cover the dustbin you will find the smell but now a day properly aerated dustbin are coming in to market which allows aerobic decomposition. Biogas generator is the best example of anaerobic decomposition, where Methane gas produce for house hold cooking.

"Stree Mukti Saghatan" in Mumbai works for Bio gas plants. They train these rag pickers especially women's which helps to empower Rag-picker women's. They started initiative called "Nisargaruna" which means 'natures Loan' or giving back to nature, they running 8 Nisaargarun plants with the help of BARC. TISS (Tata institute of social science Mumbai) and TIFR (Tata institute of Fundamental research) installed their own biogas plats to process their canteen leftover food waste. The biogas produced by this plant is used in same canteen.

C) Vermicomposting-

The other option is Vermicomposting. This is very kwon method to Indians. Just it was used by farmers only but now the group like Hariyali reinvented this method for urban context.

It is a aerobic method but you increased the speed of decomposition with the help of Worms "a Farmers Friend". In this process you will be able to produce manure which is also called Vermicasting just within 40 days and it is the best manure in the world. It is also called "Black Gold" because it's the best natural fertilizer. It contains 5 to 11 times more Nitrogen, Phosphorous and potassium as the surrounding soil.

- The type of worms which can be used in to this unit is Red Wigglers.
- Kitchen waste can be processed.
- Within 40 days it converts this waste in to compost.
- Worms need cool area to live.
- Execs of pineapple, lemon, orange peels should avoid.
- Direct sun light will be harmful to worms



Fig 33 Red worms

“Worms has no ear either eyes, But they do have 5 hearts.”

All data Ref. [9]

7.9.3 Worms [9]-

Let's understand the worms, There are hundreds of types of worms in the nature but only two types of worms are useful for vermicomposting, brandling worms or Red Wigglers (*Esenia Fetida*) and *Lumbricus rubellus*.

Anatomy of worms (*Esenia Fetida*) -

Pointed head Rings all over the body helps to move in the soil Breath through skin, have 5 hearts, Eat more than their own body weight/day Hermaphrodites (have both male and female organ) Life span 5- 10 years lay eggs on after every 7-10 days 3 weeks for baby worms to came out from eggs 90 days to get mature for reproduce.

Bedding-

Bedding is the initial home and food for worms to settle and adjust with new environment of the worm bin. shredded newspaper, coconut husk, sugarcane remains, and garden leaf. Are the best for Bedding?

What worms can eat-

- Any bio degradable like vegetable cuttings
- Fruits and fruit peels
- Egg shells
- tea leaves and coffee grounds
- Cardboard

What worms can't eat-

- Spicy food
- Oily food
- Citric food like lemon or pineapple
- cooked food (will attract maggots and insects)
- Milk and dairy products
- And any inorganic material like plastic

Vermicasting-

Worms don't have teeth so they soften food by their saliva. As food moves towards their intestine the small stones grind all eaten food. When they digest all food at the end of their intestine they have anus for passing out the casting.

Benefits of Vermicasting-

- It improves the physical structure of soil.
- Increase water holding capacity
- Decrease the rate of realizing nutrients in the soil
- Enhance plant growth and crop yield



Fig 34 Mr.Prakash Dandekar Explaining Vermicomposting

“Every Individual should take Responsibility of his own garbage.”

Prakash Dandekar

7.10 Vermicomposting Workshop By Prakash Dandekar, Mahim, Mumbai-

Mr. Prakash Dandekar is the social activist from Mahim, Mumbai. His work of area is waste management, terrace garden, fish, and composting at home. He has done lot of work and research in to vermicomposting. Although he is not having any formal education in this sector but by experimenting and by experience he is became an expert in “vermicomposting at home” he successfully implemented of his vermicomposting product in around 500 houses across the Mumbai city.

He has his own blog <http://getvermicompost.wordpress.com/> where he mentions all the procedure and techniques for home vermicomposting. I got him through his blog only, I try to contact him through email and within a day I got reply. March 26, 2014 I visited his home cum laboratory for vermicomposting.

He is very simple and very humble 63 year old man, but very active and a when I told him that I am doing my project on vermicomposting, he was very happy that young student like me interested in this kind of technology. He assures me all kind of support for my work.

Following is the transcript of his interview which I had taken on 26th march, In the introduction he says,

“The ancient Indian scholars written in so many scriptures (Veda’s) that worm is a Friend of Farmers. I will go one step ahead and would say worms are the best Pet in the world; this is how I introduce worms to today’s new generation. Worms are like natural grinder in the soil whose feed on organic materials. we pet so many other animals which are difficult and costly to tame, worm is very silent animal to domesticated, if you able to create natural habitat in your house for them; then they will help you to make compost out of your organic waste.”

Q.1 - How you got interest in Vermicomposting?

Ans. - I am very fond of Nature, I love to know about Nature, and so I inclined to this subject. I started studding about vermicomposting from some books by myself, I started collecting worms which comes out in rainy season but I failed so many times, one day at some homely occasion I met my brother in low Prof. Damle at Sangali, he gave me some very important information about vermicomposting. After a moths latter he send me some worms from Sangali, then I started succeeding, worms started eating our all wet garbage at home, then I started at housing society level. They started multiplying without any efforts, then I started giving lectures on vermicomposting and its benefits to the local peoples, I started organizing workshops for ordinary city



Fig 35 Worm bin Bedding, coconut husk



Fig 36 Vegetable cuttings

people so that they can start their own vermicomposting at home. I got worm response from people, if we able to spared the words about this we can reduce the piles of garbage at road side. The all garbage will transform inside your house only.

He got support from BMC Officer like Ms. Sima Redkar, Mr. Bhagvat from waste management Department. I gave one interview on Television in 2011 on DD channel live telephonic Program called "Hello SAKHI"

Q.2 - What are the benefits of Compost?

Ans. - In old days Indian farmers used to do farming in a very natural ways post independent some multinational companies come to India and started selling their poisonous fertilizers to Indian formers. For the sake of more yield farmers started using this and in a result we got our soil more unproductive. It takes 15 to 20 years to realize its bad effects on farming. Now normal farmer can't afford these costly fertilizers so they started shifting toward these natural fertilizers.

Because of this chemicals worms died and soil became infertile and unproductive. This affects the human health as well. All this are so interconnected that we human need to think over it and rethink over our greedy wishes.

Q.3- How this research is relevant for a city like Mumbai?

Ans. - Today we have seen those garbage trucks dumping tons of garbage on dumping grounds at kanjurmarg, Gorai etc. in Mumbai, and all other metro cities in India as well surrounded by mountains of garbage. Mumbai municipal transporting 7000 ton of garbage every day to this dumping grounds. Sooner this dumping ground will cross their limits and we don't have place to dump this waste. MSW 2000 rule says citizens must segregate their waste at home. But not even municipal staff doing segregation.

The main issue is, organic waste get mixed with inorganic waste and we letting it to dump at the dumping ground as it is, that's why it became bigger problem. If it could segregate at source level we can recycle the plastic, glass, metals and organic waste can be used for vermicompost.

Q.4- Tell me about vermicomposting process!

Ans. - All organic material are compounds of carbon, living things got energy by burning this carbon compounds. All living things eat organic stuffs and they all create organic waste, including human, animals etc., even trees create organic waste, their dry leafs are one kind of an organic waste, remains of vegetables, fruits, and all animal byproducts are organic waste. For converting this waste into food for living things, nature provided micro bio-organisms which helps for this



Fig 37 Bio culture Powder



Fig 38 Vermiculture

process. This micro bio-organism dis-integrates organic compounds in to stable and inorganic materials. In other words after dis integrate only trees can use it, other living animals can't use it as a food.

There are two types of micro organisms Aerobic and Anaerobic. Aerobic needs oxygen to dis integrate organic material; in this process they produce odorless carbon dioxide. The smell which we observe in to the dustbin, it's because of these anaerobic microorganisms. If there is no direct air or oxygen in to the pile of waste condition because of that the oxygen couldn't reach to the organic material which is about to decompose and in these situation anaerobic microorganisms start working they extract oxygen from organic material and produce methane, ammonia and hydrogen sulfide gas.

If we segregate our wet and dry waste and dump the organic waste in to the container which is aerated from all sides the aerobic microorganisms will help to decompose it, without any foul smell. And if we provide worms in to that the quality of compost is 7 time better than normal compost and it will take half time to decompose it completely.

Generally the type of worms we used here in India is "Eisenia fetida" or "Eudrilus Eugenie". These worms are known for their eating habits they eat up to one third of their own body weight in a day. After decomposed by microorganism worms eat that rotten waste,

in to their guts, the microorganisms convert this waste in to best compost in the world it also called "Black Gold".

Q.5- How's the people reaction after knowing all this about Vermicasting?

Ans.- Ohh! It's Overwhelming; when they came to my workshop they have their own misconceptions about waste and about worms. But after workshop they are surprise with the results. They became more acceptable towards vermicomposting at home. The biggest misconception they have this waste in to Vermicasting. About this system is "smell/odder". They have very strong understanding that collecting waste at home would create a foul smell because they used to see and observe it all bins around them, But after knowing about aerobic composting they confident to vermicomposting at home. They surprise when their dust bin wont smell at all the other phobia is they always think that worms will crawl out and it became messy to collect them and they won't feel like to touch them. But it's not the case worms won't crawl out unless and until they have simulated natural habitat. They are happy to stay inside their environment which is 20 to 70 degree centigrade, moist and damp. Some times during decomposition of organic waste get heated because the restriction of air (oxygen), so we need to stir it within two three days. For maintaining moist we need to sprinkle some water over it.



Fig. 39 ATM box



Fig 40 Aerobic composting

Q.6- But, what about flies and insects?

Ans.- Flies can be controlled by spreading some dry leaves from garden which covers this waste and prevent to habitat flies in it.

Q.7- What worms can eat?

Ans. - They can eat all organic waste like paper (not glossy paper), fruit peels, vegetable remains, tea and coffee grounds, egg shells are their favorite. Basically all organic food but it should be uncooked. The citric fruits like lemon, oranges and pineapples can harm if they mixed in large quantity.

Q. 8 - Why not cooked food?

Ans. - Cooked food is not a problem but you need to wash all curry and acidic oil from it. Too much oil and too much water can create "slippery" to worms they slip in to oily surface. Again too much spicy and acidic food can kill the worms because they breathe through their skin. One more thing, milk product and non-veg things will invite maggots and fungus which is harmful for worms.

Q. 9 - What is this "KALPATARU GOLD BOX ATM" and how does it works?

Ans.- This is my personal vermicomposting unit which can be used at home. One family creates average 200 to 500 gm of organic waste per day. We can process this at source level. It is a box of metal wire mesh which

has dimensions of 13 X 11 X 18 inch. At the base there is a layer of coconut coir or sugarcane bed. This is called a bed for worms. Coconut coir takes time to degrade and it provides a natural habitat to the worms. It's simulates the natural condition of the worms into the soil. On this bed they take rest, they lay eggs etc. Over this bed we spread the cow dung. Cow dung acts as an accelerator which contains microorganisms and it speed ups the degrading process. Over the cow dung we spread the worms. Generally for this unit we need 200 grams of worms.

Q.10 - How much time does it take to fill completely?

Ans. - All organic waste contain 80- 90 % of water as their weight. Water takes two three days to evaporate from the waste. Some of my clients had an experience of getting it filled in a year time. It completely depends on worms and their surrounding environment to decide the speed of composting. Sometimes if the worms are not healthy, the entire process gets delayed.

Q. 11 - How many other products do you have?

Ans. - There are two types of compost unit one is for joint or big family and another one is for housing society. The housing society can process waste of nearly 25 families. For 25 families we need



Fig. 41 Housing Society unit



Fig. 42 Family unit ATM box

25 cu ft. Of volume, it takes 60-90 days for entire composting process.

Q. 12 - How to harvest vermicompost?

Ans. - To start with spread all the compost over the sheet. Here we use basically light method, as worms don't like light. By making small piles of compost, worms get exposed to light. Layer by layer they hide inside the pipe, and at the end we get worms separated from cast. But it is a very time consuming and messy process. Sometimes people don't feel like touching worms, so it gets difficult to harvest the cast.

Q. 13 - Where can we place this unit?

Ans. - One can place it anywhere inside the house away from direct sunlight and rain contact. Some of my clients have placed this unit inside the kitchen and in the balcony.



Fig. 43 Harvesting Vermicasting

Q. 14 - What is worm wash?

Ans. - The excess water which is drained out from the unit is called worm wash. This can be used to spray over the plants and has good antibacterial properties



Fig. 44 Worm wash



Fig.45 experimenting with worm bin



Fig.46 Compost, no foul smell



Fig.47 home grown vegetable



Fig.48 shredder demo



Fig.49 beautiful terrace garden



Fig.50 Home made digester



Fig.51 Discussion on waste management



Fig.52 home grown Tomatoes

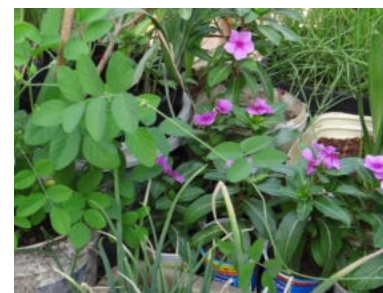


Fig.53 Flowers plants

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
- 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 Tares 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

8. Market Study-



Fig. 54 Bio gas plant at IITB Staff canteen



Fig. 55 Sintex Compact Bio gas Plant

At large hotels, Hostels This will be very efficient way of waste management. You need lot of water and food waste. here are the double benefits one you will get Methane gas which is its primary Product and Manure which is the by product you will get at the end of the process. Mumbai's Stree Mukati Sanghatan with collaboration with BARC implementing this kind of plant in Mumbai . And they got good response as well.

There are some products made for composting ...

Fig.55 Ref.
<http://paterex.com/biog/household.html>

8.1 Biogas (Digester)-

Bio gas plants are popular in rural India where they have cow dung available in abundance, in Urban area context space is the major issue as it takes a lot of space . Although there are some compact digester available in the market which can be used in



Fig. 56 "Khamba "



Fig. 57 "Manthan"

"Khamba" is the clay pots which has holes for aeration. They stacked as shown in the fig.56 as the pot get fill they have to shift at the bottom and slowly microorganism do their work in the presence of oxygen. It's a personal product made for single family. Because its clay pots it look like a garden thing not as a dust bin. Semantically it looks like a decorative and displayable think.

The other product they have is "Manthan" which is also aerobic composter, but it's made for 15 houses. It has a drum which can be rotate; this is very important process in aerobic composting that you have to stir the garbage because oxygen has to reach everywhere in the waste. If it won't happen the garbage will start stinking because then its anaerobic composting process take place the microorganism produces methane gas. In this product you have to rotate drum every day.

Fig. 56 Ref.
<http://www.dai.lydump.org/all-products>

8.2Aerobic composter-

Daly Dump is the Bangalore based Firm which has the products for composting which you can do at home. All this products are based on the aerobic composting method where organic waste get decomposes with the help of microorganisms.



Fig. 58 vermicompost pits

8.3 Vermicomposting -

Pit Method- Vermicompost is the ancient technique, generally farmers used this for natural fertilizer to their farms so that crop yield can be upswings.

Pit Method Is the oldest method generally uses for mass production of Vermicasting. cow dung farm waste and tree leafs are used to feed worms.

Fig.59 and 60 shows product which uses flow through method. In fig 59 the bin provided with scraper at the bottom so that casting can be harvest without touching to any worms.

Fig.60 shows very innovative technique for vermicompost. It's a bag which is opening able from bottom side at the time of harvesting.

Worms keep crawling up side where they get fresh food that's why this method called flow through method.



Fig. 59 Flow through bin

Fig.58
Ref. www.kvkkolhapur.com
Fig. 59 & 60
Ref.
<http://www.vermicompost.net/worm-composting-bins/>



Fig. 60 Flow through worm bag



Fig.61 Mesh box Worm bin



Fig.62 Layers method

Fig.61 http://vivamgroup.tripod.com/vermi_photo.html
 Fig.62 Ref.
<http://www.vermicompost.net/worm-composting-bins>
 Fig.63 Ref.
www.redearthworms.com

'Vivam Industries' from Aurangabad developed this kind of worm bin which are replica of pit method of vermicomposting. A box frame made out of metal channels and covered with the Metal mesh. Because of proper air circulation from all sides it gives good results. But harvesting is difficult in this type of bins; you have to dig out the Vermicasting.

Fig.62 & 63 shows the worm bin which uses layer method. In this method you start dumping waste at bottom most container then when it gets filled you have to attach another container over the old one in this way once the food got over at the bottom container worms move to next container. This method is good for harvesting but has limited capacity, one family only. Generally this type of worm bin is used in European countries.

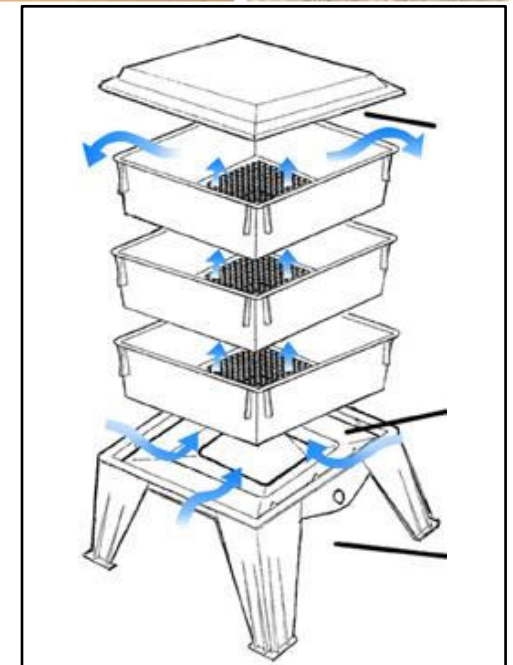


Fig.63 Layers method

9. Data Collection & field Study Analysis-

From all this field trips and market study shows how important it is to 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, Or vermicomposting, **Prakash Dandekar "kalpataru"**, shows that how efficient it is the vermicomposting.

The major issue is **People's perspective** of looking at the garbage. If they see their **garbage transforming** into useful Manure and how easy it is. They will start looking at **garbage as a resource** not a waste. Vermicompost is the best process and the results are also quicker than other processes like bio gas, aerobic composting etc. this process required 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.

I decided to go with **"Vermicomposting Process"** for waste management. so that **wet** and **dry** waste can be segregate at **housing society** level Where **people will learn** about waste management.

10. 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.

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.

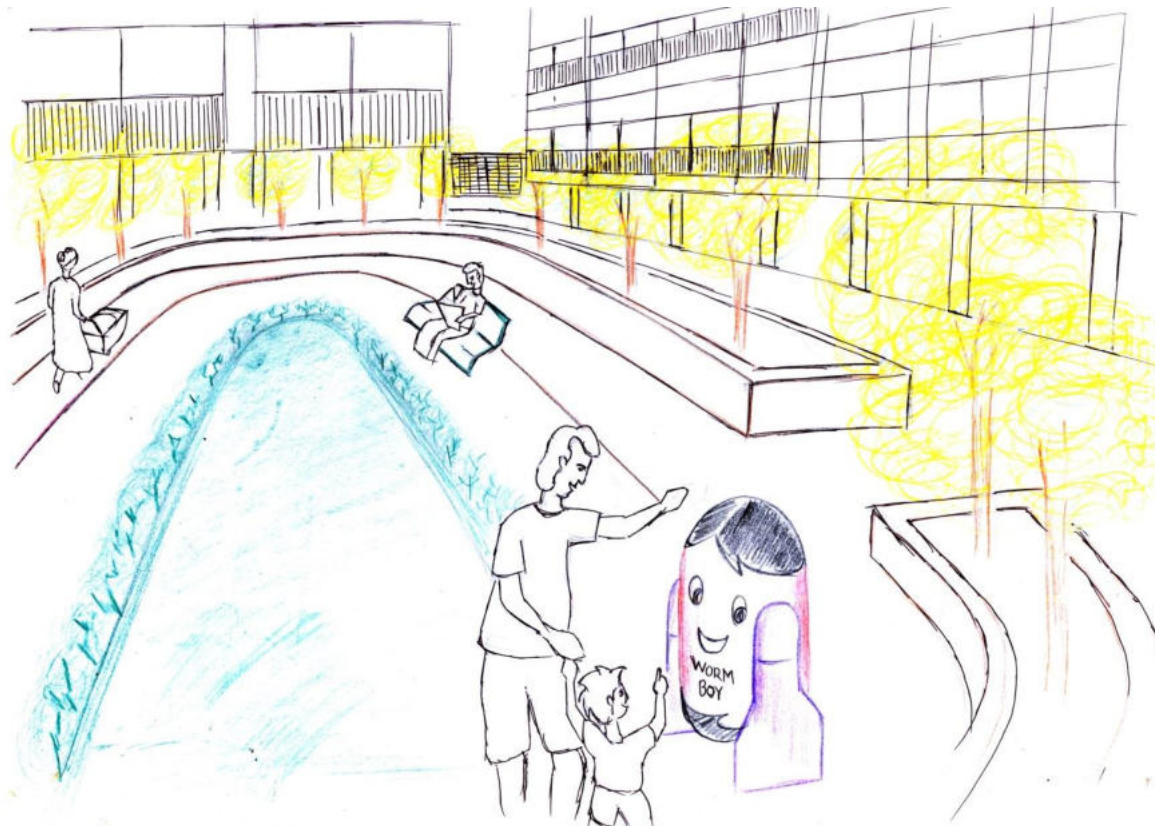
Specification-

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

Limitations-

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

11. Design Directions-



Scenario 1- Into the housing societies garden

At this place this product would be **displayable** and **informative**.

Encouraging to children's as well as visitors.

it will **educate people** about importance of waste management and vermicompost.

Advantage-

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

Disadvantages-

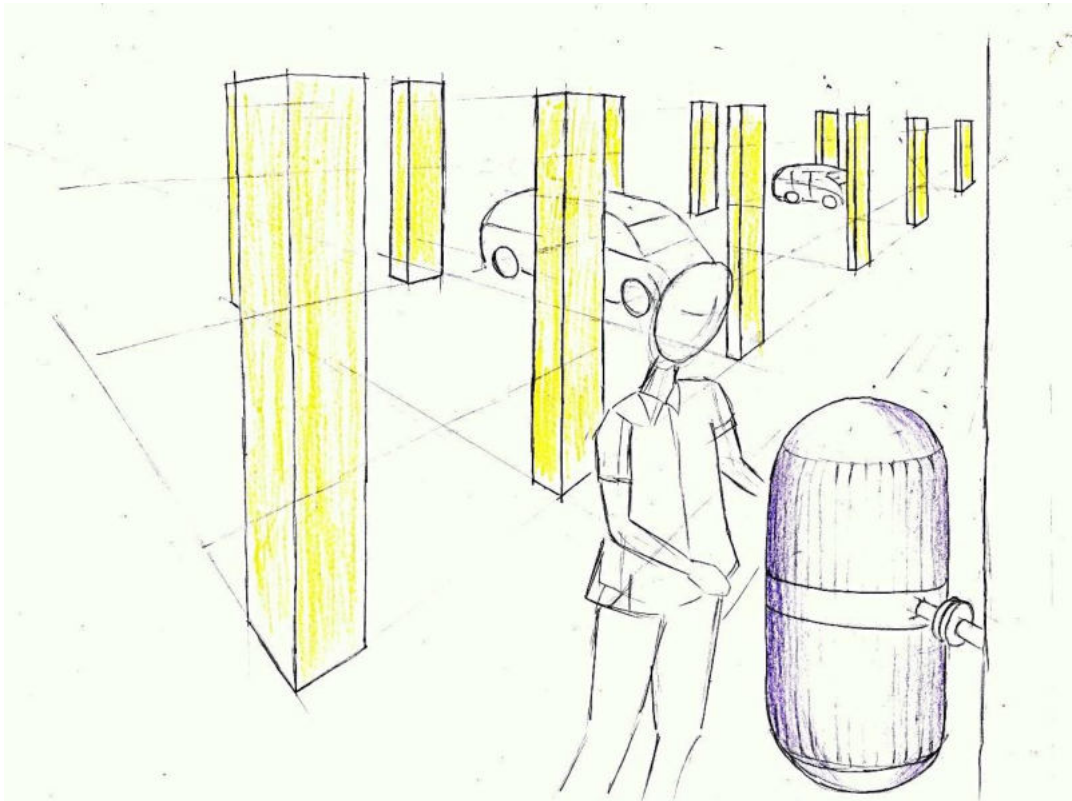
- Exposed to outside weather

In to the corner

Only Functional Product

Space utilization

Non Informative



Scenario 2- Into the Parking lot

Most of the housing societies having this area where vermicompost unit will be away from sun, rain and other atmosphere conditions,

But in this area it will be remain as a functional product, it's away from sight of everybody, after some time society people might get forgot about it.

Advantages-

- Space saving design
- Into the shed always

Disadvantages-

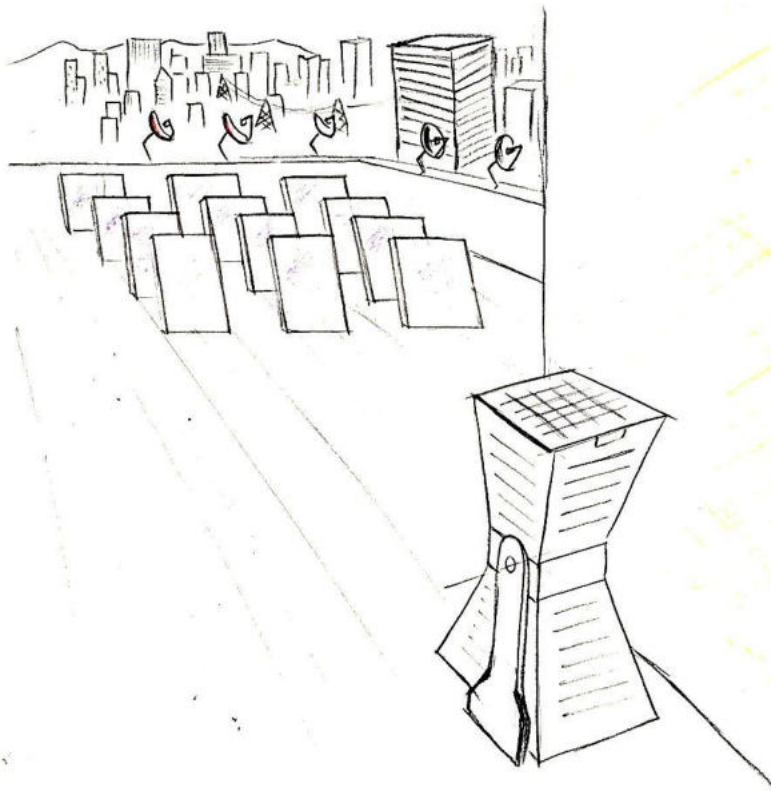
- Non educative
- Non informative

Non Informative

Non-Educational

Space utilization

Only Functional Product



Scenario 3- Terrace

There is a lot of space available on the terrace .But here it will **be out of sight of everybody.**

It's completely exposed to outside weather here, no educating and informative. It's similar like solar water heater which dose its work but there is **no other purpose** it's solve mention in project brief.

Advantages-

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

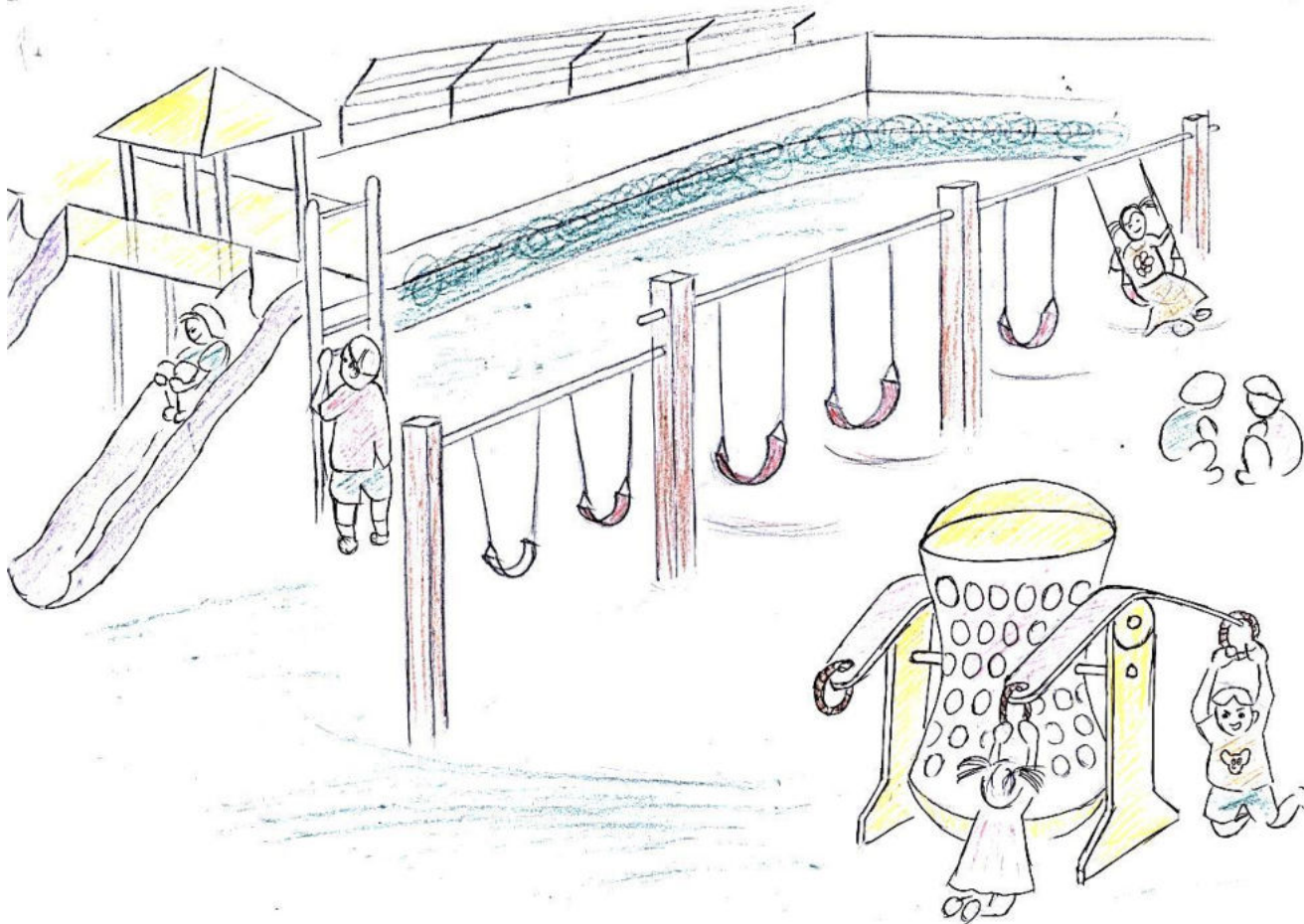
Disadvantages-

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

Educational

Space utilization

Playful



Scenario 4 - In to the Play ground

I thought why not it could become a **part of play ground** where children used to come, so that children will **learn** about it.

But it would be little discomfort for children's as they are too close to unit. Or they could damage this.

Advantages-

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

Disadvantages-

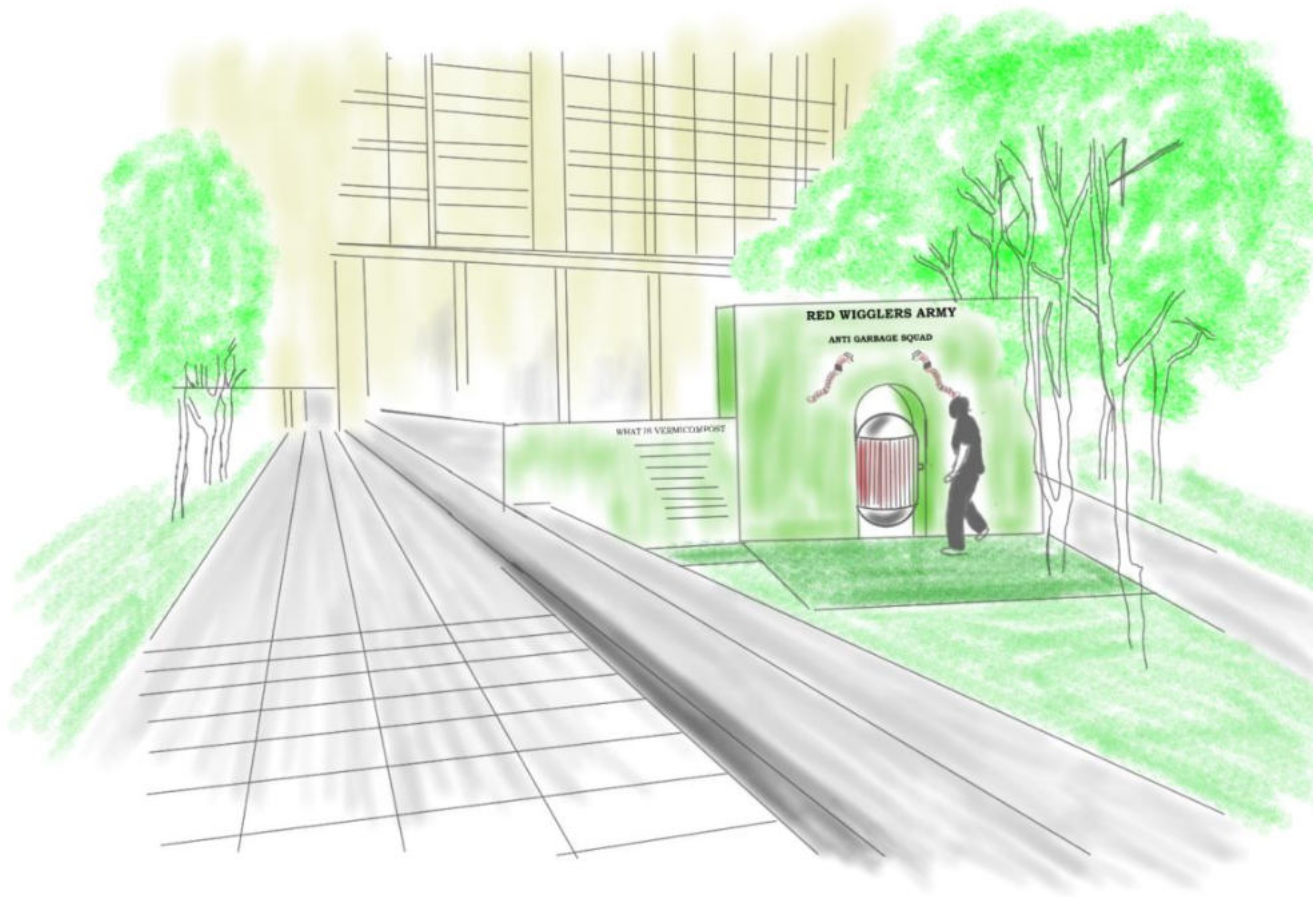
- Expose to sun
- Too close to children's, hygiene issue
- Easily get damaged by children's

Informative

Educational

Proud to Exhibit

Spreading Awareness



Scenario 5- Wall of Information

In the 1st scenario, where become a **center attraction** of the housing society. In this scenario I tried to make it **more informative**. It will be a **proud** thing for housing societies to **show cases it**.

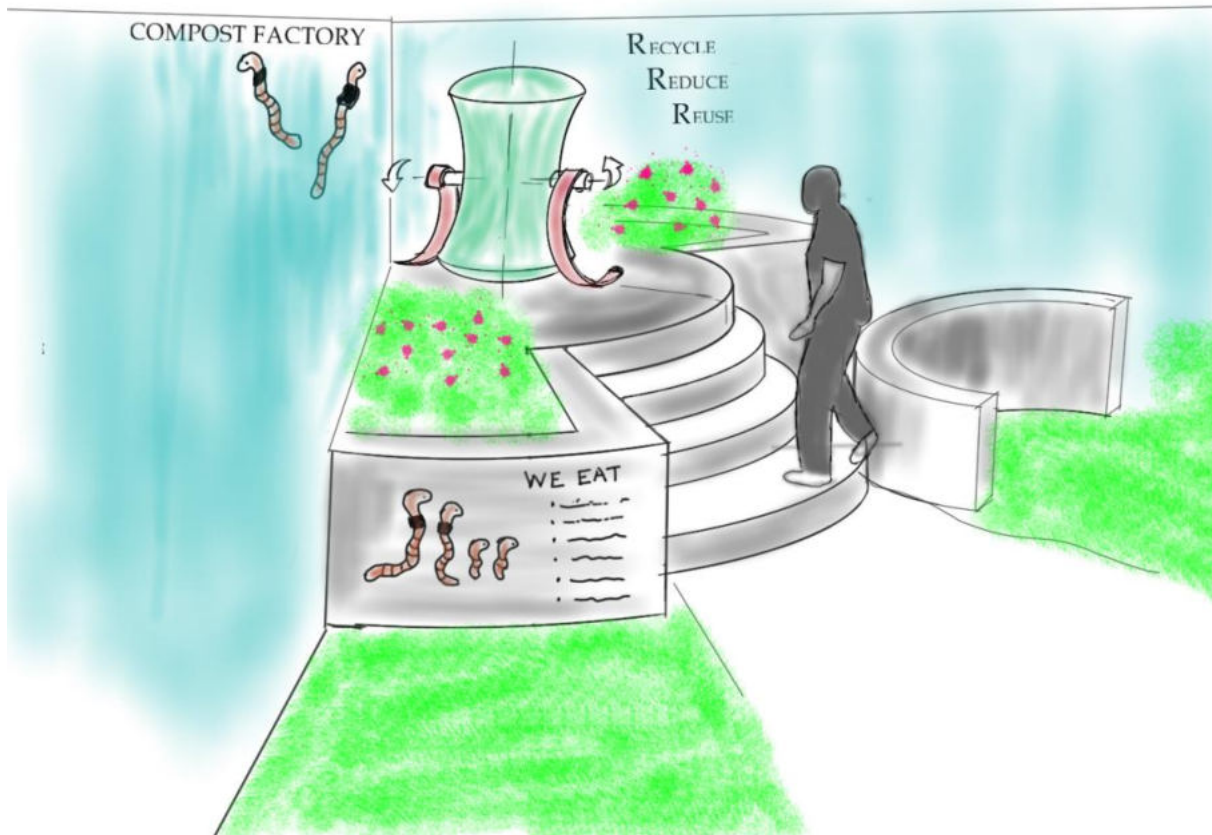
It could be a part of a wall installation where all information about vermicompost can be **displayed**. It will help **to spread the words** about vermicompost and waste management as it's located at the entry of the housing society which will **attract the visitor's attention**.

Informative

Educational

Space utilization

Beautification



Scenario 6 - At corner of the compound walls

We can utilize this space of **corner** of the compound walls. That way it will save some space. But it will be complete **knowledge corner** for waste management on which society residence can be **proud off**. The walls behind can be used as a display **educating** things about waste management.

Advantages-

- Using a wasted corner
- Corner became a information center

Disadvantages-

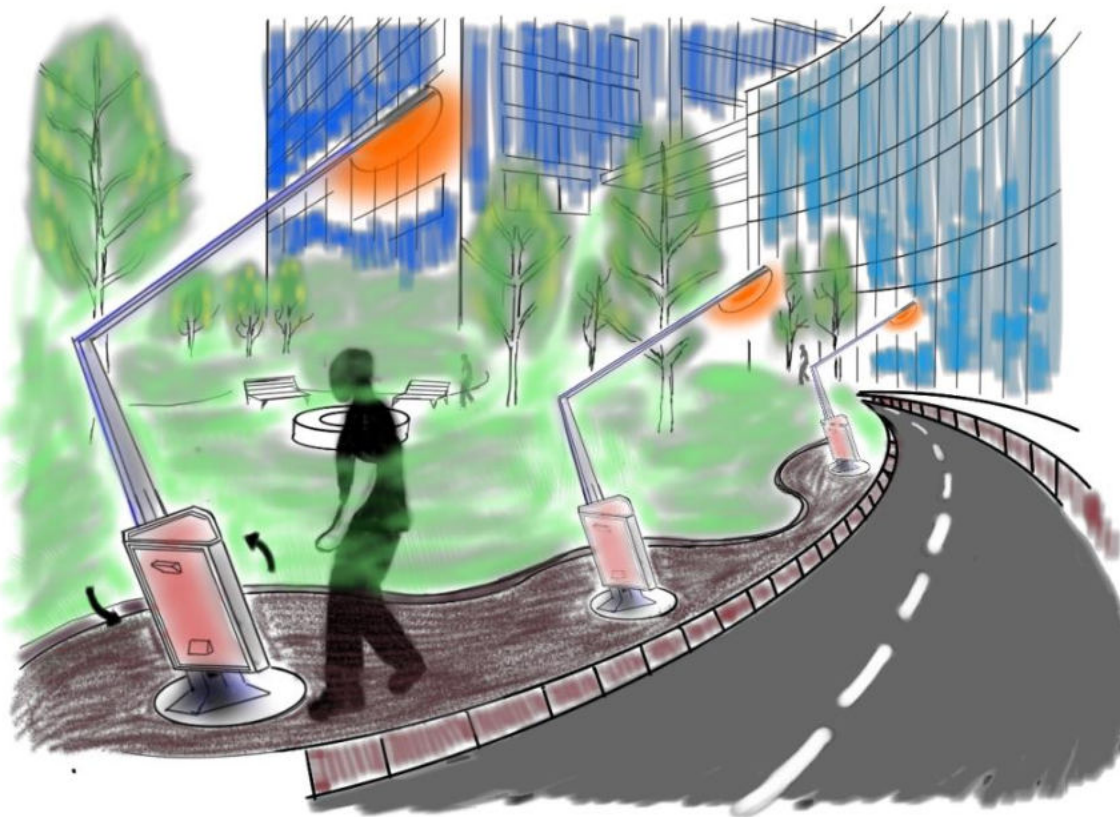
- Exposed to sun

Non Informative

Only Functional Product

Space utilization

Non-Educational



Scenario7-

Vermicompost polls.

Space is the big issue in housing societies. I was thing to use something already acquired a space and something important part of housing societies infrastructure.

The street polls are there always in housing societies what if I use light polls as a part of **vermicompost bin**. there will be small worm bins which can be **hang at this polls** .

Advantages-

- Spaces saving
- Manageable, because decentralize

Disadvantages-

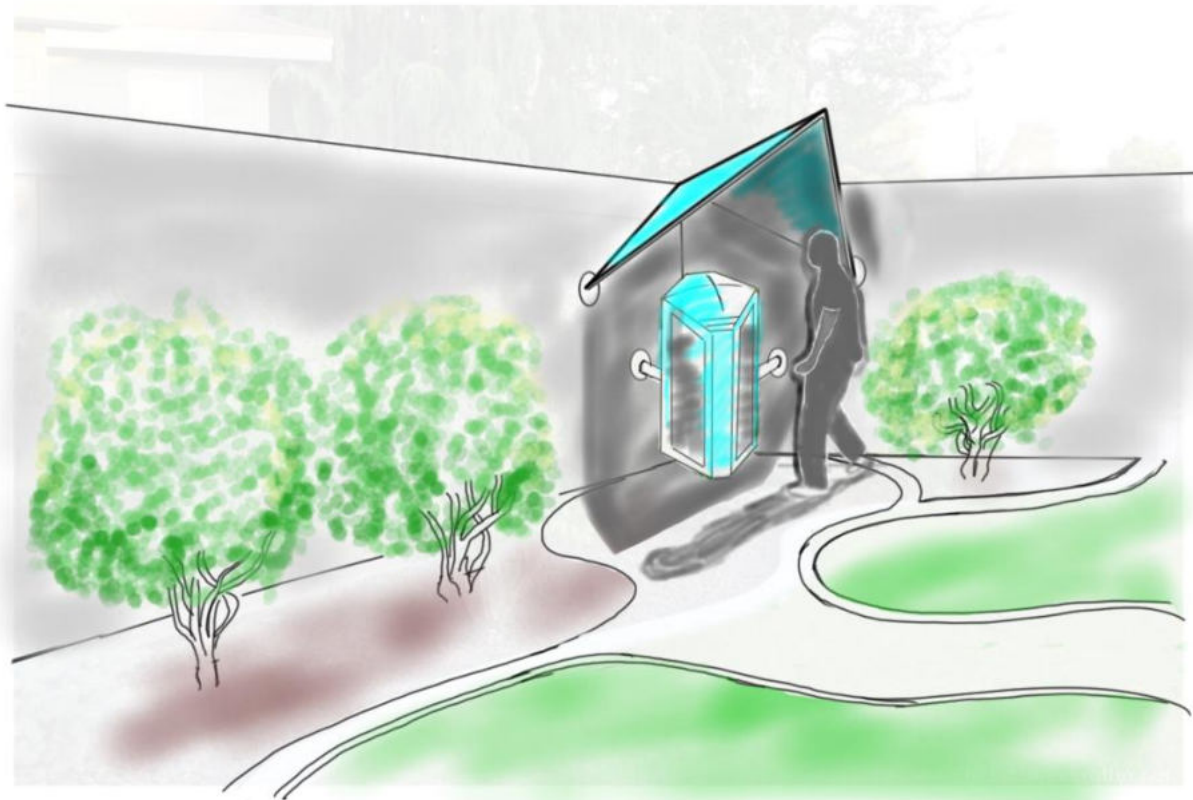
- Small worm bin could be misinterpreted as a dustbin.

Informative

Space utilization

Beautification of garden

Educational



Scenario 8 -

Wall mounted.

Again I can imagine the worm bin can be mounted on wall compound corner. The utilization of space will be better again as scenario 6 walls can be used for displaying or narrating the story of worms and vermicomposting.

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.

Informative

Educational

Proud to Exhibit

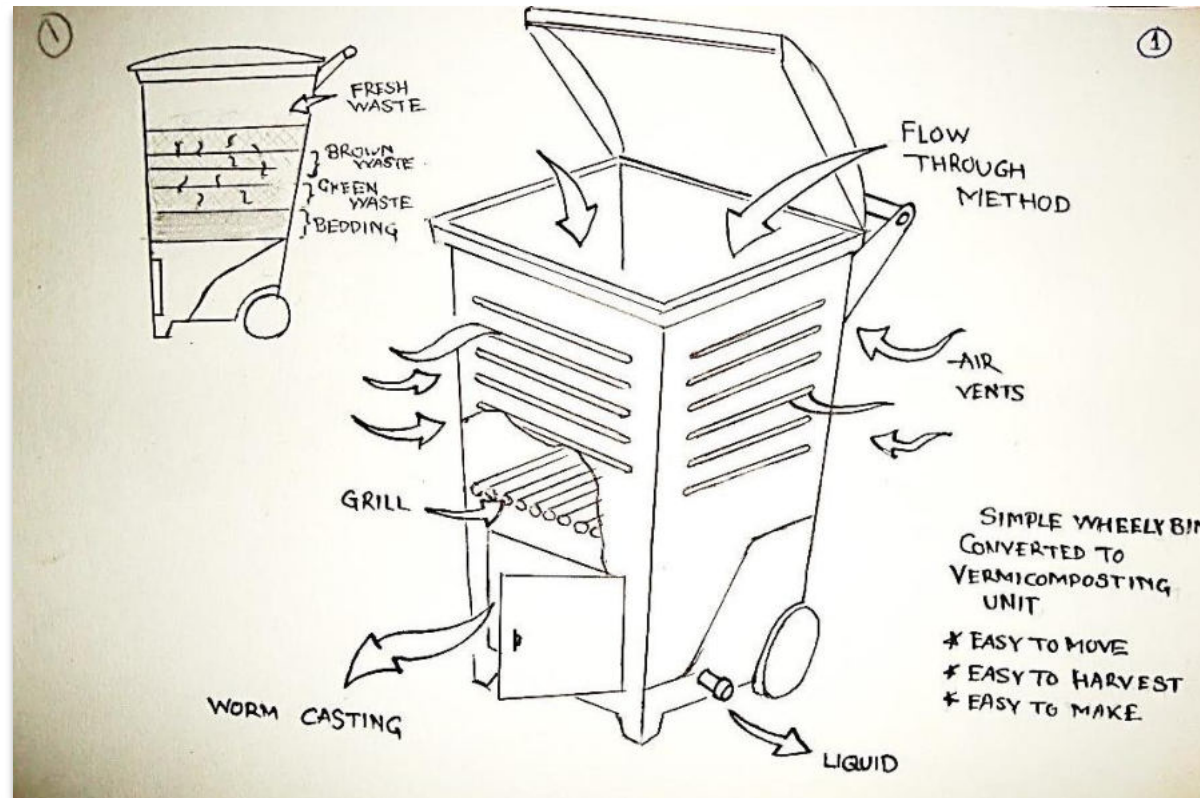
Beautification of garden



Scenario9 - Central installation at the park.

This is the similar idea like Scenario 5, Where will be the **center of attention** in the housing society. This would be more appropriate scenario for this kind of product because it's **not just a product**, it's a **culture** which I want to create in to housing societies where **people take responsibility** of their own garbage and educate to next generation about waste management . When **children's will see every day** that our garbage can be transformed in to beautiful garden, defiantly they will learn that waste is not a garbage think it's **our responsibility** to manage it, to control it.

12. Ideation-



1- Wheelie bin concept

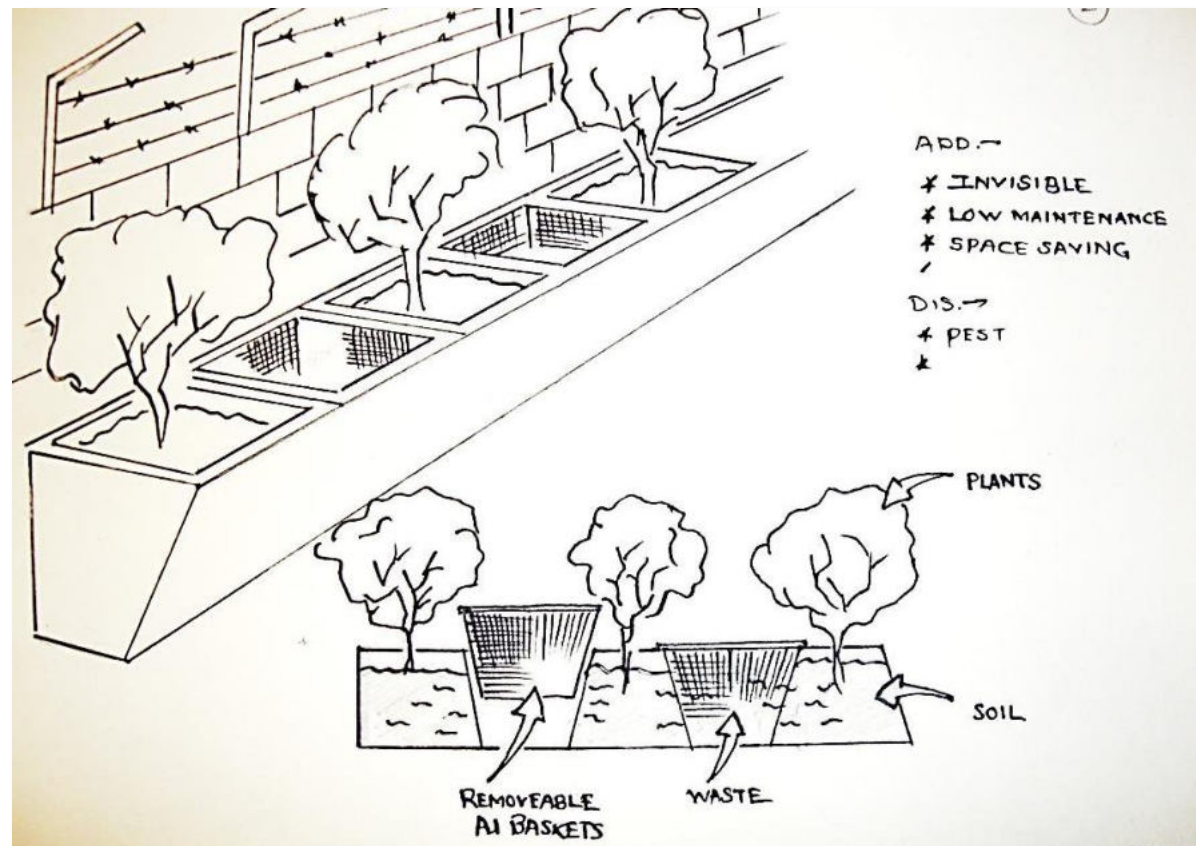
This concept is inspired from the wheelie bin design, in this concept door provided at the bottom to harvest the vermicompost. It is ventilated from all side. Wheels add feature of transportability.

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-

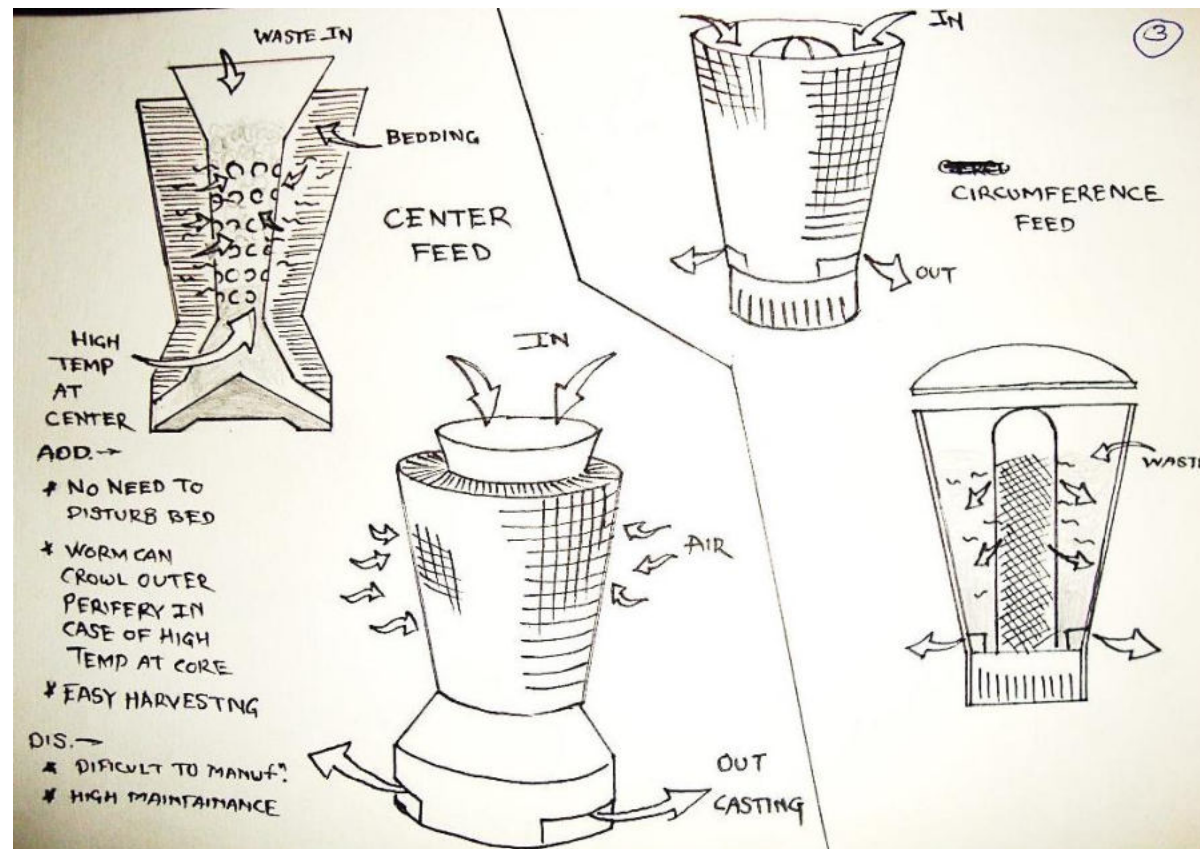
We can directly install vermicomposting at the plants root. By this way we don't need to harvest the Vermicasting. It can be directly apply to the plants. As shown in figure baskets can be a part of pot in which he plants are planted. These baskets can be removable. You just need to dump your garbage at these baskets and the worms living in the soil will enter in to this basket to eat.

Advantages-

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

Disadvantages-

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



3- Central feed-

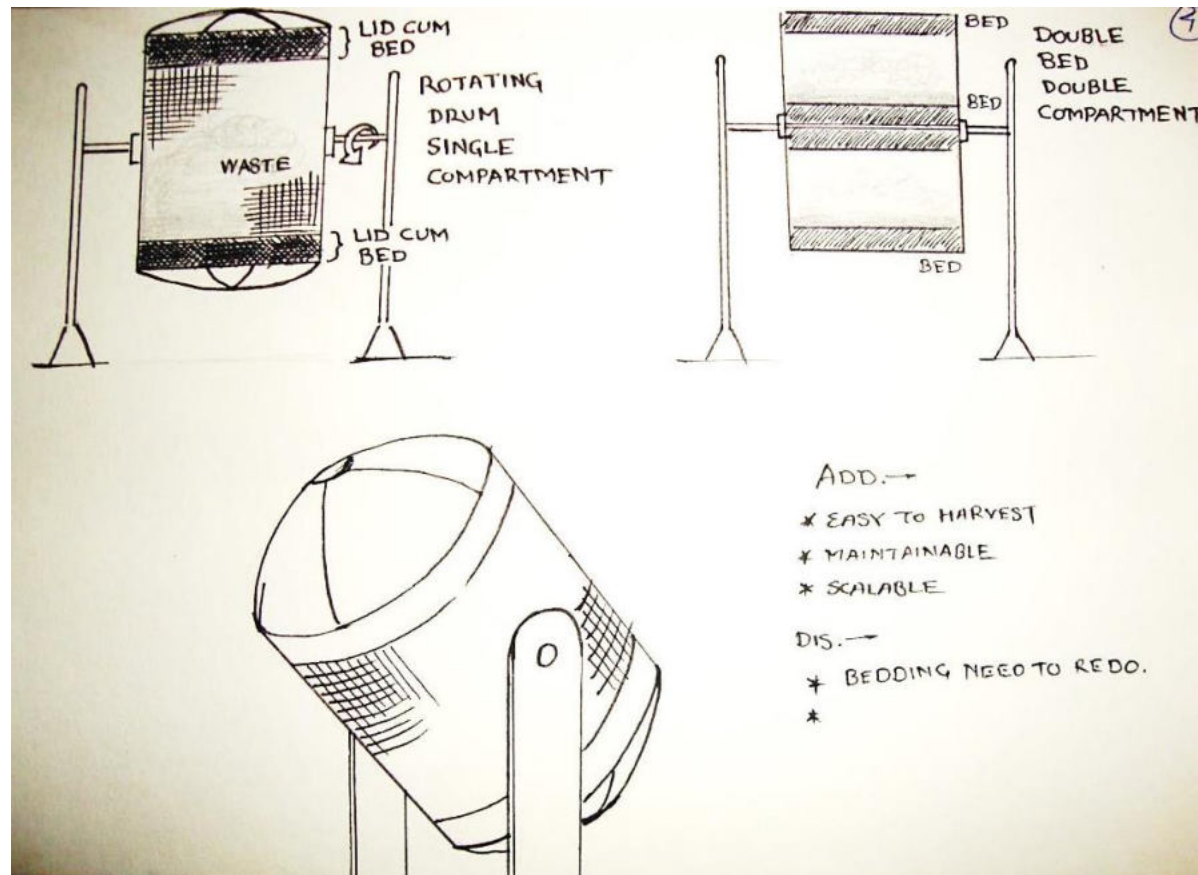
In conventional vermicomposting units the worm bed used to be at bottom only, what if food is surrounded by worm bed. Or it could be a vice a versa can be possible. In such case worms need not to disturb at the time of harvesting.

Advantages-

- No need to Disturb worm Bed
- Faster composting Process

Disadvantages-

- Working Principle need to be Verified



4- Rotating drum-

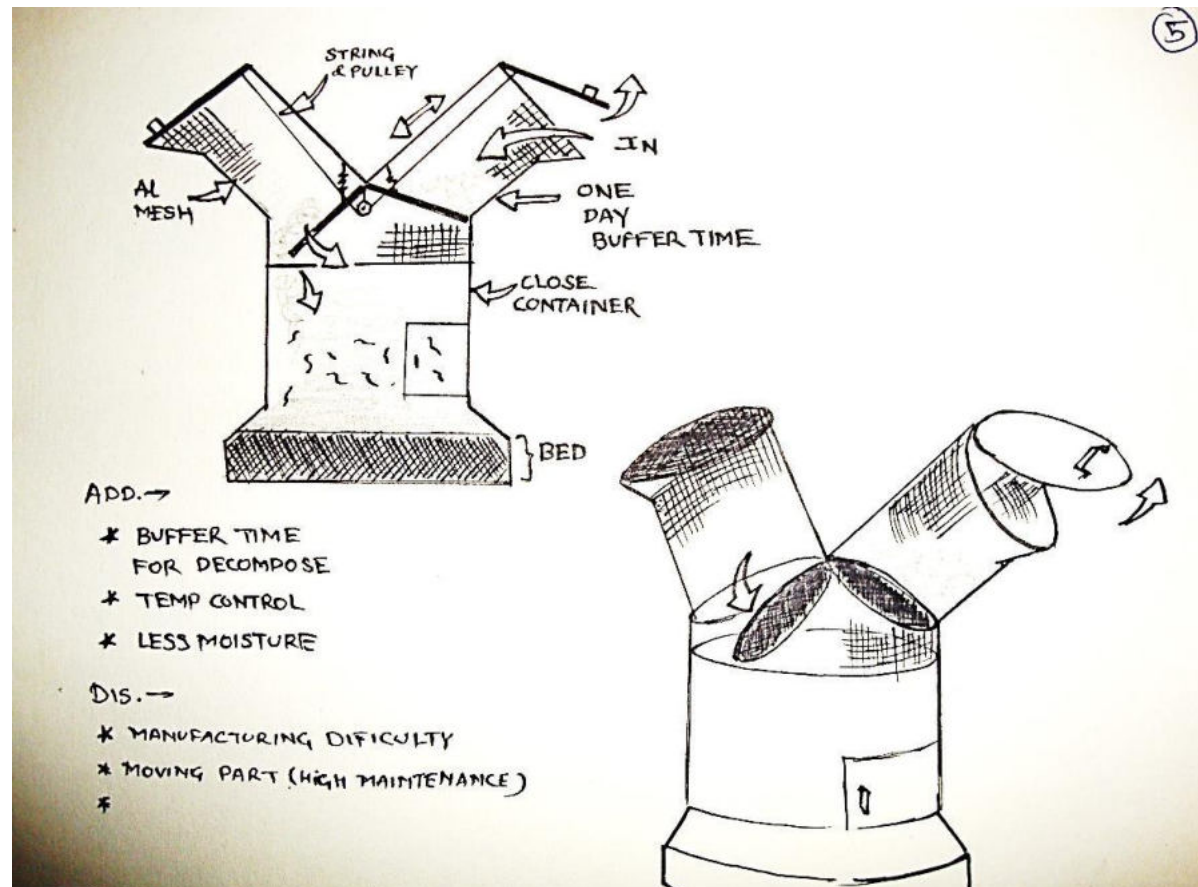
The bed can be placed at both ends of the drums which can be a part of the leads. When the drum get fill the half portion where compost is remain can be harvest by rotating the drum to other side due to natural instincts and gravity worms shifted to words the bottom part of the drum where they can find new fresh food and harvesting can be done from top side.

Advantages-

- Stirring is Possible
- Buffer time for aerobic decomposition

Disadvantages-

- Bed need to prepaid at the time of harvesting



5- Two side feed-

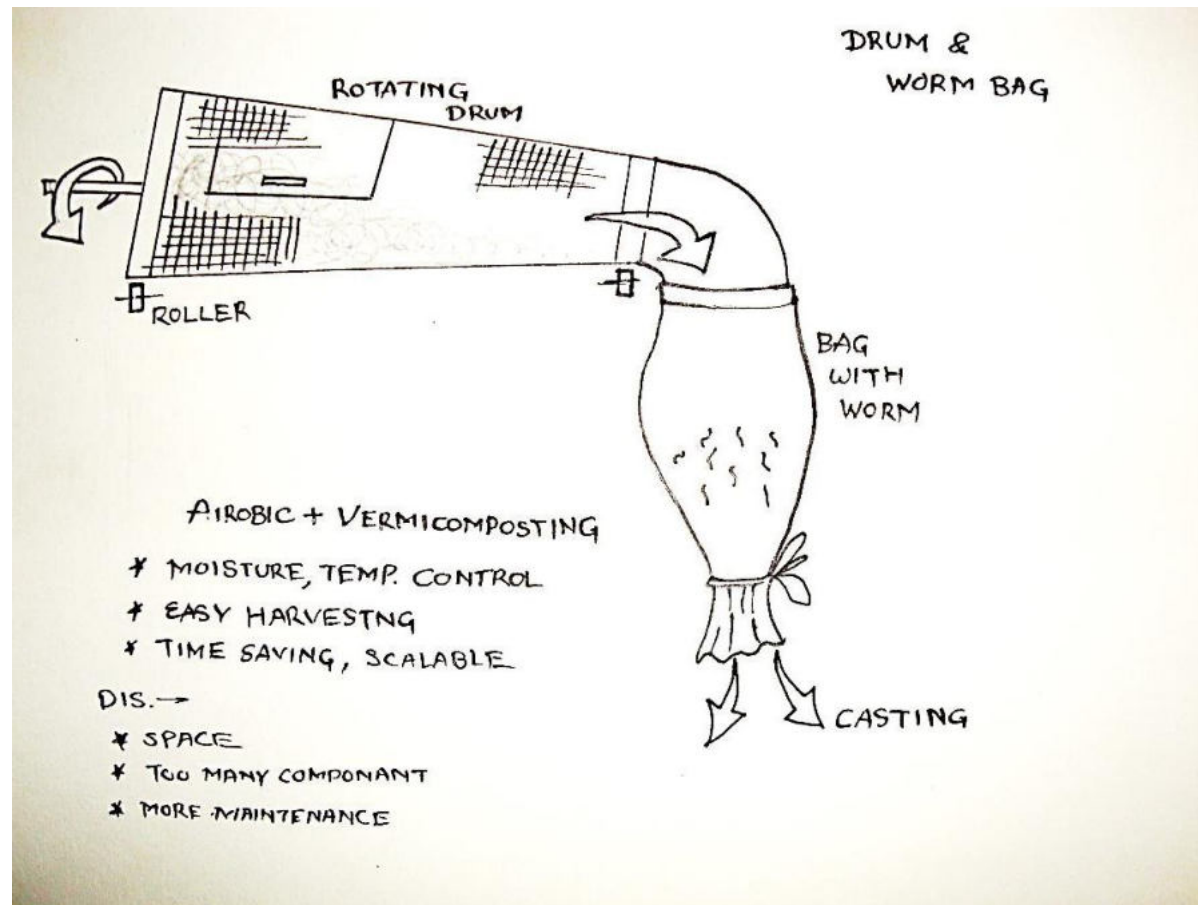
In this concept I try to give an added feature that the waste is not going directly in to the bin or not pilling up on the old half decomposed food. When you dump the garbage in to the bin it stuck at the top portion where it stays a day by allowing this to happen I am reducing water contain inside the garbage.so that there will be no foul smell.

Advantages-

- Buffer time for aerobic decomposition
- Temp can be control

Disadvantages-

- Too many moving parts



6- Worm bag-

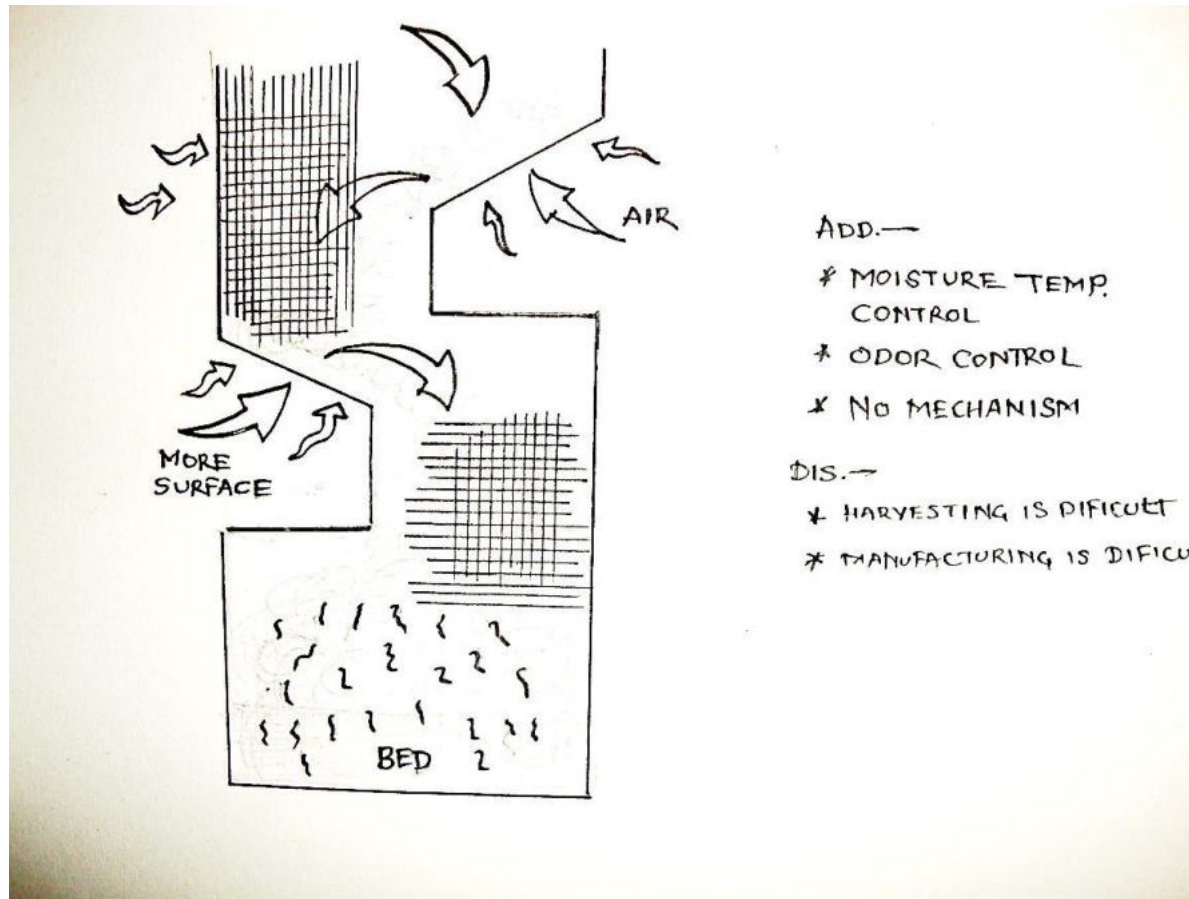
The bag allows the maximum heat transfer and you can water it from outside also. The drum provides the facility of simple aerobic decomposition and worm bag accelerate the composting process.

Advantages-

- Buffer time for aerobic decomposition
- Stirring is Possible

Disadvantages-

- Too many moving parts



7- Steps bin-

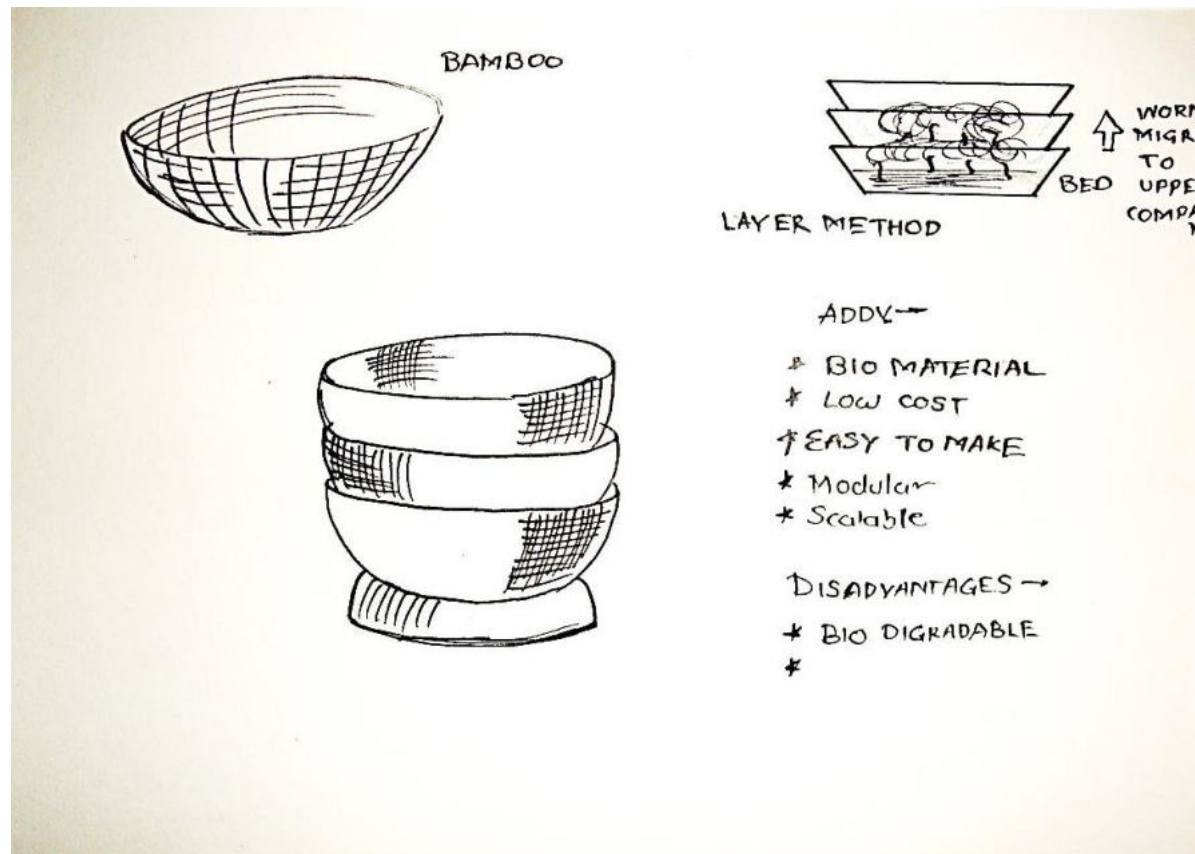
The idea is same as mention in concept five, by providing steps in between the garbage g will get stuck and aerobic decomposition will take place and at the same time the overall surface area increased for aeration.

Advantages-

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

Disadvantages-

- Harvesting is Difficult



8. Bamboo baskets-

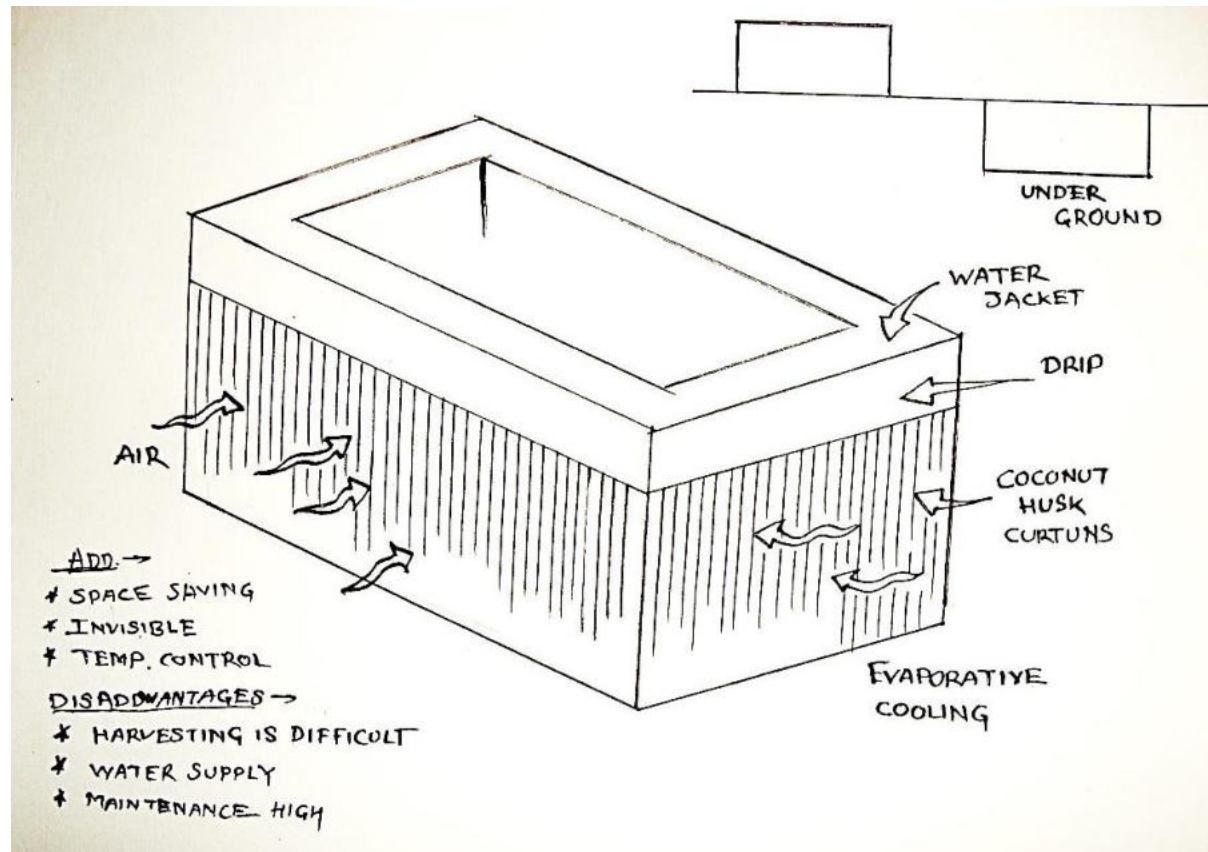
This is the simplest solution we can think about; bamboo baskets are readily available everywhere in India. They are easily to manufacture. The idea is to stack them together when the food got over at the bottom most basket worm will crawl up in search of food and then entire basket can be packed and distributed.

Advantages-

- Low Cost, bamboo availability
- Easily available

Disadvantages-

- Bio Degradable
- Pests will dig into it.



9. Underground-

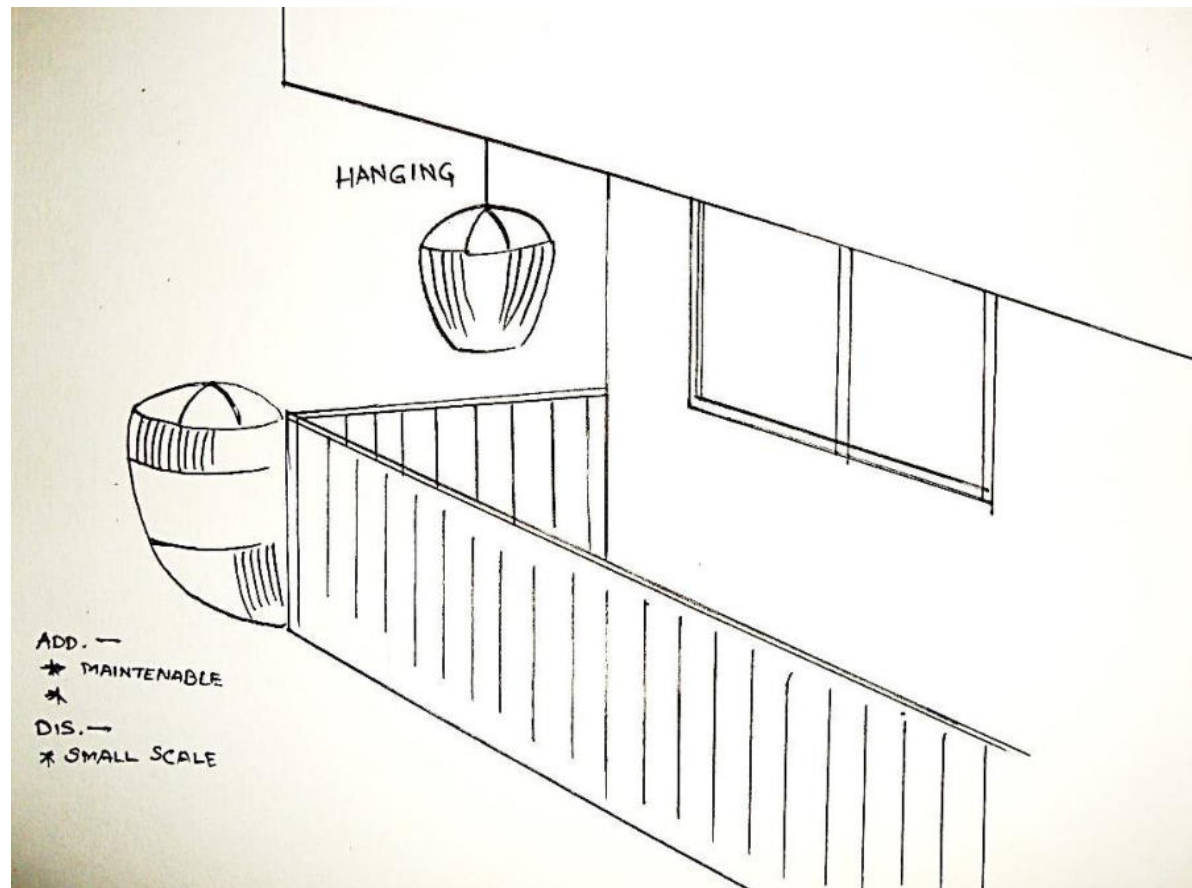
The space is the issue in the housing societies by shifting entire worm bin under ground the upper space can be utilize, but there will not be a proper aeration and heat transfer.

Advantages-

- Hidden
- Temperature and Moisture control

Disadvantages-

- Harvesting is difficult



10- Personal modules-

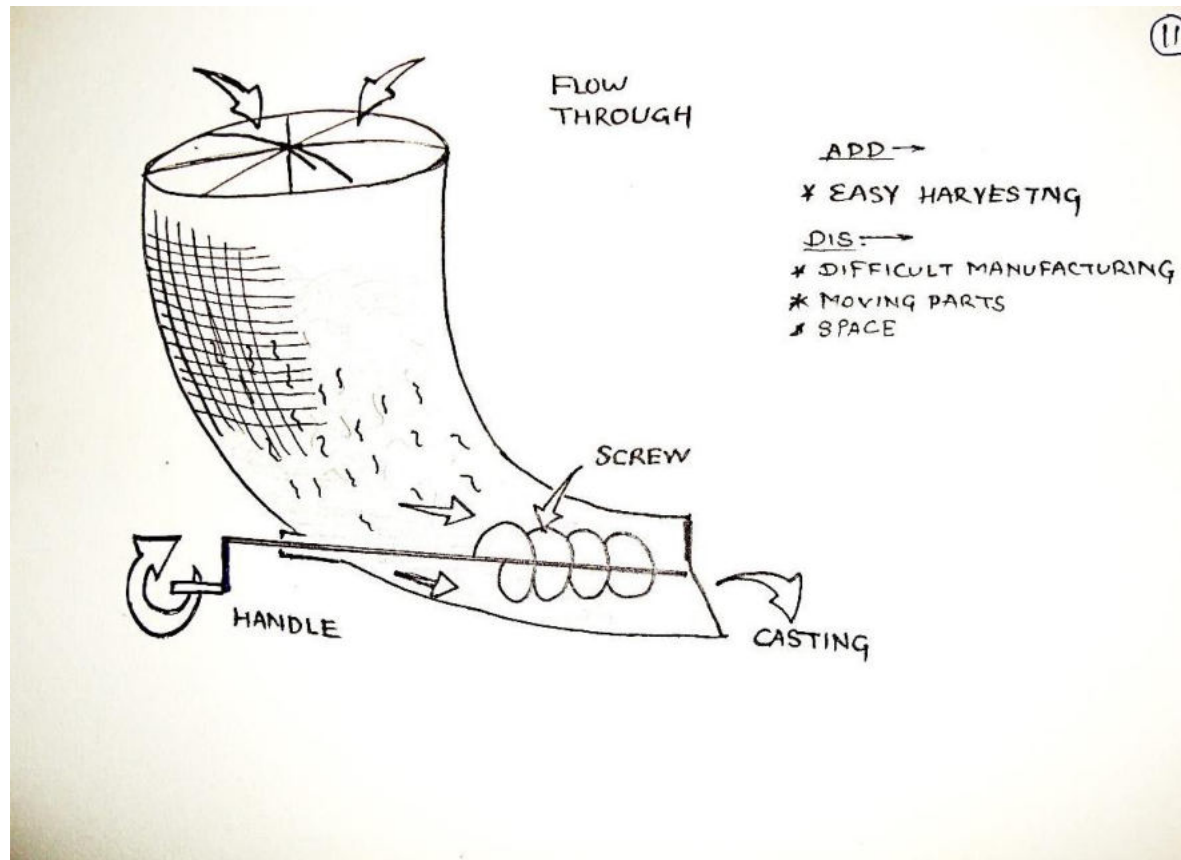
It could be a personal thing as Prakash Dandekar "kalpataru" which shifting responsibility directly to the user. It could be hanging or displayable think.

Advantages-

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

Disadvantages-

- Only for Personal use



11 Screw Bin-

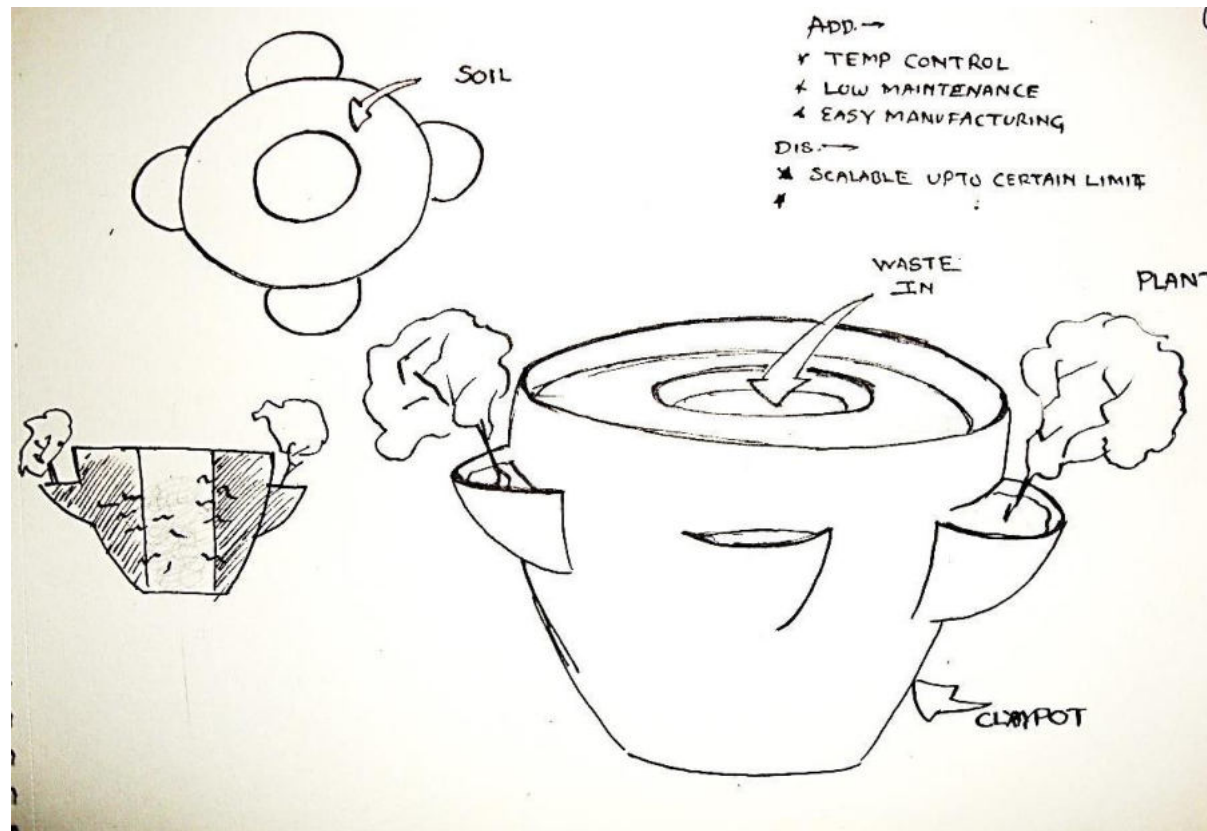
For easy harvesting, this is the flow through method in which worms moving upwards where new and fresh food feed to the system, from the top portion of the drum the fresh food will enter and worms will move towards it. And at the bottom where only casting is remaining can be drawn out by screw feeder mechanism.

Advantages-

- Easy Harvesting
- Continues flow system

Disadvantages-

- Moving Parts/mechanism



12- Clay pot-

A simple clay pot which helps to maintain temperature as well as moisture because it is porous in nature. The same pot can be used as a decorative plantation pot.

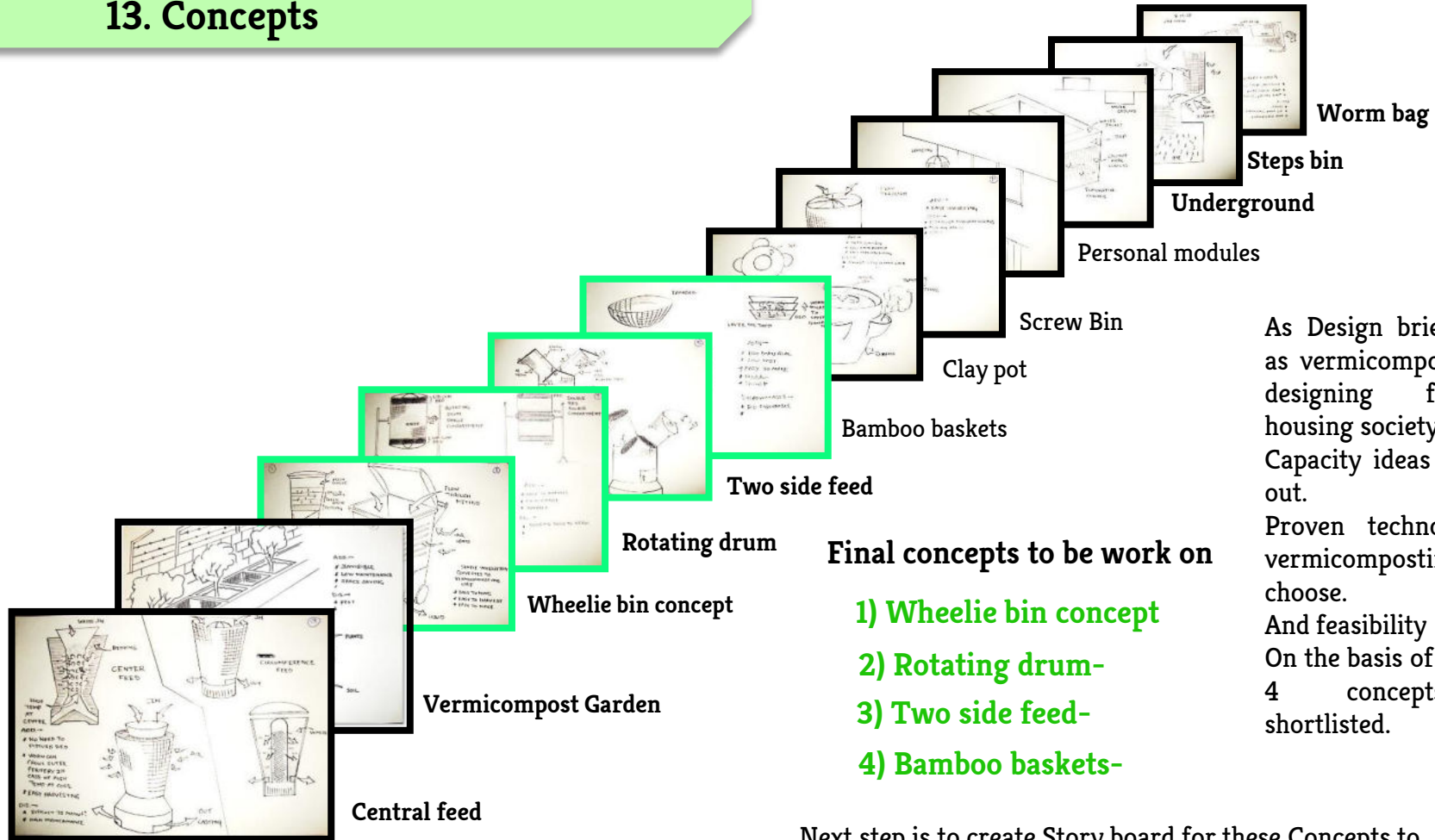
Advantages-

- Direct application of Casting
- Naturally control Temperature

Disadvantages-

- Low Cost
- Delicate

13. Concepts



Final concepts to be work on

- 1) Wheelie bin concept
- 2) Rotating drum-
- 3) Two side feed-
- 4) Bamboo baskets-

As Design brief defined as vermicompost unit is designing for the housing society. Small Capacity ideas will drop out.

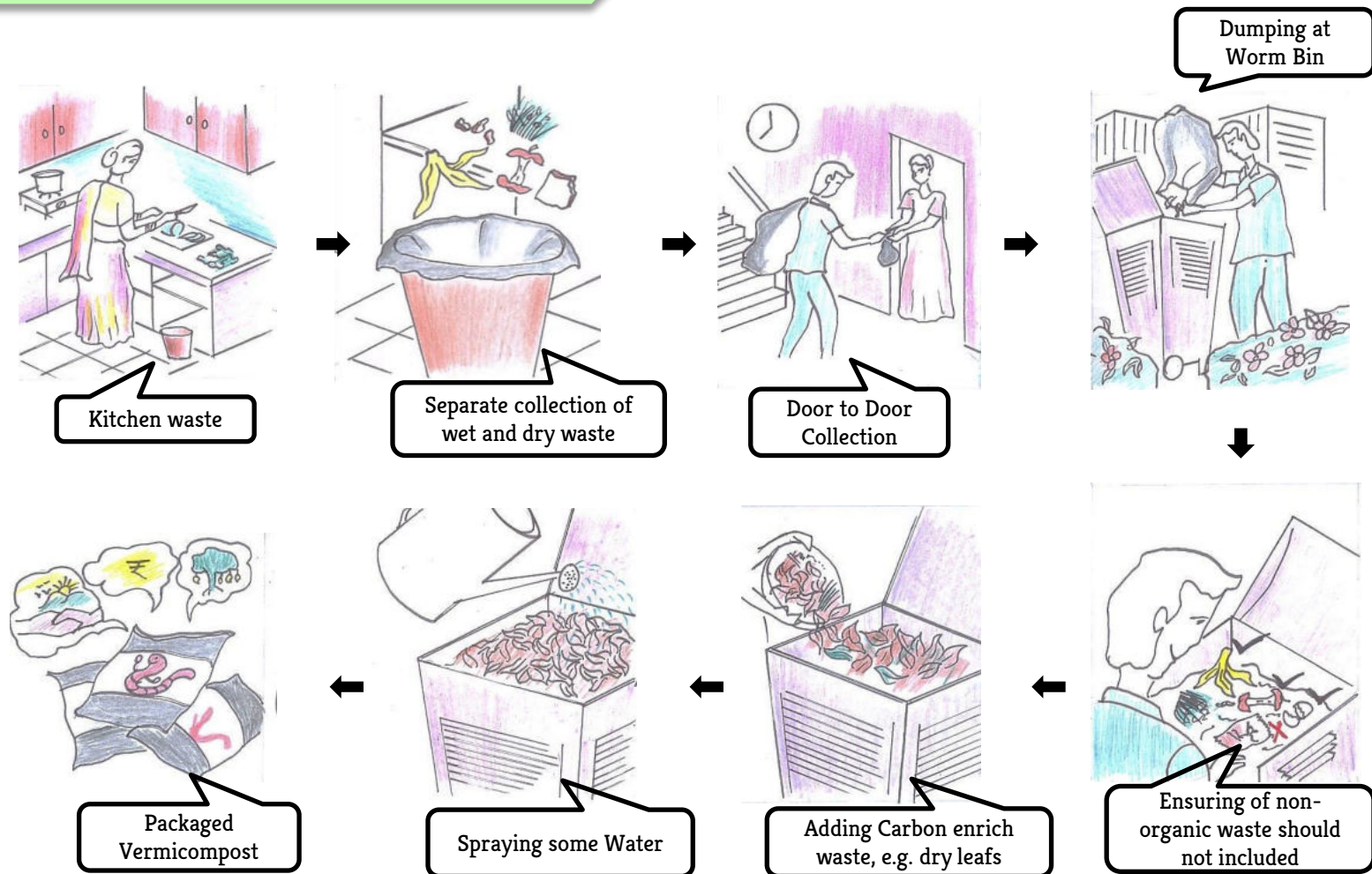
Proven technology for vermicomposting has to choose.

And feasibility

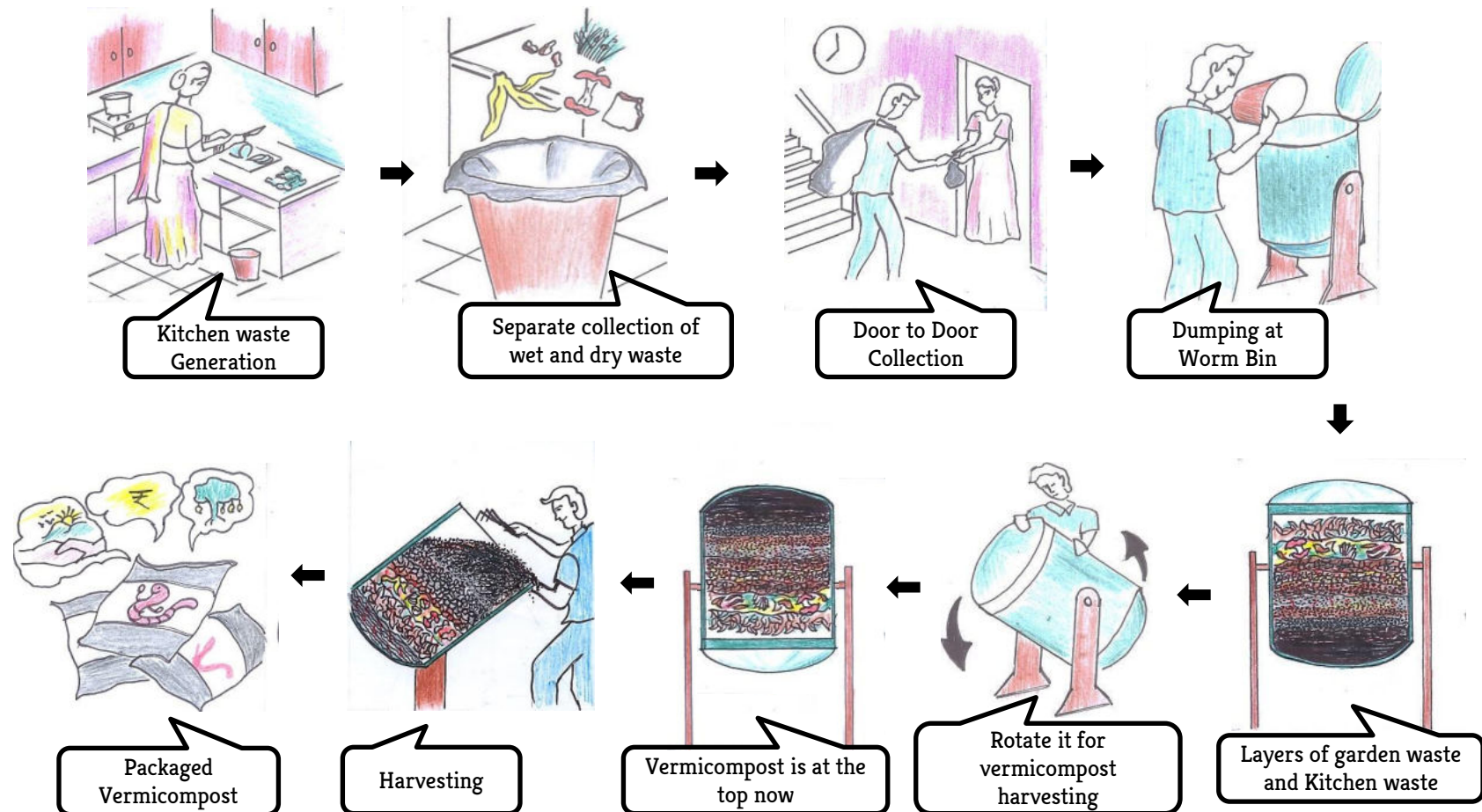
On the basis of this three 4 concepts are shortlisted.

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

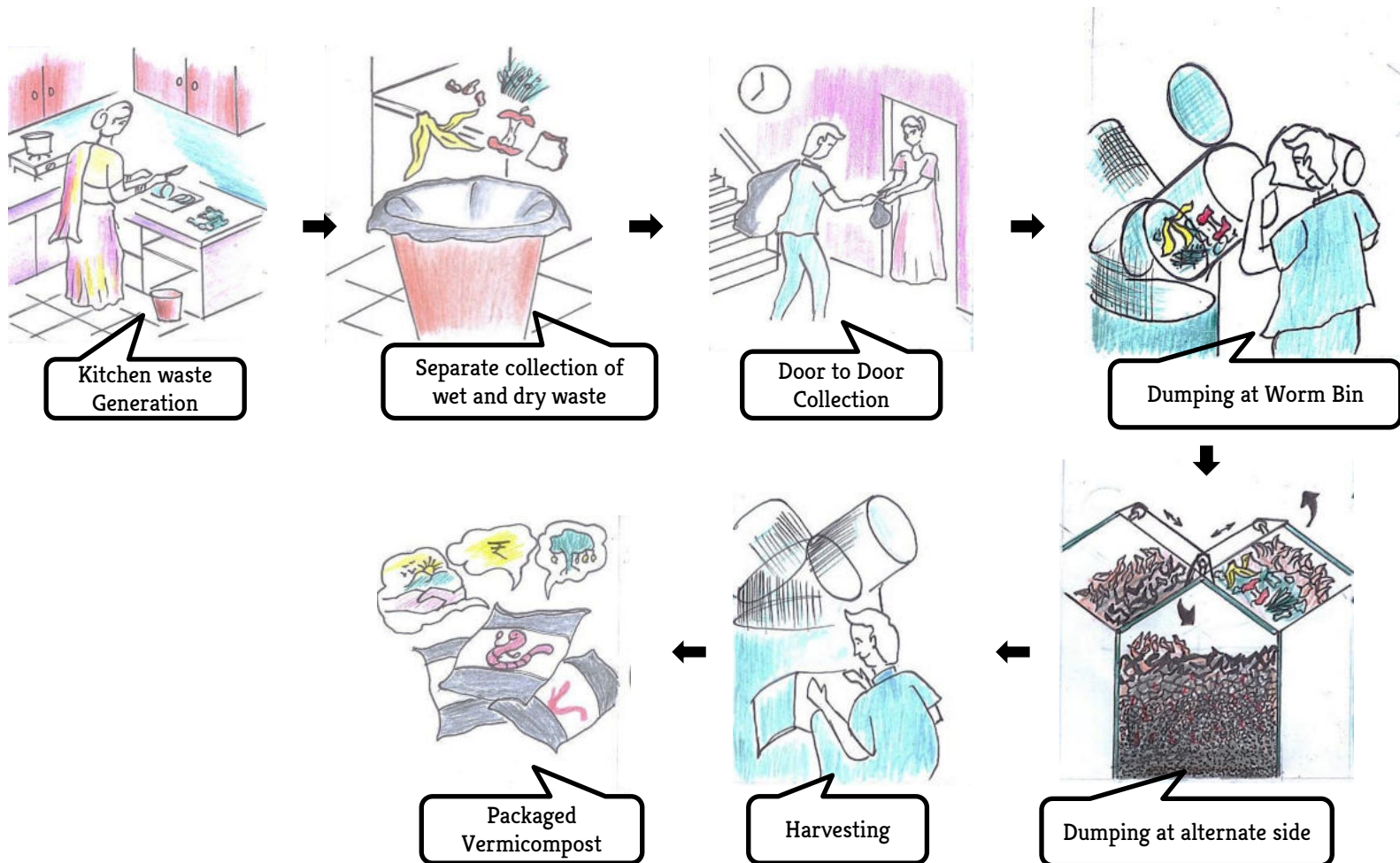
13.1. Story board for wheelie bin concept



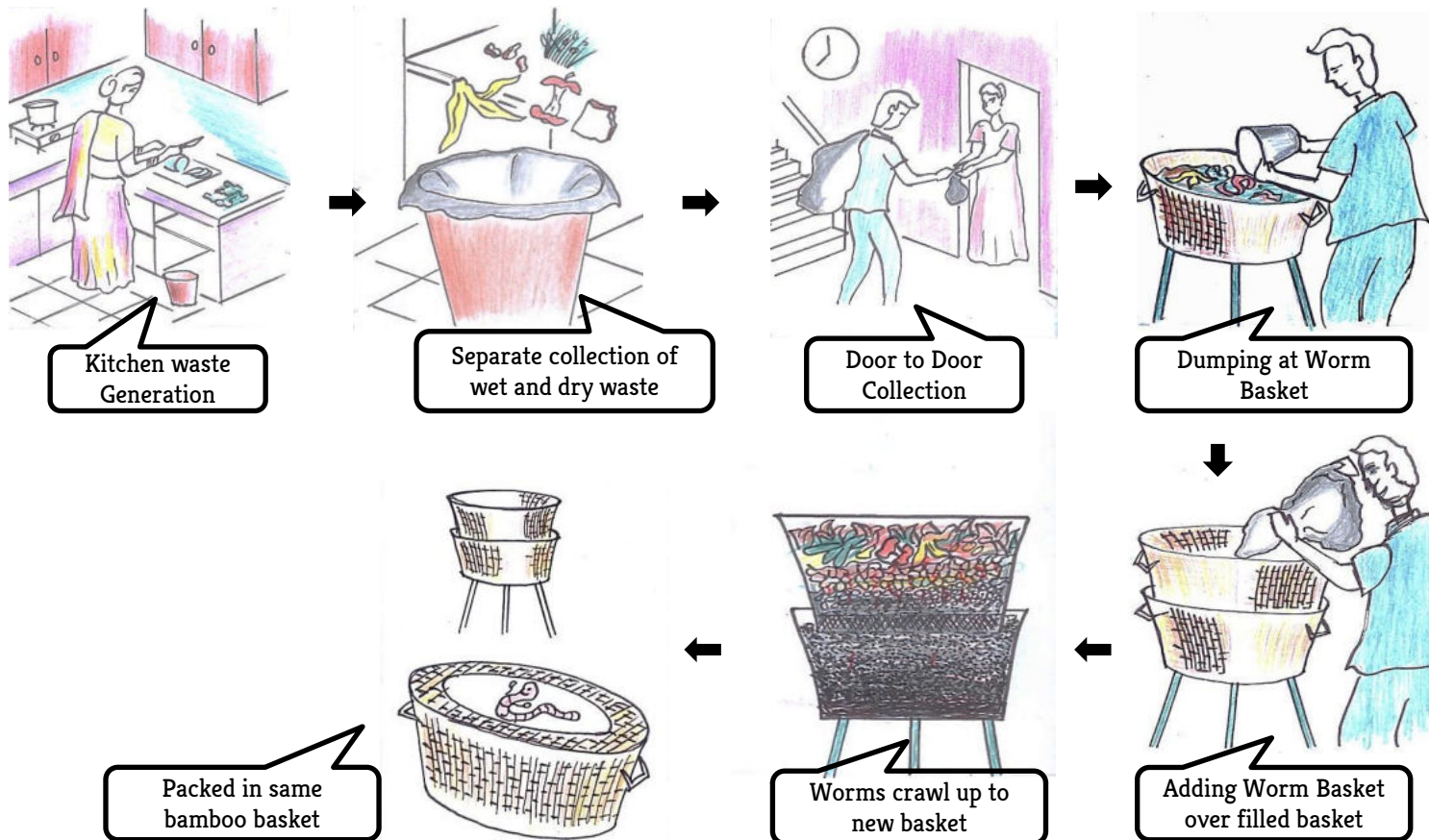
13.2. Story board for Drum concept



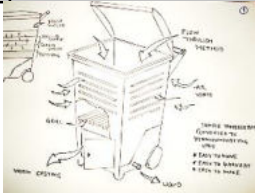
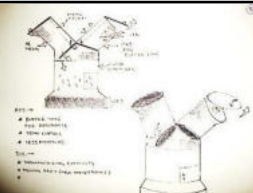
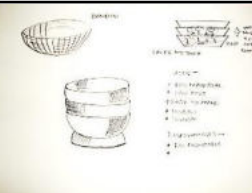
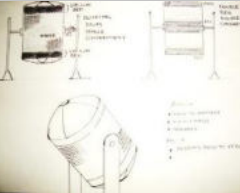
13.3 Story board for two side feed



13.4 Story board for bamboo baskets



14. 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

Following are the shortlisted concepts -

This all concepts fulfilling the Design brief.
But the rotating drum concept is the best possible solution.

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

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.

15. Rotating drum Concepts

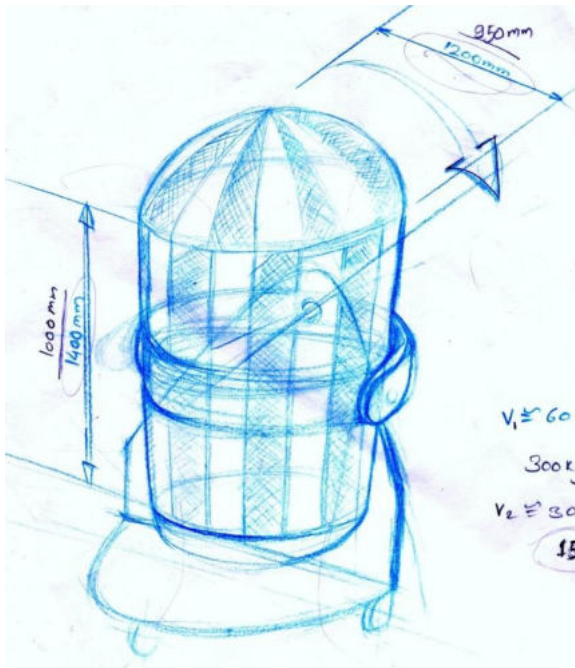


Fig. 63 side wise rotating drum



Fig. 64 side wise rotating drum

This ideation based on the orientation of the rotation of the drum.

If the drum rotate like shown in fig.64 then it can't be place along the wall so it will take some more space.

As fig.63 shows the side wise rotating drum, will help to locate it along with the wall

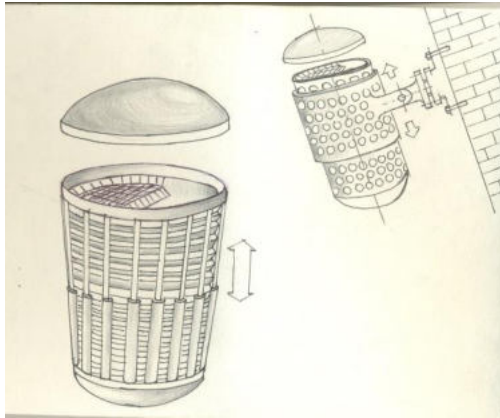


Fig. 64 Wall mounted expandable drum

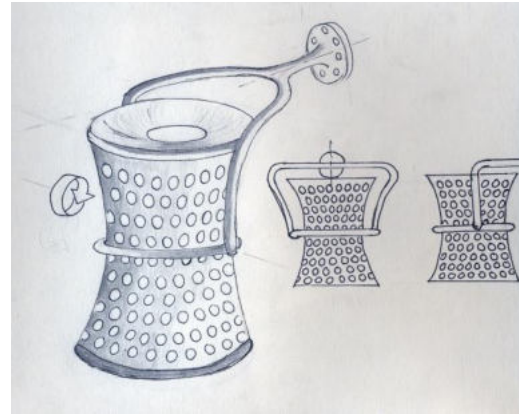


Fig. 65 Over hang wall mounted drum

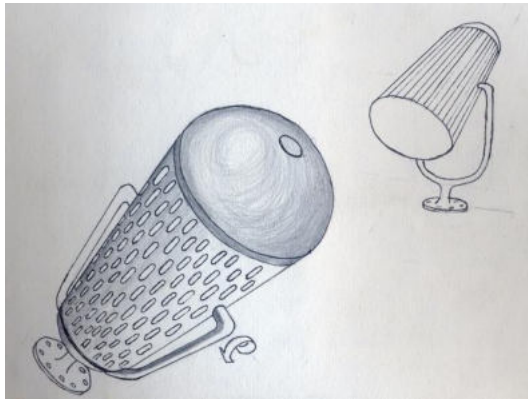


Fig. 66 Single pole mounted drum

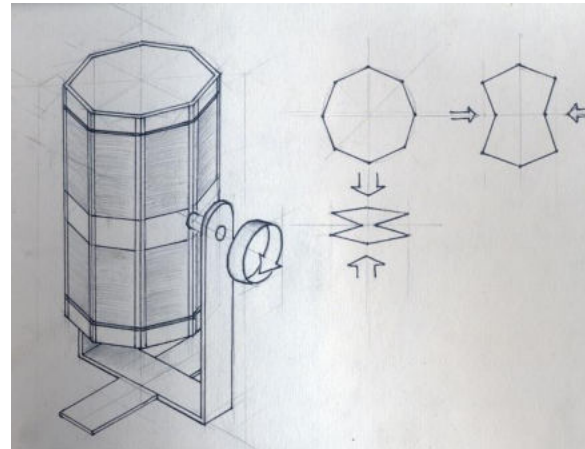


Fig. 67 Collapsible drum

Fig 64 shows a wall mounted drum. which can be expandable as it gets filled. this inspired by piston cylinder mechanism.

Fig.65 shows over hang wall mounted drum the basic form is provided for proper air circulation. The heat created by decomposition process is dis-comfortable for worms which are at the center of the drum. by reducing the diameter there the air can be reached at the core of the drum. The heat would kill the worms inside.

Fig.66 shows single mounted simple drum I try to reduce foot print there.

Fig. 67 shows collapsible drum which can be folded as shown in fig.67 and can be transport easily.

16. Mockup.

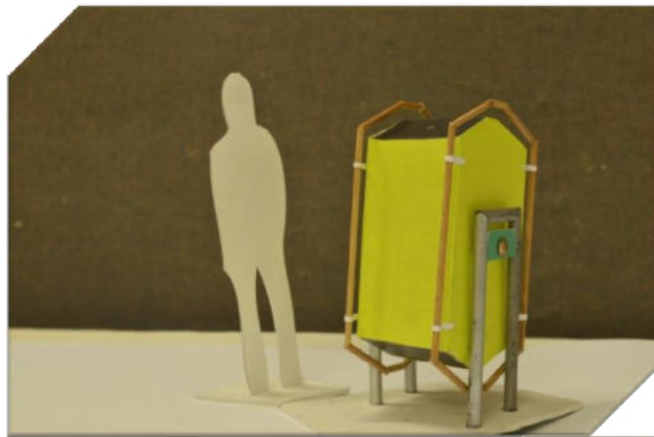


Fig. 68 Rectangular box concept



Fig. 69 Rotated view

Mock up 1-

In this concept I try to give handles all around the bin so that during turning the drum will **Rotate in a controlled manner**. The SS polls ensure that the rats and other insects won't be able to climb up.

The idea is to **break the semantic of the dust bin** and create something which **represents vermicomposting**. People should perceive it as a vermicomposting unit not something related to garbage. But it should be a product which is clean, and convert garbage in to compost without any bigger mess.

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

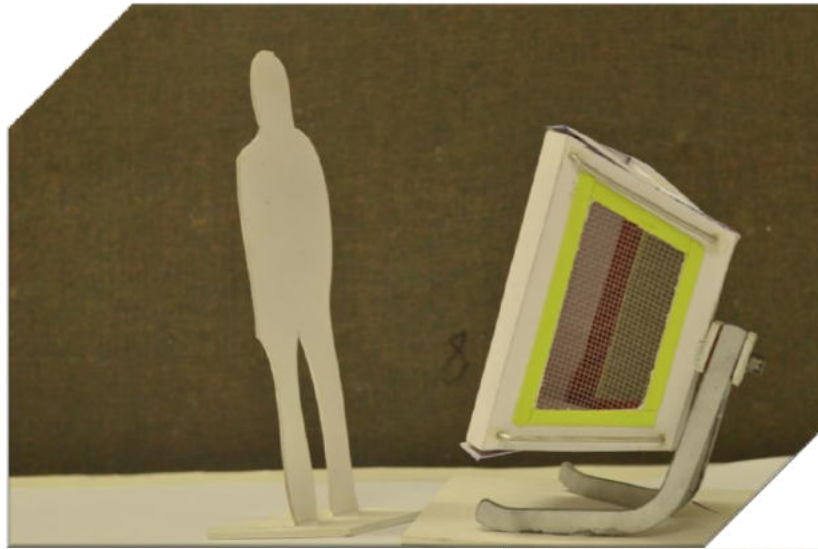


Fig. 70 Prism concept

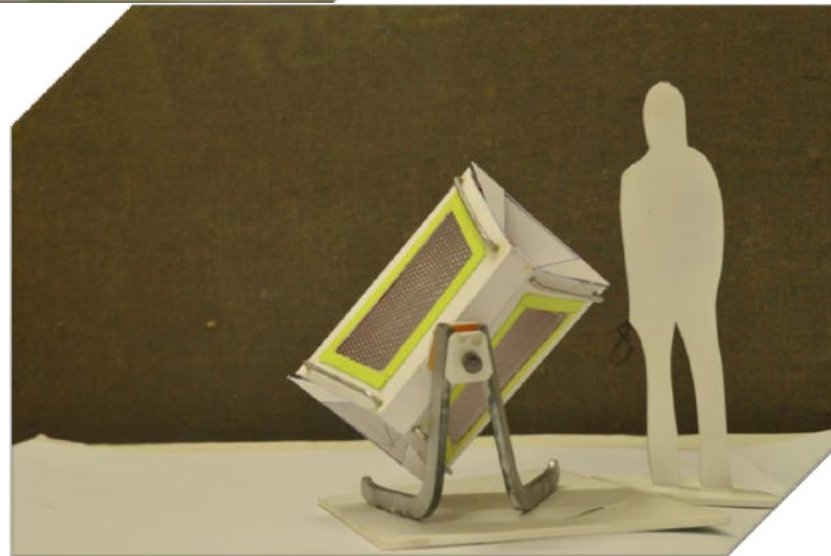


Fig. 71 Prism concept . Single bearing mounted

Mock up 2-

To change the people's perspective or not allow them to connect this worm bin to dust bin family I have to modify the form in a way that it create its own identity.

As the vermicomposting process is slow and steady so as worms too, the dynamic form shows some movement.

It gives the filling of high tech; futuristic, clean energy related.

As it can be turn side wise and take less space.. It also provides the platform for user for segregate the waste before he dumps it inside.

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



Fig. 72 Hexagonal drum



Fig. 72 Hexagonal drum during rotation

Mockup 3-

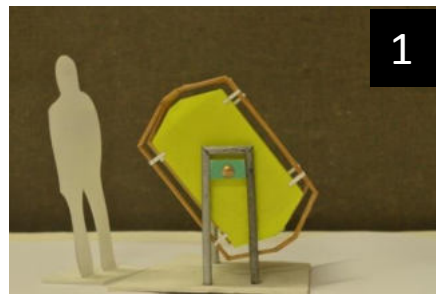
This idea is to create simple rib structure drum by using FRP process.

The hexagonal look gives very strong and rugged fill. It is very confident form.

I try to give sun shade to protect it from sun and rain.

- Sun shed
- Strong ribbing structure
- Common container form.

17. Final concept evaluation



1



2

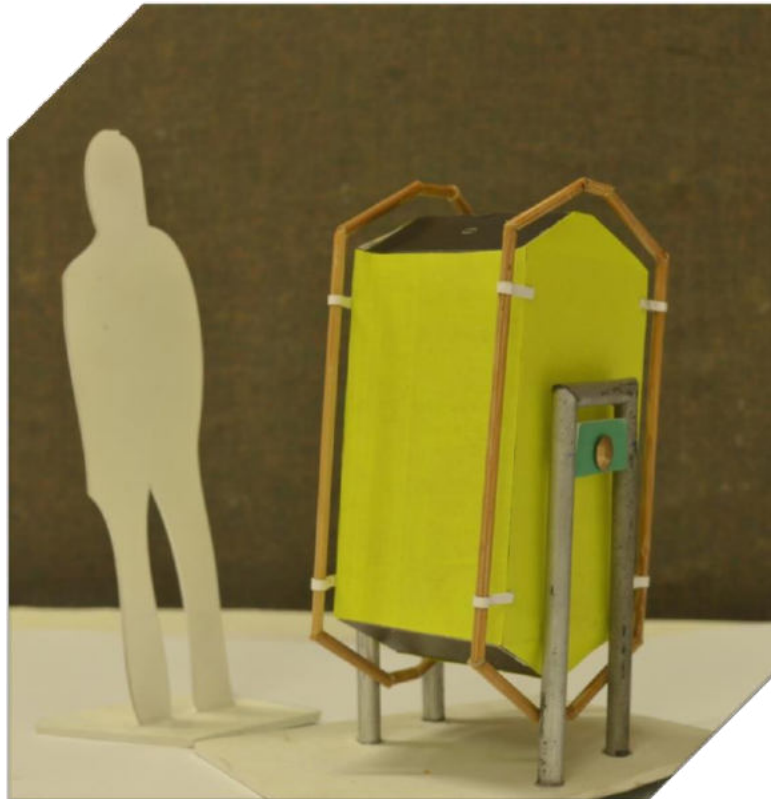


3

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

17.1 Concept Finalization



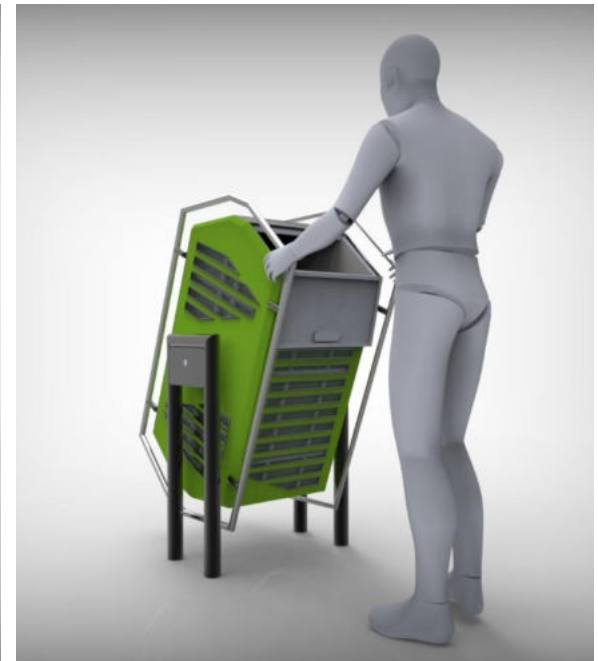
The evaluation sheet shows the clear winner, that is concept 1,

It has some demerits as well

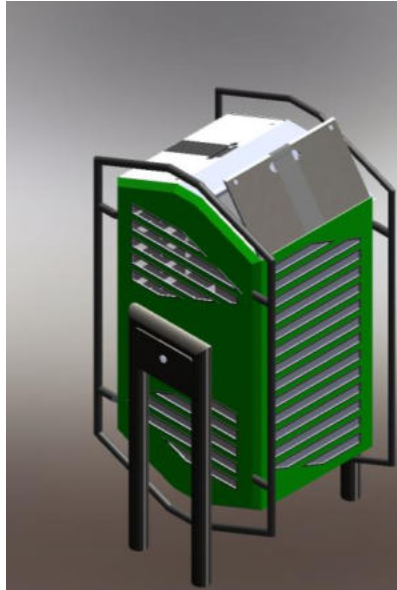
- No sun and rain protection that I need to add here.
- Form wise its very steady and rigid, I need to make it more dynamic and more playful.

I need to work on all this negative point but over all its **satisfying all aims decided in the brief.**

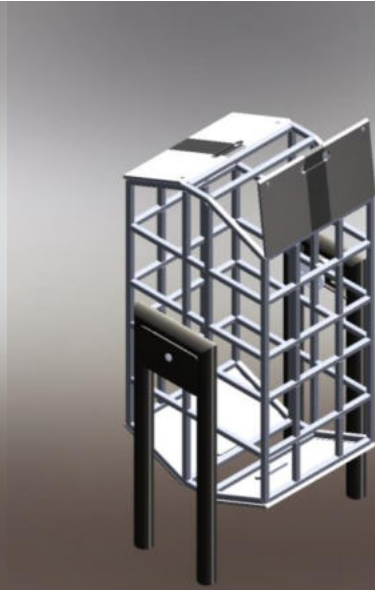
18. CAD Model Renderings.



CAD Model Assembly.



Main Assembly outer skin and handles



Internal SS chassis

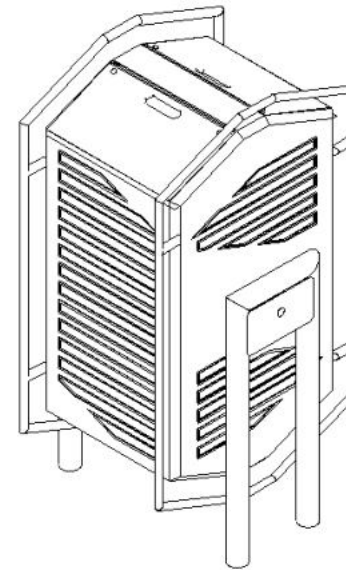
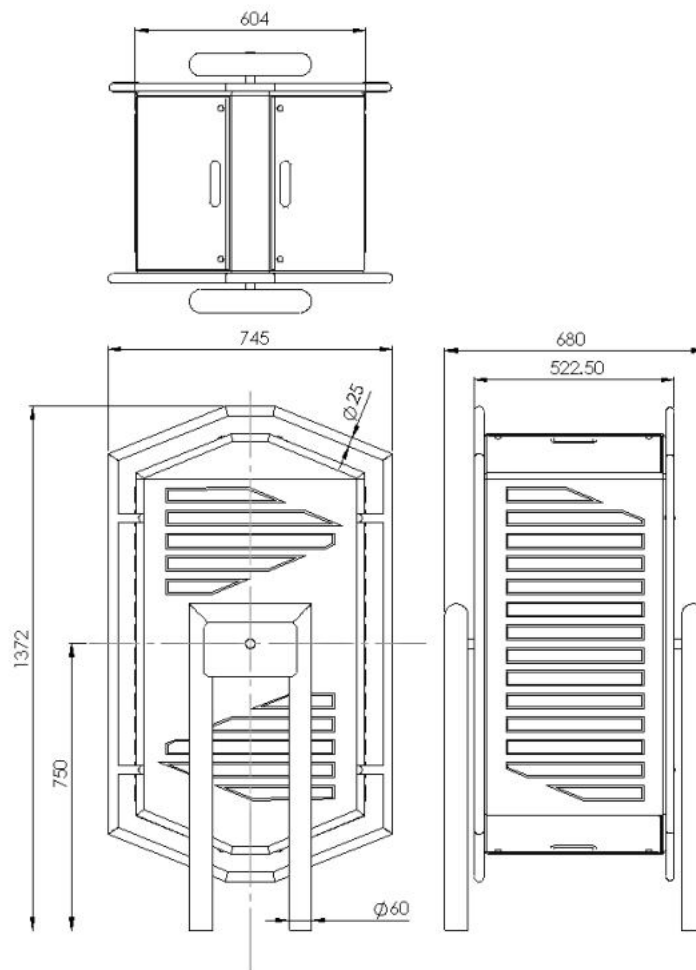


SS Pillars



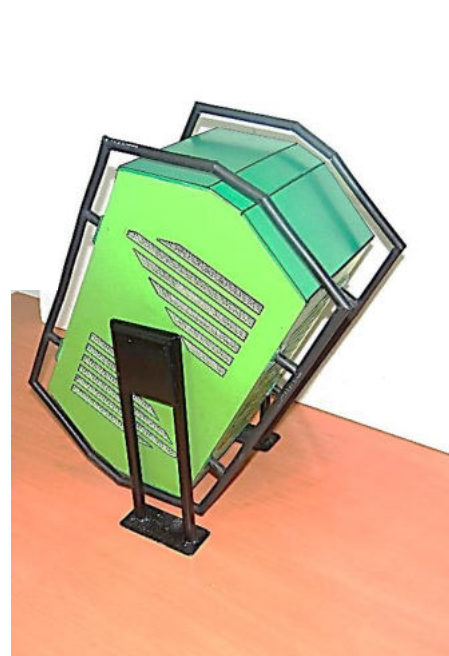
Bearing Assembly

CAD Model drafting

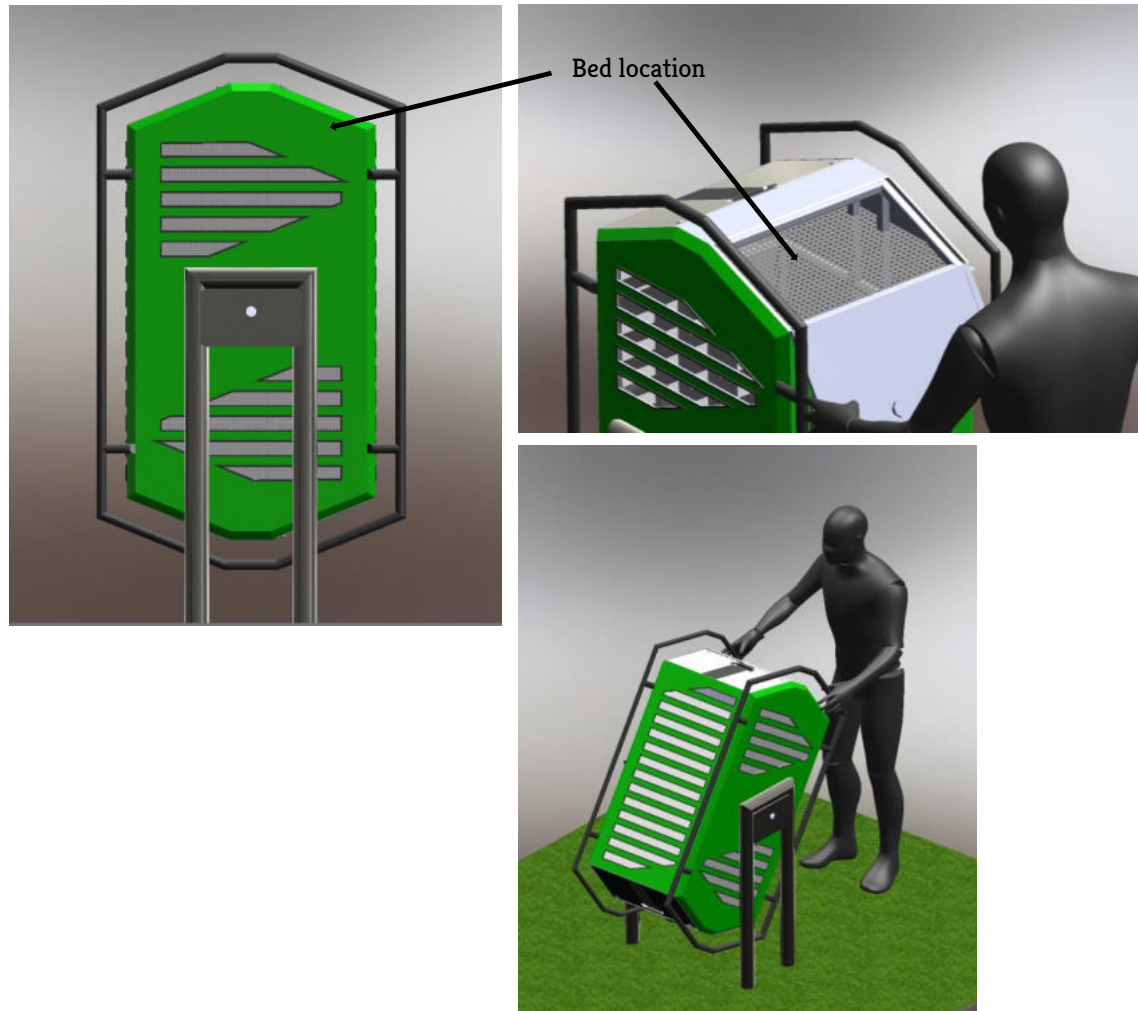


All Dimensions are in MM

19. Final Model



20. Task Analysis



1. Bed Preparations-

i) At the upper portion of the unit the compartment made for the bed mounting.

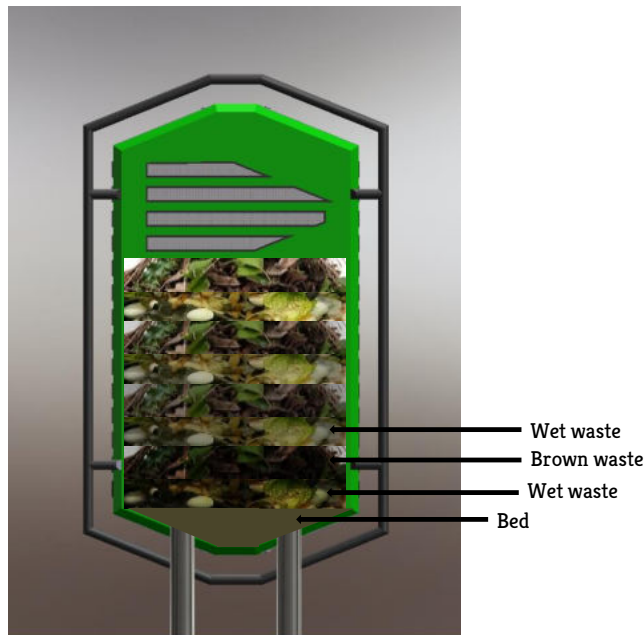
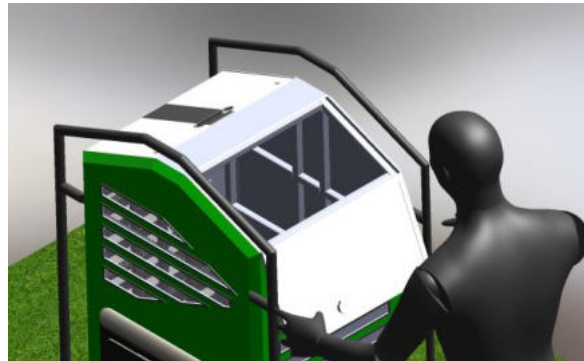
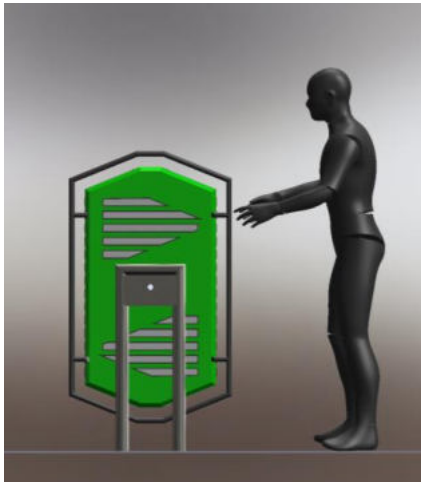
ii) Coconut coir, shredded paper or sugarcane remains are used for bed preparation.

iii) Lay this material on the mesh fixed inside the unit as it shown in image.

iv) Moistened it by sprinkling some water.

v) Add some complimentary food for worms like tee bags, banana peels, egg shell which are favorite food of the worms. To make them familiar with the vermicompost unit.

vi) Then tilt entire vermicompost unit by 180°, so that bed will go to bottom side and unit can be ready for dumping the wet waste.



2. Daily routine-

i) Start dumping collected wet waste, spaced evenly on the worm bed.

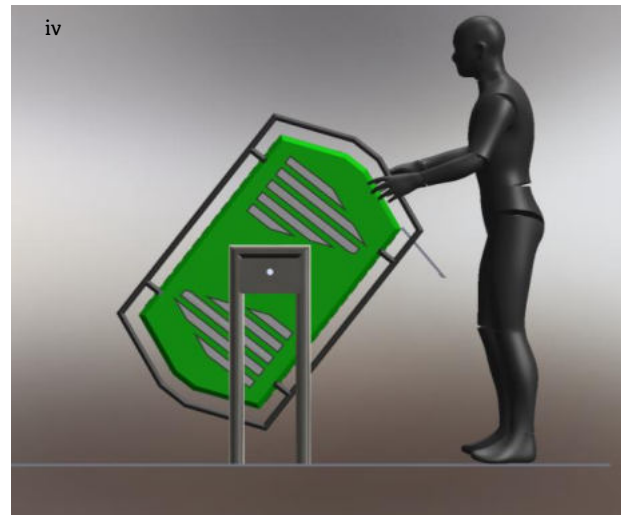
ii) Cover this wet waste with garden waste included dried tree leaves, green grass. Which maintain the PH value in the mixture. It also help to suppress the odor.

iii) Add bio culture Powder 10 gm over the layer helps to accelerate the decomposition speed.

iv) Sprinkle some water for just make mixture little damp. Don't over water it, excess water create 'slippery' in worms they won't be able to crawl.

v) stir twice in week to aerate the upper layer.

vi) Keep repeating this process until it get full.



2. Harvesting-

- i) Repeat the bed preparation procedure again at the top before harvesting.
- ii) Lock the doors.
- iii) Rotate the unit by 180° so that the completed vermicast came to top side.
- iv) Harvest the vermicast from top till half portion of the unit.

21. Business Model



Resources Required

- Wet Waste (180 kg/month)
- Red Wriggle Worms (3 kg-one time)
- Bio culture Powder/Cow dung (300 grams/month)
- Coconut Coir (2 kg/month)
- Water (10 liters/month)
- Human Resource (one)

Activities Involved



Fig. 73 Preparing the bed with coconut coir, shredded paper and sugarcane remains



Fig. 74 Moisten the bed with little water

Ref.

Fig.73. <http://msutoday.msu.edu/news/2013/creating-cleaner-dirt>, <http://www.assetsservicecommodities.com/sugarcane-bagasse.php>, <http://www.sripriyankaimpex.com/products/page/2>

Fig.74 <http://www.cardamonebros.com/untitled2.html>

Activities Involved



Fig. 75 Add red wriggle worms to the prepared bed



Fig. 76 Collect segregated garbage from housing society



Fig. 77 Add leaves/garden waste



Fig. 78 Moisten again



Fig. 79 Stir the content twice a week



Fig.80 Keep filling till the container fills up.



Fig.81 After month end Lock the Upper doors and turn unit by 180°

Further Activities Involved:

- Open the Door - Tilt the unit for ease of access of the harvest - Collect the vermicast till half of the vermicompost unit - Collect segregated wet waste again and repeat the same steps from the start by preparing the bed.

Ref.

Fig. 75 <http://marlewormgrowers.com/> , fig.76 <http://www.telegraph.co.uk/gardening/gardeningadvice/7299895/Kitchen-waste-composting-RHS-Advisory-Team.html>,

Fig.77 <http://12dos.planetark.org/media/display/319>,

Fig. 79 <http://www.squawkfox.com/2009/06/14/how-to-compost-bins/>, Fig. 80 <http://scribol.com/environment/5-composting-tips-to-turn-household-waste-into-fertilizer>.

Cost Structure:

Market price of the vermicast is Rs.20/kg, worm tea is Rs.30/liter
And for Worms it is Rs.200/kg



Fig.82 Soft Worm cast obtained



Fig.83 Worm wash/tea



Fig.84 Worms

The **Revenue** will be obtained from:

- Housing Society Welfare fund
- BMC Tax concessions
- Amenities from builder for the housing society
- Installation of Vermicompost units by NGO's

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